MAKING A 4-VALVE MIDGET PORTABLE

PRACTICAL WIRELESS

1/3

AUGUST 1957

EDITOR: F.J. CAMM

CONTENTS

PRACTICAL WIRELESS

EVERY MONTH EDITOR · F. J. CAMM 23rd YEAR OF ISSUE

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COMMENTS OF THE MONTH

BY THE EDITOR

"The Practical Householder"

OUR NEW MONTHLY MAGAZINE

THE first issue of the latest addition to our Practical Group of Journals—*The Practical Householder*—will be published on September 8th. As its name implies, it will deal with every practical aspect of the home and its equipment. It will co-ordinate the "do-it-yourself" movement which is now sweeping this country. This new and important journal will tell its readers how to wallpaper a room, tile a roof, lay linoleum, do painting, graining and decorating, repair the lawn mower, the sewing machine, the refrigerator, the vacuum cleaner; how to install and maintain electrical apparatus, how to build a shed, do household plumbing, re-upholster the suite, make furniture and other items of household equipment, how to do carpentry and metalwork, build greenhouses, sheds and garden equipment, how to re-enamel the bath, repair clocks, make jewellery, do brickwork, how to glaze windows, make pelmets, how to install and maintain a hot-water system—to mention but a few of the practical topics with which it will deal issue by issue. It will deal with the legal formalities of buying, renting or leasing a house. It will tell you how to build your own house, how to make toys for the children, how to do plastering, it will regularly review the latest tools and accessories, which a large and growing industry is now producing for those who prefer to do the job themselves. This national interest in practical work has not been brought about entirely by the high cost of material and labour. It is due to the practical training in the various crafts which people received during the war and which they put to good effect when, owing to shortage of labour and materials, they were compelled to do for themselves jobs for which they formerly engaged outside labour.

The Practical Householder advisory service will freely answer readers' questions on every practical household topic. *In these days of paper economy publishers are compelled to print only those copies which newsagents order.* Very few are supplied for chance sales. Publishers can only assess how many copies to print by totalling orders received from newsagents, and that is why it is important for every would-be reader of this important new monthly magazine to place an order now for its regular delivery, in order to avoid the disappointment experienced by tens of thousands of the public who were unable to obtain the early issues of our companion journal launched last year—*Practical Motorist and Motor Cyclist*, the sales of which now exceed 275,000 copies a month. Order your copy of *The Practical Householder* (1s. 0d. every month) now.

THE RADIO SHOW

THIS issue is on sale before the opening of the Radio Show (August 24th to September 3rd). We issue a cordial invitation to every reader to visit us at our Stand No. 107 on the ground floor, where a staff will be in attendance to answer technical queries. We shall exhibit a full range of our technical books on radio, television, electronics and engineering, as well as our group of practical journals.

FREQUENCY MODULATION

WE have been experimenting in our laboratory with F.M. units and we shall soon be publishing the results of those experiments. At present frequency modulation covers a very restricted area in this country and complete coverage will not be achieved until 1956 at least.

PRINTED CIRCUITS

WE have received some correspondence asking when we are going to produce a design incorporating a printed circuit—that is to say, a circuit the wiring of which is "printed" on to an insulated base so that the constructor merely has to bolt the components down and tune in. The matter, however, is not quite so simple as that. Most components available for home constructors are designed for mounting on a metallic chassis or baseboard. With printed circuits, special components need to be produced.

"THE BEGINNER'S GUIDE TO RADIO"

READERS will remember the series of articles entitled "The Beginner's Guide to Radio" which ran in this journal for over two years. There has been a steady demand ever since for the issues containing these articles, but all back issues are entirely out of print. We have, therefore, reprinted the series in book form and copies will be available at the end of this month. Copies cost 7s. 6d., or by post 7s. 10d. Those readers requiring copies of this limited edition should order them without delay.—F. J. C.

Round the World of Wireless

By "QUESTOR"

Network for Egyptian Police

MARCONI'S WIRELESS TELEGRAPH CO., LTD., are to supply a large quantity of radio equipment to the Egyptian Police authorities. The contract includes the supply of 221 V.H.F. mobile stations, 132 fixed-station transmitters and 139 fixed-station receivers. Also, an inter-city H.F. system has been planned involving the supply of twenty-four 500 watt transmitters together with associated H.F. receivers and receiving terminal equipments.

Gough Island Expedition

MR. P. J. MULLOCK, G3HPM, of Cambridge University Wireless Society, has been granted a licence to operate an amateur station when he leaves with the Gough Island Scientific Research Expedition.

Mr. J. B. Heaney will be in charge of the expedition. Gough Island is situated 260 miles south-east of Tristran da Cunha in the South Atlantic.

Broadcast Receiving Licences

THE following statement shows the approximate number of broadcast receiving licences in force at the end of May, 1955. The grand total of sound and television licences was 14,000,795.

Region	*Number*
London Postal	1,449,496
Home Counties	1,401,557
Midland	1,128,941
North Eastern	1,496,786
North Western...	1,150,679
South Western	937,341
Wales and Border Counties ...	584,061
Total England and Wales ...	8,148,861
Scotland	1,008,816
Northern Ireland	219,201
Grand Totals	9,376,878

R.C.E.E.A. Publicity Committee

A PUBLICITY committee has been formed for the Radio Communication and Electronic Engineering Association. The members are as follows: C. H. T. Johnson (Decca Radar, Ltd.); R. P. Raikes (Marconi's Wireless Telegraph Co., Ltd.); J. Read (Standard Telephones & Cables, Ltd.); V. M. Roberts (British Thomson-Houston Co., Ltd.); E. E. Walker (Metropolitan Vickers Elec. Co., Ltd.); and W. M. York (E. K. Cole, Ltd.). The Chairman is Mr. Roberts.

Dance Music

ON Tuesday, Thursday and Saturday nights during the summer the BBC Light Programme will broadcast three new series of dancing sessions to the music of some of Britain's top bands. The Tuesday and Thursday programmes will come from the studio, with dancing by an invited audience, and on Saturdays listeners will be taken over to ballrooms at holiday resorts.

B.R.S. Two-way Radio

WE understand that British Road Services are using two-way radio experimentally in the London area. As a result of tests in the Leicester and Liverpool areas it was found that a faster service was obtained for customers, and the control station which has been installed at Stratford will enable all vans to be controlled—other London depots being linked with control by land line.

Ekco Acquire Control of Dynatron

IT is announced that E. K. Cole, Ltd., have acquired a controlling interest in Dynatron Radio, Ltd. It is stated that there will be no change in management or policy.

Transistorised Car Radio

THE Philco company of America are proposing to introduce this autumn a fully transistorised car radio. It is stated that it will have no valves, vibrator or power transformer, will be about 20 per cent. smaller than conventional units and will withstand greater shocks and vibration. The total consumption will be between 200 and 300 mA.

Electronic Fire Detector

THE well-known Pyrene company are introducing an electronic fire detector containing a radioactive material which ionises the surrounding air, and has a dual chamber with common electrode. The circuit provides an equal voltage drop across each chamber, but smoke or gases from a fire entering the chamber result in unbalance and an alarm bell rings.

Youth Broadcasts Extended

WHEN the Younger Generation programmes return to the Light Programme in September they will be on the air every day of the week instead of only on four days as hitherto.

"Parade"—the radio conspectus of under-twenties' activities, interests, jobs and problems—will be broadcast twice a week. "Review" will also be heard on two evenings a week, one evening being devoted to current films and the other to books and a competition. A new series will be "Music Club," which will go out on Tuesdays. All these will be quarter-hour programmes.

"Question Time," which usually comes from clubs, youth hostels, or other places where young people congregate, will be heard on Sunday afternoons, while "Family Circle"—a digest of the week's programmes—will continue to be broadcast on Saturday mornings. These two series will run for half an hour.

Further details of the Younger Generation programmes, which are broadcast for and largely by under-twenties, will be given nearer the time.

R.E.C.M.F. at Copenhagen

THE Radio Component Manufacturers' Association has taken a large stand at the British Exhibition to be held in Copenhagen from September 29th to October 16th. This is intended as a prestige show for the British radio and electronic component industry. The products of between 20 and 30 prominent firms will be seen and it will be the largest display in the exhibition representative of the radio and electronics industry.

Hivac Move

HIVAC LTD., makers of the well-known Hivac valves, have moved their registered and head offices from Harrow to their factory at Stonefield Way, Victoria Road, South Ruislip, Middlesex.

BBC V.H.F. Sound Broadcasting Station in West Wales

THE BBC announces that it has placed a contract for building work at the Blaen Plwy, Cardiganshire, Television and V.H.F. Sound Broadcasting Station

with E.T. Davies and Son, Felindre Mills, Aberarth, Aberayron, Cardiganshire.

The contract covers the construction of the transmitting station building, installation of water supply and drainage, together with the provision of access and service roads and fencing.

Work is starting almost immediately and it is hoped to bring the station into service towards the end of 1956. It will serve the coastal areas around Cardigan Bay.

Provisional Figures of United Kingdom Trade in June

THE value of recorded exports in June was £157 million. This was £90 million, or over one-third, below the April/May average. The fall brought the average monthly rate for the second quarter to 12 per cent. below the first quarter.

Recorded imports in June were £293.9 million, only 3 per cent. below the April/May average. The average monthly rate for the second quarter as a whole was 10 per cent. below the first quarter. Total imports in the first half of 1955 were, nevertheless, 14 per cent. higher than in the first half of 1954.

With re-exports amounting to £8.1 million, the excess of imports, valued c.i.f., over exports and re-exports, valued f.o.b., was £128.8 million in June, compared with an average of £47.9 million a month in April/May and £77.1 million a month in the first quarter.

The extent to which the railway and dock strikes affected imports and exports cannot be assessed. The figures for the next few months will continue to be affected by the strikes as was the case after the October dock strike.

Mr. J. A. Smale

MR. J. A. SMALE, Engineer-in-Chief of Cable and Wireless Ltd., has been appointed by the Government of Cyprus to be first chairman of the new Cyprus Inland Telecommunications Authority.

The appointment is a part-time one, and Mr. Smale will continue to serve Cable and Wireless Ltd. in his present post, visiting Cyprus as necessary.

The new Authority was set up to administer and operate Cyprus's inland telephone and telegraph systems. It took over from Cable and Wireless Ltd. on January 1st. Most of the company's staff in Cyprus hitherto engaged on the work will be transferred to the Authority. Cable and Wireless Ltd. continue to be responsible for the island's external telecommunications.

Ministry of Supply Appointment

THE Ministry of Supply announce that Dr. R. Cockburn, C.B., O.B.E., has been appointed Deputy Controller of Electronics in succession to Rear-Admiral G. Burghard, C.B., D.S.O. (retired), whose tour of duty has expired.

Dr. Cockburn, who is 44 years of age, has been Principal Director of Scientific Research, Guided Weapons and Electronics, since March 1st, 1954. Before that he was Scientific Adviser to the Air Ministry.

Regentone Man Becomes A.M.I.E.M.

MR. HENRY O. THOMAS, Sales Manager of Regentone Radio and Television Ltd., has been admitted to the Institute of Export Managers as an Associate Member. He is already a member of the Sales Managers' Association.

F.M. at Science Museum

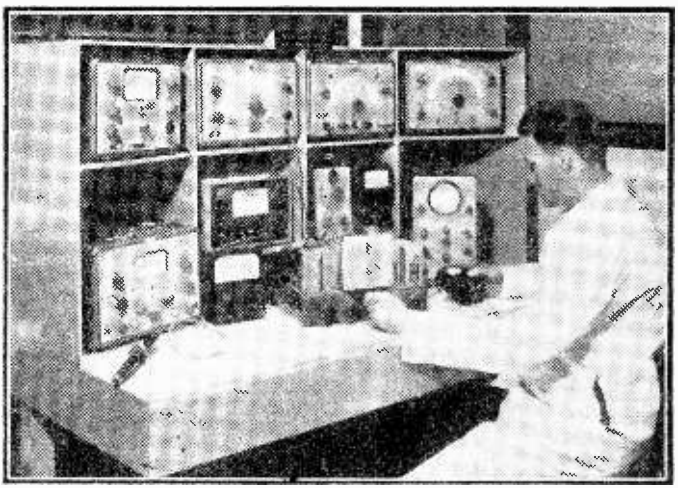
SO that the general public may be able to judge the results obtained on the new V.H.F. F.M. wavelength, a special demonstration has been arranged at the Science Museum, South Kensington. At the moment it is not proposed to make this an indefinite demonstration, but no date of closure has been announced. The museum is open from 10 till 6 on weekdays and from 2.30 to 6 on Sundays, and admission is free.

Continental U.H.F. Link

WHAT is believed to be the first U.H.F. time-charging system to link two continents was recently opened for the Compania Telefonica Nacional de España. Installed by Standard Telephones and Cables, this link handles telephone traffic between Europe and North Africa, one link being at Algeciras on the Spanish Atlantic Coast, and the other at Ceuta.

American Company to Open Here

COLLINS RADIO of America recently formed a British subsidiary to be known as Collins Radio Co. of England Ltd. The headquarters will be at West Drayton, but for the time being the company will merely act as a field service organisation for its many British customers in the communications field. No announcement can be made about manufacturing in this country.



Messrs. Taylor Electrical have designed this Test Bench for the more convenient housing of the many instruments now required by the Service Engineer in his normal work.

One Thousand Apprentices

THE Radio and Television Retailers' Association state that there are now nearly 1,000 apprentices properly indentured and registered under the National Apprenticeship Scheme. This figure has taken nearly three years to reach, and represents an intake of over 300 a year.

Using TEST INSTRUMENTS

Part 9 of a Series of Articles Dealing with the Practical Application of Standard Test Equipment

(*Continued from page 490 August issue*)

IN Part 8 of this series we considered the signal generator as an alignment aid for superhet broadcast receivers. Now, for the sake of completeness, we will briefly consider the use of such an instrument for aligning straight receivers.

Generally speaking, a signal generator is hardly necessary for this function as the circuits are usually of a simple nature ; band-pass circuits are a little more involved, however, but these can best be aligned with the aid of a wobbulator and oscilloscope (to be considered later in this series).

From the practical aspect, the receiver is generally aligned first on the medium waveband, this being due to the fact that nearly always the medium-wave trimmers remain in circuit when the set is switched to the long waveband.

A suitable dummy aerial is used to convey the signal from the generator to the aerial and earth sockets, and the appropriate trimmers adjusted for maximum output at the high-frequency end of the band. Padder capacitors are rarely used, final tracking being achieved by adjusting the split vanes on the tuning capacitors for optimum sensitivity at the lower frequency end of the band.

Band-pass coils should be adjusted so that the output falls by equal amounts when the signal generator is detuned the same number of kilocycles either side of the resonance point. Fig. 36(a) illustrates this point, where it will be seen that the frequency difference either side of the resonance point is the same when the output falls to half its peak value. An incorrectly adjusted band-pass circuit is shown by the distorted response at Fig. 36(b). Here it will be seen that the output falls rapidly at the high-frequency side of the response curve.

The response is best tested by detuning the signal generator one side of resonance until the output falls to half that at resonance, and the number of kilocycles noted. The generator should then be detuned the other side of resonance until the output falls by the same amount. If the figures so obtained differ by more than a few kc/s, the trimmers should be readjusted until a more even response is achieved.

Incorrect adjustment of the band-pass circuits often give rise to what is generally known as " double-hump " tuning, that is where a station can be tuned to maximum at two points close together on the tuning dial.

We should mention that the same effect is liable to occur on superhet receivers in which the band-pass I.F. transformers are poorly aligned. For this reason it is desirable to subject the I.F. channel to a test similar to that outlined above during the process of I.F. alignment.

Finding Unknown Intermediate Frequencies (28)

If no data regarding the alignment frequencies of a commercial receiver is available, it is often possible to obtain a good idea as to the intermediate frequency, at least. Examination of the I.F. transformer windings, generally reveals whether a " normal " or low I.F. is used. For example, in receivers using 175 kc/s I.F.s—this value frequently being found in old American sets—considerably more wire is generally used for the windings than what is now considered " average " for, say, 465 kc/s I.F.s, always provided, of course, that the trimmer capacitances are more or less equal. When using this method of acquiring a rough idea as to the intermediate frequency, due consideration must be given to I.F.s using iron-dust tuning cores, in which the inductance is brought up to the desired value by the effect of the cores themselves, meaning, of course, that they use less wire to tune a given frequency.

If it can be established that the receiver is in good working order, even though it is way out of alignment, the signal generator can be connected as for I.F. alignment. After given sufficient time to warm up properly, the generator should be slowly tuned over the accepted I.F. band, starting at, say, 500 kc/s and going down to 100 kc/s if necessary. When a signal is heard from the loudspeaker, the signal generator frequency should be carefully noted, and the search over the entire band should be continued. (It should be noted that a fairly strong generator

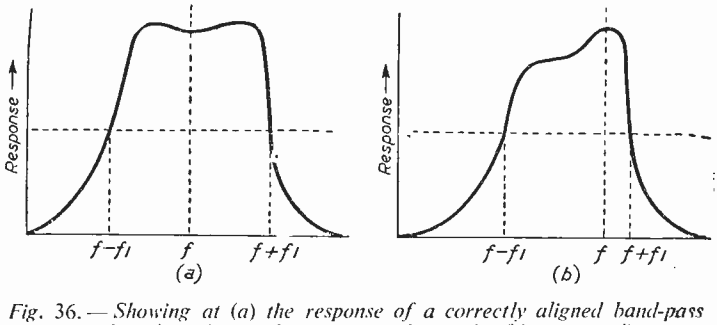


Fig. 36. — Showing at (a) the response of a correctly aligned band-pass circuit, and at (b) a distorted response as the result of incorrect alignment.

signal may be demanded to give a reasonable output from the loudspeaker, particularly if the I.F.s are grossly misaligned ; the signal should also be modulated.)

If no other signal is heard, the one noted is assumed to be the I.F., but this can be proved by adjusting the generator to exactly half the noted frequency and endeavouring to get the weaker harmonic to give rise to an output signal. As final proof, the generator should be set at double the first noted frequency, and if no signal is heard at this setting, then the first noted frequency can definitely be taken as the I.F.

It may, of course, be several kilocycles out as the result of the " range " of I.F. provided by the trimmers or iron-dust tuning cores, but if the frequency is an integer or so above or below a standard I.F., say, 463 kc/s or 467 kc/s, then 465 kc/s should be assumed as the exact I.F.

Aligning Portable Receivers (29)

With portable and " personal " receivers employing internal frame aerials, it is essential that R.F. alignment be carried out with the aerials in circuit and unloaded. This prohibits the connection of the signal generator direct, even through a dummy aerial, for this would load the aerial and circuits and give rise to detuning and mismatching.

In order to avoid these undesirable effects the generator signal must be *radiated* and picked up by the frame aerial of the receiver in the usual way. This can readily be arranged by connecting a small loop aerial across the signal generator output leads and positioning the aerial at a minimum distance of 2ft. from the receiver aerial. A disused aerial from a portable receiver is ideal for this purpose, but if such an item is not at hand, five or six turns of wire interwound on a flat cardboard former, occupying approximately the same area as the aerial in the receiver, makes a fine substitute.

Where accurate sensitivity figures are required of a portable, a more accurate and " standard " radiator is essential. A coil for this purpose has been developed by the Radio Manufacturers' Association (R.M.A.), and takes the form of a cylindrical coil, 5 cm. in radius and 16 cm. deep, wound with 20 turns to provide an inductance in the region of 40 micro-henrys. In order to prevent magnetic circuits on a plane normal to the axis of the coil, the whole coil must be shielded by means of a wire cage. Connection from the coil to the generator must also be made through screened leads (see Fig. 37).

Notes on Aligning A.C./D.C. Receivers (30)

With receivers using the A.C./D.C. technique, including certain types of " battery/mains " receivers, where the chassis is in direct contact with the mains and, therefore, liable to be " live " with respect to earth, particular care must be exercised during the re-alignment operation to prevent shock to the operator and damage to the equipment employed.

In servicing establishments it is general practice to connect such a receiver to the mains supply through a 1 : 1 ratio isolating transformer. If this method is adopted (and it is most desirable to ensure that it is) no further precautions need be taken.

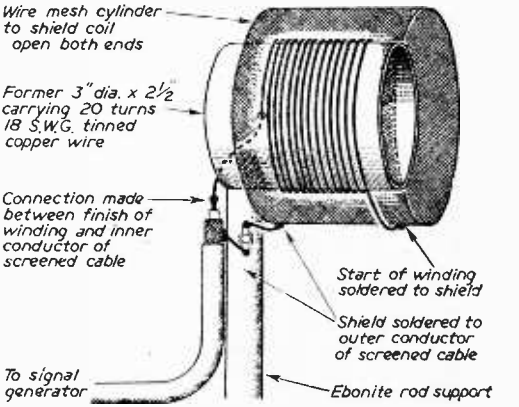


Fig. 37.—Details of a shielded coil for aligning portable receivers.

Where it is necessary to risk making adjustments to this kind of set when connected directly to the mains supply, it *must* first be established that the neutral side of the mains is connected to the receiver chassis. This can best be done by actually measuring the voltage between chassis and a *good* earth with the receiver switched on and connected to the mains ; a small neon-bulb or neon-tester occupying the same position as the meter also fairly sensitively indicates the presence of A.C. on the chassis. If the chassis is found to be " live " to earth, reversing the mains plug will nearly always put the chassis at neutral mains potential (this is usually only a few volts above earth).

If it is found that the chassis is still " live " after reversing the mains plug (this occurs on certain receivers or in certain cases where the power is obtained from a D.C. mains system), extreme care must be taken to prevent touching the chassis unless well insulated from earth—using a rubber mat to stand on and keeping one hand in the trouser pocket represent safety measures that are well worth while adopting. It is, of course, utterly pointless to stand on a rubber mat, hold a correctly earthed soldering iron in one hand and hold the chassis in the other hand. Therefore, the motto here is to keep all earthed objects well out of range of a " live " receiver and the operator.

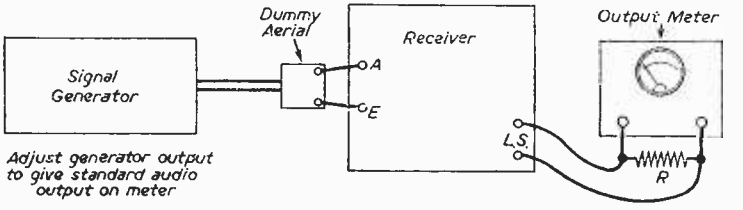


Fig. 38.—An arrangement for measuring the sensitivity of a broadcast receiver.

In all cases where an A.C. D.C. receiver, or one in which the mains is connected either directly or indirectly to the chassis, is used on the mains

without an isolating transformer, the signal generator output leads, including the screened conductor, must always be isolated from the chassis by means of good quality 0.1 μF A.C. capacitors.

Checking the Sensitivity of Broadcast Receivers (31)

For this test a signal generator and output meter are connected to the broadcast receiver as illustrated by Fig. 38. The signal generator must be correctly terminated at a dummy aerial—either a standard one or one suitable for the frequency at which the sensitivity test is to be made (see Section 26 in Part 8 of this series).

Similarly, the output meter should be matched correctly to the output stage of the receiver—resistor R, shunting the output meter, is for this purpose. We have already seen how an A.C. voltmeter (Part 5, Section 17) can be adapted to measure A.F. power, such an arrangement being quite suitable for this test, though it is always best to make use of a resistor, instead of the loudspeaker itself, for accurate loading.

The sensitivity figure is expressed in microvolts and is the least input signal which, when modulated to a depth of 30 per cent. at 400 c.p.s. and fed into the aerial and earth sockets of a receiver, will produce either a *standard* output or an output stipulated by the manufacturers.

Certain commercial receiver service data gives reference to an input voltage figure which, when the receiver is correctly aligned and working up to full standard, will produce a stipulated audio power across an output load resistor of a given value. Sometimes, instead of a power figure, an A.C. voltage figure is given which should be expected across the primary or secondary of the output transformer.

Where no figures are quoted, the *standard* output is best employed; this is 500 milliwatts for receivers capable of delivering a maximum of 1 watt or more undistorted audio power into a correctly matched resistive load, and 50 milliwatts for receivers having less than 1 watt maximum undistorted output.

It is often a good idea to check the sensitivity at three spot frequencies on each waveband; for instance, at the high frequency end, in the centre and at the low frequency end of each band. It will be found that the sensitivity varies over the tuning range of each band; this is quite normal on domestic receivers and should not be taken to indicate a fault—usually, the sensitivity is maximum at the high frequency end of the medium-wave band.

It is, of course, feasible by using the method outlined above, but injecting a signal between the control grid of the frequency changer or mixer valve and chassis, to assess the sensitivity of the I.F. channel. A test of this kind comes in useful for comparing I.F. channel circuit designs, and discovering whether an alteration in circuit make-up impairs or enhances the overall gain.

To conclude this section, we would point out that in very high gain receivers—such as communication types—appreciable noise is present in the audio section when the A.F. and R.F. gain controls are fully advanced, it being necessary, of course, to set them to this position to determine the absolute sensitivity. This noise is liable to give rise to an indication on the output meter of its own accord. This can be excluded from the sensitivity figure by adjusting the signal generator output (input to the receiver) until the difference in output with the modulation switched on and switched off is equal to the output required (for instance, the *standard* output or that quoted in the service data).

Checking Second-channel Acceptance (32)

Essentially, superhet receivers respond to two signal frequencies; one of these is, of course, the desired signal frequency; the other one, however, is a spurious response which differs from the desired signal frequency by twice the intermediate frequency. This is known as the second-channel or image (American) frequency.

The second-channel acceptance is defined as the ratio of signal voltage input at the second-channel frequency to that required at the desired signal frequency for the same output from the receiver.

The second-channel acceptance test is carried out by measuring the sensitivity of the receiver at the aerial terminal (as for Sensitivity Test), and then measuring the sensitivity with the generator set at a frequency equal to the signal frequency plus twice the intermediate frequency if the receiver local oscillator frequency is higher than the signal, or minus twice the intermediate frequency if the oscillator frequency is lower than the signal frequency. The figure so obtained divided by the normal sensitivity figure gives the second-channel acceptance ratio.

(*To be continued.*)

German Radio Exhibition

THE German Radio, Television and Phono Exhibition taking place in Düsseldorf, August 26th to September 4th, is adding gramophone products and accessories to radio and television industry, thus offering a complete view on all the markets.

Radio: The total production of German radio industry in 1954 covers a figure of 2,841,000 sets, the total amount being about 475 million D-Marks; 867,000 of these sets were exported, amounting to 30 per cent.

These figures of production and export in 1954 are the highest ever reached in the German radio industry. The coming year is also supposed to be good for trade. A figure of 1.3 million sets may be counted on, considering about 10 per cent. new sets among approximately 13 million listeners. Export is expected to increase up to 1 million to 1.2 million sets, especially in neighbouring European countries, owing to the success of good quality German sets and the lead on the ultra-short waves. Improvements, as well as novelties, in the field of individual parts and accessories will be shown.

Gramophones: The total production of the German gramophone record industry amounted to 24 million records in 1954, those of 78 r.p.m. having the largest share, namely, 18 million records. In 1956 this is expected to increase up to 30 million. This means reaching the peak production of 1928/29.

The constant development of recording sets, sound recorders and dictaphones, the sale of which has largely increased, will be shown in Düsseldorf.

Without any doubt television, now largely spread in Germany, will be the main attraction of the exhibition. Industry is estimating the further development in 1955 at 350,000 to 400,000 sets. Additionally, an increase in export up to 30,000 to 50,000 sets is expected, the figure in 1954 being 19,023.

Servicing Radio Receivers

4.—THE G.E.C. BC4850 SERIES

By Gordon J. King, A.M.I.P.R.E.

General

THE receiver is housed in an attractively louvred brown plastic cabinet; it features all-wave piano-key band switching, a variable tone control and "flywheel" tuning. Facilities for an extension loudspeaker and a pick-up are also incorporated.

The circuit is a four-valve, plus rectifier, superhet capable of supplying in the region of 3 watts to the internal 6½in. P.M. loudspeaker. Osram valves are used throughout, the line up being X61M frequency changer, KTW61 I.F. amplifier, DH63 signal detector A.V.C. rectifier and A.F. amplifier, KT61 output tetrode, and U50 H.T. rectifier.

The front end of the receiver follows conventional practice; the aerial and oscillator coils being selected by multiple switch contacts which are mechanically coupled to the piano-key band switch, the selected coils being tuned by a two-gang variable capacitor coupled to the tuning control, and an intermediate frequency of 456 kc/s being developed in the anode circuit of the frequency changer valve.

An additional piano switch, making four in all, is coupled to the main on/off switch—switch S1 in Fig. 4. The other three switches are for selecting long, medium and short waves; when a pick-up is used the receiver is switched to short-wave where there is less liability of broadcast breakthrough.

Fig. 4 shows the A.F. and power-pack sections of the circuit. It will be seen that the signal in the detector load is taken by way of the coupling capacitor C6 to the volume control R1. The desired level of A.F. can thus be taken from here and applied to the control grid of V3 (DH63). The amplified A.F. appears across the anode resistor R2 and is conveyed to the signal grid of V4 (KT61), either through C7 and S2, or, if the switch is open, through C7, C8 and R3.

Components R3 and C8 form a high-pass filter which provides a rising characteristic in the treble register; this filter is by-passed when switch S2 closes and is operated by the tone control knob. The variable tone control is the 55K resistor, R4, in series with C9 in the anode circuit of the output valve; this provides a variable degree of treble cut. Components R5 and C10, in the signal grid circuit of V4, also provide tone compensation in the form of a rising characteristic in the bass register.

Unsmoothed H.T. from the filament of V5, is applied to the output valve through a tap in the primary of the output transformer. A considerable reduction of hum disturbance results from this mode of connection as the result of cancellation of hum currents in the two primary sections.

Resistor R6 in conjunction with capacitors C2, C3 and C4 provide adequate smoothing for the 204 volt H.T. line, while resistor R7 and capacitor C1 decouple the H.T. feed to V3 anode, the frequency changer and I.F. stages. The 0.05 μF capacitor connected in parallel with C4 reduces the possibility of instability arising by reason of the inductive nature of C4.

The output valve and the triode of V3 are independently biased by R9 and R8 respectively; the A.V.C. diode of V3 and also the frequency changer and I.F. valves are in receipt of a bias potential as the result of the voltage drop across R10. Along this bias line is also taken an A.V.C. bias for the two controlled valves.

Servicing Notes

If excessive distortion occurs when the tone control switch is set to the bass lift position (i.e., when S2 closes) the trouble is nearly always caused by poor insulation in C7. This is always accompanied by V4 passing excessive cathode current and as a consequence building up to a very high temperature. The effect will also be in evidence to a lesser degree when S2 is open, though the positive potential at V4's control grid will then be somewhat less owing to the potential divider effect of resistors R3 and R11.

If there is a tendency for L.F. instability in earlier receivers in this series, the screen grid of V4 should be connected directly to the H.T. 204 volt line and the screen resistor R12 installed between V4's anode and the primary of the loudspeaker transformer. This modification has been carried out on later receivers in the series.

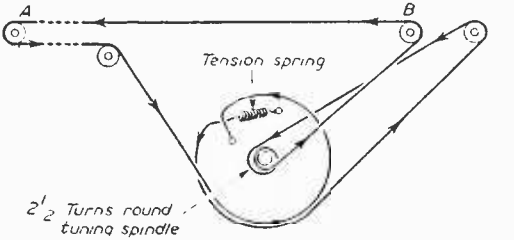


Fig. 1.—Details of the tuning drive.

A marked reduction in overall sensitivity is sometimes caused by R10 rising in value and reflecting the increase in volts drop across it to the control grids of the first two valves. This, of course, being a negative potential, relative to chassis, reduces the gain of the stages concerned.

Drive Cord

Details of the drive cord arrangement are shown in Fig. 1. If replacement becomes necessary it is best to use nylon type cord owing to its long-wearing and non-stretching nature. Approximately 66 in. of cord is required.

Before replacing, however, it is as well to make sure that the pulleys and the tuning spindle are free-running in order that full advantage may be taken of the flywheel tuning facility. This feature, of course, readily enables the tuning to be spun completely across the band by sharply twisting the tuning knob; it also has a stabilising effect on the tuning which is most desirable particularly when tuning over the short-wave band.

Only very light machine oil should be applied to the bearings and extra special care must be taken to avoid even a trace of oil getting on the tuning spindle or into the slots of the pulleys where its presence would be liable to provoke slipping of the tuning drive.

During the process of replacing the drive cord an inch length of 2mm. insulated sleeving should be threaded on the cord so that it is free to traverse between the points A and B marked on Fig. 1. It is to this sleeving that the tuning pointer should be clamped in order to avoid cutting the drive cord. The pointer should be finally clamped, not *too* tight, so that it coincides with the two dots marked on the low-frequency end of the scale when the tuning gang is fully closed.

Alignment Procedure

For alignment of the I.F. transformers a 456 kc/s modulated signal from a signal generator should be applied through an 0.1 μF capacitor to the top cap (signal grid) of the KTW61 valve. The top cap connection to the receiver should be left in position, and the "earthy" side of the generator output should be connected to chassis. The tuning gang should be adjusted to the fully closed position and the receiver switched to long-wave.

In order to eliminate alignment error as the result of the A.V.C. action it is essential to limit the audio output to a maximum of 50 mW; this limit must be imposed during the whole of the alignment process by progressively reducing the output voltage from the signal generator as the tuned circuits are brought into alignment.

We would mention that an output of 50 mW corresponds to a reading of 13.5 volts A.C. across capacitor C12 (Fig. 4); this holds good, however, only if a high-resistance A.C. voltmeter is used; a low-resistance meter will, of course, present an excessive load to the output stage and thus give rise to a correspondingly low voltage reading.

A much less sensitive A.C. voltmeter could be used as an output indicator quite accurately by connecting it across a 3 ohm resistor, which is used in place of the loudspeaker. A reading of 0.4 volt A.C. would then approximate 50 mW.

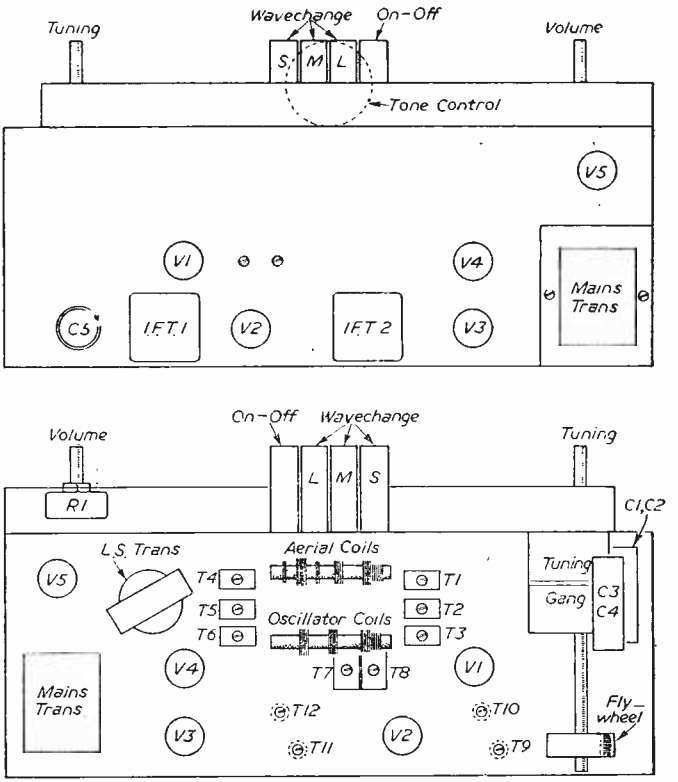
After setting up the receiver as described trimmers T12 and T11 (Fig. 3), should be adjusted, in this order, for maximum output.

The generator output, still through the 0.1 μF capacitor, should be connected to the top cap (signal grid) of the X61M valve without removing the top-cap connection from the receiver. Trimmers T10 and T9 (Fig. 3), should then be adjusted, in this order, for maximum output. This concludes the I.F. alignment.

Short-wave Alignment

For alignment of the short-wave band an 18 Mc/s modulated signal from the generator should be applied between the receiver aerial and earth sockets through a short-wave or all-wave dummy aerial and the receiver tuned to 16.7 metres (short-wave).

The oscillator trimmer T4 and the aerial trimmer T1 (Fig. 3), should be adjusted, in this order, for



Figs. 2 and 3.—Top and underside views of the chassis showing valve layout and positions of trimmers.

maximum output. It is best to start with T4 at minimum capacity and gradually increase its value until the signal is indicated; this will prevent the error of selecting the spurious response which occurs when this trimmer is adjusted towards maximum capacity. For optimum alignment of the aerial circuit the gang should be rocked about 16.7 metres when T1 is adjusted.

Medium-wave Alignment

For alignment of the medium-wave band a 1.4 Mc/s modulated signal should be applied across the receiver aerial and earth sockets through a suitable dummy aerial and the receiver tuned to 214 metres (medium-wave).

The oscillator trimmer T5 and the aerial trimmer T2 (Fig. 3), should be adjusted, in this order, for maximum output, taking care to avoid disturbing the short-wave trimmers.

Next, the generator should be adjusted to 600 kc/s, the receiver tuned to 500 metres and the medium-wave padder T8 (Fig. 3), adjusted for maximum output taking note of the output meter reading.

Final adjustment of the padder should be determined by making cursory adjustments to T8 while rocking the gang about 500 metres, the aim being to determine the setting for *maximum* reading on the output meter, even though this may not correspond precisely to 500 metres on the scale: it should, however, occur close to this wavelength.

After setting the padder it is desirable to run through the trimming operation, at the high-frequency end of the band, once again.

Long-wave Alignment

For alignment of the long-wave band a 300 kc/s modulated signal should be applied across the receiver aerial and earth sockets through a suitable dummy aerial and the receiver tuned to 1,000 metres (long-wave).

The oscillator trimmer T6 and the aerial trimmer T3 (Fig. 3), should be adjusted, in this order, for maximum output.

Long-wave padding should be carried out with the receiver tuned to 1,875 metres and the generator to 160 kc/s. T7 (Fig. 3) is the long-wave padder which should be adjusted for maximum output. This padder should also be adjusted for maximum reading on the output meter while rocking the gang, as detailed under the medium-wave section.

The alignment process is concluded by retrimming at the high-frequency end of the long-wave band after adjusting T7.

It will have been evident that the wavelength indications (in metres) correspond to the frequency indications given for each trimmer adjustment. The reason for giving both indications is to facilitate tuning both the receiver and the generator; the former generally being marked in metres and the latter in kc/s or Mc/s. It should also be noted that calibration points, corresponding to the alignment wavelengths, are marked on the receiver tuning scale.

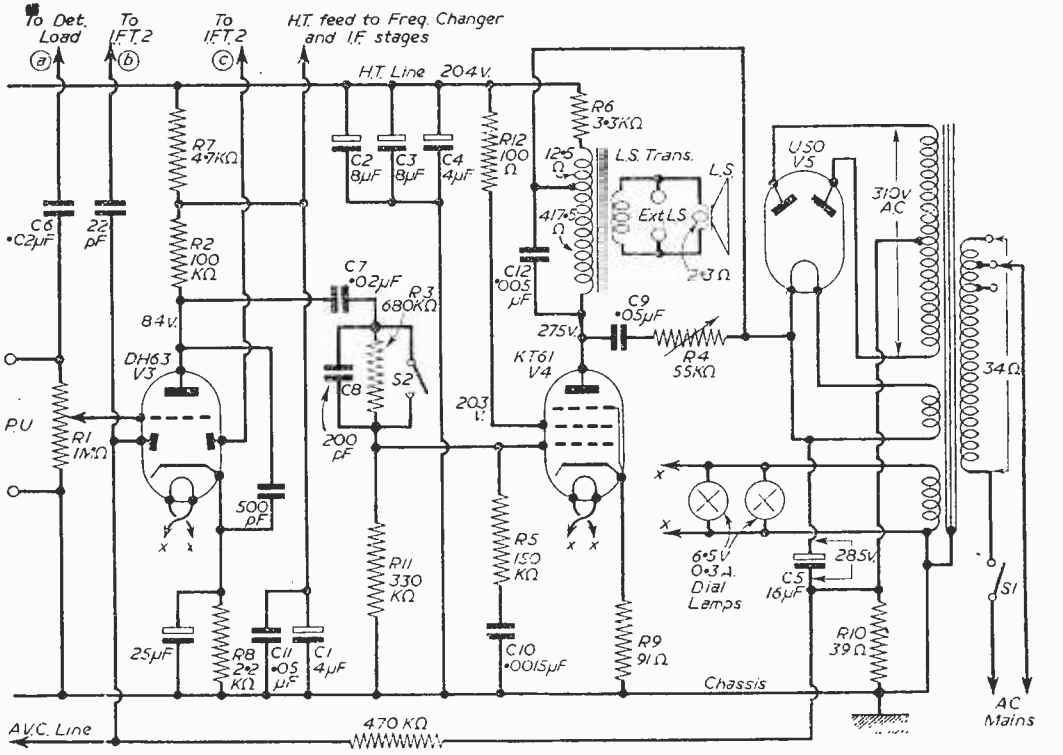


Fig. 4.—Theoretical circuit of the A.F. and Power Pack sections of the G.E.C. BC4850 series.

How Many Turns?

THE CONCLUSION OF A SHORT SERIES DESCRIBING THE HOME-CONSTRUCTION OF AIR-CORED R.F. COILS

By N. F. Back

(*Continued from page 474 August issue*)

IN practice, therefore, one very often finds a single wave-wound section used in commercial long-wave coils, an example being illustrated in Fig. 4(a). A coupling coil is also shown in this diagram. This could be used to couple the anode circuit of the preceding stage or the aerial input to the tuned coil. In its commercial form the tuned coil would be wound in a special manner which ensures that self-capacity is kept to a minimum; but it is difficult for the amateur to imitate this type of winding. When the coil is home wound, therefore, it is inadvisable to use a single scramble winding as this might introduce too much self-capacity for good results.

The difficulty may be surmounted, however, by winding the coil in several sections, or "pies," as is shown in Fig. 4(b). The individual sections are wound normally (i.e., one turn on top of another), and it will be found that the spaced construction considerably reduces the self-capacity of the completed coil.

When winding the various sections of the coil it is necessary to take care that the wire in each section travels progressively outwards as it is laid on. This will guarantee that turns on the outside of a section do not lie alongside those at the inside. The sections may be wound with one length of wire, of course, the same wire being used to start the inside of the next section as soon as the previous section is complete.

Some constructors may find it possible to make self-supporting coils in this fashion with no difficulty at all. It is usually necessary, however, to use some sort of support to keep the parts of the coil in position. Ribbed formers with slots cut in the ribs to hold the various sections provide a useful support. Again, when a smooth unribbed former is used cheeks may be mounted on the former, as is shown in Fig. 4(c). Unfortunately, this latter process is somewhat lengthy and hardly merits the time spent in cutting and fitting the cheeks.

The simplest method of keeping the sections in position on a smooth, unribbed former is to cut oblong slots in either side of the former. This may be done in a few seconds with the edge of a file. Fig. 4(d) shows the appearance of a former so treated. The sections or coils may then be wound in the slots, these keeping the wire in position.

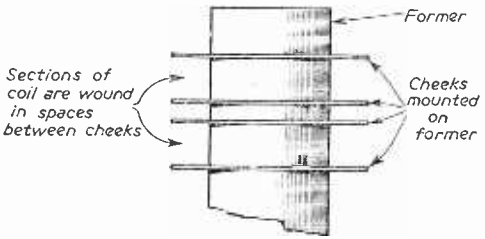


Fig. 4 (c).—Cheeks may be mounted on the former to support the sections of the coil; but this method takes time.

The Coupling Coil

The coupling coil shown in Figs. 4(a) and (b) does not need so much care when being wound as does the tuned coil. It should have about a quarter to a third of the number of turns in the tuned coil and should be positioned about ¼in. to ½in. away from the "earthy" end of it.

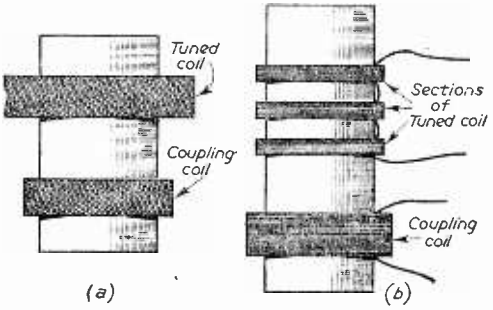


Fig. 4 (a) and (b).—A commercial wave-wound coil. In home-wound coils it is advisable to reduce self-capacity by winding the tuned coil in sections, as shown here.

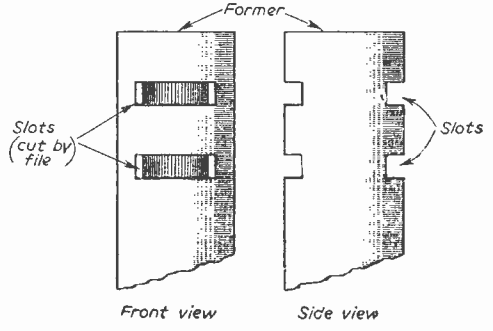


Fig. 4 (d).—Showing how slots may be cut in the former.

The wire used for the long-wave coil should have a thickness of between 32 to 38 s.w.g. (a thinner wire may introduce losses), and should preferably be d.s.c. (double silk covered) or d.c.c. (double cotton covered). Enamelled wire can be used, but it will increase the self-capacity.

Calculating the Turns

We have not as yet given a detailed description of the method of calculating the number of turns required for a wavewound (particularly a sectionalised wave wound) coil from the formulæ given in last month's article. Therefore, whilst discussing the construction of long-wave coils, it would not be out of place to give a quick example here. As was pointed out last month, we require only a rough idea of the number of turns needed, the coil being finally "pruned" with the aid of a signal generator.

If a coil which is in parallel with the normal 500 $\mu\mu$F tuning capacitor is intended to cover the long-wave band of 1,000 to 2,000 metres its inductance would need to be approximately 2,200 μH. Let us assume that we are going to wind such a coil on a 2in. former, using sectionalised windings as shown in Fig. 5. We decide to make the length of the winding, when completed, about 1in. Unfortunately, we have to make a guess at the *depth* of the winding (see Fig. 5), but we may be fairly certain that it will be around $\frac{1}{8}$in. (It may be seen that, so long as it is

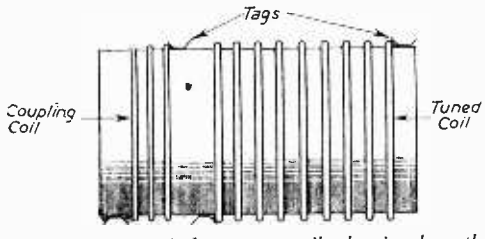


Fig. 6.—A typical short-wave coil, showing how the turns are spaced.

small, the depth of the winding does not have a great effect on the final result given by the formula, and so approximations may be used which do not impair the accuracy to any large extent.) If we take the depth of the winding as being $\frac{1}{8}$in. the average diameter of the coil then becomes $2\frac{1}{8}$in.

The formula we shall use is that which was given in last month's article:

$$n = \frac{5L\,(3a + 9b + 10c)}{a}$$

where L = inductance in μH
a = average diameter of the coil in inches
b = length of winding in inches
c = depth of coil in inches
and n = number of turns.

Substituting in the formula, we get:

$$n = \frac{5 \times 2{,}200\,(3 \times 2\frac{1}{8}) + (9 \times 1) + (10 \times \frac{1}{8})}{2\frac{1}{8}}$$

$$= 200 \text{ approx.}$$

As we are using sectionalised windings the inductance of the coil will probably be slightly smaller than if one continuous winding were used (as is assumed in the calculations given above). There is, in addition, the fact that we shall correct the inductance of the coil, when completed, by removing some of its turns. In practice, therefore, we would wind somewhat more turns on the coil than are given by the formula. For instance, we could start by putting 240 turns on this particular coil. These could be accommodated on the former as either three sections of 80 or four sections of 60 turns. When it is required to remove a few turns during the final process of correcting the inductance they may then be taken from the section with which the coil was completed.

Medium-wave Coils

Medium-wave coils (200 to 550 metres) may be made either in solenoid form or in sections. It is

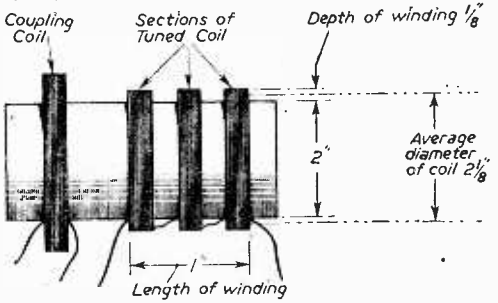


Fig. 5.—Illustrating the long-wave coil mentioned in the text. (The coil need not necessarily have three sections; four could be used in this case, if desired.)

usual to use the solenoid type of winding with formers whose diameter is $1\frac{1}{2}$in. or more. The sectionalised construction may be used with formers down to about $\frac{3}{4}$in. diameter. It will be found that the larger solenoid-wound coils will have a higher "Q": although, of course, they will naturally take up more chassis space.

The wire used for the coil should preferably be D.S.C. or D.C.C., although enamelled wire may again be used if the other types are not available. The gauge of the wire needed will vary according to the size of the former and the type of winding employed, but it should not be thinner than 36 s.w.g.

Short-wave Coils

Short-wave coils require a good deal of care in their construction as it is possible considerably to reduce their efficiency if sufficient attention is not paid to details of design.

Once again it is usually worth while making these coils as physically large as possible, since this will result in increased "Q."

Air-cored short-wave coils used below 70 metres or so should always be solenoid wound: and, in order to reduce the self-capacity the turns should be spaced (usually by approximately the thickness of the wire). Fig. 6 shows an example of this type of winding. The coupling coil need not necessarily have its turns spaced as much as those of the tuned coil itself. It should have one-third to one-quarter of the number of turns used for the tuned coil and should be mounted at the "earthy" end.

When small compact coils are used it is sometimes found that it is impossible to obtain sufficient coupling with the winding layout shown in Fig. 6, and a tighter coupling is is employed in its place. Fig. 7

shows how this may be done. It will be seen that the coupling coil is now wound between the turns of the tuned coil. To reduce capacity effects to a minimum the coupling coil is wound with very thin wire (40 s.w.g. or thinner). It should also be d.c.c. or d.s.c. to ensure that the insulation between the coupling coil and the main tuned coil is sufficient to stand any differences in D.C. potential which may be impressed upon the two (as would occur when the coupling coil was connected in the anode circuit of a previous valve).

The wire used for the tuned coil should preferably be enamelled ; although tinned copper, etc., may be used as an alternative. It should be as thick as possible and may range between 16 to 26 s.w.g.

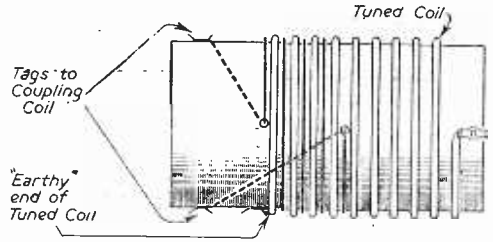


Fig. 7.—When a tighter coupling than that shown in Fig. 6 is required the coupling coil may be interwound with the tuned coil.

according to the size of the coil and the space consequently available on the former.

As only a relatively few turns are needed for short-wave coils it is advisable to see that they are wound securely. A useful idea for doing this is suggested in Fig. 8. The wire with which the coil will be wound first of all has one end secured in a vice. The other end is then stretched very slightly by means of a pair of pliers, whereupon it will be found that any kinks or twists in the wire disappear. The free end is then anchored to its appropriate place on the coil former and the coil is wound by twisting the former towards the vice, maintaining a constant tension all the time.

As mentioned above, the formulæ given in the first article in this series can be applied very accurately to short-wave coils, and it should not prove necessary to resort to the small experimental corrections on the completed coil which were required for medium and long wave coils. It should also be pointed out that when fewer than 20 turns are needed for the coil it is advisable to wind the coil to the nearest *fraction* of turn instead of to the nearest complete turn.

Superhet Coils

Up to now we have considered the methods of making coils intended mainly for receivers of the straight type. Let us now see how these methods may be applied to coils for superhet receivers.

It will be found that it is just as simple to wind coils for superhets as it is for straight sets. The only differences which will be encountered lie in the fact that the coil for the oscillator has to cover a range removed from that of the appropriate R.F. or signal-tuned circuits. The best method of making the coils consists of winding the oscillator coil first, adjusting it to cover the correct frequencies and then winding the aerial or signal frequency coils afterwards. It should be pointed out that it is always advisable to use variable padding in superhets fitted with home-wound coils, since this allows greater adjustment for any possible discrepancies in inductance to be made.

The oscillator coil should first of all be wound to the approximate number of turns as given by the formulæ, using the procedure mentioned earlier. It should then be checked for frequency coverage at the low-frequency end of the band which it is intended to cover. For this test the padder should be temporarily replaced by a fixed capacitor approximately equal to the value which would normally be needed for the particular range in question. To make the oscillator coil function it will, of course, be necessary to connect it to four temporary leads from the receiver instead of the two previously used, so that the feedback coil may be coupled to the appropriate oscillator circuit in the receiver.

Once the coil has been so connected it may be checked for frequency by applying the output of a modulated signal generator between the signal grid of the frequency changer and chassis ; listening for the modulation in the output of the receiver. The signal generator should then indicate the frequency at which the coil is oscillating minus that of the I.F. stages (assuming that these have been correctly aligned beforehand). The frequency registered by the signal generator will be the same as that received by the set when the R.F. coil (or coils) is fitted. Once the coil has been modified until it responds accurately at the low-frequency end of its range the tuning

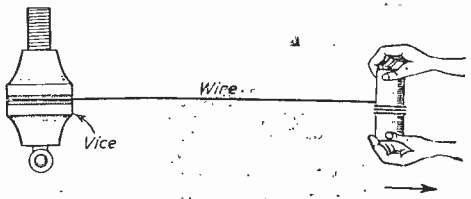


Fig. 8.—A suggested method of winding short-wave coils.

capacitor should be taken to the high-frequency end whereupon the frequency at which the receiver responds at this position should be available within the range of the parallel trimmer.

When the oscillator coil has been completed it should be mounted on the chassis and connected to its permanent variable padder ; this being adjusted to give approximately the same results as were given by the temporary fixed capacitor. The signal frequency coil or coils may then be fitted, using the same procedure as for the straight receiver. It should be remembered that it will probably be necessary to make slight adjustments to the padder before perfect tracking is finally achieved.

This procedure should not be required when making coils for short-wave superhets, since it is possible to obtain accurate short-wave coils using formulæ alone.

Fitting the Completed Coil

It was stated above that the coil is checked and adjusted for accuracy while it is connected temporarily to the equipment in which it will be used by means of short external leads.

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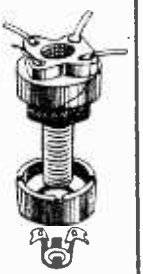

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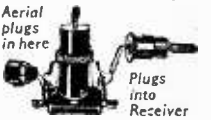

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Airmec, Ltd. ...	High Wycombe, Bucks.	108
Antiference, Ltd.	Bicester Rd., Aylesbury, Bucks.	64
Argosy Radio-vision, Ltd.	Argosy Wks., Hertford Rd., Barking, Essex	35
Arrell Electrical Accessories, Ltd.	Vincent Wks., New Islington, Manchester, 4	111
Assimil (England), Ltd.	10, Pembridge Sq., W.2	312
Automatic Coil Winder & Elec. Equip. Co., Ltd.	"Avocet Hse.," 92-96, Vauxhall Bridge Rd., S.W.1	116
Balcombe, Ltd., A. J.	52-58, Tabernacle St., E.C.2	21
Belling & Lee, Ltd.	Gt. Cambridge Rd., Enfield, Mddx.	46
British Communications Corporation, Ltd.	Second Way, Exhibition Grounds, Wembley, Middx.	217
Bulgin & Co., Ltd., A. F.	By-Pass Rd., Barking, Essex	59
Bush Radio, Ltd.	Power Rd., Chiswick, W.4	22 & 57
Champion Elec. Corpn., Ltd.	Champion Wks., Drove Rd., Newhaven, Sussex	62
Channel Electronic Industries, Ltd.	Princess St., Burnham-on-Sea, Somerset	212
Cole, Ltd., E. K....	Ekco Wks., Southend-on-Sea, Essex	12 & 121
Collaro, Ltd. ...	Ripple Wks., By-Pass Rd., Barking, Essex	39
Co-operative Wholesale Society, Ltd.	1, Balloon St., Manchester	60
Cosmocord, Ltd.	700, Gt. Cambridge Rd., Enfield, Middx.	201
Cossor, Ltd., A. C.	Cossor Hse., Highbury Grove, N.5	23
Cossor Instruments, Ltd.	Cossor Hse., Highbury Grove, N.5	114
Decca Record Co., Ltd.	1-3, Brixton Rd., S.W.9	32
Domain Products, Ltd.	Domain Wks., Barnby St., N.W.1	305
DubilierCondenser Co. (1925), Ltd.	Ducon Wks., Victoria Rd., North Acton, W.3	221
Dynatron Radio, Ltd.	"The Firs," Castle Hill, Maidenhead, Berks.	24
E.A.P. (Tape Recorders), Ltd.	546, Kingsland Rd., E.8	303
E.M.I. Institute, Ltd.	10, Pembridge Sq., W.2	311
E.M.I. Sales & Service, Ltd.	Hayes, Middx.	215
Edison Swan Electric Co., Ltd.	155, Charing Cross Rd., W.C.2	58
Electric Audio Reproducers, Ltd.	17, Little St. Leonards, S.W.14	216
English Elec. Co., Ltd.	Marconi House, 336-7, Strand, W.C.2	31
Ever Ready Co. (G.B.), Ltd.	Hercules Place, Holloway, N.7	54
Ferguson Radio Corp., Ltd.	105-109, Judd St., W.C.1	14 & 103
Ferranti, Ltd. ...	Hollinwood, Lancs.	13 & 120
Garrard Eng. & Mfg. Co., Ltd.	Newcastle St., Swindon, Wilts.	47
General Elec. Co., Ltd.	Magnet Hse., Kingsway, W.C.2	37
Gibbs, Ltd., Herbert, E.	First Avenue, Montague Rd., Edmonton, N.18	209
Goodmans Industries, Ltd.	Axiom Wks., Wembley, Middx.	20
Gramophone Co., Ltd.	Hayes, Middx.	48 & 49
Hart & Co., Ltd., Alfred	249, Upper St., N.1	210
Hartley Baird, Ltd.	Princess Wks., Brighouse, Yorks.	52
Hunt (Capacitors), Ltd., A. H.	Bendon Valley, Garratt Lane, Wandsworth, S.W.18	8
Iliffe & Sons, Ltd.	Dorset Hse., Stamford St., S.E.1	202
Invicta Radio, Ltd.	100, Gt. Portland St., W.1	53
J. Beam Aerials, Ltd.	Weedon Rd. Estate, Northampton	104
Kolster-Brandes, Ltd.	Footscray, Sidcup, Kent	16
Labgear (Cambridge), Ltd.	Willow Place, Cambridge	204
McMichael Radio,	190, Strand, W.C.2	40
Marconiphone Co., Ltd.	Hayes, Middx.	50
Masteradio, Ltd.	10-20, Fitzroy Place, N.W.1	36
Matthews (Radio & TV), Ltd.	419, Old Ford Rd., Bow, E.3	211
Mullard, Ltd. ...	Century Hse., Shaftesbury Ave., W.C.2	18
Multicore Solders, Ltd.	Maylands Ave., Hemel Hempstead, Herts.	63

Name	Address	Stand No.
Murphy Radio, Ltd.	Welwyn Garden City, Herts.	29
NEWNES, LTD., GEORGE	**Tower Hse., Southampton Street, W.C.2**	**107**
Pam (Radio & T/V) Ltd.	295, Regent St., W.1	61
Pamphonic Reproducers, Ltd.	17, Stratton St., W.1	34
Peto Scott Elec. Instruments, Ltd.	Weybridge Trading Estate, Surrey	55
Philco (Overseas), Ltd.	Romford Rd., Chigwell, Essex	15
Philips Elec., Ltd.	Century Hse., Shaftesbury Ave., W.C.2	27 42 & 43
Pilot Radio Ltd. ...	Park Royal Rd., N.W.10	56
Plessey Co., Ltd....	Vicarage Lane, Ilford, Essex	122
Portogram Radio Elec. Ind., Ltd.	Preil Wks., St. Rule St., S.W.8	65
Pye, Ltd.	Radio Wks., Cambridge	30
RCA Photophone, Ltd.	36, Woodstock Grove, Shepherds Bush, W.12	110
"PRACTICAL WIRELESS" AND "PRACTICAL TELEVISION"		**107**
Radio Gramophone Dev. Co., Ltd.	Eastern Av. West, Mawneys, Romford, Essex	11
Radio Society of Great Britain	New Ruskin Hse., Little Russell St., W.C.1	310
Regentone Radio & Tel. Ltd.	Eastern Avenue West, Mawneys, Romford, Essex	38
Roberts' Radio Co., Ltd.	Creek Rd., East Molesey, Surrey	117
Rola Celestion, Ltd.	Ferry Wks., Thames Ditton, Surrey	17
Rudman, Darlington (Electronics), Ltd.	Wednesfield, Staffs.	208
Sapphire Bearings, Ltd.	96a, Mount St., W.1	304
Simon Equipment, Ltd.	Recorder Hse., 48-50, George St., W.1	10
Sobell Industries, Ltd.	Langley Park, Slough, Bucks.	19
Specto, Ltd. ...	Vale Rd., Windsor, Berks.	206
Standard Tel. & Cables (Brimar), Ltd.	Brimar Vale Division, Footscray, Sidcup, Kent	1
Standard Tel. & Cables, Ltd. (SenTerCel)	Connaught Hse., Aldwych, W.C.2	119
Stella Radio & Tel. Co. Ltd.	Oxford Hse., 9-15, Oxford St., W.1	51
Tape Recorders (Electronics) Ltd.	3, Fitzroy St., W.1	66
Taylor Electrical Instruments, Ltd.	Montrose Ave., Slough, Bucks.	6
Telegraph Condenser Co., Ltd.	North Acton, W.3	45
Telerection, Ltd....	Antenna Wks., St. Paul's, Cheltenham	7
Telequipment, Ltd.	1319a, High Rd., Whetstone, N.20	105
Television Society	164, Shaftesbury Ave., W.C.2	315
Trix Elec. Co., Ltd.	1-5, Maple Place, Tottenham Court Rd., W.1	26
Ultra Elec. Ltd. ...	Western Ave., Acton, W.3	41
Valradio, Ltd. ...	New Chapel Rd., Feltham, Middx.	118
Vidor, Ltd. ...	West St., Erith, Kent	28
Westinghouse Brake & Signal Co., Ltd.	82, York Way, King's Cross, N.1	101
Whiteley Elec. Radio Co., Ltd.	Mansfield, Notts.	25
Wolsey Television, Ltd.	43-45, Knight's Hill, S.E.27	5
Wright & Weaire, Ltd.	131, Sloane St., S.W.1	218

Radio and TV Sales

THE British Radio Equipment Manufacturers' Association makes the following statement:

"In the light of additional information received, including late returns, the April estimates of dealers' radiogram and television set sales have been raised by 3,000 to 16,000 and by 4,000 to 75,000 respectively. The radio receiver estimates remain unaltered at 79,000.

"Radio receiver sales in May totalled 73,000; this is a high level of sales for the time of year, and the relatively small reduction from April of 6,000 sets may perhaps be attributed to the increased public interest in portable receivers.

"Sales of radiograms have also continued at a high level, amounting to 15,000 units for the month, a decline of 1,000 from April or a fall of 6 per cent. compared with a fall of 8 per cent. for radio.

"Television sales, however, fell by 11,000 units (15 per cent.) to 64,000 as compared with a fall from March to April of 10,000 sets (12 per cent.), a seasonal trend which could be expected.

"The percentage of television sets sold in May on hire purchase or credit remained at 59 per cent., the same as in April, but h.p. sales of radio receivers rose from 42 per cent. to 43 per cent., while the radiogram percentage increased from 63 per cent. to 68 per cent."

RETAIL SALES

1955	Radio	Radiograms	Television
January ...	98,000	35,000	103,000
February ...	99,000	33,000	98,000
March ...	95,000	24,000	85,000
April ...	79,000	16,000	75,000
May ...	73,000	15,000	64,000

CREDIT TRANSACTIONS

Product	H.P. or Credit as per cent. by numbers of total sales March	April	May
Receivers	41%	42%	43%
Radiograms... ...	62%	63%	68%
Television	59%	59%	59%

On Your Wavelength

BY THERMION

W. Graham Again

AS a postscript to this subject, to which I shall not refer again, I want to deal with some of the letters I have received from readers. In fairness to them, they are entitled to have their say, but it must not be concluded that I subscribe to any of their views. I am referring, of course, to those who have criticised my viewpoint, and not to those, certainly in the majority, who agree with my comment. It is clear that Mr. Graham was invited over here by the Evangelical Alliance which represents Christians of all denominations. Mr. Graham is a Minister of the Southern Baptist Church of the U.S.A., and he holds the Ph.D. degree of one of the American colleges.

Most of my critics have set views and their minds are closed books. My main criticism was that it was an error of judgment of the BBC to give so much programme time to Mr. Graham, the organisation of whose mission smacked more of a circus and film publicity than a religious crusade. If the crusade was necessary it should have been undertaken by the Church of England or any other church, not by inviting Graham over here. The impression is created that he can do what no preacher in this country can. Whirlwind tours and spell-binding oratory are not necessary appendages to evangelism. It is a personal prejudice, but I do not like preachers who assume contractions of their Christian names, like Dick Shepherd—or Billy Graham. Such contractions are more suitable for BBC and stage comedians or even film stars, who should not be aped by those preaching the Gospel.

Personal Receivers

APROPOS my note in the June issue on Midget receivers, I am reminded by a South African reader of the Regency Transistor radio, which has the advantage of operating on either a loudspeaker or on earphones. It is a genuine midget and although I have not handled one, I should be delighted to hear from readers who have.

Most of the personal receivers I have tried have suffered from one or more of the following defects: poor quality of reception; bulkiness; and short battery life. The latter is understandable and so is the former to some extent, but regarding bulkiness I see no reason for it, for there are plenty of midget components such as valves, resistances, condensers, transformers, speakers and valveholders available today. Essentially, the valves must operate at low H.T. voltage, and of all the designs submitted to me by readers none fulfils my ideal of a really personal and compact pocket receiver.

A Critic Answers

I HAVE received a hectoring and peevish note from Mr. F. G. White, of Golders Green, N.W.11, who refers to articles which have appeared in this journal. He says that Mr. Sellwood's direct-coupled cathode follower was first described by Williamson in a contemporary, "thus pre-dating P.W. by over six years." Could any argument be more fatuous? Most of the basic circuits are as old as the proverbial hills, and not the special invention or copyright of any particular journal. Had Mr. White more diligently followed our pages, he would have found that this circuit has been given in these pages on a number of occasions. He criticises Mr. Sellwood's amplifier and expresses the view that it would seem that the negative feedback does little to improve quality. Otherwise C2 and VR2 would not be effective as scratch filters and that the good quality owes its origin to using high power valves to give low output and not to the use of feedback. The particular maggot which is agitating Mr. White's mind, however, seems to be the comments of one or two correspondents on the competence of "professionals." He says, quite erroneously, that Mr. Kerslake is "wasting his time on cathode follower output stages, when they were shown to be impracticable as long ago as 1944, in the columns of a contemporary." Because a contemporary says that these ideas are impracticable, it does not make them so. Whilst this journal does not hesitate to publish letters of criticism of any of its articles it certainly does not intend to take as a guide opinions expressed in other journals, which are quite often in error themselves, anyway. Otherwise there would be no need for errata notices! Mr. White could not have been a very thorough reader of our correspondence pages, for where necessary credit is given to the inventors of particular circuits. Mr. Williamson's name is not unknown, for example, to the columns of this journal. Mr. White seems to have a very jaundiced outlook!

It is particularly necessary when acting as a critic to approach the subject under criticism with an unbiased mind, and to be particularly certain of your facts. Inventors of circuits who write in praise of their brain children often enthuse in the early days of their performance, but later change their minds, and are self-critical of their earlier efforts. We do not have to doff our hats every time we deal with a tuning circuit and acknowledge that it was produced by Sir Oliver Lodge, nor do we have to state every time we refer to a valve or a tuning coil that they were produced largely as a result of the work of Edison, Fleming, and DeForest. All of the amplifiers to which my correspondent refers make use of basic discoveries which are not acknowledged—nor need they be. Where matters are common knowledge, acknowledgment is unnecessary. I have dealt with this reader's letter at some length as a guide to other critics who may feel disposed to dash off letters of criticism couched in didactic terms before making certain that they understand the subject that they criticise. Additionally, they should read the correspondence columns to make sure the subject they criticise has not already been aired. Whilst I am on this subject, may I say that I throw into the wastepaper basket any letter which "dares" me to publish it

Switched Auto Station Selection

SOME INTERESTING APPLICATIONS OF MECHANICAL TUNING

THE convenience, accuracy and ease of tuning afforded by some form of push-button or automatic station selection is a great advantage, and methods employing switching are simplest to apply. Usually, there is little real advantage in providing for more than about five stations in this way, so that large push-button or other switches are not really necessary. The great advantage of auto selection lies in the immediate and accurate tuning of those stations most frequently chosen. For example, Light, Home and Third Programmes, with possibly one or two overseas stations. Other transmitters can at any time be selected by manual tuning if this is provided.

An existing receiver can frequently be modified to incorporate a suitable circuit. Either a push-button unit or a rotary switch can be employed, and that chosen depends largely on personal preference and the space available.

Pre-set Capacitor Selection

This is the simplest method to employ, especially with an existing receiver, and is shown in Fig. 1. Here, a rotary switch is used, but a push-button switch would be equally suitable.

When the switch is in one position the .0005μF gang condenser is in circuit, and tuning is carried out exactly as usual. Any station tunable can thus be received when occasion arises. In any of the three remaining switch positions a pair of pre-sets is brought into circuit. These are adjusted to tune in accurately the desired stations. These stations can then be obtained quickly and exactly by turning the switch to the appropriate position. The other component values are given for guidance and are suitable for the valves shown. Other valves would be equally suitable, including battery-operated types, with appropriate supplies. Coils with a different form of coupling are also satisfactory.

Little difficulty arises in the actual construction of such a circuit, but it is necessary to keep the switch and condenser leads reasonably short. Leads, etc., in the aerial circuit should also be well removed from those in the detector circuit. If this is impossible screening may be necessary to avoid instability at maximum volume.

If a local-station quality receiver is being made, the gang condenser can, of course, be omitted, tuning being by pre-sets only.

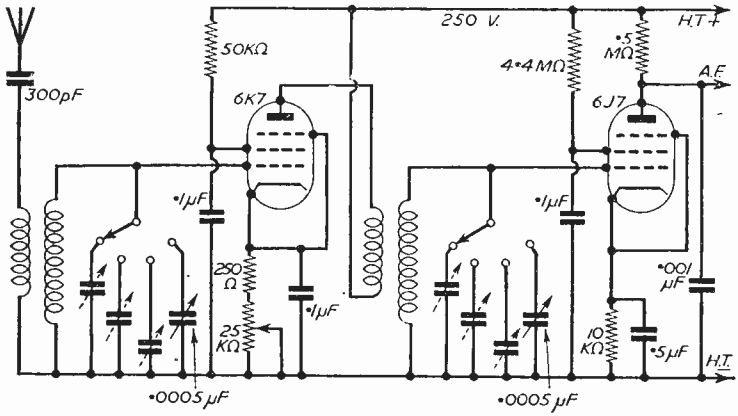


Fig. 1.—Switch selection with T.R.F. circuit.

Fig. 1 provides for medium waves only. Long waves can be obtained by using dual-range coils. A separate wavechange switch can be used with these, though it is desirable to arrange matters so that the pre-selected stations are always obtained at once if the system is to be fully satisfactory. This can be done by using a switch with an additional wafer, or set of contacts, for each coil, as shown in Fig. 2. Here, the aerial coil is switched to medium waves while any of four pre-sets are selected. This provides for four medium-wave stations. In the last switch position, the coil is operating on long waves, the last pre-set being adjusted for the desired station (e.g., Light Programme). This is desirable in parts of the country where medium waves alone are insufficient. The circuit would be duplicated in the detector section.

With Individual Coils

Commercial receivers not infrequently employ separate pairs of coils for each pre-selected station, the coils usually being slug-tuned. This has the advantage that fewer switch contacts are required for dual-wave operation. Such a circuit for superhet use is shown in Fig. 3. No further switching is required for coil changing, since the coils will be

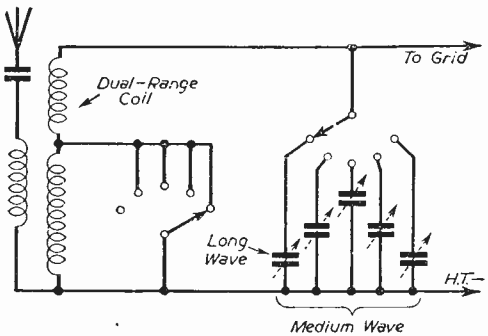


Fig. 2.—Circuit for dual-wave operation.

wound for medium or long waves as the case may be. Small fixed condensers are often wired in parallel with the coils. These may be chosen according to the wavelength in view.

Such a circuit is equally simple to build and is very convenient when both wavebands must be used. In Fig. 3, bottom-end coupling is shown. C1 is the aerial coupling condenser, usually about .002μF. C2 is the oscillator bottom-end condenser, usually of similar value, while C3 is the feedback condenser of about .0005 to .001μF. Coil makers usually specify the correct values which should be employed. Other types of coil may be used, but will in some cases introduce extra switching.

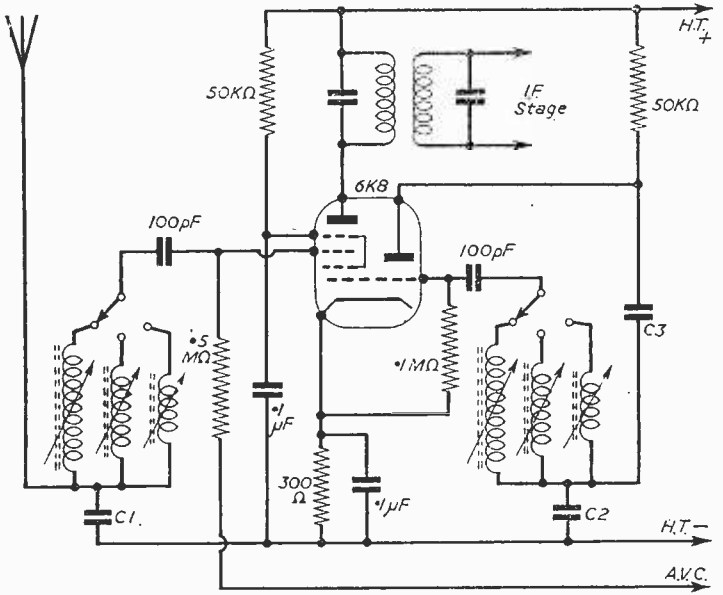


Fig. 3.—Individual coils in superhet circuit.

Push-button Units

These are available with a number of buttons, usually between five and 12. Often unwanted buttons can be used for other purposes, as for Radio/Gram switching. In addition to having a suitable number of buttons the switch should be chosen with a contact assembly to suit the circuit in view. Some very simple switches have a single-pole change-over action only. For the usual R.F. detector type of T.R.F. receiver, or superhet without R.F. stage, a double-pole change-over action is required. Other switches have up to four poles per button and may be required with more elaborate circuits.

In Fig. 4 a five-button, double-pole switch is shown. When the top button is pressed, manual tuning is obtained. The next three buttons select medium-wave stations. The lowest button switches the coils to long waves and brings in the two pre-sets required for the chosen long-wave station. This is the equivalent of the complete circuit shown in Fig. 2. Additional poles are not required for wavechanging because the coils are switched to medium waves when the long-wave push-button is out.

Superhet Use

Though Figs. 1 and 2 show T.R.F. circuits they are equally suitable for superhet circuits. The detector coils would then be replaced by the usual oscillator coils. Similarly, the circuits in Figs. 3 and 4 may be employed in T.R.F. receivers with matched coils instead of aerial and oscillator coils.

When manual tuning is to be provided in a superhet care must be taken to have in circuit the correct

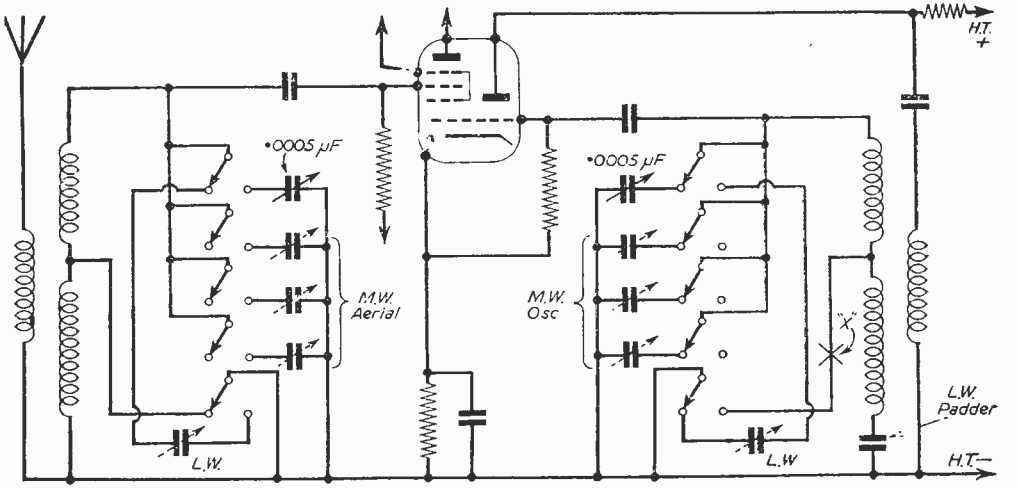


Fig. 4.—Push-button type switching.

oscillator padder as specified by the coil makers. Frequently a different value is required for the medium wave-band, and it may need to be included at " X " in Fig. 4. With individual coils, as in Fig. 3, and manual tuning, padding condensers may be included between the coils and C2.

When stations are to be selected by pre-set condensers only the use of a correct padder is less essential, as results will be satisfactory if the oscillator coil can be tuned to the correct frequency. For this reason it is sometimes possible to omit the padders when pre-set tuning only is required. It will then be necessary to adjust the pre-sets to a somewhat lower value than would be required if the padders were present.

Pre-set Condenser Values

For both medium and long waves a tuning capacity of about .0005μF is usual, but .0005μF pre-sets are not suitable for all stations which may be required, due to their high minimum capacity. For this reason .0005μF pre-sets are only suitable for about 350 to 550 metres on the medium waves and 1,200 to 2,000 metres on the long waves. For lower wavelengths pre-sets of .0002μF maximum capacity will be satisfactory. If, however, stations at the extreme bottom of the band are required, even these condensers may have too high a minimum value. To avoid any difficulty from this, 50 pF pre-sets can be used for about 200 to 230 metres, with 100 pF pre-sets for up to 275 metres or so.

The exact band tunable with any given pre-set will depend on the coils and other factors. Usually, however, no difficulty will arise if the foregoing is kept in mind. If necessary the capacity may be reduced by removing one or more plates.

The pre-sets should be adjusted with a fully insulated tool—a length of ebonite rod is satisfactory. After initial adjustments each station should be tuned in exactly and carefully. Unless the receiver is modified, or other changes arise, the stations will then be available, accurately and at once, upon operating the switch.

News from the Clubs

PROPOSED FORMATION OF A RADIO CLUB IN SWINDON

IT is proposed to hold a meeting with the object of forming a Radio Club in the town. Radio amateurs, short-wave listeners, constructors—in fact anyone interested in radio is invited to attend.

The date is August 31st, 1955, 7.30 p.m. at Connaught Café, 34, Cromwell Street, Swindon. G3AYL and G3IDW.

CLIFTON AMATEUR RADIO SOCIETY

Hon. Sec. : C. H. Bullivant, G3DIC, 25, St. Fillans Road, Catford, S.E.6.

IN spite of very bad weather the D.F. contest planned for Sunday, June 19th, took place as arranged. Four teams took part in the contest and the winner was C. Hatfull, G3HZI, assisted by W. Woolley, G3GYZ, and R. Poppi. The club station G3GHN/P situated near Hayes, Kent, working on 3504 kc/s, made numerous contacts during the day. The operators at G3GHN/P were C. Bullivant, G3DIC, and N. Moore.

Due to the rail strike only 35 members attended the Junk Sale on June 3rd. However, business was brisk and a wide variety of equipment changed hands. A general knowledge quiz on June 17th enabled many members to gain points towards the Club Championship.

The club librarian, D. Bennett, has been kept busy of late classifying the numerous magazines and books which have been donated to the society. A comprehensive collection of post-war magazines and technical literature covering all subjects is available every week on loan to members.

Forthcoming events :

August 12th—Junk sale.

August 5th and 19th—Constructional evening and ragchew.

September 4th—Third D.F. Contest.

September 9th—Annual General Meeting.

Meetings are held every Friday at 7.30 p.m. at the clubrooms, 225, New Cross Road, London, S.E.14, where new members and visitors will receive a warm welcome. Details of membership can be had upon application to the hon. secretary.

EAST KENT RADIO SOCIETY

Hon. Sec. : Mr. D. Williams, Llandogo, Bridge, Canterbury.

THE society still meets fortnightly on Tuesdays at 8 p.m. at "The Two Brothers," North Gate Street, Canterbury. Many new members have been enrolled, and one Y.L. member. Many interesting lectures have been given, also raffles and sales Morse classes are to be given by G2BBT and transmitting lectures by G3FCT have been arranged.

New members welcome, also visitors.

TORBAY AMATEUR RADIO SOCIETY

Hon. Sec. : L. H. Webber, G3GDW, 43, Lime Tree Walk, Newton Abbot.

AT the June meeting reports were heard and read from the members who co-operated in the recent RSGB National Field Day.

It was decided by the club to send a message of sympathy to Bern Symonds, BRS 19991, who is still in hospital undergoing a series of operations.

The chairman, G2GK, announced that some recorded lectures and also films are being arranged for the meetings next winter —further details later.

A general discussion on the subject of the RSGB NFD was then carried.

BRENTFORD EVENING INSTITUTE

The Brentford Evening Institute will again be holding classes in radio subjects during the session commencing on September 19th next.

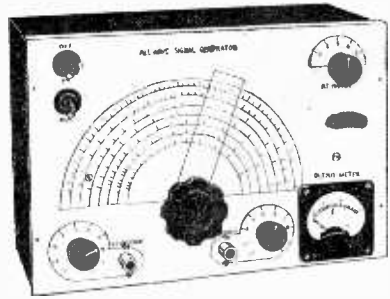
The courses are :

Radio Servicing I.—No previous knowledge of the subject is assumed. The course covers theory of all circuits commonly met in commercial radio receivers and methods of locating faults. Some practical work is included.

Radio Servicing II.—The course is mainly devoted to television and again includes practical work.

Radio Amateurs.—This class prepares students for the C. and G. examination for Radio Amateurs to be held next May. No previous knowledge of the subject is required. The class continues for several weeks after the examination.

Each class is held between 7 and 9 p.m. and on Mondays, Tuesdays and Wednesdays respectively. Enrolment may be made during the evenings of 12-16 September inclusive. The fees are 10s. for any one course, or 15s. for two courses.



COMPLETELY BUILT SIGNAL GENERATOR

Coverage 120 Kc/s-320 Kc/s, 300 Kc/s-900 Kc/s, 900 Kc/s-2.75 Mc/s, 2.75 Mc/s-8.5 Mc/s, 8.5 Mc/s-25 Mc/s, 17 Mc/s-50 Mc/s, 25.5 Mc/s-75 Mc/s. Metal case 10 x 6½ x 4½in. Size of scale 6½ x 3½in.. 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated. R.F. output continuously variable 100 milli volts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Black crackle finished case and white panel. Accuracy plus or minus 2%.. **£4/19/6** or **34 -** deposit and 3 monthly payments **25/-**. P. & P. 4/- extra.

Heater Transformer. Pri. 230-250 v. 6 v. 1½ amp., **6'- ;** 2 v. 2½ amp., **5/- ;** 13 v. 1 amp., **7 6.**

Three-speed automatic changer, by a very famous manufacturer, current model. Will take 7in., 10in. or 12in. records mixed. Turn-over crystal head. VERY LIMITED QUANTITY A.C. mains 200/250. **£7 19 6.** P. & P. 4/6.

T.V. CONVERTER for the new commercial stations, complete with 2 valves. Frequency can be set to any channel within the 186-196 Mc/s band. I.F. will work into any existing TV, receiver between 42-68 Mc/s. Input arranged for 80 ohm feeder. EF80 as R.F. amplifier, ECC81 as local oscillator and mixer. The gain of the first stage, R.F. amplifier 10DB. Required power supply of 200 D.C. at 25 mA., 6.3 v. A.C. at 0.6 amp. Input filter ensuring freedom from unwanted signals. Simple adjustments only, no instruments required for trimming. Will work into any T.R.F. or Superhet. Size 4½ x 2½ x 2in. P. & P. 2 6. **£2 19'6.**

Double Wound Mains Transformer, 200/250 v. metal rectifier, and smoothing condenser to suit above. **18 6.**

Extension Speaker cabinet in polished walnut, complete with 8in. P.M. P. & P. 3.-. **24 6.**

8in. P.M. Speakers, removed from chassis, fully guaranteed. All by famous manufacturers. P. & P. 1 6. **12/6.**

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

Used A.C. Mains 200/250 volts, 4-valve plus Metal Rectifier, medium wave superhet in polished walnut cabinet, size 14 x 9½ x 7½in., complete with valves 6K8, 6K7, 6Q7 and 6F6, 6½ PM speaker. Fully guaranteed. P. & P. 7/6. **£3'15 -.**

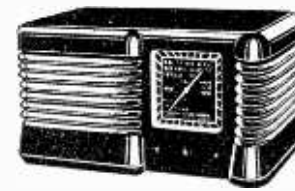
Constructor's Parcel : Medium & Long-Wave A.C. Mains 230/250 2-valve plus Metal Rectifier, 22 6. Comprising chassis 10½ x 4½ x 1¼in., 2 waveband scale, tuning condenser, wavechange switch, volume-control, heater trans., metal rectifier, 2 valves and v/holders, smoothing and bias condensers, resistors and small condensers, and medium- and long-wave coil, litz wound. Circuit and point-to-point, **1'3.** Post and packing, 2/6 extra.

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

Standard Wave-change Switches, 4-pole 3-way, **1 9 ;** 5-pole 3-way, **1/9.** Miniature 3-pole 4-way, 4-pole 3-way, **2 6,** 2-pole 11-way twin wafer, **5 -.** 1-pole 12-way single wafer, **5.-.**

Constructor's Parcel, comprising chassis 12½ x 8 x 2½in., cad. plated, 18 gauge, v/h, IF and trans. cut-outs, back-plate, 2 supporting brackets, 3-waveband scale, new wavelength stations names. Size of scale 11½ x 4½in., drive sp. drum, 2 pulleys, pointer, 2 bulb holders, 5 pax. I.O., v/h, 4 knobs and pair of 465 IFs, twin gang, 16 x 16 mfd., 350 wkg., mains trans. 250-0-250 60 mA. 6.3 v. 2 amp., 5 v. 2 amp. and 6½in. M.E. speaker with O.P. trans. P. & P., 3/6. **39/6.**

40-Watt Fluorescent Kit, A.C. Mains 230-240. Comprising choke, power-factor condenser, 2 tube holders, starter and starter-holder. P. & P. 3'-. **17 6.**
20 watt A.C. or D.C. 200 250 v. fluorescent kit, comprising trough in white-stoved enamel, two tubeholders, starter, holder and barreter. P. & P., 1 6. **12/6.**



PLASTIC CABINET as illustrated, 11' x 6' x 5½in., in walnut or cream. ALSO IN POLISHED WALNUT, complete, with T.R.F. chassis, 2 waveband scale, station names, new waveband, back-plate, drum, pointer, spring, drive spindle, 3 knobs and back, **22/6.** P. & P. 3 6.
As above with Superhet Chassis. **23 6.** P. & P., 3/6.
As above complete with new 5in. speaker to fit and O.P. trans., **40 -.** P. & P. 3 6. With Superhet Chassis. P. & P. 3 6. **41/-.**

Used Metal Rectifier, 230 v. 50 mA., **3 6 ;** gang with trimmers, **6 6 ;** M. & L. T.R.F. coils, **5.- ;** 3 Govt. valves, 3 v h and circuit, **4 6 ;** heater trans., **6'- ;** volume control with switch, **3/6 ;** wave-change switch. **2 - ;** 32 x 32 mfd., **4 - ;** bias condenser, **1/- ;** resistor kit, **2 - ;** condenser kit, **4 -.**
Complete A.C. Mains 3 Valve plus metal rectifier T.R.F. kit. In the above cabinet, **£3 15 0.** plus 3 6 P. & P.

Single speed player, A.C. mains 200/250 volt, complete with needle armature pick-up in a really wonderful polished walnut cabinet, will take up to 12 inch record. Pull-out drawer on steel runners. Original list price £8 17/6, our price **£4/9 6,** post and packing 10 -.

Used A.C. Mains, 5 valve, 3 wavebands. Superhet chassis, 11½in. x 8½in. x 3in. Complete with 3 waveband scale, 10½in. x 5½in. Pair 465, K.C.I.F., tuning condenser, main transformer, volume control with switch, Tone Control, 3 waveband coil pack. (This is a completely detachable unit on small chassis.) Various small condensers and resistors biasing condensers. **19 6.** P. & P., 3/6.

P.M. SPEAKERS, 6½in. closed field, **18 6.** 8in. closed field, **20/6.** 10in. closed field, **25/-.** 3½in., **16 6.** P. & P. on each, 2 -.

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

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

CUB one-sixth h.p. A.C. 230/240 v. by Brook Motors. Reversible for continuous running. **£4 9 6.** Post & Pkg., 7/6.

Polishing attachment for electric drills, Quarter-inch spindle, chromium-plated, 5in. brush, 3 polishing cloths and one sheep-skin mop, mounted on a 3in. rubber cup. P. & P., 1 6. **12 6.** Spare sheep-skin mops, **2/6** each.

Potato & Vegetable Peeler, by famous manufacturer, capacity 4½lbs., complete with water pump. All aluminium construction, white stove-enamel finish. Originally intended for adaption on an electric food-mixer, can easily be converted for hand operation. **39 6.** P. & P., 3 -.

Primary, 200-250 v. P. & P., 2 -.

500-0-500 120 mA. 4 v. C.T. 4 a., 4 v. C.T., 1 a. 4 v. C.T. 2.5 a., **27/6.**
500-0-500 250 mA. 4 v. C.T. 5 a. 4 v. C.T. 5 a. 4 v. C.T. 1 a., **39/6.**
P. & P. on the above transformers 3 -.

300-0-300 100 mA., 6 v. 3 amp., 5 v. 2 amp., **22'6.**

Drop thro' 350-0-350 v. 70 mA., 6 v. 2.5 amp., 5 v. 2 amp., **14'6.**

Drop thro' 250-0-250 v. 80 mA., 6 v. 3 amp., 5 v. 2 amp., **14/6.**

280-0-280, drop through, 80 mA., 6 v. 3 amp., 5 v. 2 amp., **14/6.**

250-0-250, 80 mA., 6 v. 4 amp., **14 -.**

Drop thro' 270-0-270, 80 mA., 6 v. 3 amp., 4 v. 1.5 amp., **13'6.**

Drop thro' 270-0-270 60 mA., 6 v. 3 amp., **11 6.**

Auto Trans. Input 200/250. H.T. 350 v. 250 mA. Separate L.T. 6.3 v. 7 a., 6.3 v. 1½ amp., 5 v. 3 amp., **25 -.** P. & P., 3 -.

Mains Transformer, fully impregnated. Input 210, 220, 230, 240. Sec. 350-0-350, 100 mA., with separate heater transformer. Pri. 210, 220, 230, 240. Sec. 6.3 v. 2 amp., 6.3 v. 3 amp., 4 v. 6 amp., and 5 v. 2 amp. **30'-.** P. & P., 5'-.

32 mfd., 350 wkg.		2 -	60 + 100 mfd., 200 v. wkg.		7/-
16 x 24 350 wkg.		4 -	50 mfd., 100 wkg.		1/9
4 mfd., 200 wkg.		1 3	65 mfd., 200 wkg.		1/6
40 mfd., 450 wkg.		3 6	8 mfd., 150 wkg.		1/6
16 x 8 mfd., 500 wkg. ...		4 6	50 mfd., 12 wkg.		11d.
16 x 16 mfd., 500 wkg. ...		5 9	50 mfd., 50 wkg.		1'9
16 x 16 mfd., 450 wkg. ...		3 9	Miniature wire ends moulded 100 pf., 500 pf., and .001 ca.		7d.
32 x 32 mfd., 350 wkg. ...		4 -			
25 mfd., 25 wkg.		11d.			
250 mfd., 12 v. wkg. ...		1 -	280-0-280 80 mA. 4 v. 4 a., 4 v. 2 a.		14'6
16 mfd., 500 wkg., wire ends...		3 3	250 v. 350 mA. 6.3 v. 4 a. twice. 2 v. 2 a.		19/6
8 mfd., 500 v. wkg., wire ends...		2 6	Auto-trans., input 200/250 HT 500 v. 250 mA. 6 v. 4 a. twice 2 v. 2 a. ...		19/6
8 mfd., 350 v. wkg., tag ends...		1/6	250-0-250 60 mA. 6.3 v. 1.5 a. 0-5-6.3 v. 1.5 a.		10'6
100 mfd., 350 wkg. ...		4 -			
16 + 16 mfd., 350 wkg. ...		3/3			

Terms of business : Cash with order. Despatch of goods within three days from receipt of order. Where post and packing charge is not stated, please add 1/6 up to 10 -, 2 - up to £1 and 2/6 up to £2. All enquiries S.A.E. Lists 3d. each.

IMPROVING AMPLIFIER PERFORMANCE

MODIFICATIONS WHICH MAY BE MADE TO ALMOST ANY AMPLIFIER TO GIVE IMPROVED RESULTS

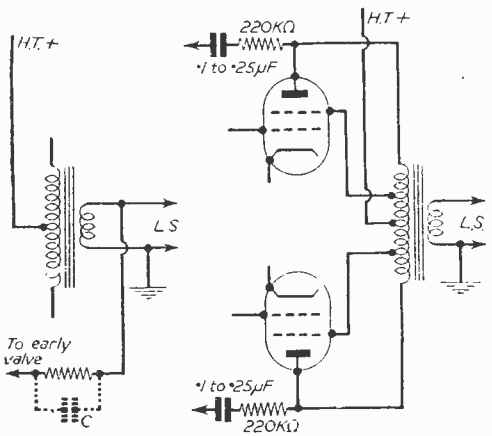
By W. J. Delaney

(*Continued from page 470 August issue.*)

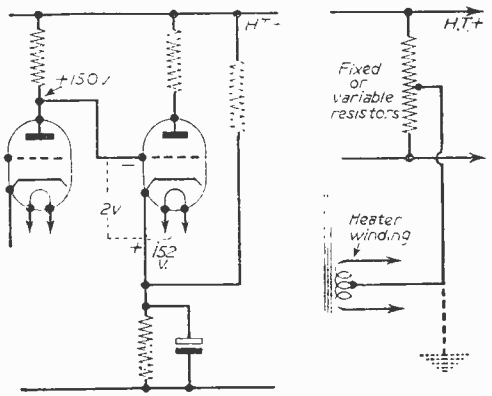
IN addition to the modifications described last month there is one other which can conveniently be added to most amplifiers without structural alterations. Taking as a basis the Williamson type amplifier, which would appear from correspondence to be the most popular type—whether built to the original specification or a modification, either home-designed or supplied by one of a number of firms—there is sufficient gain available to permit of the application of more feedback. As is well known, feedback reduces the gain of an amplifier, although it does play a very large part in reducing various forms of distortion. In the amplifier described, and in similar models, the usual practice is to include a resistance between the secondary of the output transformer and one of the early stages. Even if this is functioning satisfactorily it may prove worth while to fit a small capacitor across this resistance. The exact value cannot be given as it depends upon a number of factors, but probably something around 100 pF will improve the response curve. If this feedback loop is not taken to the first valve in the amplifier an attempt should be made to do this. The more stages over which it is applied the better the results, but the lower the amplification. If there is still sufficient gain in hand, a further feed-back loop may be added between the primary of the output transformer and the preceding stage. Simply connect a resistance and condenser in series between each of the output anodes and the anodes of the driver stage. Values again depend mainly on other circuit constants, but the resistance may be from 100k to 500k and the condenser .1 to .25 μF. In addition to levelling up the curve, this also has the effect of correcting any phase shift introduced by the normal coupling components. It should again be emphasised that these changes will not produce any audible effect, unless the loudspeaker assembly is capable of reproducing them. This is most important, and it is useless to throw away gain or go to the trouble of finding suitable values for the new networks if the speaker arrangements will not answer to them.

Direct Coupling

One of the main drawbacks of the normal reproducing system is the failure to give good transient response, and the ill-effects of phase shifts. It is only when a good multiple speaker system with proper cross-over networks is employed that the effects of modifications in this direction can be noticed, but assuming that these are available there are one or two



Figs. 3 and 4.—Two forms of feedback from the output stage.



Figs. 5 and 6.—Biasing arrangement when D.C. coupling is used, and heater biasing.

further steps which may be taken to improve the amplifier. First of all, the first stage in the Williamson is direct-coupled. The elimination of the coupling condenser may be carried out in the next stage also, and, of course, the coupling condenser is a nuisance. Apart from certain forms of distortion relative to phase shift, a leaky condenser will put a positive potential on the grid which is not provided for, and as a result will introduce distortion. By omitting the condenser we can ascertain the exact positive voltage which is applied to the grid and take steps to cope with it. Fig. 5 shows a direct-coupled stage where the grid of the valve shown requires 2 volts negative bias for correct working. In this illustration the voltage on the anode of the preceding stage is shown as having a potential of 150 volts positive. This means that in order to ensure that the grid of the valve carrying 150 volts positive is biased negatively with respect to the cathode, the latter must be made more positive than the grid by the bias called for, i.e., 152 volts positive. The voltage drop through the cathode resistor may not prove sufficient for this, and therefore the cathode will have to be connected to the H.T. positive line through a potential divider, as shown in Fig. 5. Obviously, it is not possible to give exact details here to cover all cases, but it should be remembered that the grid bias is calculated between the grid and the cathode, and the cathode must be elevated to a positive potential higher than the grid. Actual measurements are called for in this case, and it is not a simple matter to calculate just what each part of the circuit is getting. The main drawback to this arrangement is that the cathode has to be made so positive in some cases that it is possible that the heater-cathode insulation will break down. The makers of a valve stipulate the maximum voltage which may be applied between cathode and heater, or the maximum difference in potential which the valve will tolerate, and if it becomes necessary to raise the cathode to a value which would normally be higher than the figure given, then it becomes necessary to raise the heaters also to a high value so as to keep within the tolerance limits of the valve. How this may be done is shown in Fig. 6. A further potential divider, either fixed or adjustable, is placed across the H.T. line, and the heater centre-tap is taken to a point on this divider which will provide about 50 to 100 volts positive. This means that, as mentioned last month, the heater circuit must be wired with twin leads and a centre-tapped winding or artificial centre-tap employed. Experiments show that there is no audible difference when the heater is returned in this way, and some examination of the circuit is necessary to make certain that no unexpected troubles are introduced. Normally it is quite in order to carry out this positive biasing of the heater circuit, and it thereby enables the direct coupling to be introduced without difficulty, and with valve safeguards.

Miniature Valves

Before going into the question of changing the input stages there is one further simplification or modification which can be introduced in some of the older types of circuit, or those which do not employ double valves. The older Williamson used single triodes for the early stages, which called for an octal valveholder, and several commercial models of this appeared. This means that there are 4 valveholders in such circuits, and wiring is accordingly rather lengthy and liable to pick up hum. By replacing these valveholders by the miniature type of 9-pin holder, and replacing the two 6SN7's or their equivalent by a valve such as the 12AU7 or equivalent, the wiring may be kept more compact, with less liability to hum, and the spare valveholders will leave themselves available for further modifications to be described next month. *(To be concluded.)*

"British Radio Leads the World"

AN 18-page coloured, illustrated brochure, "British Radio Leads the World," is now being sent to prospective visitors from overseas to the National Radio Show to be held at Earls Court, London, from August 24th to September 3rd, 1955, with a pre-view for overseas and other special visitors on August 23rd.

With Big Ben's tower (at the British House of Commons) on the front cover and with information printed in English, French and Spanish throughout, the brochure makes the point that in the period from August 23rd to September 15th there are three great exhibitions, all of radio and electronic interest, in or near London, the others being the Farnborough Flying Display and Exhibition and the Engineering and Marine Exhibition.

After a reminder that the world's first television service was Britain's and that it is now available to 90 per cent. of the population, some American opinions are quoted :

"The 14in. TV set we rented for our London room gave us a picture that for clarity and contrast is vastly better than we generally see in the U.S."

"British television is technically the most advanced in Europe."

Photographs show striking recent developments and installations, and a graph demonstrates the rise in exports of all kinds of British radio equipment.

New Junction Transistors

THE GENERAL ELECTRIC CO., LTD., has introduced three new germanium alloy type p-n-p junction transistors, which offer the designer a range of ratings and characteristics. The type EW58 is intended for low voltage (up to 5 volts) audio frequency applications, such as hearing aid amplifiers. The type EW59 on the other hand, can be used at supply voltages up to 20 volts ; as a small signal amplifier, it can be used at frequencies up to about 0.5 Mc/s, whereas in Class B audio frequency output stages outputs of up to 300 mW. can be obtained at low distortion. The type EW53 can be used at supply voltages up to 10 volts, but has a slightly lower frequency and power output range than the EW59. All three are hermetically sealed in gold-plated metal cans, and are therefore independent of variations in humidity. They are mechanically strong and will withstand considerable mechanical shock and vibration. The cans are identical for all three transistors.

The small germanium wafer is mounted on a nickel frame. The collector and emitter leads are connected to small indium beads on opposite faces of the wafer. The base lead is joined directly to the wafer itself. These three leads are taken through a glass bead which is set in a copper thimble and the whole device is hermetically sealed inside a small gold-plated copper can.

Making a 2-Metre Walkie-Talkie

A PORTABLE TRANSMITTER-RECEIVER FOR THE LICENSED EXPERIMENTER

By R. Moores

FOR some time past the writer has been very interested in portable transmitting—particularly the small Q.R.P. equipment—and has on many occasions used all types of equipment, including most of the British and U.S. ex-Army sets, modified, of course, to bring them to amateur requirements. But owing to conditions deteriorating over the last few years, working conditions on these pieces of equipment, on the normal low frequencies, have been very bad and at times impossible, except for very short distances. In view of this fact I decided to try and build up something small for the 2-metre band which is an ideal frequency for short-range working, with 100 per cent. contacts, devoid of Q.R.M. and Q.S.B., etc.

Most pieces of equipment for this band are rather involved, due to the transmitter being multi-staged and the receiver also becomes rather complex. In addition, the necessary power supplies make it rather heavy and hardly suitable for a person to carry, so I decided to keep the equipment as simple as possible by using the minimum of valves and circuitry capable of working from small batteries and yet being able to radiate and receive signals with an efficiency comparable to the normal types of 2-metre equipment.

The Circuit

I had on hand a piece of ex-government equipment which had a novel type of oscillator which I subsequently adopted as the basis of the transmitting section. The circuit, as can be seen from Fig. 1, is a Lecher line type of oscillator using two valves, with feed-back through condensers from the anodes to opposite grids, the two lines being covered with polythene and the whole assembly being enclosed in a length of copper tubing which is earthed. The "lines" are a length of 80-ohm twin feeder cable which is 3in. long, one end shorted out with a lead taken from it to the modulated H.T. supply, the other two ends going to the anodes of the triodes and tuning condenser. The lines are slipped into a length of ¼in. inside diameter copper tubing, 2½in. long, after which the inside of the tube is filled with polythene cement which can be made by dissolving odd bits of polythene in some carbon tetrachloride. The copper tube is then earthed to the chassis.

This type of oscillator has a very high order of stability and being enclosed in the tubing it is absolutely free from capacity effects. The output is taken from one anode, through a 1.5/7.5 pF ceramic trimmer to a ¼-wave aerial which is connected to earth via a R.F. choke so as further to prevent unwanted capacity effects. The results are very good, the aerial loads up well as the trimmer is pre-set, and holding, or even shorting the aerial to earth, does little or nothing to affect the frequency. The oscillator is choke modulated from the audio section of the receiver and is perfectly readable on the ordinary type of station 2-metre receiver, even when fully modulated.

The Receiver

The receiver section consists of a 957 acorn super-regenerative detector which is coupled to the transmitting aerial through another 1.5/7.5 pF ceramic trimmer, but which is pre-set to the lowest capacity position. This cuts the unwanted radiation from this valve down to a minimum and, at the same time, prevents the receiver tuned circuit from absorbing the R.F. when transmitting. Although this coupling may seem low it is ample for this receiver.

The audio section of the receiver consists of a 1S5

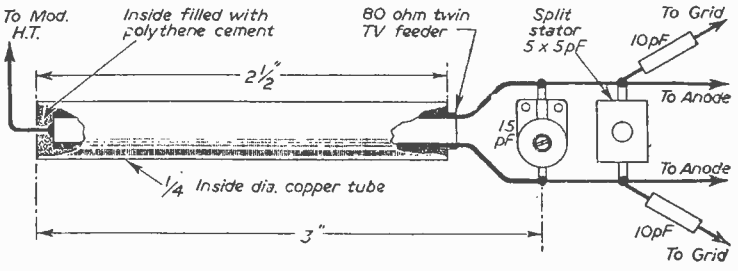
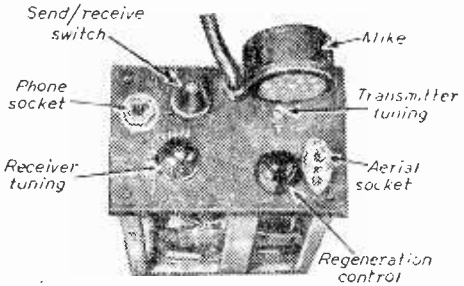


Fig. 2.—Details of the oscillator.

capacity coupled from the 957 and driving a 3A4 to a pair of phones of low impedance and light weight via a step-down transformer, the primary of which also acts as the modulating choke when transmitting.

A crystal microphone (ex-deaf aid) is used to drive the audio section when transmitting and this is fixed to the chassis, enclosed—in my model—in an old metal potentiometer case. It is desirable to fix the microphone in this way so as to avoid R.F.

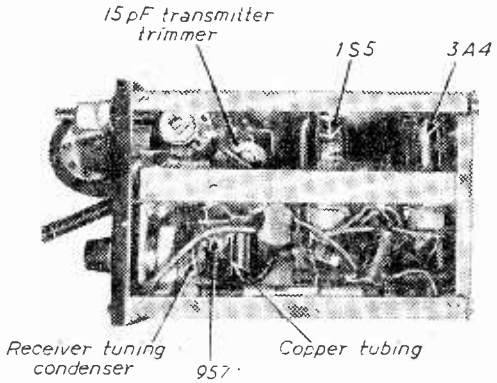


Details of the controls.

feedback when transmitting, and the type of microphone is very sensitive so it has not proved necessary to hold the unit up whilst talking or to talk loudly in order to modulate fully.

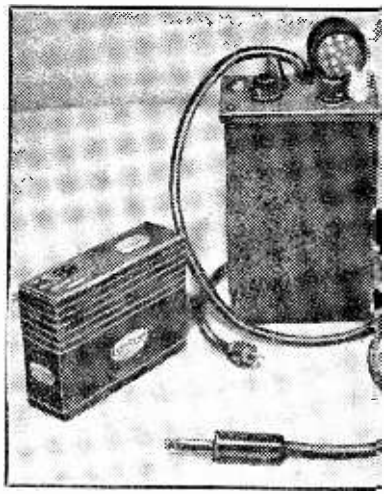
Construction

When assembling the Lecher line assembly it is advisable to leave a short length of extra wire on the 80-ohm cable in order to allow for pruning, so as to ensure that the tuning of the transmitter covers the band correctly. It is also very important that the screening as shown in the circuit is carried out, otherwise all kinds of feedback will result. The R.F.

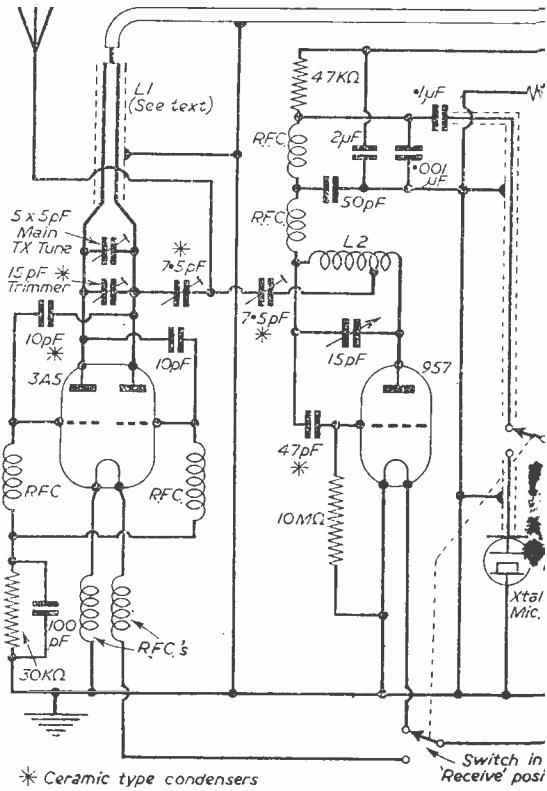


A side view of the unit.

chokes shown in the circuit are made from high-value ½-watt resistances covered with a single layer of close-wound 36-s.w.g. enamelled wire, or, if available, types found in the SCR522 receiver or the British or U.S. I.F.F. can be used. These chokes are all essential for the correct working of the equipment and none should be omitted. The three B7G type valves are, of course, plugged into normal type valve holders, but in order to save space the writer dispensed with an acorn-type holder and soldered direct to the pins of the valve, although this should be done with care in order to avoid damage to the valve. If, however, room is available the valve holder can be used. As the switching is kept simple it was possible to modify a small push-button switch to make the necessary change over from receive to send, although any type of suitable switch can be employed, particularly as no switching of the aerial is required. The controls, as can be seen, are very few and con-



The complete set re

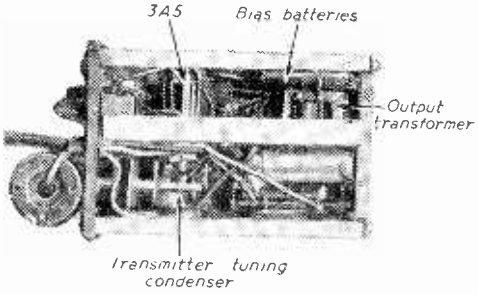


✳ Ceramic type condensers

Fig. 1.—Theoretical circuit of the transmitter-receiver. 16 s.w.g., tapped 1 turn

sist of the receiver tuning (which in my case covers from 140/149 Mc/s), the press-to-talk push-button, regeneration control for the receiver and the transmitter tuning which is screwdriver pre-set to the frequency desired. Other fixtures on the panel are the phone jack, microphone and aerial connection. The aerial used is a telescopic type which was cut so that at its fullest extension the length was 19in.—one half wavelength. Being telescopic it is easily carried and can also be collapsed when within close proximity of the transmitter. The headphones are the ex-U.S. service type, although almost any other kind can be used, and provided it is kept a fair distance from the unit an ordinary loudspeaker can be used. The reason for keeping the loudspeaker away from the set is because on transmit the output is still in circuit which is a fine monitor when headphones are being used, but which, of course, will tend to feedback when used with a loudspeaker. Of course, if the operator wants to use the unit always with a speaker, the switching can be arranged to cut out the speaker when in the transmit position.

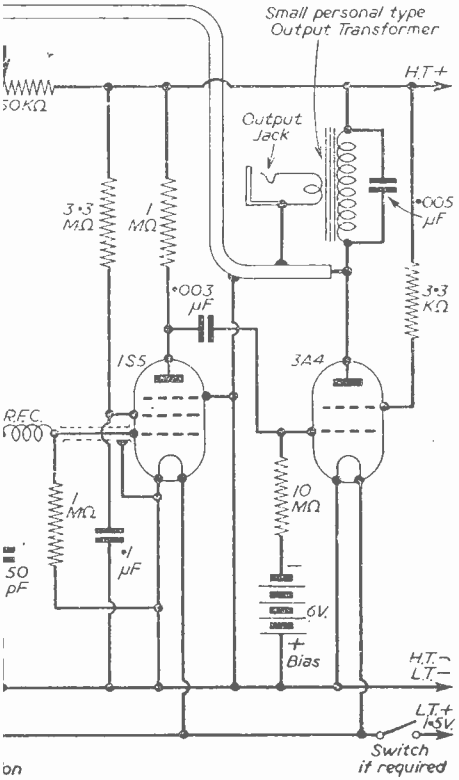
ly for use.



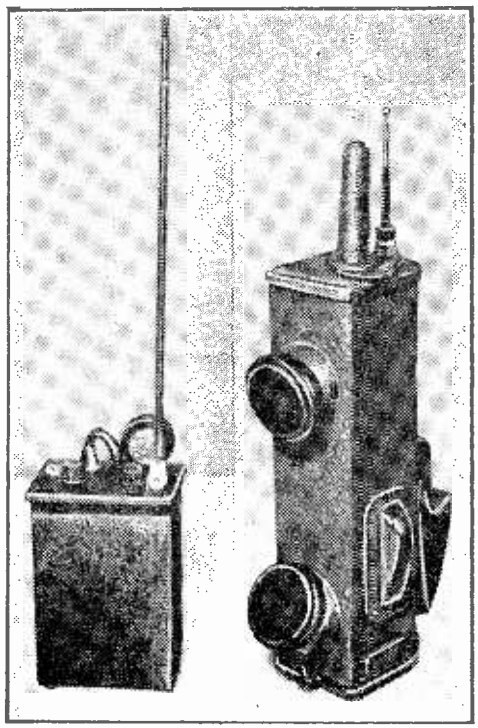
Another view of the set.

If desired the unit can be made as a walkie-talkie type of unit or even used as a small station transmitter,

(*Continued on page 561*)



L2 is 6 turns ¾ in. inside diameter, ½ in. long, rom anode end.



A comparison with the Handie-Talkie (BC 611) which it out-performs.

Diode-transistor L.S. Receiver

SOME ANSWERS TO QUERIES AND SUGGESTIONS FOR IMPROVEMENT

A NUMBER of queries have been raised since the publication of the "Diode-transistor Loudspeaker Receiver" in our February issue, and the replies to these have been classified and are given below for general information. In addition, we should like to point out that we shall shortly be publishing a Diode and Two-transistor Receiver.

Outdoor Aerial

To collect sufficient current this should be about 30yds. long horizontally, and about 30ft. high or at least above roof-tops of adjoining houses. Less if it is near a BBC station, and more if far away.

If a meter reading of 4 to 5 mA. can be obtained, the aerial and lead-in may be considered satisfactory.

All wiring should be at least 1ft. away from brickwork, and suitable insulators used at fixing points. Normal seven strands of enamelled wire used for aerials is best in one length, including lead-in. Do not use co-axial lead-in.

Indoor Aerial

For receiver with two transistors: 50yds. of wire, insulated at fixtures and at least 6in. from ceiling and walls.

If meter reading increases by 0.1 mA. when the tuned-in receiver is connected to aerial, then the receiver is near enough to the BBC transmitter for good reception, and aerial in the room suffices. If lower reading, move aerial into the loft. If more than 0.1 mA., so much the better—attenuate.

Bias

Do not exceed 2½ mA. with diode-transistor or 3 mA. with two transistors. Volume will not increase after correct bias is applied. It will decrease if bias is less than required, namely 0.2 mA. to 0.3 mA. for diode-transistor; when the second transistor is receiving 1.5 to 2 mA. bias is best.

Battery

Two volt is best for one or two transistors. More does not help; 1½ gives less background noise when two transistors are used.

Diodes

These should have low D.C. resistance to forward current at fractions of a volt and exceptionally high D.C. resistance to reverse current at several volts. About 5 μA at -0.1 volt and less than 3 μA at plus 3 volts.

Transistors

Leakage with no aerial should be less than 0.3 mA. Good transistors show no meter reading. Overheating when soldering produces leakage, as also does overloading and changing the circuit with battery connected and switched on.

Volume

Much cannot be expected, and it depends on one's capacity to hear, from sharp hearing in childhood to dull in old age. Normal output is about the same as a valve receiver, with volume turned down for listening without straining and ability to converse without raising the voice but quiet talking.

With 2 volts and 2 mA. we have 4 milli-watts D.C. The audio wattage in most cases may be less: in some cases with best components it will be much more, because there is plenty of power in the battery if the resistance is low enough to pass it. Say 10 milli-watts audio, that is one-hundredth of a watt of which the loudspeaker will waste a considerable portion. When we have power transistors more volume may be obtained.

Loudspeaker

This should have a large magnet and free moving coil—not stiff to the touch with the finger. Large HiFi speakers with freely-moving cone are best. It is the greatest offender in reducing volume, and the most inefficient item.

Transformers

The lower the D.C. resistance of a winding the more efficient will be the transmitter. The curve will be steeper and straighter, particularly if diode has low D.C. resistance, such as a junction diode; not easy to obtain, with high D.C. resistance to reverse current. For two transistors this does not so much matter if the output transformer has lowest possible D.C. resistance.

Spaced windings reduce self-capacitance and improve the audio higher frequencies.

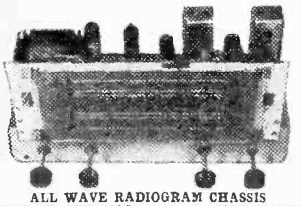
Proper matching improves volume. Impedance should be high to audio frequencies to match transistors' resistance, for the output. Too high a ratio in the intermediate transformer may increase volume, but it will also increase background noise, causing interaction between the two transistors working on the same battery and bias resistor.

"Shushing" Noise

After a few minutes a background noise may be heard during quiet periods. Positive feedback from one transistor to another makes it worse. Allow some negative feedback by reducing 100 μF capacitor to, say, 16μF or less; volume will not be so great as well as less noise; also try less than 3 : 1 transformer ratio. But the cure is to isolate completely the transistors by using two batteries and two pots, with safety resistors. The only coupling between the two units being the primary and secondary of the intermediate transformer, with earth to the diode-transistor section or both battery positives. Reducing battery from 3 volts to 1½ volts has the greatest effect of reducing "shushing" noise.

Components

Coils should not be close to metal chassis. Short leads and neat soldering are essential. Diode coil, tap and diode are the most sensitive items: they should be close together and away from other items, except the .001 μF by-pass mica capacitor.



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CONDENSERS.—New stock. .001 mfd. 7 kV. T.C.C., 5/6. Ditto, 12.5 kV., 9/6; 2 pf. to 500 pf. Mica, 6d.; Tubular 500 v., .001 to .01 mfd., 9d.; .02—.1, 1/-; .25, 1/6; .5, 1/9; .1/350 v., 9d.; .1/600 v., 1/3; .1/1,500 v., 3/6.

CERAMIC CONDENSERS.—500 v., .3 pf. to .01 mfd., 1/-.

SILVER MICA CONDENSERS.—10%, 5 pf. to 500 pf., 1/-; 600 pf. to 5,000 pf., 1/3. DITTO 1% 5 pf. to 500 pf., 1/9; 515 pf. to 1,000 pf., 2/-.

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2/450 v. 2/3	16/500 v. 4/-	8+8 16/450 v. 5/-
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C.R.T. LOW LEAKAGE ISOLATION TRANS. Ratio 1 : 1.25, 25% boost, 2 v., 10/6; 4 v., 10/6; 6.3 v., 10/6; 10/8 v., 10/6; 13.5 v., 10/6. Ditto mains primary 12/6. **MAINS TYPE** Multi Output.—2, 2½, 2½, 2½, 3 v., 2 amp., 17/6. **MAINS TYPE** Multi Output, 2, 4, 6.3 v., 7.5 v., 10 v., 15 v., two taps boost output 25% or 50%, 21/-.

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5 watt, 10 watt	1/3
15 watt	1/6
25 ohms—10,000 ohms	2/-
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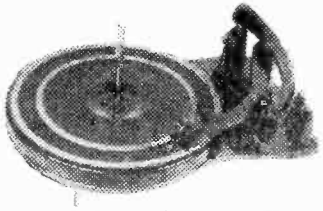

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HEATER TRANS.—Tapped prim., 200/250 v. 6.3 v. 1½ amp., 7/6; tapped sec., 2 4, 6.3 v., 1½ amps., 8/6. 12 v., 1 amp., 7/6; 6.3 v., 2 amp., 10/6.
MAINS TRANS. 250-0-250, 80 ma., 6.3 v., 4 v., 4 a., 5 v., 4 v., 2 a., ditto 250-0-250, 21/-. 2-way mounting.
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Two- and Three-valve Superhets

EXPERIMENTAL CIRCUITS USING THE MINIMUM NUMBER OF VALVES WITH MAXIMUM EFFICIENCY

By F. G. Rayer

MANY beginners avoid the superhet type of circuit because of the number of valves employed, which is most frequently four (in battery sets) and five (in mains receivers) as a minimum. The expense and complication of such circuits is fairly large, compared with the simple "straight" two- or three-valve sets with which many beginners commence construction. It is, however, possible to build a superhet with a single valve, though two valves are desirable as the minimum. It is hoped that the circuits following will encourage beginners to try this type of receiver. At all times the ease with which an extra stage or so may be added should be kept in mind. For example, an I.F. amplifier may usually be added without disturbing existing components, if the layout is not cramped. It is thus feasible to improve on the simple type of circuit, as occasion permits.

Fig. 1 shows a straightforward two-valve superhet of simple type. It employs frequency-changer and output valves only. These may be cheap ex-service 2v. types, or miniature 1.4 v. types for all-dry operation. Mains-type valves can also be used, as will become apparent later.

The circuit has no intermediate-frequency amplifier,

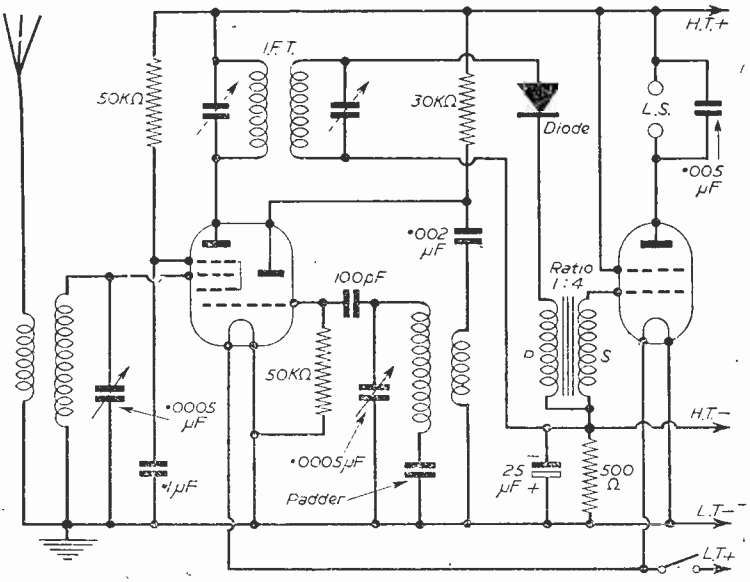

Fig. 1.—2-valve circuit with crystal diode.

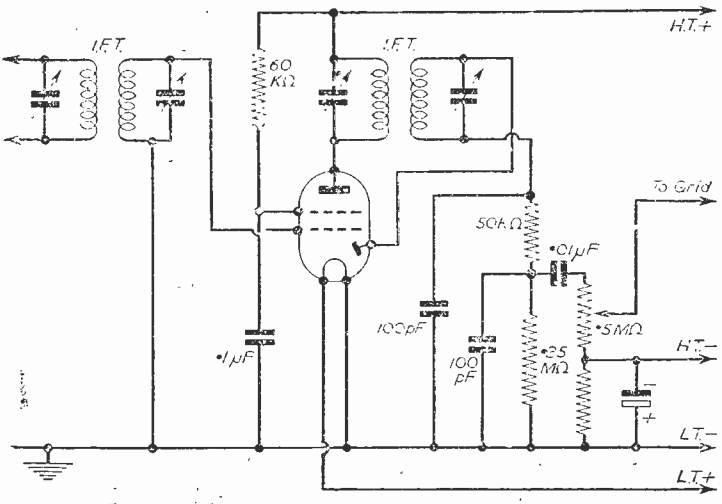

Fig. 2.—I.F. stage with diode.

and uses a crystal diode for detection. Transformer coupling between diode and output stage gives slightly greater volume than resistance capacity coupling. The selectivity of this circuit is good, compared with a simple "straight" receiver, and a useful degree of sensitivity is obtained. Though coils for medium waves only are shown, it is possible to use other coils for long waves, or to employ one of the small three-waveband superhet coil packs which are offered by many manufacturers. The padder *must* be of the capacity specified by the coil manufacturer. If a coil pack is used, it will already be present.

The circuit lends itself very well to the subsequent addition of an I.F. stage, to increase volume, selectivity and sensitivity.

Valve Detectors

The valve detector in Fig. 4 will be familiar to the builder of any simple T.R.F. receiver, and it is equally satisfactory in simple superhets, while enabling a triode to be utilised if to hand. This detector could be used in the circuit in Fig. 1, with some increase in volume. If R.C.C. is to be used, the "parafed" transformer is replaced by a grid leak of about .5

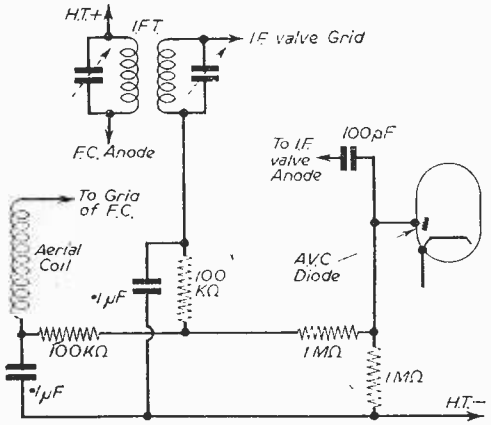

Fig. 3.—How A.V.C. may be applied to a circuit.

megohm. Because of its sensitivity, some specialised superhet circuits of comprehensive type still use such a detector.

The diode is, however, most commonly used in superhets, and is generally included in another valve. An example of a diode detector circuit is given in Fig. 2. Here, a valve such as the 1S5 is indicated, but mains types are also available. The first I.F. transformer is connected as already shown. The valve acts as I.F. amplifier, the second I.F. transformer being wired as indicated. With frequency-changer and output stage, such a circuit requires three valves in all, and can give good results. Selectivity and sensitivity equal the average for the most popular type of commercial superhet, but volume with weak stations will be somewhat less, since no amplifying stage is used between diode and output stages.

A complete "Universal" superhet circuit of this kind is shown in Fig. 5, and can employ .1 amp. universal valves. Such a circuit will give very good results, with adequate selectivity for normal purposes, good volume and a pleasing standard of reproduction. As with the other circuits, a 2-gang condenser will be

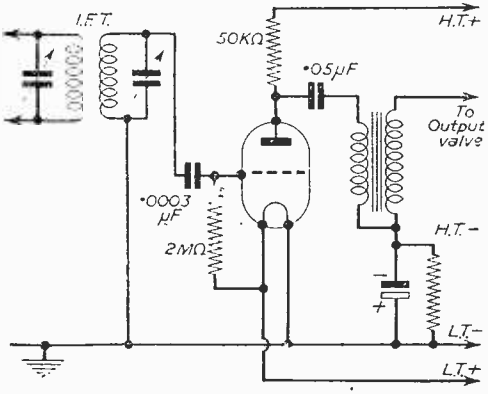

Fig. 4.—Circuit with a grid detector.

used for aerial and oscillator tuning, thereby giving "one knob" control which is much preferable to T.R.F. type receivers of simple type with reaction. This circuit could also be made up in a battery version, using 1R5, 1S5 and 1T4 valves, for 1.4v. operation. In the .1 amp. mains series, the frequency changer could be a UCH42, with UBF80 for V2, and UL41 for output. Some output valves are also obtainable with diodes. In this case they can be used for detection, and an ordinary R.F. type pentode is then used in the V2 position.

Automatic volume control can be applied to any circuit where a diode is available for this purpose, and connections for this are shown in Fig. 3.

(To be Continued)

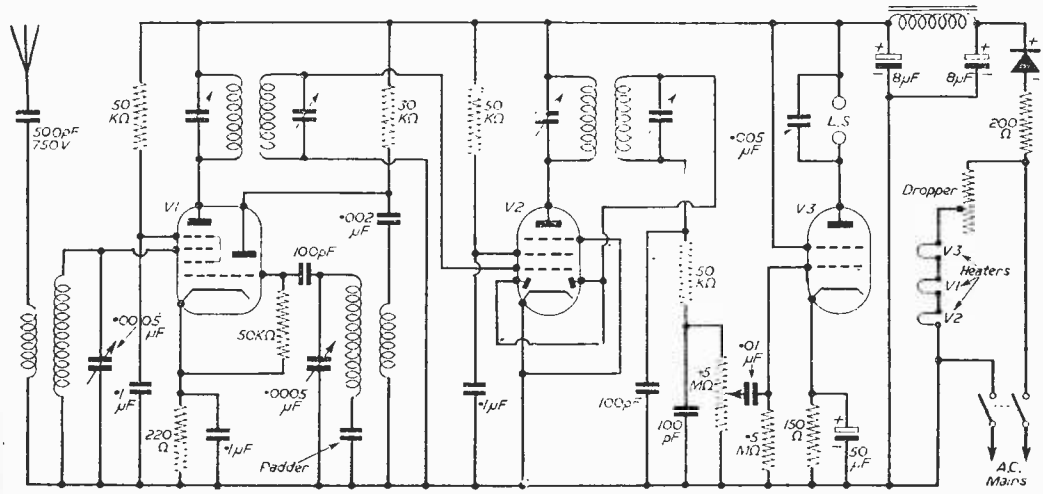

Fig. 4.—A "Universal" 3-valve superhet.

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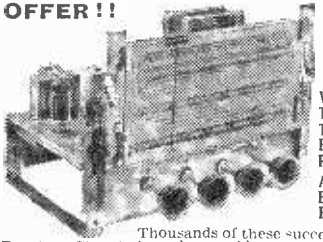

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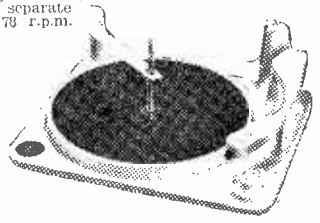

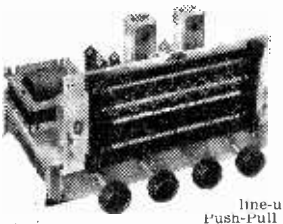

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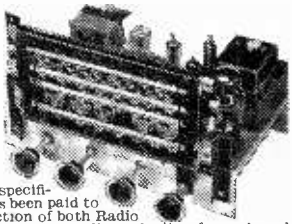

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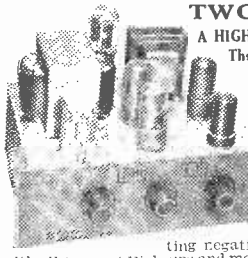

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By F. E. Apps

THE efficiency of an F.M. receiver depends to a great extent upon its correct alignment. If one handles an F.M. receiver it will be found that on tuning in to a selected station as one approaches the true centre of the signal the static and inter-station noise is very great, much more so than with an A.M. receiver. However, on reaching the true centre of the signal the noise disappears and only the signal comes through, clear of all interference. This, however, is true only when *all* the tuned circuits are in proper alignment.

The correct method of aligning an F.M. receiver requires the use of an F.M. signal generator, an A.M. signal generator, a centre zero valve voltmeter and an oscilloscope. But alignment can be done with an ordinary signal generator and a high-resistance voltmeter. The latter method is, perhaps, of more use to service engineers, where the carting of expensive and heavy instruments to a customer's house is out of the question. For alignment procedure I propose only to take into consideration the conventional F.M. receiver, using the limiter-discriminator circuits, as the other methods of F.M. reception are rarely met with. I shall refer to these other methods later.

In nearly all cases the I.F. stages are aligned first, though the limiter-discriminator stage must have slight adjustments made to render it sensitive enough.

I.F. Alignment Procedure

Feed an A.M. input directly to the grid of the limiter valve of the correct I.F. In most cases this will no doubt be 10.7 Mc/s. This input should be sufficient to produce maximum output. The primary of the discriminator transformer should now be adjusted by means of the core for maximum output, reducing the input as necessary.

Now shift the input to the grid of the I.F. valve immediately preceding the limiter. Adjust primary and secondary for maximum output. Care should be taken to keep the input as low as possible to prevent the limiter valve acting as a limiter. The next preceding I.F. stage should now be aligned, using the same procedure as with the last stage. Now align the first I.F. stage with the signal generator input to the grid of the first I.F. valve. Take care that the lowest possible input for an output of 50 mW is used. Adjust first I.F. primary and secondary and readjust all cores until no further gain can be obtained.

Now connect the centre zero valve voltmeter between chassis and the cathode output of the F.M. detector and adjust the discriminator secondary for zero reading.

Checking

Connect the F.M. generator to the dipole terminals of the receiver. Connect the oscilloscope to the end of the discriminator load resistor that is connected to one cathode of the F.M. detector.

Tune the receiver to the output of the generator at various frequencies with the oscilloscope adjusted for one cycle output. The waveform shown on the oscilloscope should be undistorted and the peaks should be equal in amplitude. If the peaks differ the secondary of the discriminator transformer should be adjusted until they are equal.

R.F. Stages

Practically all F.M. receivers are A.M. also, so the R.F. stages may be aligned exactly as an A.M. Care should be taken, however, to ensure that the oscillator frequency is the correct side of the signal frequency. In some bands it will be higher than the signal frequency, but in other bands the oscillator will be lower than the signal frequency.

The procedure to align the oscillator and the R.F. stages for the F.M. frequencies to be used is very similar to ordinary A.M. Some F.M. receivers may have continuous tuning, where station selection is accomplished by listening and observing a "magic eye," and others may have push buttons where stations have been pre-set by the manufacturers. The procedure is the same for both, except that in the continuous tuning method many points of alignment may be taken in the tuning range, whereas in the other case alignment is restricted to the selected frequencies.

With the continuous tuning method it is essential to rock the dial when adjusting the R.F. trimmers to ensure against pulling. It is important to remember that the meter reading will be of use only if the

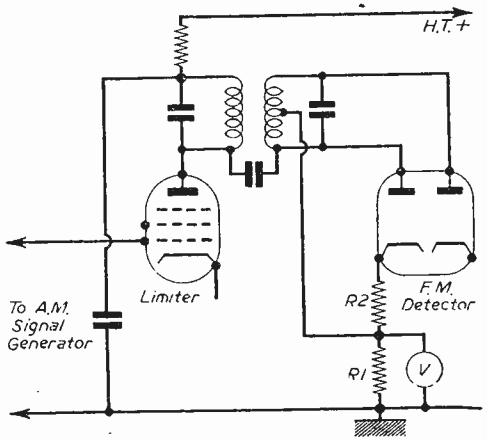


Fig. 1.—The F.M. Detector and Limiter circuit.

limiter is not saturated. Keep the signal generator output as low as possible.

Servicing

An F.M./A.M. receiver that requires servicing should be tackled as follows. The whole circuit should be divided up into six groups. First, the power supply, secondly, the output stage. Then in the following order: F.M. discriminator; I.F.s; frequency changer section; R.F. section.

The first two stages should be checked exactly as in A.M. work. Of course, in the case of an A.M./F.M. receiver if it works on A.M. and not on F.M. the first two groups can be discounted.

F.M. Discriminator section

As previously mentioned, we will deal here only with the conventional type.

By connecting an A.M. signal generator to the set we can check the discriminator (see Fig. 1). If a voltmeter is connected between point A and ground it will show a variable reading when the frequency of the signal generator is increased or decreased. This will indicate whether the circuit is working or not, but it will not indicate whether its linearity is correct for F.M. signals. This can be done by connecting the voltmeter across both load resistors and seeing whether equal and opposite deflections are obtained for frequencies equal, above and below the I.F. value. Failure to obtain correct linearity may be due to the load resistors going high or a faulty transformer. The usual value of R1 and R2 is approximately 470 K ohms.

Checking the I.F.s

In an A.M./F.M. receiver the intermediate frequency transformers are constructed so that a separate transformer for A.M. and one for F.M. are placed in the same screened box. The A.M. one is tuned to 470 kc/s and the F.M. one to 10.7 Mc/s. The checking is the same as for an A.M. receiver, by connecting the signal generator to the grid of each stage in turn, starting from the last stage and working on towards the frequency changer. Any fault in the I.F. circuit can be located in this manner. Note that the I.F.s are switched by the A.M./F.M. switch and switching may be faulty.

The R.F. and Frequency Changer Stages

When the previous stages mentioned have been checked and found O.K., and the set still fails to function, the fault must be in the R.F. or frequency changer stages. The oscillator section is the first one to question. By placing a high-resistance voltmeter between oscillator grid and cathode the frequency changer valve may be checked for oscillation at various frequency settings. If the various voltages on the electrodes of the frequency changer are correct and it does not oscillate it can be the valve itself, the oscillator circuit or the switching. Care should be taken in searching for a fault here, as it must be remembered that high frequencies are being used and any alteration of wiring or components can have a great effect upon the alignment of the circuit. Another point to note is that some oscillator and R.F. circuits may have small value condensers across them to compensate for capacity alterations when the set is warmed up. These can easily be overlooked should they go open circuit, and realignment apparently puts the set O.K. again. The trouble, however, will reoccur and means continual retuning, unless the faulty condenser is replaced. The slugs in oscillator coils and R.F. coils must be well and truly secured by wax or trouble will occur due to slight shifting caused by vibration from the loudspeaker. This takes the form of a microphonic howl. The R.F. circuits can be tested in the same way, feeding the signal into the dipole terminals. Check all voltages and valves.

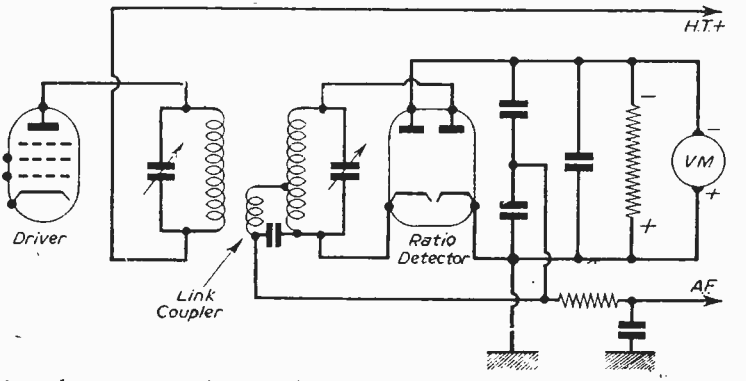


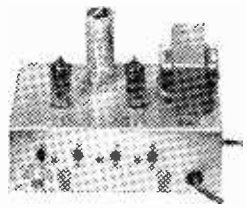
Fig. 2.—This shows the Ratio Detector circuit, which, whilst it saves a valve, is not regarded by some as the best arrangement.

The Ratio Detector. (See Fig. 2)

This is a method of detecting F.M. signals that differs from the conventional discriminator. The conventional discriminator operates on the difference of the output voltages of the two diodes whilst the ratio detector operates so that changes in signal frequency alter the ratio of these voltages.

Checking a Ratio Detector

The voltmeter is placed in circuit, as shown in Fig. 2, and the signal generator is connected to grid of the last I.F. valve. If the circuit is O.K. the meter will show a deflection which will vary as the amplitude of the signal is slowly varied. If, however, the frequency is varied on either side of the I.F. no change in reading will take place. One must be sure, however, that a change of frequency of the generator does not alter the output voltage of it. Most failures of ratio detectors are due to faulty valves. Should one diode not be operating no detection will take place.



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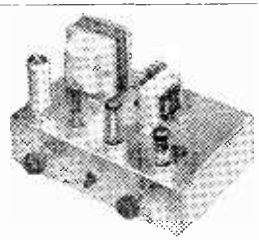

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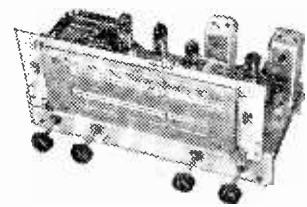

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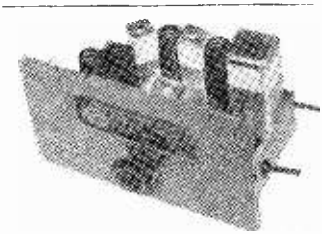

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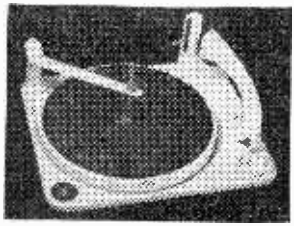

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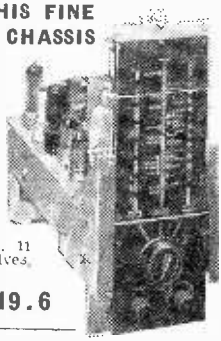

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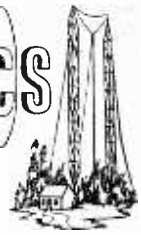

DESIGNING THE PI NETWORK TANK CIRCUIT

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

THE currently most popular tank circuit for amateur transmission is the Pi network circuit. This popularity is due to the excellent reputation of this type of circuit as a suppressor of TVI causing harmonics. The correct operation of this type of circuit, however, is somewhat different from the conventional type of tank circuit, and it is necessary to consider the correct value of components in order that satisfactory performance and efficiency are attained. These aspects can now be considered, as they are essential to the proper operation of a Pi network.

Fig. 1 illustrates the conventional Pi network tank. In Fig. 2, the electrical equivalent is shown. Fig. 2 shows that we have a valve generator of impedance ZA, supplying power to the Pi network, which is loaded to the load impedance ZB. Generally the Pi tank is loaded into 72 ohm coaxial line, so that the load is ideally an effective pure resistance of 72 ohms. The generator ZA is, of course, the PA stage valve. In order to obtain correct matching, and efficient power transfer from the valve impedance to output load, the components forming the Pi network *must* be of correct value. It is simply *not* true that full and efficient PA loading can be achieved by using any coil and condensers that will resonate to the required frequency, and twiddling the controls to obtain a match. While resonance may be achieved, and while loading may be increased up to a maximum, full loading and output are not achieved.

Generally, of course, the tank condenser CA and the output condenser CL (sometimes called the "loading condenser") are variables. Resonance and loading of a sort can be hit with an almost infinite combination of settings of these two controls, so that even with a fixed tuning inductance L the novice operator may very well feel uncertain of the position he finally lands on. Moreover, just to make things difficult, many designs of Pi tank use a variable inductance as well, of the "roller coaster" sort. Anyone attempting tuning up and loading from scratch could arrive at an infinity of different combinations for any one frequency of operation. Clearly some guidance is necessary in order to set up the circuit so that operation is straightforward and simple.

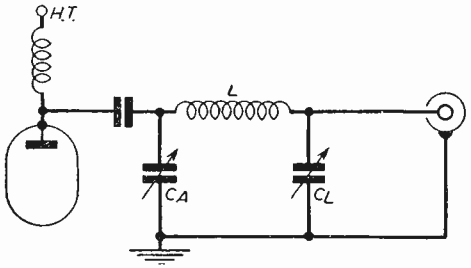

Fig. 1.—The conventional Pi network tank circuit components.

No Trouble ?

Many operators may scoff at the idea of difficulty, and will proclaim that they can tune up a Pi tank without any trouble. No doubt, but the correct control setting is not necessarily arrived at by knob twiddling to the point giving "best" loading. In fact, one eminent writer dealing with the design of broadcast transmitters employing Pi network tanks produces considerable mathematical argument to show that the position obtained by careful adjustment of tuning and loading controls is generally the wrong position, as the changes of loading lead to adjustments farther and farther from the correct position. Thus, despite the operator's confidence that he is adjusting to the correct position, the position reached may very well be incorrect, and a position giving inferior TVI harmonic rejection at that.

Without pressing into deep analyses of the operation, there are, in fact, several points that should be known about Pi networks. Unless the components have approximately their correct values, proper matching and efficient operation may not be achieved. In fact there is a definite limit to the matching ratio obtainable with given values of tank circuit components. One obvious case is the position found in which loading increases with the "loading" condenser CL increased up to full capacity, although full loading is nowhere achieved. "More capacity is needed," says the operator, and he may even shunt as much as 1,000 pF or more of additional capacity across the output condenser. This gives a little more loading, but in fact putting fantastically high values of condenser on the output side still will not give full or satisfactory loading. An analysis of the loading conditions may reveal that an infinite

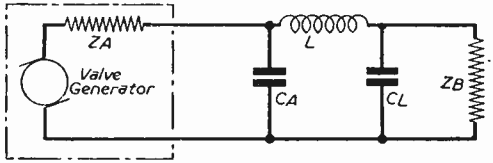

Fig. 2.—The Pi network has to match the generator impedance of the PA valve to the output load value. Generally the PA impedance is high, and the load output may be low, say, 72 ohms, when a coaxial cable correctly terminated is fed by the network. The Pi network will only effect an efficient energy transfer for such dissimilar impedances when the component values are correctly chosen from the design chart.

capacity is needed. In fact a negative value of capacity may be indicated, showing that the circuit values are such that matching conditions have broken down. A mathematician might find pleasure in pointing out that a negative condenser equals an inductance, whereas the practical amateur bewails the fact he is unable to "load his Pi tank." In fact, the mathematician could inform him that his failure to match is due to the use of too large a value of tuning inductance. A reduction of a turn or so of tank inductance would, in fact, enable a match to be made.

Another Delusion

A further delusion is that a Pi tank circuit automatically guarantees that any kind of load, any piece of wire or any aerial may be attached to the output, and that perfect loading, matching, output and TVI reduction occurs. In fact, as it is necessary for the tank components to be designed and proportioned for the ratio of PA valve impedance to output loading impedance, the attachment of "any impedance" not necessarily resistive, as in the case of an aerial, is not likely to be satisfactory. This despite the fact that in many cases some sort of apparently satisfactory loading is obtained. However, "some sort" which is usually interpreted as "it works, doesn't it?" is not the best basis for design. Despite the claims, satisfactory results can only be obtained if the circuit components are correctly chosen.

The method of designing and finding the correct value of Pi tank circuit values has been simplified and tabulated, so that the tank capacity, load capacity and tank inductance values can be read off at a glance. This disposes of any fear that the reader may have of becoming involved in abstruse mathematics. Furthermore, provided that the tank inductor is wound to the stated inductance, no trouble should occur, as the value of inductance is critical. While values slightly lower than the chart indicates may be used, it is strongly advised that the inductance value be not exceeded. If too large a coil is used, no amount of "loading capacity" will give full loading. Furthermore, the tank output is into a 72 ohm line, and not into "any piece of wire." Provided that a coil of inductance not exceeding the design figure from the chart is used, matching may be readily and simply attained. The coil may be wound by any of the standard formulas, and to be on the safe side should be made slightly less than the specified value. (*Continued on page* 561)

DESIGNING THE PI NETWORK TANK CIRCUIT

Chart figure	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500
CA pF								
At 3.5 Mc/s	520	440	360	320	280	245	210	195
7 Mc/s	260	220	180	160	140	123	105	97
14 Mc/s	130	110	90	80	70	61	52	48
21 Mc/s	85	73	60	54	47	41	35	33
28 Mc/s	65	55	45	40	35	31	26	25
CL pF								
At 3.5 Mc/s	1,800	1,650	1,500	1,400	1,300	1,200	1,100	1,050
7 Mc/s	900	825	750	700	650	600	560	530
14 Mc/s	450	413	375	350	320	300	280	265
21 Mc/s	300	275	250	232	215	203	190	180
28 Mc/s	225	205	185	172	160	150	140	133
L Micro-henrys								
At 3.5 Mc/s	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5
7 Mc/s	2.25	2.75	3.25	3.75	4.2	4.75	5.25	5.7
14 Mc/s	1.1	1.35	1.6	1.85	2.1	2.35	2.6	2.85
21 Mc/s	.73	.90	1.08	1.23	1.38	1.54	1.7	1.76
28 Mc/s	.55	.67	.8	.93	1.05	1.15	1.28	1.42

Chart figure	6,000	6,500	7,000	7,500	8,000	8,500	9,000
CA pF							
At 3.5 Mc/s	180	163	155	145	135	127	120
7 Mc/s	90	83	76	72	68	64	60
14 Mc/s	45	42	38	36	34	32	30
21 Mc/s	31	28	25	24	23	22	20
28 Mc/s	23	21	19	18	17	16	15
CL pF							
At 3.5 Mc/s	1,000	950	900	850	800	760	720
7 Mc/s	500	475	450	425	400	380	360
14 Mc/s	250	237	225	213	200	190	180
21 Mc/s	170	157	145	138	130	125	120
28 Mc/s	125	120	113	107	100	95	90
L Micro-henrys							
At 3.5 Mc/s	12.5	13.2	14	14.75	15.5	16.7	18
7 Mc/s	6.2	6.6	7	7.4	7.8	8.4	9
14 Mc/s	3.1	3.3	3.5	3.75	3.9	4.2	4.5
21 Mc/s	2.05	2.17	2.3	2.45	2.6	2.8	3
28 Mc/s	1.55	1.63	1.7	1.82	1.95	2.1	2.25

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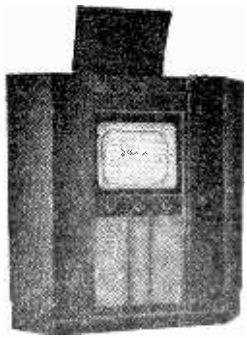

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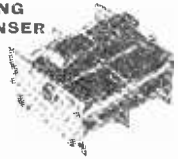

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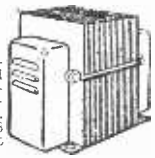

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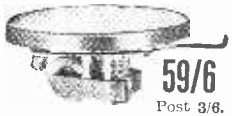

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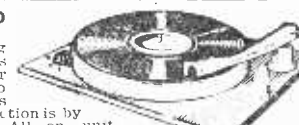

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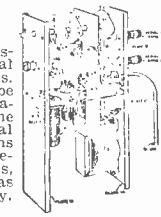

The Convertor has given very satisfactory results from the experimental Beulah Hill Station. It uses 2 valves, is not at all difficult to make and can be lined up with a simple 25/- signal generator (details on request). Price for all the components including constructional data is **£3/10/-** or **£4/10/-** with mains equipment. Price includes stove-enamelled case, prepared metal chassis, and all parts to make up convertor as illustrated—data available separately, price **2/6**.

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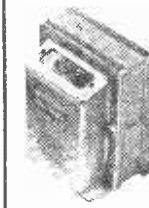
With only a simple indoor aerial made by parting the ends of ordinary flexible cable this tuner works very well at Eastbourne (over 60 miles from London) and we await reports from even greater distances.

All parts including valves, prepared metal chassis, scale, slow-motion drive, pointer, tuning knob, in fact everything needed to make the complete unit suitable for mounting through the side or back of an existing reasonably sized radio, or into a separate cabinet. **£6/12/6**, data is included free with the parts or is available separately price **2/-**.

MAINS TRANSFORMERS



Input 210 230 250 v. Sec.: 300-0-300 at 150 mA. 6.3-0-6.3 at 4 amps. 2-0-2 at 2 amps. Price **20/-**. Post 2/-.

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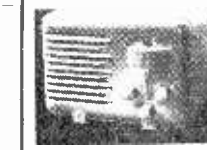

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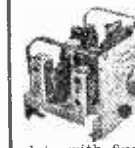

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The value of tank capacity may be estimated by the degree of mesh of the semi-circular "straight-line-capacity" type condensers, and may be set to the approximate design figure. If the output capacity is adjusted for output, good loading will be assured if the 72 ohm cable is terminated in a genuine 72 ohm load. This can conveniently be a 72 ohm "*non*-inductive" carbon resistor of the appropriate wattage rating which are available on surplus disposals. Emergency dummy loads can be made by paralleling low wattage carbon resistors, although the surplus types used as "dummy antennas" will usually handle 50 watts of R.F. or even more. Generally, of course, the coaxial cable terminates in a link coupled antenna tuning network, and this network must also be tuned and loaded, by adjusting the coaxial link winding if necessary, to present the right load to the coaxial cable. Here the "tuned link" circuit is helpful in obtaining correct cable matching to the aerial tuning unit, and this overall "Pi network to aerial feeder via a tuned link" is shown in Fig. 3.

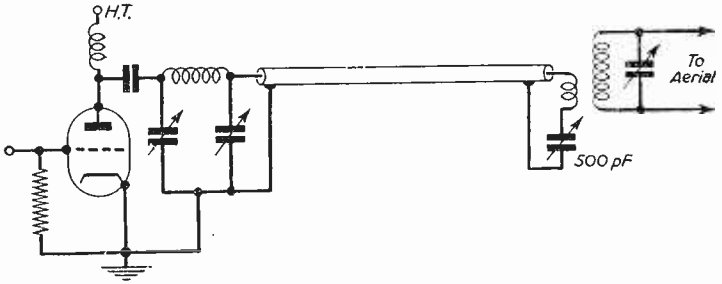


Fig. 3.—The use of a "tuned link" in the aerial tuning network is a convenient means of adjusting the loading and termination of the 72 ohm feeder cable. This aids and simplifies the adjustment of the Pi tank for correct loading and TVI suppression.

Generally, however, provided the inductance is the correct value the correct setting for the tank and loading condenser may be found as follows. Set the output ("loading") capacity to its maximum value. Then adjust the tank tuning capacity to resonance. This sets the tank to approximately its correct value. The loading condenser may now be adjusted for loading, at the same time retuning the tank condenser CA to maintain resonance. If the load circuit is the circuit of Fig. 3, the aerial tuning condenser should be resonated to the operating frequency, and the link condenser which acts as a control of loading adjusted so that full output can be drawn from the PA stage. Finally, the capacity of the tank tuning capacitor may be checked by noting the degree of mesh of its vanes, and this will indicate if the value of tank capacity "in use" is of the correct value. It should be noted that on the higher frequency bands an allowance for the inevitable circuit strays associated with the PA valves must be made. Thus an 807 has an anode to ground capacity of 10 pF or so, so that, together with strays, the figure of, say, 25 pF would be a fair allowance for circuit capacity present. A pair of 807s would have some 35 to 40 pF of total capacity including strays. Thus the tank condenser should be set low by this amount, so that the effective tuning capacity is at the desired figure.

For the case of the 72 ohm output load, the circuit values are determined by the required running conditions of the PA valve, hence the anode current in amps is divided into the anode voltage. This figure is shown on the chart from which the values of inductance, tank capacity and loading capacity are given for the usual amateur bands. Thus a single 807 at 600 volts and 100 mA, a popular maximum phone rating, gives 600 divided by .1 amp. (i.e., 100 mA), thus the chart figure is 6,000 and the circuit values for a given band may be read off. The "maximum C.W." rating of an 807 is 750 volts at 100 mA, so the chart figure is 7,500. Similarly, a pair of 807s at 600 volts, running at 200 mA, gives a chart figure of 3,000. Intermediate figures can readily be estimated, as hairsplitting accuracy is not essential, particularly if the warning *not* to exceed the coil size is heeded. The chart figures should infallibly land your tank circuit design into the region in which adjustment of the controls will produce a good match, satisfactory loading, and optimum TVI rejection. The rest is up to you!

A 2-METRE WALKIE-TALKIE

(Continued from page 545)

in which case the valves should be changed to mains types and the circuit components being changed to suit.

The unit is powered from a combined 67½/1½-volt battery of the type used in the personal type portable, with two small pen-torch batteries fixed inside the unit for supplying 6 volts negative bias for the 3A4. The use of separate bias for this valve instead of using a negative H.T. resistance ensures that the full voltage from the H.T. battery is used. The two R.F. chokes in the 3A5 heater circuit should be wound in No. 28 s.w.g. wire to keep the voltage drop low.

Coil details will be found on Fig. 1 and in the caption.

Results

With the aerial extended, a range of six miles is obtained from the main station which only uses 2 watts R.F. output and the receiver used has only a xtal diode mixer without an R.F. stage with results of Q5 S5-7, and this being across town! Even without the aerial it is possible to work up to one-quarter of a mile and still be readable. The receiver portion has picked up stations of up to over 100 miles distance, including aircraft and other civil stations, and has been used for tracking down TV oscillator harmonics.

In conclusion, the writer would like to thank G3EDG, G2UN, the Brighton radio club, for assistance with tests, etc.

N.B.—The 957 valve although listed as 1.25 volts works well as it seems to suffer no harmful effects at 1.4 volts.

SMALL MAINS TRANSFORMERS

SOME ELEMENTARY HINTS FOR THE EXPERIMENTER

By R. H. Borthwick, B.Sc., A.M.I.E.E.

Introduction

IT is often easy to obtain burned-out mains transformers or, alternatively, it is possible to purchase core stampings very cheaply.

Some readers therefore may be interested in wiring their own mains transformers for use in power packs or for driving models or ex-Government low voltage motors.

The purpose of this article is to give the practical considerations which must be taken into account when building small power transformers in the home workshop.

The Core

This is built up of laminated stampings usually made of a silicon-steel alloy such as Stalloy, each stamping being about 0.014in. thick. These stampings are of the shape shown in Figs. 1 and 2 so that when joined together the resulting shape is as shown in Fig. 3.

Typical dimensions are shown in Fig. 3, the height of the stack of stampings being one to one and a half times the width of the centre limb.

The windings are wrapped round a former which fits over the centre limb and the cross-sectional area of the centre limb determines the amount of power which we should draw from the transformer.

Let the cross-sectional area of the centre limb be A sq. ins.

Then $A = \frac{\sqrt{W}}{5.58}$ sq. ins.

Where W is the volt amperes output.

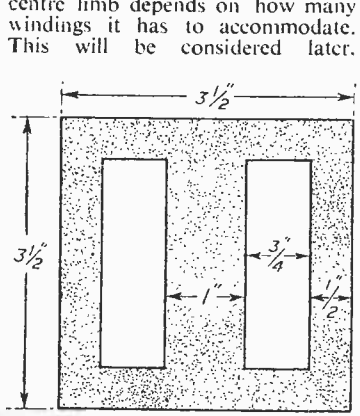
Example

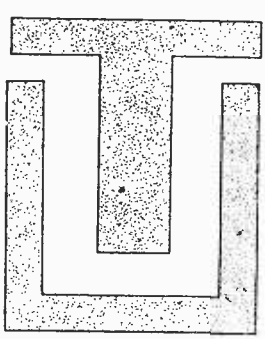
Suppose we wanted to make a battery charger transformer which gives 12 volts at 4 amps.

Then W = 48 volt-amperes and

$A = \frac{\sqrt{48}}{5.58} = 1\frac{1}{4}$in. approx.

In this case we should make the width of the centre limb 1in, and the thickness 1¼in. The length of the centre limb depends on how many windings it has to accommodate. This will be considered later.





Figs. 1 to 4.—The usual "T" and "U" laminations, core measurements and the bobbin.

The Windings—General

These can be made of cotton covered wire, but enamelled wire is generally used because it is less bulky. The windings can be put on in any order, although it is usual for any low voltage windings which have to carry a heavy current (e.g., for valve heaters) to be put on the outside. This helps to dissipate the heat produced.

The layers of all windings are normally interleaved with paper or Empire cloth while some thicker insulation is required between the primary and secondary windings. The first layer is wound on a cardboard or similar former which fits tightly over the centre limb.

A typical former is shown in Fig. 4. All the windings can be wound on this before it is fitted to the core.

The Windings—Gauge of Wire

The efficiency of a mains transformer is about 85 per cent. The power wasted is lost in the form of heat. This heat is generated mainly in the windings themselves and is governed by their resistance, and the currents they are carrying. It is therefore important to choose a suitable gauge of wire for the windings so that the temperature rise is not excessive.

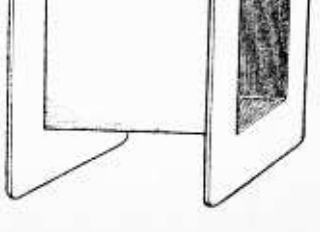
First we decide what current the particular winding is to carry. The suitable gauge of wire is then that gauge which, if a number of similar wires were pressed together to form a single conductor of cross sectional area 1 sq. in., would carry 2,000 amps. Do not be alarmed about this, however, because all the information we want is available in the s.w.g. tables of most electrical reference books.

Examples

(a) Heater winding 6.3 volts at 3 amps. We look up the s.w.g. tables. The column headed "Current at 2,000 amps. per square inch" gives a figure of 3.62 for 18 gauge wire. We therefore know that 18 gauge wire is suitable for carrying a current of 3 amps.

(b) H.T. Secondary 300-0-300 volts at 120 mA. The s.w.g. tables quote 34 gauge wire as suitable.

(*Concluded on page 570*)



Programme Pointers

Our Critic, Maurice Reeve, Reviews Some Recent Programmes

THE Derby programme, "Blue Riband of the Turf," written by Keith Bell and edited and produced by Robert Pocock, was very interesting to laymen like myself. Much enlightening and entertaining information was afforded. For instance, I was amazed at being told that no Derby winner had ever been bred by a Derby out of an Oaks winner. The roll call of some of the famous horses of the past—one could have wished it a bit longer—was touching and sounded akin to the reciting of battle honours. They were, of course, for the noble and self-sacrificing participants.

"Death has Deep Roots," by Antony Brown, adapted from the novel by Michael Gilbert, was a reasonably exciting whodunit. But why the "Saturday Night Theatre" series should always contain so many novel adaptations I shall never know, especially when, like this one, the story is unfolded in narrative form. The script, by the way, contained a reference to "His Majesty's Army," which, as most people know, is technically quite incorrect (I refer, of course, to the constitutional point and not to the sex of the pronoun).

Short Story

It was pleasant to hear again the cultured voice of Clive Brook, once so familiar to film fans, in an adaptation (yet another!) of Aldous Huxley's brilliant short story, "The Giaconda Smile." Mr. Brook successfully presented it in the West End a few seasons ago. The story of the two women in the life of Henry Hutton, one of whom is poisoned in a manner as improbable as it is conventional, makes excellent entertainment if not great drama. Betty Baskcomb and Ella Milne, with Sulwen Morgan, were the feminine interests, and Arthur Ridley, Cyril Chaps and several others completed the cast.

By the time Dick Cross—adapter—and John Gibson—producer—had finished with Joseph Conrad's "The Nigger of the Narcissus," in the Monday Night Theatre series, little was left of this great sea story. Almost my only memory is of split ear-drums and a singing, whining sensation in what remained of my hearing apparatus. The "effects" department made havoc of what was entrusted to the imagination when the author gave it to us to read. Seldom have I heard ninety minutes more solidly packed with screaming and yelling, shouting and cursing, buckets of shingle being tipped from pail to pail, sheets of tin being shaken and beaten until they must have cracked and fallen apart; in short, every contraption that is, mistakenly, meant to imitate tropical storms at sea, and rebellious crews and tyrannical ships' officers, was searched for, found and laid on in full spate. Much too much of a good thing. The only times we were allowed any respite and a chance to salve our shattered systems was when the narrator, Laidman Browne, was telling the story. Conrad will be for me in my armchair in future!

"Journey by the Niger," Rene Cutforth's story of a thousand-mile journey through Britain's largest colony, was colourful, informative and entertaining. Many places were passed through and infrequently visited tribes looked in on. Native effects were well recorded and suitably integrated with the narrative.

Hymns

Is it necessary to preface the 7 a.m. and the 8 a.m. news on Ascension day and Whit Sunday with hymns? (Or any day, for that matter.)

Shaw v. Wells

An hour's programme on this rivalry, entitled "Some Social and Literary Encounters," might not be calculated to appeal to many outside the ranks of the Shavians and the Wellsians. But as I am a humble private in that brigade, I found it fascinating and interesting. Written and compiled by Vincent Broome, narrated by Mr. Broome and Stanley van Beers, produced by Terence Tiller and acted by Robert Mooney and Norman Shelley as Shaw and Wells respectively.

"Madame Bovary," in Ben W. Levy's radio adaptation of Gaston Baty's play based on Flauberts' great novel—the BBC is nothing if not original!—was another "play" which lost something of its rare qualities in the course of its transition, if not so much as "The Nigger of the Narcissus" did. The very remarks which, one wonders why, preceded the play showed that some, at any rate, of Emma's essential femininity was deliberately being laid aside. And with it much of the original novel's true meaning was lost. It was this side of Emma's make-up and character that was missing from Constance Cummings's otherwise very fine performance. The other chief parts were all played with verisimilitude by Norman Mitchell, Bovary; Antony Jacobs, Homais; Geoffrey Matthews, Leon; Gladys Spencer, Mme. Homais; George Merritt, Roualt; and the others.

"Poet's Progress" was an entertaining play based on the life of one of the most minor of minor poets, Richard Savage. I doubt if more than a handful of people have ever heard of him, let alone read him. Savage enjoyed incredible poverty, debauchery and final obscurity, save for the notice of Sam Johnson. Anthony Jacobs played the title role with effective realism and was ably supported by Belle Chrystall, Denis Gaucher, Mary Hinton, Lois Heatherly, Mary Wimbush, Edward Jewesbury and others.

News from the Trade

Pye Provide Motor-cycle to Sidecar Intercom.

ONE of the snags of motor-cycles with sidecars is the difficulty of conversation between rider and passenger. Pye have provided Watsonian Sidecars, Ltd., with an intercommunication unit that will enable motor-cycle riders and passengers to talk to one another in comfort without dismounting or stopping the engine.

A headphone inside the rider's helmet will be connected to a unit consisting of a loudspeaker and a two-valve amplifier in the sidecar. Noise-eliminating microphones will ensure that speech is not drowned by the noise of the engine.

The operation of the new intercom. is simple, like that of an ordinary telephone. Later, it is hoped to develop a unit with provision for plugging in a radio.

The plug and socket mounted on the sidecar are designed for quick release and automatically separate by a slight pull on the inter-connecting cable. This takes care of the occasions when the rider forgets to unplug the cable before dismounting.

Watsonian Sidecars, Ltd., who foresee a great future for this new development, are considering 100 per cent. fitment, and Pye, Ltd., expect to produce several thousand units a year.

The retail price of the complete intercom. unit will be in the region of 12 guineas.—Pye, Ltd., P.O. Box 49, Cambridge.

A New High-speed Decade Counter Tube

THE Communications and Industrial Valve Department of Mullard Ltd. has recently introduced a high-speed decade counter tube of novel design. This tube, the E1T, is of the hard-vacuum type, and is, therefore, capable of much higher counting speeds than cold-cathode gas-filled decade counters. The actual counting rate is limited only by the associated circuitry, and counts of 30,000 a second are readily attainable.

The E1T can, therefore, be used in all normal industrial batching and counting operations, and in addition it is particularly suitable for high speed computing purposes in business machines, telecommunications gear, and radiation counters.

The basis of the Mullard E1T is a ribbon-shaped electron beam which can be deflected into 10 well defined positions by the input signals. In any of these ten positions the beam passes through one of ten apertures in a cylindrical anode and impinges on a fluorescent screen, causing a spot of light to appear opposite the appropriate figure ("0" to "9") marked on the tube envelope. As the last position is passed by the beam, a signal can be generated to reset the tube to "0" and simultaneously apply a counting pulse to the next tube in the chain.—Mullard Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

Mullard Junction Transistors and Rectangular 'Scope Tube

ALTHOUGH the properties and advantages in certain applications of transistors are well known, a limiting factor to their more widespread utilisation has to date been the difficulty of obtaining uniformity of performance and properties in the quantity production of such items.

Mullard have devoted very considerable research to the solution of this specific problem and two junction type transistors (types OC70 and OC71) are the successful outcome of this work. These two transistors are now being made available in large quantities and maintain a degree of consistency hitherto unobtained.

Junction transistors have definite inherent advantages over the earlier point-contact types. They have improved stability and reliability and, in addition, two other advantages enabling them to be used for all stages of audio frequency work; namely, their low circuit noise and complete freedom from microphony. One of their earliest successes, in fact, has been their application to hearing aids, in which they are widely used.

Amongst the many other applications of Mullard junction transistors on which investigations are being actively progressed are those in telephone circuits and computers.

The OC70 and OC71 are low-power transistors. Whilst the OC70 is intended for use in microphone input and amplifying stages, the OC71 can also be used as an output stage for telephone ear-pieces and hearing aids.

A special process of fusion sealing provides an all-glass fully hermetically sealed envelope. These envelopes measure about 0.6in. long and 0.25in. in diameter for both types.

New Philips L.F. Valve Voltmeter

CHIEF features of the new type GM6017 L.F. valve voltmeter, recently introduced by Philips Electrical, Ltd., are its excellent frequency range—2 c/s to 200 kc/s—and high sensitivity.

Designed for the acoustic and ultrasonic frequencies, this instrument can be used to measure A.C. voltages when investigating electro-acoustical and electro-mechanical phenomena.

There are 10 measuring ranges covering 0-10 mV up to 0-300 v. An extremely accurate R.C. generator supplies fully stabilised calibrating voltages of 10 mV, 100 mV, and 1 v. at 400 c/s, which can also be used for other purposes such as bridge-feed circuits, impedance measurement, etc.

Output voltage to the moving-coil meter is obtained from a germanium diode bridge rectifier. By replacing this with an internal resistor, the GM6017 can be used as a wide-band amplifier with a gain of 1,000 X.

Other features are automatic protection against overloading: a separate capacitor which can be shunted across the meter circuit to avoid needle vibration at low frequencies; linear anti-parallax scale.—Philips Electrical, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

New Osram Valves

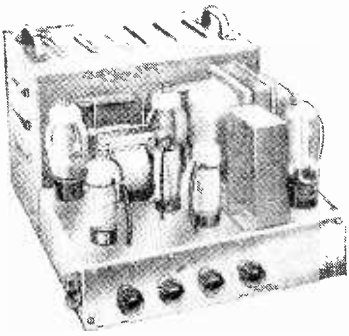
TYPE approval has now been received from the B.V.A. by The General Electric Co., Ltd., for two new Osram valves: DH719/EABC80 and B719/ECC85. Both are 6.3 v. indirectly heated valves, designed for use in F.M. and F.M./A.M. radio receivers. The DH719/EABC80, which has a list price of 13s., plus 4s. 3d. purchase tax, is a triple-diode-triode with one diode having a separate cathode. The B719 ECC85 has a list price of 17s. 6d., plus 5s. 9d. purchase tax, and is a double-triode.—G.E.C., Magnet House, Kingsway, W.C.2.

R.S.C. A4 HI-FIDELITY 25 WATT AMPLIFIER

1955 Model "Push-Pull" output. "Built-in" Tone Control Pre-amp. stages. Increased sensitivity. Even further improved performance figures. Includes 7 valves, specially designed sectionally wound output transformer, block paper reservoir condenser and reliable small condensers of current manufacture. **TWO SEPARATE INPUTS CONTROLLED BY SEPARATE VOLUME CONTROLS** allow simultaneous use of "Mike" and Gram., or Tape and Radio, etc., etc. **INDIVIDUAL CONTROLS FOR BASS AND TREBLE** "Lift" and "Cut." Frequency response ± 3 db. 30-30,000 c/c. Six negative feedback loops. Hum level 66 db. down. ONLY 20 milli-volts INPUT required for FULL OUTPUT. Certified harmonic distortion only 0.35% measured at 10 watts. Comparable with the very best designs.

Entirely suitable for Small Homes or LARGE Halls, Clubs, Garden Parties, Dance Halls, etc., etc. For Electronic Organ or Guitar. For Standard or Long-playing Records. For any "Mike" or Pick-up. H.P. TERMS ON ASSEMBLED UNITS. DEPOSIT 26/- and twelve monthly payments of £1.

9 GNS.



Size approx. 12-9-7in. For A.C. mains 200-230-250v. 50 c/cs. Outputs for 3 and 15 ohm speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Unapproachable value at **9 Gns.** or ready for use, **50/- extra.** Carriage 10/-. If required, cover as illustrated can be supplied for **17/6.**

R.S.C. 10 WATT "PUSH-PULL" HIGH-FIDELITY AMPLIFIER A3

Ideal for the quality enthusiast in the home or small hall. Two different inputs can be simultaneously applied and controlled by separate volume controls. Any kind of Pick-up is suitable and most microphones. Tone controls give full Long-Playing record equalisation for uncorrected Pick-ups. Sensitivity is very high. Only 130 millivolts required for full output. H.T. and L.T. available for Radio Feeder unit.

Complete with integral Pre-amp. Tone control stage (as A4 amplifier), using negative feedback, giving humproof individual bass and treble lift and cut tone control. **Six Negative Feedback Loops.** Completely negligible hum and distortion. Frequency response ± 3 db. 30-20,000 c.p.s. Six valves, A.C. mains 200-230-250 v. input only. Outputs for 3 and 15 ohm speakers. Kit of parts complete in every detail. Plus 7/6 carriage. Or ready for use, **45/-** extra. Illustrated leaflet **6d.** Cover as for A4 is suitable. H.P. TERMS ON ASSEMBLED UNITS. DEPOSIT **£1/13/4**, plus 7/6 carriage, and nine monthly payments **£1.**

7 GNS.

HIGH-FIDELITY MICROPHONES in stock. Keen cash prices or H.P. terms if supplied with amplifier.

A PUSH-PULL 3-4 watt HIGH-GAIN AMPLIFIER FOR £3.19.6. For mains input 200-250 v. 50 c/s. Assembled ready for use. Amplifier can be used with any type of Feeder Unit or Pick-up. This is not A.C./D.C. with "live" chassis, but A.C. only with 400-0-400 v. trans. (Output is for 2-3 ohm speaker.) Carr. 3/6. Descriptive leaflet, **7d.**

B.S.R. MONARCH 3-SPEED MIXER AUTOCHANGER. For standard 200-250 v. 50 c/cs mains. Autochanges on all 3-speeds. Plays Ten mixed 7in., 10in. and 12in. records. Separate sapphire stylii for L.P. and 78 r.p.m. High fidelity type crystal pick-up. Minimum baseboard size needed 14in. x 12½in. x 5½in. high. Brand new, cartoned, at **9 gns.** plus 6/6 carr. Or Deposit **2 gns.** and Nine monthly payments **21/-.**

BATTERY SET CONVERTER KIT All parts for converting any type of Battery receiver to All Mains. A.C. 200-250 v. 50 c/cs. Kit will supply fully smoothed H.T. or 120 v. 90 v. or 60 v. at up to 40 mA. and fully smoothed L.T. or 2 v. at 0.4 to 1 a. Price, complete with circuit, wiring diagrams and instructions, only **48/9.** Or ready to use, **8/9** extra.

ALL DRY BATTERY RECEIVER MAINS UNIT KIT. A complete set of parts for construction of a Unit (housed in metal case) to replace Batteries where A.C. Mains supply is available. Input 200-250 v. 50 c/cs. For receivers requiring 90 v. 10/20 mA. and 1.4 v. 125-250 mA. fully smoothed. Price, complete with circuit, only **37/9.** Or ready for use **45 6.** Size of unit, 5½ x 4 x 2¼in.

BATTERY CHARGER KITS
For mains 200-250 v. 50 c/cs.
To charge 6 v. acc. at 2 a., **25/6.**
To charge 6 or 12 v. acc. at 2 a., **31/6.**
To charge 6 or 12 v. acc. at 4 a., **49.9.**
Above consist of transformer, full wave rectifier, fuses, holders and steel case. Any type assembled and tested, **6/9** extra.

THE SKYFOUR T.R.F. RECEIVER. A design of a 3-valve 230-250 v. A.C. Mains receiver with selenium rectifier. It consists of a variable Mu high-gain H.F. stage followed by a low distortion anode bend detector. Power pentode output is used. Valve line up being 6K7, SP61, 6F6G. Selectivity and quality are well up to standard, and simplicity of construction is a special feature. Point to point wiring diagrams, instructions, and parts list, **1/9.** This receiver can be built for a maximum of **£4 19/6** including attractive Brown or Cream Bakelite or Walnut veneered wood cabinet 12 x 6½ x 5½in.

H.M.V. LONG-PLAYING RECORD TURNTABLE WITH CRYSTAL PICK-UP (Sapphire Stylus). Speed 33⅓ r.p.m. For A.C. mains 200-250 v. Limited supply. Brand New, cartoned. Perfect. Only **£3/19/6.** Plus carr. 5/- (Normal price £8 approx.).

FOUR STAGE RADIO FEEDER UNIT. Design of a High Fidelity Tuner Unit T.R.F. L. & M. Wave. Full decoupling. Self-contained heater supply. Only 250-400 v. 10-15 mA. H.T. required from main amplifier. Three valves and low distortion Germanium diode detector. Flat-topped response characteristic. Loaded H.F. coils. Two variable-Mu controlled H.F. stages. 3-Gang condenser tuning. Detailed wiring diagrams, parts lists, and illustration, **2/6.** Total building cost, **£3/15/-.**

TV. PREAMPLIFIER (Plessey) For Fringe Areas. Brand New. Complete with 6F13 valve. Only **22/6.**

P.M. SPEAKERS. All 2-3 ohms. 6½in. Plessey, **16/9.** 8in. Plessey, **16/9.** 10in. Plessey, **19/6.** 10in. R.A., **26/9.** 10in. Rola with trans., **29/6.** 10in. W.B. "Stentorian" 3 or 15 ohm type HF1012 10 watts, high-fidelity type. Highly recommended for use with any of our amplifiers, **£3/17/6.**

VOLUME CONTROLS with long (1in. diam.) spindles, all values less switch, **2/9**; with S.P. switch, **3/9**; with D.P. switch, **4/6.**

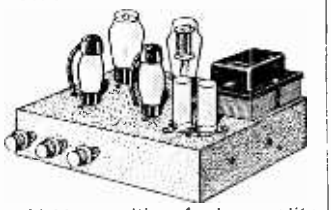
COAXIAL CABLE 75 ohms, ½in., **7d** yard. Twin Screened Feeder, **10d.** yard.

SELENIUM RECTIFIERS

H.T. Types	H.W.
150 w. 40 mA.	3/9
250 v. 50 mA.	6/9
250 v. 80 mA.	7/9
RM4 250 v. 250 mA	11/9

L.T. Types	
6/12 v. ½ a. H.W.	2/9
F.W. Bridge Type	
6/12 v. 1 a.	4/9
6/12 v. 2 a.	8/9
6/12 v. 4 a.	15/9

R.S.C. 4-5 WATT A5 HIGH-GAIN AMPLIFIER



A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high-fidelity pick-up heads, in addition to all other types of pick-ups and practically all mikes. Separate Bass and Treble Controls are provided. These give full long-playing record equalisation. Hum level is negligible being 71 D.B. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 25 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit, or Tape Deck preamplifier. For A.C. mains input of 200-230-250 v. 50 c/cs. Chassis not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate), with green crackle finish, and point-to-point wiring diagrams and instructions. Exceptional value at only £4/15/-, or assembled ready for use 25 - extra, plus 3 6 carr.

R.S.C. 3-4 WATT A7 HIGH-GAIN AMPLIFIER

Appearance and Specification, with exception of output wattage, as A5. Complete Kit, with diagrams, £3/15/-. Assembled £1 extra.

CHASSIS (Undrilled Aluminium)

18 s.w.g. amplifier (4-sided)				
14in. · 10in. · 3in.	...	...	...	7/11
16in. 10in. · 3in.	...	...	...	8/3
16 s.w.g. receiver type				
6in. · 3¼in. · 1¼in.	...	...	...	1/11
10in. · 5¼in. · 2in.	...	...	...	3/3
7¼in. · 4¼in. · 2in.	...	...	...	2/9
11in. · 6in. · 2½in.	...	...	...	3/11
12in. 8in. · 2½in.	...	...	...	5/3
16in. 8in. · 2½in.	...	...	...	7/6
20in. · 8in. · 2½in.	...	...	...	8/11
16 s.w.g. amplifier type, 4-sided.				
12in. · 8in. · 2½in.	...	...	...	7/11
16in. · 8in., 2½in.	...	...	...	10/11
20in. 8in. 2½in.	...	...	...	13 6
14in. 10in. 3in.	...	...	...	13/6

COLLARO 3-SPEED AUTOCHANGER. For standard 200-250 v. 50 c/cs mains. Fitted high-fidelity crystal pick-up with sapphire stylii for long-playing or standard records. 7in., 10in. or 12in. Limited number. Brand New. Guaranteed. **£7/19 6.** Carr. 7/6.

DEFIANT RECORD PLAYING UNITS Comprising Turntable for standard 10in. and 12in. 78 r.p.m. records (fitted auto-stop) and high impedance magnetic pick-up, mounted in attractive polished walnut finish drawer-type cabinet. Exceptional value at £5/19.6. plus 7/6 carr.

Terms: C.W.O. or C.O.D. NO C.O.D. under £1. Post 1/- extra under 10/-: 1/6 extra under £1: 2/6 extra under £3.
Open 9 to 5.30: Sats. until 1 p.m. Catalogue 6d., Trade List 5d. S.A.E. with all enquiries.

RADIO SUPPLY CO. (LEEDS) LTD. 32, THE CALLS, LEEDS, 2

Open to Discussion

An Economical Gramophone Amplifier

SIR,—The economical high-quality amplifier is basically an excellent design—I applaud its simplicity.

The " scratch filter " network, however, is within the negative feedback loop. Now the time-constant of the .005 capacitor and 250 K anode load resistor which it shunts is such that in the absence of negative feedback it would be cutting treble at a rate of 6dB/octave from a turnover frequency around 200 c/s. Therefore, the negative feedback is fully operative in reducing distortion and output impedance *only up to this frequency.*

As the audible benefits of negative feedback are most noticeable in the middle and high frequencies, you might say that to all intents and purposes the negative feedback in this design is serving no purpose other than that of modifying the scratch filter characteristics.

It is easy enough to place a filter outside the negative feedback loop.—IAN LESLIE (N.10).

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

Valve Noise

SIR,—In these days of poor selectivity and overlapping of stations, any little improvement to reduce the signal noise is welcome, so I wrote to Messrs. Osmor Radio for a few tips. They were most helpful. One tip they gave me I think is worth passing on to your readers. It is that to reduce valve noise (due to turning the wick up on weak stations) a slight reduction in heater voltage is an advantage. It certainly worked in my case.—T. OSBORNE (Hillingdon).

F.M. Receiver

SIR,—When can we expect a receiver designed for the reception of the new F.M. transmissions? Isn't it about time your designers got down to it?—G. HARROP (W.3).

(*At the moment only a very small part of the country is served by these transmissions. We have two or three designs in hand and shall shortly be describing a combined A.M./F.M. eight-valver.*—ED.)

Unpopular Valves

SIR,—Surely correspondent Richard Page (BAOR5) (June) is mistaken in his claim for a 6B8. This valve, as he states, is a double diode pentode and therefore could not be used as an I.F. amp./det. arc/first L.F. amp., thereby replacing a 6K7 and 6Q7. That is, of course, unless a reflex circuit were used. A 6M8 would, however, answer all Mr. Page's claims, except that of saving of heater current. It takes .6 amp.

Incidentally, an article on reflex circuits would be interesting, also one on infinitely variable selectivity.

Congratulations on your new series, Servicing Radio Receivers, which will give " us " amateur constructors a chance to see what " those " professionals do with their sets, and also on using test instruments.—C. R. B. WILKINSON (Malta).

The Three-channel Mixer Fader Unit

SIR,—While reading the article about this unit, I found what I consider to be a very serious mistake. When the switches to channels 2 and 3 (Fig. 2) are in the off position, the signal coming in from these channels is short-circuited. This is quite permissible if the pick-ups connected to these channels are not actually tracking the records, but if the output from a P.U. in use, crystal " mike " or tape recorder (which are very common amongst the sound men of amateur dramatic groups) is short-circuited, serious damage may result.

I consider a two-pole switch to be a better switching method than the one given. The switch would be fixed to the potentiometer so that it could be operated when the potentiometer was turned fully anti-clockwise. The advantage being that the signal would be a minimum when the switch operated and so no " plop " would be heard.—J. C. WHITMORE (Nuneaton).

[The Author replies :—What Mr. Whitmore says is quite correct—Channels 2 and 3 are s/c when the switches are in the " off " position. But does it not seem that he is making much ado about what is really a matter of choice. He talks about crystal mikes, tape recorders, in fact he lays the foundations of what could develop into one of those all too familiar " everlasting—nothing concrete " arguments. Allow me to make a few points—I will endeavour to be brief. There is no *mistake* in the circuit diagram. There is, however, a possibility of people who do not know any better putting a short circuit across a working " pick-up." Mr. Whitmore speaks as if we are to expect flames and smoke if such a thing is done momentarily—not so. It may cause damage.

The circuit sent to you and as published by you has been and still is giving efficient service, in the manner in which *it was intended* to do.

The whole object of a volume control *and a separate* switch is that the level can be preset as is required —so as not to " drown out " actors on stage—and the circuit can then be made dead by use of the switch, until required. It is not intended to " turn off " by use of the channel switches; any " dead clean cut " in sound can be achieved by use of the " sound on/off " switch—see photo of equipment.

I would further point out that Mr. Whitmore's remarks re " mike " and tape recorders are " off the beam." Channel 1 is the high gain circuit, for " mikes" it says that in the text, and channel 1 does *not* s/c the input. What does Mr. Whitmore think will

happen to the tape recorder if a s/c is applied to a channel to which it is connected? Surely he does not propose to connect the 3Ω speaker of the T.R. to a half megohm potentiometer? He talks airily about "sound men in amateur dramatics." I suggest, sir, that either he does not know any sound men or that the men he knows know little about sound.

He talks of short circuits on the output of a tape recorder—now this can only do damage on a low impedance output, i.e., the extension speaker output, and who worthy of the name "sound man" would use a low-impedance output coupled to a high impedance input—viz., half megohm.

Consider Mr. Whitmore's proposed "better switch method." Here he disconnects the input by *turning down* the volume and then switching—all very nice, but not what the unit was intended to do, there is no reason why his method should not be used if one is prepared to twiddle volume controls all evening.

Another point—suppose, as it must appear, that Mr. Whitmore's tape recorder has a switching system whereby the main speaker can be cut out and the output switched to the extension speaker terminals; these we presume are being used as input to the mixer unit.

What, may I humbly ask, does he think will happen when we use his system and disconnect the output/input, or did he intend to keep a 3Ω load across the output anyway, and has he never heard of mis-match?

In a word, Mr. Editor, the case can be argued this way and that; my circuit does what *it is intended* to do and it does it passing well.

If Mr. Whitmore wants it to do other than that for which it was intended, then he is welcome to redesign it, mis-matching and all.

One final point—just what will happen to a "pick-up or mike" that is short-circuited whilst in use? Will Mr. Whitmore not find that this is just one more of those finer points of theory that are not quite like the textbook in practice?—H. W. JEFFERIES (Worthing).]

Cathode Follower

SIR,—I have read with interest the recent discussion on Cathode-follower output and, in fairness to your correspondents and particularly Mr. Kerslake, I should like to point out that a similar discussion took place in the columns of another journal during the war.

As a result, Mr. A. C. Robb, of Liverpool, modified the said journal's Quality Amplifier with considerable success. Briefly, this meant driving the output stage (two PX4s in push-pull) through a combination of auto-transformer and choke coupling. The effect, he stated, was a sense of unlimited power. High electrical damping reduced spurious speaker effects such as combination tones and cross-modulation. The result was a great increase in reality in the high audio frequencies, while bass response was the second most outstanding quality and plucked strings sounded uncannily real.

Mr. D. T. N. Williamson commented on this type of output by pointing out some of its disadvantages and showing how negative feedback properly applied can produce a similar performance. To produce the desired effect from cathode-follower output, a specially-wound sectionalised auto-transformer is required and the speaker must be of the highest order. This obviously presents difficulties and expense, an undesirable feature for many, and since to-day we have progressed to negative feedback and ultra-linear operation, it can be said that cathode-follower methods have been superseded.

I would like to state that I have not experimented with cathode-follower output since I have only recently entered the field of high-fidelity. Perhaps I am lucky, for hi-fi is not quite so expensive as it used to be. In any case my hook-up is designed to provide the best possible reproduction of radio and records, and also enable my wife to turn on "Mrs. Dale's Diary" without an instruction book, which, no doubt, some of our purist experts would tremble to consider. —D. HANDLEY (Redland, Bristol).

SMALL MAINS TRANSFORMERS

(*Continued from page 562*)

The Windings—Number of Turns

There are various calculations used to obtain the number of turns in each winding. A good rule of thumb, however, is to use at least six turns per volt per square inch of cross-sectional area of the centre core.

Example

Consider the following transformer which has a centre core of 1 sq. in. cross-sectional area.

Primary 250 volts.
Secondary 300-0-300 volts.
6.3 volts.
5 volts.

The primary should have 1,500 turns and the H.T. Secondary should have 4,200 turns. The heater windings should be 38 and 30 turns respectively.

If, however, the cross-sectional area of the core had been 2 sq. in. we should use the figure of 3 turns per volt to obtain the number of turns on each of the windings.

The secondary windings are approximate because the efficiency of the transformer has not been taken into account. In practice the exact number of secondary turns will have to be obtained by measuring their output with a meter. This is best done by injecting a low voltage A.C. into the primary and then winding the secondary until the correct proportionate output is obtained.

Electrostatic Screening

It is usual to provide this in transformers used for radio receivers. It is achieved by winding a thin strip of brass or copper of full winding width between the primary and secondaries. The screen is then earthed.

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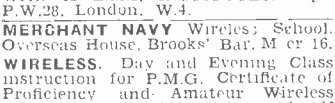

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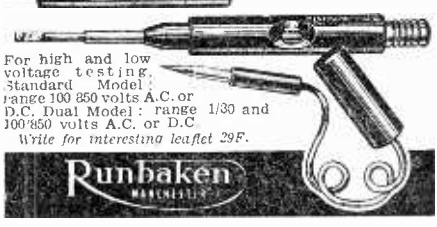

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THESE blueprints are drawn full size. The issues containing descriptions of these sets are now out of print, but an asterisk denotes that constructional details are available, free with the blueprint.

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