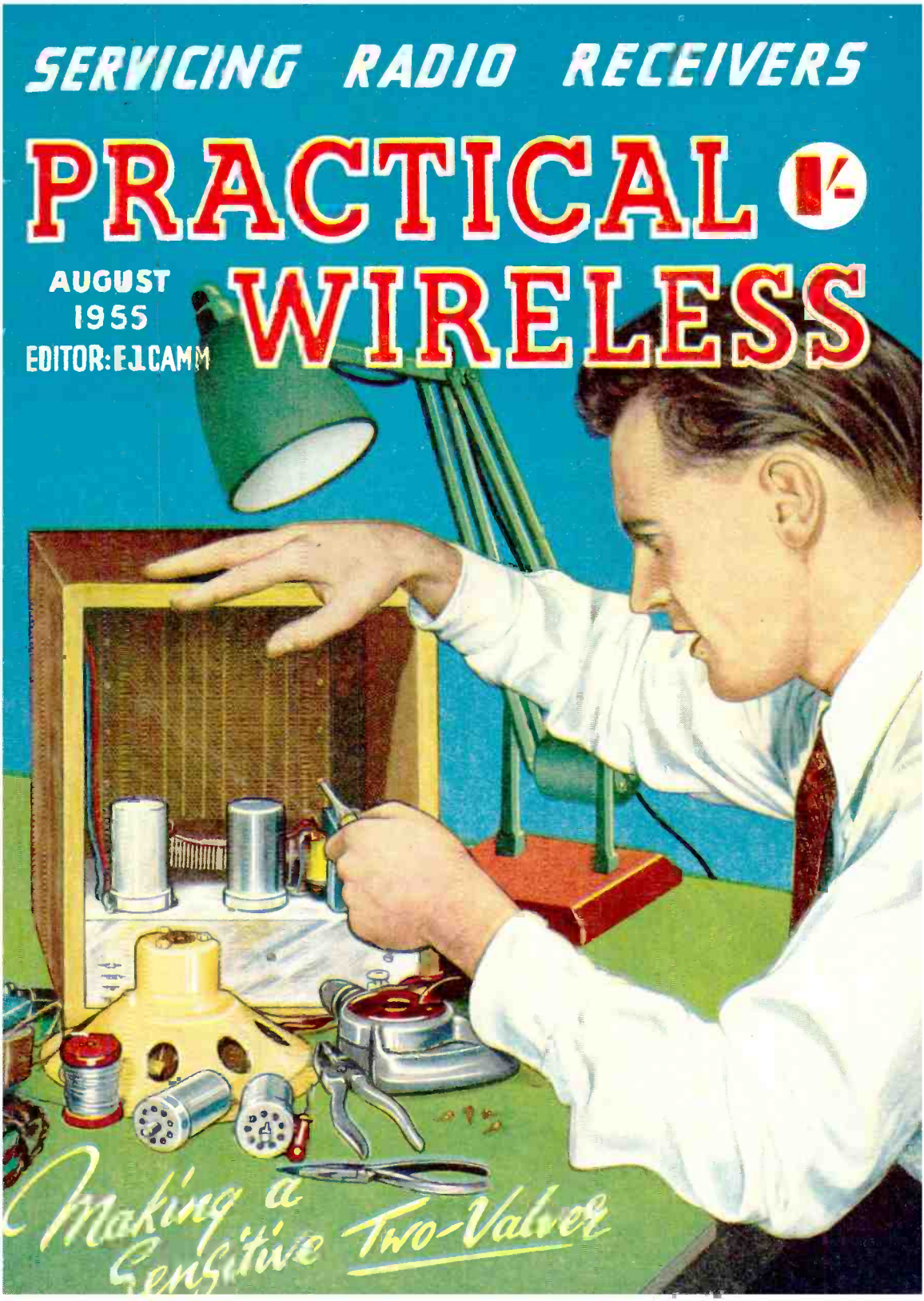
SERVICING RADIO RECEIVERS

PRACTICAL WIRELESS

1/-

AUGUST
1955
EDITOR: E.J.CAMM



Making a Sensitive Two-Valver

PRACTICAL WIRELESS
EVERY MONTH EDITOR : F. J. CAMM 23rd YEAR OF ISSUE
VOL. XXX1, No. 586, AUGUST, 1955

COMMENTS OF THE MONTH — BY THE EDITOR

Radio Emission From Jupiter?

THE Carnegie Institution of Washington issued the surprise announcement in April that radio emissions from Jupiter had been detected on a frequency of 22 Mc/s. Workers at the Radio Physics Laboratory in Sydney confirm that they have received similar signals, and there seems no reason whatever to doubt the accuracy of these observations. The receiving system consisted of a large cross aerial of the type developed by Mills in Sydney for radio astronomy, which produces a narrow beam in a fixed direction. The Carnegie aerial occupies a 96-acre field, near Seneca, Maryland, and although the beam width is not known, it is thought to be of the order of one degree, because Jupiter passes through the aerial beam in six minutes.

According to the reports, the radio emissions from Jupiter were short random bursts of static resembling thunderstorm interference as heard on a broadcast receiver. They were observed about one day out of every three during the time when Jupiter was in the beam of the aerial system. The location of the sky from which these bursts originated agreed with the positions of Jupiter over a period of several months. From this is must be concluded that any terrestrial origin of the bursts must be excluded.

The study of radio waves from the sun is now an important part of radio astronomy. The signals from it are relatively intense. Dicke and Beringer, in 1946, successfully measured the radio emission from the moon, as did Piddington and Minnett in 1949. In this case the emission measured on a wavelength of 1.25 cm. corresponds to a lunar surface temperature of 250 deg. K. The surface temperature of Jupiter is about 160 deg. K. It has been suggested that the Jupiter signals are caused by disturbances in the planetary atmosphere.

CAR RADIO AND THE ROAD FUND LICENCE

IN our issue for March, 1954, we criticised the Ministry of Transport for inserting in application forms for Road Fund Licences questions asking whether the car was fitted with car radio and whether a licence had been obtained for it. We considered this an infraction of the rights of the individual, and interference with the liberty of the subject, and an attempt by one Ministry to act as a snooper for another. Motorists who install car radios and do not take out licences for them do not deserve public sympathy and they should be prosecuted when caught, but we must be particularly careful that in the process of catching them we do not become a police state. We said that the M.O.T. had arrogated unto itself powers which it did not possess. This point of view was refuted by the authorities at the time, but we are glad now to be able to report that they have admitted that they do not possess powers and that the questions are to be omitted in future. In the meantime, car owners can refuse to answer them without fear that they will be refused a licence. If any reader experiences the slightest difficulty in obtaining a licence by refusing to answer these questions he should immediately get into touch with us. It is clear now that a Statutory Form can only be altered by an amendment to the original Act, passed by Parliament or by a Statutory Order. Unfortunately, thousands of motorists have been bluffed into answering these questions since they were added to the form about two years ago. Having disclosed the information it will be interesting to see whether in future use is made of it. Will they receive letters asking whether they have renewed their car radio licences?

RADIO-CONTROLLED MODELS

WE are often asked by readers to publish constructional articles on radio-controlled models in this journal. We have, hitherto, considered that this was the special field of our companion journal, *Practical Mechanics*, in which paper several designs have appeared and a further series is now running. We desire, however, to ascertain how many readers of this journal would be interested in such articles. We should be obliged if they would send us a postcard, indicating their views.

We should also be glad to hear from any reader who has evolved an original design. There can be no doubt that interest in such models is increasing, and already the hobby has its own association which arranges annual contests.

THE RADIO SHOW

WILL readers please note that at the Radio Show at Earl's Court which this year takes place from August 24th to September 3rd, our stand will be number 107.—F. J. C.

Round the World of Wireless

By "QUESTOR"

Broadcast Receiving Licences

THE following statement shows the approximate number of broadcast receiving licences in force at the end of April, 1955. The grand total of sound and television licences was 14,017,447.

Region	Number
London Postal	1,461,567
Home Counties	1,408,044
Midland	1,138,192
North Eastern	1,507,716
North Western	1,158,373
South Western	942,877
Wales and Border Counties ...	588,081
Total England and Wales ...	8,204,850
Scotland	1,013,003
Northern Ireland	218,869
Grand Total	9,436,722

Mr. J. A. Camacho, O.B.E.

THE BBC has appointed Mr. J. A. Camacho, O.B.E., to the post of Chief Assistant, Light Programme, and he has now taken up his new duties.

The position was previously held by Mr. H. Rooney Pelletier who was made Controller, Light Programme, in April this year.

Walkie-Phones for Rescuers

THE Austrian Life Saving Service, formed to save victims of snow avalanches, has equipped every second man of its rescue squads with a Pye Walkie-Phone. These phones are contained in specially made yellow bags.

The rescue groups are dropped by parachute on the scene of the accident then radio messages to a "Reporter" inside the aeroplane. The "Reporter" is equipped with a microphone and a low resistance head through which the person commanding the rescue operation can listen.

"Elettra II" Visits Holland

THE Marconi Marine research and demonstration vessel *Elettra II*, which has been refitting at Teddington, sailed from the Thames on May 31st on a visit to Dutch ports. In co-operation with Radio Holland N.V., the Dutch associate of the Marconi Marine Communication Company, she is to demonstrate Marconi Marine radio equipment to various Dutch shipping interests.

Electronics Exhibition

THE tenth annual Electronics Exhibition will be held under the auspices of the Institution of Electronics at the Manchester College of Technology from July 14th to July 20th.

Complete lecture and film show programmes (post free 4½d.) and lecture admission tickets are available from Mr. W. Birtwistle, 78, Shaw Road, Thornham, Rochdale, Lancs. Complimentary exhibition admission tickets are also obtainable from this address to those who send a stamped and addressed envelope.

Secret Computer Wins Award

WING-COMMANDER JERAULD WRIGHT, R.C.A.F., of Ottawa, the inventor of the R Theta navigation computer and interception device, has been awarded the McKee Aviation Trophy, Canada's premier award for aviation.

The invention enables a fighter 'plane to keep on its correct course at all times and find its way back to base, or carry out accurate interception of enemy aircraft. It has been developed and manufactured for the R.C.A.F. by Mr. J. M. Bridgeman, of Applied Research of Toronto.

New Factory

AS from June 15th, Winston Electronics, Ltd., of Hampton Hill, Middlesex, have been at their new factory premises at Govett Avenue, Shepperton, Middlesex.

The new telephone number is Walton-on-Thames 2732.

Award for Dr. A. Rosen

THE Senate of the University of London has conferred the degree of D.Sc. (Engineering) on Dr. A. Rosen, Ph.D., M.I.E.E., for his work in the field of telecommunication cables.

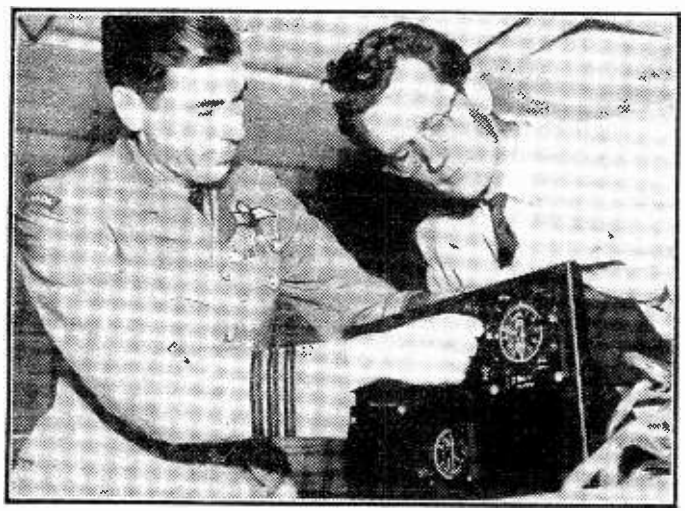
Dr. Rosen is consultant engineer (telecommunications) in the engineering organisation of British Insulated Callender's Cables Limited.

Further BBC Appointments

THE BBC announce the appointment of Mr. Harry Middleton as Assistant Head of Outside Broadcasting (Sound) and Mr. Donald McLean to the newly-created post of Variety Music Organiser.

Marconi Manager Honoured

IT is announced in the 1955 Birthday Honours List that Mr. F. N. Sutherland, M.A.,



Wing Commander Jerauld Wright and Mr. J. M. Bridgeman with the new R Theta Navigation Computer and Interception Device (see "Secret Computer Wins Award").

M.I.E.E., general manager of Marconi's Wireless Telegraph Company Ltd., has been created a Commander of the British Empire.,

This honour is in recognition of his outstanding services to British industry.

I.A.M.A. : New President

MR. CLIVE BARWELL, general publicity manager of Mullard, Ltd., has been elected president of the Incorporated Advertising Managers' Association.

Mr. Barwell first became a member of the Association in 1938 and was later appointed honorary secretary.

New Senior Development Engineer

MR. ROBERT L. GREEN, A.M.I.E.E., has joined Winston Electronics, Ltd., as a senior development engineer responsible for telecommunications research and development.

Mr. Green is 33 and was born and educated in Holland, but has now assumed British nationality.

Services On Record

BY means of a tape-recorder, the Rev. Idwal Jones, Vicar of St. Mary the Virgin, Cuddington, Surrey, is able to " bring the Church to the bedside " of patients in local hospitals. He instals the tape recorder in his church before a service, records the whole proceedings, including his sermon, and then takes his recorder to hospitals where patients who are unable to attend church can listen to the " playback."

New Mayor of Southgate

THE new Mayor of the Borough of Southgate, London, is Alderman John Clarricoats, O.B.E., general secretary of the Radio Society of Great Britain.

Alderman Clarricoats has operated his own amateur radio station —call sign G6CL—since 1926.

Retirement of Publicity Chief

MR. A. J. P. HYTCH, BBC chief publicity officer since 1942, retired on June 11th and was succeeded by Mr. Derek Russell, former publicity officer BBC European Service.

Mr. Hytch first joined the BBC at Savoy Hill in 1927.

More Hungary Listeners

THREE times as many people hold radio receiving licences in Hungary as compared with the number in 1938.

Last year 190,000 people took out wireless licences, making a grand total of more than 1,270,000.

More Schools Listen In

AT the end of May this year, 27,697 schools had been registered as listening to one or more series of broadcasts for schools.

This is exactly 1,000 more than at the same time in 1954 and means that at least three-quarters of the schools in the United Kingdom are now registered with the School Broadcasting Council.

Visit to Nigeria

WE learn that Mr. R. S. Postgate, Assistant Head of the BBC's Secretariat, is visiting Nigeria " on loan " by the BBC. He left on June 19th and is due to return at the end of July.

Amateur Exhibition

THE R.S.G.B. Amateur Radio Show will probably be held this year in the Royal Hotel, Woburn Place, London, W.C.1, from November 21st to 26th.

Released by Communists

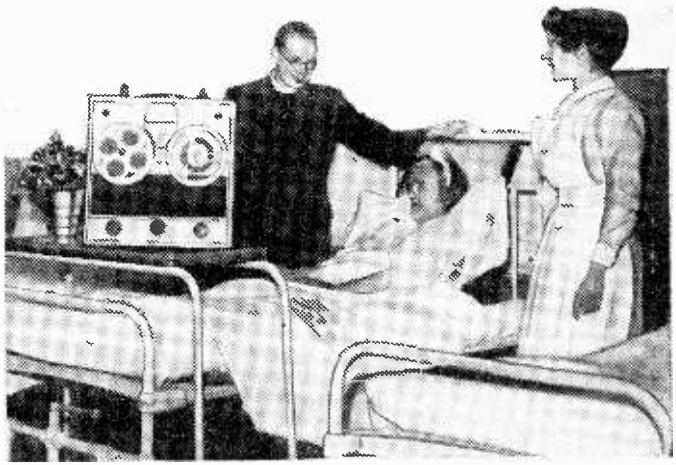
AMATEUR radio operator Robert Ford, AC4RF, has been released by the Chinese Communists after nearly five years as a prisoner in their hands.

Just after the war he began operating from Lhasa for a while, but was later accused by the Communists of spying and was arrested.

Convention in Jugoslavia

A NATIONAL convention is to be held in Zagreb from August 4th to the 6th this year by the Jugoslav Society of Radio Amateurs.

In addition to a large exhibition of amateur equipment and apparatus, the programme will include lectures, excursions, code speed tests and competitions.



The Rev. Idwal Jones plays back one of his recorded services to patients in a ward of the Horton Hospital, Epsom. A staff nurse also listens to the recording (see " Services on Record ").

Radiotelephone Service

A NEW radiotelephone service between Cyprus and the Lebanon opened on May 16th. It is operated in Cyprus by Cable and Wireless Limited in conjunction with the Cyprus Internal Telecommunications Authority and by the Lebanese Administration and Radio Orient S.A. in the Lebanon.

The new service will be available on weekdays from 12.30 hours to 13.30 hours (G.M.T.).

Mullard to Expand

MULLARD LIMITED are to extend their factory premises in Hove and have taken over 20,000 square feet of factory space in premises in Cromwell Road, near to the present factory in Wilbury Villas. Initially, only a small staff will be engaged at the new factory but the number of employees is expected to increase to about 350 within the next two years, during which time it is calculated that six million or more valves will be produced at the new extension.

A PRE-AMPLIFIER with Scratch Filter and Tone Control

A VALUABLE ADDITION TO THE HI-FI ENTHUSIAST'S INSTALLATION

By R. Taylor

IN order that the maximum amount of satisfaction may be derived from the reproduction of gramophone records through an audio amplifier and loudspeaker, certain factors must be taken into account.

There are a number of companies responsible for the manufacture of gramophone records, all using different recording characteristics. For 78 R.P.M. records, the E.M.I. group attenuate the frequencies below 1,000 c/s, while Decca not only attenuate the bass frequencies, but give, in addition, a measure of pre-emphasis to the treble. Many American companies employ what is known as the N.A.B. characteristic, which, as well as giving considerable attenuation of the bass, employs a strong pre-emphasis of the high-frequency range. The position becomes even more confused when the recording characteristics of L.P. discs are considered

It is obvious, therefore, that to reproduce any of these correctly, a flexible tone control circuit is essential, so that the playback characteristic shall be the inverse of the recording characteristic. Another factor which deserves consideration is that of needle scratch, and to extract the greatest pleasure from the reproduction of old or badly worn records, a scratch filter is necessary. Cutting the treble response by means of a tone control in an endeavour to reduce scratch, is most unsatisfactory, as by alteration of the playback characteristic, the treble response above 1,000 c/s is muffled.

A steep-cut scratch filter is not difficult to make, and one designed to cut at either 8 Kc/s, 6 Kc/s, or 4 Kc/s is usually all that is necessary to reduce to negligible proportions scratch on any but the worst recordings. This filter may also be used as a means of combating the irritating whistle, or sideband splash, found on the Medium-wave broadcast bands during the hours of darkness,

The Circuit

This pre-amplifier has been designed to meet the above requirements, yet be easy to construct and be

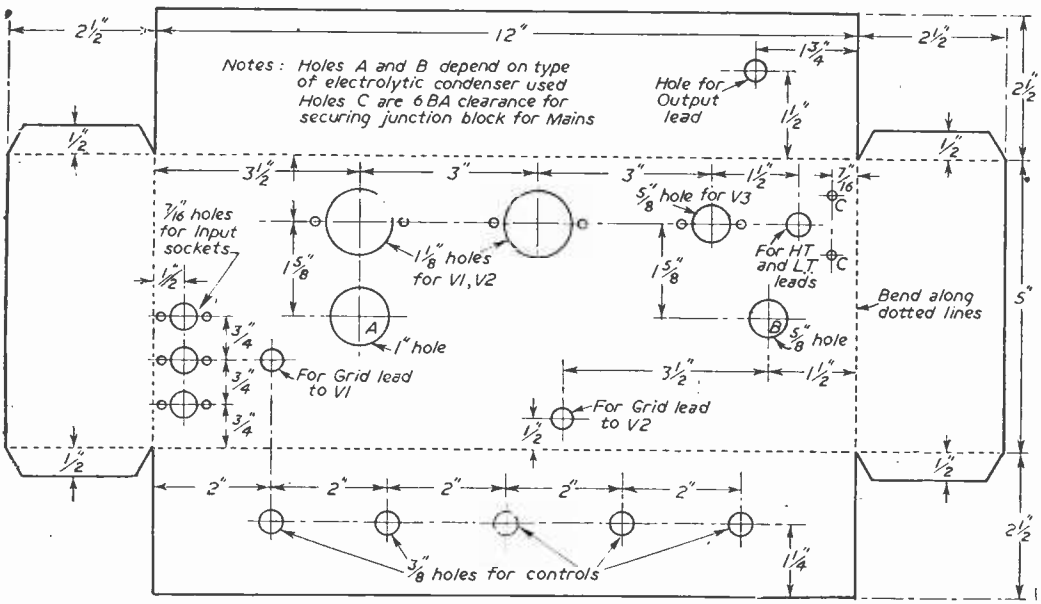
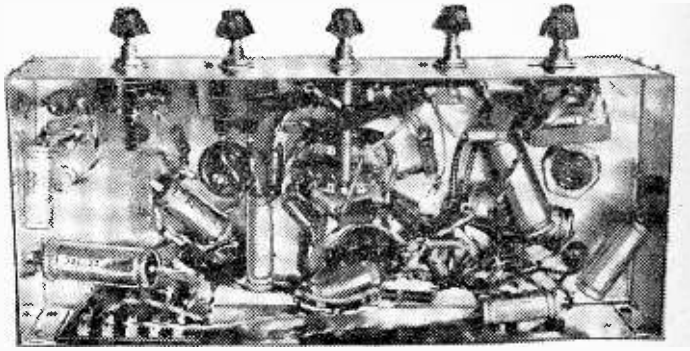


Fig. 2.—Details of the chassis—cutting and drilling.

comparatively inexpensive. It takes the form of three separate units, (a) a voltage amplifier, (b) tone control, and (c) a scratch filter, all united to form a comprehensive pre-amplifier.

The theoretical circuit (Fig. 1) shows that a low-microphony A.F. pentode is used in the first stage as a voltage amplifier. This leads in turn, via a potentiometer (volume control), to the second stage, which is designed around a triode. This valve is another A.F. pentode, but with electrodes strapped to function as a triode, and this stage gives a level response, or switched steep-cut characteristics of 8 Kc/s, 6 Kc/s, or 4 Kc/s at will, by the employment of close tolerance capacitors and resistors. The final stage incorporates a negative feedback tone-control circuit, based on the one described by P. J. Baxendall in the *Wireless World* (Oct., 1952), which gives independent control of bass and treble frequencies. The characteristics of this circuit are such that a variation between +20db and −20db at 20 c/s in the bass and +20db and −20 db at 15 Kc/s in the treble, with a crossover at 1,000 c/s is obtainable.

The decision to place the tone-control circuit at the end of the pre-amplifier was arrived at because the output obtained is of low impedance. This makes possible the use of a long coaxial line to the main amplifier, without provoking instability, or any other undesirable fault.



Underside view of the amplifier.

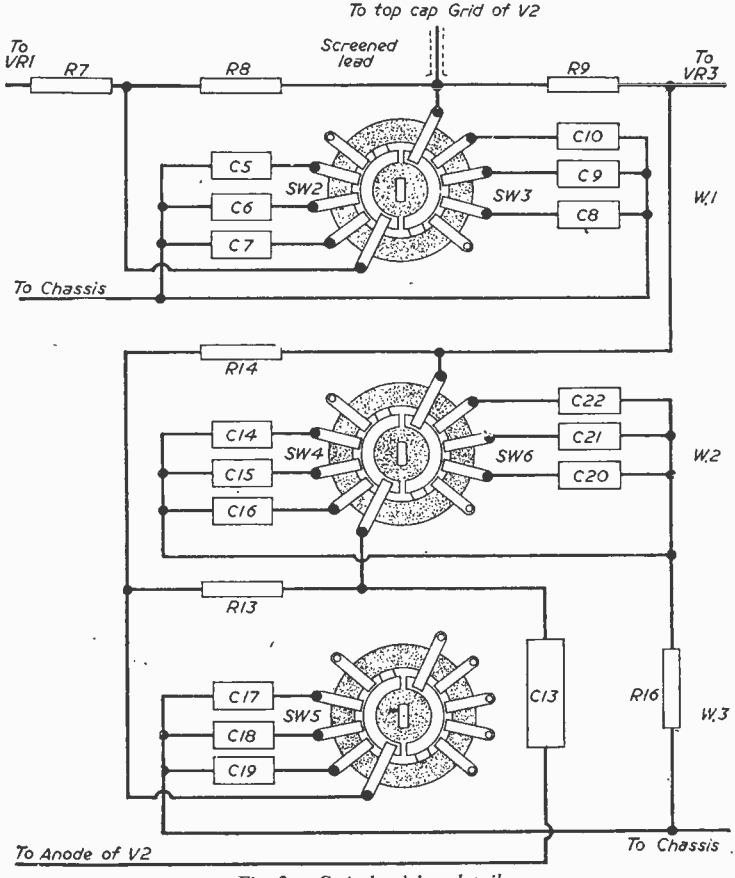


Fig. 3.—Switch wiring details.

Layout

In this design close tolerance components have been kept to a minimum. The general layout is very elastic, but due attention must be given to the prevention of hum pick up in the first stage. Coaxial input is essential if a low level of hum is to be achieved, while the chassis should be of a non-magnetic material, and the base entirely screened. This pre-amplifier will fully load a Williamson amplifier with an input of 50 mV.

Constructional Details

The chassis should be constructed of 18 s.w.g. aluminium sheet, the measurements being given in Fig. 2, which when riveted or bolted will make a sufficiently strong chassis. The position of the holes should be marked, and then drilled, or punched out, after which sockets, valve-holders, switches, etc., may be mounted. An exception may have to be made regarding the switch SW2-3-5-5-6, for difficulty may be experienced in purchasing a single wafer version. Switches of two- or three-gang types possessing the required number of poles are readily obtainable, and the particular wiring layout to be employed is, therefore, to some extent, dependent upon the switch used. A 3-gang switch has

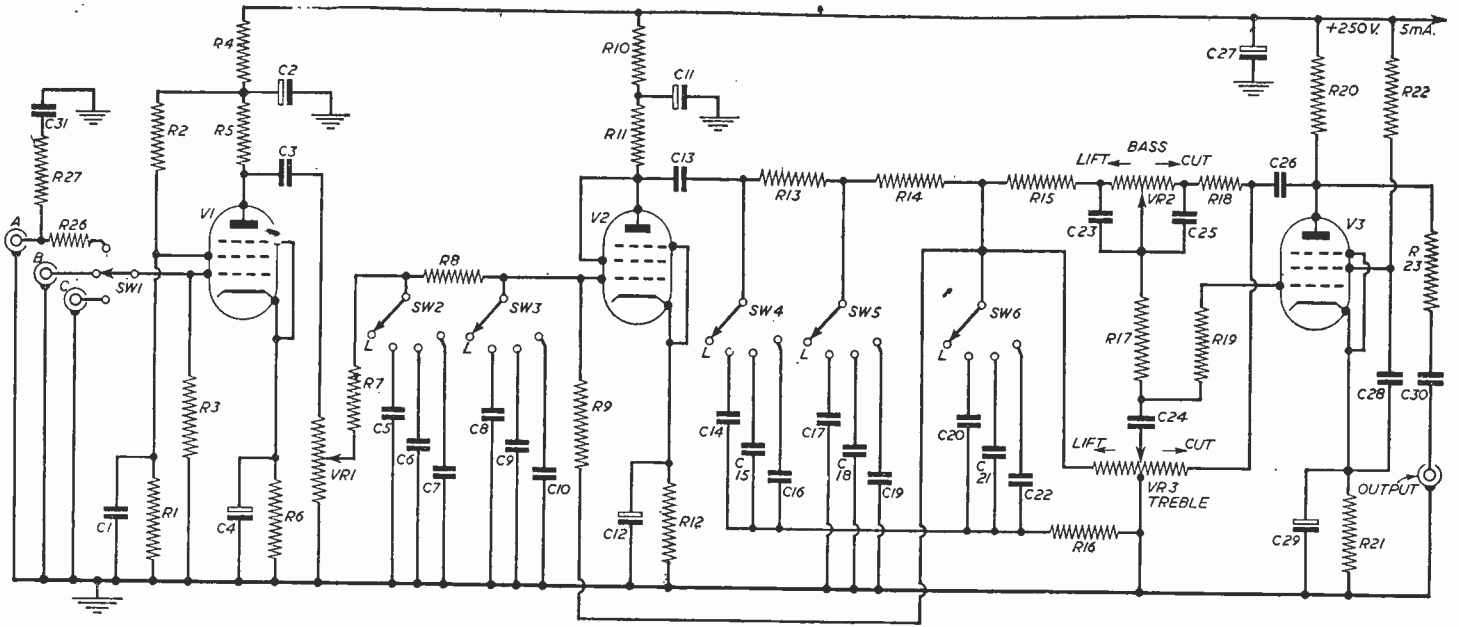


Fig. 1.—Theoretical circuit of the Pre-amplifier.

LIST OF COMPONENTS

R1—100 KΩ $\pm$20% $\frac{1}{2}$ w.
R2—680 KΩ „ „
R3—500 KΩ „ „
R4—10 KΩ „ „
R5—220 KΩ „ „
R6—4.7 KΩ „ „
R7—47 KΩ $\pm$2% $\frac{1}{4}$ w.
R8—47 KΩ „ „
R9—470 KΩ $\pm$20% „
R10—4.7 KΩ „ $\frac{1}{2}$ w.
R11—100 KΩ $\pm$20% $\frac{1}{2}$ w.
R12—3.3 KΩ „ „
R13—47 KΩ $\pm$2% $\frac{1}{4}$ w.
R14—47 KΩ $\pm$2% $\frac{1}{4}$ w.
R15—100 KΩ $\pm$5% „
R16—22 KΩ $\pm$2% „
R17—470 KΩ $\pm$5% „
R18—100 KΩ $\pm$11% „
R19—1 KΩ $\pm$20% „
R20—47 KΩ „ $\frac{1}{2}$ w.
R21—560Ω $\pm$20% $\frac{1}{2}$ w.
R22—220 KΩ „ „
R23—4.7 KΩ „ $\frac{1}{4}$ w.
R24—100 KΩ „ „
R25—470 KΩ „ „
R26—100 KΩ $\pm$5% „
R27—10 KΩ $\pm$5% $\frac{1}{4}$ w.

VR1—250 KΩ 1 log. type
VR2—1MΩ linear type.
VR3—500 KΩ linear type with fixed tapping at 50 per cent. rotation.

C1—0.25 μF paper.
C2—8 μF 350 v. wkg.
C3—0.05 μF paper.
C4—25 μF 25 v. wkg.
C5—680 pF $\pm$2%
C6—1,000 pF $\pm$2%
C7—1,500 pF „
C8—150 pF „
C9—330 pF „
C10—470 pF „
C11—8 μF 350 v. wkg.
C12—25 μF 25 v. „
C13—0.05 μF paper.
C14—220 pF $\pm$2%
C15—330 pF „
C16—470 pF „
C17—470 pF „
C18—680 pF „
C19—1,000 pF $\pm$2%
C20—220 pF „
C21—330 pF $\pm$2%
C22—470 pF „
C23—4,700 pF $\pm$5%
C24—100 pF „
C25—4,700 pF „
C26—0.25 μF paper.
C27—8 μF 350 v. wkg.
C28—0.25 μF paper.
C29—25 μF 25 v. paper.
C30—0.05 μF paper.
C31—0.05 μF.

SW1—1 pole, 3 way wafer switch.
SW2, 3, 4, 5, 6—5 pole 4-way wafer switch.

V1—EF37.
V2—EF37.
V3—EF91.
A, B and C—Co-axial sockets.

(N.B.—Both VR1 and VR2 are Dubilier Type "C" controls.)

been used in the pre-amplifier described, the wiring of which has been shown in isolation, in order to avoid obscuring any connections (Fig. 3), and if this plan is carefully followed no difficulty should be experienced.

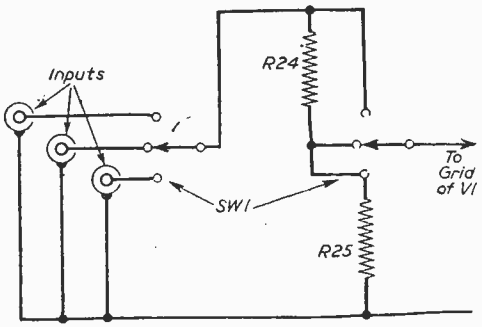


Fig. 4.—Details of the scratch filter and associated switching.

When all the components shown in Fig. 3 have been soldered into position, the whole unit can be inserted into the chassis, and the fixing nut on the spindle tightened. The connections to other parts of the circuit from this switch assembly can be conveniently left until later.

The heater wiring should now be attended to, and consists of twisted flex, starting at pins 2 and 7 of the valve base of V1, running close to the chassis to pins 2 and 7 of V2, thence to pins 3 and 4 of V3, and terminating at the junction block on the top of the chassis.

The rest of the wiring can be done in any order, although the writer favours a logical approach to this task, and completed each stage in turn, commencing at the input end of the chassis, and working through to the output stage. By so doing, and checking each stage as it is completed, there is less likelihood of error.

If this system is adopted, the next operation is to connect wires between the coaxial input sockets and SW1. These wires need not be screened, as the layout has been arranged to avoid undesirable coupling with other components, and the influence of external fields is nullified by the base-plate to be fitted on completion of construction. It is important, however, that a screened lead should run from SW1 to the top grid of V1, and that this grid be screened. It is most essential that the screening cap should make electrical contact with the metallised screening of the valve envelope, and if it does not, strips of phosphor-bronze or similar springy metal should be soldered to the cap (see photograph of top of chassis) so that electrical continuity is obtained from the end of the screening at SW1 to the earthing pin of V1. This screened circuit must be earthed at one point only, preferably at the earthing pin of V1, and the earthy end of the cathode bias circuit must also terminate at the same point.

The output of a microphone or magnetic pick-up will probably be rather low, but a crystal pickup, or radio tuner unit may impress a signal of considerably greater magnitude on the grid of V1. Under these circumstances it may be desirable to incorporate a simple attenuator prior to the grid of V1, to avoid overloading the valve, and as shown in Fig. 4 SW1 then becomes a 2-pole 3-way switch. The values of R24 and R25 may need to be altered to meet individual needs. R26, R27 and C31 form part of a fixed bass equalisation network applicable to any gramophone pickup giving constant output for constant stylus velocity at all frequencies. Good moving-iron, ribbon, or moving-coil pickups come into this category.

When the H.T. positive line has been run from the tag strip to junction block, and the H.T. negative line from chassis to junction block, and all the wiring checked, the base-plate may be fitted. This should be of similar gauge to the chassis, and should entirely cover the base; the front and rear edges of the sheet are extended, and folded up at right angles.

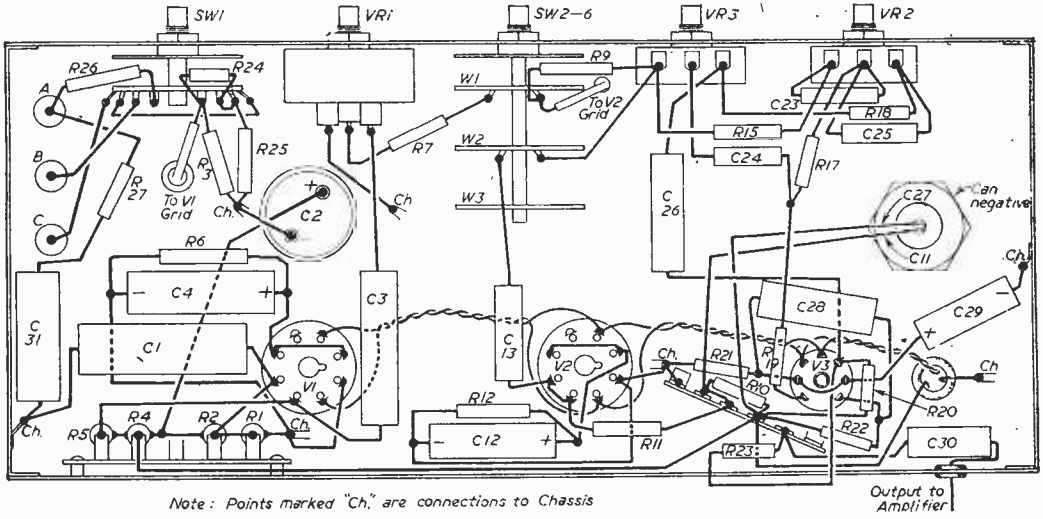
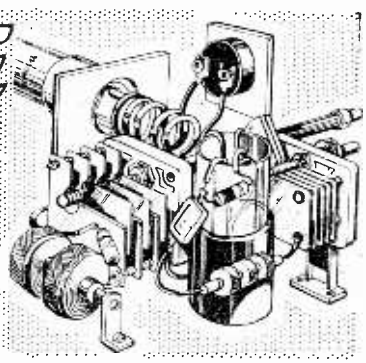


Fig. 5.—Wiring diagram of the Amplifier.

SHORT-WAVE SECTION



A CRYSTAL MARKER FOR COMMUNICATION RECEIVERS

By T. W. Dresser

PROBABLY the biggest bugbear in communication receiver construction, apart from the problem of coils, is the actual calibration of the finished apparatus. This is not quite as simple as it would seem, as is evident from the fact that the bulk of technical writers on the subject have devoted much time, ink and paper to the question of simplifying the process and at the same time ensuring a greater degree of accuracy than usually obtains. Despite all their efforts, however, it still remains an indisputable fact that the only way to calibrate a superhet is with a good signal generator and, unfortunately, very few amateurs possess such instruments. Signal generators of a sort quite a few may have, or can borrow, but good ones are rarities even among professionals. All too frequently, then, the shack receiver, whether home-built, converted ex-service or commercially manufactured, is either aligned with the aid of an old signal generator which has been around for years without ever having had its accuracy checked in that time, or is trimmed by ear, and neither method can be recommended as a worthwhile way to get the most out of a receiver.

The pity of it is that it is not necessary to tolerate such inaccuracy. The inclusion of a crystal marker oscillator in the circuit will ensure that you know precisely where you are on the dial, regardless of what means you used to calibrate the receiver, and such a marker is both cheap and simple to install in any type of set. Top-class receivers such as the Collins 75A, which customarily have markers inbuilt, are a pleasure to operate for these reasons ; there is never any guesswork as to the precise frequency you are listening on. You know to a kilocycle or two.

For the amateur bands the choice of crystal frequency needs no great thought. A 3.5 Mc/s rock will provide marker signals on all frequencies in normal use, i.e., the 3.5, 7, 14 and 28 Mc/s bands. When the main tuning or bandset is adjusted to the point indicated by the marker, the bandspread can be swung around with the certain knowledge that you will be on the band all the time.

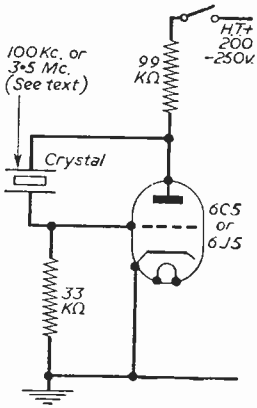
With continuous coverage receivers, or where the listener is as much interested in other broadcasts as in amateur work, a 100 kc/s crystal will provide an audible blip at each 100 kc/s division of the main tuning dial and if the original alignment has been reasonably accurate will provide spot-on intermediate points right through the short-wave bands. From these 100 kc/s blips the bandspread dial on a home-built receiver can be calibrated to cover 100 kc/s in divisions of one kc (marked at each 5 kc/s spot for simplicity) and thereby enable the user to pinpoint a station on, say, 15,395 kc/s with the assurance that it is definitely 15,395 and not merely thereabouts ! That is, of course, assuming a minimum of frequency drift or shift.

The Circuit

The circuit for the marker is given below. As shown, it could be constructed on an aluminium chassis measuring no more than 2in. by 2in. by 2in. and mounted within the receiver case, the filament and H.T. supplies being taken from the power pack of the receiver. Alternatively if the receiver has a separate audio amplifier between the second detector and the output stage it could be removed, the holder rewired for a 6SN7 and one half of that valve used as the audio amplifier with the other half functioning as the crystal marker oscillator.

Small Cost

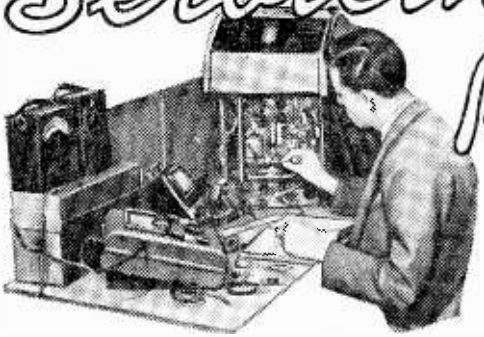
The cost of building the unit is very small. The only components needed are the valve (which may possibly be obtainable ex-surplus), two resistors whose values are not critical and may be varied within wide limits, a single-pole on-off toggle switch, one international valveholder and the crystal. 3.5 Mc/s crystals were used in some American surplus equipment and may be still obtainable from dealers, while the 100 kc/s types were very plentiful a year or two ago and could be bought from the surplus stores for a few shillings each at that time.



The circuit for the crystal marker described.

For such a small expenditure in time and money the unit will prove a valuable addition to any communication receiver and eliminate that feeling of "I wonder if that is the station on 11.5 Mc/s or the one on 11.34 ?" And that alone is worth quite a lot.

Servicing Radio Receivers



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

3.—THE FERGUSON 325 AND 326 SERIES

THE Model 326 is the radiogram version of the Table Model 325, both being of essentially similar design. Both models are made in two forms: one for use on A.C. mains supplies only—distinguished by the letter "A," and the other for use on A.C. or D.C. supplies—distinguished by the letter "U." The universal model differs from the A.C. model by way of valve line up and power-pack.

As revealed by the circuit at Fig. 2, the chassis is in the form of a four-valve—plus rectifier—all-wave superhet, embodying facilities for readily switching in a pick-up. The switching arrangement is somewhat simplified on the diagram, as switch S1 is a ganged four-position wafer rotary type. The circuit is shown switched to the gram. position.

In the medium- and long-wave positions the aerial signal is induced into the appropriate aerial coil (selected by S1B) by way of the aerial coupling coil L2. In the medium-wave position L2 is shunted by R3 and C6 in series, whilst due to S1C closing on long wave, C6 only shunts the coil on this band. On short-wave coil L1 couples the aerial signal to the short-wave coil L3 by reason of S1A. The aerial coils are variably tuned by C1 section of the tuning gang.

The oscillator coils are selected by S1D and S1E, and tuned by C2 of the gang. The 250 ohm resistor R4 serves to damp the rise in oscillator voltage which is liable to occur at the high-frequency end of the short waveband.

Mixing takes place in V1 (ECH42) and the resulting 470 kc/s intermediate frequency signal is developed across I.F.T.1. This is taken to the control grid of V2 (EBF80), and is developed in amplified form across I.F.T.2. From here it is taken to the signal diode in V2 where it is demodulated and developed in A.F. form across the load resistor R5.

On the long-, medium- and short-wave positions switches S1G and S1F remain in the "R" position. The A.F. signal is thus taken by way of the volume control R1 and the coupling capacitor to the signal grid of V3 (EF41). This valve serves to amplify at A.F. and develops its signal across R6. From here it goes through C7 to the signal grid of the output valve V4 (EL41). Extension loudspeaker terminals are provided, and switch S2 permits the internal speaker to be muted if so desired.

A negative feedback voltage is taken from the secondary of the output transformer, via R7, R8 and C8, to the cathode of V3. The feedback is frequency selective in virtue of the tone control R2, which thus provides a control of A.F. response—causing a progressive degeneration of stage gain at the higher audio frequencies.

A portion of the I.F. signal is taken by way of C9 to the A.V.C. diode of V2. Here it is rectified and passed back to stages V1 and V2 as an automatic volume control bias.

As a result of the voltage drop across R9, which is connected in series with the H.T. negative supply from the power-back, a standing bias is also existing on the A.V.C. line; this is for valves V1 and V2, which, as will be seen, do not derive their bias from the cathode circuits as is more general practice.

When the receiver is switched to the "gram" position, switches S1F and S1G change over to position "G" (as drawn on the diagram). This removes the H.T. from stages V1 and V2 and connects the volume control directly to the "live" pick-up terminal.

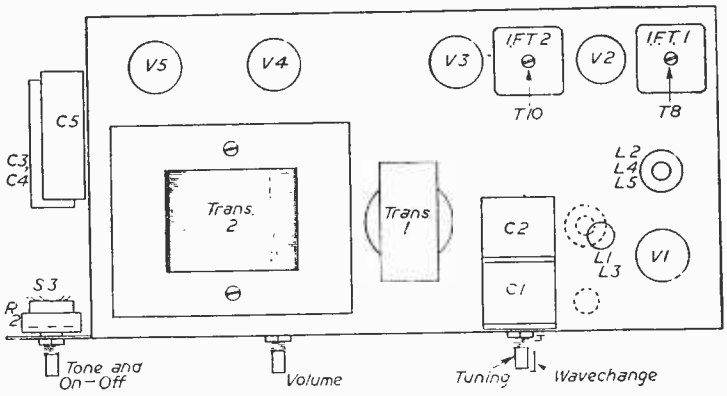


Fig. 1.—Plan view of chassis.

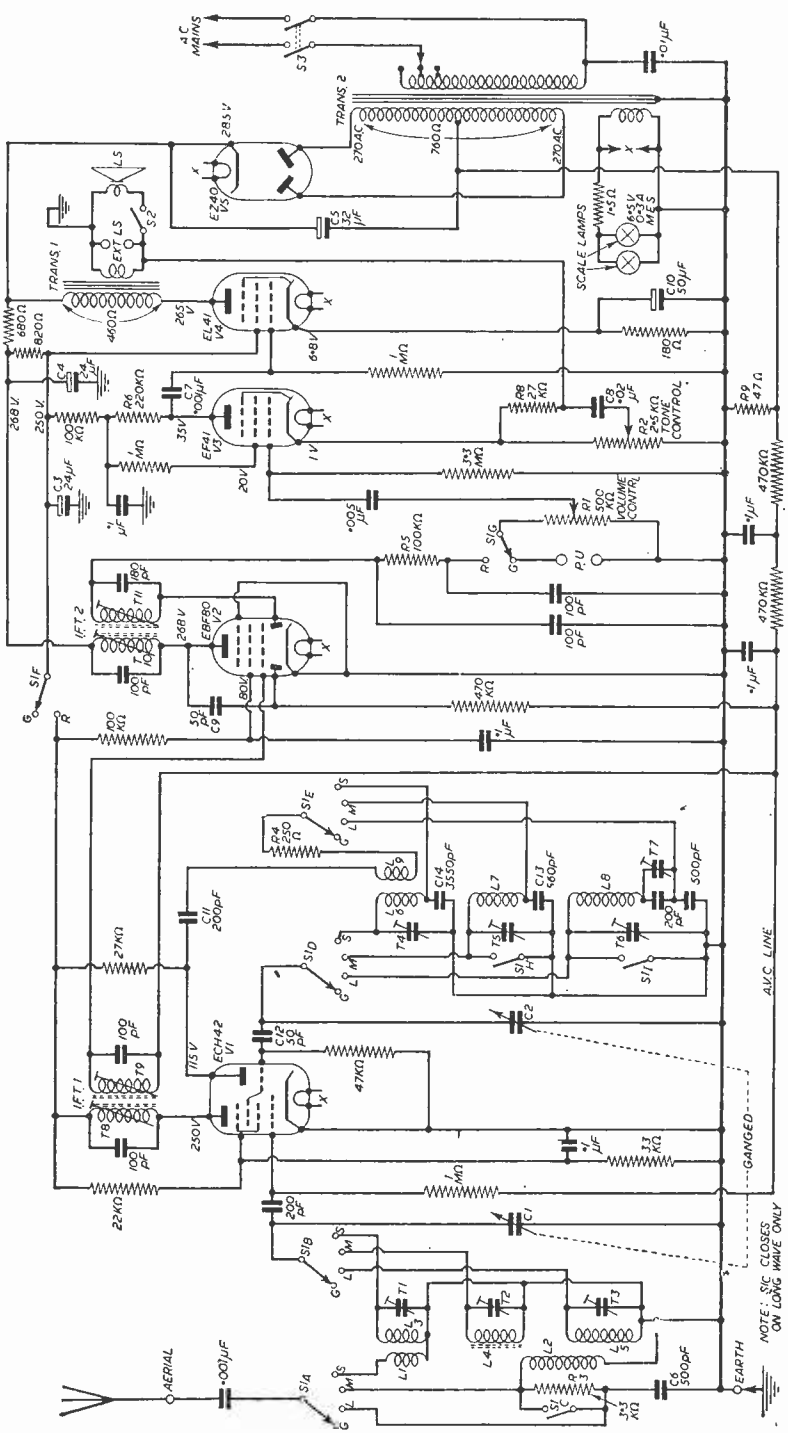


Fig. 2.—Theoretical circuit diagram of the Ferguson models 325A and 326R.G. Note that in the switching S1C closes on long-waves only. The voltage readings given are measured relative to the chassis (unless stated otherwise) and were made with a standard Avo No. 7. If for any reason the switches are disconnected, great care is necessary in replacing the leads, and the various sections are identified in the diagram by the letters following the numbers. Full details for lining-up the receiver will be found on the facing page.

Faults

A progressive fall in overall sensitivity of this receiver is sometimes caused by R9 rising in value. Such a fault will, of course, reflect an increase in bias potential to valves V1 and V2 and consequently give rise to deterioration of stage gain. This will also affect the A.V.C. delay characteristics as the A.V.C. diode of V2 is biased from this source.

Excessive distortion may be due to a fall off of insulation resistance in C7, causing V4's control grid to go somewhat positive with respect to cathode. This may generally be proved quickly by checking V4's cathode potential; a leak in C7 should be suspected if there is any substantial departure from the specified 6.8 volts—a leaky capacitor will cause the cathode voltage to rise considerably. If distortion is present, and the cathode voltage is very low or non-existent, a leak or total short across the 50 μF cathode by-pass capacitor, C10, should be suspected.

A distortion which may intensify when the receiver is tuned to a powerful local station is sometimes the result of C9 open-circuit; such a fault causes a cut-off of A.V.C. voltage and overloading of the first two stages. A high resistance—20,000 ohms

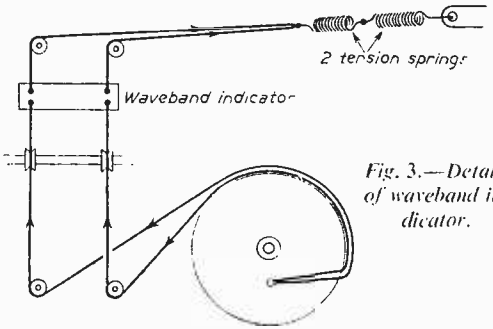


Fig. 3.—Details of waveband indicator.

per volt—meter should be connected between the chassis and the A.V.C. line to prove this possibility—an increase in negative potential relative to chassis as the receiver is tuned onto a powerful carrier is generally sufficient to indicate that the A.V.C. circuit is operational.

If the A.V.C. line has a tendency to swing over to the positive direction relative to chassis—when the receiver off-tuned—C9 should be suspected for poor insulation.

If the receiver appears lively (e.g., by cracking vigorously as the signal grid of V2 and V1 are touched with the blade of a screwdriver), and yet the receiver fails to pick up a signal, the oscillator section has most likely ceased to perform. After first establishing that the triode section of V1 is up to standard, both C11 and C12 should come under examination, as such a fault is nearly always caused by one of these capacitors becoming open-circuit.

Alignment Procedure

As is usual practice, the I.F. stages are the first to come under attention. The receiver should be tuned to the low-frequency end of the medium-wave band, and a 470 kc/s modulated signal applied, via an 0.1 μF capacitor, to the signal grid of V1 (the earthy side of the signal generator output lead should be connected to chassis). A correctly loaded output meter may be connected across the extension loudspeaker sockets and the internal speaker muted.

With the receiver adjusted for maximum volum and after allowing sufficient time for the receiver t reach a stable operating temperature, T11, T10, T9 and T8 should be adjusted in this order for maximum output, progressively reducing the signal generator

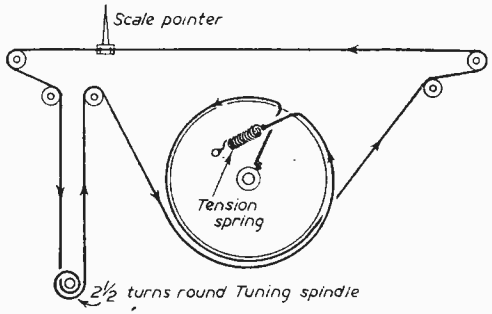


Fig. 4.—Details of tuning drive for 325 series.

output voltage as the circuits are brought into tune. The process should be repeated until no further improvement can be obtained.

The Oscillator and R.F. Stages

For these adjustments the signal generator should be disconnected from the grid of V1, and applied through a dummy aerial to the receiver aerial and earth sockets. The receiver should be adjusted to the high-frequency end of the long-wave band (857 metres at which an alignment point is marked on the scale), and the generator adjusted accordingly (350 kc/s).

Adjustment for maximum output should then be made to the long-wave oscillator trimmer T6 (Fig. 6) and the aerial trimmer T3 (Fig. 6). Adjustment to the long-wave padder T7 for maximum output is next made at 1875 metres (160 kc/s); this adjustment will tend slightly to disturb the former adjustments, and for this reason it is desirable to repeat the whole process to achieve minimum alignment error over the entire long-wave band.

Medium-wave trimming is carried out at the high-frequency end of the appropriate band (200 metres=1,500 kc/s) by adjusting T5 and T2 (Fig. 6) in this order, for maximum output. If a substantial error exists at the low-frequency end of the

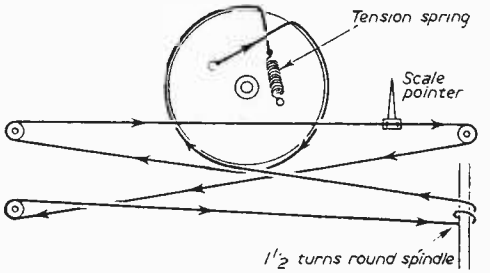


Fig. 5.—Details of tuning drive for 326 (radiogram) series.

band (517 metres=580 kc/s), the 560 pF fixed padder, C13, should be suspected for an alteration in value.

The short-wave band is next aligned at 17.7 metres (17 Mc/s) by adjusting T4 and T1, in this order, for maximum output. Capacitor C14 serves

as a fixed short-wave padder; therefore, if it is found that the scale accuracy diminishes appreciably at, say, 50 metres (6 Mc/s), the value of this component should be checked. It is often possible to counteract any slight tracking error on the short-wave band by altering the position of the lead out wires in the formers of L6 and L3.

Finally, the trimmers should be lightly sealed, the output meter disconnected, and the internal 'speaker switched into operation.

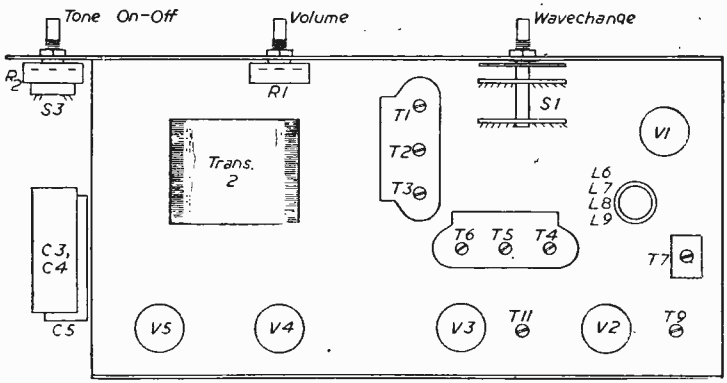


Fig. 6.—Underside view of chassis, showing coil and trimmer position.

General

The plan and underside views of the chassis are shown in Figs. 1 and 6 respectively. The waveband indicator details are illustrated in Fig. 3, the tuning drive details of the table model in Fig. 4, and the details of the radiogram tuning drive in Fig. 5. These are self-explanatory.

If the cord drive has to be replaced, the specially-produced nylon cord should be used, as this will not stretch in use and is not so likely to "fray" if the pulleys jamb and the cord rubs on the sides. To facilitate threading round the pulleys, etc., a fork-ended piece of thin wood or knitting needle should be used.

Osram KT55 A.F. Valve

THE General Electric Co., Ltd., has introduced a new valve, the Osram KT55 beam tetrode, which is designed primarily for use as an audio-frequency amplifier in D.C./A.C. equipment using a series-connected heater chain. Two of these valves used as pentodes in push-pull are capable of an output of 25 watts from a D.C. mains supply of 220 volts, double that hitherto obtainable from valves in this class.

The Osram KT55 is the first of its kind to give this performance and should find wide application in sound equipment suitable for operation from D.C. or A.C. mains. It can also be used in voltage stabilisers.

An octal-based valve, the KT55 has a maximum overall length of 14.3 cm. and a maximum diameter of 5.2 cm.; the heater rating is 0.3 amp 52 volts, and the maximum anode dissipation is 25 watts. As a pentode the valve attains the remarkable "slope" figure of 16 mA/volt, and as a triode the valve has the unusually low anode resistance of 410 ohms.

Amplifier Applications

In a recommended amplifier circuit two KT55 valves are used in conjunction with the Osram low-noise pentode Z729, and a triode such as the L63. Such an amplifier circuit has a high sensitivity, and in "ultra-linear" operation an output of 22 watts with a distortion of only 1.5 per cent. can be obtained from a 55 mV input.

When unusually low D.C. supply voltages are found, as for example in marine applications, the KT55 valve is particularly suitable. It can be used in conjunction with a 305 barretter for supply voltages from 150 to 200 volts and with a suitable resistor for voltages from 125 to 150 volts. Below 125 volts two chains are recommended, the two KT55 valves being connected in series in one chain with a small resistor, if necessary, and a barretter with the remaining valves being incorporated in the second chain. Price, 25s., plus P.T.

An Ultrasonic Fatigue Tester

A PIECE of equipment that cuts down the time required to "fatigue" a metal test specimen from weeks to hours was shown recently at the Physical Society's Exhibition. Instead of applying mechanical strains at the rate of about two per second with a conventional fatigue tester, high-power sound waves are set up in the test specimen which apply strains of as much as 30 tons per square in., 20,000 times per second. The process of fatiguing is thus greatly accelerated. This enables accurate and controlled tests to be carried out.

Technical Description

The ultrasonic power required to perform the fatigue tests is generated electronically and applied to a magneto-striction transducer. The vibrations produced are increased in amplitude by a step-up velocity transformer and applied to the test specimen, which consists of a short rod of the metal under test. The specimen is designed to be resonant at the applied frequency, so that standing waves are produced. At the point of minimum movement the strain is at a maximum, and after a time the specimen breaks there.

The ultrasonic power is so great that unless cooling is applied the test specimen rapidly becomes white hot at the point of maximum strain.

Electronic Measuring Device

In order to calculate the actual strains produced, the amount of movement at the free end of a vibrating specimen is measured. This is done electronically by means of an ultramicrometer, an instrument which measures the capacitance between the free end of the specimen and a fixed plate. The capacitance is proportional to their closeness together, and varies as the test specimen vibrates. The ultramicrometer is used in conjunction with a cathode ray oscillograph to measure dimensional changes of a few micro-inches. The apparatus was produced by Mullard.

PUBLISHED MONTHLY *Vol. 1. No. 4.* *AUGUST, 1955*

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SCRATCH FILTER, type QSF1, 6'9. To get the best from your records.

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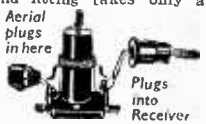
The Separator may easily be tuned to eliminate any one station within the ranges stated and fitting takes only a few seconds. Sharp tuning is effected by adjusting the brass screw provided.



7/6

Type Metres	Type Metres	Type Metres
1-141-250	4-319-405	7-1450-1550
2-218-283	5-395-492	8-410-550 kc/s.
3-267-311	6-455-567	

Special Separator to clear Radio Luxembourg, 10/6 each.

READERS' QUERIES!

Dear Sirs,
I wish to convert my set to pre-set tuning. Can this be done fairly easily?

It is quite simple to convert the standard variable tuned receiver to pre-set. Generally, this means switching in various fixed capacitors in place of (and also) the existing 2-gang. Please enquire for list of values required for all Stations.

Dear Sirs,
Can you give me a list of tips to try to get rid of hum (not modulation).

Try a substitute smoothing condenser by removing the existing one first. Check L.S. and try humbucking coil (a few turns in series with voice coil). Shield O.P.T. Also earthed screened wiring in output stage and power section. Fit humdinger across heater winding and adjust. Check 6Q7 coupling condenser to 6V6. Check vol. control and earth shielding. In general, work from speaker backwards.

Dear Sirs,
Please explain the best way to connect an external aerial to my portable superhet.

The outside aerial may be connected at either end of the F.A. or inductively coupled by several turns of the lead-in (not actually connected).

Dear Sirs,
I wish to improve my 5-valve superhet. Which is the less risky, adding an extra R.F. or A.F. stage?

"It all depends on what you mean by——" but we suggest R.F. stage.

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IMPROVING AMPLIFIER PERFORMANCE

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

By W. J. Delaney

WE are often asked to recommend an amplifier which gives the best performance which modern technique can deliver or, alternatively, to suggest how an existing amplifier, such as the popular Williamson, can be modified to take advantage of the latest techniques. Such a request is, of course, very difficult to comply with, simply because a piece of equipment in which a circuit of the "hi-fi" type is incorporated will sound completely different in every home. For instance, say a reader has a Williamson with a bass-reflex cabinet housing a 10in. speaker, and that at the moment this appears to give satisfaction: we might suggest a modification in circuitry which would give improvement to the response of the higher frequencies, but the speaker might not be capable of reproducing the increased "top." Alternatively, an improvement in bass response may also not be handled, and thus, although the suggestion offered does, in fact, increase the range of reproduction, the reproducing medium is unaffected and the result is apparently no good. It is, of course, possible to make improvements to almost any amplifier, either in straightening out the response curve, lengthening the band of frequencies handled, reducing hum, etc., but unless, at the same time, attention is paid to the speaker and its housing and placement, there is little object in carrying out the modifications.

As, however, this appears to be a more or less general topic, let us see what can be done with an existing amplifier to improve its performance.

Hum

One of the worst defects of the modern amplifier is hum and although this is often reduced to a minimum, it is still present and if a really good speaker is used, suitably housed, so that response is obtained at 50 cps, it will be audible. It is, of course, true that with full-wave rectification the hum frequency will be at 100 cps, but heater-produced hum is a different matter and arises from the fact that the heaters are fed with A.C. at mains frequency (50 cps) and the commonest wiring arrangement is that shown in Fig. 1(a), where the heater wiring is taken to the various valveholders by means of a single lead, one side of the heater winding being earthed direct and each of the valveholders having one heater terminal earthed. Whilst this is theoretically correct and can give quite good results, it is not ideal and the 50 cps hum which does arise from this arrangement is usually not heard because the loudspeaker and its cabinet will not produce a 50 cps note. Assuming, however, that it does, the heater circuit will certainly be found capable of improvement and the ideal arrangement here is for the centre of the *heater circuit* to be earthed. Now the usual heater winding is provided with a centre-tap and it might be thought that by earthing this the requirement above-mentioned is complied with. Actually, this may not be the case and in Fig. 1(b) a sketch is shown of how this arrangement works out in practice. The heater winding is centre-tapped at the actual transformer, but the leads to the valves (three are shown in this diagram) may produce an unequal run, which will upset the centre point as provided on the transformer, and perhaps make matters worse. This can, however, be overcome and, in fact, the following arrangement is to be preferred—even if a centre-tap is provided on the transformer. A low-value wire-wound potentiometer

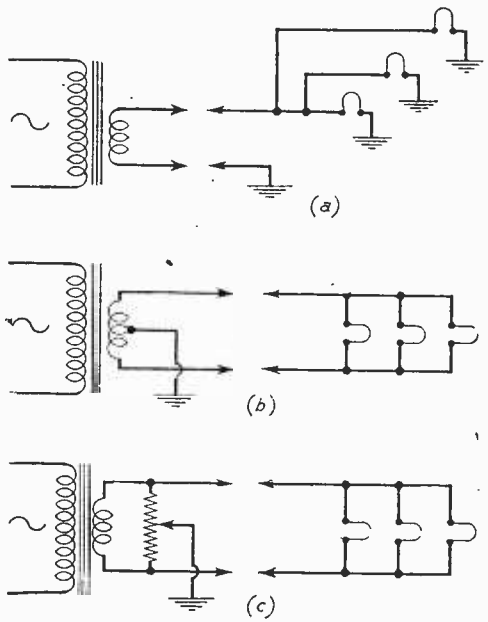


Fig. 1.—Diagrams illustrating balance and unbalance of the heater circuit.

(50 or 100 ohms) is connected as close to the transformer winding as possible and the winding centre-tap is ignored. The slider of the potentiometer is connected to earth and in use this is adjusted carefully for the point of minimum hum. Remember that a single lead, as in Fig. 1(a), will radiate a fair amount of A.C. which could be picked up on adjacent wiring as well as providing an unbalanced heater circuit; twin wiring carried out in twisted flex, as used for Fig. 1(b), will reduce the A.C. field round such wiring, but may produce unequal loads across the centre-tap; and that if you use either of these arrangements and do not experience any hum, make certain that your loudspeaker set-up is such that it can reproduce a 50 cps note if you are really interested in high-quality.

Bass Response

If the speaker arrangements result in bass boom you may have cut the bass in your particular amplifier under the impression that the reproduction is wrong—undue preference being given to the bass. A "quality" installation, amplifier or radio receiver, should deliver a straight-line characteristic and then the speaker and speaker housing may be chosen to reproduce this properly. This means that one needs a tweeter for the "top" and a large speaker, properly housed, for the bass; but it is useless to produce a "straight-line" amplifier if you use a speaker and cabinet with a marked bass resonance. Assuming, however, that you have a good reproducing outfit, what other improvement can be made to a normal "standard" amplifier? As is well known, feedback gives better quality but reduces volume. If, therefore, you have plenty of gain available, introducing more feedback can be an advantage. Alternatively, if the bass response is lacking and feedback by the omission of bias condensers is present, this may be changed by adding the bypass condenser, resulting in added bass response and more gain. It will be found that this, in turn, may alter the response curve and the added gain may again be reduced by another form of feedback. However, before going into this part of the arrangement, what can be done in the actual output stage—which may be receiving quite good results from the early stages and yet not passing them on to the speaker assembly?

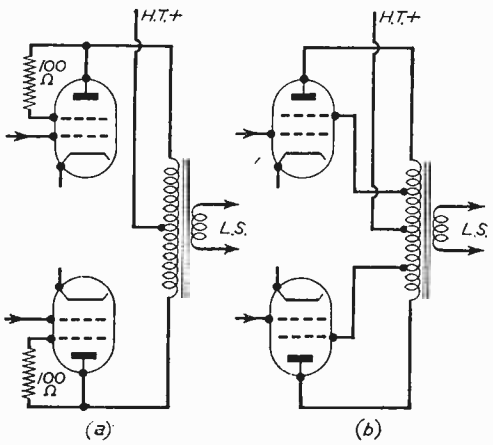
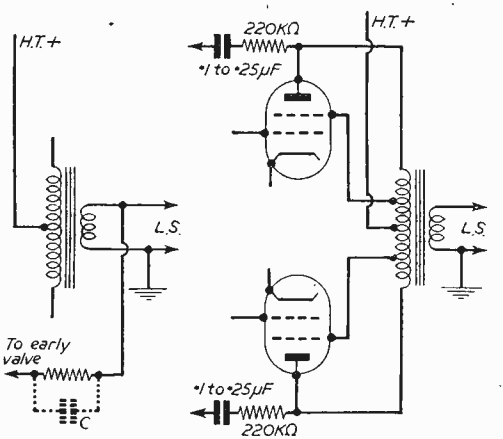


Fig. 2.—Tetrodes operated as triodes, and the modification for "ultra-linear" operation.

Ultra-linear Circuit

The Williamson, for instance, utilises two KT66 valves in the output stage, but these are connected so that they function as triodes—usually a 100-ohm resistor being joined between anode and second grid.



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

Many other amplifiers use this type of output stage which, whilst being very good, can give improved results with very little modification. Fig. 2(a) shows the arrangement as just described, and Fig. 2(b) the modification. The resistors are removed and the second grid is joined to tappings on the output transformer. This arrangement is becoming increasingly popular in the United States, and some amplifiers have appeared in this country with it. The Osram amplifier employs it, as a matter of fact, and although, theoretically, it needs a special output transformer, it is possible to introduce it with some existing types of standard transformer. The position for the tapping points is critical for optimum results, but in practice, depending upon the characteristic which is fed into it, and the speaker, etc., it may be found that alternative positions are more satisfactory. Some transformers have the winding sectionalised and connections between the various sections are available on the end cheeks. Test connections should be made to these points, which should be nearer to the centre-tap than the ends. Special transformers are now becoming available on the English market with these tapping points and are known, after the special circuit arrangement, as "Ultra-linear" output transformers.

(To be continued.)

On Your Wavelength

BY THERMION

The BBC and Evangelism

MY paragraph criticising the BBC for allowing William Graham programme time for his evangelical mission has evoked a large number of letters, some agreeing with my views, and others the contrary. The letters are in about equal proportion. I can therefore ignore the letters in support of my views and deal generally with those who oppose them.

The opponents are, almost without exception, those with strong religious feelings. I know that Mr. Graham was invited by the Evangelical Alliance to visit this country, but there are many other such missions who have not been granted similar facilities by the BBC. If such a mission was necessary, I think it should have been undertaken by our own Church, but I am certain that had the Church of England made such a request, it would have been turned down. What has Mr. Graham to teach which the Church of England does not? I reaffirm with emphasis that the publicity for Graham was responsible for drawing large crowds who merely went to see without being imbued with the desire for reform. Of the large crowds who attended, how many re-entered the fold? A few hundred. Everyone is entitled to their religious beliefs, but I for one flatly refuse to believe that the established English church is so effete that a revival of religious belief can only be obtained by importing a high-pressure preacher from America. Such amounts to admitting that America can do what we cannot. I am singularly unimpressed with the views of those who have written to me and who obviously have "got religion." Blind faith often leads to blind beliefs, and as in all other matters, I prefer to keep an open and critical mind. I do not believe in spell-binding orators, and like to analyse their claims before I accept them. Incidentally, I wrote to Mr. Graham offering to debate various points concerning his campaign on any platform on the air or on television, but I did not receive a reply to my letter. Perhaps Mr. Graham would read the Bible and quote the passage which says that religion entitles a believer to be discourteous! From this you will gather that I do not withdraw anything I have written on this subject. If anything, I am even more convinced in my views.

The I.S.W.L.

THE I.S.W.L., no doubt in its wisdom, has been particularly quiet during the past few weeks from which I must conclude that I have had the last word. In the meantime, readers will form their own opinions as to whether they should join any organisation where they have practically no say in the club's affairs. As a result of my comments, I have had a number of letters from members of other clubs and I am investigating them. It would appear that as a result of my investigation of the World Friendship Society of Radio Amateurs, that body has now ceased to exist. In my view, it was a body with a political background, and I happen to know that the authorities were rather interested in its activities. If you want to join a club, join a well-known nationally recognised one, or a good local club, where you can be kept in touch.

Incidentally, some years ago I spent a whole Sunday investigating a club, now no longer in existence, which claimed world-wide membership. I was ushered into a room to meet the secretary, who answered questions apparently under hypnotic influence! I found that the club was a complete racket and it speedily went out of existence after I had threatened police action. But not before I had obtained satisfaction for the readers who had complained to me. This particular secretary endeavoured to keep himself in the limelight by writing letters to the designer of home-built receivers (not a PRACTICAL WIRELESS contributor) reporting marvellous reception on the designer's latest creation, and listing stations he had received (!), many of which had been out of existence for years! There are those, too, who claim membership of clubs which they have never joined. At least one member of the Nottingham University Students' Radio Society falls within that category. That, however, is a matter which is still the subject of investigation.

Radio-controlled Models

THE International Radio-controlled Model Society is in a totally different category. It is run on proper lines and organises model contests on an international basis for model boats and for radio-controlled model aircraft. All readers who are interested in radio-controlled models can safely join this society. Interest in this new hobby increases month by month. Descriptions of such models have appeared in our companion journal, "Practical Mechanics." Incidentally, if any readers have experimented in this direction, I know that the Editor would be delighted to have details and photographs.

Back to the Classroom!

I STROLLED into the PRACTICAL WIRELESS laboratory the other day and was goggle-eyed to see your editor at the blackboard surrounded by a class of students and apparently giving a lecture on radio. For the moment I thought he had resumed his teaching activities, for I know that many years ago he taught machine drawing and mathematics. It proved however, to be a false alarm. He was merely posing an illustration for the jacket of his forthcoming book, "The Beginner's Guide to Radio," which is a reprint, although considerably amplified, of his series of articles on that subject, which appeared in this journal and ran for over two years. There has been a steady demand for reprints, so those readers who have asked for back copies containing the series should take steps to order a copy forthwith. On the jacket of that book you will see a reproduction of the photograph to which I have referred.

I notice also that his recent lecture during the National Book Week at Felixstowe attracted considerable attention in the local press.

How Many Turns?

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

By N. F. Back

IT is surprising nowadays to find how few amateurs there are who wind their own coils. The writer (who occasionally likes to cast nostalgic thoughts back to the earlier days) can remember the times when a very large proportion of home-built receivers used coils that were entirely home-made. These coils were used not only to reduce the cost of the completed receiver but also because the designer liked to think that he had made as much as possible of his set with his own two hands.

And yet one hardly ever encounters a home-made receiver these days which is fitted with anything but ready-made commercial coils. It is true, of course, that winding coils is more difficult now, owing to the general use of ganged circuits and the consequent necessity for more accurate coil construction. Added to that is the fact that modern commercial coils are fairly cheap and so the incentive to reduce expenditure is therefore relatively smaller.

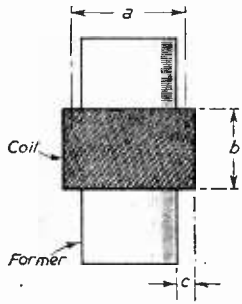


Fig. 1.—Illustrating the coil dimensions referred to in the text.

Nevertheless, accurate modern coils *can* be wound at home ; the process being very simple after a little practice has been obtained. For instance, the writer recently made the R.F. and oscillator coils for a medium- and long-wave superhet in about two to three hours, thus saving the cost of an equivalent coil pack. In addition, there was the fact that, by using large diameter formers and reasonably careful construction, he obtained coils with a higher " Q " than would have been given by the often-met small-diameter coils which are offered commercially. It may be seen, therefore, that it is possible not merely to effect a saving but also to produce a more efficient receiver if the coils for it are wound in one's own workshop.

Formulae for Inductance

There are two main formulae for inductance which may be utilised for making coils at home. These are :

1. $$n = \frac{15L\ (a+3b)}{a}$$

which may be used for single-layer, solenoid-wound coils, and :

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

the latter being intended for wavewound coils.

In both formulae,

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

The dimensions referred to by a, b and c are illustrated in Fig. 1.

How useful are these formulae ? Of the two, it will be found that the first is the more helpful, as the only dimensions needed to evaluate " n " are the average diameter of the coil, the length of its winding and the inductance required. Looking at Fig. 1 it may be seen that the average diameter of the coil is measured at points situated half-way between the internal and external diameters of the coil. When a single-layer coil is considered, this average diameter can be taken as being equal to the diameter of the former itself, a point which makes the evaluation of the formula very simple.

The necessity for finding the length of the winding (b) may raise a difficulty. As could very well be asked, how does one know the length of the coil until after it has been wound ? In practice this is overcome by choosing an arbitrary length before winding is commenced, and winding to that length. It must be remembered that the turns on the coil need not necessarily be laid side by side but may be spaced. In any case, apart from short-wave coils, it will be found that the formulae is only used for approximate results, and that the discrepancies introduced by

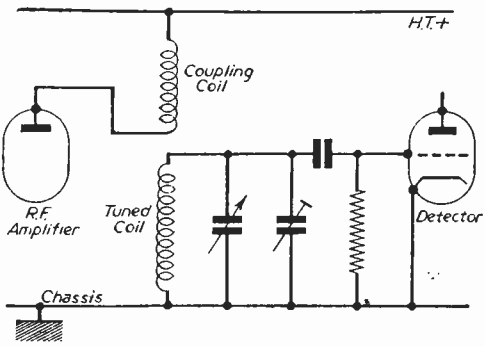


Fig. 2.—A typical circuit using a tuned and a coupling coil to feed the detector of a straight receiver. Wave-change switching is omitted for purposes of simplicity.

slight errors in measuring the length of the winding will not have very much effect upon the final result.

When we come to consider the second formula another difficulty is introduced, since it is now necessary to know the depth of the winding as well. Again, a similar question may be asked: How does one know the depth of the coil until it has been wound? This time we have to make a guess at the depth before the coil is commenced. Fortunately, this dimension does not have a great effect on the value of n (particularly if large diameter formers are used); and it will soon be found possible, after a little experience, to make very accurate guesses and thereby reduce approximations to the minimum.

Using the Formulae in Practice

As may be seen from the above, the two formulae given cannot give entirely accurate results, owing mainly to the fact that it is necessary to know beforehand the measurements of the completed coil. However, they are definitely of great help as a *guide* to the number of turns required, and cut down the initial guesswork very considerably.

In practice the formulae are used only to give an approximate idea of the number of turns needed on a particular former for a particular coil. The coil is then wound to the figure obtained from the formula, a few extra turns being added afterwards to ensure that its inductance is a little too large. The coil is then connected temporarily to the piece of apparatus with which it will be used: and the range it covers is checked by means of a signal generator. Owing to the extra windings it is almost certain to have a few too many turns, and these are removed, several or one at a time, until the coil resonates at *exactly* the frequencies required. The process is very simple if tackled correctly, and the results obtained can be very accurate indeed. It will be appreciated that the reason for adjusting the coil by *removing* turns is due to the fact that this is much easier than adding turns: and because, when the adjustments are finished, the coil is immediately ready for use.

Let us take a simple practical example of how a coil may be wound by this method. We may assume that we are building a simple three-valve straight receiver, employing R.F., leaky-grid detector and output stages, and that we intend to use home-wound coils. We first of all complete the receiver except for the coils, leaving sufficient space on the chassis for these to be mounted afterwards.

Since the aerial coils cannot be connected and checked *in situ* until the detector stage is working, the first coils we shall need to wind are those for that stage; and Fig. 2 shows the circuit which it is intended to use here. It will be seen that we require a simple R.F. transformer with one of the coils tuned. The tuned coil will be, of course, the one that needs to be accurately wound.

Let us imagine, for purposes of illustration, that we are going to wind the medium-wave coil first and that we shall make it solenoid wound. We then start by working out from the formula the approximate number of turns required for this coil. The former which we intend to use has a diameter of, say, two inches, and the length of the winding is taken arbitrarily as being approximately 2½ inches. (Or we may say that we have a space of 2½ inches available on the former, and that we intend to fill it with the coil.) We next work out the inductance required by our particular receiver; and we arrive at a figure of 175μH (an average value for medium-wave coils).

As the coil will be solenoid wound we use formula number one, thus:

$$n = \frac{15\ L\ (a + 3b)}{a}$$

By substitution we then get

$$n = \frac{15 \times 175\ (2 + 3 \times 2\frac{1}{2})}{2}$$

$$= 80 \text{ approximately.}$$

We now know that we need approximately 80 turns for our medium-wave coil. As we shall be experimentally adjusting the coil after it has been

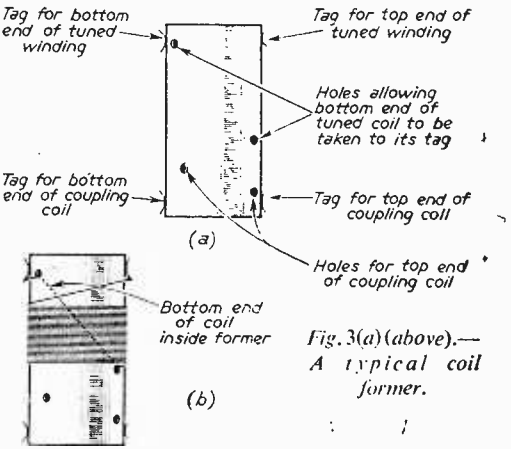


Fig. 3(a) (above).—A typical coil former.

Fig. 3(b) (left).—Showing how a coil may be wound on the former of Fig. 3(a). It will be seen that the "top" end of the coil is taken directly to its tag, and not through holes in the former. The coupling coil is not shown.

connected temporarily to the receiver, we wind, say, 90 turns on the former (i.e., 10 too many), connect up the coil and supply the signal generator across it. To avoid altering the constants in the receiver the signal generator output is applied to the grid end of the coil via a small capacitance of less than 5$\mu\mu$F or so (two insulated wires twisted together for an inch will do). The range of the coil is then checked by listening for the modulation of the signal generator in the receiver output. As the coil is almost certain to have too many turns, these are taken off one or more at a time, until the coil resonates *exactly* over the range required.

When the correct number of turns may have been found, the coil is "tidied up" and is then complete. The additional coupling coil may be added afterwards. (We shall deal with coupling coils later.)

Experimental Procedure

The above process may seem at first sight to be somewhat complicated. When carried out properly, however, it is simplicity itself. It must be remembered that no guesswork whatsoever is used during the adjustments, and that the range covered by the coil is known at all times.

It may help, at this point, if we deal in more detail with the business of connecting up the coil experimentally. The main idea behind this is to ensure

that little time is wasted and that the procedure of removing the extra turns is carried out with the minimum of difficulty. Fig. 3(a) shows the appearance of a typical coil former before winding is commenced.

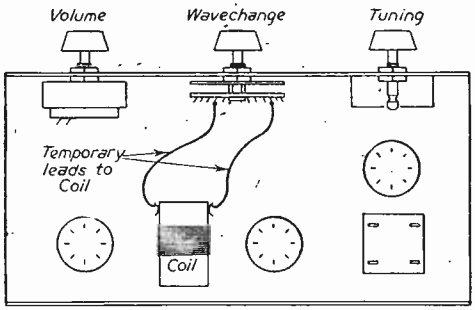


Fig. 4. — Connecting the coil temporarily to the receiver. It is assumed, in this case, that the coil would ultimately be connected to tags on the wave-change switch, and so these are used for the temporary connections.

It will be seen that suitable tags for anchoring the leads are mounted on it at convenient places. Leaving sufficient room for the coupling coil we commence by winding the tuned coil from the bottom up, as shown in Fig. 3(b). When we have put on sufficient turns (as given by the formula plus the few additional turns) we anchor the top end of the winding to the appropriate tag by a temporary soldered joint.

At the same time we connect two short temporary leads to the points in the receiver to which the coil will finally be connected. The coil is then connected to these leads, but is not actually mounted on the chassis itself. Fig. 4 shows the idea for a receiver in which the coil would be fitted to the underside of the chassis when completed. Fig. 5 gives a side view of the arrangement and also shows how the coil can be supported, if necessary, to reduce the length of the two additional leads.

It may be seen that by the use of this system it is extremely simple to remove turns from the coil. All that is required is to remove the top end of the coil from its tag, unhitch a turn or two and resolder the wire temporarily to the tag again. When the correct number of turns has been found, a proper connection can be made and the coil is then ready for use.

It must be emphasised here that the quickest method of making these temporary connections is by soldering, and *not* by twisting the wire around the tag. Apart from the fact that the second method introduces crackles and poor connections, it will be found that there is nothing so quick in practice as holding down a wire temporarily by a quick application of solder. (The application should not, of course, be so quick that a cold joint results !)

Short-wave Coils

Such is the method, then, for quickly winding accurate coils. When, however, we come to short-wave coils, the position is considerably simplified. Whereas, for medium- and long-wave coils, we may only obtain approximate results from calculations ; with short-wave coils it is possible to get completely accurate results using the formulae alone. This is due to the fact that short-wave coils are almost inevitably solenoid wound, and thereby eliminate the necessity of finding the depth of the completed winding. Also, owing to the few turns required, it is possible to very quickly wind a coil to the *exact* length chosen, without having to fall back on guess-work or approximations.

The Usefulness of the Coil

There are five general requirements which should be observed when a coil is being made. These are :

1. It should have the requisite inductance.
2. It should have as high a " Q " as possible.
3. Coupling coils, etc., must be so positioned that they function in the most efficient manner, whilst causing the least amount of losses due to damping, etc.
4. Self-capacity in the tuned coil should be at a minimum.
5. When it is required, the complete coil should be made as compact as possible.

It will be seen that some of these requirements are obvious at first sight. For instance, the fact that the coil should have the correct inductance is, of course, its first function, and should be automatically ensured when it is originally wound.

On the other hand, the necessities for having a high " Q " and of keeping the coil as compact as possible are not so easily realised. To a great extent these qualities are conflicting, since it will very often be found that the larger the size of a coil, the greater is its " Q."

The Layout of the Coil

These two points, together with the need for efficient coupling coils and the necessity for keeping losses due to self-capacity in the tuned circuit at a minimum, are all best tackled when the layout of the

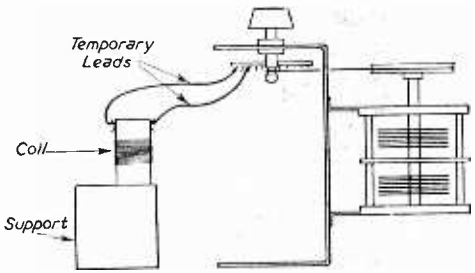


Fig. 5. — Side view of the receiver chassis, showing also how the coil may be supported in order to shorten the temporary leads to it, should this be needed. The support may be a wooden block or any similar non-conducting material.

coil and the type of winding employed are originally worked out. As the layout and type of winding will vary considerably for coils covering different ranges, it would prove helpful here if we were to effect a rough division for the purposes of description. We shall, therefore, refer to the construction of coils covering the long, medium and short wave ranges. Although the use of these ranges obviously does not represent the entire coverage possible with home-made coils, it helps considerably in so far as it offers a useful guide to the method of constructing coils which fall outside or between the ranges illustrated. (*To be concluded.*)

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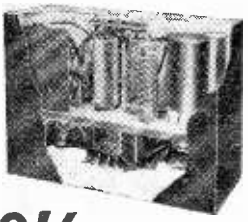

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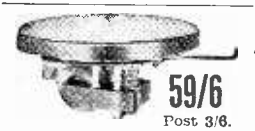

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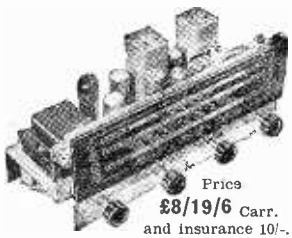

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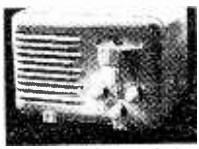

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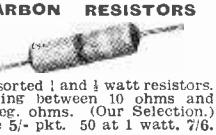

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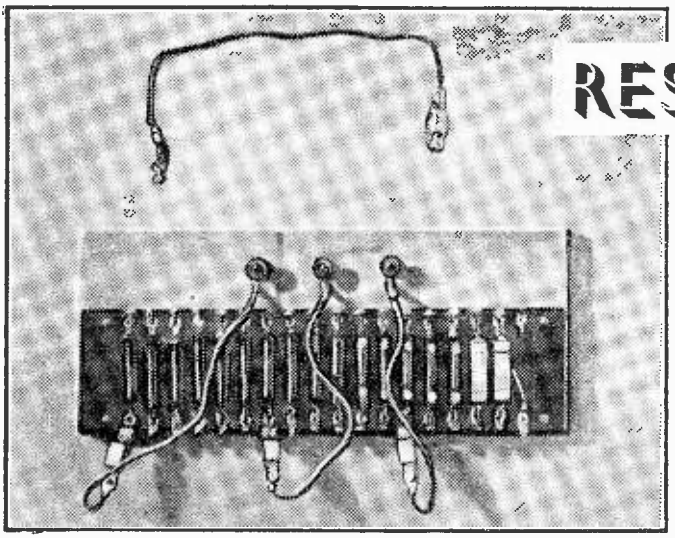


RESISTANCE RATIO BOARD

AN INEXPENSIVE AID TO CALIBRATION OF BRIDGES AND METERS

By J. C. Flind

THE writer was recently faced with the problem of calibrating the dial of the variable resistor forming the main control of a home-made capacity-resistance bridge: various methods, involving the use of protractors and slide-rules, were tried, but the results were unreliable and disappointing, probably owing to minor inequalities in the track of the wirewound potentiometer, and the difficulty of establishing the true end-points of the resistance element, which do not necessarily correspond with the travel of the moving contact.

Finally, the simple piece of apparatus to be described was evolved. As will be seen from the diagram, it consists essentially of nothing more than a chain of resistors, joined end to end, and with provision for tapping and short-circuiting at will, the tappings being brought out for convenience to a set of three terminals on the baseboard. The resistors employed are all high-stability 1 watt types, accurate to 2 per cent., which can be obtained quite cheaply: actually the total cost of the apparatus, including terminals, tagboard and clips, was under 18 shillings.

From a study of the resistance values it will be seen that the user has at his disposal two arms of a Wheatstone bridge, with extreme ratios of a little over 250 to 1, and capable, over a large part of the range, of quite fine gradations of variation, as follows:

There is a choice of unit steps all the way from 1:1, 1:2, and so on, up to 1:159, and thereafter from 1:120 to 1:259.

(e.g., 1:15 given by EF:FL, 1:120 given by JK:KQ, with shorting link between M and P).

Steps of 0.1 are available from 1:0.1 to 1:5.0 (e.g., 1:1.3 given by ML:LH) and steps of 0.01 from 1:0.01 to 1:0.59 I, e.g., 1:0.57 given by QP:PD.

All the ranges can be doubled, and the intervals halved, by the use of the shorting link, as described below.

In the writer's case, the dial of the C-R bridge was plotted out and marked with 35 useful ratios, from .01 to 100, all in half an hour or so, and in the course of dozens of measurements made since, there has never been any cause for suspicion of the accuracy of the calibrations.

Construction

Construction is simple: it is based on a paxolin tagboard, of a type readily available, about 10in. × 2½in., and bearing 18 pairs of tags, arranged in two rows, 2in. apart. Begin by soldering the end tag in one row to the second in the other, joining them with not-too-thin copper wire, say about 24 gauge. No. 2 in the first row is then joined to No. 3 in the second, and so on as shown in Fig. 2 until No. 17 in the first row is joined to No. 18 in the second. No. 18 in the top row is not used. Tags 1 and 18 in the bottom row become the two ends of the chain, respectively "A" and "R" in Fig. 1. Now lay a wooden ruler down the centre between the two rows, over the diagonal connecting wires, and position the resistors across it like the rungs of a ladder, threading their connecting wires through the tags. Solder into place, correct the spacing with a pair of pliers, trim off the ends of the wires, and withdraw the ruler. This makes a really neat job, and leaves the resistors suspended in the air, so that any heat which may be generated in use can dissipate more freely, thus

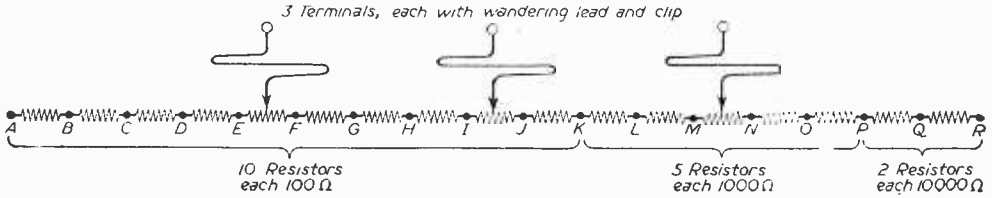


Fig. 1.—Diagram showing the general scheme of the Ratio Board.

ensuring that if necessary the chain can be run at its maximum rated wattage. For example, it is safe to apply up to 100 volts between A and K.

Now screw the paxolin tagboard down to a wooden base, say, 10in. × 4in., bearing three terminals side by side. From each should run a short piece of good quality plastic flex, long enough to reach to any

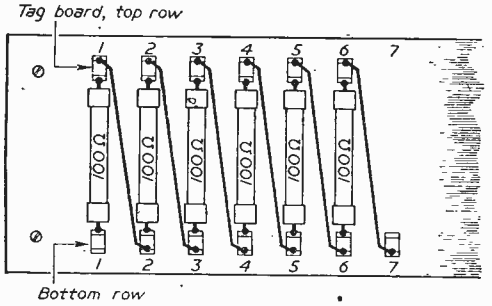


Fig. 2.—How the resistors are wired on an insulated board.

tag on the board, each flex terminating in a bulldog clip. There is thus freedom to change tappings in an instant with a minimum of fuss.

The separate shorting link takes the form of another piece of flex, say 9in. long also provided with bulldog clips at each end. This is useful in a number of ways : for instance if a ratio of 1:0.75 has to be set up, points B and D are shorted together and the tappings taken from C. The total resistance from K to C would then be 750 ohms and the desired ratio is given by LK:KC.

Besides its value as an aid to the calibration of bridge scales, the apparatus forms an excellent potential divider, especially useful in checking the scales of such things as A.C. voltmeters, notoriously inaccurate on their lower ranges. All that has to be done is to connect a known voltage, between 10 and 100, between A and K, and to take it off in accurate one-tenth steps A-B, A-C, and so on. All the resistors in the chain, while high enough to swamp accidental inequalities due to contact resistance, are low in comparison with voltmeter resistances so that the steps will be accurate to, at most, 4 per cent., which is as close as can be conveniently read on the average small meter.

Finally, it is useful for many purposes to have about the workshop a resistance standard such as this, giving up to 26,000 ohms, with 100-ohms tappings readily available and identifiable. Altogether, a good 18 shillingsworth, which has already proved its value many times over.

Sub-miniature Radio Compass

JUST released from security classification to appear in public for the first time at the Paris Air Show on June 10th, was the Marconi lightweight sub-miniature Automatic Direction Finder, Type AD722, for use in aircraft.

This new radio compass, manufactured by Marconi's Wireless Telegraph Co., Ltd., and designed for use in the M.F. band, is believed to be the smallest and lightest of its type yet developed to such an exacting specification ; the total weight of the main units is less than 10kg. It has been developed for use in all types of aircraft, and is primarily intended for pilot operation.

Fixed Receiving Aerial

The direction finding system provides one of the many outstanding features. Contrary to conventional practice, the receiving aerial is fixed, being in the form of a sealed iron-cored crossed loop having no moving parts, and which has a maximum height of less than ¾in. A low drag loop installation can therefore be achieved without recourse to full suppression, or alternatively the aerial may be fully recessed into the fuselage if desired. Even in the latter case it is not necessary to cut a large hole in the fuselage.

A Bellini-Tosi type of direction finding system is employed, the goniometer being embodied in the bearing indicator. Bearing presentation is by means of a scale pointer, driven directly from the-shaft of the goniometer search coil. There are two sizes of indicator, 3⅛in. and 2½in. diameter to allow for variations in available cockpit panel space.

Should a suitable bearing indicator of another equipment already be incorporated in the pilot's instrument panel, this may also be used in conjunction with the subminiature radio compass, with consequent economy of space and capital outlay. For this purpose a coupling unit is provided which includes a synchro element for transmission of the bearing indication to the slave indicator on the pilot's instrument panel. Transfer of the slave indicator from the other equipment to the radio compass, and vice versa, is made by remote switching.

The receiver circuits of the new automatic direction finder are contained in two rack-mounted main units, and are remotely operated from a single control unit. Plug-in sub-units are used for ease of replacement. The frequency coverage is 200-1,700 kc/s, covered in three ranges.

MAKING A Sensitive TWO-VALVER

AN ECONOMICAL A.C. HIGH-GAIN LOCAL STATION RECEIVER

By R. Berry

A SMALL portable mains set for use about the house requires some form of aerial, the usual type being a few feet of wire hanging from the back, which besides being unsightly is rather a nuisance, getting tangled up when moving the set to another room. With the frame aerial type it is necessary to adjust the orientation to get the best results if the set is not particularly sensitive and the side view of a wireless set does not add to the decorative effects of a room. The usual answer is to use a plate aerial and increase the sensitivity by using more valves.

Fig. 1 shows the circuit of a very sensitive two valver in which the first valve has been adjusted to a very sensitive portion of its characteristic. V1 uses a large anode load and a small screen voltage. The positive bias on V2 grid caused by the D.C. coupling to V1 anode has to be cancelled out, and this is done by increasing the size of the normal bias resistor, the value of which should be adjusted so that V2/1.a equals 10 mA. The voltage across R5 forms a convenient feed for V1 screen grid. R4 acts as a grid stopper and also takes the place of the usual R.F. choke. It will be noticed that a potentiometer has been used in place of the more normal variable condenser in the R.F. feedback line; this enables use to be made of a combined potentiometer and mains switch, and the arrangement works quite well.

Volume is controlled by negative feedback from the secondary of the output transformer to the cathode of the detector. The volume cannot be reduced to zero, of course, but the improvement in quality as the volume is reduced makes the use of this form of control worth while. R7 must not have too large a value or it will give V1 a positive bias. The anode load of V2 is about 20,000 ohms, and three ratios of output transformers are shown in the components list to suit three values of speaker impedances. A resistor is used in place of the more normal smoothing choke to conserve space.

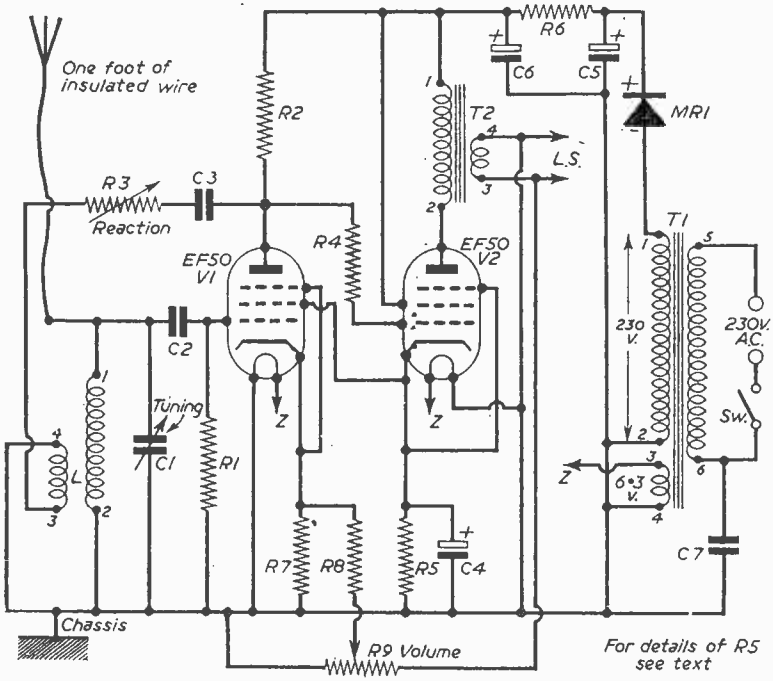


Fig. 1.—The theoretical circuit of the receiver.

The double-wound mains transformer serves to isolate the chassis from the mains, but could be dispensed with and a transformer used to supply the heaters only. One side of the mains would then go to the chassis via a switch, and the other side to the right-hand side of MR1 in Fig. 1. The heater transformer primary is connected to these two points. C7 which must be high voltage working prevents grid hum.

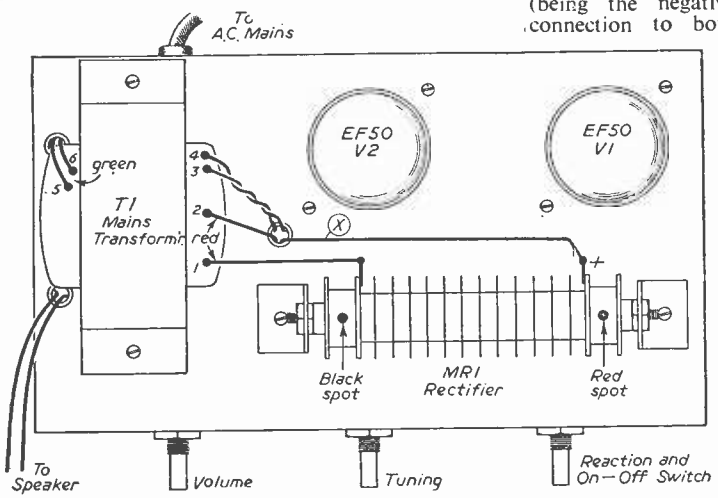


Fig. 2.—Wiring details above chassis.

Construction

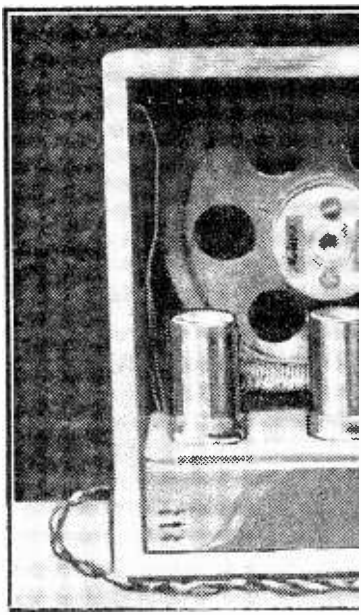
As regards the actual construction of the chassis, the main measurements are shown in Fig. 3. Other measurements will depend on the size of components used, but the most important point is to keep the grid leads as short as possible by mounting the associated components close to the valveholders. The output transformer is mounted at right angles to the mains transformer beneath the chassis, to reduce hum.

Wiring

Most of the wiring is self-supporting, but use is made of a tag strip to anchor R6. R3 is so wired that when the spindle is turned in a clockwise direction the resistance is reduced between L and C3. C5-6 is fixed in position by means of a metal clip, and the metal can of C5-6 (being the negative connection to both

COMPONENTS LIST :

R1—1 MΩ ½ watt.
R2—3.3 MΩ ½ watt.
R3—50 KΩ volume control with switch.
R4—47 KΩ ½ watt.
R5—2,200 Ω ½ watt.
R6—2,200 Ω ½ watt.
R7—20 Ω ½ watt.
R8—200 Ω ½ watt.
R9—500 Ω wire wound potentiometer.
C1—.0005 μF solid dielectric variable.
C2—50 pF mica.
C3—100 pF mica.
C4—50 μF 25 volt working electrolytic.
C5, 6—16+16 μF 350-volt working, negative can, electrolytic.
C7—.02 μF 1,000-volt working, paper.



A rear view of the Se

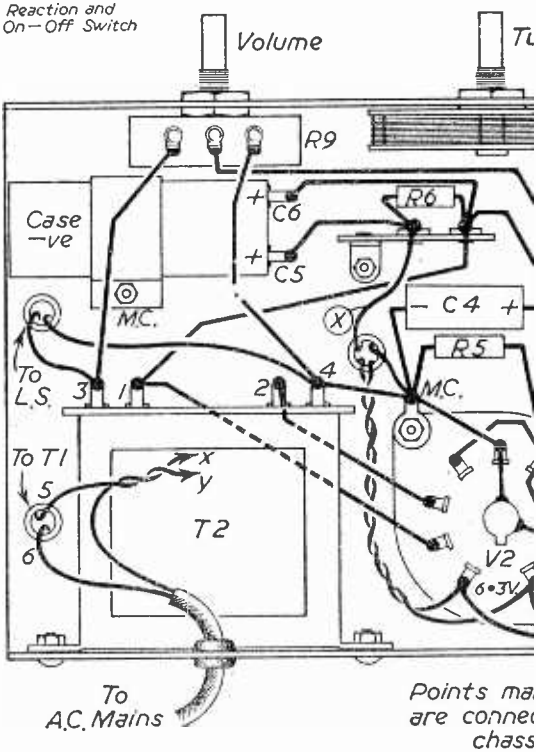
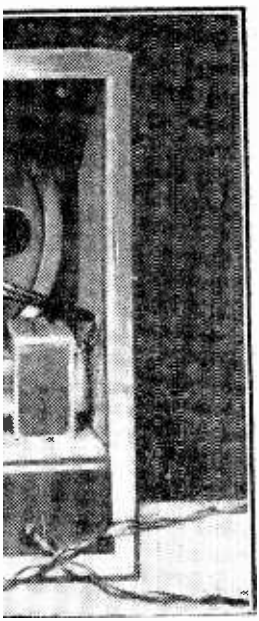


Fig. 4.—Wiring diagram below chassis. Note th



Two-valver.

condensers) is thus earthed. The fins of MR1 must not touch the chassis. If C4 has an uncovered metal body it should be insulated to prevent shorts.

When making connections make sure that the wire and tags to be joined have been scraped clean and use a hot iron, but do not keep it on a joint too long or it may damage components ; a cored solder gives best results. Use insulated sleeving to cover bare wires.

After the wiring has been completed all the connections should be checked for errors.

Testing

If a heater transformer is used the operator must stand on a dry board when touching metal parts of the live chassis.

After all the wiring has been checked the set may be plugged into the mains. When it has warmed up V2/1.a may be checked ; in the components list R5 is on the high side. Set the volume control, R9, to maximum and slowly increase the reaction control, R3, until a hissing is heard in the speaker. If the set bursts into oscillation reduce reaction slightly ; the tuning is now adjusted until the local station is received. If it covers a large portion of the tuning scale the length of the aerial must be reduced.

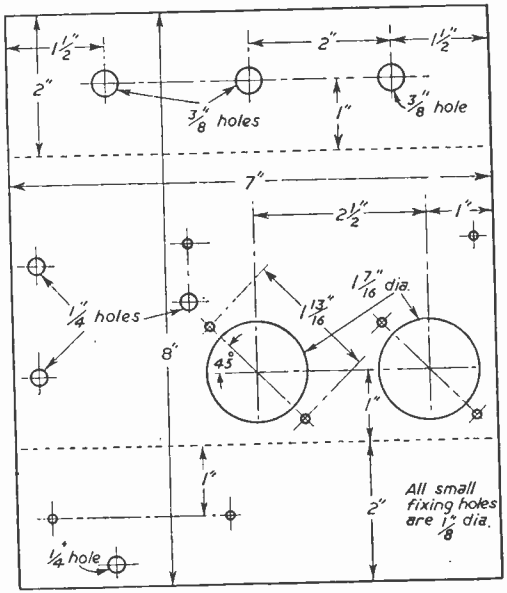
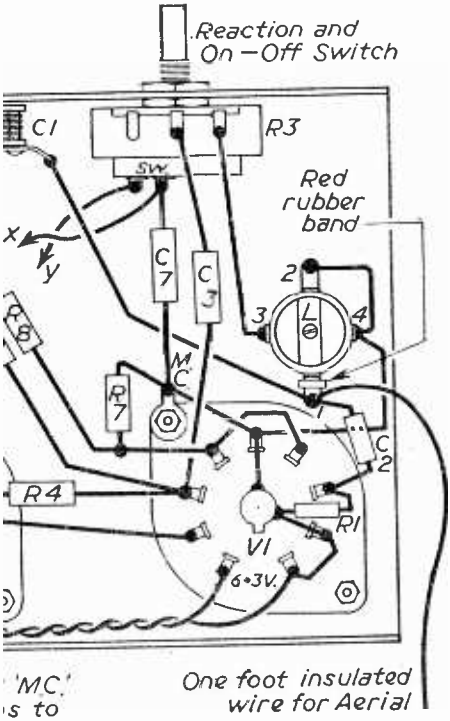


Fig. 3.—Diagram of the chassis showing the main measurements.

The length of the aerial is reduced until a compromise between sensitivity and selectivity is reached. The reaction and volume controls are adjusted together, the reaction control being used mainly to obtain good station separation. Remember, too much reaction will cause distortion. Microphonic valves should be avoided in the first stage.

If, when first switching on, the set bursts into



wiring should be taken by direct routes.

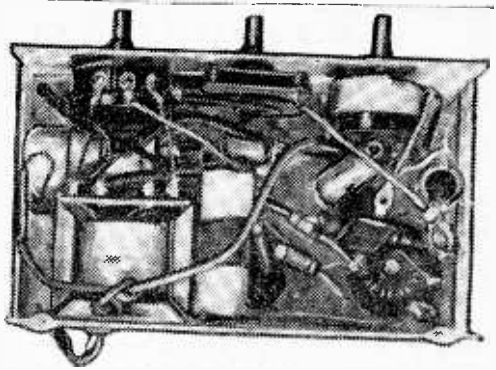
COMPONENTS LIST, Continued :

L—Wearite PHF2.
T1—Mains transformer, type 653M (Stern).
230 volts—primary.
0—230 volts 20 mA } Secondary
0—6.3 volts 1 amp. }
T2—100—1 for 2 ohm speaker ; 80—1 for 3 ohm speaker ; 35—1 for 15 ohm speaker.
MR1—250 volts 50 mA metal rectifier.
Denco Maxi—Q chassis aluminium, 7in. × 4in. × 2in. deep.
Two B9G paxolin valveholders.
Three knobs.
V1 & 2—EF50.

oscillation, which cannot be controlled by R3 but is stopped by increasing the volume control to maximum, the connections to the primary of T2 must be changed round, but if the wiring is carried out according to the illustrations this should not occur. It is also important to wire up L correctly. If reaction cannot be obtained, reverse the connections L3-4.

The constructor can please himself as to the diameter of the speaker used as long as the impedance is correct for the output transformer used.

The sides of the cabinet were made out of an egg crate, butt joints were used and a piece of hardboard used for the front. All holes are filled with putty or plastic wood and surfaces sanded smooth—the better the finish at this stage the better the final appearance. If ordinary soft wood is used it would be best to paint the cabinet, using several thin coats and sanding smooth between coats.



An under-chassis view o, the Sensitive Two-valver.

News from the Clubs

CLIFTON AMATEUR RADIO SOCIETY

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

THE winner of the first D.F. contest held on May 8th was C. Hatfull, G3HZI, assisted by W. Wooller, G3GYZ. A total of seven teams took part in this event and all but two managed to locate the transmitting site.

At the meeting on May 20th members heard a talk on Tape Recording by L. Barnes. A transmitting field day contest is being held on Sunday, July 24th, when a number of members will be setting up portable stations near Farnborough, Kent.

Programme for July:
8th—Junk sale.
15th—Constructional evening and ragchew.
24th—Transmitting Field Day.

Meetings are held every Friday at 7.30 p.m. at 225, New Cross Road, S.E.15. New members are welcome and details of membership can be obtained upon application to the Hon. Secretary.

TORBAY AMATEUR RADIO SOCIETY

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

AT a meeting held on May 21st at Y.M.C.A., Torquay, under the chairmanship of G2GK, final arrangements were made in connection with the two R.S.G.B. stations in the N.F.D. in this area. These will be manned by society members.

All members were sorry to hear that Bern Symons, BRS 19991, has had to undergo a further series of operations at the Torbay Hospital. We all hope he will soon be about again. G2GK is trying to arrange further lectures and talks for next winter season and further details will be announced later.

During the summer season, intending visitors to this area (who are always welcome) should get in touch with the Hon. Secretary or G3JD, at 46, Dower Road, Torquay.

COVENTRY AMATEUR RADIO SOCIETY

Hon. Sec.: J. H. Whitby, G3HDB, 24, Thornby Avenue, Kenilworth, Warwickshire.

MEETINGS are held at the society's headquarters, at 9, Queens Road, Coventry, starting at 7.30 p.m.

Forthcoming events include:
July 18th. Informal night.
August 1st. No meeting.
August 7th. Two-metre field day.

BARNSLEY AND DISTRICT AMATEUR RADIO CLUB

Hon. Sec.: Mr. P. Carbutt, G2AFV, 33, Woodstock Road, Barnsley.

AMONG the Club's programme of events for July will be a visit by members to Brooks Motors at Barugh Green on July 8th. On the 22nd, a talk will be given by T. Foster, G3GAH on "Mobile Operation." The lecture room of the Club is at the King George Hotel, Peel Street.

WIRRAL AMATEUR RADIO SOCIETY

Hon. Sec.: A. C. Wattleworth, 17, Iris Avenue., Claughton, Birkenhead.

MEETINGS are held on the first and third Wednesday in each month at 7.45 p.m., at the Y.M.C.A., Whetstone Lane, Birkenhead. Visitors and Short Wave listeners particularly welcome.

Publications Received

WOLF CUB BOOK

The makers of the popular Wolf Cub Drill and accessories have produced a useful book of things to make for Home, Family and Friends. It includes Handyman Hints, Home Repairs, Furniture, Toys, Gifts, Games, Models, Wood Turning and Fretwork. The book is very well illustrated and contains 100 pages of information for everyone—even if you do not possess a Wolf Cub outfit. The book is available from any Wolf stockist, or direct from Wolf Electric Tools, Ltd., Hanger Lane London, W.5, at 5s. 9d.

T.C.C. TECHNICAL BULLETIN

The latest Bulletins to be received are Nos. 49 and 50. No. 49 deals with Ceramic Trimmer condensers for TV tuners, but also has applications for V.H.F. The end of the condenser is square in section and is intended for insertion in a hole punched in the chassis, and this prevents rotation of the condenser. A screw adjustment is provided and the spring fixing nut also locks the adjusting screw. No. 50 deals with Tantalum Anode condensers, a new type of tubular electrolytic in which foil is employed instead of a block of sintered tantalum. Another feature of these condensers is that the electrolyte employed is substantially neutral, and thus should mechanical damage be sustained and the electrolyte leak, no corrosive damage will occur to other components.

EDDYSTONE RECEIVERS

Makers of the well-known Eddystone receivers have produced two new leaflets describing Models "670A" and "840A." The former is a marine receiver, for personal cabin use covering from 30 Mc/s to 150 kc/s in four bands and is intended for A.C. or D.C. operation at 110, 200 or 230 volts. The other model, "860A," is an A.C./D.C. communications receiver covering from 30.6 Mc/s to 480 kc/s in four bands and has all the normal attributes of a good communications model—B.F.O. noise limiter, etc. The leaflets are obtainable from Stratton and Co., Ltd., Birmingham, 31.

G.E.C. ELECTRONIC DEVICES

A 32-page booklet from the G.E.C. lists C.R. Tubes (instrument and special purposes as distinct from TV); Cold Cathode Triodes; Crystal Valves (including Transistors, Germanium Diodes and Silicon Diodes); Diode Noise Generator; Electrometer Valves; Gas-filled Arrester; Geiger-Muller Tubes and similar equipment. A cross-reference at the back of the book compares the G.E.C. numbers with standard C.V. numbers. General Electric Company, Ltd., Osram Valve and Electronics Department, Magnet House, Kingsway, W.C.2.

BOOKLET ON SOLDERING

A 20-page booklet, which is the third and completely revised edition of a publication called "Modern Solders," has just been issued by Multicore Solders, Ltd., of Multicore Works, Hemel Hempstead, who will send copies to engineers and technicians applying on their firm's notepaper.

The book contains several interesting articles on the uses of cored solder and the characteristics of alloys of which Ersin and Arax Multicore solders are made. A full description is given of the latest type of Multicore solder which contains five cores of non-corrosive flux.

BAND 3 T/V CONVERTER—186 Mc/s-196 Mc/s.

Complete Kit of Parts to build this most successful Unit/(Mod. W/W Circuit), with drilled chassis, 2 BVA miniature valves, wound coils, and all components down to last nut and bolt for only

Supply voltages required 250 v. 20 mA H.T. 6.3 v. 1 a. L.T. **£2 5s. post free.** Power Pack Comps. To fit chassis, 30/- extra.

Prepare for Commercial T/V now. Come and see this Unit in operation. Suitable for all types T/V sets TRF or Superhet and all channels 42 Mc/s—68 Mc/s. Blueprint and circuit details, 1/6, post free.

Volume Controls

Midget Ediswan type. Long spindles. Guaranteed 1 year. All values 10,000 ohms to 2 Megohms.

No Sw.	S.P.Sw.	D.P.Sw.
3/-	4/-	4/9

COAX PLUGS 1/2
SOCKETS 1/-
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80 ohm CABLE COAX

STANDARD ¼in. diam. Polythene insulated. GRADE "A" ONLY

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SPECIAL. — Semi-air spaced polythene. 80 ohm Coax ¼in. diam. Stranded core. Losses cut 50% 12 yds. 8/9. **9d. yd.**

BALANCED TWIN FEEDER per yd. 6d. **TWIN SCREENED FEEDER** per yd. 1/- **75 ohms COAX CABLE** 8d., per yd. ¼in. dia.

TRIMMERS, Ceramic, 4 pf.—70 pf., 9d. 100 pf. 150 pf., 1/3; 250 pf., 1/6; 600 pf., 1/9. **PHILIPS** Beehive Type—2 to 8 pf. or 3 to 30 pf. 1/3 each.

RESISTORS.—Pref. values 10 ohms 10 megohms.

CARBON		WIRE WOUND	
20% Type. ¼ w., 3d.; ½ w., 5d.; 1 w., 6d.; 2 w., 9d.		5 w. } 25 ohms—	1/3
		10 w. } 10,999 ohms	1/6
10% Type. ¼ w., 9d.; 5% Type. ½ w., 1/-.		15 w. }	2/-
		5 w. } 15,000—	
1% Hi-Stab. ½ w., 2/-.		10 w. } 33,000	1/9
WIRE-WOUND POTS.		10 w. } ohms	2/3

3w. LAB COLVERN, Etc. Standard Size Pots, 2¼in. Spindle. High Grade. All Values. 100 ohms to 50 K., 5/6; 100 K., 6/6. **W/W EXT. SPEAKER CONTROL** 10 Ω, 3/-.

MAINS TRANSFORMERS.—Made in our own Workshops to Top Grade spec. Fully interleaved and impregnated. **RADIO AND AMPLIFIER TYPE.**—250 v., 60 ma. F.W. sec., 5 v. or 6.3 v. 1 a rect. 6.3 v. 2.5 a., set Htrs., 21/-, etc. **C.R.T. HTR. ISOLATION TYPE.** — Low leakage with or without 25% sec. boost voltage. Ratio 1 : 1 or 1 : 1.25, 2 v., **10/6**; 4 v., **10/6**; 6.3 v., **10/6**; 13.3 v., **10/6**. Ditto with mains primaries 200/250 v., **12/6**. Specials to order. **SPECIAL TYPES.** — To designers spec. Simplex, **35/-**; Viewmaster, **35/-**; Lynx, **30/-**; P/W Tape Deck, **22/6**; Soundmaster, **35/-**; Mullard Amp., **35/-**; Osram 912, **35/-**. **HEATER TRANSF.**—Prim. 200/250 v. 6.3 v. 1½ a. or 4 v. 2 a., or 12 v. .15 a., **7/6**; 6.3 v. 3 a. or 5 v. 3 a. or 4 v. 4 a., **10/6**.

L.F. CHOKES.—10 H. 65 ma., **5/-**; 15 H. 100 ma., **10/6**; 10 H., 120 ma., **10/6**; 20 H. 150 ma., **15/6**; Simplex, **10/6**; Soundmaster, **10/6**; P/W Q.R. gram., **13/6**. **OUTPUT TRANSF.**—Soundmaster **6/6**; P/W Quality R'gram., **35/-**; Osram 912 sectionalised windings, **£3.10.0**. Mfrs. surplus types, standard pentode, **4/6**; ditto tapped prim., **4/9**; small pentode, **3/9**; Midget battery pentode (1S4, 3V4, etc.), **4/6**.

SOLON SOLDERING IRONS (200-220v. or 230-250v.) 25 watt, instrument type, **19/6**; 65 watt, Pencil Bit Type, **25/-**; 65 watt, Oval Bit Type, **23/-**. Comprehensive stock of spares available.

CRYSTAL DIODE.—Very sensitive. G.E.C., **2/-**. **V'HOLDERS.**—**Pax**: Int. Oct., **4d.**; EF50, EA50, **6d.** **ENG.** and **AMER.** 5-, 7- and 9-pin, etc., **1/-**. B12A CRT, **1/3**. **Moulded**: Int. Oct. **7d.** B7G, **9d.**; with screening can, **1/6**; B8A, B8G, B9A, **1/-**; VCR97, **2/6**. **Ceramic**: EF50, B7G, **1/-**. **TAG STRIPS.**—2- or 3-way, **2d.**; 4- or 5-way, **3d.**; 6-way, **4d.**; 9- or 10-way, **6d.** etc.

TOGGLE SWITCHES EX-GOVT.—"On-off." **9d.** Ersin M'core solder 60/40. 16 g., **4d.** yd.; 18 g., **3d.** yd., 3/- per ¼ lb. T.C. wire, 18 to 22 s.w.g., **2d.** yd., PVC. Connecting wire, 10 colours. Single or stranded, **2d.** yd.

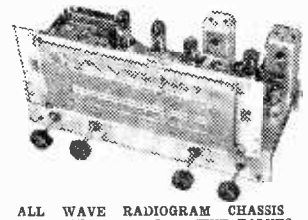
SLEEVING.—Various colours. 1 mm. and 2 mm., **2d.** yd. 3 mm. and 4 mm., 3d. yd. 6 mm., **5d.** yd.

NUTS, BOLTS AND WASHERS in packets 1 doz. ea. 4BA, 6BA or 8BA, ¼in. or ½in. length, 1/- packet. Comprehensive stock all kinds. bolts PK screws, Solder Tags, Grommets, etc.

FUSES.—1¼in. all values 60 ma. to 10 a., **4d.**

ALADDIN FORMERS and cores, ½in., **8d.**; ¾in., **10d.**

SLOW MOTION DRIVES.—Epicyclic ratio 6 : 1, **2/3.**



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THREE WAVEBANDS FIVE VALVES

S.W. 16 m.—50 m. LATEST MIDGET
M.W. 200 m.—550 m. B.V.A.
L.W. 800 m.—2,000 m. SERIES.

Brand New and Guaranteed. A.C. 200/250 v. Four position Wavechange Switch. Short-Medium-Long-Gram. Slow Motion Tuning. Speaker and Pick-up connections. High Q iron-dust cored coils, 465 kc/s I.F. Latest circuit technique, delayed A.V.C. and Negative feedback. Output approx. 4 watts. 3 ohms output transformer on chassis. Chassis size 13½ x 5½ x 2½in., Glass Dial—10in. x 4½in. horizontal or vertical type available, lit by 2 Pilot Lamps. Colour Black Station names, L.W. Green, M.W. Red. S.W. White. Four Knobs supplied. Walnut or Ivory to choice, aligned and calibrated. Chassis isolated from mains. PRICE **£9.15. 0** Carriage and Insurance, 4/6.

8in. or 10in. speakers to match available.

BARGAIN VALUE IN RECORD CHANGERS

Recommended for above chassis

B.S.R. MONARCH.—Latest Model 3 sp. Auto-Changer Mixer Unit. Famous Magidisc, 7, 10 and 12in. Record Selector. Modern Cream Styling Dual Xtal Cartridge Stylus for Hi-Fi reproduction. As used by leading manufacturers. Bargain Price.

9½ Gns. post free.

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NEW BOXED				ALL GUARANTEED			
1R5	7/6	6Q7	8/6	EF41	10/6	MU14	8/6
1S5	7/6	6SN7	9/-	EF50		PCC84	12/6
1T4	7/6	6V6	7/6	Mullard	10/-	PCF80	12/6
1S4	7/6	6X4	8/6	EF50		PCF82	12/6
3S4	8/-	6X5	8/-	Equip.	5/6	PL81	12/6
3V4	8/-	EA50	2/-	EF80	10/6	PL82	10/-
3D6	3/6	EBC41	10/6	EF85	13/6	PL83	12/6
5Z4	8/6	EBC33	8/6	EF91	8/6	PY80	11/-
6AM6	8/6	EB91	7/6	EL41	11/6	PY81	12/6
6AT6	8/6	EBC33	8/6	EL84	12/6	PY82	10/-
6C4	10/6	ECC33	12/6	EM80	12/6	SP41	5/6
6H6M	3/6	ECH42	10/6			SP61	6/6
6K7	6/6	ECL80	12/6	EY51	12/6	U22	8/6
6K8	9/-	EF39	7/6	GZ40	10/-	U25	12/6

SPECIAL PRICE PER SET
1R5, 1T4, 1S5 and 3S4 or 3V4 ... ... 27/6
6K8, 6K7, 6Q7, 6V6, 5Z4 or 6X5 ... ... 35/-

SPEAKER FRET.—Expanded Bronze anodised metal 8in. x 8in., 2/3; 12in. x 8in., 3/-; 12in. x 12in., 4/3; 12in. x 16in., 6/-; 24in. x 12in., 8/6. etc.

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F.M. TUNER-UNIT (87 mc/s—105 mc/s), by Jason. —As tested and approved by Radio Constructor. Complete Kit of parts to build this modern highly successful unit, drilled chassis and J.B. dial, coils and cans. 4 BVA miniature valves and all components etc., for only, **£6.10.0**, post free. **SUPERIOR** TYPE GLASS—Calibrated in Mc/s and edge lit by 2 pilot lamps, **12/6** extra.

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CONDENSERS.—Mica, S. Mica, Ceramics. All pref. values. 3 pf. to 680 pf., 6d. ea., 5/- doz. **Tubulars.** 450 v.. Hunts and T.C.C. .0005, .001, .005, .01, .02 and .1 350 v., 9d.. .05, .1 500 v. Hunts Moldseal, 1/-. .25 Hunts, 1/6. .5 Hunts, 1/9. .1 1,500 v. T.C.C. (Simplex), 3/6. .001, 6 kV., T.C.C., 5/6. .001 12.5 kV. T.C.C., 9/6.

SILVER MICA CONDENSERS.—10%. 5 pf. to 500 pf., 1/-. 600 pf. to 3,000 pf., 1/3. 1% 1.5 pf. to 500 pf., 1/9. 515 pf. to 5,000 pf. 2/-.

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Tubular Wire ends 25/25 v., 50/12 v. 1/9	8+16,450 v. Hunts 5/-
50/350 v., 4/500 v. 2/-	8+16/500 v. Dub. 5/6
8/500 v. Dub. 2/6	16+16/450 v. B.E.C. 5/6
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ENGRAVED CONTROL KNOBS for ¼in. Spindle. 1¼in. diam. Walnut or Ivory. Gold Filled. 16 Standard engravings, **1/6** ea. Plain knobs to match above, 1¼in., **10d.** ea., 1¾in. dia., **8d.** ea. Superior Unmarked Knobs with Gold Ring. Very stylish and becoming highly popular. Walnut or Ivory. 1¼in., 1/- ea.; 1in., **9d.** ea. Pointer Knobs, Black with White Line, **9d.**

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REACTION COND.—.0001, .0003, .0005 mfd., **3/6** ea. **MAINS DROPPERS.**—Silicone coated, with 2 slider clips. .15 amp, 1,500 ohms, **4/3**; .2 amp, 1,000 ohms, **4/3**; .3 amp 1,000 ohms, **4/9**; .3 amp, 750 ohms non-coated, **4/6**.

LINE CORD.—.3 amp, 60 ohms per foot, .2 amp, 100 ohms per foot, 2 way, **6d.** ft.; 3 way **7d.** ft.

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ALUMINIUM CHASSIS.—**18 s.w.g. Plain, undrilled, folded 4 sides and riveted corners lattice fixing holes. Strong and soundly constructed with 2½in. sides. 7in. x 4in., 4/6; 9in. x 6in., 5/9; 11in. x 7in., 6/9; 13in. x 9in., 8/6; 14in. x 11in., 10/6; and 18in. x 16in. x 3in., 16/6.**

CARBON MIKE INSERT.—Superior quality type 2½in. x 1in. Brand new and boxed only **3/6** each.

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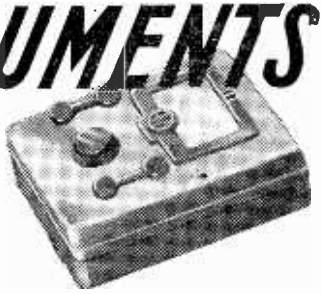
LOUDSPEAKERS P.M., 3 OHM.
Richard Allen, 5in., 16/6; 6½in. Goodmans, 17/6; 7 x 4in. Elliptical, 18/6; 8in. Goodmans, 18/6; 8in. Elac., 20/-; 10in. Plessey, 25/-; 10in. R and A, 25/-; 12in. Plessey, 37/6.

Using TEST INSTRUMENTS



Part 8 of a Series of Articles Dealing with the Practical Application of Standard Test Equipment

(*Continued from page* 410 *July issue*)

THE probe unit can, if desired, be built into a tube of well-insulated material, such as paxolin, the valve top-cap anode can be used very neatly as the probe connecting point, and the valve heater can be energised by a standard 1.5 volt dry cell housed in the paxolin tube.

Fig. 30 shows the general wiring of a probe of this kind, which, as will be noticed, simply takes the form of a conventional E.H.T. rectifier network. The valve voltmeter, adjusted to a suitable high voltage range, is connected across the 0.001μF E.H.T. capacitor. Owing to the relatively light load across the capacitor the voltage measured will be nearly equal to th peak voltage of the pulse waveform.

Although a screwdriver spark test (see Fault Symptoms, *Practical Television*, September and October, 1954) reveals the presence of high voltage pulses, they can only be measured accurately by using a probe similar to that described. Most of us realise this, of course, but our Query Service shows that there are still one or two who are not quite sure, and who expect an ordinary D.C. voltmeter to indicate something more than the receiver's H.T. line voltage, or possibly the H.T. line voltage plus the reclaim voltage, when the instrument is connected between the receiver chassis and the anode of the line output valve !

Now we are on this subject, it is worthy to note the undesirability of connecting an ordinary D.C. voltmeter between the line output valve anode and chassis as a means of measuring the voltage at this point. Such practice is liable to cause a flashover to occur within the instrument, resulting in serious damage to the instrument winding or associated resistors. To be on the safe side it is best always to take a voltage reading on the low potential side of the line output transformer primary winding, and make a resistance test of the winding, with the power off, if it is suspected for open-circuit (see Fig. 31).

The Signal Generator (25)

These days the term "signal generator" would appear to cover both the instrument which at one time was more popularly known as the ganging oscillator or service oscillator and the more up-to-date R.F. oscillator, the use of which is essential for aligning the delicately tuned circuits of television receivers.

Not so many years ago the signal generator was often classed as a piece of laboratory equipment, which, as the result of its stringent standards and consequent high cost, was not generally found in the possession of the service engineer or experimenter. The ganging oscillator was the popular instrument of those days and, even though it maintained a reasonable degree of efficiency and accuracy—at least, sufficient for broadcast receiver alignment—it was a considerably less expensive piece of test gear.

Its main drawbacks were that the R.F. output varied widely with frequency, rendering comparative frequency/sensitivity tests more of a guess and hope process ; harmonics were frequently made use of to tune into the short-wave band ; and its initial accuracy always left something to be desired and this tended to deteriorate with use, particularly on the higher frequency ranges and if the instrument was subjected to slight vibration—such as being carried in a van.

We would mention that some of the present less-expensive, so-called signal generators suffer in varying degrees from the effects described. Nevertheless, this type of instrument, and even some of the older style ganging oscillators, are still in continuous use in workshops and in experimenters' shacks all over the country. Provided their limitations are fully realised by the operator, they are adequately suitable for normal broadcast receiver alignment processes, and can even be used tentatively for television purposes.

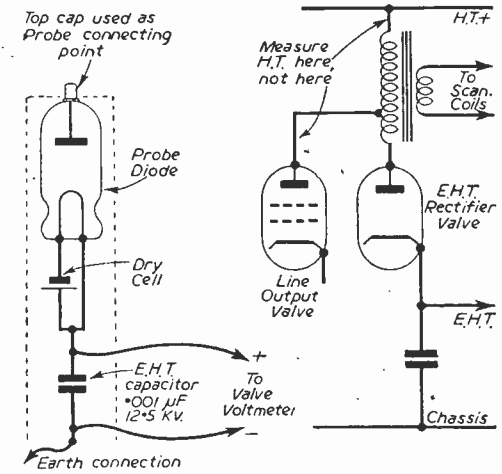


Fig. 30 (left).—A high-voltage diode probe, useful for measuring the peak voltage present at the anode of the line output valve or the anode of the E.H.T. rectifier in flyback E.H.T. circuits. Fig. 31 (right).—Never measure the H.T. voltage at the anode of the line output valve. Check the voltage at the low potential end of the transformer primary and check also the winding for resistance.

Recent enhanced design factors have considerably reduced the difference in performance between the ganging oscillator and the signal generator, so that now a compromise is aimed at so far as medium priced signal generators are concerned. Such instruments feature very good frequency stability coupled with remarkably constant R.F. output over the entire frequency range.

Furthermore, more recent instruments have an accuracy of frequency within one to two per cent. of the scale markings and tune to frequencies corresponding to Band I television, and, in some cases, to Band II (the F.M. Band) and Band III television. The better class of generator embodies an R.F. oscillator which is tunable to the fundamental frequencies corresponding to the television bands,

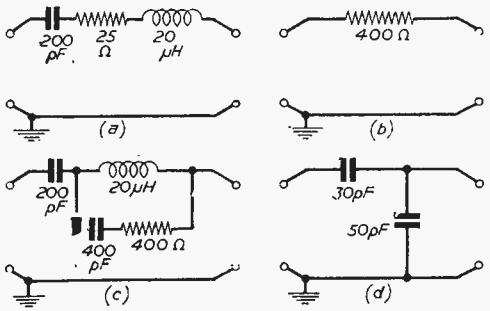


Fig. 32.—Dummy aerial arrangements for R.F. alignment.

this being most desirable, as the use of harmonics can easily mislead and bewilder the unwary novice.

A variable form of R.F. attenuator is provided on nearly all instruments. The accuracy of this is, of course, reflected directly on the instrument's cost. Essentially, two variable attenuators are adopted: one suitable for performing small changes of R.F. output voltage, and the other as a more or less coarse adjustment enabling the output as set on the fine adjustment to be multiplied by factors of ten. By these means R.F. outputs ranging between one microvolt and 500 millivolts can be easily selected.

This feature is indispensable for assessing the sensitivity of the sound and vision channels in a television receiver and, of course, as an aid to determining the overall sensitivity of a broadcast receiver. As will be realised, the accuracy of tests of this kind will depend wholly on the constancy of oscillator output voltage to frequency, and on the magnitude of R.F. voltage getting out of the instrument other than through the normal terminating lead. This latter factor comes into prominence on very low settings of the attenuator when the external R.F. field from the generator may outweigh the signal carried by the terminating lead. This being, of course, a design consideration of providing adequate screening to R.F. between the oscillator and the case of the instrument.

Facilities are also incorporated for readily making use of the full R.F. output of the oscillator. A terminal marked "force" or "full R.F." is provided for this purpose and simply connects directly to the output of the oscillator—by-passing the variable attenuator. This output is generally loaded to a relatively high impedance as compared with the typically 70 to 80 ohms leading impedance from th output of the variable attenuator.

Most signal generators also embody an A.F oscillator which can be switched on as desired t modulate the R.F. signal. The audio frequency i generally fixed at about 400 c.p.s. and is arranged t modulate the R.F. carrier to a depth of about 30 pe cent. It is nearly always possible to extract this A.F signal — free from R.F.— from a pair of terminals o the instrument, these terminals being marked "A.F." or "L.F." Certain instruments also provide variable potentiometer for permitting easy adjustmen to the voltage of this separate A.F. source, generally as opposed to adjusting the modulation depth, whicl is fixed. A conveniently positioned rotary switcl enables rapid selection of the required facility pro vided by the instrument.

Dummy Aerials (26)

As we shall see when we come on to receive alignment it is often necessary to inject a signal fron a signal generator into the aerial terminal of th receiver under adjustment. In order to achieve this without upsetting the normal loading of the aeria circuit, the signal is fed from the generator throug a dummy aerial. Such a device represents an electrica equivalent of an average aerial installation, and thu loads the aerial circuit whilst a pre-determined signa level is applied between the receiver aerial an earth terminals.

At one time two dummy aerials were set down a standard: one for use at broadcast frequencies an up to 2.5 Mc/s (see Fig. 32a), and the other fo frequencies above 2.5 M/cs (see Fig. 32b). Of recen years, however, an all-wave dummy aerial has beer standardised. This is designed to approximate th above two aerials over their essential frequency rang (see Fig. 32c). Owing to the marked difference ir characteristics of a car-radio aerial, when alignin car-radios it is often desirable to substitute the all wave dummy aerial with the arrangement shown ir Fig. 32d.

Alignment of Broadcast Receivers (27)

Before we delve too deeply into this subject we would stress the desirability of obtaining detailec alignment instructions relating to the receiver under test. This is recommended particularly so far as commercial receivers are concerned, for certain trimmers are common to more than one waveband, and unless such circuits are adjusted in the correct order accurate alignment will be impossible.

For reasons such as this corresponding to individual circuit design, the following alignment procedure should be taken only as a guide; nevertheless, in a large number of cases it will be found to be that normally adopted.

Before alignment is attempted sufficient time should be allowed for both the receiver and the signal generator to reach a stable working temperature. About ten minutes is usually sufficient, though this will depend on the frequency stability of the generator and receiver.

With superheterodyne circuits the I.F. transformers should always be the first to receive treatment, but adjustment should not be commenced until the local oscillator has been made inactive. This is best accomplished by shorting the oscillator tuning capacitor with a short length of wire, terminated with two crocodile clips for convenience. This is the

(*Continued on page* 489.)

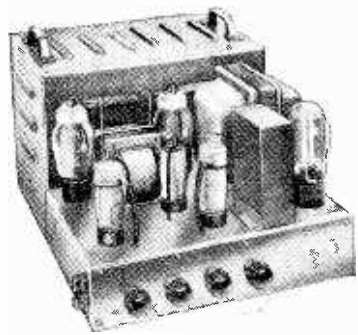
R.S.C. A4 HI-FIDELITY 25 WATT AMPLIFIER

A new design for 1955. "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 millivolts 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.

9 GNS.

H.P. TERMS ON ASSEMBLED UNITS. DEPOSIT £2 and ten monthly payments 22/6.



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.

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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.

7 GNS.

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.

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B.S.R. MONARCH 3-SPEED MIXER AUTOCHANGER. For standard 200-250 v. 50 c/cs mains. Autochanges on all 3 speeds 7in., 10in. and 12in. Plays 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 12¼in. x 5¼in. high. Offered for 1 month only. Brand new cartoned at £8.19.6, plus 7/6 carr.

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For mains 200-250 v. 50 c/s.
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, fuseholders 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.

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COLLARO HIGH-FIDELITY MAGNETIC PICK-UPS. High impedance magnetic type. Limited stocks at fraction of normal price. Only 35/-. Brand New.

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 list, and illustration, 2/6. Total building cost, £3/15/-.

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 HFI012 10 watts, high-fidelity type. Highly recommended for use with any of our amplifiers. £3/17/6.

MICROPHONES. Crystal high fidelity types. Recommended for use with our amplifiers. Acos. Hand or Desk type, 50/-; Stand type with heavy floor base and adjustable stem, £6/19/6. H.P. TERMS ON "MIKES," SPEAKERS, etc. when supplied with our amplifiers.

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350-0-350 v. 100 mA, 6.3 v. 4a, 5 v. 3a ...	22/9
350-0-350 v. 100 mA, 6.3 v. 4 a, C.T. 0-4-5 v. 3a.	23/9
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350-0-350 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a	27/9
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ganged variable capacitor C2 in the circuit of Fig. 33.

In certain circuits the H.T. potential exists across the oscillator tuning capacitor, so that in a set of this kind the short-circuit should be made to R.F. only by using an 0.1 μF capacitor.

As a means of indicating the rise and fall of the response of the receiver as the various trimmers are adjusted an R.F. indicator or output meter should be connected as detailed under Parts 5 and 6 of this series. If an output meter is employed the signal from the signal generator should be modulated, though if an R.F. indicator is used it is not essential to modulate the R.F. signal. This readily permits a wavemeter or similar R.F. generating source to be used for alignment purposes.

To avoid the A.V.C. circuit from coming into operation and making trimmer adjustments difficult, each separate A.V.C. line should be shorted to chassis, or, if a common A.V.C. line is used, a single connection between the A.V.C. line and chassis will be sufficient.

The circuit of Fig. 33 represents the frequency changer and I.F. stages of a typical broadcast receiver. It may be found desirable to refer to this during the following alignment procedure.

As a means of obtaining the maximum response at the I.F. it is often a good idea to set the tuning capacitor (C1 C2) to maximum and position the wavechange switch to long-wave.

The signal generator should next be tuned to the intermediate frequency and the signal output lead connected to the signal grid (point A) of the I.F. valve V2 through an isolating capacitor of not less than 0.001 μF, without removing the top cap connection.

Trimmers T1 and T2 should then be adjusted for maximum deflection on the indicating device. After adjusting T2, T1 should be adjusted again until no increase in output can be obtained.

Finally, the output of the signal generator should be connected to the signal grid of V1 (point B) through the same isolating capacitor, without removing the top cap connection, and trimmers T3 and T4 adjusted until no further increase in output can be obtained.

In certain receivers it is permissible to readjust the trimmers of the second I.F. transformer with the signal generator connected to the signal grid of the frequency changer valve. If this procedure is not recommended however, an indication to this effect is generally included in the alignment instructions. A dummy aerial is not necessary for alignment of the I.F. stages, an isolating capacitor is usually sufficient.

The output from the signal generator should be kept at a minimum, consistent with workable indication of the output meter, at all times during I.F. and R.F. alignment and progressively reduced as the circuits are brought into resonance.

Instead of trimmer capacitors, some I.F. transformers use fixed capacitors and iron-dust tuning slugs. Examination of such transformers will, in general, reveal the use of less wire than air cored ones. Although the correct alignment frequency should be used wherever possible, it is, in certain cases, permissible to modify the alignment frequency

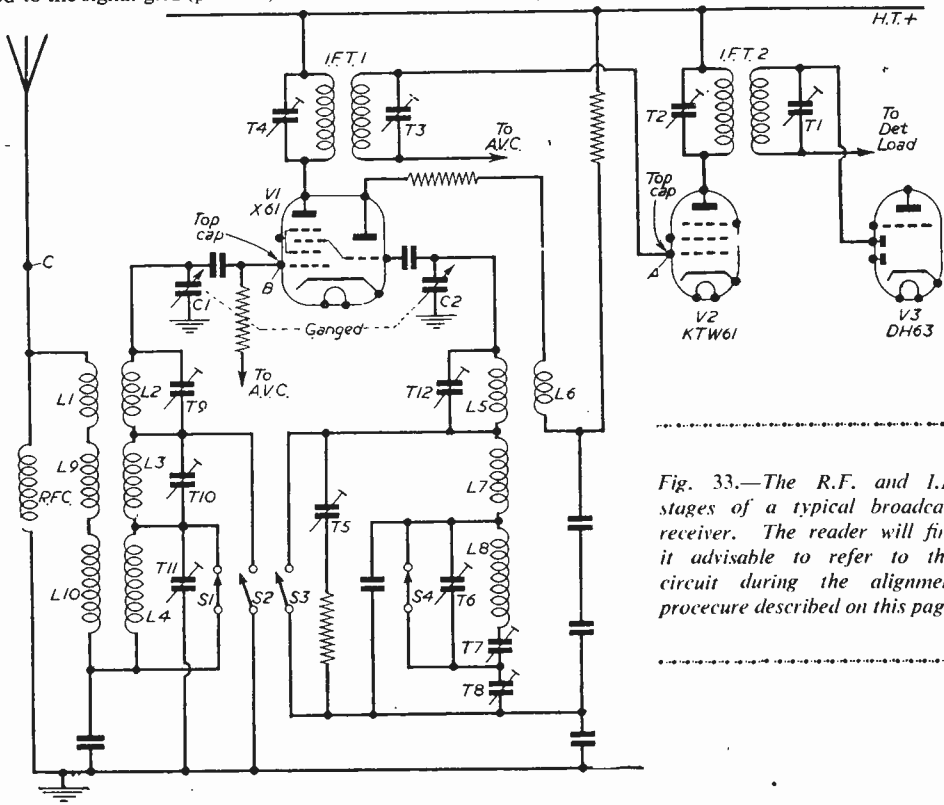


Fig. 33.—The R.F. and I.F. stages of a typical broadcast receiver. The reader will find it advisable to refer to this circuit during the alignment procecure described on this page.

slightly as a means of eliminating morse interference which is experienced in some districts. It is desirable, however, to limit the maximum shift to 10 kc/s above or below (after trying both) the correct alignment frequency.

With transformers using iron-dust tuning cores an overall shift of about 20 kc/s is possible, while with capacitor adjusted I.F.s an additional shift of about 10 kc/s is generally possible.

It should also be mentioned that receiver designers stipulate stagger I.F. tuning (e.g., primaries tuned to, say, 467 kc/s, and secondaries tuned to 463 kc/s) as a means of obtaining a

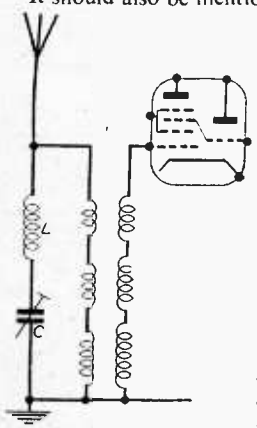


Fig. 34.—A series-tuned (acceptor) circuit sometimes included as an I.F. trap.

relatively flat-top I.F. resonance curve. A response curve similar to this can also be obtained from I.F. transformers using "over-optimum" coupling. Manufacturer's alignment data will normally provide full details in such cases, however.

Having achieved optimum alignment of the I.F. section, the short-circuit from the oscillator section of the ganged tuning capacitors should be removed, and attention should be focused on aligning the R.F. stages.

Before attempting this operation a special point should be made of examining the tuning cursor or drum to ensure correct adjustment in relation to the position of the rotary vanes of the ganged capacitor. It is wholly desirable to ascertain, before alignment is commenced, that the vanes are fully enmeshed when the cursor is at the highest wavelength reading, and fully open when the cursor is at the lowest wavelength (highest frequency) reading. It is often only adjustment of this kind that is needed to bring an apparent "out of alignment" receiver into correct alignment.

R.F. alignment is carried out at a high and low frequency point on each waveband, this being necessary to ensure optimum "tracking" of the variably tuned circuits throughout the waveband. Referring again to the circuit of Fig. 33, the R.F. alignment process is as follows:

Set the signal generator to 1.4 Mc/s (214 metres) and inject a signal into the receiver aerial terminals through a suitable dummy aerial. Adjust the receiver tuning to correspond and switch to the medium waveband. Adjust the medium-wave oscillator trimmer T5 and the medium-wave R.F. trimmer T10, in sequence, for maximum output.

Next, the receiver tuning should be set to 500 metres and the signal generator adjusted to 600 kc/s. The medium-wave oscillator padding capacitor (T8) should then be adjusted for maximum output. It is often a good idea at this point to rock the receiver tuning slightly, again adjusting T8 for maximum output, noting output meter reading. The point of maximum output should occur very close to 500 metres.

It is often found that adjustments at the lower frequency will affect those carried out earlier at the higher frequency; it is, therefore, desirable to repeat all adjustments at both alignment points until no further improvement is possible.

Long-wave alignment should now be tackled by switching the receiver to the long waveband and adjusting the signal generator to 300 kc/s and the receiver to 1,000 metres. The long-wave oscillator trimmer (T6) and the long-wave R.F. trimmer (T11) should be adjusted, in sequence, for maximum output.

The long waveband R.F. alignment should be concluded by adjusting the receiver to 1,875 metres and the signal generator to 160 kc/s, and adjusting the long-wave padder (T7) for maximum output. The receiver tuning capacitor should again be "rocked" for maximum response as detailed above.

A pre-set padder capacitor is rarely included in the short waveband of commercial all-wave sets. To align the short wave R.F. stages in such a receiver, therefore, simply requires the injection of a signal corresponding to the high-frequency end of the band (generally in the region of 16.7 Mc/s) and adjustment of the appropriate oscillator and R.F. trimmers, e.g., trimmers T5 and T9 in Fig. 33. In order to achieve maximum sensitivity, however, it is often a good point to rock the tuning capacitor in the region of the alignment frequency, during the process of adjusting T5, until maximum output is obtained.

In receivers which incorporate an R.F. amplifier valve an additional set of tuned circuits will, of course, be found. The alignment of these is similar to that of the tuned signal frequency or "aerial" circuit of the frequency changer valve.

Alignment of communications-type receivers or domestic broadcast receivers using electrical band-spread circuits on short wavebands is generally a little more involved, and owing to the multitude of trimmer capacitors employed it is a good idea to seek guidance from the manufacturer's service data before alignment is attempted.

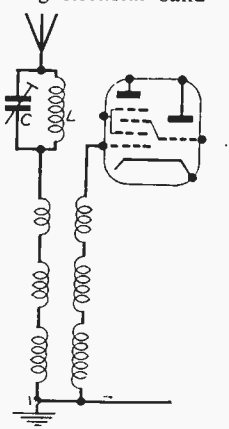
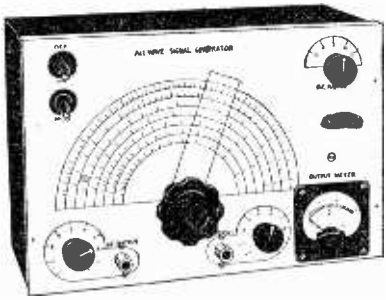


Fig. 35.—A parallel-tuned (rejector) circuit which may also be used as an I.F. trap.

An additional either series-tuned (acceptor) circuit (CL, Fig. 34) or parallel-tuned (rejector) circuit (CL, Fig. 35) is sometimes discovered in a broadcast receiver. Its function may be to reduce breakthrough of transmissions at or near the intermediate frequency or to minimise second-channel interference. In the former case the circuit should be tuned, by means of the trimmer capacitor or iron-dust tuning slug, for *minimum* output when a signal equal to the intermediate frequency is applied to the aerial and earth sockets of the receiver through a dummy aerial.

In order to obtain a reasonable output at the I.F. a large signal may be necessary. *(To be continued.)*



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TRANSMITTING TOPICS

TUNING THE LINK COIL

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

LINK coupling is a useful, though often misunderstood method of conveniently coupling R.F. energy between stages in transmitters, and incidentally in receivers also. In fact, the facility it affords of "piping" R.F. is extremely useful. It is quite feasible, for example, to have the V.F.O. and/or exciter stages remote from the P.A. stage, or to have an aerial tuning unit remote from the transmitter proper. If shielded line or coax is used, R.F. is properly confined within it, so that link coupling enables stages to be physically separated yet efficiently fed with R.F., without any undesirable effects. However, in some cases, link coupling may provide some unexpected difficulties, so that a consideration of this system may be of interest.

Basically, link coupling as illustrated in Fig. 1, enables two high-impedance tuned circuits to be coupled by means of a low-impedance feedline. Provided the coupling conditions are right, efficient transfer of R.F. can occur even with long lengths of line. For prevention of unwanted radiation effects, the coupling line may conveniently be a length of coaxial cable. In effect at the "supply" end we have a step-down transformer matching the feeding stage into the low impedance of the line, with a step-up transformer at the "accepting" end to match the low-impedance line to the tuned circuit.

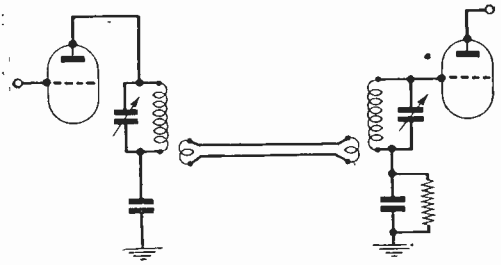


Fig. 1.—A common application of link coupling in transferring energy between two tuned circuits via a low-impedance transmission line.

This is in accordance with the usual method of using a "few turns" for the link coil, as in general the step-down ratio requires only a small coil for the link coil. Curiously enough after a little "cut and try" to find the "right size" of link coil, most amateurs obtain a high efficiency of transfer. Occasionally, however, trouble is experienced, and no size of coil for the link winding appears to offer efficient coupling, and the usual rough-and-ready methods need assistance in order to make an efficient match.

Clearly the link coil system is a transformer coupling. In fact, it is often recommended that the usual turns ratio formula be applied in order to calculate the step-down ratio needed to match the R.F. producing tank circuit into the impedance of the coaxial or other feed line. Unfortunately matters are not quite so simple. While an audio frequency transformer wound on a closed iron core with tightly-coupled windings can be calculated in such a manner, the "R.F. transformer" formed by adding a link winding to a tank coil is a very different proposition.

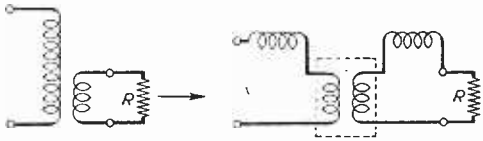


Fig. 2.—The link coupling circuit, due to imperfect coupling between coils has a high leakage inductance in both coil circuits. This is equivalent to a part of each coil being coupled as a perfect transformer (shown in the dotted surround), and the greater part of each coil completely uncoupled. The effective fraction of coil regarded as completely coupled is the coupling coefficient. A high series value of leakage inductance may prevent efficient transfer of power to the load resistor R.

In the first place, due to the absence of a closed iron core, the coupling between the coils is very far from being 100 per cent. In fact, only a small percentage of the 100 per cent. coupling of an iron closed core transformer can be achieved. This state of affairs is illustrated in Fig. 2, where the practical link coupled circuit may be shown as being equivalent to two coils *perfectly* coupled, plus the uncoupled coils representing the fact that coupling is imperfect. If the coupling is only 10 per cent., the perfectly coupled coils would represent only 10 per cent. of the total coil inductance, plus the remaining 90 per cent. in series with the hypothetical coupled portions. Thus, in effect, the load resistor R has in series with it an appreciable inductance, representing the uncoupled portion of coil. If the coupling is low, the impedance

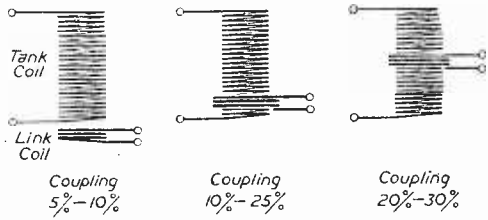


Fig. 3.—Typical arrangements of link windings and tank coils, illustrating the amount of coupling possible in practical cases.

of the effectively uncoupled section of coil may effectively limit the amount of power that can be supplied to the link circuit. Accordingly, it is necessary to consider carefully the most effective disposition of link coil to obtain efficient energy transfer.

In fact, it is very difficult to obtain coupling co-

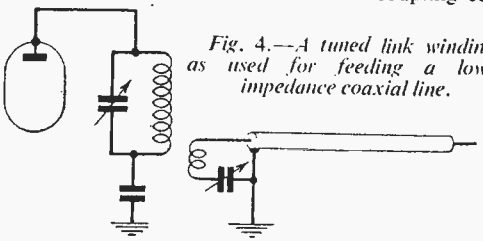
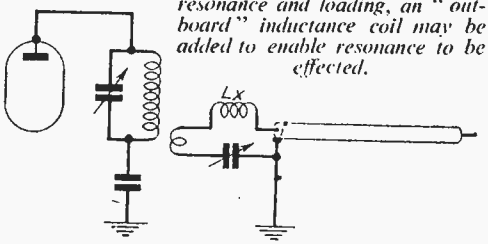


Fig. 4.—A tuned link winding as used for feeding a low-impedance coaxial line.

efficients much in excess of 0.3, that is 30 per cent. coupling as compared to 100 per cent. (very nearly) for an iron-cored transformer. In fact from an R.F. point of view 30 per cent. is "tight" coupling. In Fig. 3, the coupling co-efficients likely in three popular arrangements are shown. The end-link coil, in fact, only couples some five per cent. to 10 per cent., unless it is wound directly over the end turns of the tank coil, in which case 20 per cent. or so coupling may be obtained. The centre-link coil, only usable in balanced tank coil systems, has the highest possible coupling factor—up to about 30 per cent. This immediately gives an important object lesson in the design of link coils. The swinging end-link is unlikely to give enough coupling to give adequate power transfer under all conditions, and a more satisfactory form of end-link is clearly a sliding link that can be slid over the actual end turns of the tank coil. This will give very good coupling. The centre-link may be arranged to swing in between turns at the centre of a tank coil

Fig. 5.—Where a commercial coil unit has insufficient link coil inductance for comfortable resonance and loading, an "outboard" inductance coil may be added to enable resonance to be effected.



and thus enable adequate coupling to be achieved, as a centre link has the highest possible coupling co-efficient of the three systems shown in Fig. 3.

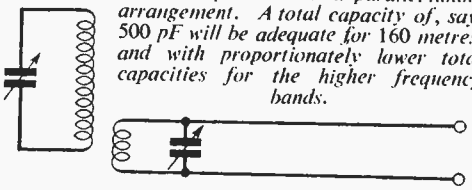
The effect of moving the link coil to and from the tank coil is, of course, really an adjustment of the coupling factor. However, the optimum size of link coil should not be calculated on a turns ratio basis. The link coil inductance Lx should be calculated so that its reactance at the working frequency is equal to the characteristic impedance of the line it feeds, or the load into which it feeds. Thus with 80 ohm coax the expression $2\pi fLx$ should be approximately 80 ohms of reactance.

An Alternative

There is, however, a much more elegant method than clumsy swinging links for effectively matching the tank coil to the linked line. This is the use of a series capacitor. The effect of the series capacitor to "tune the link coil" is really to cancel out the uncoupled "leakage reactance" present in the link-coil system. In this way, the blocking effect of this series reactance may be cancelled, so that power may be fed into the line. Adjustment of the series capacitor gives, in effect, a smooth control of coupling, so that an efficient variable "electronic" matching is effected without the use of mechanically adjustable links. It is only necessary to fit a closely-coupled link winding of approximately correct size initially, so that a simple panel adjustment effects a smooth control.

In point of fact, it is not often realised that this "link coil tuning" is achieved mistakenly by a well-known piece of "ham lore." Thus a feed line feeding an aerial from a link coupling is often "pruned" until the system "draws well." This is perfectly true, but it is usually assumed that the pruning has effected an impedance match. In reality, the line is unmatched, and shows a variable reactance along its length due to standing waves. The "pruning" procedure produces a line length with a capacitative reactance, which tunes the link-coil inductance, thus giving

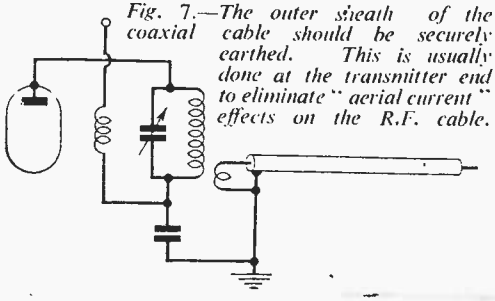
Fig. 6.—Twin-feeder lines of 250 ohms impedance and higher are more suitably used with a parallel tuning arrangement. A total capacity of, say, 500 pF will be adequate for 160 metres, and with proportionately lower total capacities for the higher frequency bands.



efficient transfer from the tank coil. In fact, it is only when a really well-matched line with a low standing-wave ratio, and hence no appreciable reactance, is used that difficulty occurs. In this case, cancellation of link-coil inductance does *not* occur and the system may *not* "draw" well, despite the fact that the load is a well-matched "flat" line. In fact "good drawing" and the transfer of power even with very loosely coupled link coils, are the hallmarks of a poorly matched system with a high standing-wave ratio, or, of course, of a legitimate resonant feeder system. However, despite the purists there is no especial virtue in having a really "flat" line provided that the coupling is correct. However, a line that is not flat will require extensive retuning procedures when the operating frequency is changed. The "line pruning" method therefore, does effect an efficient match, despite the sometimes faulty reasoning behind the procedure, and the

(*Continued on page 497.*)

Fig. 7.—The outer sheath of the coaxial cable should be securely earthed. This is usually done at the transmitter end to eliminate "aerial current" effects on the R.F. cable.



fact that the match may not hold over a wide band of frequencies.

However, the link coil tuning procedure will accommodate both flat and partly-resonant line systems alike, so that line pruning need not be resorted to. Or the unflat line may be pruned to a figure which enables the link coil tuning system to accommodate frequency changes by a panel adjustment. Thus, the link-coil tuning condenser serves two purposes. First, it corrects for inadequate link coupling, and secondly it corrects for a line presenting a reactive impedance due to a high standing-wave ratio. The correction being such that power may be effectively coupled into the line and aerial system. As the link-coil is usually of low inductance, a large value of tuning capacity is needed to resonate to working frequency. Large, that is, compared with the values used in the main tank circuit. However, as the line impedance is usually low, say 80 ohm co-axial cable, the tuning condenser need not be capable of withstanding very high voltages, and quite often a receiving type condenser may be used. In fact, high-grade mica condensers may be used in addition to give the high value needed on the lower frequency bands. In fact the requirements for a link-coil tuning condenser to tune a coil feeding an 80 ohm cable are roughly similar to those required in the output condenser of the current fashionable Pi network tanks. Thus a broadcast receiving type of 500 pF variable plus 500 pF fixed mica condensers switchable across this capacitor will enable most link coils to be tuned on the usual amateur frequencies from 80 to 10 metres. The required effective Q value is quite low of the order of 2 or 3, so that tuning is quite flat, and in practice the system gives a smooth control of coupling. In the case of some commercial end links the addition of such a tuning control will enable higher inputs to be drawn. In some cases, where the link inductance is too low, an additional coil may be added externally in order that the total inductance may be increased to a value sufficient to enable the system to be comfortably tuned with a reasonable amount of tuning capacity. (Figs. 4 and 5.)

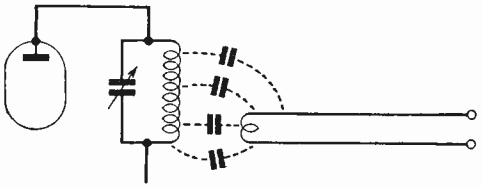


Fig. 9.—"Aerial currents" may circulate on the R.F. cable if it is not earthed or shielded from capacity stray couplings. The feedline may then act as an aerial for unwanted harmonic frequencies causing the radiation of T.V.I.-producing harmonic energy.

Higher Impedance

While the above relates to the case of a low-impedance coaxial line, similar methods may be employed when the line is of higher impedance. Thus 600 ohm line, or the more popular 300 ohm twin moulded feeder lines, may be link-coupled to a transmitter or aerial tuning network. In the case of these higher impedance lines, parallel tuning of the linked winding is more satisfactory. For covering all bands from 160 metres to 10 metres, a total tuning capacity of 500 pF will be found adequate. (Fig. 6.) On 10 metres, approximately, 50 pF will be needed for tuning a link winding. Owing to the relatively

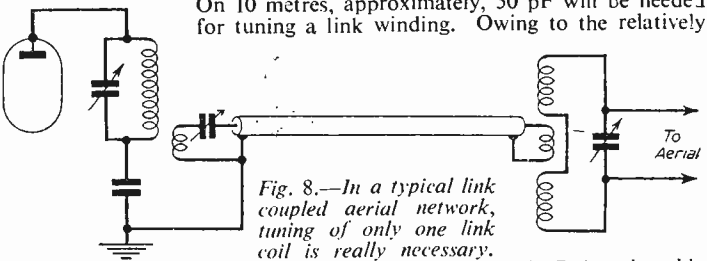


Fig. 8.—In a typical link coupled aerial network, tuning of only one link coil is really necessary. A link tuning condenser at the P.A. end enables aerial loading to be smoothly and simply controlled.

low effective Q, the initial adjustments and values will not be found unduly critical and, once determined, an elegant variable matching system may be operated through use of the link tuning control.

It should be noted that in the usual link system feeding, say, an aerial tuner from a link coil, and coaxial cable from the P.A. tank circuit, as in Fig. 8, it is only necessary to tune one of the link coils in normal practice. However, in some cases a *fixed* capacity may be used at one end for partial reactance cancellation when it is needed due to inadequate coupling, while the other link has variable tuning. The relatively flat tuning of such link circuits, however, does not make the provision of tuning at both ends of the link tedious, and many may prefer to have the convenience of a double adjustment. Generally, once the aerial tuner has been set, a good measure of control may be obtained at the P.A. tank coil end, so that while variable tuning at both ends may be fitted for convenience, only one tuning control need be used for readjustments when changing frequency.

A final warning is necessary. One very puzzling and annoying phenomena is the occasional occurrence of "aerial effects" when the length of the feed line is near a resonant length. Generally this may show up by unbalanced currents in a twin feeder, and by puzzling loading effects with only slight changes of operating frequency. Coaxial cable should, of course, be firmly earthed say at the P.A. end (Fig. 7). In the case of balanced feeder, the centre point of the link coil should be earthed. Faraday screens may also be employed, as they are also of value in reducing harmonic transfer as well. Altering the length of the feeder line in order to avoid an overall resonant length can also help. These "aerial effects" are generally due to stray capacity couplings (Fig. 9), which feed both sides of the line in the same phase, instead of in balance. The normal balanced currents, therefore, add on one side, and subtract on the other side, with the capacity coupled "aerial currents." This shows up as an unbalance of current on the two sides of the balanced feeder. The earthing of the link coil centre usually restores balance, in the case of twin feeder. The coaxial type of line is fundamentally unbalanced. However, the outer sheath should be at earth potential. Unless this is assured, "aerial currents" may circulate on the outside of the sheath.

The Phase-splitting Valve

AN EXPLANATION OF A POPULAR FORM OF PUSH-PULL FEEDER STAGE

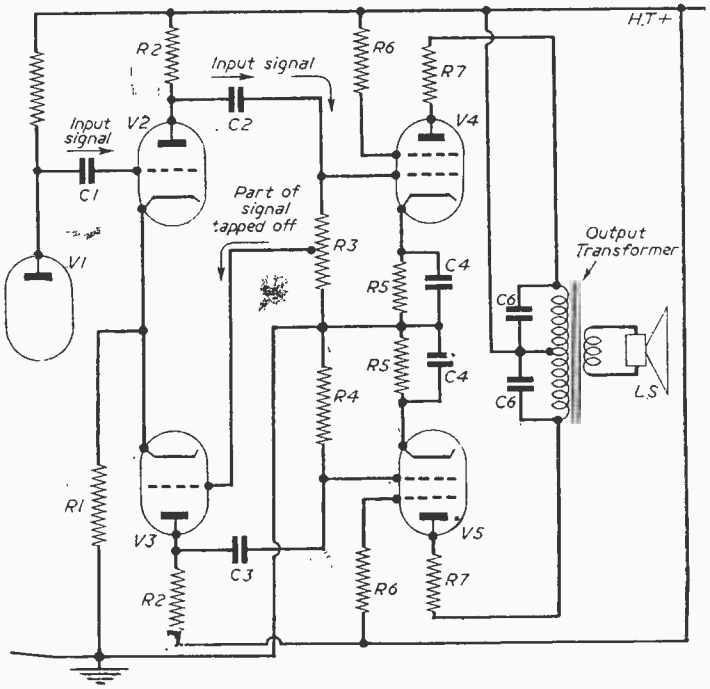
By E. G. BULLEY

THIS type of valve is necessary in receivers or amplifiers which utilise two valves in push-pull in the output stage, and where R.C. coupling is used instead of the usual A.F. transformer coupling. One must therefore appreciate that when R.C. coupling is used it is essential that the signal input to the valves in push-pull must be in the correct phase, bearing in mind that the valves connected in push-pull operate 180 deg. out of phase with each other. Failing to do this will result in the outputs cancelling each other out instead of combining to give the desired output.

To clarify this, it can be said that the output valves must be in opposite phase, and to satisfy this requirement a triode valve is used to produce the necessary signal, which is fed in opposite phase to the one already being passed on to one of the valves of the output stage. This will be appreciated if reference is made to the circuit above which is a basic amplifier circuit in which V1 and V2 are the first and second A.F. valves, V3 being the phase splitter, and V4 and V5 the output valves, connected in push-pull.

The phase-splitting valve must be identical to that used for the V2 position, and likewise circuit components are similar in ratings and value. Double triodes, which are two valves in one envelope, are to-day used for this purpose in commercially-produced amplifiers.

Nevertheless, for convenience, the circuit as shown in Fig. 1 will be described, but the description can readily be applied to a circuit using a double-triode valve instead of V2 and V3.



Basic amplifier circuit showing phase-splitting valve.

Operation

The input signal is transferred from the first stage via condenser C1 to the control grid of V2. This signal is then amplified and passed on to V4 through a conventional R.C. network. Now a portion of this signal is tapped off via a grid resistor R3 and fed to the control grid of the phase-splitting valve. This valve then, in turn, amplifies the signal and feeds it via condenser C3 to the control grid of the other output valve, namely V5. This signal, however, is in opposite phase to that fed to valve V4. It must be remembered that the tapped resistor, R3, must be adjusted so that both V2 and V3 give equal values of output to the valves in push-pull.

The connections for the output stage are conventional, the anodes being taken to the primary of the output transformer, and the H.T. is fed via the transformer centre tap. Coupling condensers C2 and C3 must be equal in value, and likewise the anode load resistors R2. Resistor R3, the tapped resistor, is usually two suitable resistors in series, whilst R6 and R7 are voltage-dropping resistors and are shown for convenience. Condensers C6 are tone control arrangements, and R5-C4 network provides the necessary bias for the tetrode output valves.

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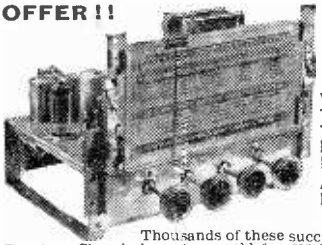

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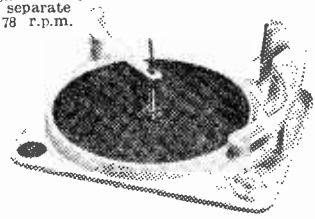

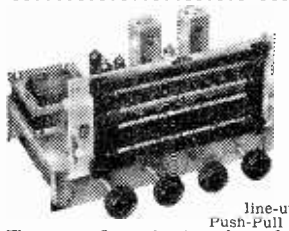

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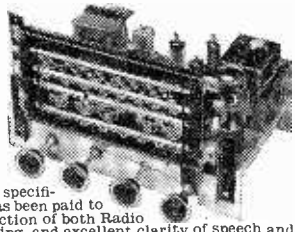
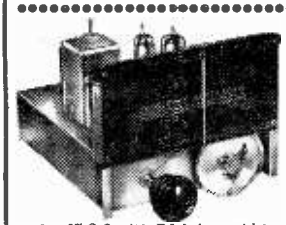


A compact and highly efficient superhet Radio-Radiogram chassis of outstanding quality for operation on A.C. mains. YOU CAN BUILD IT FOR **£10.7.6.** This receiver can be made to incorporate the new B.V.A. miniature valve line-up or the Octal valve line-up, and is designed to the very latest specification. Great attention has been paid to the quality of the reproduction of both Radio reception and Record playing, and excellent clarity of speech and music is obtained. ● Covers 3 wavebands. ● Employs 6 valves having PUSH-PULL for 5-6 watts output. ● A 4 position Tone Control operates on both Radio and Gram. THE INSTRUCTION & ASSEMBLY MANUAL is available for 2/-.



THE DENCO F.M. FEEDER UNIT INCORPORATING AN R.F. STAGE

A 5 VALVE SUPERHET DESIGN having a frequency coverage of 88 to 100 mc.s. This F.M. Receiver is designed to operate with any type of Amplifier and most Radio Receivers. It incorporates R.F.—F/Changer and two I.F. Stages followed by a Ratio Discriminator, the valve line-up being 6AM6—12AH8—two 6BA6's and 6AQ5. Overall size of assembled Chassis 7in. x 5¼in. x 4¼in. high excluding power supply, or 7in. x 8¼in. x 4¼in. high with power supply.

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(a) Assembled and Ready for use, excluding Dial Assembly **£8/17/6.**
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BRIEF FEATURES:

● Valve line-up 6J5, 6SN7, 5Z4, with 6V6s in push-pull. ● First-class reproduction of radio (where a tuning unit is used) and record playing. ● Separate Bass Boost and Treble controls provide an excellent range of frequency control.
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Comprising a Main Amplifier Chassis and a Remote Control Pre-Amplifier Tone Control Unit. The remote control unit measures only 7in. x 4in. x 2in. and contains four controls, being: Bass-Treble-Volume and a Radio, Gram. Microphone Switch control. It incorporates its own feed-back circuit on the Bass Channel. Loop negative feed-back is employed on the Main Amplifier which has a valve line up of 6J5-6N7-5U4 with two PX25s in push-pull and 6J5 and 6SN7 are used in the remote control unit. THE COMPLETE UNIT ASSEMBLED AND READY FOR USE **£17.0.0.** (Carr. and ins. 5/- extra.) H.P. Terms **£4.5.0** Dep., 12 Months at **£1.3.11.**
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News from the Trade

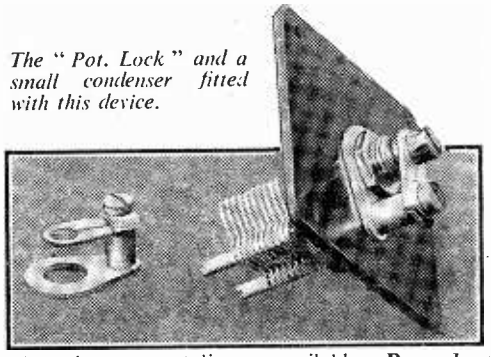
The " Pot. Lock "

AN interesting novel component is introduced by Jackson Brothers and is known as the " Pot. Lock." It is a simple and very effective spindle locking device, which is fitted by securing under the usual one-hole fixing nut of the potentiometer or any other similar fixing component. The clamp fits over the spindle, which is locked when the 4.BA screw is tightened. The lock (illustrated on the right) costs 2s. 3d.—Jackson Bros. (London), Ltd., Kingsway, Waddon, Surrey.

The B.-J. Arm

THE problem of tracking is not easily solved, and with modern long-playing discs and " permanent " needles the question becomes more involved if maximum quality and minimum wear of record and needle are to be achieved. Many attempts have been made to produce the desirable feature of accurate tracking, and although most modern units utilise a form of bent arm this does not produce " perfect " results—but compromises in a more or less satisfactory manner. A return to an idea introduced many years ago has been made by Messrs. Burne-Jones, and in place of the single arm two arms are used, with different lengths and points of suspension. As a result the remote ends, linked by the pick-up carrier, travel across the disc with a slight twisting movement, producing a true tangential setting at any given point on the disc. The diagram below shows the respective position at three points on a disc, and the accompanying graph shows the degree of correction compared with the more normal bent or offset arm. Added advantages of the B.-J. arm are the provision of weight blocks which may be attached to the rear mount so that any desired pick-up may be properly counter-balanced and the provision of a plug-in pick-up mount. The makers have further provided a special adaptor for the Acos GP.39 heads, but they supply two heads (for 78 and L.P. discs) of the crystal type. A plug-in shell for use with turnover cartridges is also provided. We have carried out a number of tests with the arm and the various pick-ups and can highly recommend them for those who are interested in really " hi-fi " results. The arm definitely does reduce tracking errors to the very minimum, and in addition appears to reduce " wow " caused by warped or badly centred discs. One or two of our special test records appeared to sound even better than with our hitherto standard equipment, and " rumble," which was previously audible on an organ test record, appeared non-existent, but the pedal notes were still present. Further, certain of the higher frequencies appeared richer, no doubt due to their position on the disc and the accuracy of the needle angle at those positions.

The arm is very well finished, is quite simple to mount from the detailed instructions given, and every serious " hi-fi " enthusiast should try to make this part of his installation. The price of the arm is 44s. 11d., plus P.T. The B.-J. crystal heads for micro-groove or standard discs are 32s. 6d. each, plus P.T., and replacement styli are available.—Burne-Jones & Co., Ltd., Magnum House, 309-317, Borough High Street, S.E.1.



The " Pot. Lock " and a small condenser fitted with this device.

New Ekco AM/FM Receivers

TWO new Ekco radio receivers designed to operate on both A.M. and V.H.F./F.M. transmissions are announced by E. K. Cole, Ltd.

Model A239 : This high-grade six-valve receiver for A.C. mains, in addition to the long-, medium- and short-wave bands, also covers the new V.H.F. band to provide reception of the F.M. transmissions.

Reception of either A.M. or F.M. transmissions is automatically effected by turning the wavechange switch to the appropriate position and the incorporation of an electronic tuning indicator simplifies tuning on all wave ranges.

List price, £27 14s. 8d. ; Purchase Tax, £9 0s. 4d. Total price, 35 gns.

Model U243 : For A.C./D.C. mains operation, this compact six-valve receiver provides an excellent performance in long and medium waves, as well as operating on the new V.H.F. band.

List price, £19 16s. 2d. ; Purchase Tax, £6 8s. 10d. Total price, 25 gns.—E. K. Cole, Ltd., Southend-on-Sea.

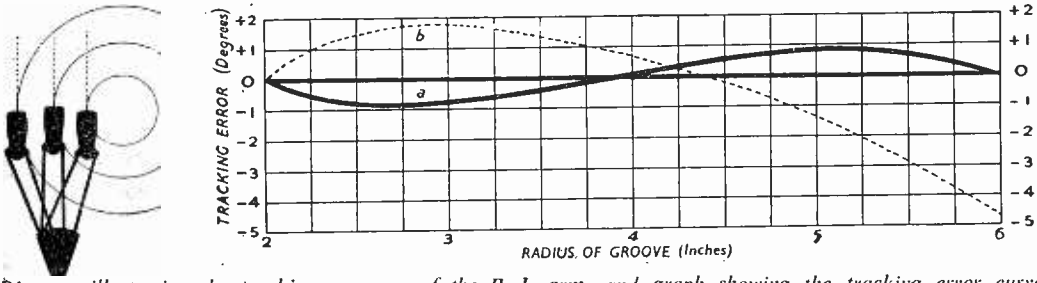


Diagram illustrating the tracking accuracy of the B.-J. arm, and graph showing the tracking error curve of (a) the B.-J. arm and (b) the conventional arm.

Programme Pointers

Our Critic, Maurice Reeve, Reviews Some Recent Programmes

The Disc Jockey

AMONG the many eccentrics of the present day bred and fostered by the BBC, high place must be accorded the "disc jockey." Whether his weight and proportions are as small as those of his brother astride a horse we can only guess. Nor do we know if he has "barged" his way to the head of the queue with less than gentlemanly patience and fortitude. All we do know for certain is that he is one of the most ubiquitous and umbrageous figures of modern times, the least gifted or original of anybody earning a fee for appearing in front of a microphone and, in exchange for other people's gifts, weaving a senseless and inane patter which loosely binds their efforts together. Occasionally, when presenting inconsequential records, he is moderately witty and slightly suggestive. But when offering those of a weightier nature, he is invariably portentous and insufferably repetitive and boring.

My dictionary defines a jockey as "a man who rides a horse in a race; a horse dealer; one who takes undue advantage in business—*v.t.* to jostle by riding against; to cheat." This seems fair enough. To it could be added, "an entertainer who amuses with one-tenth his own abilities and nine-tenths other people's."

An Actor's Playground

Two world masterpieces overlapped on the two programmes, Ibsen's "An Enemy of the People" and Beethoven's "Missa Solemnis." Ibsen's exposure of municipal corruption—Norway in the nineteenth century—followed by his plea for the superman, is both superb drama and superb entertainment. An actor's glorious playground where he can sport and tumble to his heart's, and the author's, content. Stephen Murray, Belle Chrystall, Margaret Barton, Howieson Culff, Richard Waring and others did so to good purpose.

Rudolf Schwarz and the BBC orchestra, with Joan Sutherland, Elsa Cavelti, Peter Pears and Richard Standen as the quartet of singers, gave a lovely performance of the Missa. It is impossible to say in a few words all one feels and thinks of a supreme masterpiece of music. Seemingly everything it is possible to pack into one work is contained in these wonderful pages by the greatest of all musicians.

The Sunday morning *Country Town* series is pleasantly evocative. I heard the programme on Ludlow. The historical picture is fascinating, and well presented, whilst the native worthies, gathered in the market square or caught whilst on their quiet Sunday walks, add salt and spice to the scene. Editor and Producer are Philip Bonnellan.

The trip across Dartmoor, however, suffered grievously from what has long been a besetting sin in the radio travelogue, namely the continuous, monotonous and vapid intrusions and raucous comments of a coachload of Cockneys. Why always Cockney Londoners? There are other types inhabiting the metropolis. Why always Londoners at all? A ceaseless torrent of "Shut up, Bert!" "You wait till I get you 'ome" or "Coo, Mum, what's that there?" etc., etc., pall on one long before the programme ends. A voice from Ilkley or "Berniger" would be a refreshing change if we must have tourist voices at all. This feature was called "The Lost Wilderness" and was written by John Moore. Produced, on the wrong lines, by Ian Curtis.

Plays

"Fool's Mate" was another of those Tudor or early Stuart plays which keep cropping up from time to time. Personally, I find them excellent entertainment and "history as she is taught" or ought to be taught. The "she" in the present example, by Lyndon Brook, was Frances, Countess of Essex, daughter of Thomas Howard, Duke of Suffolk, and of her affair with, King James the First's current favourite, Robert Carr, predecessor, in that unenviable and perilous distinction, of the Duke of Buckingham.

I thought James McKechnie as James the First did his best work in moons. Where did he get that authentic Scotch burr from? Always heard in impeccable English, we forgot that, remembering his name, it might only have been laid up in cold storage. It quite made us forget our unhappy memory of his recent attempt at being an American. All the others were good too: Adrienne Corri as Frances, John Neville as Carr, George Hagan as Suffolk, Robert Cartland as Overbury, and many others.

"Tomorrow's Prisoner," by the French writer Paul Quentin and admirably translated by John Holmstrom, was a powerful story set in a penal colony on an island belonging to an imaginary country. The story concerned the arrival of a strange woman attempting to obtain the release of her lover from the prison, and her battle of wits with the Governor and the Chief of Police made exciting and absorbing listening as played by Wendy Hiller, John Slater and Stephen Murray.

Three very attractive programmes in honour of St. George's Day were given of Shakespeare's songs. They were arranged in pairs made up of the original settings of Arne, Purcell, etc., together with modern versions. It was both instructive and illuminating to see how changed composers' views on the self-same lyric can become after the passing of a few generations. It has doubtless been partly conditioned by the enormous changes that have occurred in both musical writing and modern instrumental development.

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Open to Discussion

Modifying the R1132

SIR,—Having read from time to time many versions of how to modify the R1132 V.H.F. receiver I feel that my advice may help.

I removed the original coils and soldered on to the knobs that hold the ends of the coils brass caps from old car fuses. Holes drilled to take 16 s.w.g. tinned copper wire make excellent vertical sockets and with plug-in coils my set tunes from 126 Mc/s down to TV sound. Regarding the coils, I made up a set as per the originals but to plug in, and the set worked as before.

By adding one extra turn on each I was down to 75-100 Mc/s, etc

Anyone interested can write to me for the finer details which I would be glad to give.—C. L. TUCKER (Kenton).

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.

R1155

SIR,—In the June issue J. P. Marchant complained of distortion on his R1155.

I present a slight modification which may get rid of it and provide him with better response to well modulated signals, and also may impair the selectivity of his receiver.

The R1155 was designed for use as a communications receiver, with reception of C.W. its primary function. As such, the I.F.s are coupled very critically by cutting down inductive coupling and connecting between the two tuned circuits a 2 pF capacitor. This gives a very peaky response which, whilst excellent for reception of morse, is not so good over the band required for modulation, especially on the medium and long waves.

If the value of this capacitor (there are three of them —one in each I.F. can) be increased to about 10-20 pF, the response curve of the I.F.s is flattened and rounded. Selectivity will suffer, but the candle cannot be burned at both ends. However, a switch can be inserted instead of just replacing, and the set then has a selectivity control.

Addition of a crystal filter in the grid of the first I.F. is the answer to the selectivity problems, and this will be, of course, at 560 kc/s.—CPL. COLE (Aden).

Amplifier Design

SIR,—I am invited by Mr. Cornish in the June issue to comment on the correspondence regarding amplifier design. I must confess that I also was a little puzzled by the description of the "horse and pony" output and would have liked to see the circuitry that gave Mr. Kerslake such fidelity. It seems to me, however, that Mr. Kerslake's arguments are basically unsound. He has overlooked the fact that whilst the output valves in push-pull are effectively in series for the signal and the wanted signal is additive, they are in series but subtractive with regard to distortion produced by themselves. I doubt if Williamson would be happy about his name being used for an amplifier with cathode follower output and two unbalanced stages.

Actually the cathode follower output would have had a better chance of acceptance if the modern principle of feedback had not been developed, but it has its problems, not the least being the amount of drive required, and has now, it would seem, little place in the scheme of things. —R. HINDLE (Cheshire).

Our Query Service

SIR,—Thank you for your useful reply to my technical queries. It is most considerate of you to go to the trouble for a reader and a most welcome service by PRACTICAL WIRELESS to people such as myself.—R. MASON (Bilston).

An Economical Gram. Amplifier

SIR,—In the design of this amplifier Mr. Selwood has the high-frequency control circuit within the negative-feedback loop which, of course, is useless. If the H.F. gain of the first valve is shunted to earth via the small condenser across the anode load, there will be no H.F. signal passed through the amplifier to the output from whence the feedback path is taken. This means no feedback at high frequencies and therefore the gain of the amplifier will increase, *cancelling* the effect of the tone-control.

In S. A. Knight's description of the eight-valve superhet radiogram he states that to avoid having the constructor baffled by feedback loops he uses a monster directly heated triode. Surely, any constructor who can plough through the complexities of an S.H. circuit is not going to be beaten by a single resistor and wire for a feedback loop.—J. HARRISON, (R.A.F., Melksham).

Valve Replacements

SIR,—Is it not time that the valve manufacturers got together and decided upon some standardisation of types and valve bases? We have B8A, B9A, Octal and sundry others, and one is unable to try circuit changes without rebuilding a receiver. Surely H.F. valves could be standardised into say two or three types, with a common base, and so on through the normal receiver stages. What is wrong with the idea? It would simplify manufacturing processes and surely cheapen valves, and the amateur experimenter could more easily delve into his hobby if only two or three valve types were available.—G. B. MASTERS (Hinckley).

[*Before the war an attempt was made by one firm to produce a standard type of valve with common base but it did not prove popular and is no longer on the market.*—ED.]

Receiver and Amplifier Design

SIR,—I have been reading through some back numbers and am impressed by the more or less even standard in design which seems to hold in these days. There is nothing dramatic such as appeared in the earlier days of radio, and one gains the impression that the art is now static. Is this so? In television there are new ideas from time to time and this appears to be in the same position as radio in the '20s, but surely radio is not yet static! True we have recently been hearing a lot about F.M. but this is only for a few and, in any case, is quite old. I am a quality enthusiast and have been intrigued by various features and recently picked up some American magazines. They appear to have room still for improvements, although I understand from others that they are a long way behind us in quality of reproduction and speaker design. Why don't manufacturers bring out some new circuitry; for instance, why has the direct-coupled amplifier not been featured; where are the commercial receivers with U.L. output; where are the switchable A.M./F.M. receivers? I am sure there is still plenty of room for improvement and that radio is not "dead."—F. R. WINTON (Stanmore).

[*Switched A.M./F.M. receivers should be seen at this year's Radio Exhibition, and we think there will be at least one amplifier using the D.C. coupling. Unfortunately most of the things you suggest are for the enthusiast as distinct from the ordinary listener and in this issue we give some notes on an improved amplifier which may be of use to you. Other improvements will be given from time to time.*—ED.]

Short-wave Notes

SIR,—I wish to draw the attention of readers of the Short-wave Section, July issue, to the paragraph under "Aerial Systems" which, as it stands, may prove rather confusing.

This should read as follows: "52 directives, including 24 rhombic and 28 miscellaneous types, seven doublets and one long-wave aerial."—A. W. MANN.

Commercial Radio

SIR,—After 30 years of radio, when I was decidedly against the idea of sponsored broadcast, I am a convert to the idea. If the BBC are responsible for both television and radio and have to meet competition in the former only, where is the bulk of the licence money going to be spent? Unless we have commercial radio the only alternative is to have radio and television managed by separate corporations.

The Government say that part of the licence money is retained by the Post Office in order to bring broadcasting into line with other forms of entertainment. Isn't the retort to this "What other form of entertainment gives the Government so much free advertisement as radio?"—WILLIAM B. WEST (Deal).

Ex-Government Equipment

SIR,—There are many types of radio equipment, mostly in the surplus market, advertised in the columns of PRACTICAL WIRELESS which are described by numbers only, or a combination of letters and numbers. For example, "Type 1125," "Receivers Type 109," "R.F. Units Type 26," etc.

Would it be possible, please, to have a short article by one of your knowledgeable contributors, describing these items, with data as to their use, types of valves, frequencies covered, I.F.s and so on?

There must be many like myself who would appreciate such information as a guide as to whether certain types would make interesting purchases for experiment.—G. H. HOBSON (Wirral).

[*Is any reader in a position to let us have a comprehensive list on the lines suggested by this reader?*—ED.]

Test Equipment

SIR,—Reading through the constructional notes of a certain maker's superhet receiver for general lining up procedure I came across the following remarks:

". . . It will be appreciated that the alignment of a superhet receiver should really be carried out with a signal generator. We feel sure, however, that very few of our constructors will be fortunate enough to possess such an instrument. . . ."

This, no doubt, refers to the high price demanded of home constructors by manufacturers of signal generators. In view of the great number of constructors of home-made sets who probably cannot afford to pay the high prices demanded for such an instrument, surely a market exists for a reasonably priced mains-operated signal generator?

Not everyone wants to pay £6-£7 for such an instrument, and I am at a loss to understand why some enterprising manufacturer has not considered the case of the "unfortunates" referred to in the above quotation.—S. H. TAYLOR (Ramsgate).

Aerial No Eye-sore

SIR,—I was motoring through Kent recently when, for the first time ever, I had a close-up view of a BBC transmitting aerial. This was the V.H.F. mast at Wrotham, and I was most impressed by the structure.

I had always considered huge mechanical erections of this nature to be positive eye-sores, but this does not appear to be so in every case.—H. F. WAGSTAFF (New Cross).

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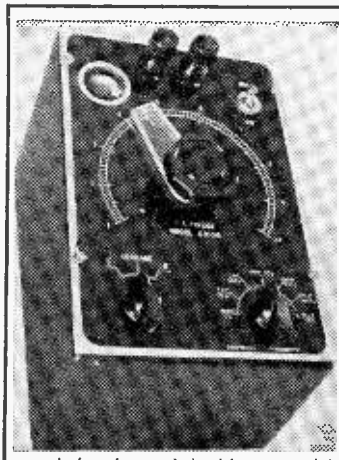

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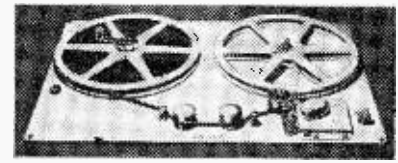

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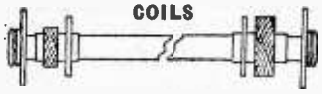

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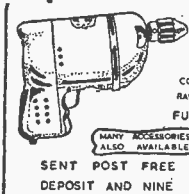

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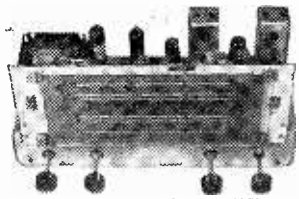

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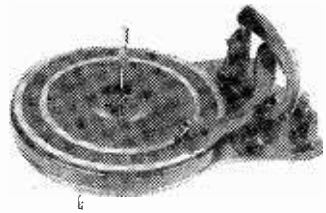

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PRACTICAL WIRELESS, Aug., 1955.

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