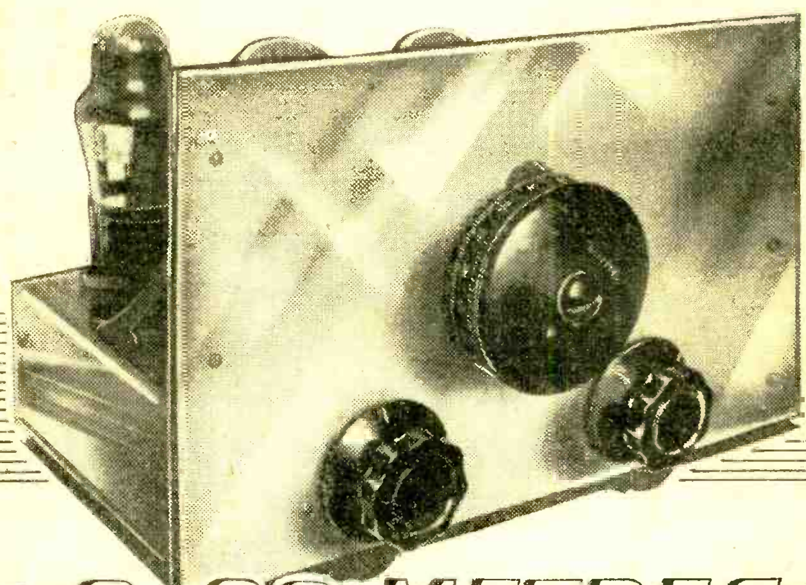
A BEGINNER'S SUPPLEMENT

1/-

Vol. 29. No. 562
AUGUST, 1953

EDITOR:
F. J. CAMM

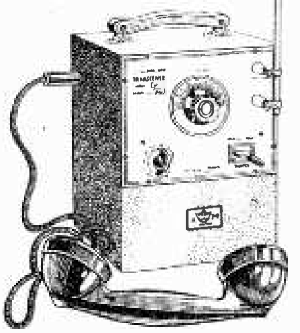
PRACTICAL WIRELESS



9-90 METRES
S-W-3

IN THIS ISSUE:

RADIO-TELEPHONES. U.H.F. (53-75 Mc/s) transceivers Brand new and boxed. Visual range. Complete with vibrator power packs for 12 volt operation. SPECIAL PRICE **£21** per pair. Carriage 15/-. Can be supplied separately at **£9/17/6.**



O.P. TRANSFORMERS. Store soiled. Match all normal O.P. valves to 2-5 ohm speech coil. BARGAIN OFFER **1/9.** Post 9d.

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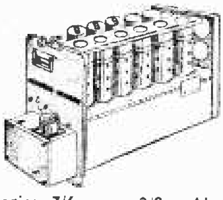

6 VALVE V.H.F. SUPERHET RECEIVER. Ex-W.D. (R.1124), but brand new condition. 30.5-40 Mc/s, I.F. 7 Mc/s. 6-channel switching. Covers T.V. sound. Fire, Amateurs, etc. Convertible to mains (A.C. or A.C./D.C.). Components include 30 ceramic trimmers, 30 small condensers, 30 resistances, 6 valve-holders, cans and covers. 2 transformers, 3 coils, etc. Our price **7/6,** post 2/9. Also supplied complete with valves at **17/6.** Drawings available at **1/-.**

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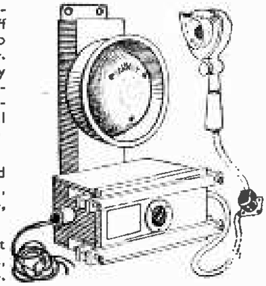

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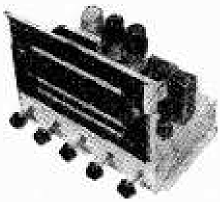

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EF50 (Red)	6/3	VR91	5/-	SP61	2/6	SP41	2/6
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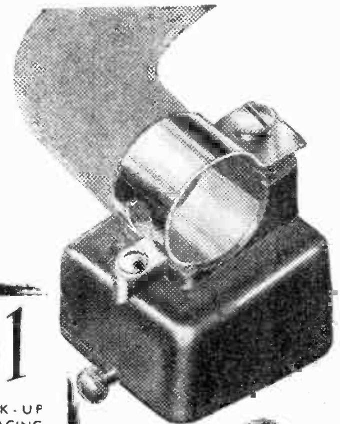

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Output voltage :
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Recommended load resistance :
not less than 50,000 ohms.

Tracking weight (G.P.32) :
56 grammes.

Tracking centres :
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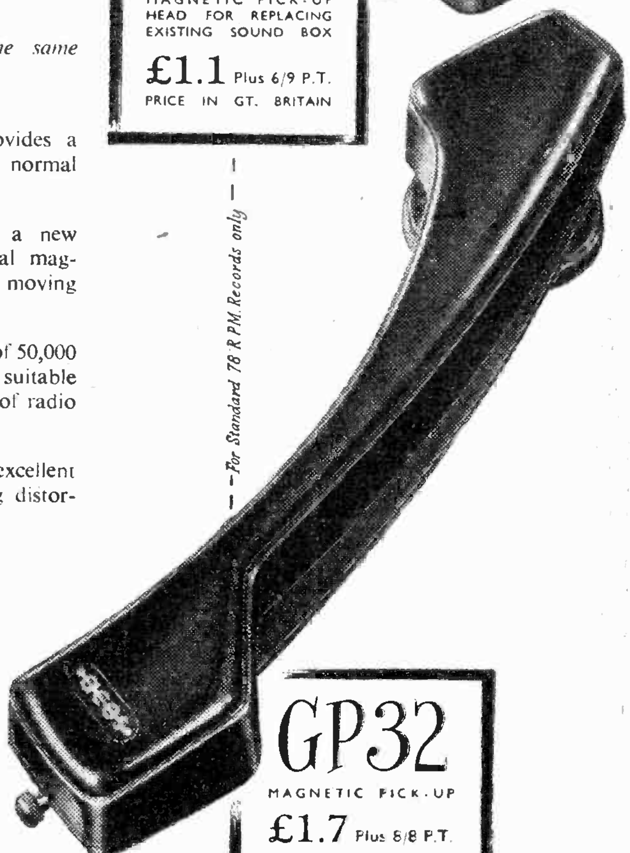

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Practical Wireless

EVERY MONTH
VOL. XXIX, No. 562, AUGUST, 1953

Editor F. J. CAMM

21st YEAR OF ISSUE

COMMENTS OF THE MONTH

By THE EDITOR

The BBC and the Coronation

THE BBC comes in for a good deal of criticism during the course of the year, but by general consent it surpassed itself in its broadcasts and its televising of the Coronation ceremony. Both were faultless, and newspapers, without exception, have praised them for the very high degree of quality they achieved in what amounted to a highly complicated technical undertaking, with literally thousands of possibilities of failure. On the sound side the BBC had little fear, for with their 30 years' experience of similar events of a national character they have passed beyond teething troubles. Television, however, is still somewhat in its infancy, and apparatus has not yet reached that degree of perfection which applies to ordinary sound transmitting equipment.

We observed the transmission from our experimental laboratory from beginning to end, looking not so much for entertainment value, which was of a very high order indeed, but for technical failures. There was nothing of which we could complain, and those in charge of O.B. deserve the very highest commendation, not only from the public but from those in the top flight in Broadcasting House.

The Coronation has been responsible for increasing the demand for both sound and vision receivers. It is impossible to estimate with any accuracy the number of people who looked in to the solemn ceremony. It is known that about 3,000,000 television licences are operative, but the number of private parties which foregathered round each screen is incalculable, although estimated to be at least six per screen, bringing the viewing public to, say, 18,000,000. It is certain that the whole of the British nation either heard or saw the ceremony, which taxed to its uttermost limit every physical and technical resource of the BBC. No wonder the press of other countries has made envious praise of this finest BBC achievement, and we add our congratulations to those of the rest of the world.

HOW MANY HOME-BUILT RECEIVERS?

WE have, in the past, criticised the trade for neglecting to supply components for home constructors, who virtually created the radio industry. We have said that having built their businesses on the demand for components they neglected the foundation and preferred to occupy the upper storeys. One firm has taken us to task on this and says that the home constructor market does not now exist in sufficient volume to support any large-scale manufacturing enterprise. This firm asks a question which it thinks provides its own answer. The question is: How many home-built receivers are in existence to-day? With 21 years of experience of catering for this market, during which our circulation has steadily increased, till to-day it stands higher than ever before, we can estimate with reasonable accuracy that at least 1,500,000 home-built receivers are in operation. The number of experimenters increases year by year, as the sale of our blueprints shows. It is our view that at the present time over 300,000 home-built television receivers are in operation, and we are enabled to arrive at these figures with reasonable accuracy from a knowledge of the number of special components which have been sold for particular receivers. Those firms who have remained faithful to the constructor market report ever-increasing turnover.

We mention these points because one or two firms have expressed a wish to return to the fold, but need to be reassured that there is still a market. Publishers, like radio manufacturers, are business people. They do not publish journals for a market which does not exist, or which exists in such paucity that it does not warrant a special publication. This journal celebrates its 21st birthday this year, and we can assure the trade that it does so in a spirit of enthusiasm, encouraged by the success which continues to reward its efforts.

SERVICING OF RECEIVERS

A SUB-COMMITTEE of B.R.E.M.A. have been considering the length of time manufacturers should be expected to service and repair radio receivers once the model has become obsolete. Their view is that after a period of, say, 12 years it is seldom economical either from the manufacturers' or the users' point of view to continue to service and repair such models. It is realised that individual manufacturers have their own policies.—F. J. C.

ROUND the WORLD of WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate number of sound receiving licences issued during the year ending April, 1953. The grand total of sound and television licences was 12,912,786.

Region	Number
London Postal ...	1,749,375
Home Counties ...	1,470,905
Midland	1,326,708
North Eastern ...	1,754,363
North Western ...	1,360,614
South Western ...	1,033,182
Wales and Border	677,929
Total England & Wales	9,373,076
Scotland	1,120,609
Northern Ireland ...	215,758
Grand Total ...	10,709,443

BBC Wants More

THE BBC has been urging the Cabinet to allow it to keep 95 per cent. of the revenue received in licence charges instead of handing over 15 per cent. to the Treasury.

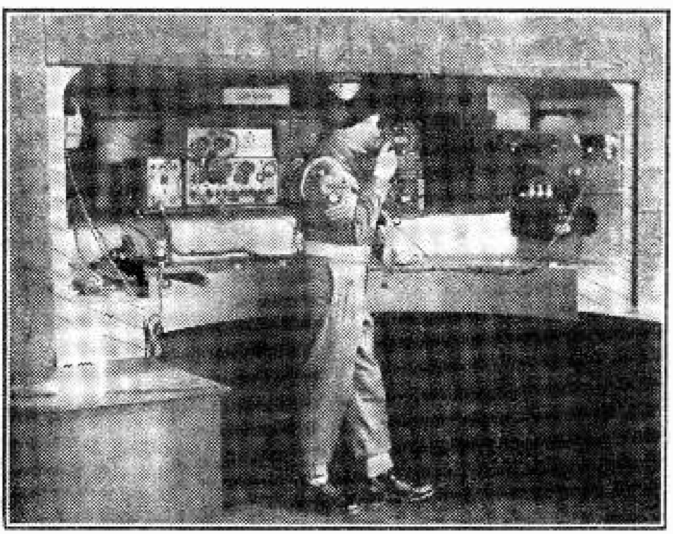
This would give the BBC another £2,000,000, enabling the speeding up of development plans.

Electronic Equipment Display

A THREE-DAY operational display of Britain's latest military electronic equipment, sponsored by the Ministry of Supply and organised by the Radio Communication and Electronic Engineering Association,- was held recently at the Royal Aircraft Establishment, Farnborough.

Exhibits covered fixed and mobile communication sets, telephone apparatus, radio navigational aids, radar equipment, components and valves. Army equipment on display included tanks showing signals and gun-control equipment, an electronically controlled tank turret, and signal equipment vehicles of different kinds.

The automatic training of an anti-aircraft gun on its target by radar was demonstrated together with the latest electronic equipment installed in the Canberra light bomber.



Demonstrated at the Farnborough electronic equipment display in what resembled the turret of a Centurion tank was a new high-frequency wireless receiving and transmitting set, the C12HF, a successor to the well-known wartime No. 19 set.

New Scottish Factory

MR. T. JOHNSTONE. chairman of the North of Scotland Hydro Electric Board, performed the official opening of a new factory of Smith Meters, Ltd., at Kinbuck, Dunblane, recently.

From components made in England, electric meters will be assembled at the factory, where forty workers are employed. In due course the components may be manufactured there as well as assembled.

Booklet on Magnets

A BOOKLET entitled, "Permanent Magnets" has been compiled by members of the Permanent Magnet Association, 301, Glossop Road, Sheffield, 10, and is available from them at 10s.

"Model Engineer" Exhibition

MANY of the models entered for "The Model Engineer" Exhibition, at the New Royal Horticultural Hall, from August 19th to 29th, are worked by electricity, while a major attraction is the water-tank where radio-controlled model yachts and boats will be seen manœuvring.

Other notable features include a miniature Grand Prix racing track, a steam-driven working model roundabout, and passenger-carrying steam locomotives. In the demonstration area all branches of model engineering will be shown.

Communications for Bermuda

WITH only five days' notice, an order for two tons of wireless communications equipment was packed at the Chelmsford factory of Marconi's Wireless Telegraph Co., Ltd., ready for immediate air freighting to Bermuda, to be used to increase existing communications between the island and the rest of the world at the forthcoming Three-Power Conference. It consists of two high-frequency transmitters and three high-frequency receivers, with ancillary equipment, which will go to make an additional telegraph circuit between Bermuda and New

York for use by delegates, officials and newspaper correspondents covering the meetings.

Coupling units and special oscillators had to be supplied, and consideration was given to the fact that the equipment was designed for 50-cycle operation, whereas the Bermuda main power supply is 60 cycles.

All the gear can be speedily assembled and put into operation at its destination, but for travelling purposes it had to be dismantled into nearly one hundred units of varying sizes and each packed individually.

Improvement of Home Service

THE BBC announces that a three-acre site has been acquired at Pages Lane, Bexhill, approximately one mile west of the centre of the town, for the permanent low-power (2 kW) transmitting station that is being provided to improve reception of the Home Service in the area.

When completed the station will take over the service on 206 m. (1,457 kc/s) at present given by the temporary transmitter of lower power near Hastings. The latter covers little more than the town itself, but it is expected that the permanent station with its higher power and better site will extend the area of satisfactory reception to include also St. Leonards, Bexhill and Eastbourne.

The permanent station is expected to be in service before the end of the year.

Radio Industries Club

EDWARD E. ROSEN was elected president of the Radio Industries Club in succession to Lord Brabazon of Tara, at its 22nd annual general meeting held in London recently. In addition, the following were elected vice-presidents: A. J. Dew, H. de A. Donisthorpe, A. J. P. Hytch and J. H. Williams. The new chairman of the Committee is H. A. Curtis, with R. F. Payne-Gallwey as vice-chairman. The other officers of the Club are unchanged.

The parent Club now has almost 800 members, and affiliated with it are six other clubs in England, Scotland and Ireland.

Obituary

WITH deep regret the death is announced of Brigadier John B. Hickman, C.B.E., M.C., M.A., on June 3rd, 1953. He was managing director of British Telecommunications Research Ltd., deputy chairman of A. T. & E. (Bridgnorth) Ltd., a director of Automatic Telephone and Electric Co., Ltd., and a director of Hivac Ltd.

Born in 1899, Brig. Hickman was educated at Southall County School and Gonville and Caius College, Cambridge, before attending the Royal Military Academy, Woolwich. He was appointed Deputy Chief Inspector of Telecommunications at the Directorate of Electrical and Mechanical Equipment in 1941, and was seconded to the Ministry of Supply in 1945 as Director of Research and Development, Telecommunications. He became managing director of B.T.R. Ltd., in 1949.

In April, 1950, he received the Diploma of Officier de la Legion d'Honneur.

B.I.C.C. "Open Week"

DURING Coronation Week more than 2,000 relatives and friends of employees visited the Helsby Works of British Insulated Callender's Cables Ltd. for the annual "Open Week." Among the visitors were many of the company's former employees who have now retired.

The guests toured the various manufacturing departments and saw the production of power capacitors and the many processes involved in the manufacture of rubber-insulated and thermoplastic-insulated cables of all types.

Continental Visit

A CONTINGENT of the London Fire Brigade left London recently on a visit to France and Italy. The purpose of this visit was, first, to provide an opportunity for personal exchanges of information and, secondly, to give London Fire Brigade service experience similar to their counterparts abroad.

Pye radio equipment was installed to allow firemen to keep in constant touch with their operational headquarters.

More Discoveries

THE new series of Carroll Levis Discovery programmes, in which unknown British artists make their broadcasting debut, will continue each Friday during the summer on the Light Programme under its producer, Trafford Whitelock, who has made some changes.

One of the firemen visiting the Continent uses part of the Pye radio equipment which was installed to maintain contact with operational headquarters.

Each week a new British song will be featured by the Song Pedlars, while the judging by the Audience Applause meter is being checked by Carroll Levis. The opening and closing presentation has also been streamlined and music for the artists will be provided by a Quintet, Jackie Brown and his Music.

List of Technical Papers

"GOVERNMENT Publications, Sectional List No. 3 D.S.I.R.," is the title of a 31-page booklet in which technical papers issued by all departments of the Department of Scientific and Industrial Research, including the National Physical Laboratory, are listed, revised to March 1st.

It may be obtained free from H.M. Stationery Office, York House, Kingsway, London, W.C.2.

A THERMISTOR-STABILISED AUDIO OSCILLATOR

A FURTHER ADDITION TO THE EXPERIMENTER'S LABORATORY

By R. Williamson

TO the high-fidelity enthusiast, an audio oscillator might be considered an absolute essential for test work. However, the writer, whilst having amassed a formidable array of test equipment for audio experiments had never constructed such an oscillator beyond an experimental layout. A variety of conventional circuits have been tried, e.g., R.C. oscillators of the phase shift and Wien bridge types, and even a not very successful beat frequency oscillator. However, for the amateur, simplicity and cheapness are amongst the first desirable features, and generally speaking the Wien bridge seemed to be the most promising. It is not intended to go into details of the working of this type of oscillator, as any good textbook will deal with the subject far more comprehensively. Of all the R.C. oscillators constructed the same difficulty was experienced, the necessity for frequent readjustment of preset controls either to maintain oscillation or to reduce the harmonic contents of the waveform to below 1 per cent. Even the usual barretter lamp as the lower limb of the resistive section in the bridge failed to maintain amplitude stability to within desirable limits.

However, the advent of the "thermistor," one of radio's newest components, promised a complete solution to the problem. Thermistors, or thermal resistors have been made in this country since 1949 and are coming into increasing usage in all branches of the telecommunications industry. As an example, it is understood that the G.P.O. Engineering Department is successfully using one particular pattern of thermistor in the type of telephone used on shared service lines.

An explanation of the action of the thermistor would not be out of the way. Briefly, it is a resistive element with a high negative temperature coefficient,

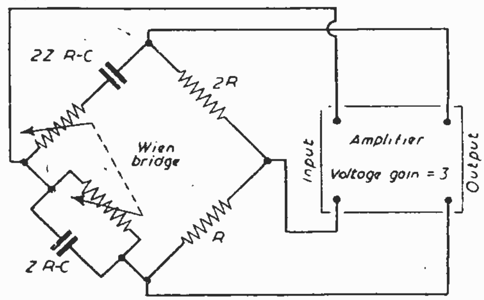


Fig. 1.—Theoretical set-up for using the bridge.

that is, the more power dissipated within it the lower becomes its resistance. It will be noted that this is the reverse effect to that obtained with the barretter, and since it has a wider resistance range than the majority of barretters for a given power input, the possibility of its use as a stabilising device became obvious. A suitable thermistor, Standard Telephones Co. type A2552/100, was chosen and substituted for the upper resistive arm in the Wien bridge.

In the completed oscillator shown, results exceeded

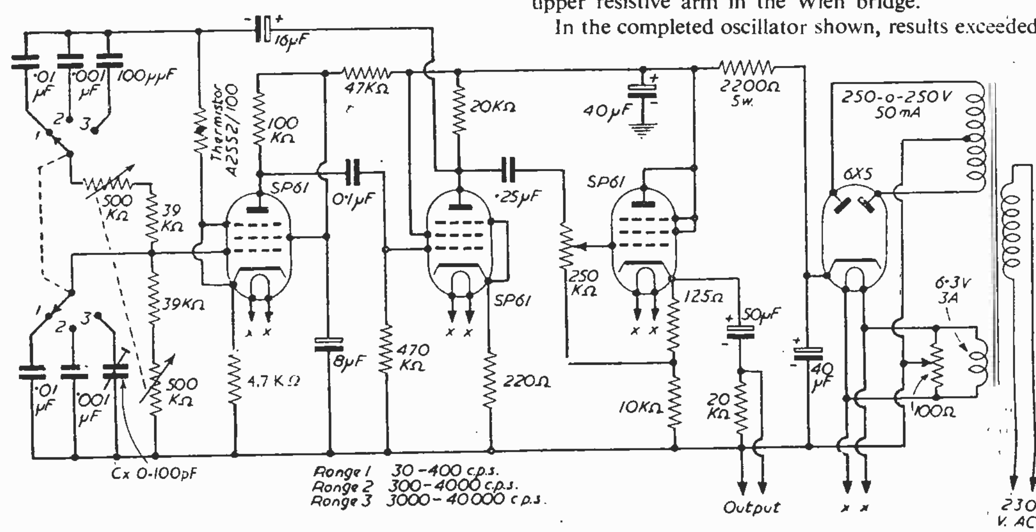


Fig. 2.—Theoretical circuit of the audio oscillator.

expectations. Preset controls were completely dispensed with, the thermistor automatically compensating for variations in the gain of the amplifier stages and, most important, reducing to negligible proportions the effects of tracking errors in the ganged potentiometers. Over the range 30 c/s to 40 Kc/s amplitude remained constant ±0.2 db, for a maximum output of 25 volts R.M.S. and has even been extended experimentally down to 3 cycles per second, and in the upper range, up to 200 Kc/s. with deviations of no more than ±3 db. A better layout would probably have improved these figures in the model constructed.

The circuit follows conventional technique, the cathode follower giving a low output impedance. This may be loaded with up to 600 ohms without any serious fall in voltage. The unit may be calibrated by any of the usual methods. the easiest being by direct comparison with a known variable source of audio tones. With the values of R and C shown, ranges should be in multiples of 10. To allow for wiring capacitance Cx has been made variable and should be adjusted. i.e., the generated frequency is a multiple of 10 of the previous range when the resistive portion of the R.C. element in the bridge is fully in.

As a further refinement the inclusion of a low-power monitor section with a small speaker will be found an advantage. Whilst in the circuit shown the versatile S.P.61 combines reliability with low cost, they may be substituted by the B7G based 6AK5. Some component values may, however, have to be altered.

Adding an R.F. Stage

By Col. D. A. K. Redman, O.B.E., B.Sc., R.E.M.E.

ALTHOUGH the performance of a good quality commercial domestic receiver as used in so many homes is very satisfactory for average purposes, there are conditions or requirements which induce the home experimenter to seek after "that little bit more."

While serving overseas for instance, the addition of an R.F. stage to the normal 4+1 superhet will facilitate reception of signals from BBC stations when these are weak due to distance or poor reception conditions. Alternatively the listener may wish for better quality from local stations.

It was with these two requirements in view that the writer recently made the modifications described below to his H.M.V. table model receiver. They have been most successful and could be applied to almost any similar instrument, with minor adjustments depending on its circuit and the position of added components. A block diagram of the general arrangement is shown in Fig. 1.

R.F. Stage or Tuned Pre-amplifier (See Fig. 2)

This consists simply of an E.F.50 valve choke coupled to the normal aerial input circuit of the receiver. The extra aerial/grid coils used were the well-known Osmor type, but any other similar modern coil will do. They were tuned by the usual variable condenser; this gives an extra tuning control, but it is only necessary to "peak up" the signal with this control after the main tuner has been correctly adjusted.

Slight instability was at first experienced but cured by the addition of the 10 KΩ resistance in the anode circuit and choice of a suitable valve for the screen resistor. Any similar R.F. pentode could be used.

Power supply was taken from the normal H.T. and L.T. system of the set; if thought necessary a filament transformer for the E.F.50 could be used, but in any case there should be no difficulty in providing the 10 mA or so for the anode and screen from the set H.T. line.

S1 gives normal wave-band switching, and an OFF position which connects the aerial straight through to the normal input circuit of the receiver. This switch is also operative for the local station channel described below.

Local Station Channel

This employs simply a germanium crystal working into the pick-up terminals of the set (Fig. 2). For tuning purposes the same set of coils is used as for the R.F. stage. If this is insufficiently selective to separate two local stations a simple wave-trap can be used in the aerial lead.

The writer used a G.E.C. high resistance G.E.55/1 crystal diode, but these cost 30/- and a G.E.X35 44/1 or 45/1 would probably serve quite adequately.

It is desirable, of course, to choose a crystal with high enough resistance to match sufficiently well with the set volume control without a transformer.

The two 100 pF capacitors and the 75 KΩ resistor filter the R.F., while S2 gives choice of:

crystal and A.F. amplifier—3.
R.F. stage, crystal and A.F. amplifier—2.
R.F. stage and main set, or main set only, or P.U., to A.F. amplifier—1.

The second combination is used if there are no "very local" stations to give a strong enough signal for the crystal alone.

Construction

Details of this must depend on the receiver, but the

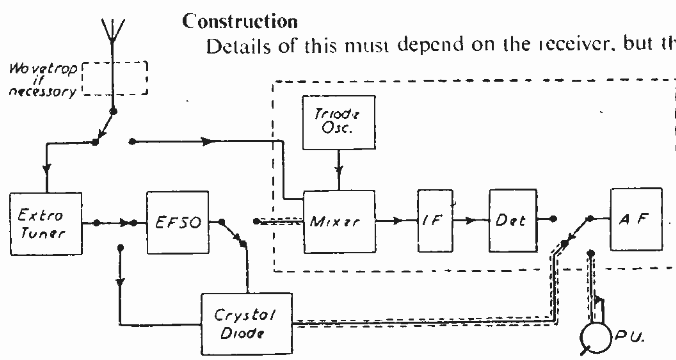


Fig. 1.—Schematic diagram of the arrangement described here.

writer's took the form of a small sub-chassis with a front panel, both of aluminium, on which all the components shown in Fig. 1 were mounted. The aerial coils were screened, but it would be better if the addition took the form of a completely enclosed box with, say, a removable side. It was then positioned inside the cabinet and holes in the latter drilled for the three control spindles to pass through.

Connections to the appropriate points in the set should, at first, be temporarily made as the sub-chassis will probably have to be removed once or twice for adjustments to resistor valves, etc.

If the switching of the main set to gram does not disconnect the set aerial terminal from the aerial coupling coils it will be necessary to add a separate switch to do so when S2 is switched to 2, otherwise there will be a low impedance path to earth in parallel with the crystal.

Results

The addition of the R.F. stage gave considerable extra gain on L.W. and M.W., although, of course, on any signals but weak ones the effect is masked by the A.G.C. arrangements in the set proper. On short waves the gain is still appreciable up to about 10 Mc/s, but then begins to fall off as the circuit is not designed with efficient short-wave operation in view.

On local stations the crystal diode arrangement gives really excellent results, particularly if comprehensive bass/treble/boost/cut controls are added to the A.F. amplifier. Suitable ones have been described of late in this magazine but, of course, sufficient spare A.F. gain must be available.

In the writer's case in Germany, there are two local 2 kW stations 10 miles away on 247 and 425 metres. Both are received using the crystal diode without the R.F. stage at sufficient strength to permit the operation of such a tone control without extra A.F. gain.

The quality can, of course, only be as good as the A.F. amplifier and loudspeaker will allow, but with the standard (diode)-triode and output pentode, using negative current feedback, and the H.M.V. 11in. elliptical loudspeaker the results are almost as good as the average domestic conditions warrant.

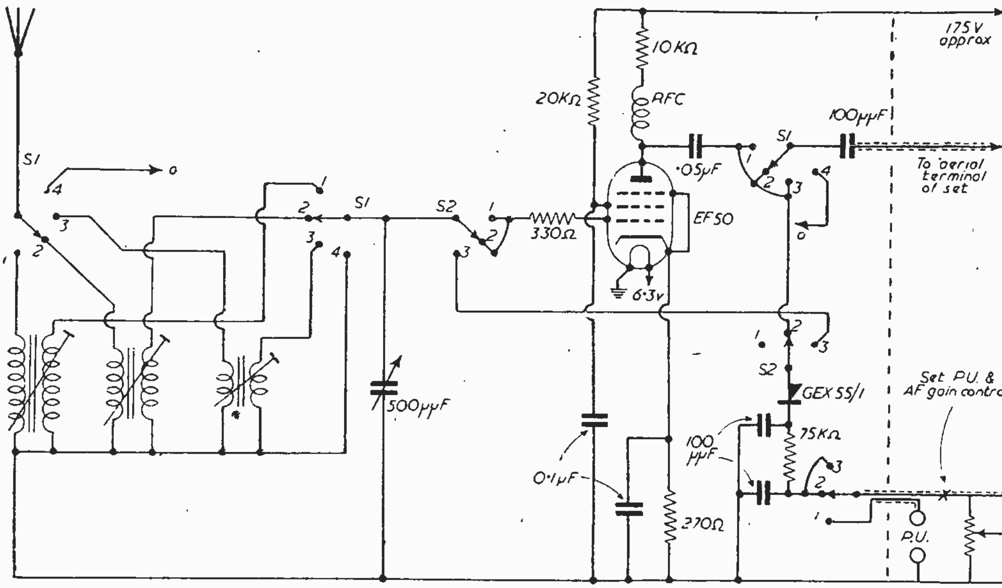


Fig. 2.—Theoretical circuit of the amplifier or R.F. stage.

A Selective Amplifier

AMONG the many examples of scientific research of particular interest to electronic engineers is the Plessey Selective Amplifier E.1.17.

This is a high gain selective amplifier designed to be used in conjunction with a crystal detector for the detection, comparison and measurement of low-level modulated R.F. voltages.

The amplifier is provided with two independent input sockets and gain controls which are selected by a switch situated directly above the input sockets on the front panel. The centre position of this switch connects a 200KΩ resistor from the input grid to ground, thus giving an indication of the noise generated with this input impedance. A calibrated attenuator and a fine gain control, which are common to both inputs, are also provided.

The instrument may be used as a selective or wide band amplifier. In the former case it may be tuned over the band 300 c/s-6 kc/s by the frequency control. Maximum sensitivities are not less than 1.6 μV in selective, and not less than 4 μV in wide band condition. These figures are for full-scale deflection on the meter.

Output sockets are provided for a cathode-ray oscilloscope, and external meter which must be connected into circuit by means of the meter switch.—Plessey Co., Ltd., Ilford. Essex.

A MULTI-RANGE TESTER—2

FULL CONSTRUCTIONAL DETAILS OF A VERY HIGH QUALITY TEST SET WITH A SENSITIVITY OF 10,000 Ω PER VOLT

By E. N. J. Marguerit

(Continued from page 405 July issue)

As stated earlier, there are two types of resistance measurements, the high-ohm and the low-ohm, each having four ranges. The high-ohm ranges are based on the series principle, while the low-ohm ones operate on the shunt system. The O calibration of the high-ohm scale corresponds to Infinity on the low-ohm scale.

Both high and low-ohm ranges are operated by two $4\frac{1}{2}$ volt flashlight batteries connected in series to give 9 volts; these are housed in the special compartment provided in the instrument case.

It is not advisable to use a grid-bias battery, for this purpose, as the drain on it, when using the lowest ranges, is 100 mA.

Alternative Circuit

The second circuit proposed (Fig. 10b) differs only in the fact that a second potential divider is used for the A.C. voltage ranges. The additional items are the 15 High Stability resistors, and the substitution of a four-pole two-way switch in place of one of the two-pole two-way type.

Controls

There are five electrical controls on the front panel:

1—Top left-hand corner: A.C./D.C. switch.
2—Top right-hand corner: mA/V switch.
3—Bottom left-hand corner: mA and V—R/10-R-10R-100R-Audio.
4—Middle: Adjust Ohms.
5—Bottom right-hand side: High-Low—and 10 mA and V ranges.

All measurements are obtained through three terminals, one being the common negative; the second is for volts and milliamps and low-ohm readings; the third is reserved for high-ohm and audio.

Those three terminals take the form of a three-way female socket, being an ex-A.M. unit No. 10H/7394. It is easily fixed to the panel by 2 6 B.A. bolts and nuts.

Switch No. 1 is a two-pole two-way self-cleaning instrument type switch; if circuit 10b is adopted, this is replaced by a similar type but having four-pole two-way.

Switch No. 2 is a similar type, two-pole two-way.

Switch No. 3 is a three-bank one-pole six-way low contact resistance.

Switch No. 4 is a three-bank one-pole 12-way, also of low contact resistance.

The adjust ohm is a Colvern 5,000 ohm wire-wound potentiometer.

LIST OF COMPONENTS

Circuit of Fig. 10b.

Switches
S1—4-Pole 2-way } low contact resistance.
S2—2-Pole 2-way }
S3—1-Pole 12-way 3 banks low contact resistance.
S4—1-Pole 6-way 3 banks low contact resistance.

Resistors (assuming meter resistance = 500 ohms).
R1 to R10—Same as for circuit 10a.
R11 { 85,000 ohms + 4,000 ohms + 500 ohms
R12 { 800,000 ohms + 10,000 ohms
R13 { 1 Megohm + 350,000 ohms
R14 { 2 × 1 Megohm + 250,000 ohms
R15 { 4 × 1 Megohm + 0.5 megohm
(R11–R15:) 1 W. Dubilier H.S. carbon ± 1%.
R16 to R24—shunts, same as for circuit 10a.

R25 = R20	R28 = R23	R31 = R26
R26 = R21	R29 = R24	R32 = R27
R27 = R22	R30 = R25	R33 = R28
		R34 = R29

C—0.1 μF. 1,500 v. D.C. paper condenser.
WX—1 Westinghouse Westectors.

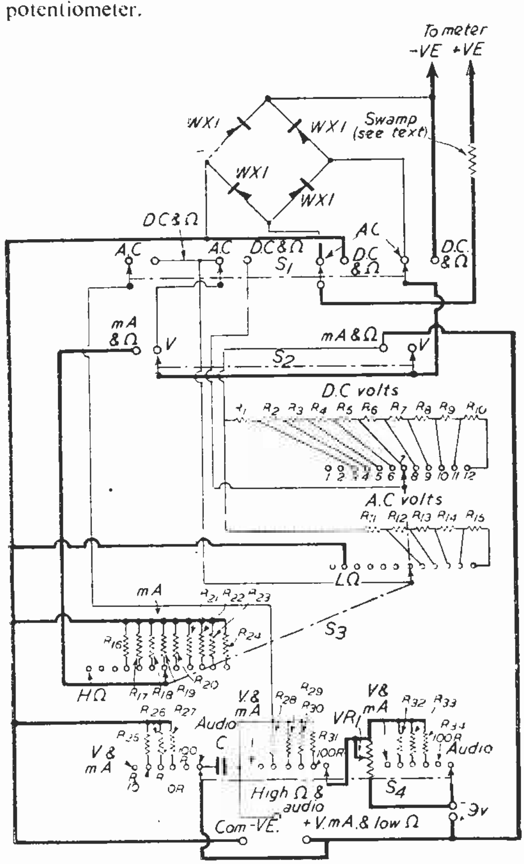


Fig. 10(b).—An alternative circuit for which a list of components is given on the left.

All resistors including the four Westectors are mounted on tag boards, from which wires are taken to the different switches. The wiring is carried out with 24 s.w.g. insulated copper wire. Here different colours of insulation would make the wiring easier. Particular attention must be paid to the wiring of the low-resistance ranges. Short lengths of thick wire (16 s.w.g.) should be used. The actual resistance of the wiring of these ranges should not exceed 0.01 ohm, otherwise it will not be possible to obtain zero setting.

The writer's instrument contains some wire-wound precision resistors of $\pm$ 1 per cent. tolerance. These were of ex. W.D. origin. If such resistors of the appropriate values can be obtained they can replace with advantage the carbon high-stability type. Commercial equivalents are rather expensive.

As already stated the shunts are "home-made." The formers may take the form of small, wooden dowels, dipped in dilute shellac varnish and allowed to dry. When the winding is completed the shunts are given a coat of shellac. They are mounted on a panel made of insulating material which is fixed under the scale by means of the four 1½in. long bolts previously mentioned.

Marking the Scale

The marking of the scale is made with Indian ink on best quality Bristol card. Green ink is used for the low ohm scale. Red ink for 0-10 v. A.C. scale. (See illustration.)

The calibration of the ohm scales can be made by placing resistors of known values across the leads and marking the scales accordingly.

There is, however, a mathematical formula to enable one to draw a calibration curve. For high-ohm the formula is:

$$\frac{I_1}{I_2}=\frac{1}{1+A} \quad \text{where } A=\frac{R_x}{R_1+R_m}$$

where

I_1=current given by meter when R_x is in circuit
I_2=full scale deflection of instrument (when R_x=O)
R_x=resistance to be measured.
R_1=limiting resistance to obtain f.s.d. when R_x=O (R31 and VR1 in diagram for 100R range). Fig. 10b.

For low-ohm the formula is:

$$\frac{I_1}{I_2}=\frac{1}{1+\frac{1}{A}} \qquad A=\frac{R_x}{R_1+R_m}$$

where the symbols are the same as previously.

In each case R_1 represents the value of resistance that will be shown by half-scale deflection. To draw the curves, the values of $\frac{1}{1+A}$ or $\frac{1}{1+\frac{1}{A}}$ are plotted on the horizontal line, while values of A, from 1 to 10, are plotted on the vertical line of a special log-linear graph paper.

Replace A in the formulae by a series of numbers from 1 to 10 and calculate the corresponding values of $\frac{I_1}{I_2}$. Mark the points on the graph paper and join them by a smooth curve. The appearance of the two types of curves is shown in Fig. 12.

These curves apply to any type of ohmmeter and are, therefore, universal.

To mark them in resistance values, a strip of this special log paper is cut lengthwise from a fresh sheet. This strip is marked, say from 0-1,000 ohms, 0.1 to coincide with 0 ohm and 10.0 with 1,000 ohms. R_1, which is determined from the circuit values (R31 +VR1), Fig. 10b, on the strip is made to coincide with the 1.0 mark on the sheet where the curve is drawn. Hence the most usual value of resistance, such as 10, 15, 20, 25 ohms, etc., is referred to the horizontal line by means of the curve. This line is equally divided and represents the linear D.C. current scale or voltage of the meter. Therefore, by referring to the graph it is easy to mark the meter scales directly in ohms.

Each of the four ranges being decimal multiples of one another, one calibration is sufficient.

Calibration of A.C. Volts Scales

Depending on the circuit chosen there are either two or three A.C. volt scales.

If one uses the circuit incorporating a separate potential divider then the ranges 0-250, 0-500 and 0-1,000 v. are read directly on the D.C. volt scale, as the necessary correction has been applied in the choice of resistors.

The other circuit requires a separate scale for these ranges. Although the scale above 100 v. is a linear one, it is 1.11 times higher in values than the D.C. scale. Therefore, the ranges are 0-277.5, 0-555 and 0-1,110 volts.

In both circuits the 0-10 volt range is calibrated as follows. A transformer, of suitable mains primary, and having a secondary of 0-30 volt, is used. A 50-100 ohm wire-wound potentiometer is connected across the secondary as shown in the circuit in Fig. 13. An Avo Model 7, or other suitable voltmeter is used as standard. The potentiometer is adjusted until a reading of 1 volt A.C. is obtainable on the standard voltmeter, the deflection on the instrument being calibrated is then noted by reference to the D.C.

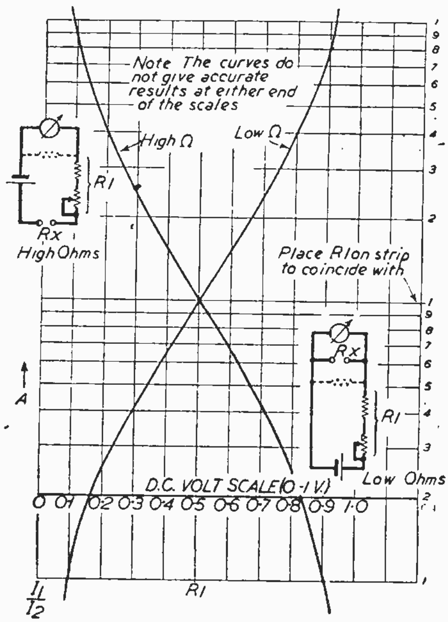


Fig. 12.—Curves for marking out the scale as described above.

volt scale. A number of voltage points are then taken in the same manner from 0-10 volt, including 6.3 volt for filament checks.

Calibration of the 100 volt A.C. Scale

The principle is similar to calibrating the 10 volt scale. If a suitable transformer is available, say with a 0-150 volt secondary, it can be incorporated in a similar circuit employing a 1,000Ω w.w. 5 watts potentiometer for VR1. Points are then taken at 5 volt intervals with reference to the D.C. volt scale.

Alternatively, two power resistors, as used in A.C./D.C. receivers can be employed connected in series, one being kept fixed while the resistance of the second one is varied by means of the slider, which is usually incorporated in these units, to give readings on the standard volt-meter equidistant by 5 volts. Again reference is made to the D.C. volt scale for plotting the values. To avoid fluctuations due to the heat developed by these resistors, it is advisable to have a switch in the circuit, so that the current only flows when a reading is to be made.

In the description of the instrument mention was made of an anti-parallax mirror. This may sound more difficult to incorporate than it actually is. It consists, as the illustration shows, of a 3/16in. wide segment cut in the Bristol card with a sharp razor blade thus exposing a segment of similar width on the aluminium panel on which the scale is glued. This panel can be given a high polish by means of a fine abrasive such as a good quality metal polish. The polish is then prevented from tarnishing by the application of a thin layer of clear varnish.

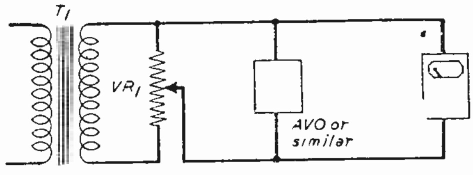
Care of the Instrument

When the wiring is completed, check it against the circuit diagram to make sure that no error has crept in.

If the wiring is satisfactory, try the different ranges to see that they are working well and check the calibration.

Do not measure volts when S_2 is on the current position, as this will undoubtedly destroy the pointer and probably also burn out the coil.

Although the pointer is made of glass, it is re-



T_1 = Pri. To suit local mains Sec. 0–30 V. approx. VR_1 = 50–100Ω WW Pot SW.

Fig. 13.—Circuit for calibrating the A.C. volt scales.

markably robust and a slight overload will not damage it, but it is wise to make sure that the knobs are in the correct position for the reading required. If you are not sure of the quantity you are measuring, always set the switch to the highest value. This will save disappointment.

Try to get your readings so that they are as near the right-hand side of the scale as possible. This is where the accuracy is highest.

The test leads are taken from a 3-core rubber covered cable capable of carrying 15 amps. Thin wires should not be used as their resistance will affect the low-ohm ranges.

One end is fitted with a banana plug to fit in the socket on the instrument while on the other end can be accommodated a socket to receive either a crocodile clip or a test prod.

German Radio Show

THE second post-war exhibition of the radio and gramophone industry will again be held at Dusseldorf from August 29th to September 6th, 1953. New and extended halls will offer space for a representative exhibition of all branches of the many fields of radio and television engineering and the gramophone industry.

As indicated by its official name, the Grand German Radio, Gramophone and Television Exhibition will show radio and television alongside each other.

The main emphasis will be placed on FM radio. The quality of the programmes broadcast by the German FM stations is higher today than ever before. The way in which various problems were solved will be shown by the receivers on exhibition ; in accordance with tradition, the Radio, Gramophone and Television Exhibition will at the same time start the new radio year. The industry will show all its new developments, so that the Radio, Gramophone and Television Exhibition will offer both the radio trade and the friends of radio a unique opportunity to examine everything in one place.

The exhibition will be the large show-window for all branches of the electro-technical industry and its subsidiary fields. The increasing attention being paid in all countries of Europe to frequency-modulated UHF broadcasting, with its reception free of interference and static, makes a visit to Germany particularly attractive. At the present time there are approximately 70 FM stations on the air in Europe with powers between 0.1 and 10 kilowatts, while there are about three million combination receivers, i.e., radios equipped for the reception of FM and short, medium and long waves, in operation. The German firms therefore have considerable experience in the design of FM receivers.

F.M.

New radio receivers will be on hand for the visitors. These sets have an FM range with an efficiency virtually unknown until now. The tone has once more been made the subject of special attention, so that it has been possible to increase even further the fullness of tone and brilliancy of the music being reproduced and the clarity of the speech. Improved circuits with high amplification valves offer the maximum performance on all wavelengths in spite of the not very satisfactory distribution of wavelengths in the medium wave range, whereas push-button tuning further simplifies the operation of the receivers. The range of receivers offered in the low and medium price classes is particularly wide. Receivers with built-in gramophones and record players with a number of speeds, as well as radio receiver and magnetic recorder combinations at reasonable prices will probably be the hit attractions at the Exhibition, as well as a series of new magnetic tape and wire recorders for the home recording of radio and microphone shows which are expected to be on view.

The Beginner's Guide to RADIO

The Fourth of a Series of Articles for Those New to Radio. This Month I Explain the Purpose of Grid Bias in Relation to Characteristic Curves

By F. J. CAMM

THE three-valve circuit shown last month represented a receiver incorporating a detector valve with two amplifying valves in its simplest form. The valves were *unbiased*. Now, valves which are used for audio frequency (low-frequency) amplification need to operate at a special part of the characteristic curve of the valve. The circuit given below (Fig. 20) shows the modifications necessary to Figs. 18 and 19 given last month, in order to apply correct bias to the valves. A pictorial representation of these modifications is shown by Fig. 21. So that the valve can function at its best, according to the characteristic curve, grid bias should be applied, and it now becomes necessary to explain what a characteristic curve means. A typical characteristic curve is shown in Fig. 24, and it will be seen that the vertical line at the extreme right (known as an " ordinate ") represents anode current in milliamperes, and the bottom line (abscissa) the grid volts. Not all characteristic curves express this relationship. Some show anode current in relation to anode volts. The standard terms used in connection with characteristic curves are Vg for grid volts, Va for anode volts, and Ia for anode current. The grid volts line is sometimes divided into two parts, a zero line being placed near the right-hand edge and the volts to the left of this being marked negative, those to the right positive. Now this set of curves will give us all the details which are known of the characteristics of the valve. We can plot a characteristic curve ourselves. First obtain a piece of graph paper and mark it off as shown in Fig. 24. Connect up a valveholder, grid-bias battery, H.T. battery and L.T. battery and connect a milliammeter in the anode lead between plate and H.T. positive. With no grid bias and 60 volts H.T., note the current indicated by the milliammeter. On the square paper on the zero line make a dot where the line corresponding with the anode current intersects. Now plug the grid-bias plug into the 1.5 volt socket and note the anode current, making a dot on the chart about the 1.5 volt line at the point of intersection with the new anode current. Proceed in this way with various H.T. and G.B. values, finally joining up all the dots to form a *curve*. The result of this will be, or should be, a set of curves exactly the same as those supplied by the valve makers, and the various figures such as *amplification ratio*, *slope*, etc., may now be found.

The amplification ratio is the ratio of change in anode voltage to change in grid volts. When preparing the curves as explained above, it will be noted that as the grid bias is increased, the H.T. voltage remaining unaltered, the anode current decreases. For example, with 100 volts H.T. and no volts on the grid the anode current may be, say, 50 milliamps. When the grid-bias is increased by three volts the anode current will drop to just under 10 milliamps, a drop of 6 milliamps. Therefore, to obtain the same anode current without altering the bias it will be necessary to increase the H.T., and in the example quoted about

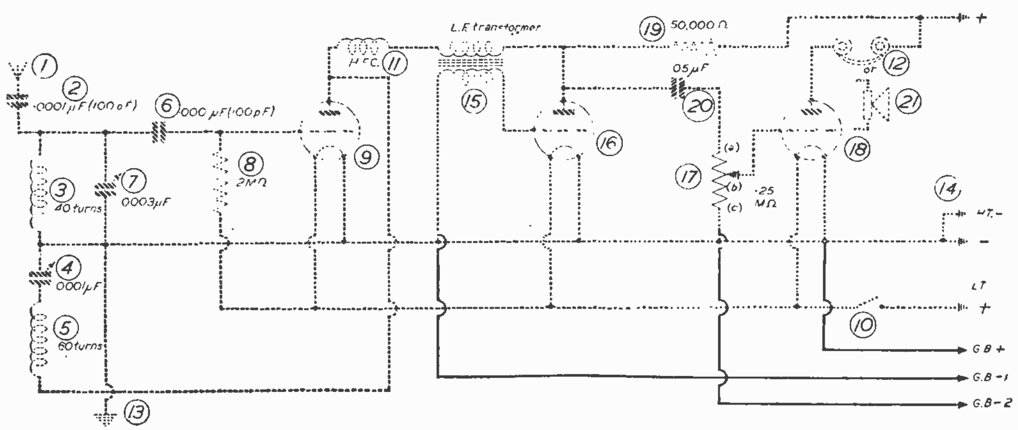


Fig. 20.—The circuit revised for applying bias to both L.F. stages.

24 volts are required to obtain the same anode current. From this it can be concluded that it is necessary to add 24 volts H.T. for every 3 volts G.B. added and this ratio, $\frac{24}{3}$ or 8 : 1, is the amplification ratio.

The term *slope* is another name for mutual conduc-

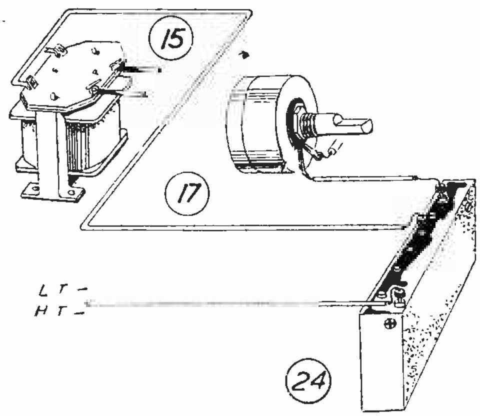


Fig. 21.—Pictorial illustration showing connections to the grid bias battery.

tance and it refers to the change in anode current divided by change in grid volts ; or to put it another way, the anode current change per volt grid potential change. For this factor the anode potential, or H.T., must be left unaltered. Only the grid bias must be varied. It will be found that as the bias is increased the anode current will decrease and, therefore, a set of figures are obtained from which it will be observed that the anode current decreases, say, 2 milliamps for every volt increase in grid bias. In this case the slope would be known as 2 milliamps per volt or, as it is expressed on the valve chart, 2 mA/V.

Impedance

The impedance of a valve has a bearing on the value of resistance, etc., which is used in coupling a valve to its next stage. No further calculation needs to be made to obtain this figure as the two previous items, slope and amplification ratio, are used to ascertain the impedance. You simply divide the amplification ratio by the slope, multiply the answer by 1,000, which in the example given will be $\frac{8}{2}$; which multiplied by 1,000 equals 4,000 and this gives the impedance in ohms.

It is important to remember, however, that these figures are *static* characteristics, which means that they are only applicable to a valve which receives constant voltages. When the valve is operating in the receiver, the grid and anode voltages are constantly changing and it is therefore impossible to ascertain from the curves such details as the *maximum undistorted output*, the correct *anode load*, the percentage of *second harmonic distortion*, etc., and it is therefore necessary to prepare a set of curves known as *dynamic* curves. I shall not explain how to plot these curves this month except to say that when they are plotted it will be observed that the values of both grid bias and H.T. are carried to a value higher than is normally used.

In order to make use of these curves the current at the correct working point must be shown, that is to say, the correct anode volts and correct grid volts and, in addition, at half and double these values. During the operation of the valve (dealing with the valve as an L.F. amplifier), the grid potential varies when the valve is operating on the proper part of its characteristic from half the applied bias to double that bias. If it does not do this then distortion is taking place. The effect of the variation in bias is equivalent to a change in anode volts and therefore the dynamic curves will show the anode current at various grid and anode volts.

Receivers operated from the mains dispense with batteries, including the grid-bias battery. I shall explain how this is effected when I deal with mains receivers.

Automatic Bias

It is possible with battery receivers to employ automatic bias. The object of bias in a valve is to render the potential of the grid less than that of the cathode or filament. With ordinary battery bias the filament is at a potential equal to the potential at the negative end of the high-tension supply, and by connecting the positive pole of the grid-bias battery to the same spot the grid potential is equal to the voltage of as much of the grid battery voltage as is included in the grid circuit. In order to bias the valve it does not matter whether the cathode is at zero voltage and the grid at some negative potential, or whether the grid is at a zero potential and the cathode at some positive potential. This is the condition which usually obtains when automatic bias is used. In most mains arrangements the grid is maintained at the same potential as the negative terminal of the high tension supply, while the cathode is raised to a higher potential by the inclusion of a resistance in the lead connecting the cathode to the negative high tension terminal. Battery auto-bias is carried out by including a resistance in the H.T. lead. Fig. 22 shows the arrangement of the two resistors for the two values of bias required. Experimenters may try different values to see the effect. For example, a voltmeter may be connected across the resistor to ascertain what value is applied.

The advantages of automatic or self-biasing are many. In the first place, if the value of the biasing resistance is correct there is no possibility of under-

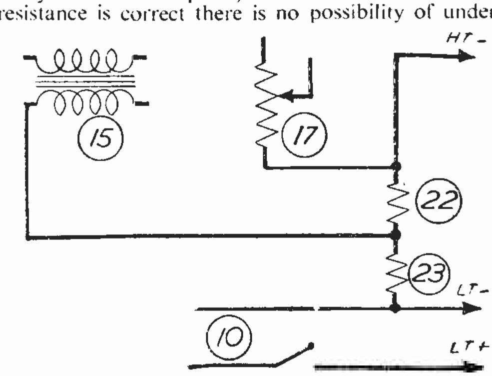


Fig. 22.—Modified circuit for providing automatic grid bias.

biasing or over-biasing the valve. The biasing resistance automatically controls the value of the anode current, for should the anode current rise, due perhaps to an increase in anode voltage, the drop through the biasing resistance will rise in proportion ; the negative bias will be increased and the anode current reduced to a safe value. Further, the biasing resistance does not deteriorate as does a grid-bias battery ; it does not vary in value, and needs no replacement. If desired, the biasing resistance can be made variable or semi-variable.

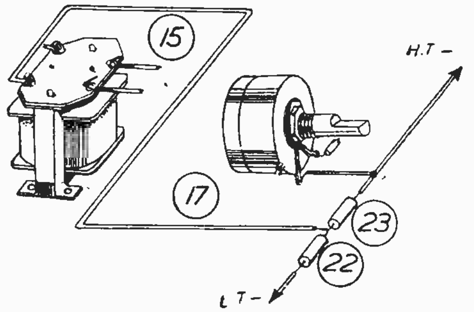


Fig. 23.—Pictorial diagram of the auto-bias wiring.

There is, however, one disadvantage. Any biasing voltage thus applied is deducted from the total H.T. voltage. This, of course, makes no practical difference to the efficiency of the average mains set where 200/250 volts H.T. is available from the mains and the maximum bias voltage required does not exceed 30 volts. In the case of some of the bigger output valves, however, which are designed to operate at about 400 volts on the anode, as each valve requires over 100 volts grid bias, the loss if this amount of bias were subtracted from the available 400 volts H.T. would be serious.

Biasing resistances generally should be of the stable type and must be capable of carrying the full anode current of the valve continuously without overheating. In the case of early-stage low-frequency amplifiers and screened-grid valves, ordinary fixed resistances are quite suitable, but for output valves, where a certain amount of preliminary adjustment of grid bias is usually necessary, it is advisable to use a variable resistor, or preferably a fixed resistor and a variable resistor in series. This allows of adjustment, but at the same time prevents the valve from being run entirely without bias if, by mistake, the variable portion is reduced to zero. For variable-mu valves, where continuously adjustable bias is required, the resistance must naturally be of the variable type. The calculation of the correct value of biasing resistance is a simple matter, and is merely the application of Ohm's Law. The formula is :

Value of biasing resistance in ohms $= \dfrac{\text{Desired bias in volts}}{\text{Anode current in amps.}}$

As the anode current is usually expressed in milliamps, the value of the biasing resistance is found by multiplying the desired bias voltage by 1,000 and dividing by the anode current in milliamps.

As a typical example, take an output valve requiring a grid bias of 32 volts at full anode voltage, the anode current being 30 milliamps., the correct resistance for self bias would be 32 multiplied by 1,000 and divided by 30, or 1006.6 ohms. Actually, a total resistance of 1,250 ohms would be used, consisting of a 750-ohm fixed resistor in series with a variable resistor of 500 ohms maximum.

In mains receivers, in addition to the biasing resistance itself, certain additional apparatus is usually required, by way of decoupling. If the anode supply is not efficiently smoothed, and a bad mains ripple is present, there is a risk that this may be transferred to the grid by the bias arrangement, when the anode current will be correspondingly modulated and serious main hum result. Moreover, there is always a chance that the biasing circuit may pick up mains hum from some other part of the apparatus, while any other low-frequency component in the anode circuit will have a similar effect. To reduce this risk, a grid decoupling or smoothing circuit may be employed. This consists of a high resistance, usually of about 50,000 ohms, included in the grid return and by-passed to the cathode through a condenser which, in the case of most low-frequency valves, should be of at least 2 μF capacity.

Such decoupling is not essential, but should be added without hesitation if serious hum cannot be cured by other means. Different designers prefer different arrangements of the auto-bias circuit, but the circuits given on pages 448 and 449 are tried arrangements and quite suitable for the types of battery circuit for which they are recommended. The manner in which the automatic bias is obtained in the circuit shown in Fig. 22 is quite simple. When a voltage is applied across the ends of a resistance there is a voltage drop through the resistance caused by the current flowing, and this in turn is dependent upon the voltage which is applied, and the value of the resistance.

(To be continued)

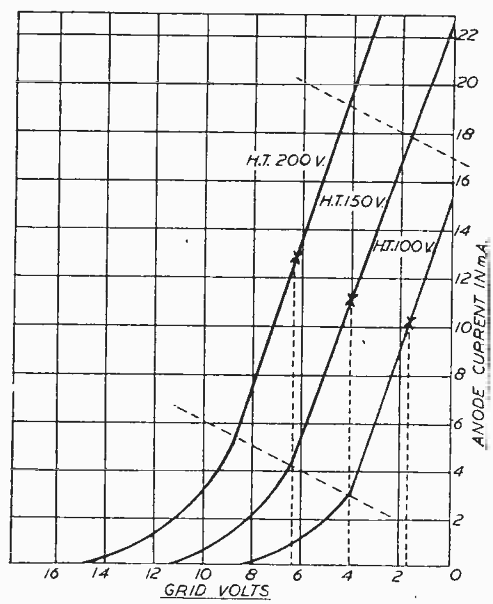
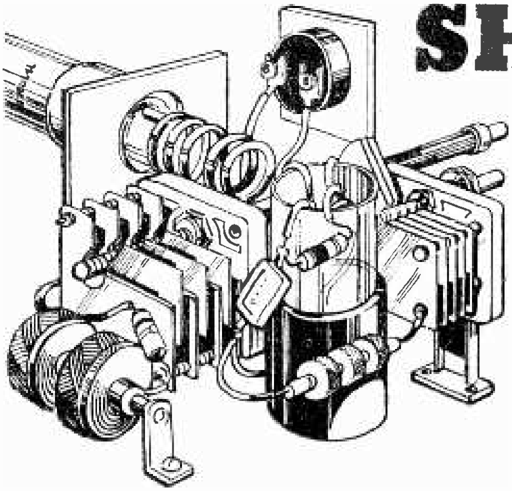


Fig. 24.—Typical characteristic curve of an amplifying valve, showing the variation in grid bias resulting from variation in H.T. voltage.



SHORT-WAVE SECTION

VERTICAL AND FIXED BEAM AERIALS

WITH SUGGESTIONS FOR COMPARATIVE TESTING

By A. W Mann

IN the author's opinion one of the most interesting branches of short-wave radio experiment centres around aerial design and comparative efficiency tests. This applies especially to directive aerial systems which of necessity are developed on original lines rather than on text book recommendations.

Rotary Aerial Systems

With aerials of this type testing is to some extent straight-forward. A soundly-designed system used in conjunction with a sensitive receiver, a pair of headphones and some form of output indicating device, as for example, an S meter or alternatively an L.F. output meter, will enable the experimenter to check signal gain and decline by oral and visual means, and with the minimum of trouble.

It will be noted that I specify a pair of headphones and not a loudspeaker, for this applies to all types of set. The reason is that one is thus in more intimate contact with what is taking place, as compared with listening via a loudspeaker. Actually, it is surprising how minute variations and slight defects pass unnoticed using the latter method.

This applies especially to improved selectivity and the clearing up of the hash created by jamming, especially on the short-wave broadcast bands.

Fixed Beam Systems

While we can effectively test rotary aerial systems on short-wave commercial broadcast and amateur 'phone transmissions, the same does not apply to fixed beams unless we have two or more which can be instantaneously switched in and out of circuit.

The only alternative when live transmissions are the test medium, is to test the new beam against a check aerial. That the check aerial should be an efficient one should not be overlooked. If such is not the case the experimenter will find the results to be very misleading. For example, what is intended to be a beam aerial with focusing properties may, when tested against a really efficient check aerial of horizontal or vertical type, be found to possess very little in the way of directive properties, and, in fact, compare unfavourably with the checking aerial.

If, however, the checking aerial is an inefficient one, the gain obtainable with the new beam may not be due to its more marked directional properties, but to the fact that as a collector of signals, it is a more efficient piece of wire having better pick-up.

This state of affairs could, of course, be due to increased height, length comparatively and angle of inclination, etc.

As is well known, individual copies of text book beams do not always come up to expectations. It follows, therefore, that some of those based on individual theories may in some instances fail to please. An unsuitable location, screening, space restriction, are all factors with which one may have to contend. Of equal importance, and do not let it be disregarded, is the inability to install an efficient earthing system.

Professional radio engineers have also to consider the suitability of terrain, and the attractions of a site high above sea-level will soon fade if it is found that the subsoil mitigates against the installation of a satisfactory earthing system.

While the short-wave listener and amateur is not likely to be tied down by such highly technical requirements, he cannot afford to sacrifice efficiency, neither can he, as a rule, choose another site. The earthing system should, therefore, be the best possible under the circumstances.

It may be that the beam is more efficient when used with an unearthed receiver. On the other hand the receiver to be used may be at its best when an earth is used.

In the writer's opinion the most satisfactory aerial to use for checking purposes is one which does not discriminate as to direction. In this respect the vertical type is ideal.

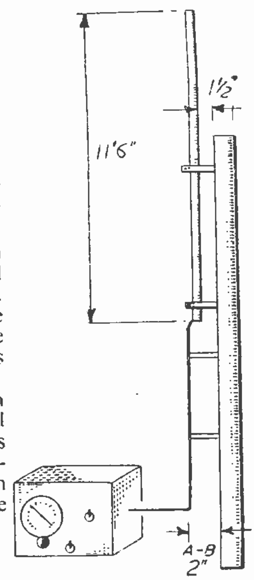


Fig. 1.—Typical vertical rod aerial arrangement.

A Vertical Aerial

Fig. 1 shows in detail the vertical rod aerial used by the author for checking purposes. This consists of an 11ft. 6in. length of ¼in. solid copper rod. This is mounted on blocks of insulating material. A 25ft. pole is used. The down lead being of insulated stranded copper wire fastened to hardwood spacers.

While this is a very simple type of aerial it is also a very efficient one. The rod proper stands only one foot above the top of the pole, and thus swaying and perhaps bending due to high winds is avoided.

In cases where the erection of horizontal aerials is impossible, and, for general use, I can strongly recommend an aerial of this type. Precautions should be taken to avoid any possibility of whip in the interest of stable signals. This applies especially in the case of DX.

Whip Aerials

No doubt the vertical aerial described has brought to mind the idea of using an ex-Service whip-type vertical aerial. Some time ago I remarked that it was surprising as to the number of transmissions which could be received when using an aerial of this type with a communications receiver.

That remark, however, was not intended to convey that a whip-type could be stood up anywhere and anyhow with the result that the transmissions would roll in. Among the writer's receivers are two very good R1155 models. Using an R1155A plus an output stage and a whip aerial mounted on top of the workshop, powerful world broadcasters are received well, the A.V.C., however, running flat out. Volume consequently must be reduced to provide a better signal-to-noise ratio. Even so, more than sufficient output is available.

Switching over to the copper rod vertical we get a considerably better signal-to-noise ratio with increased output. A temporary arrangement of the whip at equal height provided as might be expected almost equal effects.

Tests were then carried out using an R1155B on headphones, and less a pentode output stage, with the whip mounted in the original position. The powerful broadcasters were fairly good although the reduced pick-up and higher noise ratio was much in evidence, so much so that when we switched over to the copper rod the additional gain made a reduction in volume most desirable. A whip or any other type used under similar circumstances for reception of weak world-broadcast, and especially amateur 'phone transmissions is useless. They must be erected as high as possible and not less than 20ft. if satisfactory results are desired, even with a communications type receiver.

I do not recommend this type of aerial mounted in its rubber base for use with non-H.F. stage receivers. Swaying by even a slight breeze will result in the receiver being unstable and most difficult to operate. Rigidly mounted at a suitable height on the lines of the copper rod aerial they should prove to be very efficient.

Experienced readers will undoubtedly be fully aware of the facts outlined. There are, however, to my knowledge, a considerable number of newcomers to the pastime who read these articles, and it is quite possible that some, having noticed whip-type aerials mounted at no great height on some service vehicles more from necessity than choice, may have come to erroneous conclusions.

An Alternative Method

While much useful work can be accomplished using world broadcasts and amateur 'phone signals as a medium, a spell of poor conditions may hold up the tests and thus prolong the experiment.

This being the case experimenters are strongly advised to build the simple unit about to be described. Fig. 2 shows the theoretical circuit of a simple oscillator in which provision is made whereby a modulated signal or an unmodulated one is available by means of a switch. A one-valve receiver layout of the components is arranged on a sheet aluminium-

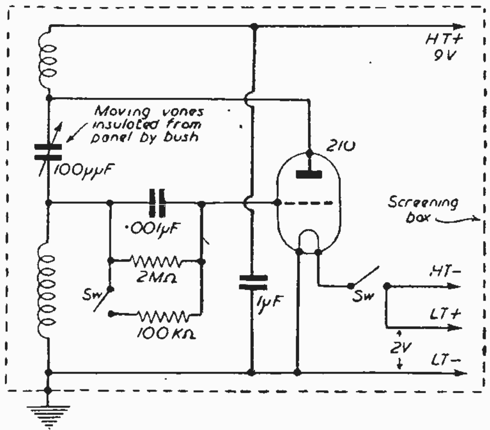


Fig. 2.—Simple oscillator circuit for test purposes.

faced baseboard, and the whole unit, including batteries, fitted into a small screening box with a well-fitting lid. By means of plug-in coils the full tuning range of the receiver can be covered with the additional advantage that, if desired, the instrument can be calibrated for use as a wave or frequency meter.

H.T. is supplied by a standard 9-volt grid bias battery, and L.T. via a small accumulator of the portable type or from dry batteries. A 4-volt flash lamp type battery can be used, with the voltage dropped by means of a 30-ohms rheostat as used in early broadcast receivers, if such is to hand.

An aerial, even a very short one, is not required and if the recommended H.T. of 9 volts is used, sufficient radiation, even though the unit is completely screened, will be available. This recommendation should be followed, as all we require is a weak but steady signal which will not cause local interference, depending on the amplification by the receiver to make it sufficiently audible for our purpose.

Procedure

Suppose, for example, a simple outside V beam has been erected at the back of the house. We can check its directional possibilities by placing the oscillator as far away as possible from the beamed direction, using a modulated note, and having tuned the unit to the desired frequency, set it working. Next, check the side pick-up using the same strength of signal, then, with the unit set up behind the apex end, repeat the test. At all times the oscillator should be equidistant.

On your Wavelength

by THERMION

Radio Taxis

THE new radio taxi service, which is operated in London and other cities, is a further example of the harnessing of the benefits of radio to the practical service of the public as distinct from pure entertainment. Almost everyone at some time has tried to hail a taxi in vain, usually in wet weather. You will see, even at London termini, queues of travellers waiting for the taxi to pick them up with their luggage. People in the remoter parts of cities and towns where taxi services, other than private cars, are non-existent, are particularly unfortunate when they have to make an awkward journey not covered by a bus route, or at a time when bus services are not running.

Now, you ring up Radio Taxis, explain where you are and they immediately put a call out to all of the taxis operating their system, which are equipped with two-way radio. The driver nearest to the fare will reply to central control stating that he is on the way to pick up the fare. The other drivers are then told to carry on.

This radio taxi service is spread over London and most of its suburbs, and consequently there is always a radio taxi in or around a particular vicinity with an owner-driver ready to serve you.

The company operating this system do not own the taxis. The taxi-owner-driver pays 35s. a week and the company installs the radio transmitter and receiver. Needless to say, most London taxi drivers are adopting this new system which puts them in touch with fares all day long and prevents wastage of time on the rank. I travelled in one of these radio taxis the other day and listened-in to the various calls put out from central control, and I must say I am most impressed with the general efficiency of the system. Taxis are despatched immediately upon receipt of telephone calls and are at your door within a few minutes. You may pre-book your taxi to arrive at any specified date or time and, as in the case of immediate requirements, the driver will take you any distance from anywhere. For coast or country runs, airport, docks, etc., charges are based on 1s. a mile return, and all drivers serving through Radio Taxis have agreed to execute all such hirings at prices arranged between the customer and control.

A Plea for the Beginner

MR. J. H. WHITE, of Swinton, in a ten-page missive, enters a plea for more articles in this journal for beginners. Although he has only just taken up radio, he came across No. 34 of this journal dated May 13th, 1933, in which we gave some prominence to our aims to produce material which can be easily assimilated by the non-technical. Ah, yes! But that was twenty years ago and our readers have graduated from the tyro stage since then. I am certain if the entire contents of this journal were based on the 1933 formula, our long-standing readers would object—*O tempora! O mores!* This journal came into the field when broadcasting was about ten years old, but the passing of two decades and the publication of thousands of articles dealing with the elementary side of radio have created a public which, in the main, requires articles of a more technical nature.

This does not mean that the beginner is overlooked. Every year there are new recruits to our hobby and, as with a school, it is necessary to have Standard I matter for them, so that in the course of time they can move up through the various classes to Standard 7. It is a problem which confronts every technical journal. No journal can remain static. It must progress as its readers progress.

One point often overlooked by new readers is that the very type of article they require has probably been published about a month before they enter the fold. This journal has always made a point of catering for the very beginner. We publish many books, such as "Everyman's Wireless Book," which take the reader in a non-technical and a non-mathematical way right through the fundamentals, and I suggest that beginners could make up some of the leeway by studying these books.

Mr. White makes a plea for pictorial layouts such as those we used twenty years ago, with all the components drawn in perspective and point-to-point wiring. Is there to-day really a demand for this style? If so I gather there would be no objection to re-introducing it. For myself I am of the opinion that most beginners are able to follow a simple circuit in conjunction with a wiring diagram. However, I invite readers who are new to the hobby to write to me regarding this.

Mr. White's particular interest is short-wave sets, and he wants designs which may be easily built from spare parts in the amateur's junk box. Unfortunately, most of the components of this character are unsuitable for modern circuits.

Beginners also should bear in mind our free advisory service, which daily deals with dozens of their problems. This journal is entirely behind its readers, it will help to solve their problems, and its pages will reflect their majority requirements. I understand that the circulation of this journal is far greater to-day than it was before the war, and one is entitled to conclude from this that its policy suits the majority. It is not possible to design a journal which will appeal to every reader, any more than a daily paper can guarantee that none of its readers will disagree with its views. Those who disagree with mine are entitled to their opinions and I do not hesitate to air opposing points of view. Our correspondence pages show also that we do not hesitate to publish criticisms of contributed articles. The running of a journal is a complicated task. A contributor or a draughtsman has to make only a trifling mistake and the critical eyes of our readers will immediately spot it. How nice to be a doctor! He buries his mistakes. We can't!

Standard Frequency Transmissions

DETAILS OF A NEW SCHEDULE OF N.P.L. BROADCASTS FROM RUGBY

STANDARDS of frequency and time differ from the other standards of measurement in that they can be made available continuously over wide areas by means of radio transmissions. The frequencies of 2.5, 5, 10, 15, 20, 25 Mc/s have, by international agreement, been allocated to this purpose and a continuous service on all of these frequencies is in operation from station WWV of the National Bureau of Standards situated near Washington D.C.

Such transmissions enable the user to standardise his equipment without having to install and maintain costly and elaborate equipment, but to be fully effective they must be received in all parts of the world at all times. The WWV transmissions do not meet this requirement, and experiments on an international scale are, therefore, being conducted under the general direction of the International Radio Consultative Committee in order to discover the best means of securing world-wide coverage.

Transmissions from the United Kingdom

As the United Kingdom's contribution to this programme, transmissions, each of 31 minutes duration, on 5 and 10 Mc/s have been made daily since February, 1950, from the Post Office station at Rugby, under the call sign MSF. Numerous reception reports have been received and have helped in the planning of the second stage of this experiment which was inaugurated on May 26th, 1953. The transmission period is now extended to 24 hours per day and the power reduced from 10 kW to 0.5 kW. The transmission is interrupted during the interval between 15 and 20 minutes past each hour to enable one station alone to be measured under those conditions in which two stations such as MSF and WWV are being received at nearly equal strengths. The break in transmission also permits radio noise measurements to be made if no other transmission is present.

Transmissions at present are made on 2.5, 5 and 10 Mc/s; later, 15 and 20 Mc/s may be used, but only three frequencies will be broadcast simultaneously. The carriers are modulated in accordance with the following 60 minute schedule:

Minute past each hour	Modulation
0 - 5 30 - 35 45 - 50	1,000 c/s
5 - 10 20 - 25 35 - 40 50 - 55	1 c/s pulses, the 59th pulse in each minute being omitted
10 - 14 25 - 29 40 - 44 55 - 59	unmodulated
14 - 15 29 - 39 44 - 45 59 - 60	speech announcement

Accuracy of the Transmissions

The carrier and modulation frequencies are all derived from the same 100 kc/s standard and are maintained within $\pm$ two parts in 10^8 of their nominal values. The frequency of the received signal may vary throughout the day, however, if there are ionospheric reflections in the transmission path. This frequency error is due to the movement of the reflecting layers; it seldom exceeds $\pm$ two parts in 10^7 and for a large part of the day is not more than a few parts in 10^8. The transmitted frequencies do not, in general, vary from day to day by more than $\pm$ two parts in 10^9.

Uniform Time—A New Time Scale

The frequencies and, therefore, the time intervals marked by the seconds pulses are measured on what may be called an estimated uniform time scale.

There is evidence that the length of the day varies by about one millisecond in a periodic manner in the course of the year, partly due to a variation in the position of the earth's poles and partly due to a variation in the rate of rotation of the earth on its axis. For precise physical measurements such as the checking of the long-term stability of a quartz standard it is desirable to remove this fluctuation.

Frequencies measured on the uniform and the astronomical time scales do not differ by more than 1.5 parts in 10^8, and the maximum difference in time on the two scales is about 60 milliseconds. The difference is, therefore, of significance only for the most precise measurements.

Special Experimental Transmission on 60 kc/s

The frequencies allocated to standard transmissions are not the most suitable for use within the United Kingdom. A lower frequency has some advantages because the ground wave is then received and errors due to the Doppler changes at the reflecting layers are avoided. A special transmission at a frequency of 60 kc/s and a power of 10 kW is, therefore, made for use in the United Kingdom. The transmitter used for this purpose is a standby transmitter for a communication channel and is not always available for standard frequency transmissions. Experience has shown that a reliable service can be maintained if the transmissions are restricted to one hour per day. This transmission period is 1429-1530 G.M.T. and the modulation programme will be the same as for the short waves.

Some adjustments to the frequency of the standard are necessary in order to keep within the stated tolerance of $\pm$ two parts in 10^8. The standard, which is an Essenring oscillator made by the Radio Branch of the General Post Office, has increased in frequency fairly steadily at the rate of about two parts in 10^9 per month since its installation in February, 1950. It is therefore set to be 1×10^{-8} less than its nominal value and is reset when it has drifted to 1×10^{-8} above nominal.

The seconds pulses are derived from the standard by division and consist of five cycles of 1,000 c/s tone. The precision of the pulses is $\pm 1\ \mu s$ and the time interval between two pulses is, therefore, accurate to $\pm$ two parts in $10^8 \pm 2\mu s$. For example, if the frequency is 1×10^{-8} high then the time interval between corresponding pulses on consecutive days is 1×10^{-8} (approximately one millisecond) less than one day. The time error is integrated and in general no attempt is made to alter the phase of the pulses so as to make them coincident with uniform time. If, however, they are in error by more than 50 milliseconds an adjustment of 50 or 100 milliseconds is made. Such adjustments are made on the first day of the month and the extent of the adjustment is announced.

Reception Reports

The MSF service of transmissions is still experimental and reports concerning reception will be welcomed.

They should be addressed to The Director, National Physical Laboratory, Teddington, Middlesex, England.

DESIGNING A RESISTANCE CAPACITY-COUPLED STAGE

By J. S. Kendall

An article dealing with the design of the drive stage of an amplifier, giving the calculations for both triode and pentode valves when used as voltage amplifiers.

IN these days it is usual to have at least one stage of voltage amplification before the output stage in order that it may be fully loaded. Fig. 1 shows a simple voltage amplifying stage, in which the valve is chosen to give the required gain, and the other components to suit it. It should be pointed out here that it is impossible to get a stage gain equal to the μ of the valve chosen.

Most amateurs are now using the 6.3 volt range of valves or the equivalent universal types, although some are still using the four-volt series.

Perhaps it would be as well to consider just how the valve amplifies. If an alternating voltage is applied to the grid it will be taken alternately positive and negative of the normal standing grid voltage. If the grid is taken in a positive direction the current through the valve increases, and by Ohms law the voltage across the anode load resistor increases, thereby reducing the actual anode voltage. Conversely, if the grid is taken negative the current through the valve is reduced with the result that the anode voltage rises, with a reduction in the drop across the resistor. From this it will be seen that there is what is known as a phase shift of 180 degrees between the input and the output voltage of the valve; this is also known as a phase reversal, i.e., a change over from negative to positive and vice versa. So far we have omitted the effect of the internal impedance of the valve. This valve impedance must not be confused with valve resistance, which would be found by dividing the anode voltage by the anode current, whereas the impedance is found by applying a standing voltage and fixed grid voltage, and measuring the anode current; after recording these two increase the anode voltage and not the current. After recording these two sets of readings, the change in anode volts is divided by the change in anode current. The impedance, it should be noted, is far higher than the D.C. resistance of the valve.

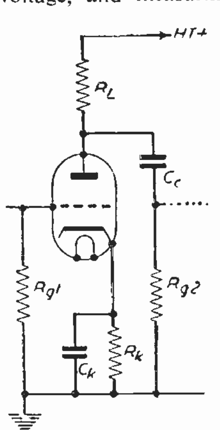


Fig. 1.—A simple voltage amplifying stage.

If, then, a voltage V_G is applied to the valve, a voltage of μV_G will be developed by the valve, in series with its impedance Ra. The complete circuit can be regarded as being as shown in Fig. 2. From a simple application of Ohms law it is possible to prove that the voltage in a series circuit is inversely proportional to the value of the two resistors, so that the portion of the output voltage developed across the load will be $\frac{R_L}{R_L+R_A}$, and since the valve can be regarded as a generator of μV_G, then the output voltage will be $\mu V_G \frac{R_L}{R_L+R_A}$.

The ratio of input to output voltage will be,

$$\frac{V_G \dfrac{\mu R_L}{R_L+R_A}}{V_G} = \frac{\mu R_L}{R_L+R_A} = a \text{ (stage gain).}$$

This is a very useful formula and should be committed to memory by the reader. Another useful version of this formula is $R_L = \frac{aR_A}{\mu - a}$ as from it it is simple to calculate the anode resistor R_L to obtain a specified voltage gain. Take, for example, a valve required to deliver four volts r.m.s. to a high-slope output pentode of the PenA4—EL33 type, from a gramophone pickup capable of an output of 0.5 volts maximum. To ensure that there is gain to spare to compensate for low power recordings, a voltage gain of 15 would be chosen. This gain of 15 means that the amplification factor of the valve chosen must be over 15. On looking over our valve stocks it is perhaps found that a 6J5G is available, and the amplification factor of this is 20 and its impedance is 8,000 ohms with 100 volts on the anode.

Applying the formula $R_L = \frac{a\ R_A}{\mu - a}$ and substituting the known factors we get $R_L = \frac{a\ R_A}{\mu - a} = \frac{8{,}000 \times 15}{20-15} =$ 24,000 ohms.

Having thus calculated the anode load resistor the next step is to calculate the values of two resistors that will, in parallel, give this value of resistance, as to

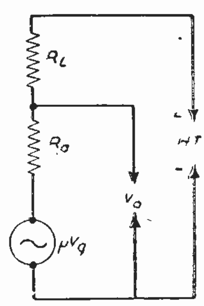


Fig. 2.—Equivalent circuit of a simple valve stage.

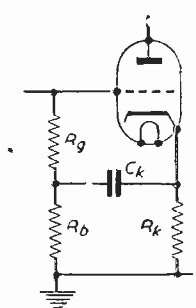


Fig. 3.—One form of bass boosting circuit.

all intents and purposes the load presented to the valve consists of the anode resistance and the grid resistance of the following valve in parallel. If the ratio of the calculated anode resistor to the maximum grid resistor is greater than 10 : 1, then no further calculations are necessary, as the tolerance of the resistors is only 10 per cent. With the case quoted, the valve following would have a slope of 10 m/a/V, so that a grid resistor in excess of 100 KΩ should not be used. The anode resistor of the drive valve would, therefore, have to be raised to 35 KΩ.

The calculation of the bias resistor and condenser are the same for any type of valve in any type of circuit, and is the bias voltage required divided by the total cathode current. In the case of a triode requiring 10 volts with a total anode current of 5 mA. a resistor of 10/5 KΩ would be required. The by-pass condenser should be as high as possible in order that the low frequencies are not unduly cut.

The power rating of the cathode resistor must not

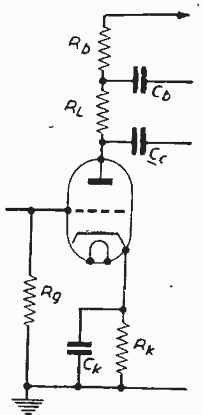


Fig. 4.—Simple bass compensation circuit.

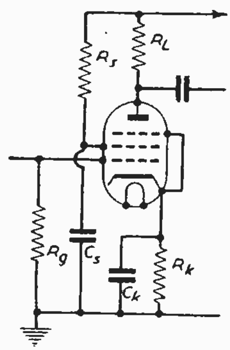


Fig. 5.—A typical 6J7 A.F. stage.

be overlooked, but in most resistance-capacity stages it can be ignored. Take the foregoing resistance calculations, for instance, that would require a power of E^2/r equals $10 \times 10/2{,}000$, which is only 1/20 of a watt!!!!!

Bass Response

There are several ways of improving the bass response. One is to use the circuit shown in Fig. 3. In this there is a condenser joined between the bottom of the grid resistor and cathode, whilst another resistor provides a path to chassis to supply the valve with bias. It must be realised that the condenser must be a high-grade paper one and not an electrolytic. If the maximum permissible grid resistor is used, divided into two equal parts, and as large a condenser as possible employed, the best low-frequency response is obtained. It should, however, be pointed out that a 10 μF electrolytic with a 2,000 Ω resistor, will give the same result as a 0.1 μF and 200,000 Ω in this circuit. The cost of the components resulted in this circuit falling out of use many years ago.

Another bass compensation circuit is given in Fig. 4. In this, it is best if the stage gain at normal frequencies is about half the amplification factor of the valve, i.e., Rl equal to Ra, then Rb is designed to give the required bass lift at a frequency determined by Cb. The actual calculations for the values of these components are rather complex and the writer has found that if Rb is twice Rl, the value of Cb can be found by trial and error and usually lies in the range of 0.001 to 0.1 depending on just what response is required.

Many people have great difficulty in calculating the component values of H.F. pentodes used as R.C. amplifiers. The calculations of the stage gain and the cathode components are the same as with a triode; it is the calculation of the screen resistor and condenser that gives the trouble. In R.C., H.F. pentode stages the anode voltage must not be allowed to fall below that of the screen or distortion will result. If, for example, we take the old favourite the 6J7G being used with an anode load of 100 KΩ we see that under normal conditions the anode current is 3 mA. and the screen current 0.8 mA. with a voltage of twice that on the screen applied to the anode (250) this makes a current ratio of 4 : 1 if then the two electrodes were to be supplied with the same voltage, then the screen resistor would be four times that on the anode, but as it is being worked at half the anode voltage then it will have to be eight times that of the anode load.

The method then is to multiply the value of the anode feed resistor by the ratio of anode to screen current of the valve, then multiply the result by the ratio of anode voltage to screen voltage, usually two, quite simple isn't it?

The screen condenser should always be of paper and should at the lowest frequency required have an impedance of about one-fifth of the screen resistor.

Transistor Hearing Aid

THE first British commercial device incorporating a germanium crystal triode was recently demonstrated in London by Multitone Electric. The new device consists of a simple attachment which can be used with most hearing aids to extend the range of hearing by providing the user with a much higher maximum amplification and power output, enabling him to understand speech at a far greater distance. The attachment relies on a germanium crystal triode transistor of the point contact type made by The General Electric Co., Ltd. Its use amplifies the sound given by a deaf aid by 15 decibels (which in layman's language is about 30 times) when operated from a 22½-volt battery. This range extender could never have been introduced were it not for the development of the transistor.

The attachment, which will be marketed at six guineas (including a high-impedance earpiece) can be used with most hearing aids. It is plugged into a battery and has two leads, one to the hearing aid and the other to the earpiece. A neat device, it can be accommodated with its associated battery in a waistcoat pocket or inside a jacket or blouse. The attachment can be operated from batteries of 9 volts to 45 volts, the size of battery depending upon the degree of deafness of the wearer. It is not thought, however, that even the severest cases of deafness will demand the use of a battery of a higher voltage than 22½ volts.

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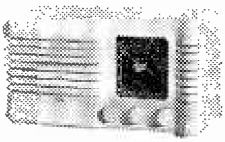

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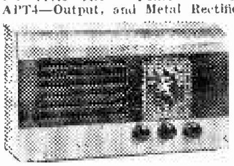
Engraved Glass Dial, 180-550 and 800-2,200m With station names, new wavebands ... 1/6
T.R.F. Coils, 180-550, 800-2,200 metres, pair 6/6
Punched chassis, 3-valve plus rectifier T.R.F. 3/9
Cabinet, Bakelite, in Walnut or Ivory or Wooden in Walnut finish 17/6
Packing and insurance 2/6

SEND 1/6 FOR EASY TO FOLLOW POINT-TO-POINT DIAGRAMS AND CIRCUIT DIAGRAM, which shows how YOU can build the Receiver illustrated above.

THE COMPLETE KIT

to construct a 3-valve plus rectifier T.R.F. Receiver for use on 200/250 v. A.C. mains can be supplied at **£5/19/6**, plus 2/6 packing and carriage.

Each Kit is complete in every detail, nothing has to be made or improvised. Easy to follow point-to-point diagrams are supplied, making construction very simple. The Dial is illuminated, and the Receiver housed in its Cabinet size 12in. x 5in. x 6in. presents an attractive appearance. The valve line-up is: 717A—H.F. Pentode. VR116—Detector. APT4—Output, and Metal Rectifier.



Waveband coverage is for the medium and long bands. Choice of 3 Cabinets: Bakelite in Walnut or Ivory, or Wooden (Walnut finish).

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A complete kit of parts for the construction of the latest version of this famous amplifier complete with valves, output and mains transformers.

15 Gns.

Plus 7/6 pkg., carr. and ins.

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The Output Transformer 3.6 ohms sec., £4/4/-. The Mains Transformer **PREMIER SP425A**, £3 7 6.

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Low impedance. Incorporates press-to-talk switch. Housed in strong black bakelite case. Dimensions: 2in. wide, 2½in. high, 1¾in. deep.

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A matching transformer for high impedance can be supplied at 3/6 extra.

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All parts to construct an eliminator to give an output of 120 volts at 20 mA. and 2 volts to charge an accumulator. Uses metal rectifier. £2.

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12ft. 3 4ft. sections of copper-plated steel highly flexible tapering ⅜in. to ⅛in. Brand new in container. Plug-in type **6/9**. Screw-in type **7/9**. Packing and carriage 1/6. Insulated Base 3/-. Webbing waterproof carrying case with shoulder sling, 2/6.

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By world-famous maker. 2 volt 10 amp. ... 4/11

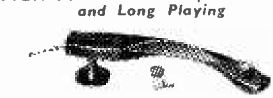
Famous Set Manufacturer's surplus of ELECTRIC 'GRAM UNITS

Two-speed, 33⅓ and 78 r.p.m. For playing Standard and L.P. recordings. Complete with Turntable. For use on 200-250 v. A.C. mains. Each unit is in its original manufacturer's carton and is fully guaranteed. Limited quantity only available at approx. half list price.

£4.2.6

Plus 2/6 pkg. carr. ins.

SPECIAL OFFER THE FAMOUS "CHANCERY" HIGH FIDELITY MICROCELL PICK-UP TYPE GPX *for Standard and Long Playing*



The Chancery Light Weight GPX Pick-up embodies certain unique features achieving a standard of performance not possible with normal magnetic or crystal pick-ups. The secret of the high standard of performance is in the use of the special microcell crystal cartridge assembly which has an unusually wide frequency response. The sapphire stylus is precision ground and semi-permanent. With two cartridges, 1 L.P. and 1 Standard. **Price 52/6.** *Additional L.P. or Standard Cartridges can be supplied from stock at* **£1/11/6** *each.*

GRAMOPHONE UNITS

GARRARD Type 75. Latest 3-speed Autochange Unit complete with 2 Acos High Fidelity G.P.19 Pick-up Heads. 1 L.P. and 1 standard. **£14.19.6**

GARRARD Rim Drive 78 r.p.m., complete with magnetic pick-up and turntable £5.19.6

COLLARO 3-speed single gram. unit, complete with head for L.P. and Standard recordings £8.8.0

Packing and carriage on each of the above units, 2/6.

B.S.R. "MONARCH" AUTO-CHANGER

This is a 3-speed automatic mixed record changer designed to play 12in., 10in. and 7in. records intermixed in any order. Capacity 10 records, operates on 100/125—200/250 volts 50 c/s A.C.

New reversible dual stylus crystal pick-up has extended frequency range to 10,000 c.p.s. Self compensated for the L.P. lower frequencies with the Turnover frequency at the correct point. **PRICE £16.10.3** plus 5/- pkg., carr.

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ELAC.—2½in. dia., Moving Coil 15 ohms imped. 15/-
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PLESSEY—8in. dia., Mains Energised 3 ohms imped. (600 ohms field) with Pentode Transformer 22/6
PLESSEY—8in. dia., Mains Energised, 3 ohms imped. (600 ohms field) ... 19/6
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GOODMANS—12in. dia., Moving Coil, 15 ohms £8/8/-
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Plus 5/- packing and carriage.

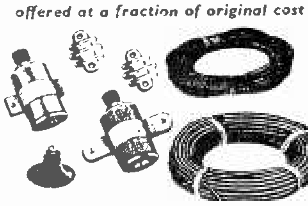
PREMIER MAINS TRANSFORMERS

All primaries are tapped for 200-230-250 v. mains 40-100 cycles. All primaries are screened. All LTs are centre tapped.

SP175B. 175-0-175, 50 mA., 4 v. @ 1 a. 4 v. @ 2-3 a. 25/-
SP250B. 250-0-250, 60 mA., 4 v. @ 1.2 a. 4 v. @ 3-5 a. 25/-
SP300A. 300-0-300, 60 mA., 6.3 v. @ 2-3 a., 5 v. @ 2 a. 25/-
SP300B. 300-0-300, 60 mA., 4 v. @ 2-3 a. 4 v. @ 3-5 a. 4 v. @ 1.2 a. 25/-
SP301B. 300-0-300, 120 mA., 4 v. @ 2-3 a. 4 v. @ 2-3 a., 4 v. @ 3-5 a. 28/-
SP350A. 250-0-350, 100 mA., 5 v. @ 2-3 a. 6.3 v. @ 2-3 a. 29/-
SP351. 350-0-350, 150 mA., 4 v. @ 1-2 a. 4 v. @ 2-3 a. 4 v. @ 3-6 a. 36/-
SP352. 350-0-350, 150 mA., 5 v. @ 2-3 a. 6.3 v. @ 2-3 a. 6.3 v. @ 2-3 a. 36/-
SP375A. 370-0-375, 250 mA., 6.3 v. @ 2-3 a. 6.3 v. @ 3-5 a. 5 v. @ 2-3 a. 55/-
SP501. 500-0-500, 150 mA., 4 v. @ 2-3 a. 4 v. @ 2-3 a. 4 v. @ 2-2 a. 4 v. @ 3-5 a. ... 47/-
SP501A. 500-0-500, 150 mA., 5 v. @ 2-3 a. 6.3 v. @ 2-3 a. 6.3 v. @ 2-3 a. 50/-
SP425A. 425-0-425, 200 mA., 6.3 v. @ 2-3 a. 6.3 v. @ 3-5 a. 5 v. @ 2-5 a. 67/6

Famous Manufacturer's Surplus of ANTI-INTERFERENCE AERIALS

offered at a fraction of original cost



The aerial is designed for reception of long, medium and short waves with any ordinary or communications receiver, having an input impedance greater than 1,000 ohms long medium waves and 150 ohms short waves. The installation discriminates against locally generated electrical interference, especially on the short wave bands. The equipment enables the installation of an 8.3 Mc/s flatly-tuned dipole which operates as a "T" aerial on medium and long waves. The aerial and receiver transformers are intended to be interconnected with a 70 ohms co-axial cable.

The **aerial transformer** comprises a dual transformer matching network whose function is to transfer the energy picked up by the aerial to the down lead. This transformer is inserted in the centre point of a 60ft. aerial.

The **set transformer** is a dual transformer matching network which transfers the energy from the down lead to the receiver.

COMPONENT PARTS
Aluminium Aerial Transformer Assembly

Comprising one each: Aluminium transformer, Transformer clip, Rubber sucker, ⅜in. x ⅜in. brass screw, 4BA x ⅜in. brass bolt, 4 BA nut.

Receiver Transformer

Complete with Insulators, clips, etc.: Porcelain Insulators 2 each. 50ft. Insulated Aerial Wire, 60ft. Screened Co-Axial Down Lead. *Installation instruction leaflet included.*

LESS CO-AXIAL CABLE & AERIAL WIRE
15/- *plus 1/6 pkg. & carr.*

COMPLETE WITH CO-AXIAL CABLE & AERIAL WIRE
37/6 *plus 1/6 pkg. & carr.*

TERMS OF BUSINESS :—CASH WITH ORDER OR C.O.D. OVER £1.
Please add 1/- for Post Orders under 10/-, 1/6 under 40/-, unless otherwise stated.

Those Were the Days!

A SERVICE ENGINEER AND EX-SHIP'S OPERATOR LOOKS BACK ON THE EARLY DAYS OF RADIO

By F. E. Apps

FORTY-FOUR years is quite a space in a man's life, but that is the time I have spent in radio, or as it was called in its infancy—Wireless Telegraphy.

In those early days, when I first became a "Sparks," the standard receiver was the "Magnetic Detector," this having succeeded the old "Coherer." This receiver (a Marconi invention) was a clockwork device, which had to be wound up every half-hour. Fig. 1 will show how it worked.

As the soft-iron band slowly revolved it caused the field of the permanent magnets to be bent over in the direction of rotation. When a wave train induced a voltage in aerial it passed through primary winding to ground. This set up a field which caused the permanent magnet field to flick back, cutting across the secondary and inducing a voltage there, which was passed to headphones. Of course, under present-day standards, this was a very insensitive job, but it was definitely a great advance on the coherer. In those days, signals were few and far between and unless one was very careful and remembered to wind up every half-hour, one could set on watch, listening very carefully but with the M.D. stopped. It could only be used for telegraphy, but as telephony had not yet become possible, it did its job.

In those days, when at sea, one had to rely for news from the Marconi station in Cornwall (the one he used for first bridging the Atlantic), Poldhu. The transmission was spark, of course, and generally started about 11 p.m. and consisted of about 2,000 words sent at a speed of approximately 15 words per minute. About every quarter of an hour, a short break occurred, during which one seized the opportunity of winding up the M.D.

A notable transmission I remember receiving was the one giving the news of the sinking of the *Titanic*. We were at sea at the time, proceeding from Harwich up to the north of Scotland and I shall always remember the shock it gave everybody on board.

As a point of interest, the distress signal in those days was CQD, the CQ, of course, being—All Ships, and the D—Distress. It was quite a while before the SOS came in. The alteration took place so that automatic receivers on board one-operator ships could respond. The morse symbols for CQD are too complex for automatic receivers so the much simpler SOS was adopted.

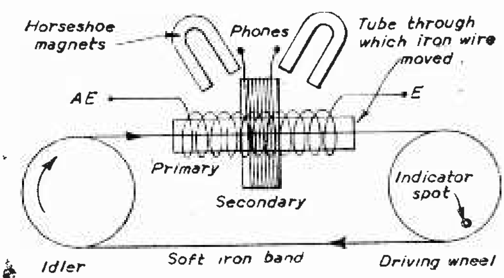


Fig. 1.—Circuit arrangement of the magnetic detector.

The transmitters on ships at that period were either (a) 10in. spark induction coil, (b) synchronous or asynchronous rotary spark gap, (c) spark gap with blower, (d) telefunken multi-gap.

The first type was obsolescent in my early days and the fixed and rotary gaps were coming in. As transmitters they were very inefficient, their range was very limited and the selectivity awful.

Selectivity

This selectivity business meant some very cumbersome devices in the receiving gear. The rejector principle was the one used to try to overcome this. It was quite a big job in itself; larger, in fact, than the complete present-day communications set. Theoretically it was as Fig. 2.

The dimensions of the rejector were governed by the fact that the resistance of the circuit had to be kept as low as possible. Thus the inductance of the circuit had to be low, consisting of a tapped coil of heavy gauge wire and a fine tuner which was a semicircular copper strip of approximately 18in. diameter, over which a large wiping contact arm was moved. Owing to the low inductance of the circuit, the capacity had to be large (due to the frequencies being used at that period). It consisted of blocks of condensers which were plugged in as required with capacities ranging from about four jars to 2,400 jars. By the way, the jar was a standard of capacity at that time. It was the approximate value of the original Leyden Jar and was one nine-hundredth part of a microfarad. Normally the rejector was not in circuit but was kept tuned to the frequency being used. On interference one connected the rejector to earth by means of a plug and, by careful manipulation of the fine tuning inductance, a signal comparatively free of interference could be received.

Crystal Receiver

It was about 1911 when the crystal receiver became the regular job. It was not the cat-whisker and hertzite type, but at the commencement two different crystals were used in contact, Bornite and Zincite being a usual pair. Their use brought about a

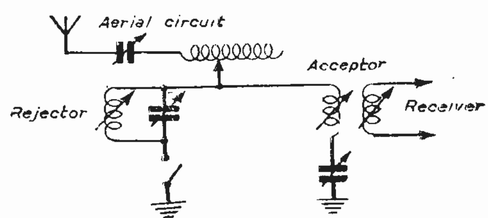


Fig. 2.—Aerial circuit arrangement in early receivers.

great increase in range, their sensitivity being approximately 200 per cent. up on the now-obsolescent M.D. After this type came the semi-permanent type, carborundum and steel using a small battery and potentiometer. This type was a definite boon on a ship, where vibration would cause loss of necessary contact at the psychological moment.

During the Dardanelles campaign of the 1914/18 war I was serving on a coal-burning destroyer' These old-type destroyers had no protection for guncrews against shrapnel and shell splinters, so round the guns were placed coalsacks full of clinker from the stokehold. My last piece of carborundum was losing its sensitivity, so having noticed amongst the clinker some small pieces that were noticeably crystalline, I tried two or three pieces as a detector. The first piece was no good, but the second piece I tried was quite successful and in every way as good as a piece of carborundum. It would have been interesting to have this piece examined by a metallurgist and know what it really was.

An interesting event that occurred about this time was the sinking of the *Britannic*. She was a ship of about 50,000 tons and at the outbreak of the war had just been completed by Harland and Wolff's at Belfast. She was immediately converted into a hospital ship and at the time was on a trip to Salonika to pick up wounded. I was on a destroyer at the time and we were rescuing the survivors from a Greek cattle boat that had been torpedoed off the Piraeus (Port of Athens). At about 8 a.m. I picked up a faint SOS from a " G " callsign accompanied by a position. I checked the call and found it was from a British ship—the *Britannic*—and the position was just in the " Zea channel," about 200 miles from our position. The Greek ship was now aground and crew could easily be picked up by shore boats, so we proceeded at our maximum speed (25 to 26 knots) to the rescue. We arrived in the afternoon, just after she had sunk, and were immediately surrounded by innumerable lifeboats full of the survivors. A wonderful sight was a lifeboat full of Red Cross nurses, pulling valiantly at the oars, to get alongside us. We took all we could on board, and I have never known a destroyer with such a ship's company as we then had. The sea had got up a bit, so we put the nurses in out of the elements as much as possible. The wardroom and the officers' cabins were allocated to them and I even had six of them in the W/T cabin. We took as many lifeboats as possible in tow and proceeded at a slow speed back to Piraeus. We arrived after dark and landed them.

Having had such a multitude to feed, we found after they had landed that there was no bread and very little of anything else to eat left on board. Happily, a depot ship was stationed off Athens and we did not have to go hungry for the next few days.

Continuous Waves

It was about this time that C.W. began to be used for W/T. The first transmitters used the Poulsen arc. This consisted of an electric arc with a carbon and a water-cooled copper electrode. The arc was struck in an airtight chamber and burnt in methylated vapour from an automatic drip. The arc was across an L/C circuit, tuned to the frequency to be transmitted. This resulted in a C.W. oscillation being set up in the L/C circuit. This was passed to the aerial via a coupled tuned circuit. Some transmitters used a marking and spacing wave arrangement, others an aerial circuit break by means of a magnetic key.

The Valve

Valve receivers had, of course, now appeared, as a local oscillator was necessary for the reception of C.W. The first ones I used were a single valve type, using a local oscillator circuit for setting the valve in oscillation and then detecting the resultant beat frequency. Some of these circuits were very interesting. One I remember had what was called a musical inductance. This had an iron core inside the local oscillator coil which altered the note of the signal received by varying the amount of iron inside the coil. As it was easily variable, one could tune in on a steady carrier and then play a tune by judicious variation of the coil. Hence, I suppose, the term musical inductance.

Things now began to move in radio. Multi-valve receivers appeared, generally consisting of two or three R.F. stages, mostly aperiodic, a detector, and then two or three L.F. stages. Telephones were being replaced by loud speakers. The arrival of C.W. transmission and the valve also made possible telephony, and with telephony the experimental station at Writtle, the ham, and the BBC.

Broadcasting

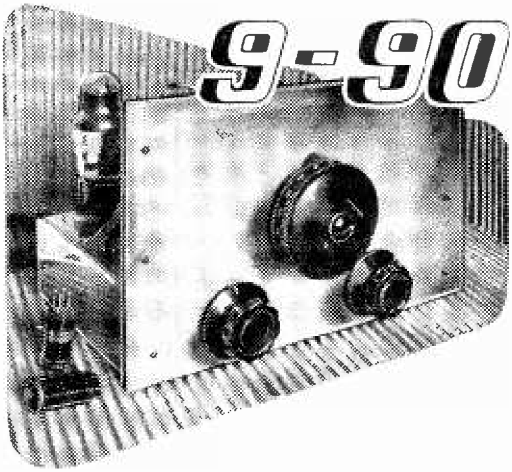
For the general public, for receiving broadcast programmes, the average valve receiver at this time was too expensive. A one-valve receiver was about £20, so crystal sets were used. A popular crystal set with one pair of headphones and a length of aerial wire was sold at £4 19s. 6d., and they sold like hot cakes.

The receiver circuits used were either aperiodic radio frequency, or tuned radio frequency with a detector stage and L.F. stages. As the screened grid valve had not yet appeared, it was necessary, to prevent tuned radio frequency stages from bursting into oscillation, to use small pre-set condensers between anode and grid of each R.F. stage, to offset the inter-electrode capacity of the valve.

The Superheterodyne

A notable advance now occurred. The invention of the screened grid valve, the pentode and the first super-het. These were enormous jobs. The intermediate frequency stages or, as they were often called then, supersonic stages, were themselves about half as big as a complete receiver now. In fact one commercial superhet I saw was approximately 4 ft. long and about 1 ft. wide. The I.F.s were tuned with a condenser about the size of one section of the modern average gang.

Valves were still bright emitters, the indirectly heated valve still had to appear, but the number of people getting radio-minded was growing rapidly. Even the schoolboy was now building his own set and learning from his mistakes. This has no doubt contributed to the vast strides we are making now, so that in these days of world-wide communication, frequency modulation, radar and television, one can ponder, how did we ever get on without it?



9-90 METRES S-W-3

A SIMPLE RECEIVER FOR THE SHORT-WAVE ENTHUSIAST

A RECEIVER such as this may be said to provide the maximum degree of efficiency with the minimum complication. As many users of short-wave equipment know, "straight" receivers can achieve an exceedingly high degree of sensitivity. This is primarily due to the presence of reaction, which increases the volume of weak transmissions to a very great extent. The noise level of such receivers is low, and signals which are inaudible with the simpler type of superhet may be resolved with a straight receiver, if reaction is correctly used. Such a receiver as that described here should not, therefore, be looked upon as a "local station" set. When conditions are normal, the range of reception is literally world-wide.

The receiver employs plug-in coils. Consequently, the user is not restricted to one waveband, though any losses which might arise from wavechange switching are avoided. For general use, the coil which covers approximately 17.5 to 45 metres is most useful. With a second coil, the bands up to approximately 90 metres may be tuned. A third coil permits tuning down to approximately 9 metres. With three coils, therefore, the coverage is from 9 to 90 metres—and this embraces all the bands in most general use. If desired, higher bands may be tuned by using suitable coils, and coils for the usual medium- and long-wave bands are also available. (Though the latter increases the field of utility of the receiver, it should be emphasised that it is not primarily intended for long- and medium-wave reception, and not designed with such wavelengths in view. As a result, selectivity is not high, though it reaches a fair level, due to the type of coil employed.)

Auto-bias circuits have not been provided, since their presence restricts the builder to certain specified valves. With battery bias, a wide range of valve types can be used with success. For this reason, a separate feed has been provided for the detector H.T., rather than deriving this from the maximum H.T. point, with a dropping resistor.

Tuning is simplified by using a reduction drive of high quality. Since the design of the coils makes it necessary for the reaction condenser to be wired directly to the detector anode, an insulated extension shaft is added here. The third control is for on/off switching and volume. Low-loss components and

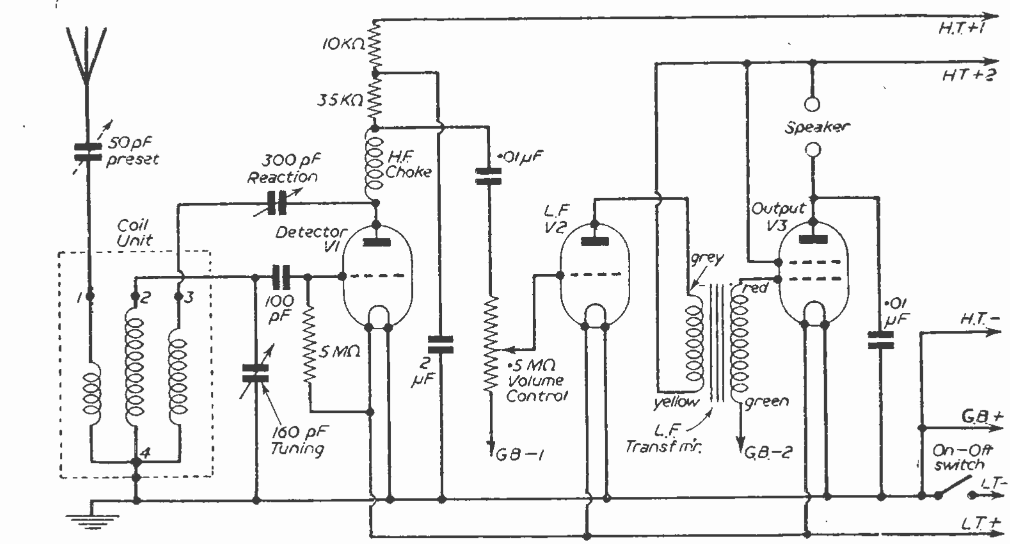


Fig. 1.—Theoretical circuit of the receiver.

sound construction help to assure maximum efficiency and reliability.

Chassis and Panel

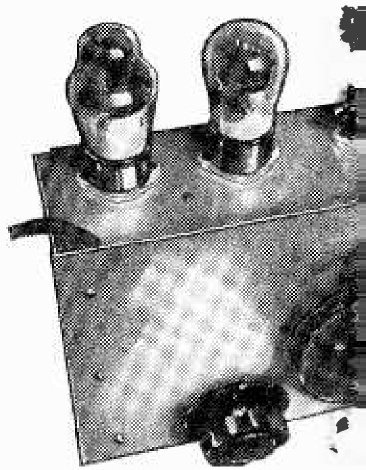
The positions of the valveholders and other parts are clearly shown in the diagram. For the valveholders, holes approximately 1in. in diameter are necessary, while the coil-holder requires a $\frac{3}{4}$in. diameter hole. These parts, and the stand-off insulator used for aerial connection, are held in position by 6 B.A. bolts. These should not be tightened with undue force, or the insulating material may be fractured. The large holes may most easily be made with one of the special cutters intended for this purpose.

The sockets for speaker connections pass through clearance holes roughly $\frac{3}{8}$in. in diameter. Three holes of this size are also required in the panel, and two smaller holes, to secure the reduction drive. It is preferable that all drilling be done before any components are mounted. Erratic operation may arise from fragments of metal dropping between the condenser plates, or elsewhere.

If the receiver is not to be mounted in a cabinet, it is recommended that two panel brackets be added. These can, if desired, be made by cutting a 4in. square of aluminium diagonally, bending over flanges, and drilling these. Each bracket should be secured by four bolts, two passing through the panel, and two through the chassis.

Approximately $\frac{1}{4}$in. required to be cut off the condenser spindle, with the tuning dial listed. If this is not done, the dial will project excessively. It is also necessary for the condenser to be spaced back from the panel, so that the fixing bush does not foul the dial. This may be done by adding several washers, or a nut, behind the panel. The dial should be set to read 180 deg. with the tuning condenser fully closed.

The reaction condenser should be carefully positioned exactly in line with the panel bush, or operation will be very stiff. If a length of $\frac{1}{4}$in. diameter metal rod is to hand, this can be used with an *insulated* shaft coupler. A flexible coupler may be used, with either metal or insulated rod. As the insulated bracket is adjustable, proper alignment is simplified.



Another view of

Wiring Details

Only two leads pass through the chassis — one from the 50 pF. aerial condenser to socket 1 of the coil-holder, and one from the fixed plates tag of the tuning condenser to socket 2 of the holder. For wiring, 20 s.w.g. tinned-copper wire, with insulated sleeving, is convenient. A number of points are connected to the metal chassis; these are marked "M.C." in the diagrams. For these, it is as well to use soldering tags.

All leads associated with the coil, tuning and reaction condensers, and detector valve should be kept short and direct, yet away from the chassis. No difficulty should then arise in reaching the minimum wavelength of the smallest coil.

The coupling transformer shown is specified because of its efficiency, with triode stages, and because its primary can carry a moderately heavy direct current. It has a

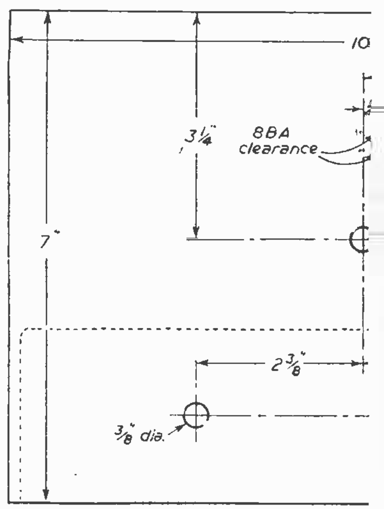
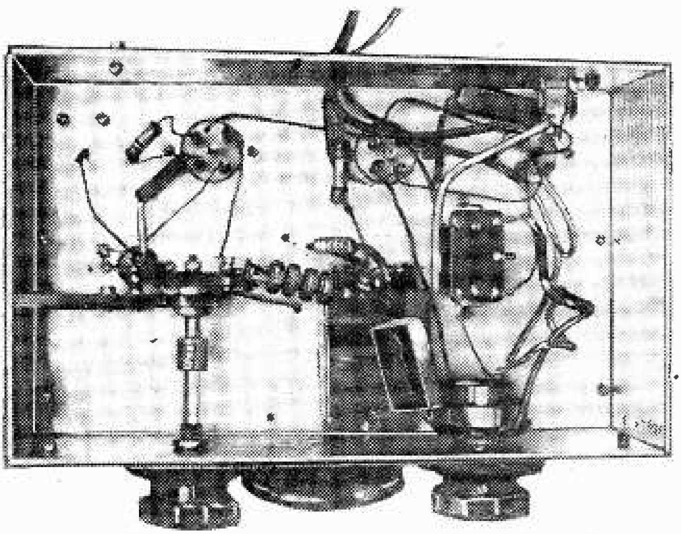


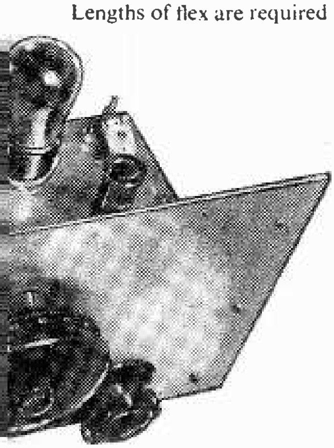
Fig. 4.—Panel



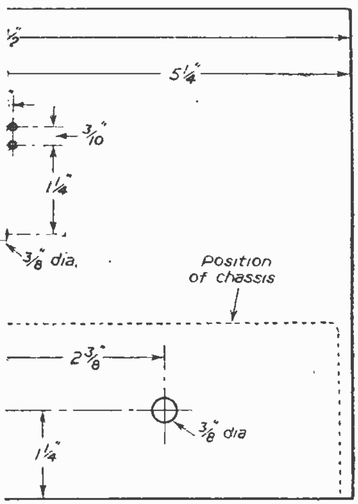
A view of the underside of chassis.

centre-tapped secondary. This centre-tap is not used. The remaining leads are colour-coded as indicated.

Lengths of flex are required for battery connections, and these should terminate in identified tags and plugs. These leads may be corded together, and pass through a hole at the rear of the chassis. An earth terminal is also secured directly to the rear runner.



the receiver.



drilling data.

Beginners who have not previously built a receiver should note one or two further points. The coil-holder has one large socket, so that coils may only be inserted in one position. This large socket should be positioned as illustrated, and wired to the chassis. The valveholders must also be placed so that the sockets come as shown, and ample clearance should exist between the sockets of both coil and valveholders and chassis. Finally, all connections should be carefully checked before connecting the batteries. A wrong connection could render the set inoperative, or cause actual damage to valves or other parts.

Operation

The exact wavelengths covered by the receiver will depend to some extent upon individual wiring and stray capacitances, but the influence of these factors would be comparatively slight. Accordingly, it is possible to give a list of logging points for each coil. The constructor should not expect these to be *exactly* correct for any particular receiver. Nevertheless, in the majority of cases they will be sufficiently accurate to prove a real guide to tuning. The various bands can then be located with ease, and individual readings noted.

The dial readings for various wavelengths are as follows :

Red Spot Coil

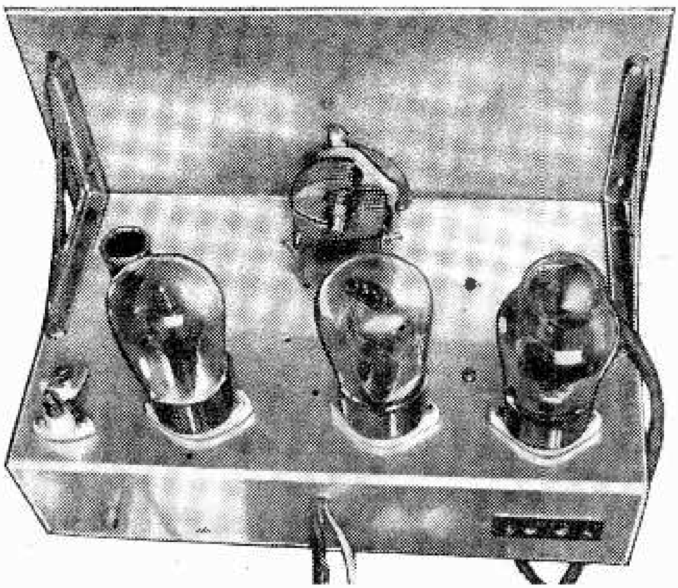
100 metres	180 degrees
90 ,, ...	148 ,,
80 ,, ...	114 ,,
70 ,, ...	85 ,,
60 ,, ...	60 ,,
55 ,, ...	50 ,,
50 ,, ...	38 ,,
45 ,, ...	24 ,,
40 ,, ...	14 ,,

Yellow Spot Coil

40 metres	163 degrees
35 ,, ...	130 ,,
30 ,, ...	98 ,,
25 ,, ...	55 ,,
22.5 ,, ...	40 ,,
20 ,, ...	32 ,,
17.5 ,, ...	18 ,,

Blue Spot Coil

17.5 metres	162 degrees
15 ,, ...	124 ,,
12.5 ,, ...	71 ,,
10 ,, ...	24 ,,



Rear view of the completed receiver.

When tuning, the operator should note a few wave-lengths of stations actually received. With the Amateur bands, it must be noted that the wave-lengths are not exactly those expected. For example, the so-called 40-metre band is centred round an actual wavelength of 42 metres. However, many stations announce their wavelengths, in English, quite frequently, with transmitting schedules.

Receiver Adjustments

A wide range of valves may be used, with satisfactory results, and ex-Service valves in good condition may be employed. The valves used in detector and L.F. positions may be either clear or metallised. It is also possible to use a triode, preferably of small-power type, in the output stage. Amplification will be slightly reduced, but good loudspeaker reception may still be expected. Detector, L.F. and output valves will be found listed by all manufacturers, and no difficulty should arise in obtaining suitable valves. If it is desired to try a triode in the output stage, no connections require to be altered.

Grid bias should be adjusted to the highest voltages which can be employed without distortion or loss of volume. Values of 1.5 to 4.5 volts for G.B.1, and 4.5. to 7.5 volts for G.B.2, according to type of valves and H.T. voltage, are usual.

A 90 or 120 volt H.T. battery can be used. With the latter, the H.T.1 plug should be inserted in a socket providing roughly 90 volts, or reaction will be excessively fierce. The voltage applied to H.T.1 may subsequently be adjusted to obtain smooth reaction with the detector valve employed.

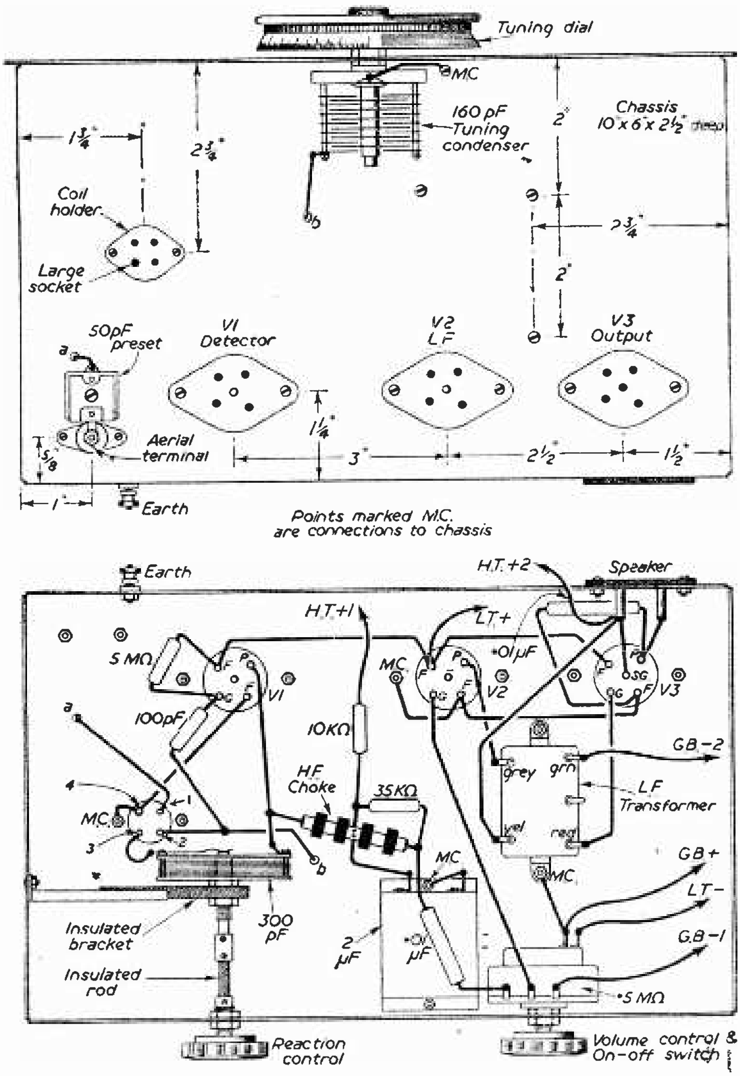
For low-tension, a 2-volt accumulator should be used. More than 2 volts must not be applied to the valve filaments.

For loudspeaker reproduction, almost any permanent-magnet moving-coil speaker is suitable. Miniature speakers are not recommended, one with a cone about 5in. to 7in. in diameter being usual. The speaker *must* have a matching transformer, and this should be for output triode or pentode, according to the type of output valve used. If the speaker has a multi-ratio transformer, the ratio giving best results should be selected, or the optimum load of the output valve looked up, and the tags giving this load employed. Transformers suitable for mains-operated pentodes have insufficient impedance for best results, with a battery-operated pentode or tetrode. They may, however, be used with a battery-operated power triode. The loudspeaker must be enclosed in a cabinet, or secured to a baffle-board, for proper results.

Tuning Points

Many of the more powerful stations will readily be picked up, but additional care in tuning and the use of reaction becomes essential, for really long-distance reception. The reaction condenser should be closed to a sufficient extent to keep the detector in its most sensitive condition. This will be shown by a faint hissing in the speaker, and by the receiver

(*Continued on page* 469)



Figs. 2 and 3.—Above and below chassis wiring information.

(*Continued from page* 466)

almost oscillating, when being tuned through a station. Slow tuning is essential, despite the high reduction ratio of the drive. Final, careful adjustment of both tuning and reaction will bring any station up to maximum volume.

Volume may be reduced by turning back the volume control. This is particularly necessary if headphones are used, but must not be confused with the reaction control. When the latter is turned towards minimum, sensitivity will be reduced, and weak stations will not be heard.

The aerial should preferably be high, and well away from earthed objects. A length of about 30 to 60ft. is suitable. Excellent results may be obtained with a short indoor aerial, but the greater efficiency of the outdoor aerial will become apparent when listening to weak, distant transmissions. The 50 pF. aerial condenser may be adjusted until satisfactory results are obtained with all coils. If screwed down excessively, reaction will begin to fail as the lower wavelengths are tuned. On the other hand, a setting of very low capacity will reduce volume, especially on the higher wavelengths. The result of adjustments to this condenser may readily be discovered ; it is in no way critical.

Stations will be found congregated into "bands," with few transmitters (other than Morse) between. Amateur transmitters will be found in the 10, 20, 40 and 80 metre bands. These are most active over the week-end, with the 40 metre bands generally giving best reception, from Europe, during the afternoon and early evening. At this time many American and more distant stations will be audible on the 20 metre band. Long-distance reception on the 80 metre band is not usual, while the 10 metre band may at times be almost dead, according to conditions.

Commercial stations are best heard on the 13, 17, 19, 25, 31, 41 and 49 metre bands. The lower bands (19 to 31 metres) will give best results, generally, during the afternoon and early evening. Later, many stations will be heard upon the 41 and 49 metre bands, but the lower wavelengths will begin to deteriorate. Short-wave propagation is greatly influenced by daylight and darkness, and this should be allowed for, when searching for distant transmitters. However, even cursory tuning should bring in quite a large number of stations, at most hours of the day or night.

Finally, though a good standard of performance is maintained with no earth lead, it is best to provide an earth, if convenient, so that sensitivity and stability are not unnecessarily sacrificed.

COMPONENT LIST FOR 9-90 METRE S-W-3

50 pF pre-set condenser.
706/LB. 706/Y and 706/R plug-in coils. (Eddystone.)
Type 707 coil-holder. (Eddystone.)
Type 1007 adjustable insulated bracket. (Eddystone.)
160 pF low-loss tuning condenser. (Wavemaster.)
300 pF reaction condenser. (Wavemaster.)
Muirhead 50 : 1 slow-motion drive.
Two 1¼in. diameter control knobs.
Insulated extension spindle with bush.
Three low-loss ceramic valveholders. (S.W.41 : Bulgin.)
S.W. H.F. choke. (Eddystone.)
1 : 4 intervalve transformer.
.0001 μF and two .01 μF mica condensers. (T.C.C.)
2 μF 250 v. working condenser. (T.C.C.)
10 KΩ, 35 KΩ and 5 megohm, ½ watt resistors.
.5 megohm volume control with single-pole switch (Reliance Type SG/1.)
Chassis, 10in. x 6in. x 2½in. Stand-off insulator. Speaker sockets, wire, etc.
Valves—HL2, HL2 and 220/OT, or similar.

The Top Band

DURING the currency of the Cairo Radio Regulations, the band 1,715-2,000 kc/s has been available (shared with other services) for use by radio amateurs throughout the world. United Kingdom amateurs have been permitted to use the band subject to a power limitation of 10 watts.

The Post Office has given very careful consideration to the question as to how far it will be practicable for U.K. amateurs to continue to use the band without causing harmful interference to the authorised services of other countries.

The Post Office has, therefore, decided to assign to U.K. amateurs a band 200 kc/s wide in this part of the spectrum subject to strict non-interference with other services (United Kingdom and Foreign).

The Post Office points out that, for some time, conditions in the band will be particularly difficult as stations settle down to their new assignments.

Following a meeting between representatives of the Post Office and the R.S.G.B. it was announced that the 200 kc/s band is to fall between 1,800 kc/s and 2,000 kc/s. We are asked to stress the importance of licensed power not being exceeded under any circumstances.

The Post Office has issued a list of assignments which are likely to be particularly vulnerable to interference. In the list which follows centre frequencies are quoted but all the assignments are for A3 working and normally occupy a bandwidth of 6 kc/s.

Frequencies kc/s	Assignments
1,827	Wick and Folkestone.
1,834	Niton.
1,841	Cullercoats and Land's End.
1,848	North Foreland and Oban.
1,855	Burnham, Stonehaven and Newhaven.
1,869	Humber.
1,883	Portpatrick.
1,911	Land's End, Niton and Seaforth.
1,925	Land's End, Niton and Seaforth.
1,953	British ships.
1,960	French ships.
1,974	Dutch ships.
1,981	British ships.
1,988	Danish ships.
1,995	Dutch ships.

In the interests of all concerned U.K. amateurs would do well to avoid the vulnerable frequencies which are in use by the marine services in their own particular locality.

Design Considerations for Oscilloscopes

THE EXPERIMENTER WILL FIND THIS ARTICLE OF ASSISTANCE IN DESIGNING HIS OWN TEST SET

By E. G. Bulley

MANY designs of oscilloscopes have in the past appeared in this journal and they have been ably described so that the reader can construct them with very little difficulty.

For the newcomer to radio these are ideal, as one can learn a great deal by constructing such apparatus. Nevertheless, the time arrives when the constructor likes to experiment with his own designs, and this article is written to assist such constructors in designing their own oscilloscopes.

The first consideration in the design of an oscilloscope is that of the power supplies, bearing in mind that such apparatus requires fairly high voltages and exceptionally good filtering. Selection of transformers is important, because one must not forget that the cathode-ray tube is a device which is sensitive to either electrostatic or magnetic fields. Such fields can originate from transformers, and care must therefore be taken to ensure that such components are suitably screened and positioned so as to prevent any interference with the electron beam.

Transformer Position

The location of the high-voltage transformer (assuming a separate one is used for the low-power supplies) is important, because not only does it affect the deflection of the beam, but the actual balance of the instrument. This balance will be appreciated more if one plans to design a portable instrument and does not want it to be top-heavy. However, it is good practice to locate the power supplies at the rear of the tube, so that the other units of the oscilloscope can be located under or alongside the tube. The positioning of these units should be such as to balance the weight of the power supplies.

Another safeguard against stray fields is to screen the tube itself. Suitable screens or shields can be obtained quite reasonably on the surplus market.

Insulation

Insulation of power supplies is also an important factor, and consideration must therefore be given to the insulation of the high-voltage transformer, as well as the operating frequency at which the oscilloscope will be required to work.

It is advisable to endeavour to use a transformer with a high turns-per-volt ratio and that the windings are made upon a laminated stack. Reduction of transformer ratings in order to get a transformer of smaller physical size is not good practice; in fact, it is false economy, because the insulation usually suffers. Furthermore, it is advisable when selecting a transformer to endeavour to obtain one with the primary winding screened with an electrostatic shield. The shield is always at earth potential and the purpose of this earthed shield is to eliminate the possibility of capacitive coupling to the high voltage windings on the secondary.

Capacitive coupling causes pattern distortion, which can also be due to the heater winding for the C.R.T. not being suitably screened.

Power Supply

Generally speaking, it is good practice to use a separate power supply for the tube and another one for the amplifier and timebase, etc.

The output from the low-voltage power supply must be filtered to the best of one's ability. It is, of course, advisable to stabilise the output, bearing in mind that good smoothing and regulation will prevent unwanted signals to be introduced into the amplifier, which in turn would be passed on to the tube. There are, however, many types of voltage stabilisers on the surplus market which can be purchased at quite a small cost.

Oscilloscope amplifiers are perhaps treated too lightly, but here again it is advisable to pay special attention to the design. The amplifier that is most suitable is one that is sensitive to the signal applied to it. That is to say, no matter how minute the signal may be, the amplifier is such that it is sensitive enough to amplify it and reproduce the effect on the tube. Furthermore, stability is essential bearing in mind that any inherent noise, such as microphony, hum, etc., must at all costs be avoided. One may, of course, have to sacrifice some of the amplifier's gain to obtain this. Failure to do this will, however, cause pattern distortion.

Linearity

The linear timebase is best described as the unit that is to generate the sweep voltage. This is accomplished by means of a suitable oscillator or trigger circuit in which a thyratron or a suitable hard valve is incorporated. The hard valve timebase was originated by O. S. Puckle, and is to-day very popular. Nevertheless, one need have no fears on the timebase question, because whatever suitable valve one decides to use, a circuit can always be obtained from the valve manufacturer.

Alternatively, a great many timebase circuits have been developed and one can, therefore, select a suitable one. These are to be found in most of the well-known radio textbooks.

It is important when deciding upon the actual timebase to bear in mind that an ideal timebase must have the sweep as near linear as possible, not forgetting that the ratio of the actual sweep to the return time must be very short. Naturally, one must give attention to the frequency range as well as the synchronising of the frequency of the timebase to that of the unknown signal.

In conclusion, however, the tube, being the heart of the instrument, must also be given consideration. There are many types available from surplus and should, wherever possible, be selected. The operating voltages are a major point, because the lower the operating potentials required by the tube the smaller and cheaper will be the high voltage transformer.

A SUPERHET FOR BEGINNERS

CONSTRUCTIONAL DETAILS OF A 6-VALVE A.C. RECEIVER USING MINIATURE VALVES

By R. Hindle

(*Continued from page 390 July issue*)

THE dial can now be put on and the pointer, with the vanes fully meshed, fitted horizontally.

The final operation in preparation for wiring is to fit the coilpack in the central hole of the front of the chassis (it is a single-hole fixing component) to ensure that there is nothing in its way. The pack must be handled with care if trouble later is to be avoided. Under no circumstances should any of the trimmers or cores be touched until final testing of the finished receiver and, when satisfied that all is as it should be, the pack should be removed again and put carefully aside until a later stage in the wiring.

Wiring

Connections have to be soldered and this is the only exacting demand made on the beginner. No receiver, no matter how simple, can be made using modern technique and components without soldering. On the other hand, all the worry has been taken out of soldering by modern electric irons and cored solder and the process is nothing like so difficult as it used to be.

The material used for wiring is 24 S.W.G. tinned copper wire and sleeving, which is easy and quick to use. The important thing is, of course, to avoid undesired points of contact and to make sure that the connections required are well made. The valve pins of these miniature valve-holders are near together and an excess of solder on one of the connections might well run over on to the next pin, so take care not to draw too much solder for these connections.

The sequence of connections following will enable the constructor to avoid any pitfalls and the actual route of the wire will be seen by reference to the wiring diagram, Fig. 4. The leads carrying mains and the A.C. heater supply are run along the inner surface of the chassis throughout their length, but all other leads take the shortest route, direct from point to point. Where there are slight deviations from the shortest route on the wiring diagram these are merely for the purpose of clarity on the two-dimensional drawing. If the constructor can follow the theoretical circuit it is a good plan to follow the leads in Fig. 1 as they are wired in, and finally, when all wires have been put on, a final check can be made to the wiring diagram.

The output transformer used is a single ratio type to match the output valve used to a standard 3-ohm speaker. The two outside tags of the six-way tagboard fitted are connected to the primary winding and the two secondary connections are brought out on flexible wires. The first step is to shorten these two secondary wires and solder them on to the two centre tags of the tagboard. Then proceed as follows, bearing in mind that the valve pins are numbered clockwise, as seen from underneath the chassis, the pin on the clockwise side of the wide gap being No. 1. Check to the wiring diagram at each step to see how the wire is run and tick off on the wiring sequence below as each connection is completed. Where a component is specified at the left-hand side of the sequence this component is connected between the two points mentioned to the right; where no component is specified the points given are connected together. Refer to the wiring diagram, Fig. 4, for the numbering of the tags on the components referred to in the wiring sequence. It is very important that the I.F. transformers should be mounted with their connecting wires in the positions shown in the wiring diagram; these numbers are on the bottom of the transformer and they should have been carefully checked before screwing the component on to the chassis.

Components Required	Connections
	V1 pins 4 and 5 and centre ring to earth. (No sleeving.)
	V2 pin 3 and centre ring to earth. (No sleeving.)
	V3 pins 1, 3, 5, 6 and centre ring to earth. (No sleeving.)
	V4 pins 5 and 6 and centre ring to earth (No sleeving.)
	V5 pin 3 and centre ring to earth. (No sleeving.)
	V6 pin 3 to earth. (No sleeving.)
	Mains transformer tag 1 to tag 6 to earth.
	Mains transformer tag 3 to V6 pin 4. Run near to chassis.
	Mains transformer tag 3 to V1 pin 9 to V2 pin 4 to V5 pin 4. (Run near to chassis.)
	V1 pin 9 to V3 pin 4 to V4 pin 4. (Run near to chassis.)

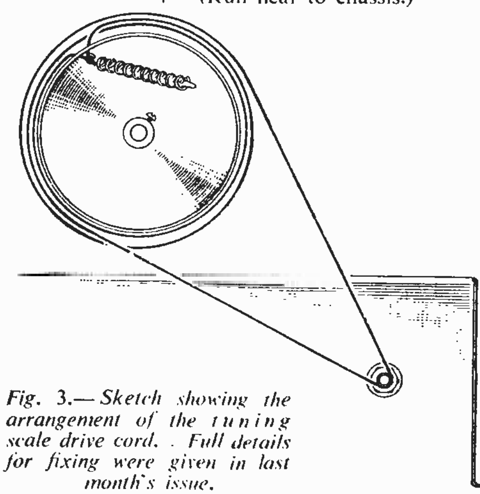


Fig. 3.—Sketch showing the arrangement of the tuning scale drive cord. Full details for fixing were given in last month's issue.

Components Required		Connections
		Mains transformer tag 5 to V 6 pin 6.
		Mains transformer tag 7 to V6 pin 1.
		V6 pin 7 to C21 (8 μF in 8-16 μF electrolytic. Identify as indicated on can).
		Smoothing choke wires, one to C20 and one to C21.
C5	.1 μF	
R4	220Ω	Connect both between V1 pin 3 and earth.
		V1 pin 6 to 1st I.F. transformer pin 4.
		Connect 2in. of wire to V2 pin 1 and another 2in. to V2 pin 5. (Other ends not connected at present.)
		V2 pin 2 to V2 pin 7.
C12	.1 μF	
R9	100Ω	Connect both from V2 pin 2 to earth.
R7	33 KΩ	From V2 pin 6 to 2nd I.F. transformer pin 6.
C9	.1 μF	From V2 pin 6 to earth.
		Wire previously connected to V2 pin 1 to 1st I.F. transformer pin 3.
		Wire previously connected to V2 pin 5 to 2nd I.F. transformer pin 4.
		2nd I.F. transformer pin 3 to V3 pin 2.
C11	100 pF	From 2nd I.F. transformer pin 4 to V3 pin 7.
R10	1 MΩ	From V3 pin 7 to earth.
R8	1 MΩ	From V3 pin 7 to 1st I.F. transformer pin 1.
C10	.05 μF	From 1st I.F. transformer pin 1 to earth.
C13	100 pF	From 2nd I.F. transformer pin 1 to earth.
R11	47 KΩ	Connect one end to 2nd I.F. transformer pin 1, making wire as short as possible without damaging resistor (¼in.). Shorten other end wire of R11, connect inner of 4in. of screened wire to this end and connect outer braid to earth at V4 holding bolt.
		Open braid of wire to R11 at 1in. from end not yet connected, using pricker, and pull through inner without damaging it. (If wire is type not having loose outer braid it will be necessary to strip braid off to connect inner, when a piece of 24 s.w.g. wire can be soldered to the braid for earthing.)
		Connect inner of the screened wire to VR1 tag 1.
		Solder braid to case of VR1 and to tag 3 of VR1.
C14	100 pF	From pin 1 to pin 3 of VR1.
		V4 pin 3 to V4 pin 9.
C17	25 μF	
R16	2.2 KΩ	Connect both from V4 pin 9 to earth.

Components Required		Connections
		V4 pin 8 to tag 1 of C16, C18 electrolytic.
R15	220 KΩ	From V4 pin 7 to tag 2 of C16, C18 electrolytic.
R12	1 MΩ	From tag 1 of C16, C18 electr. to 2nd I.F. tfr. pin 6.
R14	22 KΩ	From tag 2 of C16, C18 electr. to 2nd I.F. tfr. pin 6.
C19	.1 μF	From V4 pin 7 to unearthed tag of tagboard by V5.
R17	4.7 KΩ	From unearthed tag of tagboard to V5 pin 7.
R18	220KΩ	From unearthed tag of tagboard to earth.
R19	220Ω (1 W.)	From V5 pin 2 to earth (pin 3 of V5).
		V5 pin 5 to output tfr. tag 6.
		V5 pin 6 to output tfr. tag 1.
		2nd I.F. tfr. tag 6 to output tfr. tag 1 to 1st I.F. tfr. tag 6 to C20 tag on 16-8 μF electr.
C22	25 μF	From V5 pin 2 to earth.
		Clip off lead soldered to tag 4 of mains transformer and shorten to 1½in. the other lead coming out of the transformer windings.
		Solder one end of a piece of twin flex 2ft. long (transparent PVC type), one lead to tag 4 of mains tfr. and one to the shortened mains input lead, in the latter case covering the joint with sleeving or rubber tape.
		Pass a second piece of the same type of flex through the grommet at the back nearest to the mains tfr. leaving outside the chassis sufficient length to reach the power socket from where the receiver is to be used and inside the chassis about 2ft. Make a knot in the wire inside the chassis to prevent the lead from pulling through.
		Pass both flex leads together round the chassis as indicated in the wiring diagram, keeping them near the chassis.
		Connect one pair to tags 4 and 5 of VR1 and the other pair to tags 6 and 7 of VR1, cutting away any surplus.
		Now fit the coilpack.
		The wire passing through the chassis from the section of the tuning condenser farthest from dial to coilpack tag 3.
		The wire from section of tuning condenser nearest to dial to coilpack tag 4.
		Coilpack tag 3 to V1 pin 2.
R6	100Ω	
C3	100 pF	Connect in series; the free end of C3 to coilpack tag 5 and the free end of R6 to V1 pin 8.

(*Continued on page 477*)

(*Continued from page 474*)

Components Required		Connections
R5	47 KΩ	From V1 pin 7 to V1 pin 3.
C4	50 pF	From V1 pin 7 to coilpack tag 4.
		R.F. choke, tag farthest from coilpack to earth.
C23	.1 μF	From coilpack tag 2 to R.F. choke, nearest tag.
R1	100 KΩ	From coilpack tag 2 to 1st. I.F. tfr. tag 1.
		Pass a piece of flex, long enough to go to speaker in working position, through grommet nearest output tfr. and connect to output transformer tags 3 and 4.
		Output tfr. tag 4 to earth.
		Take a length of coaxial cable (as used for television leads) about 6in. long. Strip back ½in. of the outer insulation at both ends and remove screening braid. Try the cable in position from the aerial input socket to the coilpack tag 1 and mark the cable where it passes nearest to the earthed tag of the R.F. choke. Strip ¼in. of outer insulation at this point.
		Solder the middle of a piece of connecting wire 2in. long to the earthed tag of the R.F. choke to leave two 1in. ends. Put the coaxial cable back into position and solder the two bared ends of the cable, one to tag 1 of the coilpack and the other to the inner of the coaxial socket projecting inside the chassis. Pass the 1in. ends of the wire soldered to the R.F. choke round the bared braid of the coaxial cable and with a hot soldering iron solder the wire to the braid.

Note.—Where one side of a .1 μF or .05 μF condenser is connected to earth this should be the lead from the end of the condenser marked " O.F." (i.e., outside foil) on the cardboard case of the component.

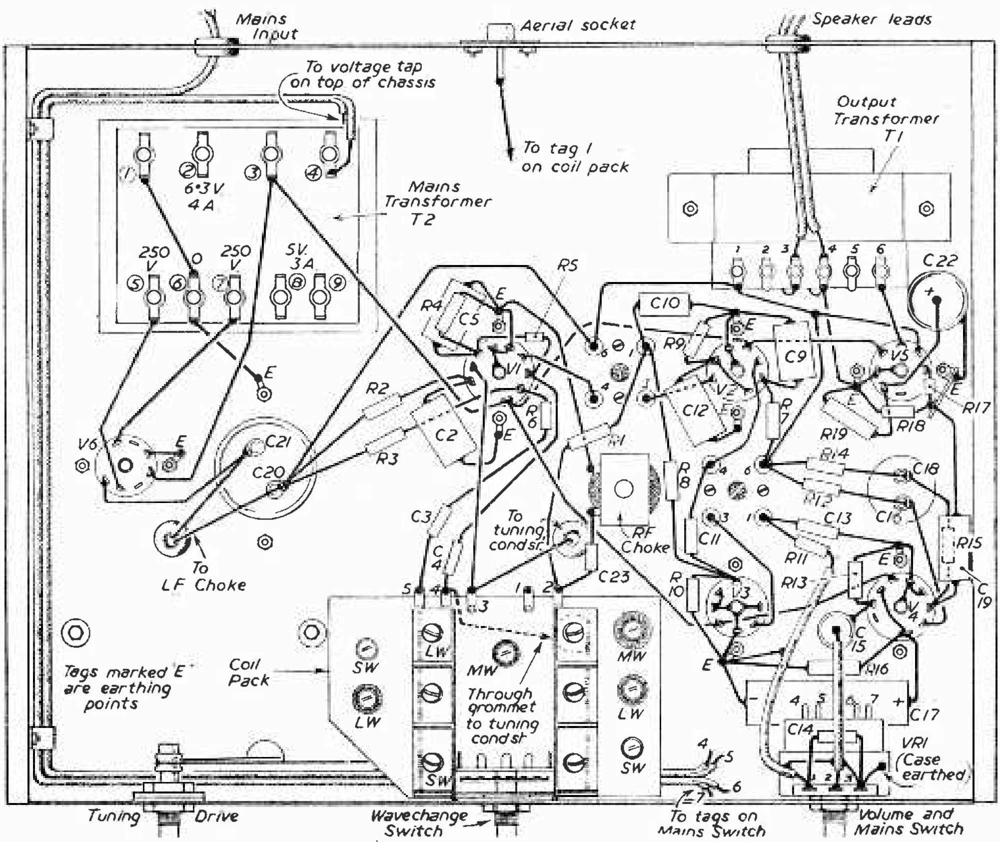


Fig. 4.—Underchassis wiring diagram.

Perhaps it is a little unusual to use a coaxial socket for the aerial and earth connections to a sound receiver, but it is a practice followed by the designer for some time and it makes for neatness as well as efficiency. The arrangement is to run the aerial and earth leads (underneath the floorboards if possible) to a point on the skirting board near to where the receiver is to be used. Here they enter a junction box from which comes the single coaxial cable to the receiver. A good aerial and earth should be used if possible and it is recommended that the aerial system should be put up before finally adjusting the receiver. It should be mentioned, however, that the chassis gave a good account of itself when tried out in far from perfect conditions using only a yard of wire for aerial, this dangling over the side of the bench.

It will be an encouragement to the beginner who is a little doubtful as to his ability to set up such a receiver as this to know that the prototype played as soon as it was switched on, and there remained only the minor adjustments necessary to get the best results. Of course, this would not have been so if care had not been taken to avoid alteration of the adjustments made by the manufacturers of the coilpack and I.F. transformers.

Before commencing the adjustments, temporarily connect a piece of wire across the AVC condenser C10 (i.e., from tag 1 of the first I.F. transformer to earth). This will stop the AVC action and it will be easier to detect the peak tuning points. This link should be removed, of course, when adjustments are complete.

Connect up the receiver to the mains and speaker, plug in the aerial plug and switch on, waiting then until the valves have warmed up. Then switch to the medium waveband (the central position on the wavechange switch) and search for a signal which should be tuned in to maximum strength on the tuning knob (i.e., until the tone is at its deepest).

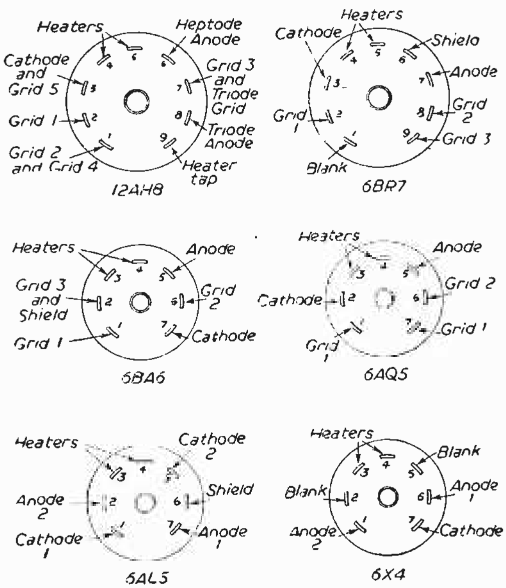


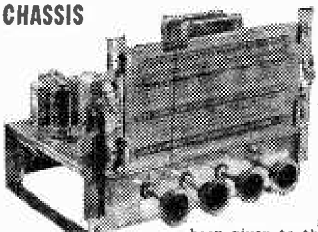
Fig. 5.—Valve base data.

Now adjust the four I.F. transformer cores for maximum signal. Each transformer has one adjusting screw in the top of the can and one accessible through the centre hole of the base. If a signal generator was available, of course, these adjustments would be made whilst injecting a 465Kc/s. signal into the frequency changer grid, but the possession of such a generator is not assumed and, in fact, it was found that the makers' adjustment of these transformers was such that, after adjusting the prototype by the method suggested above, a test was made with the generator and the setting was found to be almost exactly correct: near enough to make not the slightest difference to the final results.

Now find a transmission towards the top end of the waveband that can be identified. It should appear not far from the position marked on the dial if the pointer was placed correctly as previously explained, i.e., horizontal with the condenser vanes fully meshed. Tune the signal to maximum by adjustment of the medium wave aerial coil core, using an insulated tool. A piece of broken plastic knitting needle filed at one end to form a screwdriver will be ideal for the purpose. Now swing the condenser slightly towards the calibrated position, bringing the signal back into tune with the oscillator and aerial cores, until the signal tunes accurately at the correct position. Remember that the coilpack was aligned by the manufacturers, so that if the signal appears to be a long way from its calibration point to start with, suspect that it has been incorrectly identified and check carefully before moving the cores. Then find a transmission at the lower end of the scale which can be identified and tune to maximum, using the aerial trimmer and without touching the cores. Bring this transmission on to its correct calibration point by swinging the tuning condenser slightly and following up by adjustment to the oscillator and aerial trimmers but leaving cores alone. Again the amount of adjustment should not be great. Now return to the transmission at the upper end and repeat the adjustment, using cores only, followed by a further adjustment at the lower wavelength, using trimmers only. Alternately adjust at the upper and the lower end of the scale in this manner until satisfied that no further improvement can be effected. Ideally, these adjustments should be made on 450M. and 250M., and these points would be used when adjusting by means of a signal generator, so if possible use stations near these two positions.

On long waves a similar procedure is followed, the theoretically correct points being at 1,000M. and 1,800M. Be very careful to use the long wave cores and trimmers and not to upset again the medium wave adjustments, which will have no effect on this waveband. The short wave oscillator adjustments are less easy to make without a signal generator. They will not be far out and it will be better to leave them alone unless the constructor is quite sure what he is doing. The aerial adjustments can be made, of course, and a signal at the upper end of the waveband should be brought in, using the aerial core, and a signal at the lower end using the aerial trimmer, alternating these as before to secure best results. The theoretically correct points are at 45M. and 20M. Do not forget, when adjustments are completed, to remove the temporary link across the AVC condenser.

A COMPLETELY ASSEMBLED "ALL-WAVE" SUPERHET CHASSIS



MODERNISE YOUR OLD RADIOGRAM FOR £25

INCLUDING 10" P.M. SPEAKER — PLUS 10/- CARRIAGE AND INSURANCE

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 7¾in. x 8½in. high. Dial size. 9½in. x 4½in. Price, complete and READY FOR USE, excluding speaker, £12/12/-. (Carr. and Pkg. 7/6 extra.)

A GENUINE SPECIAL OFFER!

PLESSEY 3-SPEED AUTO CHANGE UNITS

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

£11 . 3 . 6
(Normal price is £23/10/-)

- These units will auto change on all three speeds, 7in., 10in. and 12in.
- They play MIXED 10in. and 12in. records.
- They have separate sapphires for L.P. and 78 r.p.m., which are moved into position by a simple switch.
- Minimum base-board size required 16in. x 12½in. with height above 5½in. and height below baseboard 2½in.

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

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 is available separately for 1/3. Completely assembled and ready for use, £5 5/-.

THIS IS THE "TELE-VIEWER"

5 CHANNEL TELEVISOR—A design of a complete SUPERHET T/V RECEIVER FOR THE HOME CONSTRUCTOR

This receiver has been developed after most careful research to provide a Televisor employing SUPERHET circuit for 12in. or 9in. tubes, which can be readily assembled by the home constructor. In designing it we had three objectives :—(a) OUTSTANDING QUALITY AND DEFINITION ; (b) EASE OF ASSEMBLY ; (c) ECONOMY IN COSTS. We confidently believe that not only have we achieved a T V receiver that surpasses in efficiency any other designed for the home constructor, but also the stage by stage diagrams permit the inexperienced to successfully assemble it at about half the total cost of a similar type of commercial receiver.

SOME OUTSTANDING FEATURES

- A SUPERHET CIRCUIT suitable for reception of all present transmissions, i.e., LONDON, SUTTON COLDFIELD, HOLME MOSS, WENVOE and KIRK-O'-SHOTTS.
- A BRILLIANT and SHARP PICTURE afforded by provision of high E.H.T. (approx. 10 K.V.).
- Outstanding QUALITY and DEFINITION for daylight viewing.
- NEGATIVE FEEDBACK in the Audio Frequency Stages.
- Simple control. Only two controls on the front of receiver.
- Simple and compact design with rigid C.R.T. mounting.
- The complete Televisor, including all Valves can be built for only **£28** (plus cost of C.R.T.).

We are able to supply a New Mullard 12in. C.R.T. to purchasers of this T/V at the specially reduced price of £12/19/6.

- As no hire purchase terms are available the receiver can be bought in five separate stages (practical diagrams and circuits are provided for each stage), thus enabling Hire Purchase interests rates to be avoided.

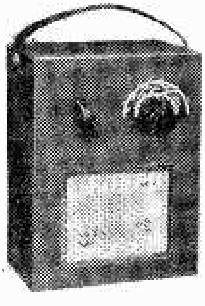
The complete set of ASSEMBLY INSTRUCTIONS are now available, price 5/- (refunded against first order). The instructions include really detailed PRACTICAL LAYOUTS, WIRING DATA AND COMPONENTS PRICE LIST.
ALL COMPONENTS ARE AVAILABLE FOR INDIVIDUAL PURCHASE.
A CABINET WILL ALSO BE AVAILABLE.

A MAINS OR BATTERY PORTABLE KIT

A midget 4-valve Superhet Portable Set covering medium and long wave bands.
Designed to operate on A.C. mains 200-240 volts or by an "All-dry" battery. The set is so designed that the mains section is supplied as a separate unit which may be added at any time. The Kit therefore can be supplied (a) as an "All-dry" Battery Superhet Personal Set which can be accommodated in the Attache Case as illustrated (size 9½in. x 4½in. x 7in.). This is attractively finished in lizard, maroon, dark green, or blue rexine. (b) or as a Combined Mains Battery Superhet Portable Receiver, for which a polished Wood Cabinet is available to accommodate both Mains Unit and Batteries together.
Circuit incorporates delayed A.V.C. and Pre-selective Audio Feedback. Kit is complete in every detail and includes ready-wound Frame Aerials, fully aligned I.F. Transf. and drilled chassis, etc. Overall size of assembled chassis 8in. x 4in. x 2½in. This receiver as illustrated can be completely built for approx. £10 (plus Mains Unit if required). Send 1/9 for the fully descriptive Assembly Book which includes Practical Layouts and complete price list of Components.

"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.

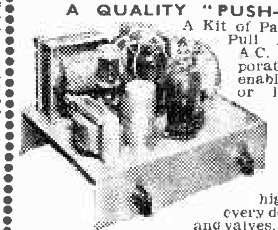


THE "MINI FOUR."—A 4-valve Battery Superhet Receiver, designed by "Practical Wireless" to receive 4 Pre-set Stations, no tuning being necessary. The complete Receiver can be built for £9/10/- (plus case 15/6). Send 1/6 for Assembly Instructions, Layouts and Component Price List.

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

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

A QUALITY "PUSH-PULL" AMPLIFIER



A Kit of Parts to build a 6-8 watt Push-Pull Amplifier for operation on A.C. mains 200-250 volts. Incorporates a simple arrangement to enable either a magnetic, crystal or light-weight pick-up to be used. A 10-watt Output Transformer is designed to match from 2 to 15 ohm speakers. Tone control is incorporated. The overall size of the assembled chassis is 10in. x 8in. x 7½in. high. Price of kit complete in every detail, including drilled chassis and valves, £6 17 6. Component layout is supplied. Price of assembled chassis, supplied ready for use, £8 12 6. Instructions, layouts and price list 1/-.

STERN RADIO LTD.

109, & 115, FLEET STREET, E.C.4
TELEPHONE : CENtral 5812/3/4.

An Improved A.V.C. Circuit

DETAILS OF AN AMERICAN CIRCUIT FOR SCREEN GRID CONTROL

By P. Dodson

FIG. 1 shows a simple detector and A.V.C. circuit employing a single diode, a modification of which is to be found in almost all modern superhet receivers.

On each positive half-cycle of signal voltage, when the diode plate is positive with respect to the cathode, the diode passes current. Due to the flow of current through R1, the diode load resistor, there is voltage drop across R1, which makes the top end of R1 negative with respect to earth. This voltage drop across R1 is applied through R2 and C2 as negative bias to the grids of the controlled valves. Thus, when the signal at the aerial increases, the signal applied to the A.V.C. diode increases, the voltage drop across R1 increases, the negative bias voltage applied to the R.F. and I.F. stages increases and the gain of these valves is reduced.

When the signal strength at the aerial decreases from a previous steady value the A.V.C. circuit acts in the reverse direction, applying less negative bias, and permitting more gain from the R.F. and I.F. valves.

The main disadvantage of this method of A.V.C. is that on strong signals the controlled valves may receive too much bias, and be operated over the curved portion of the characteristic ; thus appreciable modulation distortion would be evident and, in the R.F. stages, excessive cross-modulation.

To overcome this the circuit shown in Fig. 2 has been devised. The action of the circuit is different from the one just described. Instead of a negative control voltage, a positive A.V.C. voltage is developed and applied to the screen-grids of the controlled valves. As the control-grid voltage does not change nearly so much as when the A.V.C. voltage is applied to it, the valves are being operated over the most linear portion of the characteristic at all times.

The control valve is a high-mu, sharp cut-off, R.F. pentode. Resistors R2, R3 and R4 make up a voltage divider across the H.T. supply. The junction of R2 and R3 feeds the screen, and the cathode is fed from the junction of R3 and R4. The screen should operate at its maximum permissible voltage. The cathode should be three to four volts positive with respect to the grid. The size of the resistors should be selected so that the above conditions are fulfilled. R1 is the dropping resistor supplying the screen grids of the R.F. and I.F. valves controlled by the A.V.C. Its value should be chosen so that the screen voltages of all the valves being controlled are normal with no signal. The grid of the control valve is connected to a point which goes positive with increasing signal. This can be the cathode end of the metal rectifier, which is used as a diode detector.

Operation

The operation of the circuit is quite easy to follow. From the description of the diode action, it follows that, as the signal in the aerial increases, the grid of the control valve will be driven more positive. This will cause the valve to conduct more heavily with a consequent drop in the voltage across R1. As the screen grids of the controlled valves are fed from the anode end of R1, this will lower the screen voltage and reduce the gain of the receiver.

When the signal in the aerial decreases the circuit operates in the reverse direction, the screen voltage increasing, with a consequent increase in the receiver gain.

This system of A.V.C. is suitable for controlling the R.F. and I.F. valves, but should not be used to control a single valve frequency changer, as a change in screen volts will result in a change of frequency. However, if a separate oscillator valve is used, the mixer may be controlled.

By using a metal rectifier, such as a WX type, for the detector existing receivers can easily be converted. The control valve can occupy the holder which was used for the detector/A.V.C. valve. The circuit eliminates much of the elaborate A.V.C. network previously necessary with the negative biasing system.

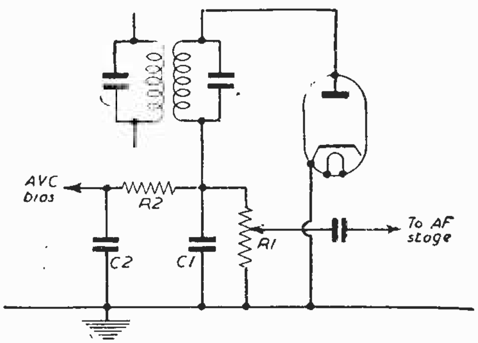


Fig. 1.—Simple diode detector and A.V.C. circuit.

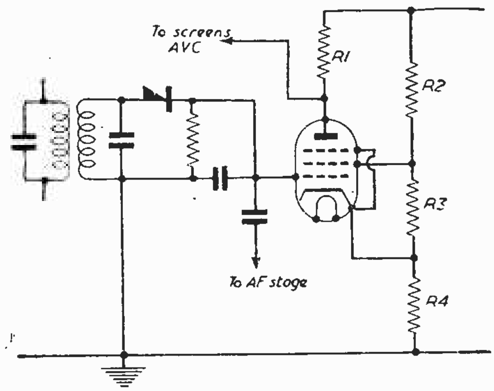


Fig. 2.—Circuit of diode detector and control valve for supplying A.V.C. to screen grids for improved control.

EARTH CONNECTIONS

SOME INTERESTING INFORMATION AND SOME EXPERIMENTS FOR THE BEGINNER

By W. J. Delaney (G2FMY)

THE earth connection is regarded by many amateurs as an "incidental" which can easily be ignored. It is true that in many cases removal of the earth connection apparently makes no difference to the performance of the receiver, and in some commercial receivers the warning not to connect an earth lead has served to give the impression that it is, in fact, unnecessary in modern receivers. It should be remembered, however, that the transmitted signal may be regarded as being in two parts—a ground wave and a sky wave—and depending upon the distance from the transmitter, the weather conditions, time of the day and various other factors, these two waves will arrive at the receiving point as different times and in different strengths. Theoretically, the ground wave is unaffected by weather conditions, etc., whereas the sky wave is reflected from an upper layer which is not constant in height. An aerial system may be regarded as a wire above the ground connected to its "reflection" in the ground through the tuning coil and, strictly speaking, for maximum performance the system should be complete. Absence of an earth connection will mean that only a portion of the system is in use and this should result in weak signals.

Why is it, then, that many receivers seem to operate quite satisfactorily without an earth lead? First of all, in the receiver there is a tuning circuit connected to aerial and earth sockets. This circuit has been designed by the makers to cover a certain band of frequencies when properly loaded, and on some wavebands absence of an earth (or aerial) will affect the band over which the circuit tunes. In most receivers this circuit is tuned by a ganged component which tunes other circuits, to which, under normal operating conditions, no additional connections have to be made. Obviously, therefore, unless the various circuits are properly tuned maximum results will not be obtained, and absence of the proper loading on the aerial circuit will result in a lowered performance. To some extent this is avoided by making the circuit flatly tuned, or otherwise arranging that the actual loading does not make a great deal of difference, but the actual power of the signal which is received does, in fact, depend upon the connections which are made to the receiver.

Some Experiments

If you remove the earth lead from a receiver at present working with one, and the signal strength of a received station increases, try slightly retuning. If the ganged tuning arrangements are not accurately set it is quite possible for the removal of the earth lead to bring the circuits into line and thus give an apparent increase in signal strength. If there is a trimmer across the aerial circuit, therefore, in such a case this should be re-adjusted. Another interesting experiment is to tune in a weak distant station and then remove both aerial and earth and plug the earth into the aerial socket. If the receiver is an A.C./D.C. or D.C. model, care must be taken to ensure that adequate isolating condensers are fitted or there may be a danger when doing this of damaging the receiver. If the wavelength, distance of the station and other factors are suitable, it may be found that this arrangement will provide a stronger signal than from the aerial itself, proving that the ground wave is stronger, and therefore an efficient earth *plus* the aerial should give an even stronger signal.

The general cause of the earth being regarded as unimportant is because it is inefficient, and this can be due to a variety of causes. The ideal earth connection is a short direct wire to a buried plate in moist conditions, thus giving a low-resistance connection. In flats, etc., it may not be possible to obtain this desirable condition, but where three-point electric sockets are provided the earth connection here should be ideal. A gas pipe is not by any means satisfactory, firstly because joints in the piping are usually painted before screwing up to prevent leakage and as a result may provide high-resistance joints, and secondly, in the case of mains receivers, a leakage may result in arcing at the joints, with risk of fire, if there is a gas leak. A water system, too, can give rise to inefficient working if there are screwed joints between the receiving point and the actual earth. Such screwed joints may also be painted or made with the aid of hemp which, whilst providing a watertight joint, will electrically be very poor. Therefore, if a connection is made to a water system, try to find a pipe which is rising from earth, not going up to a tank or cistern in the roof.

Capacity Earths

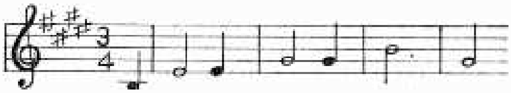
Where earth connections are made to gas or water systems which are not effectively earthed the results are obtained by capacity coupling to earth. A popular type of transmitting aerial some time ago utilised what was known as a "counterpoise" earth. The aerial proper was slung between two masts, and below the aerial and a few feet above ground level a similar erection was placed and connected to the earth terminal. Due to its capacity loading it was very efficient, and a similar arrangement may, in flats and similar places, give better results than a long, wandering lead to the ground or a connection to a water system. In fact, in larger types of receiver the metal chassis upon which the receiver is built actually acts in this manner, and if a similar or larger plate of sheet metal is placed underneath the receiver (*not in actual contact with it*) and connected to the earth socket it may be found that this will provide better results than an apparent orthodox connection. An experimental arrangement for use in the larger types of radio-gramophone is to cut two pieces of thin copper or aluminium which will just fit inside the lid, and to place one in this position, connected to the aerial socket, and the other piece to be placed on the floor under the cabinet (under the carpet on which it stands, for instance) connected to the earth terminal. At certain frequencies this will be found to offer all that is necessary and will avoid the necessity of erecting an outside aerial. Similarly,

(Concluded on page 490.)

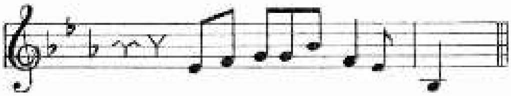
Identifying Musical Interval Signals—2

A SUMMARY OF SOME OF THE MORE POPULAR MUSICAL INTERVAL AND IDENTIFICATION SIGNALS USED BY FOREIGN TRANSMITTERS. A SPECIAL ARTICLE FOR THE LONG-DISTANCE LISTENER

THE next country in alphabetical order is Germany, and even greater confusion can be caused here due to the use of certain transmitters by the occupying authorities. In the American zone there are two main transmitters—" Bayerischer Rundfunk " and " Hessischer Rundfunk." The former has two transmissions known as 1st and 2nd programme. The latter is carried out on F.M. and unlike the other uses a musical identification signal in addition to the various announcements which are made in several languages. The programmes are heard on medium and long waves. The musical signal most likely to be heard in the F.M. transmissions is the following :



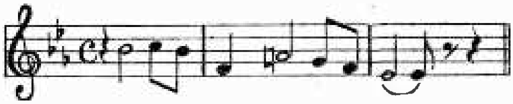
The Hessischer station radiates from Frankfurt and Meissner on medium and short waves and the interval signal consists of an air from Humperdinck's opera " Koenigskinder," the usual tune being this :



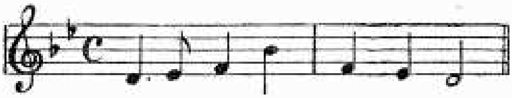
The West Berlin transmitter (Radio in American Sector—RIAS) provides also A.M. and F.M. signals on medium and short waves and uses the following tune as its identification signal :

The call " Hier ist RIAS-Berlin " will also serve to identify this transmission.

Transmissions are also made in Czech and Hungarian, with various calls and on various wavelengths. The Czech transmissions are usually accompanied by the following air :



and the Hungarian by this :



The Slovakian air

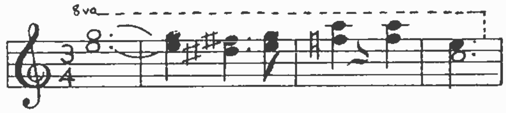
may also be heard and will identify the transmissions in this particular sector.

British Zone

In the British zone the main German transmitter is the Nordwestdeutscher Rundfunk, which also, incidentally, has an experimental television transmitter radiating from Hamburg. An interesting point about the interval signal which is used by the NWDR is that the air is taken from Brahms' 4th Symphony but is played by different instruments according to the area from which it is played. The air is this :

From Hamburg it is played on two oboes, from Cologne on two horns, from Berlin on two clarinets, and from Hanover on two trumpets. These will be heard on short waves only.

The British Forces Network will easily be identified as all announcements are in English, but in addition there is a delightful little air played on a celeste, thus :

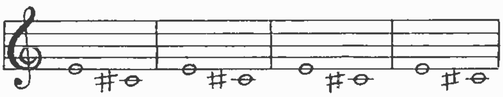


which most musical readers will recognise as part of " Moonlight on the Alster."

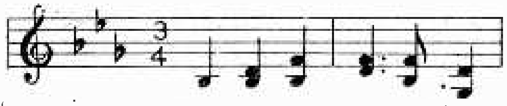
French Zone

In the French zone the most important transmitter is the Südwestfunk, and from Baden-Baden the following motif, taken from Mozart's " Zauberflöte," is used as the interval signal :

From Freiburg the following tune may be heard,

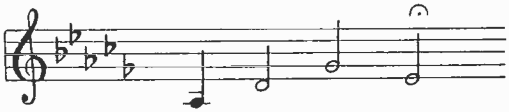


whilst from Tûbingen this is the tune which is used :

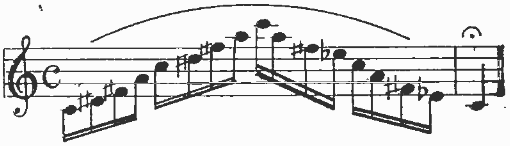


A further melody is heard from Mainz (Rheinland-Pfalz) and goes thus :

Another melody may be heard from Saarbrucken on 211.1 metres and is the following :



In the broadcasts from the German Democratic Republic, which also includes a number of F.M. stations, there are two tunes which are often heard as interval signals, the actual instrumentation varying not only from transmitter to transmitter but also apparently from time to time. The following are the two usual airs which are heard :

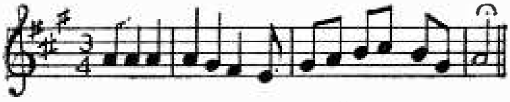


Owing to the political situation it is not possible to make any definite recommendations regarding certain transmissions, although the main transmitters appear to remain constant. A signal, for instance, on the following lines :

may sometimes be heard from Leipzig on 287.6 and 30.83 metres. It may be heard on a xylophone or bell-like instrument.

Greece

The National Broadcasting Institute radiates on medium and short waves, and the transmissions come from several stations and are referred to as Home and Foreign service transmissions. On the short waves the interval signal most likely to be heard is an air from a folk-dance played on a clarinet :



(To be continued.)

Book Received

"RADIO Designer's Handbook." 4th Edition. Edited by F. Langford-Smith, B.Sc., B.E. (1st class honours), Senior Member I.R.E. (U.S.A.), A.M.I.E. (Aust.). Published by Iliffe & Sons, Ltd. Price 42s. (postage, 1s. 6d.). 1,474 pages.

This is a comprehensive reference handbook for all who are interested in the design and application of radio receivers and audio amplifiers.

Previous editions of "Radio Designer's Handbook" have achieved exceptional success, many thousands of copies having been sold throughout the world. The work deals in detail with basic principles and the practical design of all types of modern radio receivers, audio amplifiers and record-reproducing equipment.

This fourth edition is more than four times as large as the previous edition and is the work of 10 authors and 23 collaborating engineers, under the editorship of F. Langford-Smith. The enormous amount of data it contains has been made readily accessible by means of a fully-detailed list of contents and a very complete index. The book is a self-contained source of information but exhaustive bibliographies are provided.

The main subjects are : valves and valve testing ; general theory and components ; audio frequencies ; radio frequencies ; power supplies ; design of complete A-M and F-M receivers ; and reference information.

CLUB NEWS

RAVENSBOURNE AMATEUR RADIO CLUB

Hon. Sec. : Mr. W. Wilshaw, 4, Station Road, Bromley, Kent.

THE club meets every Wednesday evening at 8 p.m., at Durham Hill School, Downham. The club transmitter G3HEV has now QSO'd 125 stations on four bands A1/3 in 12 countries. Morse practice is given. Equipment includes : 6V6-CO-6V6 PA ; 6AC7-6AC7-TT11 PA ; Edystone 640RX, Denco RX, class D wavemeter and 200ft. marconi aerial.

New members welcomed. It is also proposed to visit places of interest in the radio sphere.

SOUTH MANCHESTER RADIO CLUB

Hon. Sec. : M. Barnsley (G3HZM), 17, Cross Street, Bradford, Manchester, 11.

THE Radio Amateurs Examination Course has now commenced, and is held every Monday night at headquarters. Time 7.45 p.m. Persons interested are invited to attend.

The Annual Direction Finding Contest is about due and arrangements are in hand to see if it can be held this month.

GRAVESEND AMATEUR RADIO SOCIETY

Hon. Sec. : R. Appleton, 23, Laurel Avenue, Gravesend.

AT the Special General Meeting, held in May, Eric Woods (G3FST) asked to be released from his office of chairman, owing to pressure of work. Leslie Belger was elected in his place.

Three members sat for R.A.E. on May 1st last. Medway and Grays Clubs have been invited to a lecture on T.V.I.

ENFIELD RADIO SOCIETY

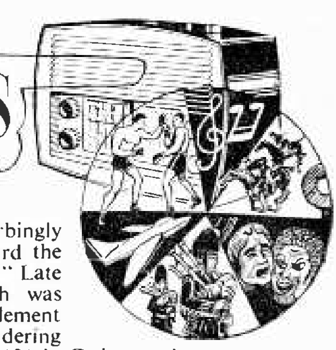
Hon. Sec. : F. A. Tickell (G3ICV), 10, Cowdrey Close, Enfield.

THE above club has just moved into new quarters, and although the meetings at the moment are informal, a varied programme is being arranged which will include at least two field events in the near future.

The Secretary would like to hear from any new members in the district and from older members who have not been contacted.

Programme Pointers

By MAURICE REEVE



Talks

SIR COMPTON MACKENZIE has recently become a radio star of the first importance. Amongst other things he has made us realise that, in not having come forward as such years ere this, we have been denied a personality of the greatest charm, force and culture. He is that rare being, someone who talks with us instead of constantly at us. He makes us feel we are being privileged to share his experiences with him, and many of those experiences are well worth the sharing.

There are two first class Mackenzie features now running concurrently: a radio adaptation every Sunday evening of his early eighteenth century romance, "The Passionate Elopement": and on Tuesdays "Beaux and Belles," recollections of Edwardian songs, shows, dances and personalities. Both are very gay, colourful and nostalgic entertainments. Early in life, Sir Compton made himself a master of both English and the eighteenth century—the century which gave us Tom Jones, Sir Peter and Lady Teazle, Clarissa, Pamela and a galaxy of other charmers of both sexes—to such an extent that not only did "The Passionate Elopement" first see the light, but passages from it were included in *The Oxford Book of English Prose*.

Sunday Evenings

Its presentation on Sunday evenings suffers from the same *malaise* that all the serials do, inseparable, perhaps, from the change of medium and the twelve "signings on" and "signings off." The latter, however, are reduced to the minimum by the enchanting voice and personality of the author's sister, Fay Compton, a radio star in her own right. The memories revived by "Beaux and Belles" are very vivid to quite a number of us, and are charmingly recalled by a number of well-chosen artists, a weekly guest star of Sir Compton's, and, of course, Sir Compton's gracious and infectious personality, knitting the whole thing together most admirably. May we have plenty more of Sir Compton Mackenzie please.

"Coronation Concert"

The concert I heard in the "Coronation Concert" series was devoted to three works by British composers, Vaughan Williams, William Walton and the late Gustav Holst, with William Primrose the brilliant soloist in the Walton viola concerto. It made me realise how British music has flourished during its renaissance of the last fifty years. With even greater masters such as Elgar, Delius, etc., listening, as it were, from the wings, whilst—to continue the metaphor—Sullivan and German, etc., were acting as ushers, there was still sufficient material to make up an opulent programme.

Music Criticism

To the Third Programme intelligentsia the six Studies in Music Criticism, arranged by William Glock, are absorbingly interesting. I heard the third in the set, "Late Beethoven," which was preceded by the Element String Quartet rendering the immortal Op. 131 in C sharp minor.

"Our Island Music"

The third musical event I signal out for mention is Stephan Williams's series (on records), "Our Island Music." A very mixed bag, but well compiled and documented. So far it has been classified under the headings, "Brass Bands," "Songs," "Opera," "In the Home," "Poets in Songs," "Light Opera Stage" and "Songs that Made History." The interest has been maintained throughout.

"Variety Playhouse"

The Saturday evening "Variety Playhouse"—"Music Hall's" latest title—has taken on yet a new lease of life with the assumption of the mastership of ceremonies by Vic Oliver. We can only hope that these duties will not prevent Mr. Oliver introducing himself in what must surely be radio's best music-hall turn.

Plays

There were so many departures from the original story in Terence Rattigan's and John Gielgud's dramatisation of "The Tale of Two Cities" that it is difficult to know just where to begin a criticism. The whole thing has been bedevilled ever since the authors of "The Only Way" magnified out of all proportion Sidney Carton's and Charles Darnay's physical resemblance and change-over in prison, so that Martin Harvey could have a star acting vehicle. All adaptations of the great book distort this episode which, in Dickens, is not even hinted at till three parts of the way through. And when Carton does eventually take Darnay's place under the guillotine's knife, it is not the sacrifice of a lover for a lady who prefers another—if it was, Carton would be the greatest of all lovers, which he most certainly is not—but an easy and spectacular way out for a shiftless and good-for-nothing, if charming, waster.

The whole centre and purpose of the story is the French revolution and nothing else. And the two greatest characters, and two of the glories of all Dickens, are Monsieur and Madame Defarge. Gerry Cruncher is not missed because he is very minor Dickens. Here I disagree with the writer in *The Radio Times*. Nevertheless, it made good entertainment for those who do not mind Dickens diluted, and it suited Eric Portman down to the ground.

Miss Rebecca West continued the delightful series of unscripted interviews. Rene Cutforth's "London Journey" was good but too long. The bus conductors were very poor imitations. I will not say whether this is flattering the originals or not.

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).

Beginners Transmitter

SIR,—I thought that you may be interested in my version of the "beginners transmitter" details of which were given in the May issue of PRACTICAL WIRELESS. Not having an ex-U S tuning unit to spare, I made the chassis from 16 gauge aluminium, having the completed job "black crackled" for a few shillings. Facilities are available for switching in the 80 and 40 metre bands at a later date, but as it stands, the circuit is yours, but for two slight modifications. A 6SH7 was tried in the oscillator stage, but with the 350 volts supply available, the tube ran very hot, and the frequency drifted badly. To stop this, two VR150/30's, with a resistor in series were placed across the 350 volts, and the anode supply for the oscillator taken from their mid point—150 volts. With this arrangement, the 6SH7 would not oscillate, and was replaced by a 6AC7, which works extremely well. The other modification was designed to help my one and only 807 to a ripe old age, namely a thermal delay valve, which switches the 807's H.T. on after an interval of 50 seconds. This valve can be seen in centre foreground of the photograph, whilst the 6AC7 and the two VR150's can be seen in the left side compartment.

Since the photographs were taken, the white ceramic former has been rewound to act as the aerial loading coil, along with the condenser underneath. The split stator condenser in the tank circuit was paralleled to give the required capacity, per your original diagram. A point is that the three coil cases in the oscillator contain the 80 and 40 metre coils, but have not yet been wired up.—H. N. KIRK (Rotherham).

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

Correspondent Wanted

SIR,—I would like, through your very good magazine, to correspond with another boy who is 16 years old. I am a regular reader of PRACTICAL WIRELESS and though I sometimes find it a bit too advanced for me, I intend to become a ham before very long.—H. M. WILSON (Leuchars).

The Amateur Transmitter

SIR,—I would like to thank Mr. Cole for his letter in the June issue of PRACTICAL WIRELESS. At last someone has the courage to put forward an argument for the would-be transmitter! As a reader of your paper for some years now, I have often wondered why the P.M.G. requires an intending "ham" to pass a Morse test and the City and Guilds exam. If the TX is crystal controlled and the operator complies with all the regulations, what more is needed?

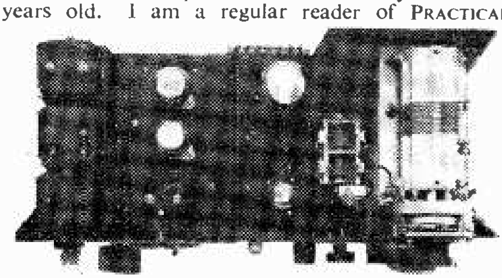
Under the present conditions amateur radio is only for those who have the time and money to study for their licence. Let us have a better deal for the novice, who is the true "amateur" in amateur radio.—KENNETH FRASER (Fife).

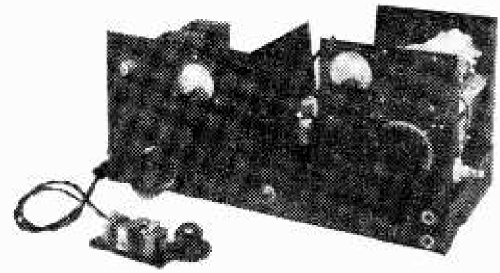
SIR,—With regard to Mr. H. Cole's letter (June issue), may I, as an ex-Leading Telegraphist (Royal Navy) venture some remarks on the use of Morse.

As any experienced operator will tell you, Morse transmissions are often readable through a high level of QRN or QRM which would render speech modulation absolutely unintelligible (and using less power). That is why Morse is favoured—especially on the congested channels available for H/F ship-to-shore traffic.

As to why the P.M.G. insists on amateurs possessing a good knowledge of Morse, surely it is evident that the amateur should be able to distinguish that he or the person he is working, are not causing interference to essential services on adjacent channels.

Alternatively, there have been occasions where





Two views of Mr. Kirk's transmitter built from details given in these pages.

the amateur has been of great value (through ability to read Morse) in intercepting distress signals, etc., which for some reason or other (skip distance, etc.), have not been received by the proper authorities.

He mentions an allocation of VH/F or UH/J. bands to "speech only" enthusiasts, surely a very limited field, precluding any DX work, which is the chief joy of the amateur I understand.—A. F THOMPSON (Banchory).

[*Many other letters have been received in the same strain, and obviously a really keen amateur would be prepared to understand and try to perfect every branch of his hobby.*—ED.]

Quality Amplifiers

SIR,—Reading your article, "The 'Modern' High-power Quality Amplifier" (March), I wondered if any readers have seen the American modification of the popular Williamson circuit. A new output transformer, with tapped primary for screens, has been used in this. Valves 807, 5881, KT66 can be worked in this "ultra linear circuit."

Output increased from 15 w. for 2 v. input to 30 w. 1 v. input, at levels of 1-2 w. The intermodulation is in vicinity of .06 per cent. at 13 w., .3 per cent. at 20 w. approx. 1 per cent. power 450 v. at 130-140 mA.

I should like to see an article on design and construction of P.P. output transformers, such as inductance required, and easy formulae for number of turns and type size of stampings. Seems most books can only bother to give method of finding turns ratio.—R. ALLEN (Wellingboro').

A Multi-range Tester

SIR,—I was interested in the article by E. N. J. Marguerit on the multi-range tester. It is definitely the type of article that helps the amateur to get the best out of radio. The possession of a good meter, such as this, is essential, but in many cases too expensive. Here we have a first-class meter at reasonable cost.

The method of measuring the resistance of the meter is very similar to the one used in our laboratory. The power supply we use is a variable one, covering 100 to 400 volts; it is stabilised, but has no reference standard. The resistors used for those in series are of the Dubilier high stability carbon type of ample wattage rating. The variable resistor shunted across the meter is a resistance box that can be altered in steps of 1 ohm. Resistance readings are taken at three points on the scale, $\frac{2}{3}$, $\frac{1}{2}$ and $\frac{1}{3}$ deflection. The resistance of the box is then double, equal and half the meter resistance. The taking of the three readings and taking of the average reduces the error of the resistance calculations.—JAMES S. KENDALL (Kendall and Mousley) (Tipton.)

L.F. Couplings

SIR,—After reading Mr. Bryan A. Cox's letter in the July issue I am not sure whether I wrote too little or too much in my article on A.F. transformers (May issue). I could have gone on to give practical examples to illustrate the principles I stated; on the other hand, it is evident that what I did write was too much for Mr. Cox to read in its entirety. Two points seem basic in his letter:

(a) He has missed the whole point of my article, which recommended giving transformers their *rightful* place, which is certainly not to replace a capacitor and resistor costing much less. I did not suggest that. Maybe Mr. Cox has never met an equipment in which the supply section constitutes the major part of weight and cost. In such equipments, proper design and/or use of A.F. transformers would often save a lot on the supply side, resulting in lower overall cost, weight and bulk.

(b) He makes the common mistake of thinking most other people have the same viewpoint as himself; the letters in "Open to Discussion," as well as many I receive, show that *some* people like to be original. Also those clever people who design for others to make *occasionally* read what someone else has written. Bad choice of values for circuits in which transformers are used is a fault not confined to constructors, but also applies to many professional designers — including transformer manufacturers themselves.

To the bigot, an open-minded man is bigoted, because he disagrees. That is the only basis on which I can see Mr. Cox's allusion to my "passion" for transformers is justified. I say use a transformer where it is the best component to use, rather than using an extra valve and bigger mains transformers and chokes to avoid using it. I also say use the capacitor and resistor where that is the best and cheapest arrangement. *But consider each case on its merits.*—N. H. CROWHURST (S.E.27).

Transistors

SIR,—Re Mr. Law's most interesting and helpful letter on this subject, when these transistors are available in this country, is it too much to hope that British manufacturers will agree to some *definite standardisation* of *fitting, mounting* and *connecting*?

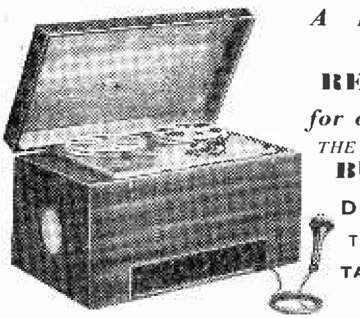
Not only to avoid ruining these valuable instruments by wrong connections, as Mr. Law so aptly explains, but to save the radio fraternity the unending nightmares caused by literally hundreds of valve types, valve patterns, valve shapes and base connections. To say nothing of servicing sets with valves of unheard of types. Why on earth must English octal valve bases and holders be different from American? Many English manufacturers who, as Mr. Law points out, have shown lamentable weakness for individualism over standards and identification figures and letters, must long ago have defeated their own objects. Is it really too late to rectify all this chaos?—A. J. SWEENEY (Gloucester).

(*Concluded from page* 482.)

if an indoor aerial is fitted, say, round a picture rail, a similar wire running along the skirting board connected in place of an earth lead may also provide better results.

Warning

In any experiments with earth connections in A.C./D.C. or D.C. receivers the greatest care is necessary, as one side of the mains forms the H.T. connection and may be in contact with the chassis or "earth" socket, and apart from damage to the receiver or fuses there may actually be a risk of personal injury of a serious nature. As a general rule, a direct earth connection should not be made to these types of receiver and the maker's instructions should be carefully studied in this connection.



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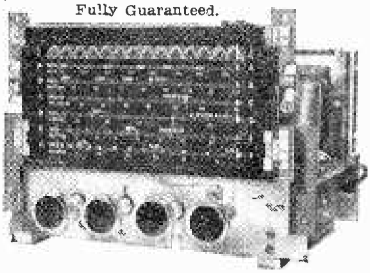

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16mf, 500v. D	3/3	32-32mf, 450v. (550 surge) T	6/-
25mf, 25v. T	1/2	40-40-30mf, 275v. D	3/3
25mf, 25v. D	1/4	24-24-24mf, 350v. D	3/6
25mf, 50v. D	1/9		
250mf, 25v. B	2/3	60mf, 350v. T	5/-

D = Dubilier, T = T.C.C., B = B.E.C.

25 std. value resistors all different ... **5/-**
20 mixed condensers 10pf-1mf... ... **5/-**
Germanium Xtal diodes **2/3**
Germanium Xtal diodes ½in. wires ... **1/6**
G.E.C. selenium rectifiers, 230v. 30ma. **7/-**
Mumetal shield, 100 x 45x ½mm. ... **1/-**
3-gang .0005mf **3/6**
30pf mica trimmer ... ... **8d.**
Plessey vibrator 12v. 4-pin 1214 ... **6/6**

Tubulars, metal cased. 1mf, 250v., **9d.**; .1mf, 600v., **1/-**; .1mf, 500v., **10d.**; .1mf, 350v., **7d.**; .05mf, 500v., **9d.**; .02mf, 750v., **9d.**; .01mf, 1,000v., **10d.**; .001mf, 1,000v., **8d.**

Silvered mica. 10, 12, 15, 18, 20, 22, 25, 30, 33, 50, 82 and 100pf, all **3d.** each.

Coil pack, with diagram, 7-short waves, medium and long completely wired, **20/-**; other items include switches, cabinets, etc.

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CITY OF COVENTRY EDUCATION COMMITTEE

COVENTRY TECHNICAL COLLEGE

Session, 1953-54

ELECTRONIC ENGINEERING

Applications are invited for entry to the next 3-year full-time course commencing in September, 1953, from those requiring a comprehensive training to an advanced level in ELECTRONIC ENGINEERING, to qualify them for technical posts in radio, telecommunications, television and Industrial electronics. The syllabus will cover the requirements of C. & G., Brit.I.R.E., and I.E.E. examinations. Entry age 16 years or over. Application forms and further information available from the Principal, Coventry Technical, College.

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Director of Education
Council House, Coventry.

News from the Trade

H.M.V. Record Cabinet

THE record-filing cabinet illustrated below forms a worthy housing for a library of gramophone records. It has a capacity of over 700 records of all sizes and types, including the new 7in. 45 r.p.m. records, for which there is a special centre section. It will also take every type of record album.

The doors are of the folding type with centre hinges ; a lock and key are provided.

As will be seen from the illustration, this cabinet, finished in highly polished, figured walnut, is a most distinguished article of furniture and fully representative of the fine craftsmanship for which " His Master's Voice " have always been renowned. The overall size of the cabinet is 33¼in. high, 34¾in. wide, 17¼in. deep. Price 28 gns. (tax paid).—The Gramophone Co. Ltd., Hayes, Middlesex.

New Ever Ready Portable

THE latest all dry portable is the " Sky Queen," which has been designed around the new low-consumption valves combined with the new Ever Ready radio battery " Batrymax " B.136, which is of advanced construction compared with other radio batteries. The whole object of the new set is to reduce the cost of battery-operated radio listening—the " Sky Queen " operates at less than three farthings per hour.

The set is of handsome appearance, looks expensive, but is reasonably priced.

The cabinet is of strong wood covered with good quality grey imitation lizard skin leatherette. Loudspeaker grille of convex shaped expanded metal gold finish, surrounded with cream plastic fillet. Folding clear Perspex handle and clear open-tuning scale. The aerial is a self-contained directional loop. The circuit is a four-valve superhet covering 930 metres to 2,000 metres, and 194 metres to 540 metres.

Ever Ready low-consumption valves, type DK96, DF96, DAF96 and DL96 are employed, and the price is : Receiver, less battery, £9 10s., plus purchase tax £3 1s.; " Batrymax " B.136, 16s. extra.—The Ever Ready Co. (Gt. Britain) Ltd., Hercules Place, N.7.

New Low-noise Voltage Amplifying Pentode

OSRAM valve Z729, which is the latest addition to the range of valves marketed by the General Electric Co. Ltd., is a low microphony, low hum, voltage amplifying pentode of all-glass construction on a B9A (Noval) base.

The new valve has been designed primarily for use in the early stages of high gain amplifiers where the hum and microphony introduced by the valve must be kept to a minimum. Typical applications include record reproduction and sound reinforcement equipment, tape recording and microphone head amplifiers, as well as tone control apparatus incorporating bass boost circuits.

The rigid electrode structure materially assists the reduction of microphony, and specialised design, including a double helical heater, internal screening and the disposition of the pin connections have enabled the very low hum level of 1.5 microvolts referred to the control grid to be realised. This figure represents at least a sevenfold improvement on that given by a valve of normal construction, and has been obtained without the necessity for specialised circuitry. A hum-balancing resistor is not necessary if the heater is supplied from a winding with an earthed centre-tap. A stage gain of the order of 180 is obtainable.

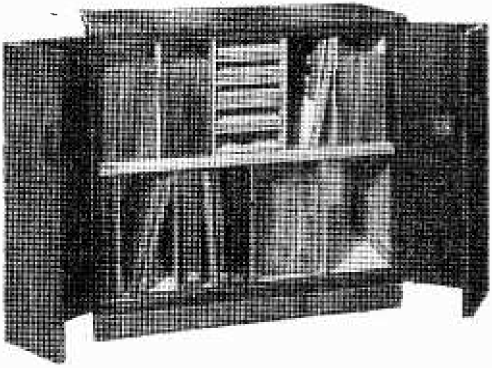
Application to Instrument Design

The low value of reverse grid current of Osram valve Z729 renders it particularly suitable for use in valve voltmeters and other instrument applications where this characteristic is of importance, and in cases where a valve better in this respect than normal is essential but the high cost of an electrometer valve is not justified.

Characteristics :

Heater voltage	6.3 v.
Heater current	0.2 A.
Anode voltage max.	300 v.
Mutual conductance	1.85 mA/volt

General Electric Co. Ltd., Magnet House, Kingsway, W.C.2.



The new E.M.I. record storage cabinet.

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BOOKS

LATEST AMERICAN RADIOS.—New and novel miniature receivers, portables, all-wave receivers, 1 to 6 tube: Electronic equipment, etc. Build your own from available parts. Complete list of blue-prints and parts lists available, with full details, 3d. AMERICAN PUBLISHERS, Sedgford, Norfolk.

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.

THE SHORT WAVE MAGAZINE will keep you in close touch with all that is worth while in Short Wave Radio, whether you are a listener, an experimenter or an amateur transmitter. Annual subscription 24/-. THE SHORT WAVE MAGAZINE, LTD., 55, Victoria Street, London, S.W.1.

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RECEIVERS & COMPONENTS

OSMOR for really efficient coils, coil-packs, and all radio components as specified for many "Practical Wireless" circuits. See our advert. on page 433 of this issue for free circuit offer, or send 5d. stamp to address below. OSMOR RADIO PRODUCTS, LTD. (Dept. PC6), Borough Hill, Croydon, Surrey. (Tel.: Croydon 5148/9.)

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HR PHONES, 12/- p.f.: T.V. Formers, **6d.**; 4 B.A. Wrenches, **6d.**; Blowers, 24v, **12/6** p.f.; Chokes, 10h. **250** ma, **10/6** p.f.; J Box No., 240, **6/6** p.f.; Control No. 227, **4/6** p.f.; Rem. Con. No. 223,**5/6** p.f.; 6K7G, 5/6. Free lists. ANNAKIN, 25, Ashfield Place, Otley, Yorks.

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RATES: 5/- per line or part thereof, average five words to line, minimum 2 lines. Box No. 1/- extra. Advertisements must be prepaid and addressed to Advertisement Manager, "Practical Wireless," Tower House, Southampton St., Strand, London, W.C.2.

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ELECTROLYTICS, capacity, voltage, size, type of mounting; price post paid, in that order: 16 + 32, 450/525, 1⅜ x 2, clip, **5/6**; 24 + 24 + 16, 350/425v, 1⅜ x 2, clip, **4/9**; 60 + 200, 275/350v, 1¾ x 4½, clip, **6/6**; 1,000, 12v, 1 x 2¼, clip, **2/9**; 4, 150v, ⅝ x 1¾, clip, **1/1**; 60 + 100, 350/425v, 1⅜ x 4½, clip, **6/6**; 500, 12v, 1⅜ x 2¾, clip, **2/6**; 8, 350v, ¾ x 2, **2/-**; 6,000, 12v, 1⅜ x 4½, lug, **4/6**; 100 + 200, 275/350v, 1⅜ x 4½, clip, 6⅝-; 8 + 16 + 16, 450/525v, 1⅜ x 2, lug, **5/9**; 32 + 32, 350/425v, 1⅜ x 2, clip, **5/-**; 2,000, 6v, 1 x 3, clip, **3/3**; 8 + 16, 450/525v, 1 x 2 clip, **4/-**, 2, 450/525v, ¾ x 1¾, tag, **1/6**; 2, 350v, ¾ x 1¾ tag, **1/3**; 8, 350/425v, ¾ x 2, clip, **1/9**; 16 + 32 + 8, 450/525, 1⅜ x 3½, lug, **5/9**; 8, 450v, ¾ x 2, clip, **1/11**; 1,000 + 1,000 6v, 1 x 3 lug, **3/6**. All are Ali cans; some with sleeve; all new stock; all voltages WKG, with surge v where marked. Television! Set of 3 Components, comprising line output trans. with E.H.T. winding to give 7Kv, using EY51 (heater winding for EY51 also included), and fitted with width control. Scanning coils, low impedance line and frame, focus coil, optional high (10,000Ω) or low (200Ω). Set of 3, **42.-**, plus 2/- postage. Diagram of line trans. supplied. RADIO CLEARANCE LIMITED, 27, Tottenham Court Road, London, W.1. (Telephone: Museum 9188.)

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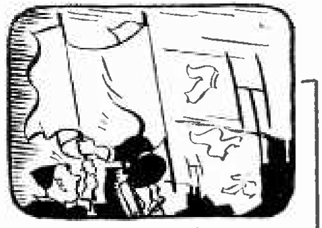

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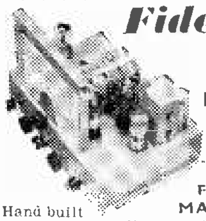

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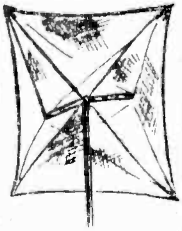

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40 mA. Multi-ratio	6/11
80 mA Multi-ratio	14/11
80 mA Pentode	12/6
60 mA Plessey. 6,000 ohms	5/11
Standard pentode	4/11
Pentode	3/6
Midget pentode	4/3
Miniature pentode, 3S4, 1S4	4/6
PX4 Intervalve	8/6
5 : 1 Intervalve	5/11

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For 6- or 12-volt operation. Complete with magnetic pick-up and volume control. In metal cabinet, size 17 x 14 x 11in. Very limited quantity.
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SPECIAL OFFER. 4 Valves: 1 each 1R5, 1T4, 1S5 and 3S4.
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1R5	9/-	XH	3/6	6K8	13/6	EA50	2/6
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LASKY'S RADIO

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Telephones: CUNningham 1979-7214. All Depts.
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40 mA. 8 H.	3/11
40 mA. 10 H.	4/3
100 mA. 10-20 H.	7/3
120 mA. 10 H.	15/-
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The very latest "Sentercell" S.T.C. range.

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4-Watt Model. Ex Government. Complete with 10 valves: 2 25L6; 1 6H6; 1 25Z6; 6 6SK7. For operation on 110 volts AC/DC. Balance and push pull. High, medium and low impedance inputs, A.G.C., etc. **LASKY'S PRICE** £5/19/6 complete. No circuits available. Carriage 10/- per unit extra.

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EX-A.M. RECEIVER TYPE R1155.
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FULLY ASSEMBLED POWER PACK AND OUTPUT STAGE FOR R1155 RECEIVERS. For use on 200-250 volt A.C. mains. Wired and complete with valves. LASKY'S PRICE, 79/6. Carriage 5/- extra.

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Contains 1 c.r. tube type VCR97, and 11 valves:—3 EF50; 3 EB34; 3 SP61; 2 EA50. Also hundreds of components, resistances, switches, etc., etc. On metal chassis, in grey enamel steel case. Size:—18 x 8 x 8ins. **LASKY'S PRICE** 69/6. Carriage and packing 10/6 extra.