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PRACTICAL WIRELESS

EDITOR:
F.J.CAMM

IN THIS ISSUE

Practical Wireless

19th YEAR OF ISSUE

EVERY MONTH.
VOL.XXVII. No.539. SEPTEMBER 1951

Editor F. J. CAMM

COMMENTS OF THE MONTH

By THE EDITOR

Government Views on Beveridge

THE Government views on the Report of the Broadcasting Committee set up in 1949 under the chairmanship of Lord Beveridge to advise on sound and television broadcasting services in the United Kingdom (whose findings were summarised in our issue dated March) have recently been published as a White Paper. In principle the Government approves of most of the Committee's recommendations, not excluding that which expressed the need for a continuation of the B.B.C. monopoly in broadcasting, which is likely to be incorporated in the new B.B.C. Charter and Licence, which are due to come into force on January 1st, 1952.

The Government agrees with the majority of the Committee that the best interests of British Broadcasting require the continuance of this monopoly on the present basis, as any alternative would result in a serious decline in the service to the public. The Government is also in favour of the clause prohibiting commercial advertisements or sponsored programmes without the written consent of the Postmaster-General. This clause will be repeated in the new licence.

Whilst the Committee said there was a case for granting 100 per cent. of the net licence revenue to the B.B.C. for the first five years of the new Charter, in view of the large programmes of broadcasting and television development, the Government proposes that the Corporation should receive 85 per cent. of the net licence revenue for the first three years of the new Charter, and that the position should be reconsidered at the end of that period.

It is also accepted that the B.B.C. should be authorised to borrow up to £10,000,000 for capital expenditure, and the Government approves the recommendation that the current independence of the Corporation in making programmes and in general administration should be continued, while the existing powers of giving directions and of veto should, subject to minor changes, be retained by the Government, whose control over the Corporation in the last resort will remain absolute.

The Committee's alternative proposal to that in which they said that the new Charter and Licence should have no time limit but should be subject to revocation and the working of the B.B.C. reviewed quinquennially, has been adopted. It is that the Charter should be for a period of 15 years. It was felt that it would not be right for the present Government to tie future Governments, either as to frequency or the precise terms of reference of the review. The Radio Industry Council thinks the period too long, and that it should not exceed five years. We agree.

The Charter should provide for the delegation of powers in Scotland, Wales, and Northern Ireland, and the English regions to secure a reasonable measure of independence and greater variety and initiative in the selection of programme material.

On small matters affecting the Charter or Licence the Government agree that the Corporation should no longer be bound by the opinion of its auditors as to the provision to be made for depreciation, and that freer delegation of power to sign documents should be permitted.

It is agreed that the Whitley document should disappear and that the position of the governors in future should be defined only by the Charter; as to their remuneration, whilst the Government agrees that it is most important to secure persons of outstanding ability for these posts they feel (and we agree) that this can be done at the existing salaries of £3,000 a year for the chairman, £1,000 for the vice-chairman, and £600 for the other governors. Bearing in mind that the positions are largely sinecures, and that the Governors in reality do very little work, we consider that these salaries are far too high. The positions are more ornamental than useful. The proposal that national governors be appointed is accepted as is the recommendation that there should be national bodies to be called Broadcasting Councils.

The Paper says that it is impracticable at this stage to reach any definite conclusion on the problem of television for public shows. In the matter of party political broadcasts, this is to be discussed with other parties. It is also thought to be essential that the B.B.C. should continue to employ aliens.—F. J. C.

ROUND the WORLD of WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ended May 31st, 1951.

Region	*Number*
London Postal	2,363,000
Home Counties	1,657,000
Midland	1,766,000
North Eastern	1,910,000
North Western	1,619,000
South Western	1,070,000
Welsh & Border Counties ..	731,000
Total England & Wales ..	11,116,000
Scotland	1,116,000
Northern Ireland	208,000
Grand Total	12,440,000

The above total includes 869,200 television licences.

Type Approval

IT is announced by the Westinghouse Brake and Signal Co. Ltd. that their "Westalite" and double-voltage "Westalite" series of metal rectifiers have been approved for use in Services equipment.

Dr. D. B. Foster Joins Mullard

DR. D. B. FOSTER, M.I.Mech.E., F.Inst.F., A.M.I.Chem.E., has joined Mullard Ltd. as chief engineer of the equipment division. He has also been appointed executive director of Mullard Equipment Ltd., the subsidiary company which manufactures scientific and telecommunication equipment.

Dr. Foster brings to his new position an all-round knowledge of research and development administration in the fields of engineering, physics and chemistry together with experience of production and works organisation.

Camberwell Show

A CORDIAL welcome is extended to readers to visit the exhibition of radio transmitting equipment which is part of the Borough of Camberwell's Festival celebrations.

The exhibition will be open from Sunday, August 26th, until Saturday, September 15th, inclusive (except Fridays), daily 1 p.m. to 8 p.m., Sundays 3 p.m. to 7 p.m.

The exhibition will contain many fine specimens of home-built equipment, including a working station which will have three transmitters. Contacts will be made on all bands, 40 metres being mainly used during the day. A Q.S.L. card has been specially designed for the occasion and will be sent to all stations who are contacted. In conjunction, an exhibition of model engineering will take place at the same site by the South London Model Engineering Society.

The exhibitions are to be held at the Art Gallery, Peckham Road, Peckham, S.E.

Marconi Transmitter for Oslo

THE largest single order ever awarded by the Norwegian broadcasting authorities has just been placed with Marconi's Wireless Telegraph Co., Ltd. It is for a 200 kW. long-wave installation, for Oslo, and comprises two 100 kW. transmitters in parallel.

These transmitters are in the new range of air-cooled equipments recently designed by the Marconi Company. They have met with immediate success, for orders have been received from Finland, Denmark, Argentine, and other countries.

These are the first transmitters of 100 kW. output which have been successfully air-cooled. Such an installation was recently opened by the B.B.C. at Daventry for the Third Programme.

Paralleling equipment, phase and coupling circuits will also be engineered by Marconi's for the Norwegian order.

Air-cooling dispenses with the large reservoir always associated with water-cooled valves, and the design of these new transmitters allows considerable saving in space, building, and maintenance costs. A novel feature is the use of the exhausted air, after it has been heated in its passage through the transmitter and assimilated the heat from the valves, to warm the transmitter building.

Third Festival Theatre Opens

A NEW theatre has been opened in the Festival Pleasure Gardens at Battersea.

The Tent, towering behind the Lakeside Stage, recently put on its first show. It will house more than 400 people, and every seat will be priced at 1s.

First "turn" at the new theatre was a dark young man, with the famous handlebar moustaches which invariably indicate an R.A.F. origin. He is Squadron Leader David Stewart, who for the past four years has been astonishing Britain with his hypnotic powers.

Last October, it will be remembered, during "In Town To-night," he succeeded in putting Brian Johnston and the B.B.C. engineers to sleep.

E.M.I. Institutes

IN January of this year E.M.I. Institutes Ltd. inaugurated a special Four Year Course in Electronics. Associated with the course is a scholarship scheme providing for considerable financial assistance to selected candidates. The course and scholarship schemes were devised to cater for the ever increasing need for large numbers of highly trained electronic engineers.

The E.M.I. Group of Companies—whose products are marketed under such famous names as "His Master's Voice," Marconiphone, Columbia, etc.—have an option on the services of beneficiaries under this scheme.

In view of the continuing demand for highly trained engineers, E.M.I. Institutes Ltd. have the present intention of holding similar courses and scholarship schemes annually. The commencing date of the annual courses has been advanced to August to fit in with the normal school leaving period. The next Four Year Course is scheduled to start on August 27th, 1951, and applications for consideration are now being received by E.M.I. Institutes Ltd. Full details may be obtained on application to the Institute.

The Grasshopper

AN ingenious automatic weather-testing transmitter developed in the U.S.A. has been given the name of "Grasshopper." The apparatus is intended for parachuting on inaccessible territory where a controlled explosive charge disengages the parachute, releases springs which bring the unit into an upright position, erects a telescopic aerial, and then calls up the monitor station and transmits appropriate weather signals. It operates on a frequency of 5 Mc/s and has a range of over 100 miles. The self-contained dry batteries provide service for 15 days' intermittent operation.

High Prices in India

WE see from an Indian radio journal that apart from high prices for component parts there are also some serious restrictions for the purchaser. It is stated that when purchasing a valve one must also purchase others, and as an example it is stated that to obtain one 1N5GT you have to purchase one each of 1A7, 1H5 and 3Q5. If, therefore, a receiver is rendered inoperative due to a valve blowing, one has to buy three unnecessary valves to get it going again.

Amateur Band Restrictions

IN view of extensive American Government use of the frequency band 3,700-3,900 kc/s, amateurs in the U.S.A. have been asked to give up the use of this band in various areas from August 6th to September 7th.

Air Radio Licences

PROSPECTIVE radio operators and maintenance engineers in the Ministry of Civil Aviation may obtain detailed information of the examinations required in a publication now available from H.M. Stationery Office, price 1s. 6d. Known as "Certification and Licensing of Aircraft Radio Personnel, MCAP90," this includes, besides the syllabus, specimen papers.

Tilted Aerials

SOME interesting experiments were recently carried out by the R.C.A. with tilted aerials. An aerial was erected on one side of the Bridgeport transmitting tower and a motor-driven arrangement tilted the aerial back and forth over approximately 12 degrees. It was found that maximum received signal strength was obtained when the aerial was tilted 2½ degrees up or down. Further tests are to be made on V.H.F. and television channels to see if a similar improvement is obtained.

H.F. Heating

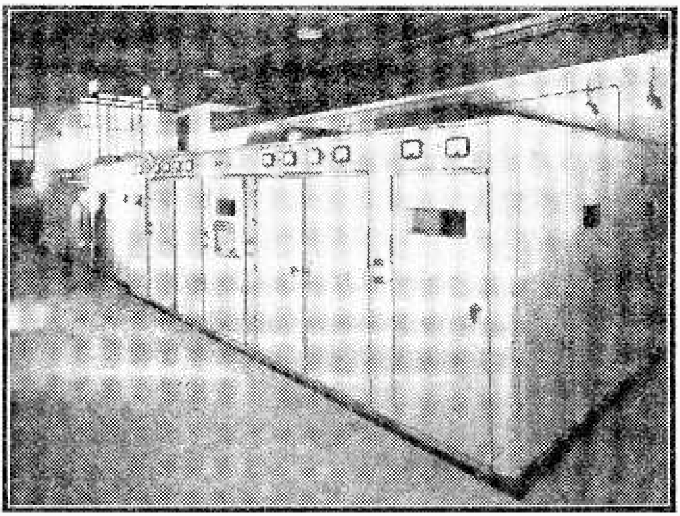
THE British Electrical & Allied Manufacturers Association are preparing a glossary of terms and a code of safety precautions for industrial H.F. heating equipment, and it will be issued in a few months' time.

Radio Telephone Links

COMPLETION of a chain of 107 radio relay stations along the Bell System's coast-to-coast communications route will provide more than 100 through telephone circuits between Chicago and San Francisco. It is anticipated that the route will be ready by the end of August.

Super-conductivity

IT is reported that the Royal Society Mond Laboratory in Cambridge have discovered that osmium and ruthenium in their purest forms, when subjected to a temperature of less than a degree above zero, possess the feature of super-conductivity, or the virtual disappearance of electrical resistance. These two elements are in the region between uranium and rhenium, which are also super-conductors, in the chemical periodic table.



This installation, similar to the one ordered by the Norwegian Broadcasting Authorities for Oslo, is the new 200 kW. air-cooled installation now broadcasting the B.B.C.'s Third Programme from their Daventry station.

A New Approach to Crystal Diode Reception

MODERN CRYSTAL RECEIVERS EXPLAINED

By W. P. HALKET

WHILE silicon or germanium crystal diodes make extremely efficient R.F. rectifiers only a small percentage of this efficiency is used if they are placed across a tuned circuit, using conventional values of inductance and capacity, that is, values of L.C. suitable for high-impedance rectifiers.

If a thermionic valve is used for rectification the input impedance—resistance across grid and filament—is of a high order, measured in megohms. The older type crystal depending on the light contact of a fine wire for rectification also has a high impedance. For these rectifiers a high L.C. ratio is, therefore, very desirable.

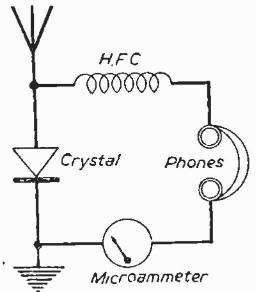


Fig. 1.—The experimental test circuit used by the author.

Silicon and germanium diodes are, however, of a comparatively low impedance and if they are placed across a circuit of high L.C. ratio two bad effects show themselves. First, the signal strength will be inferior and, secondly, and more important, selectivity will be almost non-existent; indeed, tuning can only be said to occur in the very broadest sense.

Situated close to a powerful transmitter neither of these bad effects matter much, but at any considerable distance from a local station (over 50 miles), efficiency is of vital importance. Signal strength must be good while selectivity must be kept high.

What follows is a description of the circuit arrived at and the results obtained with a fairly long aerial at a distance of 72 miles from the Scottish Home Service aerial and 330 miles from the long-wave Light Programme aerial at Droitwich in a district, West Highlands of Scotland, not particularly good for reception.

It will also be shown that by applying a bias voltage to these and other rectifiers, signal strength is increased to a marked degree.

Test Circuit

Fig. 1 shows the first circuit used.

The crystal is a silicon and the 'phones are of about 50 ohms resistance, reed type. It is of major importance that 'phones of the correct impedance are used. Neither high resistance, whether reed or diaphragm, nor low resistance 'phones, moving coil, will give satisfactory results. Of the reed type used it was found that those with an aluminium diaphragm were considerably more sensitive than those using brass or copper.

This simple circuit was used to test if un-amplified reception was possible. It proved to be possible and it was seen at once that the difficulty was not the reception of a wanted station but to keep out the unwanted ones.

Selectivity was, of course, non-existent, the loudest signals being those stations nearest to the natural frequency of the aerial-earth circuit. After dark the general medley of stations produced a steady aerial current of about four or five microamps. This current rose frequently to 10 or 20 microamps as conditions changed and occasionally the B.B.C. European Service raised it to close on 50 microamps at which current volume was very high.

Any attempt to tune this circuit failed completely. When a conventional tuning circuit was used the local or long-wave stations were scarcely audible and moving the .0005 μF tuning condenser had little effect on the signal. Tapping the aerial down the coil only resulted in complete loss of the signal. Tapping the crystal down the coil had the same effect.

Characteristic Curve

Since very little data on these crystals is published it was necessary to work out their characteristic curves.

They are shown in Fig. 2, and are very instructive.

First, they showed the crystals to be of low impedance, and, secondly, it was obvious that a bias

PARTS LIST FOR TWO-STATION RECEIVER USING AIR-CORE COILS

- 1 Germanium crystal diode, type 1.
- 1 .004 μF. condenser.
- 1 .002 μF. condenser.
- 1 2 μF. condenser.
- 1 1,000-ohm fixed resistance.
- 1 500-ohm potentiometer.
- 1 2-way 2-point switch.
- 1 on-off switch.
- 1 phone jack socket.
- 4 terminals.
- 2oz. 28 s.w.g. enamelled copper wire.
- 1 coil former 3¼in. dia. x 2in. long.
- 1 coil former 1½in. dia. x 3in. long.
- 1 pair phones, reed type, 50-ohm resistance.

voltage was necessary to obtain full efficiency since, in the case of a silicon diode, unless the signal voltage reaches .03 volt, no signal will be heard at all. With a germanium diode a signal voltage of over .25 volt is necessary before rectification can take place. With the correct bias applied even the weakest signal will be rectified.

Tuning Circuit of Low Impedance

In the conventional tuning circuit using a tapped coil this coil is in effect a step-up transformer. This is completely wrong for these diodes since a step-down transformer is required.

A small iron-cored coil, ½in. diameter, was taken from an ex-W.D. Type 21 receiver and it was found to tune approximately to the long-wave band. After some experiment it was found that with this coil as primary, and a secondary wound over it tuned by a .004 μF fixed condenser, signal strength was good and free from all interference. By making the tuning condenser larger, selectivity is gained without too great a loss in signal strength. With a germanium diode as rectifier, signal strength was still good with a tuning condenser as high as .02 μF.

Attention was then turned to the broadcast band and finally the method of applying bias worked out. When this was done a two-station receiver, using low-impedance tuning and bias voltage, was built and gave a very satisfactory performance. Fig. 3 shows the circuit. The primaries are small iron cored, Litz wound coils.

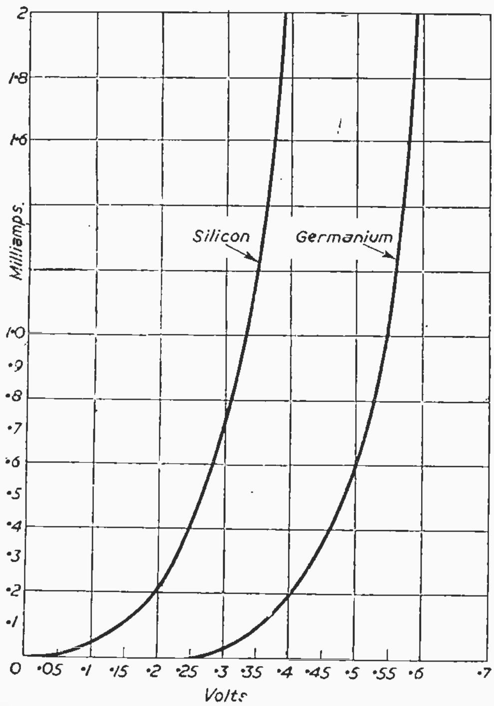


Fig. 2.—Curves of the silicon and germanium crystals.

Winding the Secondaries

All the components were assembled on a board, a silicon diode being used without bias. Aerial, earth and 'phones were connected and the wave-change switch turned to the medium band. About four yards of Litz wire was connected between "A" and "B," Fig. 3, and wound over the primary until the desired signal reached a maximum. The wire was then cut and the turns adjusted when reconnected until the maximum signal was again reached. The same procedure was used on the long-wave band, the Litz wire being connected between "C" and "B."

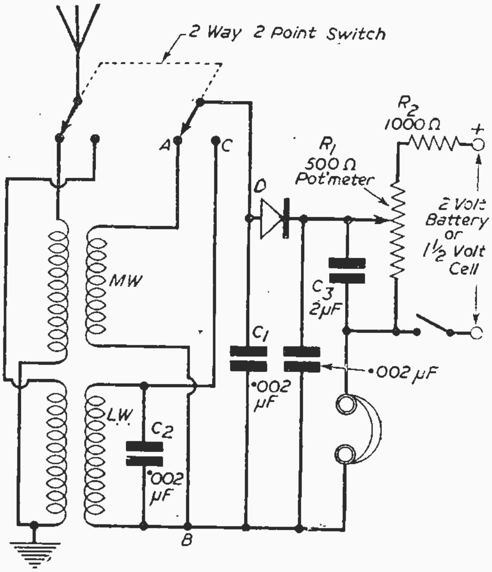


Fig. 3.—Two-station crystal receiver.

Should the reader require greater selectivity on the medium band, C_2, should be dispensed with and C_1 made .004 μF. As already stated the greater the capacity of the tuning condenser the greater will be the selectivity. The values shown in Fig. 3 give optimum results in the district where the receiver is used.

The Bias Voltage

Bias voltage is supplied through a 500-ohm potentiometer with a 1,000-ohm fixed resistance in series. This resistance R_2 may be considerably increased to reduce the current flowing from the battery, but R_1 should be kept to half the value of R_2. Without R_2 the setting of the potentiometer is too narrow, that is, the change in bias voltage for a given movement is too abrupt.

The larger is C_3 the better, since it must be remembered that the circuit is of low impedance.

The Diodes

In the circuit as shown in Fig. 3 the diode must be connected the right way round. With a germanium diode "D" is the red end. With a silicon "D" is the large end. With the resistance values shown, the potentiometer should be set about half-way for the germanium diode and somewhat less than quarter for the silicon. It must be remembered, however, that the characteristics of different crystals vary slightly.

The application of bias voltage makes a very considerable difference in signal strength particularly with the germanium diode, which in the district where this receiver operates produces no signal without bias. With bias the signal is stronger than with a silicon diode.

Of the two crystals the germanium is the more robust and will stand a greater impact or surge voltage than the silicon. Indeed, if the silicon is used close to a powerful transmitter the contact may soon be destroyed. On the very high frequencies the silicon crystal is superior, but for ordinary broadcast reception it is advisable to use the germanium.

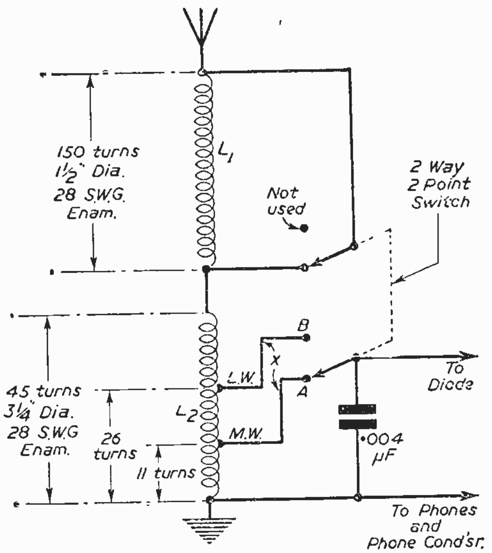


Fig. 4.—Details of the tuning coil.

If the contact of a silicon crystal is destroyed it can be broken open, mounted on an adjustable holder and reset.

A Simpler Coil Arrangement

Fig. 4 shows an air-cored coil arrangement much simpler than the iron-cored coils described and equal in performance.

The loading coil L_1 is necessary to prevent medium-wave band break-through and also to give an increased signal on the long waves. It is wound with 28 s.w.g. enamelled wire.

A cardboard Saxa salt container was used as the former for L_2, and was cut 2in. long, the metal end being left in place and used to screw the coil down. The winding is begun ¼in. from the top end. 28 s.w.g. enamelled wire is again used. Wind on 45 close turns, then, with a piece of fine emery, bare a narrow strip along the coil and screw to baseboard with the other components and wire up, leaving out connections marked "X" in Fig. 4.

With headphones on, connect a test-prod to "A" with wave-change switch on medium waves. Move the test-prod along the bared strip until the station comes in. Prise up the turn of wire and push a tapered match under it. Do the same on the long-waves. Then solder permanent connections from the tappings to the switch.

Full-wave Rectification

So far only half-wave rectification has been described.

Circuits employing full-wave rectification have been tried thoroughly, but always with results inferior to half-wave. Using two crystals and double secondary gave the poorest signal, while four crystals in bridge and a step-down L.F. transformer to the phones was still far from satisfactory. Voltage doubling gave promising results and so also did a circuit employing two crystals in parallel and opposed, feeding into a centre-tapped L.F. transformer. But in no case did the signal strength equal that obtained by half-wave rectification. From this it would appear that the half cycle not used in half-wave rectification is not lost but goes back into the circuit and "keeps the pot boiling." Unlike the primary of a mains transformer, which for all practical purposes may be considered capable of supplying unlimited power, the power supplied by the aerial is strictly limited, and any attempt to take more than it can supply only results in a reduction of signal strength.

Westinghouse Rectifiers

When a full-wave 5 mA. Westinghouse instrument type rectifier was used in the low-impedance circuits described results were surprisingly good, particularly on long waves, and though not equal to silicon or germanium diodes in signal strength, quality seemed to be very much better.

With C_1, Fig. 3, at .02 μF there was little to choose between the Westinghouse and the germanium diode so far as signal strength was concerned, while selectivity was extremely good.

From the above it would seem that a receiver employing one of these bridge rectifiers and close to a powerful long-wave station would give extremely good results.

A Westinghouse 250-microamp bridge was also used, but its higher resistance offset any gain it might have had through possessing a lower self-capacity.

A single element taken from a Westector W6 also gave a good performance.

With all the above copper rectifiers bias voltage is also necessary.

Conclusion

The main point to be grasped from the above is that low-impedance tuning circuits are necessary when using low-impedance rectifiers, and also, as in the case of copper rectifiers which have a comparatively high self-capacity, in low-impedance circuits this self-capacity has less ill effect. Also that with correct bias voltage applied efficiency is greatly increased.

Though the circuits described give very satisfactory results it is felt that from certain effects noted during the work done, even better performances can be achieved.

Measuring Small Condensers

A NOVEL BUT ACCURATE MEANS OF MEASURING THE CAPACITY OF VERY SMALL CONDENSERS AT VERY HIGH FREQUENCIES BY MEANS OF AN INCH TAPE OR METRE RULE

By J. S. KENDALL

THE accurate measurement of small condensers at very high frequencies is a problem that is often met in these days of V.H.F. experimenting. Bridges that measure at a frequency of one megacycle per second are available, but are above the means of the average radio experimenter. But if one has access to one of these bridges, how are the results going to compare with those made at 100 Mc/s? Will they be accurate? Or will the various losses at V.H.F. make them of little or no use? The only way to be sure is to make the measurement at a frequency within the region of those at which the component is to be used.

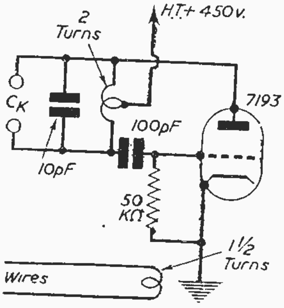


Fig. 1.—Simple Oscillator Circuit.

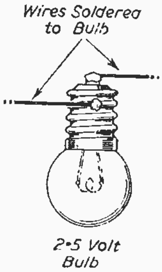


Fig. 3.—A Current Indicator for Lecher Wires.

One of the simplest and most accurate methods is to use the condenser under test to "tune" a V.H.F. oscillator and feed the output on to a pair of Lecher wires which are several wavelengths long.

The tuning coil can be made out of a piece of copper wire of about 12 gauge and 6in. long. Bright copper should be used with no insulation, and should be bent to form a two-turn coil. A suitable valve is the ex-W.D. 7193 or the CV6. Fig. 1 shows the circuit and the values of the components.

The output of the oscillator is fed into the Lecher wires by means of a one-and-a-half turn loop which forms the end of the wires. The coupling should not be too great or the line will load up the oscillator too much.

Measuring the Wavelength

Each half wavelength will have two current nodes, one at each end, so that the total number of nodes on the Lecher wires, less one, will be the number of half wavelengths. The easiest way to measure the current nodes is with the aid of a small flashlamp bulb with wires soldered to it so that it can be slid along the wires; the lamp will shine brightest at the current node. It is first essential that the LC ratio for the oscillator be found before any measurements are made, and this is carried out by measuring the average length of the waves on the Lecher wires and applying the formula $LC=\frac{\lambda^2}{4}$ where λ is the wavelength in metres, and LC is the capacity in pF multiplied by the inductance in microhenries.

A second set of readings should be taken with a small condenser across the "unknown" terminals and the formula again applied. From this the value of the formula $L(C+Ck)=\frac{\lambda^2}{4}$ is found. It is then possible by simple algebra to find the value of L and C in the circuit (see Appendix). Once this is done the oscillator can be used to measure unknown capacities by placing them across the "unknown" terminals, measuring the "length" of the oscillations and applying the simple formula.

Precautions

The points to be watched are the lead lengths of the condensers under test, and that the size of the condensers is limited to about 50-70 pF. If larger condensers are required to be measured, they must be placed in series with a small known condenser of, say, 50 pF.

Appendix

Given that LC is the inductance-capacity ratio.
L is in microhenries.
C is in pF.
Ck is the value of the known capacitor in pF.
λ_1 is the length of wavelength 1 in metres.
λ_2 is the length of wavelength 2 in metres.
L and C are the inductance of the coil and the total stray capacity of the circuit.

Given $LC=\frac{\lambda_1^2}{4}$ and $L(C+Ck)=\frac{\lambda_2^2}{4}$

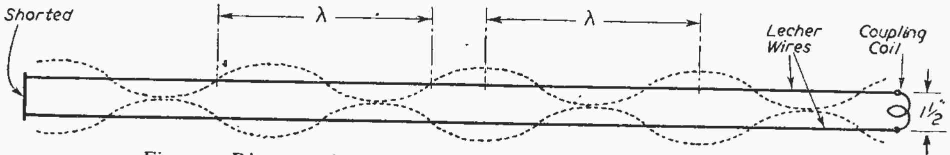


Fig. 2.—Diagram showing distribution of current on Lecher Wires.

By dividing these two equations by each other we get rid of L.

$$\frac{L(C+Ck)}{LC} = \frac{\frac{\lambda^2_2}{4}}{\frac{\lambda^2_1}{4}}$$

$$\therefore \frac{C+Ck}{C} = \frac{\lambda^2_2}{4} \times \frac{4}{\lambda^2_1}$$

$$\therefore 1+\frac{Ck}{C} = \frac{\lambda^2_2}{\lambda^2_1}$$

$$\therefore \frac{Ck}{C} = \frac{\lambda^2_2}{\lambda^2_1} - 1$$

$$\therefore \frac{C}{Ck} = \frac{1}{\frac{\lambda^2_2}{\lambda_1} - 1}$$

$$\therefore C = \frac{Ck}{\frac{\lambda^2_2}{\lambda^2_1} - 1}$$

Having now obtained the value of the stray capacity of the circuit, we substitute it in the formula $LC=\frac{\lambda^2_1}{4}$ and find the inductance of the circuit.

If the circuit constants are known, and Ck is the capacity being measured, it will be seen from the foregoing that $Ck=C\left(\frac{\lambda^2_2}{\lambda^2_1}-1\right)$.

The error of this system is about 6 per cent. as, in order to simplify calculations, 1.887 has been taken as equal to 2. Therefore, for more accurate results, the answer should be multiplied by 1.059.

Modifying the SCR 593

UTILISING BC 728 AS A CAR RADIO

By R. HINDLE

THE American SCR 593 (of which the receiver alone is styled the BC 728) is a very attractive receiver for use as a car radio. It is a six-valve superheterodyne receiver built into a compact, weather-proof metal case measuring approximately 12in. by 7½in. by 5½in., incorporating speaker and power equipment. Miniature battery valves are used, with filaments heated from a two-volt spill-proof accumulator accommodated in an acid-proof compartment within the case, with a rubber vent arranged to lead the corrosive gases out of the case. High-tension is derived from a two-volt vibrator, and also incorporated in the case is a second vibrator circuit, arranged to charge the internal accumulator from either a six-volt or a twelve-volt supply in the car. Thus it can be used in the car, taking its power from the car battery, or it can be taken out of the car, indoors or into a field or on to the beach, when it will play from the internal accumulator which will always be fully charged from the car circuit.

The Circuit

The set in its original form is push-button tuned to four pre-set frequencies in the range 2 to 6 Mc/s. A circuit diagram, simplified and omitting the power supplies, is given in Fig. 1 and will be much easier to follow than the full circuit diagram drawn in such quaint order and appearing in the instruction book issued with the set. The component identification numbers in Fig. 1 correspond to those in the instruction book.

The aerial is coupled into the grid of V1 by virtue of the impedance of C1 common to aerial and grid circuits. V1 is R.F. amplifier with tuned anode, resistance-capacity coupled to V2, which is the mixer. V3 is a separate oscillator using a Colpitt's circuit, i.e., the tuned circuit is connected across from grid to anode, C19 and C20 forming a capacity potentiometer across the tuned circuit connected to earth and thus, effectively, to the cathode. The local oscillation is fed from the anode of the oscillator to grid 1 of the heptode mixer, the signal going to grid 3. The 455 Kc/s I.F. signal is selected and fed in the usual way by an I.F. transformer to V4, a straightforward I.F. amplifier. The second I.F. transformer has an untuned primary, but the three tuned circuits give adequate adjacent channel selectivity.

The single diode in V5 gives audio signal and the D.C. fluctuating with signal strength for A.V.C.,

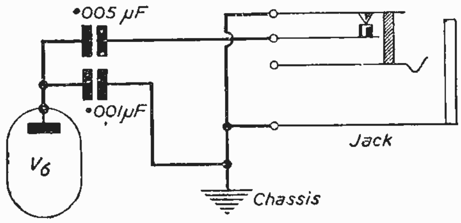


Fig. 2.—Use of a phone jack for tone control.

both being produced across the volume control (R17). The D.C. is blocked off from the audio stage by C24. The audio signal is smoothed out of the A.V.C. supply by filter R9, C13 and the resulting control voltage is supplied to the grids of V1 and V4. V2 is also controlled by A.V.C., but has a separate filter R10, C15, fed direct from the diode load of different time constant.

V5 is a diode-pentode and the audio signal from the volume control is fed to the pentode grid 1 for audio amplification. The anode signal is resistance-capacity fed to the output pentode (V6). This valve normally drives the internal speaker, but a jack socket is provided for a pair of 'phones, driven from a separate secondary winding on the output transformer. When a jack is inserted, the speaker circuit is broken.

A valve rectifier operating from a separate secondary winding gives 9 volts grid bias for the output valve. The main H.T. is from a self-rectifying vibrator, giving 95 volts.

Coil Replacement

For general use, frequencies in the medium and long wavebands will probably be required and, in the case being described, three medium band stations and one long band station were required. It is necessary, therefore, to replace the original coils with suitable broadcast frequency coils. To permit tuning adjustments iron-cored coils are preferable. It is fortunate that the coil formers of modern miniature iron-cored coils are a good fit into the holes vacated by the originals and coils of the Osmor range are very suitable. Twelve coils will be required if all four channels are to be used. Channel D was used for the long-wave Light programme, L4 and L8 being Osmor long-wave aerial coils (red) and L12 being Osmor long-wave oscillator coil (black). The other channels all being for medium-wave stations, L1, L2, L3, L5, L6, L7, were all Osmor medium-wave aerial coils (yellow), and L9, L10, L11 were Osmor medium-wave oscillator coils (brown). All coils were bottom-end coupling types.

The original tuning assembly should be removed carefully. This is done by first taking off the cover plate over the sub-chassis components. Then carefully unsolder the leads passing through the chassis plate from the tuning assembly, taking note of the point of connection of each lead. The tuning assembly is then released from the chassis by unscrewing three holding bolts. The coil connections are then unsoldered and the coils themselves removed.

It is advisable before mounting new coils to remove also the fixed condensers in the original tuning circuits. These limit the lower level to which the circuit can be made to tune and it is desirable to be able to set the circuits to tune to the bottom of the band for which they are designed. The condensers in question are C2, C5 (across L6 only and not shown in Fig. 1), C6 (across L5 only and not shown in Fig. 1), C7 and C21. It will be difficult to make connections from the R.F. coils to the switch assembly unless, before mounting the coils, stiff wires (say 18-gauge tinned copper in sleeving) about 2½in. long are soldered to switch connections 37, 39, 41, 43, leading out to the edge of the tuning assembly, the ends of the wires being bare to take the top end coil connections. A similar wire should be provided from contact 40 for the common bottom-end connections of all four channels. All these should run along the baseplate. Capacity to earth will not cause loss, because it becomes part of the tuned circuit capacity. Other connecting points are accessible with Osmor coils in position.

The coils will be found a good push fit into the holes, but they should be firmly anchored by running in a generous layer of cellulose cement, which should also embed the five wires fitted as above to prevent them from moving.

The lead-out wires of the Osmor coils are already tinned for soldering to tags, and it is better not to attempt to shorten them, as it will be found difficult to ensure satisfactory connection of every strand of the wire, and some puzzling effects can often be experienced if strands are not all connected.

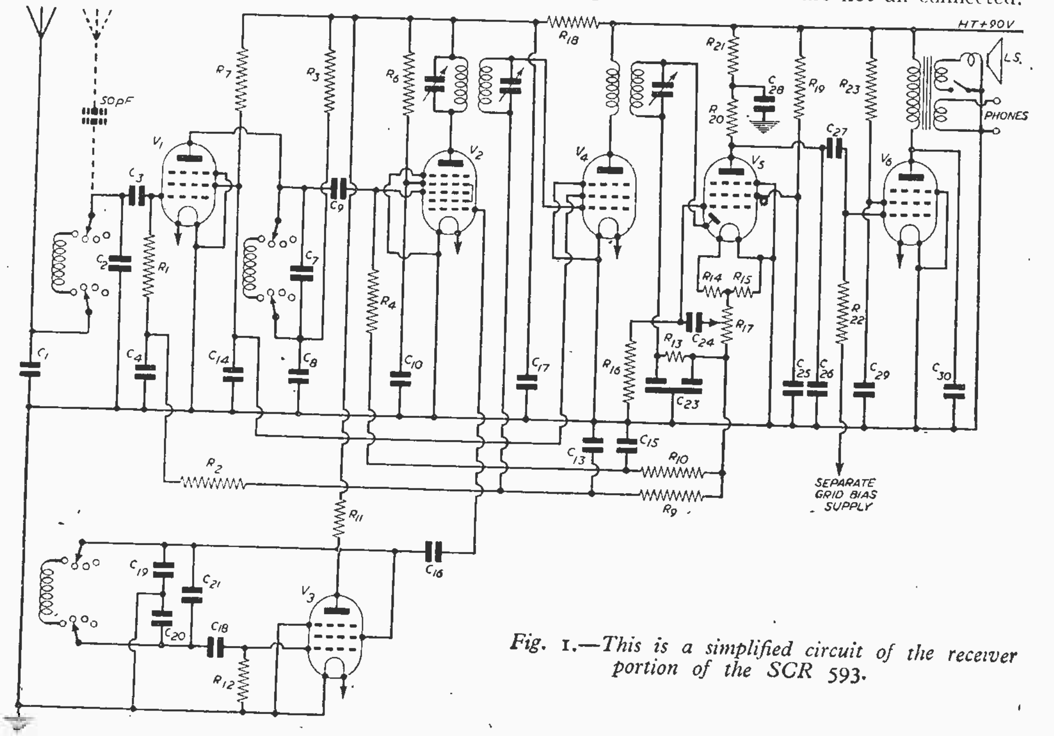


Fig. 1.—This is a simplified circuit of the receiver portion of the SCR 593.

It was originally intended to retain the bottom-end aerial coupling, but experiments indicated that, with any practicable value for C1, the set was too sensitive to interference from the vibrator. Accordingly, it was decided to use top-end coupling, and the aerial was coupled via 50 pF into the grid end of the circuit, as shown dotted in Fig. 1. The reader may like to try bottom-end coupling himself, but he will find the impedance of C1 originally used (50 pF) too high for medium and long waves, and about 2,000 pF is suggested for these waves.

Lining Up

Setting up the circuits for the stations required is quickly done with a signal generator, but equally satisfactory results are obtainable with a little patience, using the signals from the stations themselves. Connect the aerial, turn the volume-control to maximum, and press button A to select the circuit for the lowest wavelength required. Now adjust the core of L9 and see if the required station can be tuned. If the station gives only a weak signal it may be necessary to adjust L5 at the same time, the indication that both circuits are in resonance when not tuned to a station being the increase in background hiss. It will not be necessary, generally, to adjust the aerial coils until the required station has been detected, and it may be a help during the preliminary adjustments to tap in the aerial direct to the top of the appropriate coil, omitting the 50 pF condenser, which should be reintroduced as soon as the station is being received and before final adjustments are made.

If the station cannot be received it is probable that some capacity is required across L9. It is worth while to have available a miniature variable condenser that can be wired temporarily across the coil between points 24 and 32. The station is then tuned in on the variable condenser and an estimate made of the capacity required. Alternatively, a 50 pF condenser can first be tried and then a 100 pF, and so on until a tuning peak can be obtained with the cores. Then turn attention to L5, first trying the core adjustment and then, if necessary, trying capacity as before. Finally L1, the aerial coil, is given similar attention. The circuit is such that a sharp tuning point should be obtained in all circuits and, if this is not so, either the capacity is wrong or there is a fault in the circuit.

Station B is similarly tuned to the next lowest wavelength, adjusting L10 (oscillator), L6 (R.F.) and L2 (aerial) circuits in that order. One can be guided by the capacity required for A and the difference in wavelength between the two stations. Then station C and finally channel D (the long-wave station in the original case). Go over all the tuning adjustments again to ensure best results, but remember that A.V.C. will mask the effect of tuning if the signal is strong. C13 and C15 could be shorted to prevent the A.V.C. from functioning, but the easiest way is to use only a short piece of wire as an aerial (only a few inches in many localities) for final adjustments so that the background hiss is prominent whilst the station is tuned. As the station is tuned the background will decrease, and this is a better indication, with a weak signal, than the strength of the audio output.

To help in determining the capacity required, the table below gives the capacities in pF used by the author to tune to the stations shown. The capacity is far from critical, of course, because there is a considerable range tunable on the cores.

	A 285 m.	B 341 m.	C 464 m.	D 1,500m.
Aerial circuit ..	100	200	300	100
R.F. circuit ..	100	100	300	200
Oscillator ..	50	50	100	100

'Phones plugged into the jack socket may be a help if there is any difficulty in finding the stations. When set up, however, this socket is not likely to be used for 'phones, and it was found desirable to adapt it for tone-control. There is a fixed condenser for tone adjustment in the original circuit at C30 (.006 μF). This was reduced to .001 μF. The two connections to the jack socket were removed, the earth connections via the chassis remaining. A .005 μF condenser was wired between the anode of V6 and the jack socket as shown in Fig. 2. The tag that is normally shorted to earth is used. The earthed contacts complete the circuit, putting the condenser across the output circuit. When a jack plug is inserted, however, the contacts are opened and the .005 μF condenser is disconnected. This gives a greater preponderance of the higher audio frequencies, giving greater clarity when used in the car.

News from the Clubs

BRIGHTON AND DISTRICT RADIO CLUB

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

INFORMAL club meetings on Tuesdays will be held during August. Any visitors on holiday will be most welcome. The club station, G3EVE, is now installed in the cupboard which facilitates getting on the air. The club will be active on 80-metre C.W. to start with, and be very pleased to QSO any station. Several well-known manufacturers have promised talks during the late summer programme. Details next month.

HAMPSTEAD RADIO TRANSMITTERS GROUP

Hon. Sec.: Basil Wardman (G5GQ), 59, Eton Place, Eton College Road, N.W.3.

G3DCU (Walter Schreur), taking up new post in VK, maintained contact with group members from ham stations at all ports of call en-route. Another B.B.C. broadcast recently took place, when Nina Barrett (G3GYL) talked on "Friendship by Radio" in Woman's Hour. This is the second broadcast by Hampstead members in last twelve months.

Meetings (rag-chewing only) on Fridays, September 14th, October 19th, November 16th, December 21st, at 8 p.m., 1, Broadhurst Gardens, N.W.6 (behind John Barnes, Finchley Road).

STOURBRIDGE AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: W. A. Higgins (G8GF), 28, Kingsley Road, Kingswinford, Staffs.

INFORMAL meeting held on Friday, June 22nd. Future field days discussed. General meeting held at H.Q. on Tuesday, July 3rd. Excellent film of Society's effort in N.F.D., filmed and presented by Dai Barlow (G3HG1). Followed by a talk, "A Simple Transmitter," by Tom Cashmore (G3BMY)—a really clear description.

READING RADIO SOCIETY

Hon. Sec.: L. A. Hensford (G2BHS), 30, Boston Avenue, Reading, Berks.

THE activities of the Society for the past months are as follows: Opened the Reading "Hobbies' Exhibition" at the Town Hall. A stand was occupied by the Society and the SWL club. Mr. Ruddle's "Hellscriber" was operated during the four days of the exhibition, as was a compact 160 metres TX under the call-sign G2BHS/P.

A varied selection of equipment used by the amateur was displayed and created very great interest among the public. G2AHY gave a further lecture in his series "Electronic Theory," this one covering the "triode valve"; many interesting discussions came forth from these lectures.

On your Wavelength

by THERMION

The National Radio Show

BY the time you read these notes the Radio Show at Earls Court will be well in the offing. How glad I am that the Exhibition has come back to London, and indeed that it has moved from Olympia. It is now a National Radio Exhibition, a title which is more in keeping with what it is than the old title "Radiolympia," which, whilst being euphonious, gave rather undue prominence to where it was instead of to what it is. Earls Court is spacious, and although there are fewer firms in the radio industry to-day, which would make Olympia at present suitable for a Show, I think the new venue will enable exhibitors to display their goods in a manner where crowds can examine them in comfort and go from stand to stand along spacious gangways, without that cheek-by-jowl jostling which characterised Olympia.

I am always assailed at this time of the year with an attack of nostalgia aroused by memories of previous shows held in happier times, when there were more component makers, prices were much lower, and we had not yet thought of purchase tax.

The ever increasing army of set builders who prefer to build rather than to buy is an indication that the cost of living index figure is causing many of the earlier constructors to return to the fold. This is a fact which component manufacturers might bear in mind.

The very first radio show was a much smaller affair, but year by year it has grown to its present enormous dimensions. The industry has been built entirely by amateurs who not only supported it by their avid purchases of components, but by their experimental work providing the designs and the personnel which built up the industry. All of the designers and most of the shop personnel first entered the radio industry through the constructor market.

I shall this year again make my pilgrimage to this mecca, and make my annual renewal of acquaintance with readers and my friends in the trade.

Readers' Complaints

WHEN, as occasionally happens, an advertiser is unable to deliver goods as a result of an unforeseen demand, some readers will write to me inviting me to wave my magic wand over the advertiser concerned so that he can produce the goods out of a conjurer's hat. I am always delighted to assist readers when they feel they have cause for complaint. Our advertisers are utterly reliable. They have to be before their advertisements can appear in this journal. But the radio trade, like all others, is suffering from shortage of material, shortage of labour, rearmament programme, as well as the short temper of the public. I have every sympathy with them, and can only ask readers on those rare occasions when the goods are not dispatched with the promptitude they would like to sympathise with the advertiser, too. Theirs is a difficult task. They are not deliberately withholding goods; they are as anxious to despatch goods as you are to receive them.

On Sapphire Needles

MR. J. HUNTER, a member of the British Sound Recording Association, thinks my recent comments regarding sound recording are inaccurate. He says that high-quality reproduction of sound recording entails the minimum of non-linear and frequency distortion and sounds more like the original sound. That is a nice definition, but how can one listen to the original sound and the reproduction at the same time? Of course, one could take an oscillograph of the original transmission and of the recording and compare them. What I was referring to was the fact that the ordinary listener merely *thinks* the reproduction is better when he has no means of knowing whether it is or not.

He says that the use of sapphire needles, or diamond needles, must be intelligently applied. I made no imputation to the contrary. I am sure that all my readers are intelligent. They would not use them with a heavy pick-up which was one point I made, namely, that one has to scrap the pick-up and buy a new one. For the mild claimed improvement, if any, I doubt whether it is worth the expense. He goes on to say that correctly used in pick-ups of correct design and of a weight on the point of from 6 grms. for $33\frac{1}{3}$ r.p.m. to 15 grms. for 78 r.p.m., jewel tipped needles not only result in reduced wear owing to their accurate profile, but have a very long life and eliminate frequent needle changing. My answer to that is that it is just as easy to make a steel needle with an accurate profile as it is a jewel.

He thinks that for L.P. records jewel tips are indispensable, for accuracy in tip radius is of the greatest importance. He then goes on to draw a red herring across the scent. He asks me why watch makers have for years used jewels as bearings. That argument is quite fallacious. In an unjewelled watch the pivots, which are subjected to considerable pressure from the mainspring, soon wear the holes oval, and it was in order to maintain the correct centre distances of the pivot holes so that the gears retained their correct mesh that jewels were introduced. Even so, Mr. Hunter should not presume that even in the best watches jewels *are* used. They go by that name, but they are all synthetic and mostly glass with polished holes. Some of the early English watch-makers used rubies and white sapphires for the jewel holes and diamonds for the endstones. None is used to-day. However, I am very much obliged to Mr. Hunter for his views which I gladly pass on.

As regards the lapping effect, at least one reader doesn't know that a soft material will lap a harder one, *even though it is not charged with abrasive.*

Overhauling Your Aerial

IMPROVED PERFORMANCE IS POSSIBLE BY A SEASONAL CLEAN-UP

By W. J. DELANEY (G2FMY)

A GRADUAL falling-off in the performance of a receiver is not noticeable and many readers are not getting the best from their equipment. It is found when complaints are received concerning lack of power or range that the receiver has been overhauled or new valves fitted, but hardly ever is it stated that the aerial has been attended to. This is usually erected and left to look after itself until it falls down due either to a supporting rope rotting away or to the wire itself corroding through. Many listeners, too, are still using the old-fashioned inverted "L" type of aerial running from one end of a long garden to the other, not realising that such an aerial may not be the best for present-day requirements.

Aerial Types

First of all, let us see what type of aerial we really need for our individual requirements. The inverted "L," where the wire is supported at the bottom of the garden, runs to the house, and then drops down to the receiving point, is directional towards the house and picks up strongest signals from that direction. It is not, therefore, suitable for all-round general-purpose reception. Fancy aerials of different patterns have been suggested from time to time, but again all have marked directional properties which are not always desirable. In the old days it was thought desirable to keep as near to the regulation maximum of 100ft. as possible, but with the improved efficiency of valves and circuits and of the radiating powers of transmitting stations (especially so far as concerns the "beaming" of signals) a long aerial can be a drawback as it will provide very poor selectivity.

In this connection it should be mentioned at this point that the majority of high-powered stations to-day use as their normal aerial a radiating vertical mast, and this applies to all the B.B.C. transmitters. To receive such a transmission at its best the receiving aerial should also be of the vertical type ; a horizontal aerial will actually give a poorer response although it may be much longer.

Main Requirements

The main requirement of a good receiving aerial is height, and unless a special transmitter is required as a main source of reception an "all-round" type of aerial will prove most efficient. This means a vertical wire and the top of it should be at the highest possible point. It is obvious that this may be on a chimney stack, or even at the point of the roof inside the loft or attic. It should be brought down in the most direct manner possible, without sharp bends or turns, direct to the aerial socket of the receiver. The top should be supported by a good insulator, and at the bottom end it is desirable to provide some form of anchor point, again using a good insulator. Where possible, the earth-lead should pass out of the house immediately beneath the down-coming aerial and enter the ground below it, using a proper copper earth-spike or something equivalent. The height may be obtained by using a short mast clamped to the chimney stack, but a protecting piece should be fitted to the top so that the aerial is held at least 18in. away from the walls or metal guttering, etc. If you are using an indoor aerial try to bring it down to the receiver without running parallel with metal pipes or electrical wiring. If you are in a flat and forced to use an aerial in the same room as the receiver, don't take it round three sides of the room to get in a lot of wire. The angles introduce losses which offset any advantage gained by the increased amount of wire. Try a vertical wire running straight up from the receiver to a nail or pin fixed in the corner of the ceiling immediately above it, and if there is no water-pipe connection in the room simply connect a wire to the earth terminal, dropping down to the floor and connecting to a large piece of metal or loosely run hank of wire under the carpet beneath the set.

Selectivity

The arrangements described will make for better all-round selectivity, although it may be thought that signals are weaker. You will find, however, that such weakness will only be in the direction of a directional effect previously provided with a directional type of aerial, and improved performances should be obtained in the remaining directions. If the receiver is of the "all-wave" type, of course, a short vertical aerial is most definitely to be preferred to the 100ft. of wire running down a long garden.

Overhauls

If you are satisfied with your present aerial it should at least be given an overhaul once a year. Lower it and see if the supporting rope is in need of replacement. Any insulators should be thoroughly cleaned—especially in towns where they become quickly covered with a carbon (sooty) deposit which provides a very good leakage path at some frequency or other. Hot soda water and a scrubbing-brush will be needed to remove the deposit, but if it has been left too long it may not be possible to remove it without a corrosive solution. It is better in such a case to scrap it and obtain a new one of Pyrex or similar material. There are a number of ex-Government insulators now available quite reasonably. If the wire had been joined it should certainly be inspected at the joint and, unless it was soldered, it should be cut and joined again, making a soldered connection if possible, but, if not, at least using the standard "telephone" method of junction and binding this with insulation tape. A coating of bitumastic paint is worth while over such a joint as it may corrode and set up a very high-resistance leak instead of a direct connection at this point and provide a very inefficient aerial. Buried earths should be examined and replaced where it

(*Continued on page* 407)

Reactance Valves

AND DISCRIMINATOR CIRCUITS FOR F.M. RECEIVERS

By D. McDONNELL

IN view of the recent announcement by the B.B.C. to transmit frequency-modulated signals on 90 Mc/s., a few comments on the theory of reactance valves and discriminator circuits may prove useful to the radio enthusiast who intends to explore this new field.

A few general features of F.M. systems will first be considered. In an F.M. system the intelligence, i.e., the music or speech, is conveyed on the carrier wave by changing the carrier frequency backwards and forwards about some arbitrary point, the amplitude of the carrier being kept constant. A simple analogy between F.M. and A.M. is signalling, using an electric lamp. Amplitude modulation compares with the lamp system when the lamp is being switched on and off to convey the dots and dashes. Frequency modulation compares with the lamp system when the colour of the light is changed instead of being switched off. In one case the frequency of the carrier is kept constant and the amplitude is changed, in the other case the amplitude is kept constant and the frequency changed.

When music or speech is being transmitted by means of a frequency-modulated carrier, the intensity of the music or speech governs the amount by which the carrier is shifted from its normal position and the frequency of the music or speech governs the rate at which the carrier is shifted backwards and forwards about the centre frequency. The outer limits to which the carrier is allowed to shift are fixed by the designer. It may be decided that the loudest passages will cause the carrier to deviate by, say, 50 kc/s., this is called 100 per cent. modulation; parts of the music which are not so loud will cause the carrier to deviate by less than 50 kc/s.

The functions of the circuits to be described include (a) automatic frequency control of local and master oscillators and frequency modulation of oscillators, (b) detection of frequency-modulated signals.

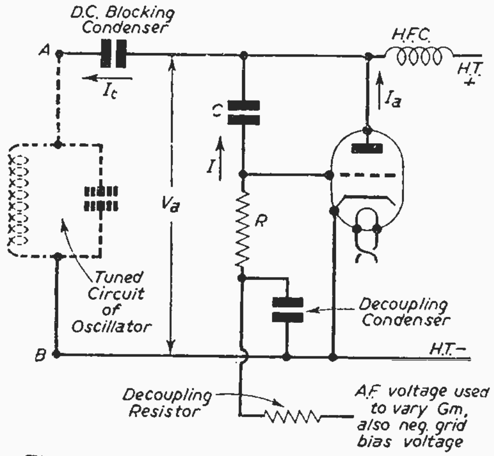


Fig. 1 (a).—Simplified reactance valve circuit.

In an F.M. transmitter, instead of the usual modulator circuits there are circuits which are used to change the master oscillator frequency in sympathy with applied audio signal. A simple method of achieving this change would be by connecting a condenser microphone across the M.O. tuned circuit, but a more usual method is to use a reactance valve in place of the condenser microphone.

In the F.M. receiver the normal detector is replaced by a frequency discriminator circuit. The function of this circuit is to produce an output proportional to the instantaneous frequency being received, the output being the audio signal.

The Reactance Valve

The "reactance valve" is a circuit arranged in such a way that the effective reactance (inductive or capacitative) of the circuit may be changed in sympathy with an audio or slowly varying voltage. A simplified form of the reactance valve is shown in Fig. 1. The valve is shown as a triode for simplicity, but pentodes and pentagrids are often used, since the operation of the circuit depends upon the variable mutual conductance of the valve. In the circuit the condenser C and resistance R, forming the phase-shifting network, have values such that the current I is nearly 90 degrees out of phase with Va. (The reactance of the condenser is made large compared with the resistance.) The current Ia will also be 90 degrees out of phase with Va. The magnitude of Ia is given by the product of the grid voltage and the gm, i.e., Ia is equal to I × R × gm; this current and the current I being in phase may be added to give the total current

$$I_t,\ I_t\ I - I_a,\ I_t\ I - I \times R \times gm,\ I_t\ I(1 - R \times gm).$$

The current I is very nearly equal to the voltage Va divided by the reactance of the condenser (since R is small compared with the reactance of the condenser C). This gives :—

$$I_t = \frac{Va\ (1 + Rgm)}{Xc}$$

The effective reactance of the circuit to the right of A and B is equal to Va divided by I_t or :—

$$\text{Effective reactance} = \frac{Xc}{(1 + Rgm)}$$

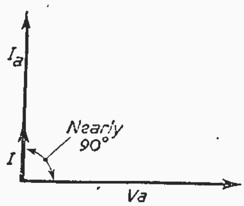


Fig. 1 (b).—Vector diagram for reactance valve.

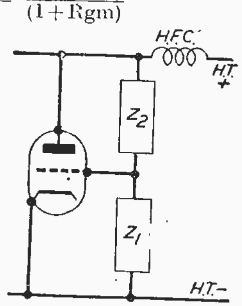


Fig. 2.—Study this diagram in conjunction with the table on the next page.

If the resistance and gm are such that $R \times gm$ is large compared with unity, the effective reactance is given simply by :—

$$\text{Effective reactance} = \frac{Xc}{Rgm}$$

or remembering that the reactance of a condenser is given by :—

$$Xc = \frac{1}{2\pi fC}$$

The effective capacity of the reactance valve is given by :—

Effective capacity = CRgm.

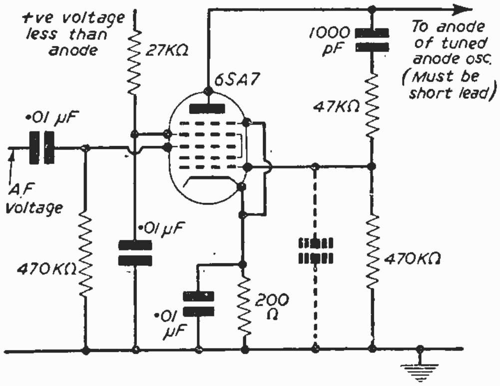


Fig. 3.—Practical circuit of a reactance valve.

This means that if the gm of the valve is changed the effective capacity between the points A and B is changed. The gm of the valve is changed by applying the modulating voltage to the control grid of the variable μ valve used.

If the positions of the resistor R and the condenser C are interchanged, the total current will lag on the voltage Va and the circuit will behave as an inductance.

Instead of using a condenser and resistance in this phase-shifting network an inductance and resistance may be used. The table, together with Fig. 2, gives the necessary conditions and effective inductance or capacity in each of the four possible cases.

A practical circuit of a reactance valve is shown in Fig. 3, a pentagrid valve being used, the effective gm of which is changed by applying the audio voltage to the injector grid. The circuit used is that of case 2 in the table. The 47 kΩ resistor between the anode and grid being one element in the phase-shifting network and the input capacity of the valve being the other. This circuit will work satisfactorily up to 10 Mc/s, giving frequency

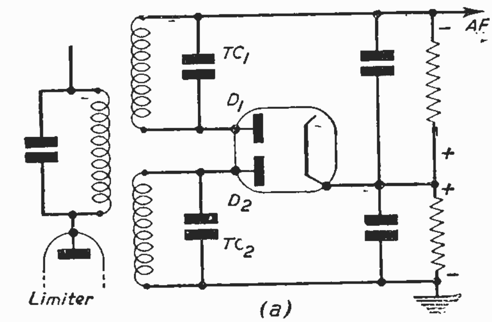


Fig. 4 (a)—The Travis discriminator circuit.

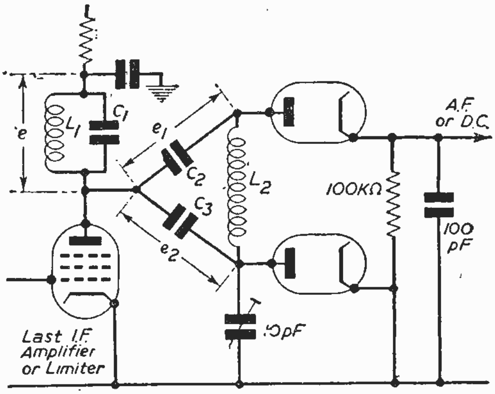
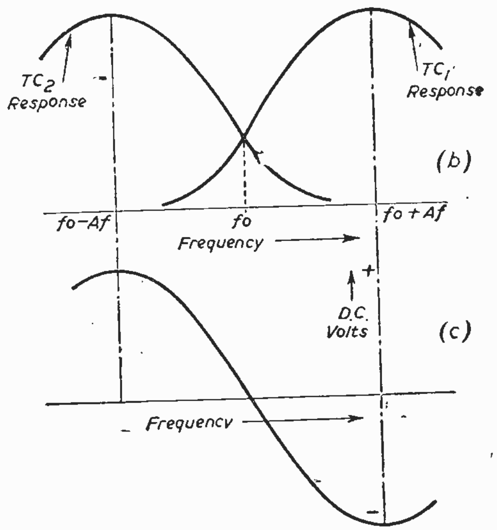


Fig. 6.—Practical form of discriminator circuit (L1 and L2 are not coupled.)

	Z_1	Z_2	Circuit conditions	Effective C or L
1.	R	C	$R \ll \frac{1}{\omega C}$, $Rgm \gg 1$	$C_e = CRgm$
2.	C	R	$R \gg \frac{1}{\omega C}$, $\frac{gm}{\omega C} \gg 1$	$L_e = \frac{RC}{gm}$
3.	R	L	$R \ll \omega L$, $Rgm \gg 1$	$L_e = \frac{L}{Rgm}$
4.	L	R	$R \gg \omega L$, $\omega Lgm \gg 1$	$C_e = \frac{Lgm}{R}$



Figs. 4 (b) and (c).—Response curves of the circuit shown in Fig. 4 (a).

deviations up to 150 kc/s with suitable audio voltages.

The Discriminator Circuit

The purpose of the discriminator is to convert the deviations in frequency into audio or D.C. voltages. The Travis, an early form of discriminator, is shown in Fig. 4a. The tuned circuits TC1 and TC2 are tuned one above and one below the mid-frequency. Fig. 4b shows the response curves of the two circuits. Fig. 4c shows the output against

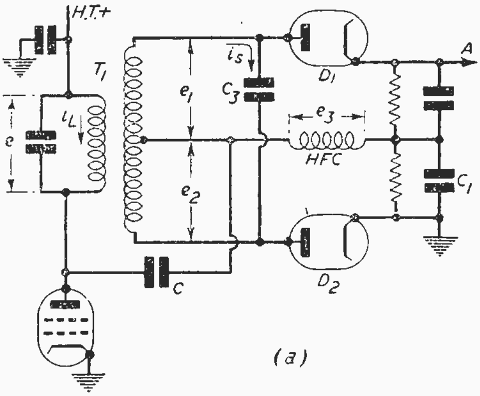


Fig. 5 (a).—The Foster-Seeley discriminator circuit.

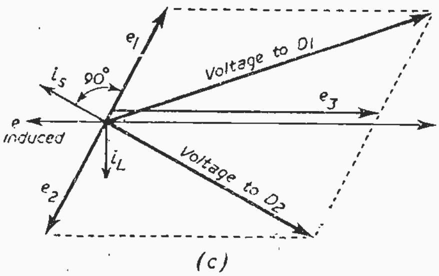


Fig. 5 (c).—Off resonant vector diagram.

frequency curve. The operation is simple. The voltage due to diode 1 will be a maximum when the frequency increases, and the voltage due to diode 2 will be a maximum when the frequency decreases; the non-linearity of the slope of one response curve is offset by the non-linearity of the other.

The Foster-Seeley Discriminator

Another form of discriminator circuit often used is the Foster-Seeley, shown in Fig. 5a. This discriminator relies for its operation upon the change in phase between the primary and secondary voltages in the I.F. transformer T1. The primary voltage, e, is in phase with the voltage e_3, since the reactances of C and C_1 are very low to the I.F. The voltages e_1 and e_2 are always 180 degrees out of phase with each other with respect to the centre tap. The phase relationship between e_1 and e_3 or e_2 and e_3 can be obtained from the following considerations. The current i_L in the primary inductance must be lagging by 90 degrees on the voltage e. The induced E.M.F. in the secondary must be 90 degrees out of phase with the primary current.

The induced E.M.F. in the secondary can be represented as a generator in series with the coil. This induced E.M.F. drives a current around the secondary circuit, which will appear inductive, resistive or capacitative depending upon whether

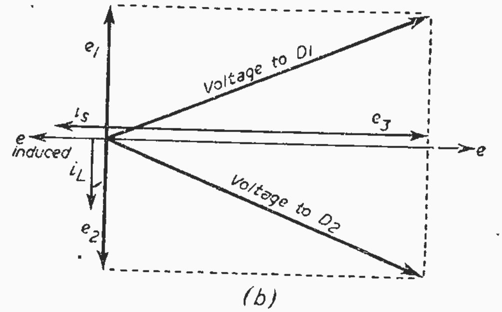


Fig. 5 (b).—Resonant vector diagram.

the signal being received is higher, equal to, or lower respectively than the resonant frequency of the tuned circuit. The current i_s will either lag, be in phase with, or lead the induced voltage. The voltage across the condenser C_3 will be 90 degrees out of phase with the current, this voltage is the sum of e_1 and e_2.

The voltage applied to the diode 1 is e_1 added to e_3 vectorially; the voltage applied to the diode 2 is e_2 added to e_3 vectorially. At resonance the outputs across the diode load resistances will be equal and will cancel out: off resonance they will be unequal and the point A will be either positive or negative with respect to earth depending upon which way the frequency has changed. The vector diagrams showing the phases of the voltages and currents are given in Figs. 5b and 5c.

A practical circuit of a discriminator is shown in Fig. 6. This is similar to the Foster-Seeley circuit except that capacity coupling is used instead of the inductive coupling. The coupling between the two circuits is via the 10 pF condenser. The two condensers C_2 and C_3 are of equal capacity and are arranged to tune the secondary circuit to resonance. The primary circuit is tuned by C_1. The advantage of this circuit over the Foster-Seeley is that the coupling between the two circuits can be adjusted to give the desired characteristic.

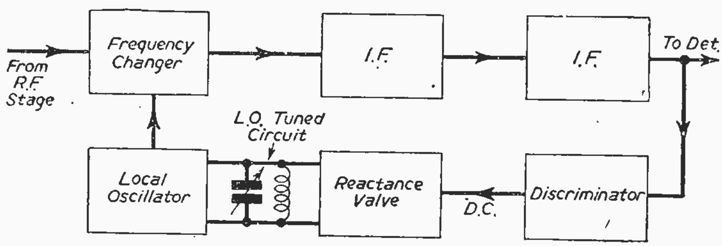


Fig. 7.—A typical A.F.C. system.

The See-saw Amplifier

DETAILS OF OPERATION OF AN EXPERIMENTAL AMPLIFIER

By I. ROGERS

THE wireless experimenter is often faced with the problem of measuring the amplitude of waveforms on an oscilloscope to a fair degree of accuracy, for example, television sync pulses and video waveforms. The principles underlying the operation of a see-saw amplifier suitable for this purpose are now discussed.

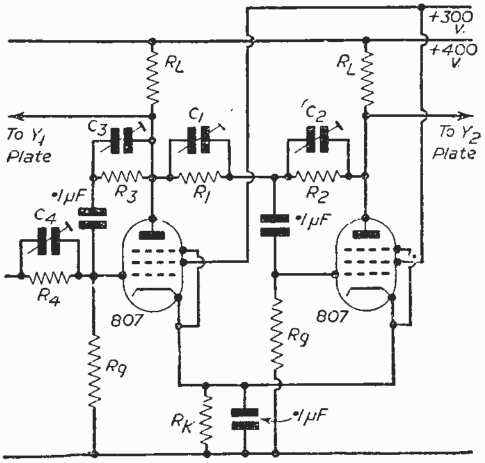


Fig. 1.—Circuit of a see-saw amplifier.

Practical Values

$R_L = 3$ KΩ.
$R_1 = R_2 = 25$ KΩ.
$Rg = 25$ KΩ.
$R_3 = 125$ KΩ.
$R_4 = 25$ KΩ.
$R_K = 470$ Ω.
$C_1 = C_2 = C_4 = C_3 = 15$ pF max.

The two methods commonly employed are, firstly, by using a D.C.-coupled amplifier to compare the voltage under test with a known voltage, using slide-back technique, or a D.C. shift voltage: and secondly, by using a gain-stabilised amplifier and direct calibration of the oscilloscope tube. In order to achieve this stability in gain required for the amplifier, a large degree of negative feedback is used to compensate for variations in the mutual conductance of the valves used.

A circuit of the type to be described is shown in Fig. 1. The principles underlying its operation can best be described by considering a part of the circuit, as shown in Fig. 2. The circuit has been simplified to show the A.C. conditions. The anode load is shown connected directly to earth since the smoothing condensers in the power supply effectively short circuit the A.C. components, and the grid coupling condenser has been omitted because its reactance to A.C. is small when chosen correctly.

Assume for the moment that R_2 has been omitted and that the value of R_L has been chosen such that e_o is very large compared with e_g, i.e., the gain of the amplifier is very high. If R_2 is chosen large compared with R_L, making i_2 small compared with i_3, the conditions in the circuit will be substantially unchanged, i.e., the gain of the amplifier between grid and anode remains high. A small fraction, e_g, of the input e_1 to the amplifier is developed across R_g, an amplified version e_o appearing across the load resistor R_L. Since the gain is high, e_g will be very small compared with e_o, which implies a very small current through R_g. For all practical purposes, i_1 may, therefore, be taken as equal to i_2, this condition being more exactly fulfilled the higher the gain between grid and anode.

Thus, by considering the grid to be effectively at earth potential, the voltage e_1 across R_1 is equal to $i_1 \times R_1$. Similarly, the voltage e_o across R_2 is equal to $i_2 \times R_2$.

$$\text{i.e., } e_1 = i_1 \times R_1 \text{ or } i_1 = \frac{e_1}{R_1}$$

$$e_o = i_2 \times R_2 \text{ or } i_2 = \frac{e_o}{R_2}$$

$$\text{But } i_1 = i_2, \text{ therefore } \frac{e_1}{R_1} = \frac{e_o}{R_2} \text{ or } \frac{e_o}{e_1} = \frac{R_2}{R_1}$$

The gain of the amplifier, therefore, depends on the ratio $\frac{R_2}{R_1}$ and is independent of the mutual conductance, providing the gain from grid to anode is high (i.e., the mutual conductance multiplied

(Continued on page 422)

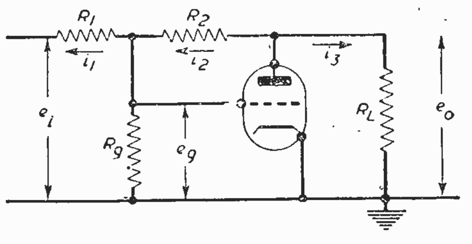


Fig. 2.—Part of see-saw amplifier showing A.C. conditions.

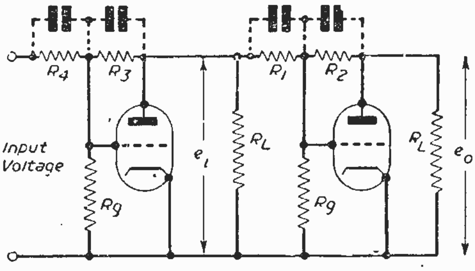


Fig. 3.—The equivalent circuit of Fig. 1 for A.C. conditions.

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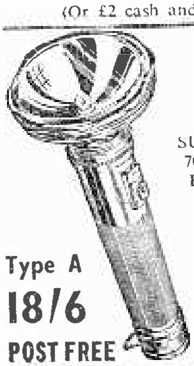

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Two-valve Regenerative Receiver

A NOVEL DESIGN UTILISING STEPPED CHASSIS CONSTRUCTION By A. W. MANN

ONE has to take into consideration, when presenting short-wave receivers of experimental design, that while constructors will adhere to the values specified, the physical dimensions of certain components may differ somewhat from those used in the original model.

Obviously, in cases where the receiver design to be followed is decided on before the components are purchased, the smaller and more compact modern types will be chosen. This applies especially to L.F. chokes and transformers. Early models of these components are, in several instances, on the large side. Being perfectly sound, however, the constructor naturally wishes to use them.

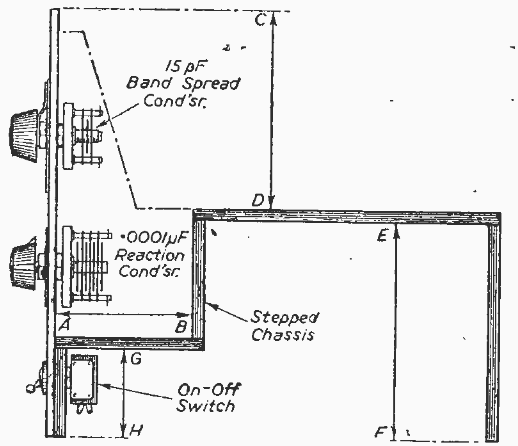


Fig. 1.—Details of the chassis used in this receiver.

When the receiver contemplated is of the three- or four-valve T.R.F. type, it is not difficult to arrange matters so that such components can be used. When it comes to the building of the humble two-valver we must, in the interests of efficiency, aim at compactness, but at the same time avoid cramping.

A Rebuild

Some time ago the writer decided to rebuild a well-tried two-valver. Using the same circuit, the requirements were to retain the same layout of panel and chassis components, also to use the original screening box and mount the L.F. transformer and output choke under the chassis.

The output choke which was of an older type, and of comparatively large size, could have been discarded. As the receiver, however, was used in conjunction with a H.T. battery eliminator, it was most desirable to include this choke.

Stepped Chassis

In order to solve the combined problems by, so far as the writer is concerned, departing from the general practice associated with metal chassis construction, it was decided that the new chassis should be of stepped formation. By the adoption of this method, the original panel and chassis layout has been retained apart from the fact that whereas in the first instance the L.F. choke was mounted on top of the chassis, it is now on the underside, the overall efficiency of the receiver being somewhat improved.

In contemplating the writing of this article, it was at first decided to present the circuit used in its original form. On second thoughts, however, I have modified it. In this instance the six-pin coils are replaced by four-pin types, and the output choke is excluded. It may be added later if the constructor desires. In its present form the reader who has to depend on H.T. batteries and has not an L.F. output choke to hand is catered for, and he will find that the whole can be built at comparatively low cost.

Advantages

The inclusion of an L.F. output choke offers certain advantages, among which may be mentioned that of overcoming head-capacity effects. In addition, it also improves the stability of the receiver in the general sense.

It does not follow, however, that by later adding output choking arrangements to an unstable receiver, stability will automatically result. It may in some cases, perhaps, but not all. Neither should it be imagined that a receiver, which is built without an output choke, is bound to be unstable. Much depends on layout, wiring and suitable voltages, to mention but a few of the causes of instability.

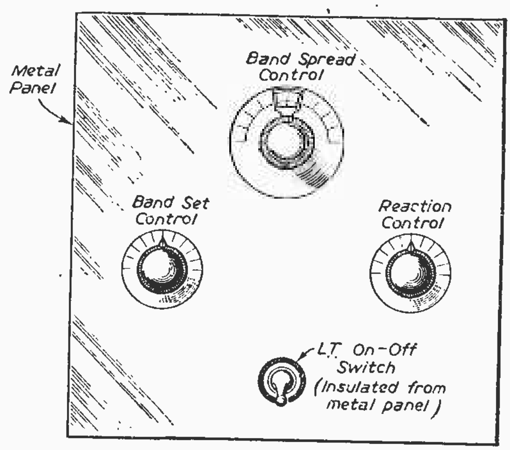


Fig. 2.—Panel layout and control identification.

The Circuit

The circuit shown was used by the writer some years ago when carrying out a few layout experiments. It will be found to be very adaptable in this respect, and can be built to provide stable operation down to 10 metres.

The Chassis

The chassis consists of two wooden end runners cut to shape, a wooden top of plywood, a step-piece and front-piece respectively. The back-piece, front-piece and step are, like the top, of plywood. Yellow pine or whitewood can be used for the end runners. The top and step are covered with aluminium sheet of stout gauge.

If glue and screws are used in the construction of this form of chassis, a rigid unit should result.

Baseboard type valveholders if to hand may be used. The same applies to the coil-holder. If chassis types are to be used, suitable holes must be cut through the metal face and the plywood top of the chassis.

Considerations

In deciding the chassis dimensions, various factors must be taken into consideration. While the distance between G and H (Fig. 1) could be $1\frac{1}{4}$in., the distance between the chassis base at F to the underside of the top face at E will depend on the height, base to top, of the L.F. transformer, plus $\frac{1}{4}$in. clearance. This is assuming that an L.F. output choke is not to hand for future inclusion.

Should one be to hand, it should be checked for size and the chassis depth E to F made to suit. Space should also be allowed for its later inclusion. In the case of this component being purchased, the smaller modern type should be chosen.

Assuming that the distance between G and H is $1\frac{1}{4}$in. or so, a 9in. square or a 10in. by 9in. aluminium panel could be used. Actually, the latter with a chassis $\frac{1}{2}$in. less would be very suitable.

It is left to the constructor to decide on these things. It must not be forgotten that the height of the valves and coils plugged into their associate holders and mounted on top of the chassis must be taken into account. It will be realised that careful calculation is necessary before making a start. Follow this by making a full-size drawing of the chassis and panel, as shown at Fig. 1 and Fig. 2. This may appear to be rather troublesome, but the unseen work usually results in a better job.

The component values specified in Fig. 3 will prove satisfactory. Raymart type tuning condensers are recommended, especially where 10-metre reception is desired.

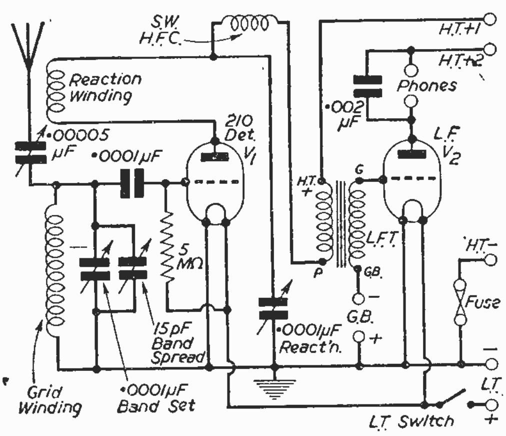


Fig. 3.—Circuit of the receiver.

Layout

Fig. 4 shows the chassis layout. With a chassis 10in. long there will be sufficient room to mount another valve holder, and on rebuilding at some future date, add an R.C.C. stage. I am, however, more in favour of replacing the output triode by a pentode.

Bandspread

Bandspread facilities are included, because the writer appreciates the advantages to be derived.

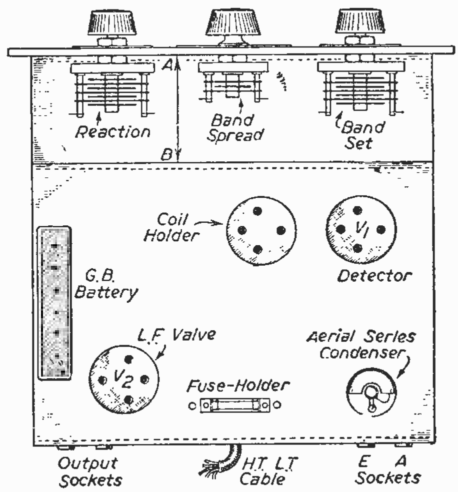


Fig. 4.—Plan view of the chassis.

The relative positions of the coil-holder sockets will depend on the types of coils to be used, and will perhaps differ from those as shown at Fig. 4. The constructor is advised to trace these out before drilling the coil-holder fixing bolt holes. Likewise the distance A to B, Fig. 4, will depend on the dimensions of the band setting and reaction condensers.

The Underside

In laying out the underside chassis components, leave room for additional components, such as decoupling condensers, which, like the output choke, you may wish to include later on. Fixed condensers can be screwed to the ends and sides of the chassis at convenient points.

This, after all, is an experimental receiver in its most simple form, which can, if desired, be further improved. If the complete receiver is not to be fitted in a cabinet or screening box, behind panel brackets, as shown at Fig. 1, are recommended.

Should head capacity be experienced, and the 'phone leads appear live when the receiver is tried out, the inclusion of a standard S.W. H.F. choke in each headphone lead should prove effective.

Incidentally, when moving coil headphone and a suitable matching transformer are used with most receivers, such capacity effects are not experienced.

Regeneration

It should be appreciated that when a normally stable receiver is used under extremely bad reception conditions, and with the regeneration pushed to the extreme limit in order to hold erratic and very weak signals, spill-over is to be expected, and instability will result.

Aerial Coupling

Aerial coupling should not be too tight, and a compromise setting of the series aerial condenser should be found which provides reasonable selectivity and volume.

Detector By-passing

Perhaps you have at some time tried a by-pass condenser between the anode of the detector and the earthed side of the filament, and found that regeneration ceased. The most suitable type of condenser for use with a regenerative short-wave detector, is a 100pF pre-set of the trimmer type. If this type is used adjust it so that a satisfactory regeneration is obtained on the lowest wavelength covered, and it will be found satisfactory throughout the full tuning range.

Aerials

While the choice as to the type of aerial used is left to the operator, it should be noted that under present-day conditions, regenerative detector type receivers should not be used with long aerials, unless, of course, they are tuned. A half-wave 14 Mc/s type will, if free from excessive damping, be found to be very satisfactory.

The purpose of this article has been to describe a simple short-wave headphone receiver devoid of frills. It is thus a good foundation upon which to improve. Suggested lines on which to work are, try different layout schemes according to your own ideas. Add decoupling, try parallel-feed L.F. coupling, add L.F. output choke, wind your own coils on discarded valve bases.

Do not, however, use old valves. A new detector of the 210 type will be worth the outlay. The same applies to the L.F. valve. As described, this circuit is capable of providing satisfactory results if carefully built and wired.

Overhauling Your Aerial

(*Continued from page* 398)

is found that they have rotted away. A good copper earth spike is a worthwhile investment, although they are at the moment in short supply. A suitable alternative is a length of metal of any kind, the larger the surface area the better. The earth lead should be soldered to it if possible, or screwed or otherwise *firmly* attached. Again the junction point should be protected by binding and/or painting, and to keep a point of low resistance in the earth it is worth while digging out a hole and filling this with old coke and cinders, etc., before putting in the earth rod. Ramming the earth round this will ensure a low-resistance earth which will always remain moist—remember that dry earth has a high resistance. Attention to the above points will in many cases give new life to a receiver and perhaps bring in signals previously unheard—especially in the case of a change from horizontal to vertical systems.

Tilted Wires

Although it has been stated that the vertical wire is best, it must be remembered that contours of surrounding country can play some peculiar tricks with radio waves. It has been found, for instance, that a television aerial on a house situated a quarter mile from a rather high hill gave a poor signal until the aerial was tipped back so that it met the television signal as it followed the downward contour of the hill. As is reported on page 389 also, the R.C.A. have carried out tests in this connection, and it may therefore prove worth while to try in each area the effect of allowing the vertical type of aerial to run a few degrees out of the vertical in different directions.

Midget Components

MODERN equipment calls for extremely small components, and "miniaturisation," which has now become a very definite trend in all branches of component manufacture, will be much in evidence at the Radio Show. It is a trend which is likely to continue, for, in the first place, as radio apparatus becomes increasingly complex and more components are needed, the size of components has to be reduced in order to keep the overall dimensions within reasonable limits. Secondly, there is a growing demand for smaller equipment such as hearing aids and miniature receivers. Thirdly, reduction in size means at least a saving in raw materials; and finally, what is probably more important, small components are essential for efficient working at the high frequencies which are in common use to-day.

Temperature

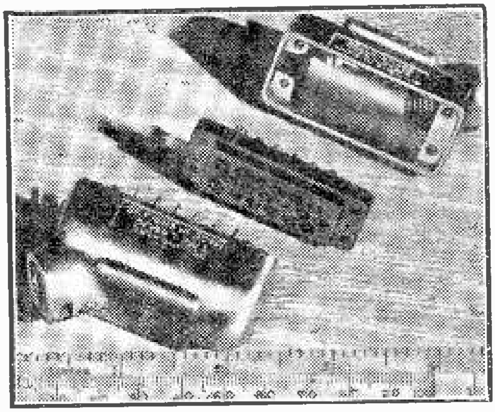
Miniature components still use as much electrical power as when they were bigger, so that if a lot of them are crammed into a confined space, they tend to get very hot. Ventilation is therefore a major problem—but not so bad as it might be, for a new technique is being developed for deliberately running the components at high temperatures. This is, in effect, tropicalisation; but sometimes the heat is even greater than that encountered in the tropics.

Aircraft

Miniature transformers for aircraft radio, for instance, are designed to work at temperatures well above boiling point, and the wire in them is insulated either by glass, which will not melt, or by its own layer of oxide, which is, of course, made more effective by heat.

A PRE-VIEW AND ADVANCE INFORM

OWING to the fact that we go to Press some time before publication it is not possible to give a very up-to-the-minute report as to the exhibits at this exhibition, and it has always been the practice of manufacturers to hold until the last minute details of their latest release. In past years there has been keen competition to find out what might be new and there was a very bright sense of rivalry between firms to introduce something which would catch the imagination of the public. In these days of austerity and shortage of all kinds of materials, due to the rearmament programme, manufacturers are unfortunately unable to make as many receivers as they wish, and, accordingly, it is hardly likely that there will be any new developments at this year's exhibition. Another change this year will be the venue, which, as may be seen on our cover illustration, will be at Earls Court instead of Olympia. The popular term "Radiolympia" has, therefore, apparently now been dropped for good and a new term will have to be found unless we keep the official term "National Radio Show."



Plugs and sockets in the Belling Lee range of accessories.

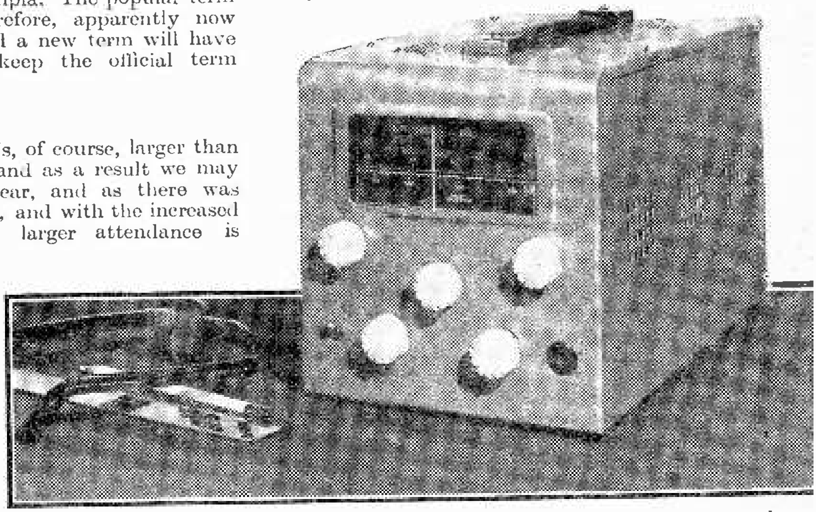
A Larger Show

The hall at Earls Court is, of course, larger than was previously available, and as a result we may see a larger show this year, and as there was no London show last year, and with the increased interest in television, a larger attendance is expected.

The exhibits may be divided roughly into three main groups, receivers and complete apparatus; test equipment; and component parts. The latter will, of course, include such items as valves and C.R. tubes, as well as many of the smaller items which go into both complete apparatus and test equipment.

Receivers

Among the receiver designs so far received the only changes seem to be in cabinet work, some of which is derived as a result of the shortage of suitable timber and some as a result of the attempt to improve response. As has been mentioned before in these pages, improved techniques on the A.F. side have led to a much higher standard of quality and in many cases the loudspeaker and its containing cabinet or method of mounting are the weak link in the chain. The average loudspeaker fitted in commercial receivers to-day is a much better instrument from a quality point of view than that of a few years ago, and even a 10in. speaker to-day gives a much crisper reproduction, mainly



An eight-watt amplifier which may be seen on the Grampian stand.

NAL RADIO
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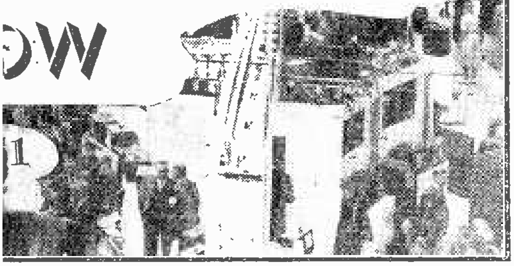

ATION ON SOME OF THE EXHIBITS

due to the increased flux resulting from the use of new magnet materials. As a result, there is a brisker quality about the sound of the modern receiver, which, when heard alongside a pre-war receiver, especially if the latter has not been fitted with new valves since it was installed, makes it sound remarkably high-pitched, or, if you prefer it the other way, makes the old model sound "boomy." A few models appear to be fitted with twin speakers, although there has not been the expected development of twin speakers with cross-over networks on the larger radiograms which at one time appeared to be developing. Again, it is undoubtedly the material shortage which is preventing this step. Tuning dials appear to be

R STAND
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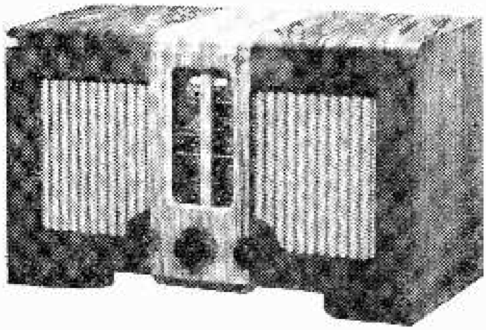
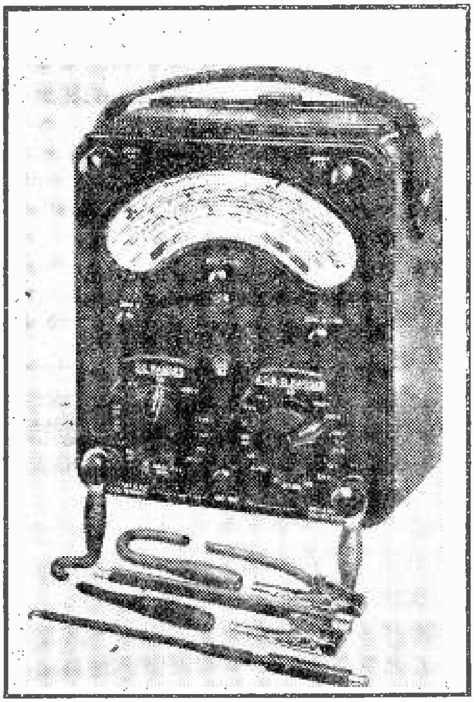
UND FLOOR
›ks, Blueprints,
Reader Service



The McMichael A.C./D.C. transportable with twin speakers.

developing on rather large lines, and many manufacturers seem to be developing the scale which has a separate section for each waveband, and the majority are of the straight line type—disposed either vertically or horizontally. Coloured or separate light switching is incorporated and makes tuning very easy on some of the short wavebands, and even the youngest member of the family will find little difficulty in tuning to a desired station on any waveband.

With the increasing miniaturisation of component parts the actual receiver chassis are generally smaller in overall size, advantage of this being taken by some makers to produce smaller table receivers, and by others to include radiogram autochange mechanisms in a much smaller console cabinet. As an instance of this reduction and of the attempt to improve reproduction may be mentioned the McMichael Model 851, which is illustrated on this page. This is a transportable model designed for A.C. or D.C. operation and includes two specially-matched 5in. high-flux loudspeakers. It also has

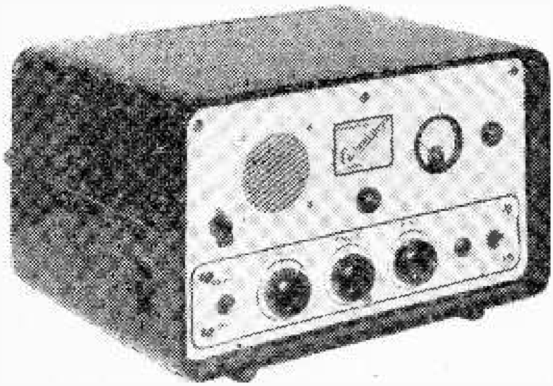


The well-known Avometer which is still regarded as a standard in many workshops.

the large, open type of scale mentioned, and in spite of the inclusion of these features it measures only 16¾in. wide by 10in. high and 7⅞in. deep.

Amplifiers

Included in the apparatus section are the various types of amplifier, some designed for P.A. work, and others designed for the listener who is interested in high-quality reproduction and is prepared to build a special loudspeaker cabinet to use with an amplifier for gramophone record reproduction or with a small tuner for local station reception. There are dozens of units of this type available, all claiming various special features. Some amplifiers are available with special tuners designed to work only with that particular unit, whilst others are available for any type of pre-amplifier or radio unit. Some novel designs will be found in these, from the two-station local high-fidelity type to the all-wave superhet unit which may be switched to provide high-quality local station reception by a circuit change. The only difficulty some constructors may find with these particular units is the housing of them in a suitable cabinet, as they have so many controls to enable advantage to be taken of all the available features that they tend to look rather more like laboratory equipment than domestic items. However, the panels, as a rule, are in a coloured material and mostly the controls are white with gilt engraved lettering, so making the finished item fairly neat provided that the home-made cabinet is suitably designed.



A quality amplifier—the Connoisseur—to be seen on Sugden's stand.

A notable feature of most of these domestic amplifiers (as distinct from those designed specially for P.A. or commercial use) is the high-wattage output which is provided.

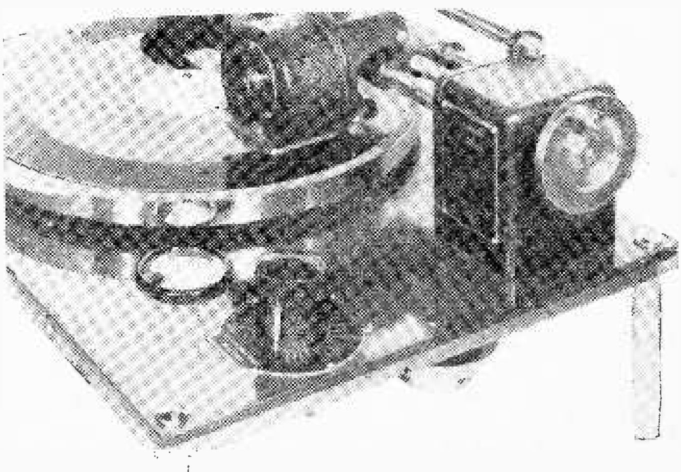
Some of these run to 12 and 15 watts and although such an output is not normally needed in the home it does permit of a fairly reasonable output with all risk of overloading on peaks removed. Another feature of these units is the wide range tone controls, some incorporating separate controls for bass and treble, in some cases the individual controls providing both cut and boost, but in others separate controls being used, thus leading to four separate controls for tone. Another feature found in many of these is the switched input, which is designed to provide for the feeding into them of a radio signal, a signal from standard gramophone records, from the special long-playing records, or from tape or wire recorders.

Test Equipment

In the range of test equipment there are a few new models introduced as a result of the growth of television. For ordinary equipment for radio reception there is not much new, many old friends being seen, such as the Avometer, the Taylor, etc., in company with signal generators, etc. Larger scales will be found on some of these, whilst the signal generators and similar items are in many cases modified to cover some of the higher frequencies used in television and proposed for F.M. Again compactness has been introduced into some of these by the inclusion of smaller valves and components. Among the special instruments are the pattern generators and similar special units which have their use only in television receivers, and these will be dealt with more fully in our companion paper "Practical Television." They are, in the main, designed to enable a television receiver to be tested outside broadcasting hours, and provide a geometrical pattern on the tube face which serves to test practically every part of the modern television receiver. A few special test units designed for measuring and testing audio outputs have appeared recently which will be found of value in testing and making quality amplifiers, but in most cases these are of the high-class quality type and as a result are rather expensive.

Component Parts

The component market is still well covered and some very interesting coil units are probably among the most popular. As most amateurs to-day wish to take advantage of all-wave reception the superhet is the most popular type of receiver, and the main difficulty in making up such a set is the ganging or lining up of the various coils required for even a simple non-H.F. stage superhet. There are two coils at least required for each range, and thus in a three-band set there would be six coils with trimming and padding condensers and the associated switchgear. Some very compact coil units are now available completely self-contained on a metal panel, and in most cases incorporate coils with powder-iron cores. Construction is greatly simplified with these as the wiring is already completed and there are only three or four wires to be connected to the unit.



Another Connoisseur product—a Varigroove recording unit.

Guide to the Exhibitors

List of Exhibitors in Alphabetical Order, with Stand Numbers

Name	Address	Stand No.
Ace Radio, Ltd.	Tower Works, Tower Rd., Pound Lne., Willesden, N.W.10	41
Admiralty	Dept. of Chief of Naval Information, Admiralty, S.W.1	231
Aerialite, Ltd.	Castle Wks., Stalybridge. Cheshire	47
Air Ministry	Parliament Sq. Hse., Parliament St., S.W.1	232
Ambassador Radio (R. N. Fitton, Ltd.)	Princess Wks., Pollard St., Brighouse, Yorks.	4
Amplion (1932), Ltd.	230, Tottenham Ct. Rd., W.1	114
Antiference, Ltd.	67, Bryanston St., Marble Arch, W.1	94
Association of Radio Battery Mnfrs.	41, Gordon Sq., W.C.1	67
Automatic Coil Winder Co., Ltd.	Winder Hse., Douglas St., S.W.1	9
Avimo, Ltd.	Taunton, Somerset	10
Balcombe Ltd., A. J.	52, Tabernacle St., E.C.2	89
Barclays Bank, Ltd.	54, Lombard St., E.C.3	20
Belling & Lee, Ltd.	Cambridge Arterial Rd., Enfield, Middx.	64
Board of Trade	Commercial Relations & Export Dept., Lacon Hse., Theobalds Rd., W.C.1	1
British Broadcasting Corporation	Broadcasting Hse., W.1	237
British Railways	The Railway Executive, 222, Marylebone Rd., N.W.1	70
Brown Bros., Ltd.	Brown's Bldgs., Gt. Eastern St., E.C.2	T.107
Bulgin & Co., Ltd. A. F.	By-pass Rd., Barking, Essex	2
Burndept, Ltd.	West St., Erith, Kent	40
Bush Radio, Ltd.	Power Rd., Chiswick, W.4	62
Cole, Ltd., E. K.	Ekco Wks., Southend-on-Sea, Essex	57
Collaro, Ltd.	Ripple Wks., By-pass Rd., Barking, Essex	81
Co-operative Wholesale Society, Ltd.	1, Balloon St., Manchester, 4	91
Cossor, Ltd., A. C.	Cossor Hse., Highbury Gve., N.5	86
Decca Record Co., Ltd.	1/3, Brixton Rd., S.W.9	82
Dept. of Scientific & Industrial Research	Charles Hse., 5/11, Regent St., S.W.1	235
Dibben, Ltd., Horace	Upper Banister St., Southampton	T.108
Dioptric Mfg. & Dist. Co., Ltd.	Cranleigh, Surrey	69
Dubilier Condenser Co. (1925), Ltd.	Ducon Wks., Victoria Rd., N. Acton, W.3	45
Dynatron Radio, Ltd.	Perfecta Wks., Ray Lea Rd., Maidenhead, Berks.	71
Eastick & Sons, Ltd., J. J.	12, Errol St., E.C.1	T.100
Econasign Co., Ltd.	92, Victoria St., S.W.1	11
Edison Swan Electric Co., Ltd.	155, Charing Cross Rd., W.C.2	63
Elwin, Ltd., Henry	Plumptre St., Nottingham	14
English Elec. Co., Ltd.	Queens Hse., Kingsway, W.C.2	58
Ever Ready Co (G.B.), Ltd.	Hercules Pl., Holloway. N.7	49
Ferguson Radio Corporation, Ltd.	105, Judd St., W.C.1	77
Ferranti, Ltd.	Hollinwood, Lancs.	74
Gamma Electronic, Ltd.	518, Ipswich Rd., Trading Estate, Slough, Bucks.	15
Garrard Eng. & Mfg. Co., Ltd.	Newcastle St., Swindon, Wilts.	68
General Elec. Co., Ltd.	Magnet Hse., Kingsway, W.C.2	28 & 51
General Post Office	Headquarters, E.C.1	233
Goodmans Industries Ltd.	Lancelot Rd., Wembley Middx.	96
Gramophone Co., Ltd.	Hayes, Middx.	84 & 85
Grampian Reproducers, Ltd.	Hanworth Trading Estate Feltham, Middx.	110
Hale Electric Co., Ltd.	Radio Wks., Talbot Rd. W. Ealing W.13	92
Haynes Radio, Ltd.	Queensway, Ponders End Enfield, Middx.	6
Hobday Bros., Ltd.	21, Gt. Eastern St., E.C.2	T.101
Hunt, Ltd., A. H.	Bendon Valley, Garratt Lne., S.W.18	95
Imhof, Ltd., Alfred	112, New Oxford St., W.C.1	93
Invicta Radio, Ltd.	Parkhurst Rd., Holloway, N 7	78
J.B. Mfg. (Cabinets) Co., Ltd.	86, Palmerston Rd., Walthamstow, E.17	33
Kerry's (Gt. Brit.), Ltd.	Warton Rd., Stratford, E.15	T.102
Kolster-Brandes, Ltd.	Footscray, Sidcup, Kent	52
Lee Products (G.B.), Ltd.	90, Gt. Eastern St., E.C.2	16
L.E.S. Distributors, Ltd.	15, Alfred Pl., W.C.1	T.109
Lloyds Bank, Ltd.	Premises Dept., 71, Lombard St., E.C.3	42
London & Provincial Factors, Ltd.	230, Tottenham Ct. Rd., W.1	T.105
McMichael Radio, Ltd.	190, Strand, W.C.2	59
Marconiphone Co., Ltd.	Hayes, Middx.	46 & 79
Margolin, Ltd., J. & A.	112/116, Old St., E.C.1	25
Masteradio, Ltd.	10/20, Fitzroy Pl., N.W.1	80
Metro Pex, Ltd.	42A, Denmark Hill, Camberwell Grn., S.E.5	31
Ministry of Civil Aviation	Aerial Hse., Strand, W.C.2	236
Mullard, Ltd.	Century Hse., Shaftesbury Ave., W.C.2	75
Multicore Solders, Ltd.	Mellier Hse., Albemarle St. W.1	48

Name	*Address*	*Stand No.*
Murphy Radio, Ltd.	Welwyn Garden City, Herts.	61
National Provincial Bank, Ltd.	Premises Dept., 15, Bishopsgate, E.C.2	26
New London Electron Wks., Ltd.	Boleyn Rd., East Ham, E.6	A.44
Newman, J. & S. ..	100, Hampstead Rd., N.W.1	29
Newnes, Ltd., Geo...	**Tower House, Southampton St., W.C.2**	**30**
"Ossicaide," Ltd. ..	Suffolk Hall, 1, Upper Richmond Rd., S.W.15	32
Peto Scott Electrical Instruments, Ltd.	Addlestone Rd., Weybridge, Surrey	73
Petter Radio & Elec. Supplies	201/9, Forest Rd., Walthamstow, E.17	T.103
Philco (O'seas), Ltd.	Lion Hse., Richmond, Surrey	54
Philips Electrical, Ltd.	Century Hse., Shaftesbury Ave., W.C.2	83 & 90
Pilot Radio, Ltd. ..	31/37, Park Royal Rd., N.W.10	66
Plessey Co., Ltd. ..	Vicarage Lne., Ilford, Essex	8
Portogram Radio Elec. Ind. Ltd.	Preil Wks., St. Rule St., S.W.8	115
"Practical Wireless" and "Practical Television"	**Tower House, Southampton St., W.C.2**	**30**
Pye, Ltd.	Radio Wks., Cambridge	17 & 65
Radio Gramophone Dev. Co., Ltd.	Pale Meadow Print Wks., Bridgnorth, Salop	76
Regentone Products, Ltd.	New Factory, Eastern Ave., Romford, Essex	88
Roberts' Radio Co., Ltd.	Creek Rd., E. Molesey, Surrey	44
Rola Celestion, Ltd	Ferry Wks., Summer Rd., Thames Ditton, Surrey	39
Savory & Moore, Ltd.	61, Welbeck St., W.1	22
Scharf, Erwin ..	49, De Beauvoir Rd., N.1	35
Scophony-Baird, Ltd.	Lancelot Rd., Wembley, Middx.	50
Scott & Co., Ltd., Geo. L.	Cromwell Rd., Ellesmere Port, Cheshire	18
Simon Sound Service, Ltd.	48, George St., W.1	13
Skarsten Mfg. Co., Ltd.	21, Hyde Way, Welwyn Garden City, Herts.	19
Sobell Ind., Ltd. ..	Langley Pk., nr. Slough, Bucks.	56
Standard Telephone & Cables, Ltd.	Footscray, Sidcup, Kent	87
Stratton & Co., Ltd.	Eddystone Wks., Alvechurch Rd., W. Heath, B'ham., 31	7
Sugden & Co., Ltd., A. R.	Well Green Lne., Brighouse, Yorks.	12
Stella Radio & TV Co., Ltd.	9/15, Oxford St., W.1	111
Taylor Elec. Inst., Ltd.	419, Montrose Ave., Slough, Bucks.	38
Telegraph Condenser Co., Ltd.	N. Acton, W.3	97
Telerection, Ltd. ..	12, Suffolk Pde., Cheltenham, Glos.	27
Trix Electrical Co., Ltd.	1/5, Maple Pl., Tottenham Ct. Rd., W.1	23
Ultra Electric, Ltd.	Western Ave., Acton, W.3	53
Valradio, Ltd. ..	New Chapel Rd., Feltham, Middx.	21
Vidor, Ltd. ..	West St., Erith, Kent	55
War Office	Directorate of Public Relations, The War Office, Whitehall, S.W.1	234
Waveforms, Ltd. ..	26, Oakleigh Rd., New Southgate, N.11	34
Westinghouse Brake & Signal Co., Ltd.	82, York Way, Kings Cross, N.1	43
Westminster Bank, Ltd.	Premises Dept., 51, Threadneedle St., E.C.2	72
Whiteley Electrical Radio Co., Ltd.	Victoria St., Mansfield, Notts.	60
Winter Tdg. Co., Ltd.	6, Harrow Rd., W.2	T.99
Wolsey Television, Ltd.	75, Gresham Rd., Brixton, S.W.9	5
Wright & Weaire, Ltd.	138, Sloane St., S.W.1	112

Valves at the Show

THE British radio valve industry by its display in the National Radio Show will demonstrate how, on the one hand, it is encouraging the widest use of electronic devices by designing valves and tubes for specific applications while, on the other hand, continuing the process of rationalization which permits quantity production of established types and results in a highly efficient product at an economical price.

The industry to-day is enjoying greater advantages in the techniques of design and production than ever before. Facilities for research are far more extensive than they have ever been and the installation of new plant in the past few years has been without precedent. On the marketing side it can be said that the overseas distribution of British valves is now highly organized and that the customer can expect good service.

There is a general trend towards the use of miniature valves in broadcast receivers. The ranges now available include directly heated types for battery-operated sets and indirectly heated types for A.C. and A.C./D.C. sets and also for car radio. One outstanding feature of the new British A.C./D.C. valves is low heater current which greatly helps the set designer. Subminiature valves, primarily designed for hearing aids and combining high efficiency with extremely low filament consumption, are likely to have applications in industrial equipment and in electronic computing.

Both miniature and subminiature valves are widely employed in all types of radar and navigational equipment for commercial use. Among the more outstanding are magnetrons of entirely new design, klystrons, travelling-wave tubes, special cathode-ray tubes and types in which the circuit becomes an integral part of the valve itself.

In the expanding scope of electronics in industry, science and medicine, quantities of valves are being used, for instance in high frequency heating, process control, electronic computing and encephalography. It is, however, the "special" valves which have greatly extended this field of applications. Available devices include atom research valves, photocells and photo-multipliers, cold cathode valves, electrometer valves, accelerometers, gas-filled stabilizers and voltage reference tubes. In addition there are flash tubes for stroboscopes and ultra-high-speed photography.

Transmitting valves of the air-cooled and water-cooled varieties have been progressively improved and both types are equally efficient in their respective functions. In the smaller glass transmitting valves much has been done to add rigidity to the internal structure and to achieve more compact dimensions.

An Auxiliary Receiver

A SELF-CONTAINED A.C. RECEIVER WITH TUNING INDICATOR

By T. D. DAWSON

WHILE looking through some old radio circuits recently, the author came across the design for a three-valve tuning unit, incorporating a tuning indicator. The demodulator stage was a 6H6G double diode preceded by a variable-mu R.F. pentode (6K7G). A.V.C. was applied to the grid of the 6K7G by a standard "delay" line which also fed the indicator.

It was decided to modify this unit by replacing the 6H6G by a double diode triode 6Q7G, and to feed the A.F. signal thus developed after amplification by the triode portion of this valve into an output stage.

Circuit

As will be seen from the circuit diagram in Fig. 1, V1 affords a considerable amount of R.F. amplification, the output being fed via a tuned circuit, into a shunt-fed diode. The diode portion of this valve acts as a signal demodulator providing across R8 a positive voltage proportional to the signal amplitude as an A.V.C. bias for the 6K7G, and the audio-frequency signal. The signal is filtered by R9 C13 and fed via a blocking capacitor C14 to the gain control R14. Note should be made of the fact that the grid resistance R8 is returned to the cathode and not earth.

Standard resistance-capacity coupling is employed between V2 and V4, the latter being a 6V6G beam output tetrode.

The rectifier assembly utilises a normal full-wave rectifier, the output being smoothed by a 15 henry L.F. choke. Alternatively, the output stage could be fed through a separate choke and capacitors. The L.S. is mounted away from the chassis.

Wave-change

It was found desirable to include arrangements for wave-change switching covering medium and long-wave bands. The coils used were Wearite PA2 and PHF2 for the medium waveband and PA1 and PHF1 for the long. These were tuned by a two-gang 500 pF. variable capacitor which incorporated 50 pF. trimmers.

Tuning Indicator

The tuning indicator is a mere accessory and may be cut out if desired. It serves, however, as a useful guide when aligning the receiver, and as the current taken by it is very low, its inclusion is desirable. Its operation follows standard practice, the positive voltage set up across C8 by the A.V.C. line on the diode detector controlling the grid.

Automatic Volume Control

The current set up across the load resistor R8 consists basically of two components; an alternating component at an audio-frequency for feeding the A.F. amplifiers, and a direct component to provide a bias for the R.F. valve. The separation of these currents is a simple matter. C14 acts as a D.C. blocking capacitor, so only the alternating component acts on the L.F. valve. The alternating component acts across R5 C8, which are in series, and thus allows only the direct component to act on V1. This is achieved by making the impedance of C8 low in comparison with the resistance of R5 so that only a negligible portion of the alternating component remains across C8 and the voltage on the controlled valves is thus sensibly D.C. in character. The line is decoupled by R1 C2 and returned to the aerial coil.

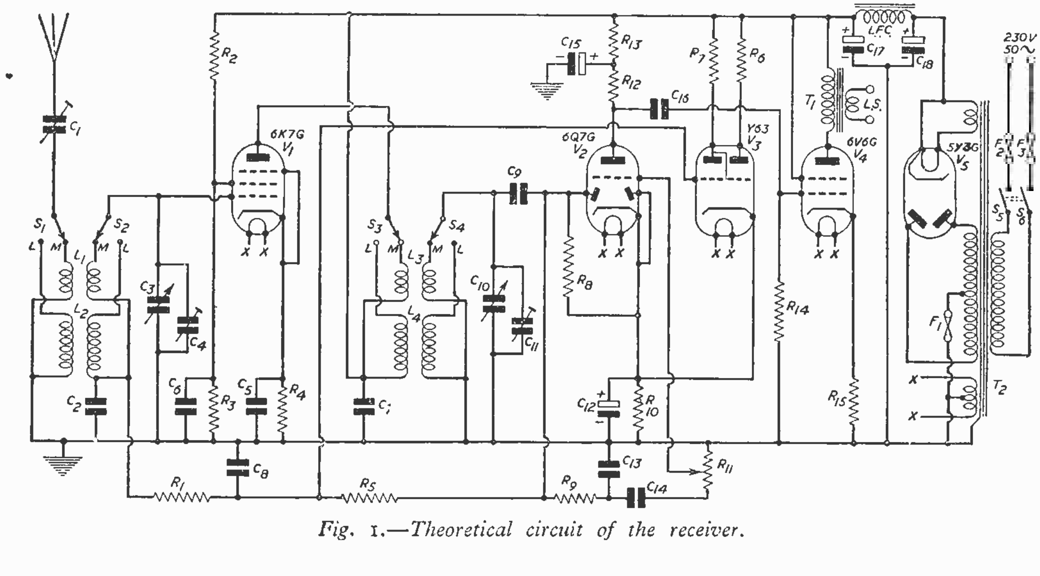


Fig. 1.—Theoretical circuit of the receiver.

Alternative Valves

If the 6K7G is changed for an EF39 or a similar variable-mu pentode, care must be taken to ensure that the cathode bias on this valve is greater than on the 6Q7G. This is because in the absence of a signal, the A.V.C. line has a positive bias equal to that of the 6Q7G, and in these circumstances the control grid will become negative with respect to the cathode.

The 6V6G may be changed to a 6L6G with slight component modifications that will become apparent on consultation with the valve manufacturer's tables. Attention must also be paid to the fact that with a maximum signal on the control grid, the 6L6G requires 86.3 mA. of anode and screen current compared with the 34.0 mA. required by the 6V6G. The mains transformer and rectifier valve must be selected accordingly. The respective power outputs are 4.5 watts with the 6V6G, compared with the 6.5 watts given by the 6L6G each with 250 volts on the anode and screen.

The 6Q7G can be replaced by an EBC33, this being an exact equivalent but of British manufacture.

The 5Y3G should be replaced by a 5Z4G if a 6L6G is used in the output stage. This valve supplies a higher current at the same voltage.

Any valve suffixed by a G may be substituted for a similar one suffixed by a GT, for with the exception of their overall dimensions and inter-electrode capacities, they are similar.

Chassis Construction and Alignment

The layout used in the author's set is not given as individual constructors usually prefer their own layout. Any chassis in the 8in. by 10in. class will prove suitable.

Connect the aerial to the tuner stage and with the trimmer set at half capacity tune to a weak station low in the band. Adjust the trimmers to give maximum volume, or greatest degree of closing of the shadow. Trim the detector stage first, rocking the tuning condenser slightly as the adjustment is made, and then the R.F. amplifier. The aerial trimmer is then adjusted to give good volume consistent with selectivity.

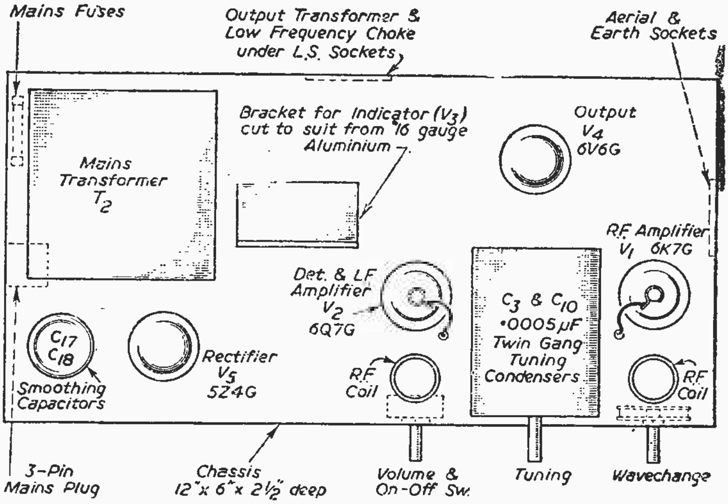


Fig. 2.—Layout of the receiver.

LIST OF COMPONENTS

Capacitors. T.C.C. Type Numbers.

C1—100 pF. Max. Adjustable Trimmer, T.C.C. Type TCK1010.
C2—0.05 μF. 200 v.w. Paper. T.C.C. Type CP34H.
C3, C10—500 pF. Max. Adjustable 2-gang Variable.
C4, C11—50 pF. Max. Adjustable Trimmers, incorporated in C3, C11.
C5, C8—0.1 μF. 200 v.w. Paper T.C.C. Type CP36H.
C6, C7, C16—0.1 μF. 500 v.w. Paper. T.C.C. Type CP46S.
C9—300 pF. 350 v.w. Mica. T.C.C. Type CM20N.
C12—25 μF. Electrolytic 25 v.w. T.C.C. Type CE32C.
C13—100 pF. 350 v.w. Mica. T.C.C. Type CM20N.
C14—0.01 μF. 350 v.w. Paper. T.C.C. Type CP32N.
C15—4 μF. Electrolytic, 450 v.w. T.C.C. Type CE11P.
C17, C18—8+8 μF. Electrolytic, 450 v.w. T.C.C. Type CE21P, with British 5 pin base.

Resistors. All values ½ watt.

R1, R12—0.25 MΩ.
R2—30 KΩ.
R3—40 KΩ.
R4, R15—250 Ω.
R5, R6, R8—1 MΩ.
R7—20 KΩ.
R9—50 KΩ.
R10—2 KΩ.
R11—0.5 MΩ Wire-wound Variable with D.P.S.T. Switch.
R13—25 KΩ.
R14—100 KΩ.

Transformers.

T1—Output Transformer: Gardners Radio Type T98. Or similar Multi-ratio O.P.T.
T2—Mains Transformer: Gardners Radio Type R114. Primary: 0-210-230-250 volts. Secondary: 350-0-350 volts, 80 m/as. 0-4-5 volts, 2.5 amps. 0-4-6.3 volts, 4.0 amps.

Coils, Wright and Weaire Type Numbers (Wearite).
L1—PA2; L2—PA2; L3—PHF2; L4—PHF1.
S1, S2, S3, S4—4 Pole 2-way Yaxley Type Wave-change Switch.
S5, S6—D.P.S.T. Switch, incorporated in R11.

Valves.

V1—Brimar 6K7G-GT.
V2—Brimar 6Q7G-GT.
V3—Marconi-Osram Y63.
V4—Brimar 6V6G-GT.
V5—Brimar 5Y3G-GT.

Alternatives.

Mullard EF39; Mullard EBC33; Marconi-Osram Y61-Y62-Y64; Brimar 6L6G (see text); Brimar 5Z4G (see text).
LFC—20 H. 100 M/as.
5 International Octal Valveholders.
Fuses: F1—250 μA. fuse with holder; F2-F3—2 A. fuses with holder.
Chassis: Aluminium—6in. x 12in. x 2½in. Mains 3-pin Input Socket.
Input Sockets, Aerial, Earth, Output Sockets, etc.

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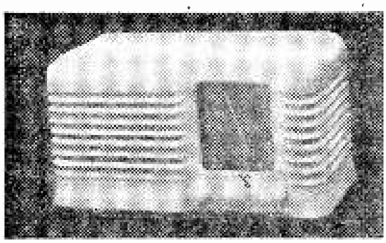

Drum (2¾in. diam)	1/-
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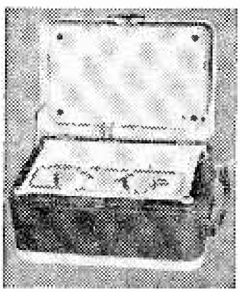
SPEAKER.—Midget, "Plessey" 3in.. **14/6.**



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ON/OFF SWITCH.—Lid operated, **1/6.**

RESISTORS.— Miscellaneous, total 8, **4/-.**

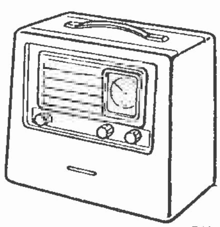
CONDENSERS.—Miscellaneous, total 9, **4/6.**

B7G AMPHENOL.—Valve holders, **8d.** each.

ASSEMBLY INSTRUCTIONS.—Including wiring diagram and alignment data, **2/6.**

Note.—All these parts can be bought separately. Valves required are 1R5, 1T4 1S5, 3S4 or 3V4, all available at low prices, send for our current valve list.

MAINS/BATTERY PORTABLE



Ultra modern cabinet highly suitable for making up an all-mains and/or all-dry battery Receiver. Cabinet dimensions, 7¼in. deep and 10½in. high x 12in. wide.

Imitation crocodile cabinet with back and wooden platform, battery dividers, inner front drilled for three controls, and handle	**22/6** complete.
Ivory fret with Perspex window, loud-speaker louvres and tuning scale	**5/6.**
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Unwired	**2/6.**
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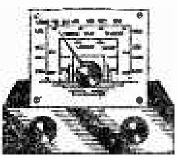
Assembly for holding dial and lamps	**1/9.**
Matched knobs, set of 3	**2/-.**

Or all items unwired frame aerial, **38/6**, wired frame aerial **42/6**. Wiring diagram and constructional details, **2/6**. All components available (total cost of set should not exceed **£7 10s.**). For details see constructional data.

MAINS CHASSIS



Equivalent to 4-valve receiver, uses 3 valves and rectifier. Not a kit, ready to work. Large clear dial, tunes long and medium waves and operates off A.C. mains. Can be fitted into cupboard, cabinet or made into really compact portable. Complete with valves but less speaker. Price **69/6**, plus 2/6 post and insurance. Moving coil speaker, with tax, **16/6** extra.

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A Utility Tester

AN ALL-PURPOSE UNIT FOR THE TEST BENCH

By T. W. DRESSER

GOOD quality multi-range meters are necessarily expensive and often enough the amateur feels the cost is not warranted for the fairly small use to which the instrument is put. Similarly, many designs for home-constructed test apparatus which have been published are not particularly cheap to build if they incorporate high-grade components. In such circumstances the enthusiast whose pocket is limited either resorts to borrowing an instrument or builds the gear and hopes for the best, and neither method is very satisfactory for obvious reasons.

The needs of most amateurs, as far as meters go, are generally very few, and inexpensive equipment, used with an intelligent appreciation of radio circuitry, will fulfil most of these needs. Practically speaking, the principal requirements are a good indication of continuity, which enables one to check valve filaments and heaters, electrode shorts in some cases, coils, switches, volume controls (for continuity and dead spots), transformer windings, pilot lamps and wiring generally, as well as short-circuits to chassis, etc., and some means of testing condensers, one respect in which the amateur is often badly handicapped.

All these requirements can be covered by very simple apparatus which can be assembled for a few shillings only and which takes up little more space than a large packet of cigarettes. Such a tester was built by the writer some months ago and has been in steady use on a test-bench ever since. Constructed around a midget transformer, a couple of lamps and resistors and one or two switches it has been in constant demand by friends and is now rarely at home.

Circuit

The circuit is more or less self-explanatory. A single-pole switch selects a tap on the transformer secondary to give the required voltage to test such things as valve heaters, and in view of the extensive range of A.C. and A.C./D.C. valves a large number of taps was required. In the two-volt lead, a poten-

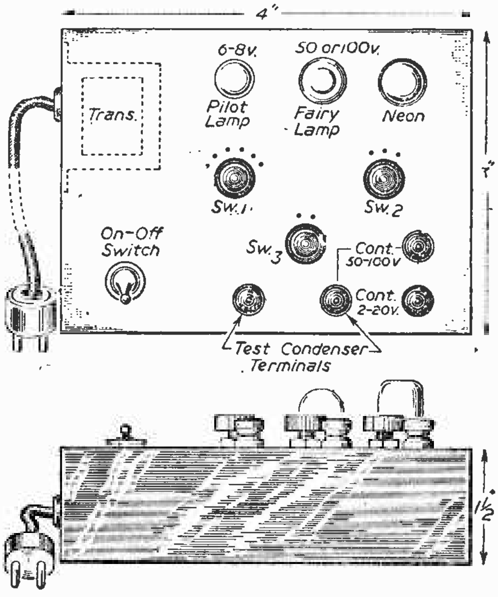


Fig. 2.—Panel layout and details of containing case.

tiometer is incorporated in order to reduce the E.M.F. to 1.4 when testing 1T4s, etc. The valve heater is placed in circuit at the terminals marked "continuity" and an indication is given by the lamp in series with it. These connections are also used for resistor testing.

Condenser testing is carried out by the well-tried charge-and-discharge method; the 100 mA selenium rectifier (which can be obtained very cheaply on the surplus market) supplying D.C. to charge the condenser, and switch 3 being used to charge and discharge it alternately as shown in Fig. 1, an indication being given by the neon lamp in the circuit. A limiting resistor is included in the circuit to prevent damage to the neon or the rectifier in case of a short-circuit.

The transformer used can be easily wound at home on the core of an old output transformer. If the primary

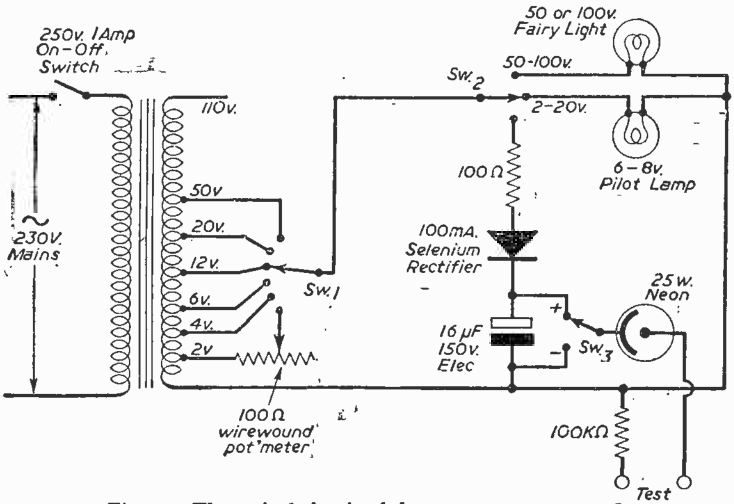


Fig. 1.—Theoretical circuit of the tester.

is intact, strip the secondary after checking the output voltage with the primary connected across the mains. A four- or six-volt lamp will give sufficient indication in most cases if a meter is not available. Next count the turns carefully as the secondary is removed, then divide that number by the output voltage and you have the turns-per-volt. A simple multiplication will then give you the number of turns required for the tester voltages, in Fig. 1, and these should be wound with 40 S.W.G. enamelled wire, bringing out loops for the various taps. A strip of thin tissue paper every third layer will serve as insulation. Alternatively, the primary and secondary can be stripped and the bobbin completely rewound to the following specification :

Primary : 3,120 turns 42 S.W.G. enamelled wire. Paper every third layer.

Secondary : 1,430 turns 40 S.W.G. enamelled wire. Paper every third layer. Tap at 26, 52, 78, 156, 260 and 650 turns.

The total cost of the instrument should not exceed fifteen shillings, and in many cases where a good spares box is available will not even approach this figure. The writer's tester was made up in a small aluminium case as shown in Fig. 2.

Switch 1 should be of the "break before make" type as otherwise a section of the transformer will be short-circuited.

For the Transmitter

Crystal Oscillators–2

A STUDY OF THE INITIAL PRINCIPLES OF TRANSMITTER DESIGN

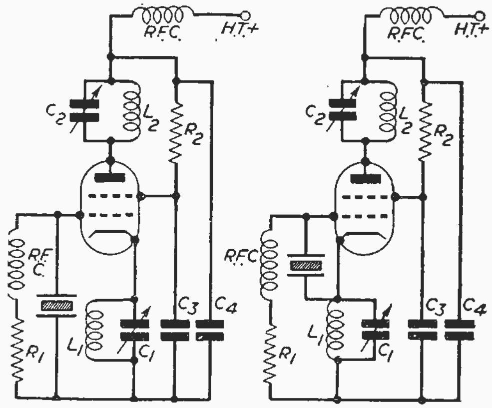
By O. J. RUSSELL, B.Sc. (G3BHJ)

(Concluded from last month's issue)

Overloading

As the urge to obtain adequate output on high harmonics readily leads to overloading the crystal, it is preferable to use additional multiplier stages rather than overrun the crystal. With a 6L6 or similar oscillator valve, with 400 volts on the anode, eight to ten watts of second harmonic output can be obtained, with about five watts on the third harmonic. The third harmonic output will be useful when the 21 Mc/s band becomes available. It is regarded as axiomatic in this type of circuit that the anode tuned circuit L_2C_2 should not be tuned to the crystal frequency, as this tends to give a very high crystal current. The cathode tuned circuit is not critical, and should be arranged so as to resonate at a frequency slightly higher than crystal frequency, with full capacity. In adjusting the Tritet oscillator, it will be found that crystal current and output are smoothly affected by adjustments of the cathode circuit, and that it is easy to select an operating point giving adequate output without excessive crystal current. An indicator of crystal current is very desirable when adjusting this type of circuit, for if the cathode circuit has been accidentally constructed so as to be capable of tuning to the crystal frequency, the crystal may be fractured. Adjustments should start, therefore, with both tuning condensers set at minimum capacity. The circuit will in fact oscillate whatever the setting of the anode tuned circuit, and the cathode circuit is so uncritical that oscillation will occur with almost every setting of the cathode condenser, and is unaffected by the tuning of the anode circuit. With some indicator of crystal current inserted in series with the crystal it is easy to avoid excessive crystal current settings if the controls are cautiously adjusted. Once oscillation starts with a suitable setting of the cathode condenser, the anode circuit should be resonated to the desired harmonic with the aid of an absorption wavemeter, or tuning loop. The optimum adjustment of the cathode condenser can then be found, with final settings for good output consistent with a reasonable value of crystal current, and freedom from chirp under keying.

The aim has been to present the above well-known circuits, with notes on their behaviour, as a step leading to consideration of a number of other crystal circuits. In this connection, keying arrangements, coupling systems and coil sizes have been disregarded. However, anyone who wishes to key directly a crystal oscillator will find cathode keying satisfactory. A closed circuit jack inserted in the cathode lead, and by-passed with a .02 μF. condenser will allow a key to be inserted in the cathode lead, which will give excellent keying for break-in working. It is also popular with some operators to provide a small amount of cathode bias in such oscillator circuits by placing a 300 ohm cathode resistor by-passed by a condenser of, say, .01 μF. in the cathode return. Furthermore, although an R.F. choke is shown in series with the grid leak, this is usually unnecessary, particularly as a value of 100,000 ohms is generally suitable for tetrode oscillator grid leaks.



Two forms of the Tritet type of oscillator.

G. E. C.

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6F6G	9/6	—	6K7GT	6/9	—	EB34	—	2/6
6J5	6/9	—	6Q7GT	13/-	—	KT66	9/6	—
6J5GT	6/3	—	6SK7	7/3	—	KTW61	—	8/6
6J7	—	7/-	12H6	—	2/9	RL18	—	5/-
6J7G	—	6/6	807	—	9/6	VU111	4/6	—

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VOLUME CONTROLS.—Lg. spdls., all values, 4/- ; with SW, 6/- ; D.P. SW, 7/- ; Midg. type, ¼, ½, 1, 2 meg., 5/- ; with SW, 7/- ; D.P. SW, 8/- ; Wire wound, less SW, 1 K. to 80 K., 6/6 ; 100 K., 7/9.

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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).

Superhets and T.R.F.s—Almost Obsolete?

SIR,—May I thank you for the article on crystal sets (page 208, May PRACTICAL WIRELESS). I had built an amplifier and found the cat's whisker crystal did not provide a signal strong enough for our comfortable listening after amplification, though reception was remarkably clear. I have clung to my age-old theory that best domestic reproduction would be crystal plus "hi-fi" amplifier.

I tried germanium crystal diode (as advertised in PRACTICAL WIRELESS) in consequence of Mr. Delaney's article. Coil was wound to approximate size for London (no condenser); aerial in loft 15 miles from London; earth was earth on power plug. Amplifier is rated at about 5 watts: crystal delivering o amplifier: Goodman's 15-ohms speaker in bottom of cabinet; vent in baffle, but 10in. circle in back of cabinet. It does not appear to be necessary to finish by padding cabinet, etc.

However, a Royal Albert Hall orchestral piece was in crescendo when we switched on with all four controls "full on" and "harmonic generator valve" (to provide harmonic bass) in circuit.

In a few moments we understood how it was "the walls of Jericho fell down at the blast of a trumpet." During a lull we managed to get near enough to the amplifier to twist knobs, and congratulated ourselves we had not put a germanium crystal in front of a 10-watt amplifier 15 miles from London.

Tuners to precede quality amplifiers are expensive, and I need not amplify that for those who know. What sort of tuner one needs when living near London and possessing a 5-watt (upwards) amplifier, if only the Home Service, the Light and Third are required, is clear. One germanium crystal and a length of wire, something (preferably an iron dust core) around which to wind the wire and, as we found by experiment, a variable mica condenser in the aerial-to-coil line, another across aerial and earth, and a .0003 ordinary midget variable condenser to tune. Even then the "European Service of the B.B.C." creeps in, though it is not noticeable except during "quiet" moments in the broadcast. The "European Service" must be a curse to crystal users.

Of course, with a germanium crystal tuner one has no A.V.C., and consequently no "contrast expander" is necessary to offset what is not there. The B.B.C. provides ample modulation, we find. Of course, there is no "boom," and none of that "commercial bass." Production is wonderfully clear. Speech is as clearly understood at distant parts of the house—and that's a test and, believe it or not, a complaint! "I can hear every word too clearly." All instruments are clearly distinguishable.

By the way, if you decide to publish this, G3AJK, of Farnborough, may be interested to know that our first rig-up with the crystal (cat's whisker) brought him in as a competitor with London at good loudspeaker strength.—O. G. KERSLAKE (Orpington).

S.W. Correspondent Wanted

SIR,—I am a regular reader of your magazine and would feel very much obliged if you would kindly published the following lines in your esteemed columns.

I am greatly interested in amateur radio and am anxious to correspond with S.W. enthusiasts of any country. I am 20 years old and I read both English and French, hence I shall equally appreciate any technical matters on radio in either language.

I would be very grateful to anyone who would send me any data or circuits on the Tx No. 18 III.

May I take this opportunity of thanking you and at the same time in wishing you every success in the publication of this world-wide magazine, the only one that can satisfy the insatiable appetites of radio enthusiasts.—Y. KHODBACCUS (21, Benares Street, Port Louis, Mauritius).

The Alignoscope

SIR,—With reference to my article in the July issue, it appears that the following points need clarifying.

The potentiometer 1,000 ohms in the list of parts can be between 500 and 1,000 ohms; the value for this attenuator is not critical and 500 ohms was used and shown in the circuit.

Just below P_3 in the diagram the sliders of the sections of SW_2 for switching coils and capacitors of the oscillator should be strapped together. In other words, the .001 μF condenser should be between G_2 and G_3 of the Transitron valve.

It has been found that the Transitron works even better if the anode voltage is kept lower than provided now. This can be achieved if the 10 kΩ anode load is taken to a potential divider of two 27 kΩ resistors between H.T. supply (180 volts) and chassis.

Of the transformers in the unit, the one with six tags can be used for X-deflection without rewinding; the side marked with a red spot is used as primary, the centre and one end tag being used.

Point "LS" can be another Pye socket or just a lead with a crocodile clip to go straight to the speech coil of the loudspeaker.

The co-axial cable from point DL to the diode-load in the set should end in a hook of 16-gauge wire, as this is easiest to insert into the wiring of most receivers. TV cable was found to be most useful for this lead and the aerial connections. Screened cable is essential to prevent pick-up or radiation of interference.

As the alignoscope must be in direct connection with the set under test, it will be "live" with A.C./D.C. models, and the chassis of the unit can only be earthed through a .1 μF condenser.

A dummy aerial consisting of 400 ohms and 200 pF connected in series with the lead to the receiver is a useful addition.

In the text page 313, line 12, it should read: I.F. coil with 120 turns. In Fig. 5a this is given correctly.

For the coils enamelled or cotton or silk-covered wire can be used. Point "DL" can be a Pye socket or the co-axial cable can be taken direct to the .05 μF condenser in the unit.

When using the alignoscope on hum test, the 7.5 Mc/s generator is working, so obviously the receiver under test should *not* be tuned to pick up the 50 c/s modulated carrier.

The metal-cased potentiometers contained in the unit have earthed sliders. However, they can be used in the cases of P_2 and P_3. No. 10C/9003 is 500 ohms, 10C/9006 is 5,000 ohms.

In this case, the .1 μF condenser is not taken to the slider on P2, but to one end of the track, and the 6.3 volts A.C. are fed to this same point through a 50-ohm resistor (2 watts), the slider being earthed will thus short out the signal voltage to the valve.

A similar method can be adopted for P3 where the slider of SW2 feeds one end of the track of P3 through 50 ohms, and the 200 pF condenser to the aerial lead goes to the same point.

These modifications are only recommended if one wishes to avoid the expense of obtaining new, proper potentiometers. But they have been tried out and work all right.

One reader asks for the circuit of the unit 198 before conversion, but I am afraid I did not go to the trouble of sorting out the circuit, in any case so many wires lead to connectors to ancillary equipment that one would have to know the circuits of these other units as well.—P. LEWIS (N. 10).

My Favourite Circuit

SIR,—I have been a reader of PRACTICAL WIRELESS for many years, in fact "Amateur Wireless" and "Wireless Magazine" also. I have a copy of "Wireless Magazine" for 1929, in which is the popular set the Clipper Two, also the Drum Major; both use the Hartley circuit. The Hartley is my favourite circuit and I often wonder why it is not more widely used, because it does not need as much wire in the coil and it is better on short waves than most circuits and uses less H.T.

In my one-valve circuit I receive numbers of short-wave stations with only 9 volts H.T. (valve 1C5 or Mullard equivalent).

Anyway, I will not bother you with a lot of details, but I should like to see the Hartley circuit brought to the notice of the newcomers through your paper.—SAM NAYLOR (Leeds).

Car Radio

SIR,—I fear that your contributor may have missed the target in the design for a car radio receiver (August issue), and that anybody constructing the set may be in for a lot of disappointment.

From wide practical experience of all types of car radio installations, I know that it is absolutely essential for the receiver to be completely screened and thoroughly earthed to the vehicle chassis. This also applies to the aerial lead in which should be of suitable co-axial R.F. cable, with its capacitance matched to suit the input stage of the set. The screening of this cable should then be well earthed at *both* ends.

Failure to observe these screening precautions may result in so much interference being picked up from ignition and charging system, that the set may be useless when the car is in motion.

This also applies even when the ignition and dynamo interference has been thoroughly suppressed at the source by means of the usual condensers and H.T. resistor.

Furthermore, his design does not include *automatic volume control*, which is needed more in a car radio with the constantly changing signal strength than with any other receiver.—F. W. GILLIANS (Farnham).

THE SEE-SAW AMPLIFIER

(*continued from page* 402)

by the anode load resistance should be very large compared to unity).

If another valve is used to provide e_1, as shown in Fig. 3, a push-pull output may be obtained between the two anodes when $R_1=R_2$. The overall gain of the amplifier may be changed as desired by adjusting the ratio of R_3 to R_4.

At H.F.

At high frequencies, stray capacities become increasingly important, shunting R_1, R_2, R_3 and R_4. Due to asymmetry in wiring, these capacities are unlikely to be equal. To preserve the waveform of the input signal the values of the resistors with their respective shunt capacities must bear the same relation to one another as they did at low frequencies. To compensate for unequal wiring capacities the trimmers C_1, C_2, C_3 and C_4 are connected across their corresponding resistors. Also, to maintain proportionality between the R.C. impedance combinations it is necessary to ensure that the time-constants $R_2 \times C_2 = R_1 \times C_1$ and that the time-constants $R_3 \times C_3$ and $R_4 \times C_4$ are equal.

807's Not Essential

The practical circuit using the component values shown in Fig. 1 has been used to give faithful reproduction of signals with components up to 4 Mc/s. Although 807's have been used in this application, almost any power pentode will prove suitable.

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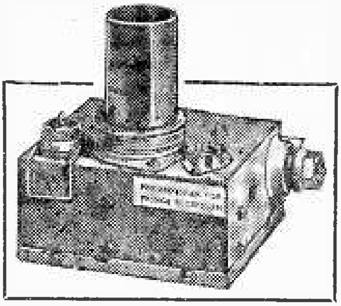

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TRADE NOTES

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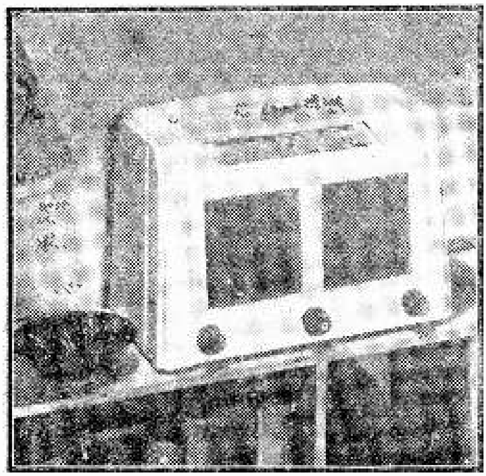

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Model T25DA is for operation on mains supplies of 195-255 volts D.C. or A.C., 25-100 cycles, and is competitively priced at £19 15s. including tax.

The Testoscope

WITH reference to advertisements which have recently appeared concerning the Rumbaken Testoscopes, we are asked to point out that the Popular Model at 12s. 6d. referred to in our June issue has now been withdrawn from production. Particulars of other models may be obtained from Rumbaken, Manchester.

Electronic Equipment

GREEN Radio Co., of Mount Road, Madras, are starting an electronics division to deal with Industrial Electronic Control equipment and other electronic devices in all aspects.

They would like to pass their address on to manufacturers of such equipment with a view to receiving details of the products marketed by them.

G.E.C. Radio Price Increase

THE General Electric Co., Ltd., announces that the price of its radio receiver model BC.5639 is now £20 16s. 2d. plus £8 18s. 3d. purchase tax.

Engineering Facilities, Ltd.

THE above firm, of 29, Rea Street, Birmingham 5, hold a large stock of ex-Government Magslips which should prove of great interest to the experimenter. As most readers know, Magslips resemble small motors, 3.37in. by 6in. long, with 5/16in. shafts. The stators are wound for 50 v. 50 c. A.C. supply, and the rotors arranged to move in step with one another. Magslips are normally used in pairs, connected in parallel, and are designed to transmit motion with great accuracy over any distance.

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Engineering Facilities point out that a considerable proportion of their stocks arrive damaged but that such damage is superficial, and they are accordingly offered in three groups as follows:

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Programme Pointers

THIS MONTH MAURICE REEVE DEALS WITH SOME MORE RECENT PROGRAMMES

I CANNOT refrain from commencing this month's article with a shout of praise, gladness and thanksgiving at the news that Queen's Hall is to be rebuilt. Although not one hundred per cent. a broadcasting news item, it will have important broadcasting repercussions, as many concerts will be transmitted from there.

The destruction of the famous hall in a blitz was the most disastrous single blow music ever suffered in this country. Its full restoration to pre-war glory could never be achieved in any way other than by its restoration on its original site. With the Government's sanction, this will be commenced in the not-too-distant future, together with a new "small" hall for recitals, etc., to seat 1,100 (the new "large" Queen's will seat 3,500, as against the old one's 2,500).

It is ironical and sinister that it was not commissioned before the Royal Festival South Bank-cum-Waterloo Hall. As things are, its estimated cost is little more than half that of its rival. It might have been considerably less. However, in spite of the fact that London may soon find itself with a superfluity of concert halls, in contrast to recent years in which there has been an absence of a single suitable building, let them be given the tools and allowed to get on with the job. Let us also keep our fingers crossed against fancy acoustics and chocolate box, dressing table, warehouse-like architectural effects.

Turntable News

"Desert Island Discs," with Roy Plomley as the Island's Governor, Commander-in-Chief and principal Travel Association agent, is a very pleasant programme deserving of wide patronage. I much admired Eric Coates's choice of discs; although a distinguished composer of light music, his selections were those of a cultivated and sensitive musician. I am sure he would not regret his stay on the island on that score.

Woman's Hour

I took the liberty the other day of peeping into that little quiet circle of things feminine known as "Woman's Hour." I suppose it must be considered one of the most consistently high-standard features in all seasons and at all times. An enormous variety of subjects are dealt with—not all of them, by any means, embarrassing to the male listener—and presented with much charm. It is very comparable to the women's columns in the daily papers. They make one wonder, seeing that women are interested and take part in every conceivable thing from Test Matches v. Australia, to joining the Cabinet, whether they are needed. Don't they just deprive the menfolk of that particular column of newspaper reading, or that hour of radio listening? But, next to "Children's Hour," which I have always considered maintains the highest day-to-day standard of any wireless feature, "Woman's Hour" is on a consistently high plane. I am sorry they have scrapped what was the best of all signature tunes.

My Job

"I Like My Job" is a series, at present limited to six instalments, which might well be continued. I heard Margaret Rawlings talk charmingly on her work as an actress, and James Langridge on his as a professional cricketer. I thought them extremely interesting, instructive and entertaining. One would easily think of another six jobs worth discussing. And I strongly urge the B.B.C. programme department to run a counter series on "I Do Not Like My Job." There is limitless scope here. Seeing that the vast majority of mankind is engaged for its daily bread in tasks ranging from the completely monotonous and deadly dull to the vile and loathsome. The series could either be devoted to an entirely fresh field of human endeavour, such as coal mining, tram driving, dish washing, road sweeping, etc., or it could be given over to the less glamorous and rewarding sides of the jobs at present being dealt with. The one stipulation, of course, is that the subject chosen to make the broadcast must loathe the job under discussion; if he, or she, after selection, were found actually to like coal mining or dish washing, then they would be packed off straight to Coventry, Halifax or Timbuctoo, made to live on bread and water, and and made to listen-in daily to "Keep Smiling."

Scrapbook

Two Scrapbooks, for 1906 and 1912 were, as usual, very good. They are, of course, a very easy type of programme to compile, the main pre-occupation being what to leave out rather than what to include. But the presentation of what is finally selected can easily be marred by wrong handling—e.g., too many old time musical comedy excerpts is always trying as the atmosphere and civilisation of those days cannot be re-created try how you will, and the result is a skeleton. So all credit to those who handle the job.

Plays

Two distinguished plays last month were, "The Way of the World," and "The Devil's Disciple." Mrs. Millamant's famous entry to the immortal lines of Mirabell, "Here she comes in faith full sail, with her fan spread and streamers out, and a shoal of fools for tenders," was completely unrealised by Griffith Jones as Mirabell, even allowing for the fact that it ought to be seen as well as heard. Hell's bells! just fancy not being able to see Mrs. Millamant! One might as well not hear Carmen or taste mint sauce. But what we heard from Hermione Hannen was very good.

Shaw's comedy of the American Revolutionary War, is melodrama, and again some of it was lost in the absence of the visual element. But it was played with great verve and gusto, and the whole went with a fine swing. Joan Hart and John Slater as Judith Anderson and Dick Dudgeon were fine.

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Impressions on the Wax

Review of the Latest Gramophone Records

ONE of the highlights of this month's releases are actual recordings of items played and sung at the opening of the Royal Festival Hall in May of this year. The hall is regarded as the finest in Europe and was opened by Their Majesties the King and Queen. Before the concert a short Service of Dedication was held. A part of this service—the hymn "All People That On Earth," with its beautiful string background—is recorded on *H.M.V. DB*21273. It is by the Royal Festival Orchestra and Choir conducted by Dr. J. Dykes Bower with Dr. W. N. McKie at the organ. "Ode of St. Cecilia's Day," played by Orchestra and Choir conducted by Sir Adrian Boult, is on the reverse side. Sir Malcolm Sargent conducts the orchestra and choir in the recording of the "Hallelujah!" and "Amen" choruses from "Messiah."—*H.M.V. DB*21274.

Although Louis Kentner is still only in his forties, he has the remarkable record of having appeared in public for over thirty years. He has made a considerable name as an interpreter of Liszt, and he has chosen this composer's "Sonata in B Minor" for his pianoforte recording on *Columbia DX*1760-2.

The partnership of Menuhin and Kentner has long been associated with a standard of performance that is exceptional. On this occasion they play the Bach "Sonata No. 2 in A Major" on *H.M.V. DB*9638-9. It is one of six works for clavier and violin written by the composer during the period 1717-1723. All six have been recorded by Menuhin and Kentner; this is the second of the series; the first was issued on *H.M.V. DB*9607-8.

To think of Delius is to remember that Sir Thomas Beecham's untiring efforts have brought the composer recognition in this country. The composer wrote his "North Country Sketches" in 1914, and each of the pieces that comprise this suite, played by the Royal Philharmonic Orchestra conducted by Sir Thomas Beecham, on *Columbia LX*1399-401, is a sound picture of the moorland scenery of Delius' native Yorkshire. The woodwind, in solos and chorus, is a delight to hear, and this recording will add considerably to the available Delius repertoire on the gramophone.

Novelty Record

An interesting release is the "Classical Juke Box," played by the Boston Promenade Orchestra conducted by Arthur Fiedler, on *H.M.V. B*10098. It is based on the recent hit tune "Music! Music! Music!" which is presented in three styles—those of "Tannhauser," "Faust" and Liszt's "Hungarian Rhapsody No. 2," to which, of course, the "Music" song owed its middle section. Juke box effects come into the orchestration. On the reverse is "The Continental."

"Where'er You Go" and "At the End of the Day," both brand new British songs, provide Webster Booth with splendid material for his latest recording on *H.M.V. B*10092. Both are the work of Donald O'Keefe—a name which masks the identity of a well-known figure in show business, who is himself a former recording artist of considerable reputation.

Variety

Described as America's greatest folk singer, Burl Ives sings two numbers on *Columbia DB*2884 that display his remarkable versatility. They are "The Little White Duck" and "There's a Little White House."

For his fourth "Dancing in the Tower" medley, Reginald Dixon has chosen a nicely balanced selection of melodies from the current hit parade, on *Columbia FB*3610.

The popular singer Alan Dean has now been signed up by His Master's Voice Company, and this month records "Come Back to Angouleme" and "If You Go." Incidentally, in the former title he sings a quartette with himself—a remarkable singing feat as well as a clever recording achievement.

The Three Suns make another excursion into Leroy Anderson's light-classical domain this month, performing his new "Syncopated Clock" piece in their well-known instrumental fashion. The coupling on *H.M.V. B*10095 is "March of the Cards" from Disney's "Alice in Wonderland."

Another newcomer to the H.M.V. lists is David Hughes, who created quite an impression in Henry Hall's Guest Night programmes. His first titles are "A Beggar in Love" and "With These Hands" on *H.M.V. B*10104.

Dance Music

Joe Loss and his Orchestra give danceable interpretations of four tuneful numbers drawn from the current list of Tin Pan Alley hits. They are "The Loveliest Night of the Year" and "Ten Thousand Four Hundred and Thirty-two Sheep" on *H.M.V. BD*6098, and "Beggar in Love" and "Choo-choo Samba" on *H.M.V. BD*6099.

Sid Phillips and his Band play "Ivory Rag" and "When You and I Were Young, Maggie" on *H.M.V. BD*6100, and Semprini introduces six popular hit tunes in his recording on *H.M.V. B*10103 of "Dancing to the Piano."

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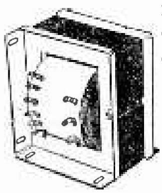

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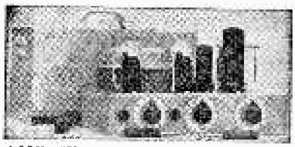

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