Practical Wireless, February 18th, 1933

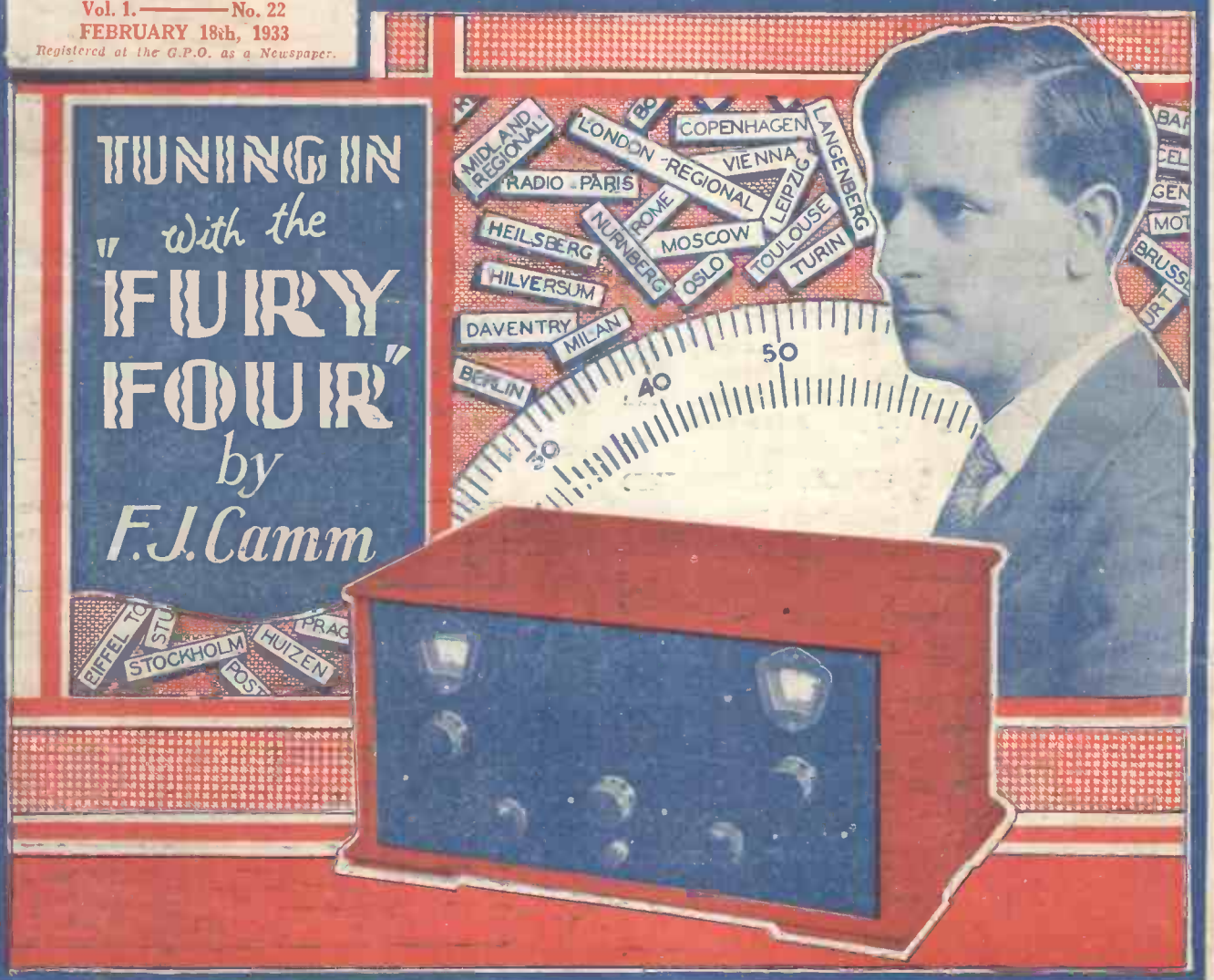
FREE DATA SHEET INSIDE!

Practical Wireless

3D.

Published every Wednesday by
GEORGE NEWNES LTD.
Vol. 1. —— No. 22
FEBRUARY 18th, 1933
Registered at the G.P.O. as a Newspaper.

TUNING IN with the "FURY FOUR" by F. J. Camm



Build your FURY FOUR with a PILOT AUTHOR KIT

. . . the only Kit that carries the Editor's personal guarantee

LISSEN "SKYSCRAPER 3." Chassis model with (Lissen) S.G., Detector and Pentode valves. Cash Price £4/9/6. Carriage Paid. Send **8/3** only

Balance in 11 monthly payments of 8/3.

LISSEN "SKYSCRAPER 3" KIT with Lissen Valves, Walnut Consolete Cabinet and special Balanced Armature Loud-speaker, Cash Price, £6/5/0. Carriage Paid. Balance in 11 monthly payments of 11/6. Send **11/6** only

TELSEN "ASTRALA 3." Chassis kit complete with full-size Blueprint, building and operating instructions. Detector, L.F. and Power. Cash or C.O.D., 39/6. Balance in 7 monthly payments of 5/6. Send **5/6** only

BLUE SPOT SPEAKER UNIT AND CHASSIS, TYPE 100U. Cash Price £1/12/6. Carriage Paid. Balance in 6 monthly payments of 5/2. Send **5/2** Only

BLUE SPOT UNIT AND CHASSIS, Type 99 P.M. Including matched transformer. Cash Price £2/19/6. Balance in 11 monthly payments of 5/6. Send **5/6** Only

EPOCH PERMANENT MAGNET MOVING-COIL SPEAKERS

Type "20C" (New Edition) with 3-Ratio Input Transformer. CASH or C.O.D. Carriage Paid. £1/15/0. Balance in 5 monthly payments of 6/6. Send **6/6** Only

Type "A.2." Complete with 5-ratio Input Transformer. CASH or C.O.D. Carriage Paid. £3/3/0. Balance in 11 monthly payments of 5/9. Send **5/9** Only

R & A "CHALLENGER" PERMANENT MAGNET MOVING-COIL SPEAKER. With special Ferranti multi-ratio input transformer. Cash Price, Carriage Paid, £1/15/0. Balance in 5 monthly payments of 6/6. Send **6/6** Only

ORMOND PERMANENT MAGNET MOVING-COIL SPEAKER R/475 with input transformer. Cash Price £1/18/6. Carriage Paid. Balance in 5 monthly payments of 7/-. Send **7/-** Only

ROLA PERMANENT MAGNET MOVING-COIL SPEAKER F.6. With universal tapped input transformer. Cash Price £2/9/6. Carriage Paid. Balance in 11 monthly payments of 4/6. Send **4/6** Only

ATLAS ELIMINATOR. Type A.C.244. Three tappings: S.G., Detector and Power. Output: 120 volts at 20 m/A. Cash Price £2/19/6. Carriage Paid. Balance in 11 monthly payments of 5/6. Send **5/6** Only

PETO-SCOTT 1933 WALNUT ADAPTAGRAM, with contrasting inlaid walnut veneers. Takes your radio and gramophone equipment. Cash Price £3/3/0. Carriage and packing, 2/6 extra. Balance in 11 monthly payments of 5/9. Send **8/3** Only

PETO-SCOTT 1933 ADAPTAGRAM RECORD-CHANGING MODEL. As item above but with Garrard Automatic Record Changer as advertised. Cash Price, Carriage Paid, £13/13/0. Deposit £3/13/0. Balance in 11 monthly payments of 20/-.

GARRARD AUTOMATIC RECORD CHANGER for A.C. mains. Mounted on unit plate complete ready for fitting in position, including Garrard pick-up and tone-arm. Cash Price £10/0/0. Carriage Paid. Balance in 11 monthly payments of 18/6. Send **18/6** Only

PETO-SCOTT SHORT-WAVE BOOK

48 pages profusely illustrated.

Contents include fully-illustrated constructional articles by G. T. Kelsey, the world-famous short-wave expert, for building four **different types of short-wave Receivers.** Full price details given, together with technical and wiring details for every set and **1/-**

FREE FULL SIZE BLUEPRINT of Short-Wave Adaptor.

Obtainable from all shops and branches Messrs. W. H. Smith and Sons, or direct.

FURY FOUR

EXACT TO SPECIFICATION

THESE ARE THE PARTS you must use to qualify FOR THE EDITOR'S PERSONAL GUARANTEE

	£	s.	d.
1 **LISSEN** three gang coil Unit L.N.5162 ..	1	6	0
1 **LISSEN** 2 megohm Grid Leak with wire ends		1	0
1 **LOTUS** two-gang .0005 condenser with disc drive Type P.C.2..		14	0
1 **LOTUS** .0005 condenser Type P.C.1 with disc drive		9	6
1 **TELSEN** .0003 differential reaction condenser W.185		2	6
1 **TELSEN** Pentode Output choke (Type W.72)		7	6
8 **ERIE** Resistances (1) 100,000, (2) 30,000, (1) 5,000, (4) 1,000 ohms., 1 Watt Type		8	0
1 **BULGIN** Fuse and Holder Type F5 ..		1	0
1 **BULGIN** S.G. choke, H.F.4		5	0
1 **WEARITE** three-point switch, GWC ..		1	3
1 **WEARITE** S.G. H.F. Choke, type HFPA..		4	0
1 **PETO-SCOTT** Standard screened HF choke		3	6
2 **DUBILIER** .1+.1 mfd. condensers type B.E.31L		6	0
3 **DUBILIER** 1 mfd. condensers type B.B..		7	6
2 **DUBILIER** .0003 mfd. condensers type 665		1	0
1 **DUBILIER** .0002 mfd. condenser type 665			6
1 **LEWCOS** 50,000 ohms Potentiometer ..		3	0
1 **SOVEREIGN** .0003 pre-set condenser ..		1	3
1 3 to 1 L.F. Transformer		8	6
3 **CLIX** Wander Plugs, (2) GB—, (1) GB+ .			4½
3 **CLIX** 4-pin Sub-Baseboard Valve Holders.		2	0
1 **CLIX** 5-pin Sub-Baseboard Valve Holder..			9
1 **BELLING LEE** four-way Battery Cord ..		1	9
3 **BELLING LEE** Terminal Mounts		1	6
6 **BELLING LEE** Type "B" Marked Terminals		3	0
1 **PETO-SCOTT** Red Triangle Ebonite Panel 16 x 8in. Ready drilled		5	6
1 **PETO-SCOTT** Plywood Baseboard, 10 x 10 x 3-8 and 2 side strips 10 x 2in. ..		2	0
Screws, Insulated Connecting Wire, Flex, etc.		2	6
KIT "A" CASH OR C.O.D. ..	£6	10	0

KIT "A" Author's Kit of specified parts, including *ready drilled panel*, but less valves and cabinet.

CASH OR C.O.D. *Carriage Paid.*

£6:10:0

or 12 monthly payments of 12/-

Specified Valves, £2/17/6. Peto-Scott Oak Cabinet, 15/-

KIT "B"

As Kit "A" but with valves, less cabinet, CASH or C.O.D. Carriage Paid.

£9 7 6

or 12 monthly payments of 17/3.

KIT "C"

As Kit "A" but with valves and Peto-Scott American Type Cabinet with lift-up lid. CASH or C.O.D. Carriage Paid.

£10 2 6

or 12 monthly payments of 18/6.

PILOT "FURY FOUR" STRUCTAKIT Cash or C.O.D. **10/-** Post Charge Paid.

CONTENTS.—1 Red Triangle Ebonite Panel Ready Drilled 16" x 8" x 3-16"; Plywood Baseboard (16" x 10") and 2 Side Supports (10" x 2") Screws, insulated connecting wire, rubber covered flex. IN SEALED CARTON.

IMPORTANT

Parts, Kits, Miscellaneous Components, Finished Receivers or Accessories for Cash, C.O.D. or H.P. on our own system of Easy Payments. Send us a list of your wants. We will quote you by return. C.O.D. orders value over 10s. sent carriage and post charges paid.

BUILD THIS REVOLUTIONARY Q.P.P. INTO YOUR PRESENT SET

THIS AUTHENTIC Q.P.P. PILOT CONVERSION KIT

Saves you 50% H.T. Energy, yet gives you mains volume and Quality. Supplied with full size working diagrams and copious constructional notes. Guardian Milliameter, if required, add 10/- extra to cash price, or add 1/5 to each monthly payment.

CONTAINS: Q.P.P. Input Transformer and Output Choke; 4 non-inductive Resistances; 2 Mansbridge Condensers; 2 Valve Holders; Potentiometer; G.B. Plugs; H.F. Chokes; on-off Switch; Tone Compensating Condenser; Wire, Screws and flex.

CASH OR C.O.D. CARRIAGE PAID.

42/6

OR 8 MONTHLY PAYMENTS OF 6/-.

Kit as above but with 2 Pentode valves, Cash or C.O.D., £3/17/6 or 12 monthly payments of 7/-. If Meter required, add 10/- to Cash Price or 11d. to each monthly payment.

OUR TECHNICAL DEPARTMENT IS ALWAYS AT YOUR SERVICE.

QUIESCENT PUSH-PULL ACCESSORIES CASH OR C.O.D. CARRIAGE PAID.

Of course, Peto-Scott are first again with full stocks of components for this latest development.

VARLEY	Cash or C.O.D. Carriage Paid
D.P. 36 Q.P.P. Input Transformer 9 : 1	17/6
D.P. 37 Q.P.P. Output Transchoke 3 : 1 and 42 : 1 ..	18/6
D.P. 38 Q.P.P. Output Transchoke 3 : 1 and 50 : 1 ..	16/6
D.P. 39 Q.P.P. Output Transchoke 3 : 1 and 75 : 1 ..	16/6

SOUND SALES Q.P.P.	
Intervalve Transformer : 9 : 1	15/-
Sound Sales Q.P.P. Output Choke 1 : 1; 2 : 1; 3 : 1 ..	10/6
R.I. "Q" Type Q.P.P. Multi-Ratio Choke D.Y. 33 ..	12/6
"Q" Type Q.P.P. Transformer D.Y. 34—8 : 1	16/6
Q.P.P. Guardian Milliameter 0-6 m/a	10/-

Above Q.P.P. Transformer prices include Royalty 1/6.

PETO-SCOTT CO. Ltd. 77, City Road, London, E.C.1

Telephone: Clerkenwell 9406/7.

West End Showrooms: 62, High Holborn, London, W.C.2. Telephone: Holborn 3248.

Dear Sirs, Please send me CASH/C.O.D./H.P. .....

for which I enclose £.....s.....d.....CASH/H.P. Deposit.

NAME .....

ADDRESS .....

..... Pr.W. 18/2/33.

Buy by Post—it's Quicker

ROUND *the* WORLD *of* WIRELESS

Long-distance Wireless from Aircraft

THE first of the "Atalanta" aircraft, which are to be used by Imperial Airways Limited for the Cairo-Cape Town air route, has arrived in Africa. The aircraft was flown from Croydon to Cairo under the charge of Major H. G. Brackley, and its equipment included a medium and short-wave wireless transmitting and receiving apparatus which, together with Marconi-Robinson wing coil direction finding apparatus, is installed in this type of machine. The operator reports that good telephone and telegraph communication was established on both wave-ranges. On the medium waveband, communication was maintained with Malta and with Cairo over ranges up to 600 miles for continuous wave telegraphy, and 400 miles for telephony, while on short waves the range for continuous wave telegraphy was more than 1,000 miles, and for telephony 450 miles.

Have You Heard Athlone?

THE new station at Athlone seems to promise great things. The few occasions on which I have heard this station it has come in at great strength, and it will undoubtedly provide a good alternative to some of the poorer foreign stations on the normal wave-band. By the way, do not be misled if you chance to pick up this station while the announcer is talking in Erse. Announcements are generally given in English in addition to the native tongue, and the strain of bagpipes has also been heard.

Radio-Paris

THE well-known French station at Radio-Paris, at present owned and operated by the Compagnie Francaise deRadiophonie, is shortly to be taken over by the French Postal authoritics, if rumours are to be believed. I wonder if this will have any effect on the sponsored programmes of the English commercial firms which are so popular on Sundays?

The Current Craze

HAVE you noticed how every season brings some new stunt to the wireless industry, with a tremendous raising of interest, and a final fading away to nothing. This season's craze is, of course, quiescent push-pull, and the various new components designed for this form of amplification. What will next season bring us I wonder? Experiments which are being carried out by several technical people may lead to the complete abolition of the tuning condenser as a method of station selection. If this becomes the thing, what will happen to all the variable condensers which are now in use or in stock in the shops? Perhaps someone can suggest a new use for these components before the crisis arises.

Bad P. A. Equipment

ON a recent visit to one of the big towns I called into a fun fair where various forms of amusement were taking place, and all the side shows were equipped with loud-speakers. The receiver feeding these was fitted with a glass cover and was standing out in the open for all to see. The maker's name was clearly printed across this and the pick-up was of very well-known make. The valves and other components which were not covered in were first-class, but the output from the various loud-speakers was nothing short of appalling. Surely it would not be difficult to arrange a few meters to show that overloading is taking place, and this would give a fillip to wireless instead of giving many people cause to say they will never use a loud-speaker if that is the noise they make. This comment has been heard on several occasions.

Listen to Ljubljana

WITH its increase in power to 7 kW this Jugoslavian broadcaster is altering its wavelength to 575.8 m. (521 kc/s). Every Wednesday between 5.0 and 5.30 p.m. G.M.T., the studio gives out announcements in the English language and devotes these thirty minutes to an English concert. The interval signal is a cuckoo call.

The Amsterdam "Broadcasting House"

A.V.R.O., the most important of the broadcasting associations in Holland, is erecting new headquarters and studios at Amsterdam. The programme organizers have acquired for the purpose an historical mansion which is being completely rebuilt. In order to duplicate the original plan of its frontage each brick was numbered as it was taken down to facilitate its being put back in its exact place! The A.V.R.O. boasts of 175,000 members, who subscribe towards the costs of the radio transmissions put out through either the Hilversum or Huizen stations according to the period of the year.

Madrid on Short Waves

ADVICE has been received that the broadcasts from EAQ, Aranjuez (Madrid) on 30.4 metres, are now taking place nightly from 10.30 p.m. until midnight. These, in most instances, are destined to South American States.

From Film to Microphone

AN incident which set all Europe laughing in 1906 and of which a film version was made under the title of *The Captain of Köpenick*, has been adapted for broadcast over the National and Regional wave-lengths on respectively February 21st and 22nd. For this production three stage celebrities will make their *début* in a radio play, namely, Lawrence Hanray, as the haro-cobbler, Wilfred Lawson and Marda Vanne.

An Edgar Allan Poe Thriller

THE Fall of the House of Usher, of which the broadcast was postponed some months ago, will be given in the National programme on March 9th and repeated "Regionally" on the following evening. It is a true thriller in Edgar Allan Poe's best style; the tone is indicated by his introductory note: *Nor was I indeed ignorant of the Flowers and the Vine, but the Hemlock and the Cypresses overshadowed me night and day—a gruesome thought!*

ROUND *the* WORLD *of* WIRELESS *(Continued)*

"Chu Chin Chow" on the Ether

MOST of you may recall the remarkable success of *Chu Chin Chow* at His Majesty's Theatre, where it ran from 1916 until the end of the Great War—a marvellous five-year record. The B.B.C. have decided to adapt it to the microphone, and two performances will be broadcast in April next. Oscar Asche, who wrote the book, will play his original part and will be supported by a cast of well-known artists.

French Radio Police

THE French Government has issued a decree in regard to a special police service which will include in its duties the control of all broadcasting stations in the country as well as the supervision of amateur transmitters. The headquarters of this organization are situated at the Paris Home Office, where a transmitting and receiving station has been installed. Sub-stations are to be erected in most of the provincial cities. During the last year experiments have been carried out with the Bélin system of picture transmission, with a view to the broadcast of finger-prints, descriptions and photographs of individuals wanted by the police authorities. The service is being extended to co-operate with the Criminal Investigation Departments of other countries.

Reorganization of Austrian Broadcasts

IT is fully expected that the Austrian Government will shortly take over the "Ravag" broadcasting system, and place it under the control of the Ministry of Education. At the same time, it is suggested that the two State-subsidized theatres at Vienna, namely, the *Opera House* and *Burgtheater*, may be brought into the network. In this manner it would be possible to divert part of the income derived from the listeners' tax in order to wipe out the deficit incurred in the past year's working. As an offset to this measure, the broadcasting station would benefit by the greater number of relays which could be carried out of operatic and other performances.

New Dutch Short-Wave Station

PHOHI is the call sign of a 40 kilowatt transmitter which has resumed operations at Eindhoven (Holland). It was closed down some eighteen months ago, after working a regular broadcasting service destined to the Dutch East Indies. The station now tests almost daily towards 8 a.m. G.M.T. on 16.88 m. (17,769 kc/s), but an endeavour is also being made to find a suitable wavelength in the 25-metre band; and tests have been carried out on 25.57 m. (11,730 kc/s). The call-letters stand for *Philips Omroep Holland-India*. Although the greater part of the transmitting time will be devoted to work of an experimental character, some hours weekly are reserved for the broadcast of programmes emanating from the V.A.R.A. and other associations already responsible for the Dutch wireless entertainments.

INTERESTING and TOPICAL PARAGRAPHS

The Land of Depressions

ATMOSPHERIC conditions are now proving favourable for the reception over the greater part of the British Isles of transmissions from Reykjavik, Iceland. The station works on 1,200 metres with a power of 16 kW (aerial). It can be well heard towards the later hours of the evening, when Radio Luxembourg has finished testing, namely, about 11.30 p.m. G.M.T. On Saturdays, dance music is broadcast until 12.30 or 1.0 a.m. Icelandic time being one hour *behind* G.M.T. In Northern districts of the United Kingdom broadcasts from Iceland can be picked up from 6.30 p.m. G.M.T.

B.B.C. ENGINEERS AT WORK

Engineers at work on the back of an amplifier at the Control Room, among an apparently impenetrable tangle of wires.

Train Telephony in Holland

STEPS are being taken by the Netherlands State Railways to install wireless telephony transmitting and receiving apparatus on a number of express trains for the convenience of travellers using these routes. In the meantime, and until passengers are able to telephone from special vans, public telephone cabins have been placed on the platforms of the main stations. By this means it is possible to ask for a call to be put through on the arrival of the train at the following stop, the call being timed accordingly.

New German 5 Kilowatter

THE Treves broadcasting station will formally be opened on February 19th; it will operate on 259.3 metres in common with Frankfurt-am-Main. Although a studio is attached to the transmitter, the bulk of the programmes will be taken from the mother station. When local programmes are broadcast, listeners will pick up the call: *Hier Trier* (phonetically: *Treer*). Special programmes, to which artists from that city are contributing, will be transmitted during the first week of the station's arrival on the air.

Norway's Forty-three Broadcasting Stations

THE Norwegian Houses of Parliament (Storthing) has passed the Bill by which the broadcasting stations in that country are acquired by the State, and the long-postponed reorganization of the system is to be carried out with as little delay as possible. It calls for a network of forty-three transmitters of powers varying from 150 watts to 40 kilowatts. The reconstruction will be carried out in three separate periods, starting with the installation of a 10-kilowatt transmitter at Bergen to replace the weaker station now in operation. The old plant will be transferred to Stavanger or Haugesund. The existing transmitters at Aalesund and Tromso are also to be rebuilt. During the second and third periods, new broadcasting plants are to be installed at Drontheim, Arendal, Farsund, Florö, Kristiansand, Narvik, Egersund, Maaloy, etc., etc. The entire network will be linked up with Oslo as central headquarters in order that S.B. programmes may be carried out from the capital.

Two More Giants for Europe

WORK on the 60-kilowatt Berlin station is being hurried forward; according to a report from Germany its official opening will coincide with the 1933 Berlin Radio Show. The 120-kilowatter now being erected on the Bisamberg Hill overlooking Vienna will probably be ready to take over its duties towards the end of June.

SOLVE THIS!

Problem No. 22.

The signals from Dobson's set had gradually become distorted and indistinct, and eventually speech was almost indistinguishable. Dobson tried various leads to see if anything had become detached, and as a final test decided to change the value of grid bias applied to the output valve. He removed the negative plug and signals immediately increased in strength and became quite clear, although not up to the standard of the set when first installed. The bias plugs were in the correct sockets, and had never been moved. What was the cause of the distortion and reduced signal strength? Three books will be awarded for the first three correct solutions opened. Mark envelopes Problem No. 22, and send to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8–11, Southampton Street, London, W.C.2, to reach us not later than February 20th.

SOLUTION TO PROBLEM No. 21.

Johnson had each time inserted the mains plug into the mains socket the wrong way round. If the plug had been turned round, he would have received signals.

The following three readers received books in connection with Problem No. 20:—

W. H. Knight, 9, Fintill Avenue, Mitcham; N. W. Farmer, 2, Thorpebank Road, Shepherd's Bush, W.12; E. Beazley, 2, Ducie Street, Clapham, S.W.4.

WHAT IS WRONG?—1

A Series of Articles by FRANK PRESTON, F.R.A., in which it is Explained how Receiver Faults can Easily be Located by Applying Systematic Tests

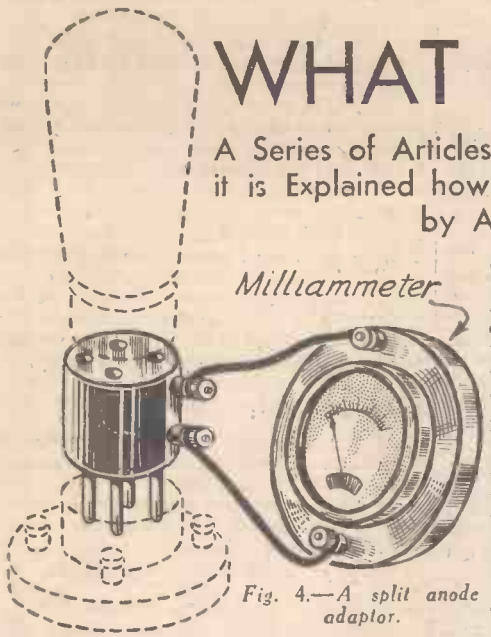


Fig. 4.—A split anode adaptor.

THE process of locating faults in a wireless set has been reduced to a fine art and there are in this country to-day scores of service engineers who have been trained to do nothing else. But this does not mean that the amateur set builder need fight shy of the job of "trouble-shooting" (as Americans call it), because it should not be beyond his scope to tackle any fault which might arise in respect to a set he has made himself and which he should therefore know almost "inside out." If the work is undertaken in a systematic manner, and a logical and progressive procedure adopted, there is absolutely no reason why it should not be attended by perfectly satisfactory results.

Although a large number of tests can be applied without any apparatus at all, there are a few simple instruments which should be considered as almost indispensable to any serious efforts at fault finding. For this reason we will first of all give our attention to the question of necessary apparatus, bearing in mind throughout the financial limitations of the average amateur.

A Milliammeter

A good milliammeter is the most useful instrument that any wireless enthusiast could possess and if there is any reader whose "den" is without one I can strongly advise him to make a sound investment. If you can afford it, buy a moving coil instrument with a full-scale reading of 5 or 10 milliamps (Fig. 1). This will cost something like thirty shillings, but you will never regret its purchase, and the cost will be repayed many times. Should you feel indisposed, or unable, to pay quite so much, a good moving-iron milliammeter can be obtained for as little as seven and sixpence, and although this will not be quite so accurate, it will nevertheless prove of extreme value in making tests and adjustments.

The Voltmeter

A reliable voltmeter is not an absolute essential but is, at the same time, very useful indeed. But please do not be tempted to buy a "cheap" voltmeter, because it will always be a source of trouble and might do far more harm than good. The meter should be a high-resistance one, having a resistance of not less than 100 ohms per volt; it will then pass a current of not more than 10 milliamperes, which cannot be considered excessive in consideration of the purposes for which it will be used. Many of the cheap meters are of low resistance and consume so high a current that they give an entirely false reading of high tension voltages and so mislead the user into receiving an erroneous impression of the conditions existing in the set. It is preferable to choose a two-range meter giving a full-scale deflection on, say, 100 volts and 10 volts.

Combined Test Meters

If you have not yet bought a meter of any kind it will be best to get one of the multi-range type, which can be used to measure two voltage ranges and also current in milliamperes; this will be both cheaper and more convenient than two separate meters. A reliable instrument of the latter type is the compact all-in-one meter illustrated at Fig. 2. This is a good high-resistance meter. I cannot, in fairness to you, advise the purchase of a cheaper instrument because I know that it will not be satisfactory for the tests I shall describe in later articles. On the other hand, you can, if you wish, effect an appreciable saving by making your own test meter, as described in last week's issue of PRACTICAL WIRELESS. This latter instrument is highly satisfactory and will give very accurate readings as a high-class milliammeter is used. Another home-made test instrument is illustrated in Fig. 3.

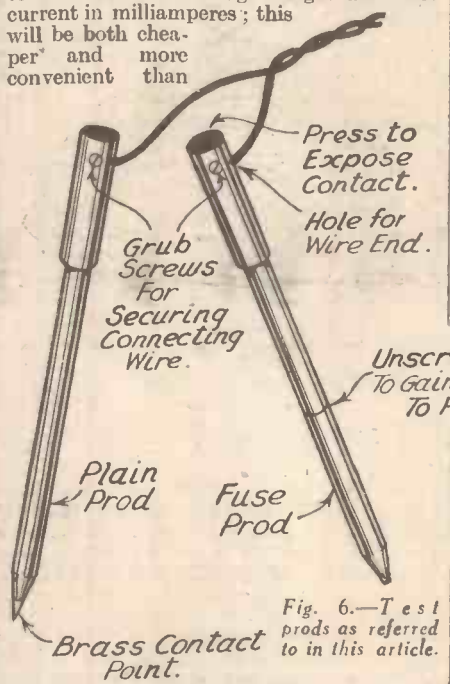


Fig. 6.—Test prods as referred to in this article.

Useful Testing Accessories

In addition to measuring instruments there are a few more accessories which are particularly helpful when tracking faults. One of these is called a "Split Anode Adaptor," and is shown in Fig. 4. The adaptor takes the form of a combined valve base and valve socket; it replaces the valve in its holder and the valve is then plugged into the adaptor. The connection between the anode pin and corresponding socket is broken, whilst each side of the break is connected to a small terminal, and thus by connecting a milliammeter to the two terminals the steady anode current passed by the valve can quickly be determined. These adaptors are made by Messrs. Bulgin and are obtainable in 4-pin and 5-pin types suitable for use with either battery or A.C. valves.

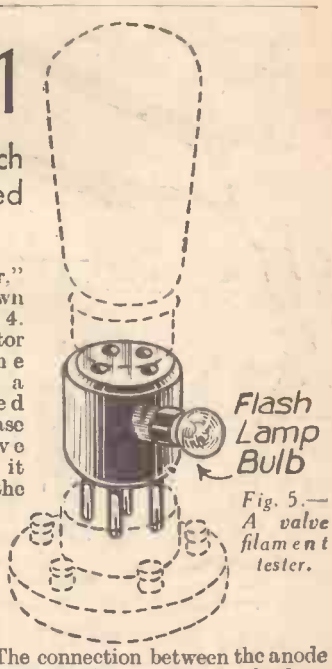


Fig. 5.—A valve filament tester.

Another useful accessory, which is not quite so necessary, but which is an excellent time-saver, is the Bulgin "Filament Tester" also shown in Fig. 5. This is similar to the adaptor just referred to, but the filament circuit is broken instead of the anode. The two sides of the break are joined to the terminals of a flash-lamp bulb-holder, which is built into the tester. Thus, when a bulb is inserted, it will glow when the filament circuit is intact, so indicating that the valve filament is unbroken and that the low tension leads are continuous.

Insulated Test Prods

It is generally necessary to apply various tests to the receiver components with the

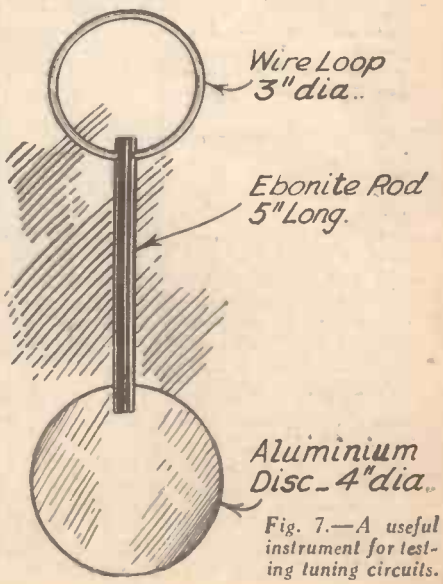


Fig. 7.—A useful instrument for testing tuning circuits.

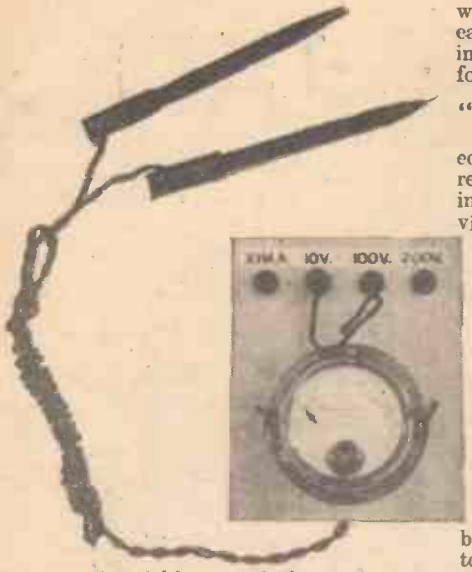


Fig. 3.—A useful home-made four-range meter.

power supply connected, and in doing this there is always a danger of getting a nasty shock or of short-circuiting different points and so ruining the high tension battery or even burning out the valve filaments by putting the H.T. across them. These dangers can be guarded against by taking great care to use properly insulated wires for connecting up the testing instruments and by making quite sure that there are no stray ends of flex which can make unwanted contact. A much better way, however, is to employ a pair of insulated test prods like those shown in Fig. 6. One of these consists of a plain bakelite tube with a pointed brass rod passing through it. Contact with the brass rod is made by attaching a wire to the top of the component by means of a small grub screw. The second test prod is fitted with a fuse so that in case of a wrong connection the latter will "blow" before any damage can be done. Besides the fuse, another safety device is incorporated in the test prod, for the contact point is normally entirely encased by the outer bakelite tube, and before it can be exposed the top of the prod must be pressed down against the action of a spring; this prevents the user from accidentally touching a wrong terminal. These useful test prods are made by Messrs. Bulgin and one or two other firms; they cost about four shillings a pair, inclusive of fuse.

An Accessory for Testing Tuning Circuits

There are no more instruments which require to be bought, but a very useful article for testing tuning circuits, etc., is illustrated in the sketch of Fig. 7. This consists of a 6in. length of ebonite rod to one end of which is attached a circular loop of 16 gauge bare wire and to the other, an aluminium disc. The device can easily be made at home by following the approximate dimensions given on the diagram. Its use will be dealt with at a later stage.

Useful Spares

Before commencing the tests it is very helpful to have one or two fixed condensers, grid leaks, and resistances handy for use as replacements in cases of doubt in regard to similar components, whilst a 100,000 ohm variable resistance or potentiometer will often prove useful. A pair of reliable ear-phones can also be of great assistance in many cases, and they will be specified for making certain tests.

"Localise" the Fault

Having collected the simple testing equipment dealt with above, you will be ready to tackle the job of tracing faults in almost any type of receiver, and provided the work is followed through in a logical sequence there should be no great difficulty in setting things right. Do not dismantle anything for the time being, but try to estimate in which part of the set the fault lies by studying its effect. Also make full use of the information conveyed by the manner in which the fault developed. For instance, suppose that signals had been coming through quite normally when the volume gradually fell off; you would first look to the accumulator and if it had been in use for some time you would naturally suppose that it has run down. If the accumulator had recently been charged you would suspect the high tension battery or possibly a valve.

But if a complete cessation of signals suddenly took place you would draw the conclusion that a wire had come adrift or that a contact between a plug and socket

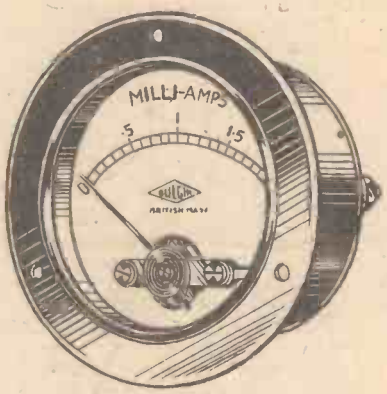


Fig. 1.—A commercial milliammeter.

had been broken. You would first look to the battery switch and, by rotating the knob, make sure that the broken contact was not there; if crackling sounds were heard as the switch knob was turned round you would know that the spring contacts were either dirty or strained. Next you could try the effect of slightly moving the valves in their holders; if this caused signals to return you would be practically certain that the valve-pins required to be opened out or cleaned with fine emery. If the fault had not been traced so far you would apply similar tests to plug-in coils and loud-speaker jack, if used, and also to the H.T. battery wander plugs and aerial-earth switch. A final test would be made by tapping the receiver cabinet with the knuckles to detect the presence of a loose wire. When the fault evidenced itself by a continuous or periodic crackling sound the tests just mentioned would also prove helpful, and additional ones would take the form of twisting battery, aerial, earth, and loud-speaker leads about in the fingers. An increase or reduction of noise when holding any part of a wire would indicate a fracture.

If the set were to develop signs of instability, uncontrollable oscillation or susceptibility to hand capacity, the earth lead would come under suspicion. Its effectiveness would be judged by firmly grasping the earth terminal with the moistened fingers; if this caused any change whatever the earth lead would immediately be condemned. Should the earth appear to be satisfactory, the high tension battery would be tested, but if it showed no signs of inefficiency more thorough tests would be necessary. When the set had previously been working in a normal manner and yet signals were weak or inaudible on again switching-on it would be feasible to assume that the contacts of the aerial-earth switch were dirty or that the connection of the aerial to the lead-in tube was bad, or possibly that the aerial down lead had actually broken away.

Preliminary Tests

All the tests just mentioned are merely preliminaries to the main task of locating faults, and are mentioned just to indicate a few likely sources of the very minor troubles which are encountered in the everyday routine. But they should not be ignored because, more often than not, the faults which arise are due entirely to small matters that are too often taken for granted. Next week I shall go more deeply into the questions of fault finding by explaining how more involved and less obvious forms of trouble can be tracked to their source.

Fading on Medium and Long Waves

HAVE you noticed how the Midland Regional and the Scottish National stations have been fading lately? I am finding neither of these stations worth listening to, excepting at mid-day, and the fading that occurs at very frequent intervals is of the "quick" variety, and is accompanied by terrible distortion. Even a large set I was using that has automatic volume control, was unable to deal with the distortion on several evenings, and I am giving these stations a rest for a while. It used to be an accepted thing that fading could only happen on the short and medium wavelengths, but I should be interested to hear if any of you can report fading on the long-waves. I mention this because I found that Radio-Paris started a patch of slow fading soon after Christmas, and while it could not reasonably be termed chronic, it was sufficient to make me turn to the knobs in an attempt to rectify it. Needless to say nothing could be done, and the signal soon came up to strength again.—P.

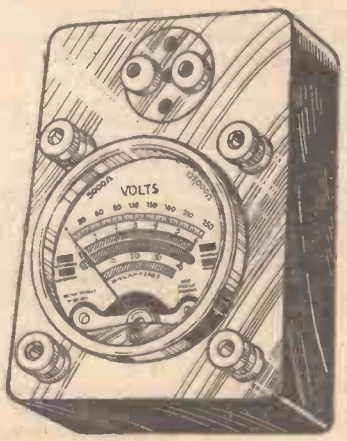


Fig. 2.—A commercial multi-range test-meter.

TWELVE YEARS of RADIO PROGRESS (1921—1933)

BY OUR TECHNICAL STAFF

A Chat About the Developments Which Have Taken Place in—the Design of Receivers Since the Early Days of Broadcasting

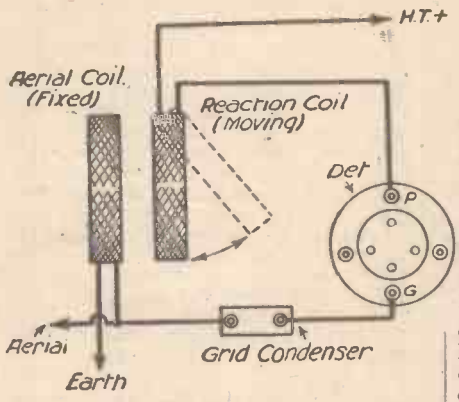


Fig. 9.—Connections for a swinging coil reaction circuit.

Continued from page 988, February 11th issue.

Early Valve Sets

It is impossible to deal with every notable development in chronological order, and we must now go back about two years to the beginning of 1923. By this time the British Broadcasting Company had come into being and had established its main high-powered stations at London, Manchester, Newcastle and Birmingham, which were all giving regular programmes every evening. One or two firms were manufacturing valve receivers, generally in the 2- and 3-valve class with headphones, but most of the sets in use were probably of amateur construction. As we (both readers and writers) who are connected with PRACTICAL WIRELESS are most interested in the amateur movement, let us see what an amateur-built receiver of this time was like. Most of us made our sets on the "unit" system and they looked something like that illustrated in the sketch of Fig. 3. The tuner, comprising tuning coils and variable condensers—not to mention a few switches here and there—formed the first unit and was made in a separate container. After this we generally made a detector unit which could be used with the tuner as a single-valve receiver. When the detector was eventually persuaded to operate in the desired manner, and if funds permitted, we added a high-frequency amplifier in the form of a second unit fitting between the tuner and detector. The next stage was to add a low-frequency amplifier in the hope that we should be able to work a loud-speaker. In time, if we were sufficiently "flush," other H.F. and L.F. units would be added until the complete outfit became a five or six-valve receiver.

The unit system of construction was ideal in many ways, for it made possible the gradual building-up of a large receiver and enabled the experimenter to make adjustments to any particular part with the minimum of trouble. In addition, it had the advantage that various circuit arrangements could quickly be made and compared.

Before passing on to a later "era" it will be interesting to consider the components and circuits in vogue at this time. Plug-in coils of the basket or honeycomb type were almost invariably used, for they were found to be most efficient on account of the fact that they had no dead-ends and any wavelength could be obtained by the simple process of changing over from one set of coils to another. As wavelengths up to 3,000 metres were still used fairly extensively it can be seen that a goodly number of coils was always necessary, and an amateur's status was frequently judged by his stock of coils. Then, as now, the highest degree of coil efficiency was attained when self-capacity was reduced to a minimum; for this reason various patterns of "honeycomb weave" were tried, as were different forms of construction for basket coils. In general, however, the plug-in coils were very similar to many of those still in use. It was usual to employ a three-coil holder like that shown in Fig. 3 and with the coils mounted in the positions indicated. The middle coil holder was fixed, but the other two were movable by means of ebonite knobs mounted on spindles, so that the degree of coupling between individual coils could be varied. Thus, reaction could be applied either to the aerial or tuned anode coil, or both, at will. This gave what was at that time excellent selectivity, because the application of reaction, sharpened the tuning of both circuits. In addition to enhancing selectivity, however, the very fact that signal currents could be passed back to the aerial circuit and so amplified again both by the H.F. and detector valves ensured that a maximum degree of amplification was obtained with the minimum number of valves. It is interesting to note that the same idea has recently been used by one or two set-designers, who write in the

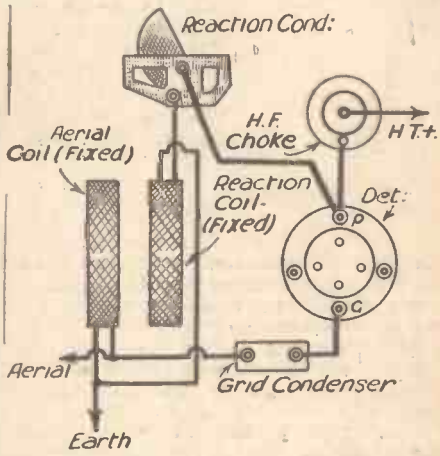


Fig. 10.—Connections for Reinartz or capacity-controlled reaction.

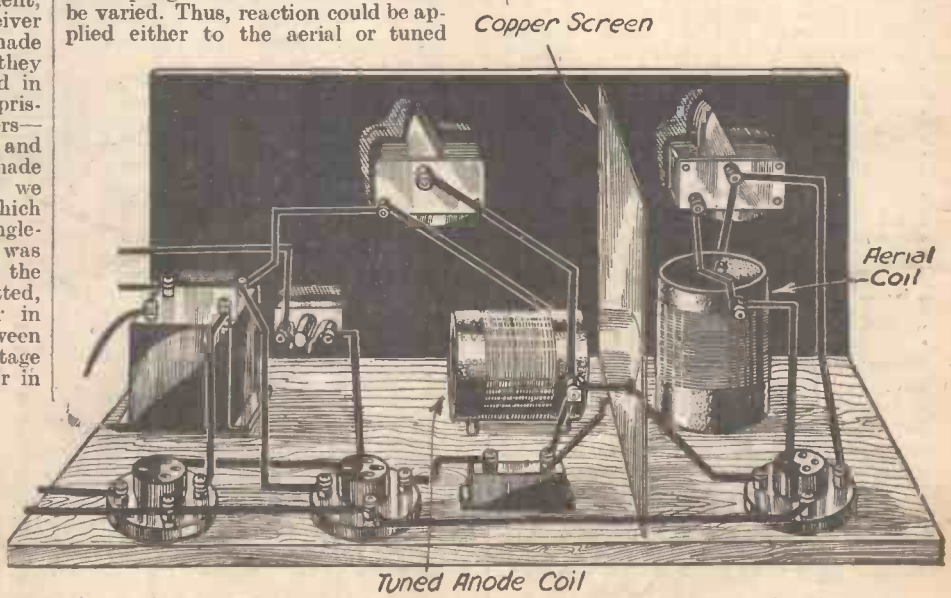


Fig. 11.—The kind of screening first used between large tuning coils of the solenoid type.

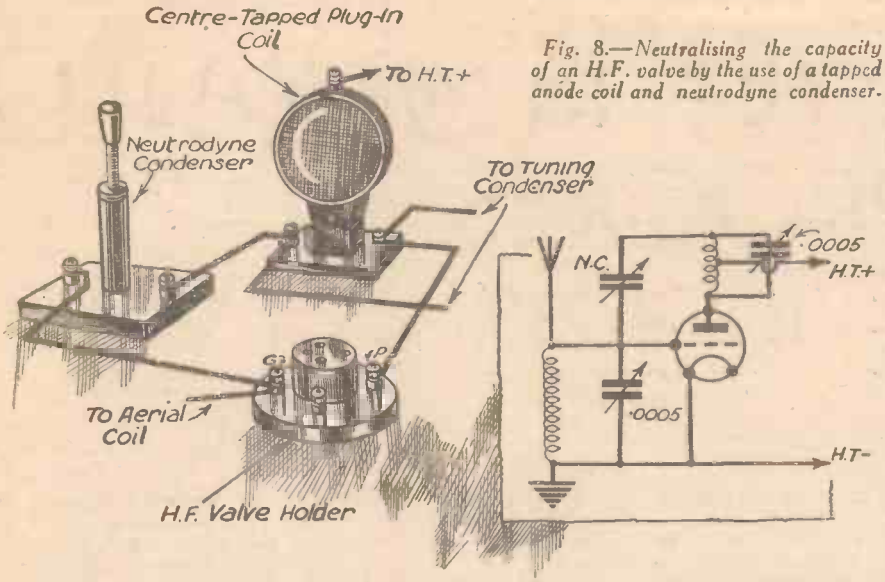


Fig. 8.—Neutralising the capacity of an H.F. valve by the use of a tapped anode coil and neutrodyne condenser.

wireless Press (not in PRACTICAL WIRELESS), and described as something quite new.

Tuning condensers used at the time we are considering were invariably of the semicircular-plate or straight-line-capacity type; the one tuning the aerial circuit had a nominal capacity of .001 mfd., and that used in the tuned anode circuit was of about .0005 mfd. or .0003 mfd. Peculiarly enough the .001 mfd. condenser did not cover any greater wavelength range than does the customary .0005 mfd. component of the present day, because it had a high minimum capacity and, in consequence, a comparatively low maximum to minimum ratio. There was another reason for the comparatively narrow waveband covered by the large capacity condenser; this was that the aerial was connected directly to one end of the aerial tuning coil and since the former was invariably long, it had a fairly high capacity, which was, of course, added to the minimum capacity of the condenser. The great effect of the aerial capacity will be realized when it is borne in mind that the .0005 mfd. (or smaller) condenser used for the tuned anode coil (to which no aerial was connected, of course) covered the same range of wavelengths as did the .001 mfd. aerial condenser.

Another fault of the straight-line-capacity type of condenser in use at this time was that it had the effect of "crowding" together the wavelengths covered by the lower half of the dial and "spreading out" the wavelengths covered by the higher dial readings. Both this fault and that of high minimum capacity were later overcome by the introduction of condensers of the straight-line-frequency pattern with which the increase in capacity is proportionately less over the lower portion of the dial and becomes more rapid as the dial approaches its highest reading.

So much for the tuner, and now what about the rest of the receiver? The general circuit did not differ greatly from that of a present-day set; an ordinary three-electrode valve was used for high-frequency amplification, and, for that matter, for every other purpose as well; a tuned anode coil connected the H.F. to the detector valve; "swinging-coil" reaction was the only kind known; grid-leak rectification was employed; the L.F. valve was fed through an L.F. transformer not unlike the ones we use to-day; de-coupling was unknown, and, due to the low degree of amplification per stage, was unnecessary.

Valves

The valves were all "bright emitters" taking a filament current of from ¾ to 1 ampere at 4 or 6 volts. For the benefit of those who have taken up wireless during fairly recent years, it might be explained that a bright emitter valve earned that name because its filament lit up like that of an electric lamp. It was due to the fact that the filament had to be brought to incandescence that its current consumption was so great. The life of these valves was comparatively short, and since they cost about a guinea each, they had to be treated with care. It was known that sudden switching on of the low-tension current would tend to damage the filament, because, when cold, it would pass more than its rated current. Partly to obviate this, and partly for other reasons, each valve had a variable resistance (or rheostat) wired in its filament lead so that the current could be turned on gradually, and the filament heated from dull red to whiteness by degrees. The rheostats also served as volume controls, whilst that operating on the detector valve could be used to provide a vernier regulation of reaction. In all cases the idea was followed that the filament should be run at the lowest temperature consistent with satisfactory operation, so that its life should be as long as possible.

There was practically only one type of valve in use and it was known as an "R" valve; this was of the "general-purpose" variety, serving for H.F., detector and L.F., but shortly afterwards special valves were introduced for L.F. amplification, and these were the forerunners of our present-day small power valves. In addition, there was a special valve, known as the "V.24," intended specially for high-frequency amplification. For this reason it was not fitted with a 4-pin base like the others, but connections from the electrodes were brought out to four metal caps attached to the bulb so that capacity could be reduced to a minimum. A sketch of a valve of this type is given in Fig. 4. Due to its higher price, and also to improvements effected in valves of the more usual type, the special high-frequency valve was not used very extensively after about 1923.

High- and Low-tension Supply

Even in 1922 and early 1923, high-tension batteries similar to those we have to-day were made, but as they were not in great demand their cost was extremely high. Batteries had to be used for valve sets, of course, and most amateurs built up their own from 4½ volt flash-lamp batteries; these were connected in series either by soldering together the positive and negative tags of adjacent batteries, or by the use of small spring clips which were made by several manufacturers. Besides effecting an economy in initial battery cost, this system had the advantage that any individual battery which became exhausted could be replaced at very little expense, instead of discarding the whole batch. The great popularity of flash-lamp batteries for high-tension supply can be judged from the fact that a number of firms put on to the market special containers for holding a dozen or more batteries and having sockets in the lid to which a tapping could be taken at any voltage, in multiples of 4½, from zero to the total voltage of the battery. These containers generally had spring connectors affixed to the underside of the lid which automatically joined the small batteries in series when the lid was fastened down in its place.

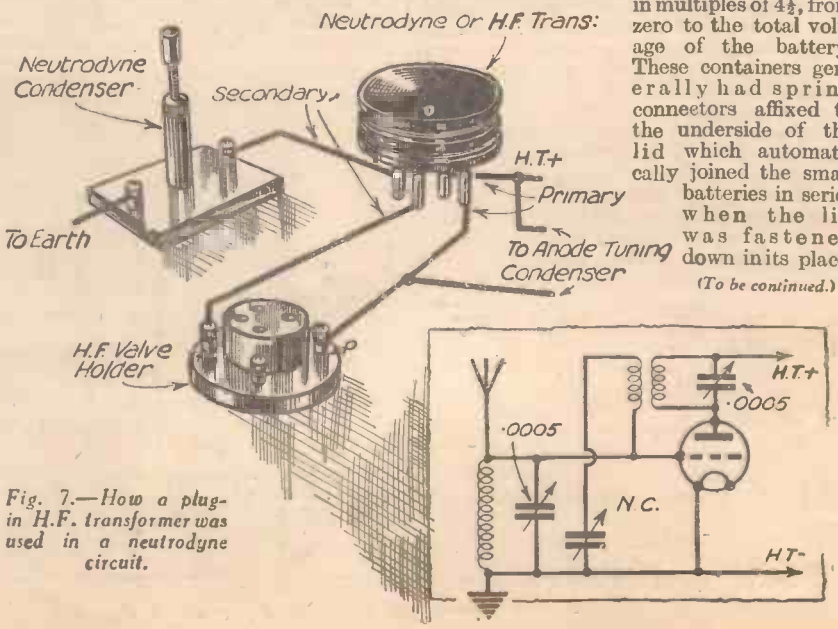


Fig. 7.—How a plug-in H.F. transformer was used in a neutrodyne circuit.

(To be continued.)

FURTHER PRACTICAL INFORMATION on

QUIESCENT PUSH-PULL

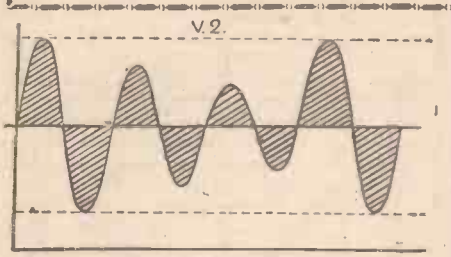


Fig. 6.—One half of an output signal in a push-pull stage.

A Continuation of the Article on page 973 of Last Week's Issue Dealing with the New Battery Economy Scheme.

By

H. J. BARTON CHAPPLE,

Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

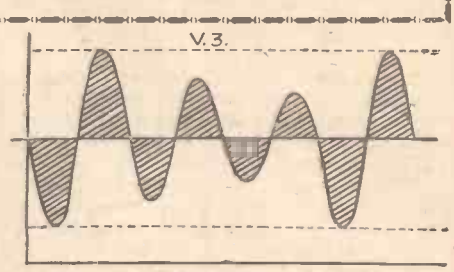


Fig. 7.—The other half of the signal shown in Fig. 6.

A SLIGHTLY different state of affairs occurs in Quiescent Push-Pull. As we have seen, instead of the two anode currents being complete cycles, out of phase, current only flows in each valve during alternate half-cycles as was indicated in Fig. 4, where the graph at the top right represents the anode current of, say, V_2, and the bottom right graph the anode current of V_3. When these anode currents are applied to the primary of the output transformer T_2, there will be a current flowing in the half-winding CD of Fig. 5 during one half-cycle and no current in the half-winding DE. During the second half-cycle current will be flowing in the half-winding DE and in the opposite direction, while no current will flow in the half-winding CD. We shall see later that this has a considerable effect on the design of the output transformer or choke.

A Practical Circuit

A very practical circuit for Quiescent Push-Pull is given in Fig. 8, and is suitable for use with the special Quiescent Push-Pull components which have appeared already on the market. Here again, V_1 is the detector valve and V_2 and V_3 the two output valves. In this diagram these valves are shown as pentodes and may be of the small low-consumption type or the standard pentode. The diagram is really quite simple to follow and the layout itself calls for little or no comment. Something must be said, however, about certain of the components and about the operating conditions of the output valves.

In the first place, it will be obvious that as the full grid base of each valve is employed to handle only one-half of each signal wave, in order to fully load the valves the amplitude of the grid signal voltage or grid swing must be about twice that which could be safely applied to a single valve if normally biased. Either the previous stages of the receiver must, therefore, be capable of providing this large grid swing or, alternatively, an intervalve transformer of high ratio must be used.

Another way of looking at the same thing is to regard the high ratio as necessary in order to prevent the detector or penultimate valve overloading before the quiescent valves are overloaded. Furthermore, this high ratio must be obtained while still retaining adequate primary impedance for the best quality of reproduction. In this connection, one can cite for example the new Varley Quiescent Push-Pull input transformer which has a step-up ratio of 9 to 1 with a primary inductance varying from 30 henries to 22 henries, as the current flowing through that winding increases from zero to 4 milliamperes.

On the Output Side

Next for consideration comes the output coupling which may be either a transformer with a centre-tapped primary or a centre-tapped choke, or a combination of the two. A choke is shown in the circuit reproduced in Fig. 8 and has alternative tappings for load-matching purposes. Two very important points must be mentioned in connection with this component. In the first place, as only one half of the winding is in use at any moment, the inductance of the whole choke must be high—in fact each half should have an inductance at least equal to the inductance of a choke for use in a normal single output stage.

Then it is essential that the winding of the choke or of the primary of the transformer should have a low resistance. The reason is that in Quiescent Push-Pull the variations in anode current are much greater than in the normal circuit, ranging from a high maximum to practically zero. If, therefore, the choke or transformer had a fairly high resistance the voltage drop due to the resistance would be small on weak signals or soft passages, and abnormally high during loud passages. The "light and shade" of the music would be to a great extent lost and this would tend to produce a monotonous level of volume, besides which there would probably be considerable distortion during loud passages.

Here again let me, for example, quote from the new Varley range, where there are three types of Quiescent Output Transchokes available, that is, a combination of transformer and choke in the one component. These components are output chokes as far as the high impedance is concerned, and a transformer with regard to the low-impedance output. Therefore, when the high-impedance terminals are used these should be connected to the output through a 2 mfd. condenser in series with each terminal. This feature of using a combination of transformer and choke in the output circuit enables a high standard of performance to be obtained without making the components unduly large. Furthermore, it is valuable in that it allows *either* a high or a low impedance loud-speaker to be used with the one Transchoke, thus avoiding the losses entailed by the additional matching transformer on the loud-speaker, as well as its expense.

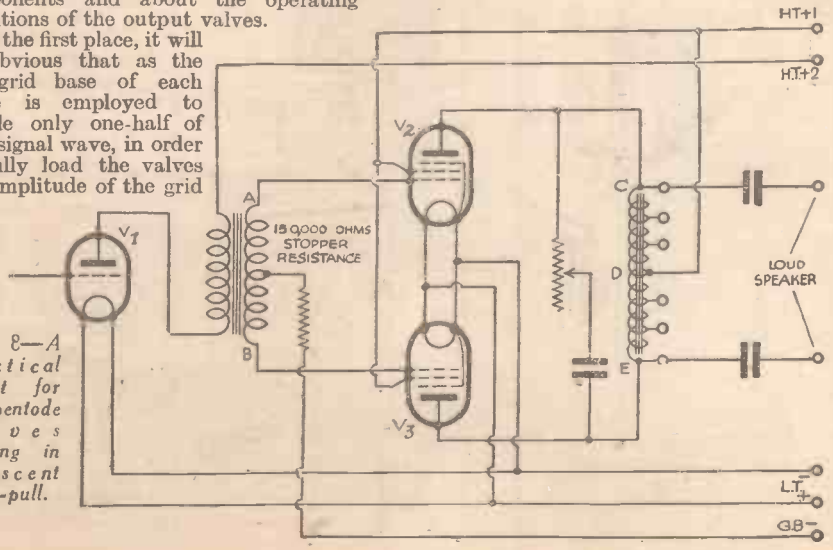


Fig. 8—A practical circuit for two pentode valves working in quiescent push-pull.

Precautions

Most listeners know the danger of disconnecting the loud-speaker from a pentode valve while the valve is in operation, the result of which is the generation of peak voltages high enough, in many cases, to destroy the valve and to damage the transformer or choke. This danger is still more serious in Quiescent Push-Pull and in the circuit shown the usual protective scheme is included. This takes the form of a high resistance in series with a fixed condenser shunted across the output circuit. The object of this arrangement is, of course, to limit the rise in impedance of the output circuit in the event of the

loud-speaker being disconnected accidentally and thus to restrict the extent to which the high peak voltages will be generated. For ordinary pentode valves the value of the protective resistance may be from 20,000 to 25,000 ohms, and for low-consumption pentode valves from 40,000 to 50,000 ohms. The condenser, which should be of the mica dielectric, may be of about .01 mfd.

In the diagram the protective resistance is shown as a variable unit and this is a useful modification as it can then be used as a tone control. By varying the value of the resistance the high notes of the pentode valve can be toned down somewhat when desired to give a better effective bass response. One other point must receive consideration, namely the value of the grid bias to be applied to the output valves. The general rule for Quiescent Push-Pull is to use the largest amount of bias which will give undistorted reproduction. In practice this will be approximately twice the normal bias recommended by the valve maker for ordinary working. It is important also that the usual grid-stopping resistance in series with each grid in ordinary push-pull be substituted by a single anti-oscillation resistance of 150,000 ohms in the common grid lead as shown in Fig. 8. A balancing of the anode current should be achieved by adjusting the voltage applied to the individual auxiliary grids of the pentode valves.

Before finally concluding this article, perhaps the following details will be of interest to the reader. They have been supplied by the Mazda Laboratories, and give valuable information which has been obtained as the result of much research.

It should be mentioned that, owing to the large increase of impedance with frequency of the moving-iron type of speakers, these instruments cannot satisfactorily be used with pentodes in Quiescent Push-Pull.

The pentodes are given a common bias, and the quiescent currents are balanced by suitably adjusting the screen voltages. In setting up the circuit the recommended bias should be applied and the screen voltages adjusted so that the feed current of each valve is at the minimum value, and in order to provide the necessary fineness of gradation in screen volts it is desirable to use an H.T. battery which is tapped at 3-volt intervals.

The average consumption of the Mazda Pen. 220 and Pen. 220A valves, when used in this manner, is given in the following table.

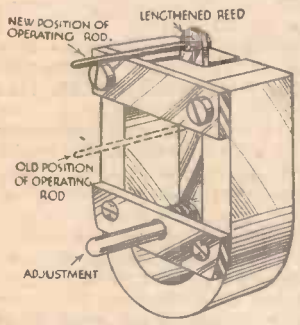
Operating Conditions of Mazda Type Pen. 220 and Pen. 220A Valves in Quiescent Push-Pull.

	Pen. 220	Pen. 220A
H.T. voltage	120	120
Bias voltage (recommended)	—6.8	—14.5
Max. undistorted power output (milliwatts)	600	1,300
Plate-to-plate load (ohms)	40,000	18,000
Grid swing per valve (R.M.S.)	4.85	10.6
Quiescent anode current (mA.) (two valves)	2.5	3.5 to 4.0
Average anode current when operating (two valves)	3.0 to 4.5	5.0 to 6.0

It is not generally realized by listeners that some output transformers are very inefficient, and although there is ample power available with two Mazda Pen. 220A valves for operating a moving-coil speaker, disappointing results will be obtained if the output transformer is of low efficiency, especially when the H.T. battery has run down in voltage. As a rough guide, the primary resistance of a transformer primary, measured from plate to plate, should be not more than 500 ohms when Mazda Pen. 220A valves are employed, and 800 ohms when the Pen. 220 valves are used. Amplion (1932) Ltd. are producing a Moving-coil Loud-speaker, fitted with an output transformer specifically designed for Quiescent Push-Pull.

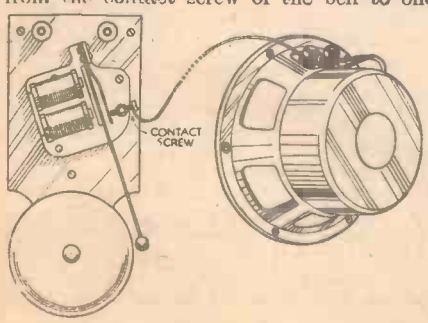
An Improvement to a Balanced-armature Unit

THE accompanying sketch shows an improvement I have recently made to a balanced-armature movement for a cone speaker. By replacing the armature with one ¼in. longer I was able to put the reed below, instead of above, the bobbin and pole pieces. This gave me twice the distance from the pivot and correspondingly greater movement of cone, resulting in a vast improvement in bass response and general tone. In fact it is as near moving-coil tone that I have heard. No dimensions are given as these will vary with different units.—A. SHAW (Leeds).



A Loud-speaker as a Bell Indicator

ELECTRIC bells and light switches sometimes affect the loud-speaker, giving a faint popping sound for bells and a clicking with switches. My wireless set is in the sitting-room, and when a loud programme is on and no one is in the kitchen, we cannot hear the bell, and the popping in the speaker is very weak. This may be made louder by connecting a wire from the contact screw of the bell to one of the speaker terminals, as shown in the accompanying sketch. This gives quite a loud clicking sound in the speaker that can be heard above the programme.—J. R. HOPKINS (Wallasey).



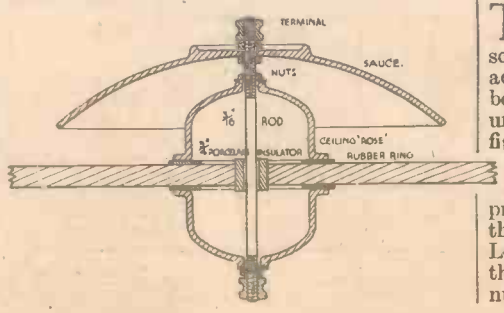
PRACTICAL PARS.

"Artificial" Aerial

THERE is not generally any very great difficulty in obtaining a licence to conduct experiments on an "artificial" aerial, and the annual fee for such a licence is only ten shillings. Perhaps the meaning of "artificial" as applied to an aerial should be explained. An artificial aerial is not an aerial in the generally accepted sense, since it cannot be employed for sending signals over distances of more than a few feet. It has all the electrical characteristics of an outside aerial, such as inductance, capacity and resistance, and enables the user to carry out the greater part of his preliminary experiments. The artificial aerial consists merely of a fixed resistance, coil and condenser joined in series between the aerial and earth terminals.

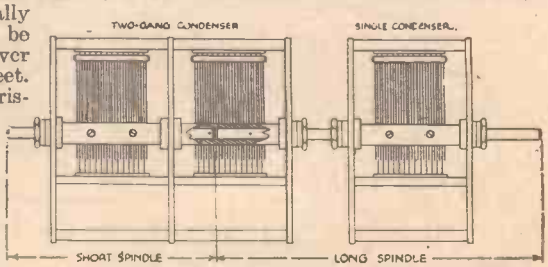
An Efficient Lead-in Tube

A GOOD lead-in tube can be made from two covers from electric light ceiling roses, in the manner shown in the sketch. A length of 3/16in. brass rod and nuts; two terminals; two discs of rubber; a saucer; and a porcelain insulator. These parts are assembled as shown in the drawing. I use this type of lead-in for transmitting work and it will stand a very high voltage test.—R. G. (Swansea).



A Triple-gang Condenser Mounting

THE accompanying sketch illustrates a dodge which enabled me to avoid scrapping a two-gang condenser when it was necessary to use a three-gang. The spindle of the two-gang condenser was partly withdrawn and on the projecting end a single condenser was mounted. The short spindle from the single condenser was inserted in the other end of the spindle bush of the two-gang condenser, shown in the illustration. One end of the short spindle is gripped by one of the grub screws of the middle condenser. The resultant assembly is quite rigid, and has remained so for some time.—F. J. HAYWARD (New Malden).



Primary Cells for L.T.

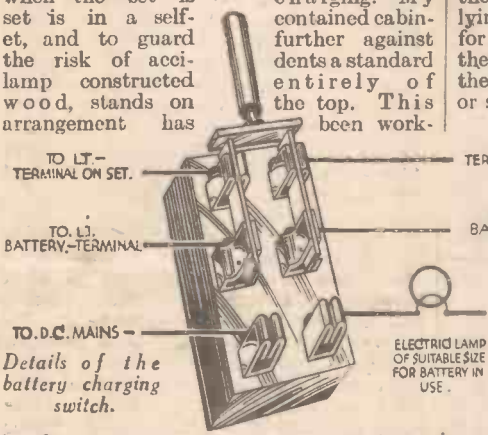
THE difficulty of obtaining L.T. in the Colonies is great, because it is scarcely a practical proposition to send an accumulator a hundred or more miles to be charged. But I can see no other way, unless the user has a car or other machine fitted with a dynamo. It seems that the best form of L.T. unit for use in the Outposts of Empire would be some kind of primary cell which could be charged by the process of replacing the electrolyte. Leclanché cells are not suitable because they polarize too quickly, but there are numerous satisfactory modifications.

THE HALF-GUINEA PAGE

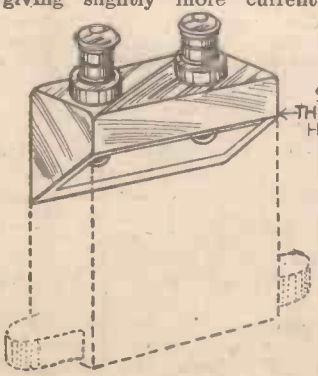
Radio Wrinkles FROM READERS

Battery Charging Switch

THE accompanying sketch shows a convenient and efficient method of keeping an L.T. battery charged in situ—at the same time cutting down the cost of upkeep, as it permits the battery to be charged while the set is not in use, and when the current is being used for illumination. When charging, the battery is entirely isolated from the set, and when the set is working, it is, in turn, isolated from the charging arrangement. This is controlled by the D.P.D.T. switch, and by fixing separate flexible leads for the charging arrangement, and for the D.C. eliminator—if such is in use. In the original scheme, the D.P.D.T. switch is fixed to the back of the cabinet, inside, the twin flex being passed through a hole in the back. This prevents accidents when the set is charging. My set is in a self-contained cabinet, and to guard further against the risk of accidents a standard lamp constructed entirely of wood, stands on the top. This arrangement has been working for over a year now, and except for an occasional glance to see if topping-up is required, or to wipe over the top with a bit of rag, the battery needs no attention. By standing the lamp on the top of the cabinet, it is easy to distinguish the different leads and by using the type of plug in which the flex enters the side instead of the top, it is easy to remember which way—back or front—the flex should be for the plug to be in the socket the right way round. It will, of course, be necessary to ascertain which is the positive lead from the mains, before completing the wiring, also to procure a carbon filament lamp capable of giving slightly more current than the normal output from the battery when the set is working. I find the metal filament lamp is unsatisfactory, in India, at any rate.—R. H. AUSTIN (Poona, India).



Details of the battery charging switch.



By cutting the top off a fixed condenser as shown it will make a useful terminal block.

THAT DODGE OF YOURS!

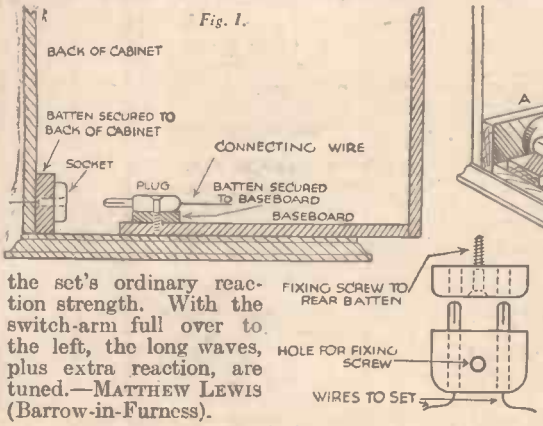
Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? For every item published on this page we will pay half a guinea. The latest batch is published below. Turn that idea of yours to account by sending it in to us, addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*. Mark envelopes "Radio Wrinkles."

Improvised Terminal Blocks

MANY readers, no doubt, have a broken down fixed condenser (of the Mansbridge type in bakelite casing) lying in their junk box. Here is an idea for making useful terminal blocks from them. First remove contents by melting the sealing compound in front of the fire, or stove (taking care to hold it over an old cardboard box or sheet of paper) and lever out the condenser element with a screwdriver. Then saw off the top end obliquely, as shown in sketch. Two screw-holes drilled in the broadest portion completes the job.—C. T. NOBBS (Mitcham).

Improving Reaction

SEVERAL types of modern tuning coils fail to give sufficient reaction on long waves, although an abundance on the medium band. To remedy this, the method shown in the accompanying sketch will be found useful. A single-pole double-throw switch provides for the necessary wave-change. When the switch arm is over to the right, medium waves are tuned, and when the arm is out of contact, *i.e.*, halfway between each side contact, the long waves are tuned in on the set's ordinary reaction strength. With the switch-arm full over to the left, the long waves, plus extra reaction, are tuned.—MATTHEW LEWIS (Barrow-in-Furness).



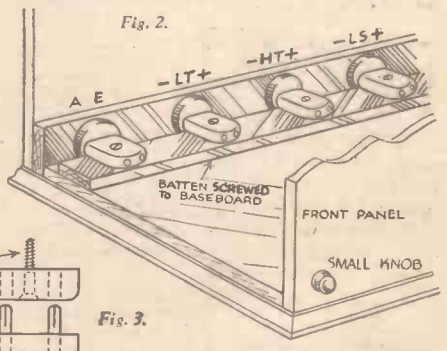
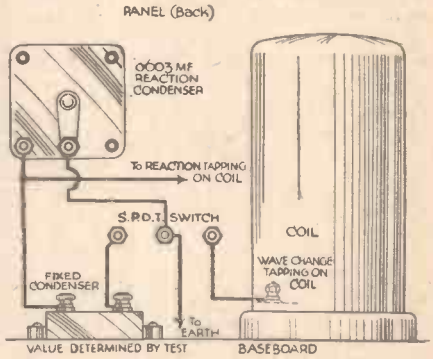


Fig. 3.

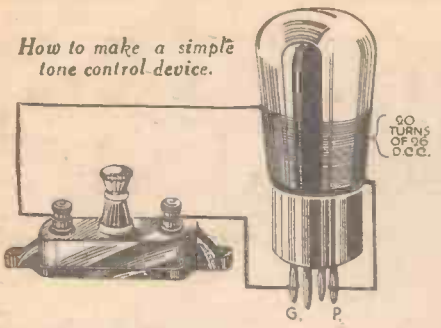
Showing how plug and socket connectors can be used for eliminating terminals.

Plug and Socket Baseboard Connectors

BEFORE the panel and baseboard of a radio set can be withdrawn from its cabinet all the wires on the terminals at the rear, connecting batteries, loud-speaker, etc., have to be disconnected, and if the set is being taken in and out several times, owing to a fault or alteration of the wiring, the job of connecting up and disconnecting becomes irksome. To overcome this a number of sockets (ordinary plugs and sockets used for loud-speaker extension, etc.) are fixed to a wood batten about 1½in. wide by ¼in. thick (Fig. 1). The plugs are drilled on the flat side, in the centre between the pins, to take a small screw, and these are fastened on the flat on another batten on the rear of the baseboard. This batten should be similar to the first but sufficiently thick to bring all the plugs in line so that when the panel is pushed home the connections to A. E., batteries, pick-up, and loud speaker are automatically made, and broken when the set is withdrawn. Fig. 2 shows all in position, the sockets having taken the place of the terminals these are wired to the set in the usual way. Fig. 3 shows an enlarged view of plug and socket. To facilitate the withdrawing of the baseboard, two small knobs are provided, one on each side at the bottom of the front panel. When once wired up it is impossible to make a wrong battery connection, and there is a great saving of time.—C. M. CURWEN (Liverpool).



Adding reaction on the long waves to modern tuning coils.



How to make a simple tone control device.

A Simple Tone-control Device

THIS simple tone-control device can be made as follows:—Take a length of 26 D.C.C. wire and wind twenty turns around the bulb of the detector valve. Connect one end of the wire to the plate or anode and the other to one terminal of a pre-set condenser. Connect the other terminal of the condenser to the grid leg of the valve, as shown in the accompanying sketch. Used in the detector stage, every move of the condenser alters the quality of reproduction and also the manner in which foreign or distant stations are received. As it requires careful handling, it is advisable to use a long, thin screwdriver for moving the condenser knob. It can also be tried in the first L.F. stage, varying the tone. If using a metallised det. valve in this experiment it is advisable to wrap the bulb with some insulated paper, or similar material, because if the covering of the wire happens to have become frayed or stripped it is likely to cause a short circuit.—WM. MARSLAND, Jnr. (Stockport).

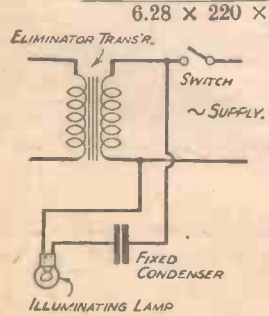
Supply Lamps for Illuminated Drives

THERE are no doubt many people who use A.C. mains to supply high-tension current to their sets, and who have, or would like to have, illuminated dials. If the transformer of the eliminator has no filament winding, or if it is desired not to overload that winding, the following suggestion may be adopted to save taking a supply from the accumulator. By connecting a suitable size fixed condenser with the lamp in series, across the supply side of the eliminator transformer as shown in the diagram, the lamp, which can be an ordinary flashlamp bulb, will light up as soon as the eliminator is switched on. In finding the correct size of condenser, the current taken by the bulb should first be found and then the size of the condenser in microfarads will be given thus:—

$$\frac{1{,}000{,}000 \times \text{Current of bulb}}{6.28 \times \text{Voltage of Supply} \times \text{Frequency of Supply}}$$

Thus in the case of a bulb taking .3 amp., if the supply is 220 volts at 50 ∞ the size of the condenser required will be:—

$$\frac{1{,}000{,}000 \times .3}{6.28 \times 220 \times 50} = 4.3 \text{ mfd.}$$



Lamps for illuminated drives.

which means that a 4 mfd. condenser will be quite suitable.

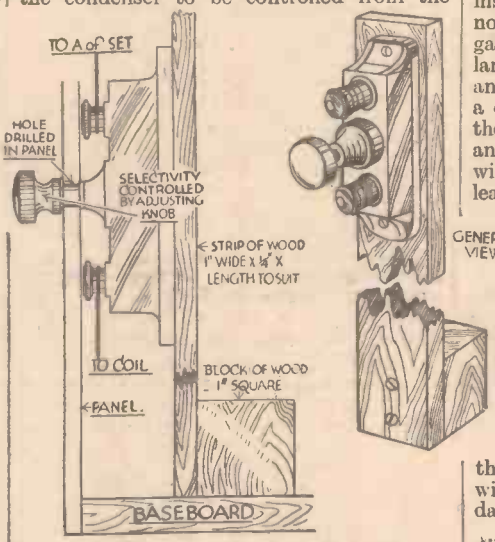
The voltage of the lamp used is not taken into account as it will adjust itself, thus any ordinary type of flashlamp bulb may be used.

Points to be noted in connection with this are:—

1. If possible connect the condenser to the live side of the supply.
2. Insulate the lampholder from any metal parts which may be touched during the operation of the set.
3. Keep the leads from any components where hum is likely to be caused.
4. Remember that when the lamp is withdrawn with the eliminator switched on, the full mains voltage exists across the lampholder.
5. If the lampholder does get short-circuited no damage will result.
6. The arrangement will only work on A.C. supplies.—J. R. PERRY (Norwich).

Controlling Selectivity From the Panel

MOST sets have a pre-set condenser (as a selectivity device) connected between the aerial terminal and the tuning coil. Generally, this is placed on the baseboard, at the back of the set, and this makes it necessary to take the back off the set every time an adjustment is necessary, or if the set is in a radio-gram cabinet, frequently the whole set has to be moved to get at the back of it. An easy method of overcoming this difficulty is to arrange for the condenser to be controlled from the

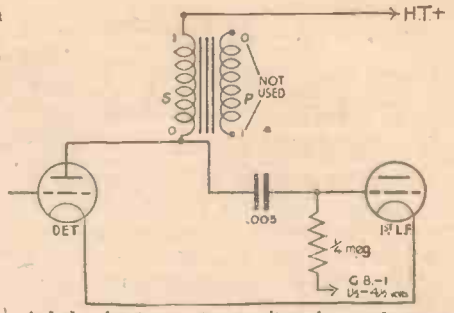


Controlling selectivity from the panel.

panel. This can easily be done by the method shown in sketch. A small wooden bracket is made, to which the pre-set condenser is fixed, a hole is then drilled in the panel to allow the knob of the condenser to pass through. The wooden bracket is then fixed to the baseboard so as to allow the knob of the condenser to be operated from the front of the panel. Thus you have selectivity and volume always under your control by simply adjusting the condenser in the usual way.—A. SHARP (St. Margarets-on-Thames).

A Coupling Hint

HERE is a coupling arrangement which can be put into use in case of emergency when the primary of an inter-valve transformer breaks down, or it can be tried to give a marked improvement in quality of reproduction, which it did in my case. The grid bias and grid leads are disconnected from the faulty transformer



A dodge for improving quality of reproduction.

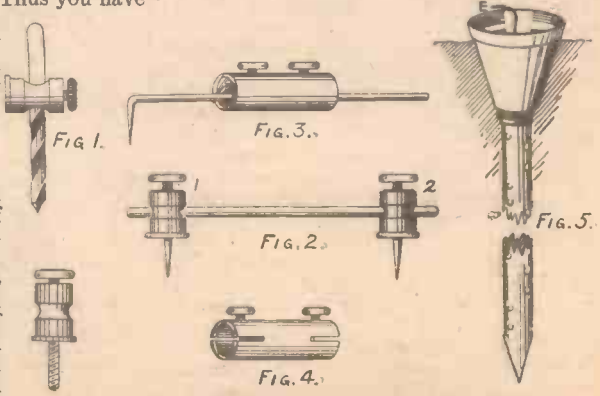
while the anode and high tension positive wires are left as before. A wire is taken from anode on transformer to one side of a .005 fixed condenser, the other side of which is taken to one side of a ½ meg-ohm grid-leak, and also to grid of the following L.F. valve; the other side of the grid-leak is plugged into 1½–4½ volts grid-bias negative.—S. HARRINGTON (Wigton).

Some Useful Dodges

HERE are some useful dodges, the materials for which can usually be found in the junk box. Terminals, for instance, can be made to serve at short notice. Fig. 1 shows one used as a depth gauge, the hole being drilled to take a larger drill. The screw portion sawn off and one side of the terminal filed flat: a cardboard washer may be placed against the flat side. With stems filed to points and a knitting needle or piece of 16-gauge wire soldered to No. 1 terminal (Fig. 2), leaving No. 2 terminal, a useful tool for equalizing distances and for scribing circles can be made. Connectors have their uses, and one used with a knitting needle with pointed end bent and sharpened makes a useful device for scribing or gauging distances. Fig. 4 shows how a connector can be slotted with a hack-saw to take improvised fixed condensers or for connecting flash-lamp batteries. A dodge for ensuring a better earth is shown in Fig. 5. A flower pot, arranged over the earth tube, can be occasionally filled with water for keeping the earth in a damp condition.—W. F. ARCHER (Leeds).

NOTE TO READERS!

DO NOT SEND WRINKLES WITH QUERIES. All Radio Wrinkles should be sent separately.



Some simple dodges for practical men.

FOR THE SUPER-HET ENTHUSIAST

"BAND-PASS FILTERS" AND THE SUPER-HETERODYNE

An Article Explaining the Principles and Working of Filters for Use in Conjunction with Super-het Circuits

By H. GODLEY

ONE of the chief difficulties of the set designer to-day is how to obtain the necessary degree of selectivity, at the same time preserving a sufficiently wide frequency-response to ensure good quality. Owing to the increasing number of high-powered stations transmitting all over the world, it was found necessary to determine a minimum wave-length-separation which would be recognized internationally, as otherwise the ether would have become congested to the point where it would have been impossible to separate any station from its neighbours. The waveband allotted to each station was, after much deliberation, fixed at 9 kilocycles, and even under these conditions, if any stations are to be received without a background accompaniment of other stations, heterodyne whistles, etc., it is necessary for the tuning circuits of the receiver to be very carefully designed.

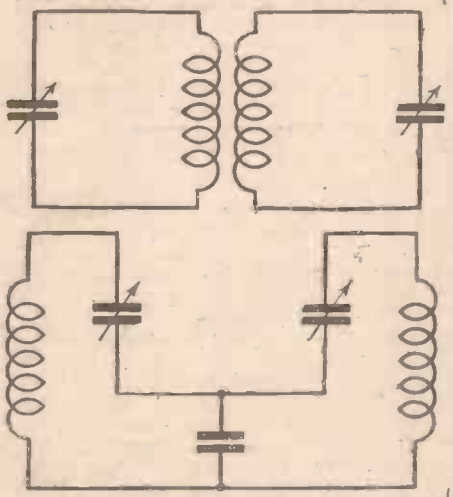


Fig. 1 (a) and (b)—Two methods of coupling two tuned circuits.

In order to cope with these conditions, many new tuning circuits have been evolved within recent months, the most popular of which has undoubtedly been the "band-pass filter." This consists of two accurately-balanced tuned circuits, which can be coupled in a variety of ways: The two tuning condensers are always ganged, and in most cases, the two coils have to be efficiently shielded.

In Fig. 1 (a) the two circuits are coupled magnetically, the disadvantage being that the degree of selectivity varies with the wavelength of the incoming signal.

(b) In Fig. 1 (b), the circuits are coupled by means of a condenser, which is usually of the order of .02 mfd. This arrangement suffers from the same disadvantage, in that the "reactance" of the coupling condenser is greater on the longer wavelengths with resultant loss of sharp tuning.

Fig. 3 is a patented Tuner, in which the two circuits are resistance-coupled. The resistance is of the order of 100,000 ohms, and, as the degree of coupling is independent of frequency, the arrangement is fairly efficient.

Two coupling condensers are used in Fig. 2, one of small capacity and the other larger, thus giving a double-humped response curve. The two peaks are arranged close together, thus becoming in effect a square-topped curve. Fig. 4, in some form or other, is that used in the more successful band-pass filters, in which it will be seen that the two circuits are coupled, both by inductance and capacity. With effective ganging and careful design, this circuit can be made to give a fairly constant degree of selectivity at all normal frequencies. These are not, by any means, the only forms of band-pass filters, but they are fairly representative of the many various types. The ideal response curve is one whose peak is level over a frequency band of 9 kilocycles, but falling away rapidly on either side of the peak. It should be noted here that the form of band-pass filter employing a large coupling condenser common to both circuits, commonly called "bottom-end capacity filter," is often not suitable in a superhet. circuit

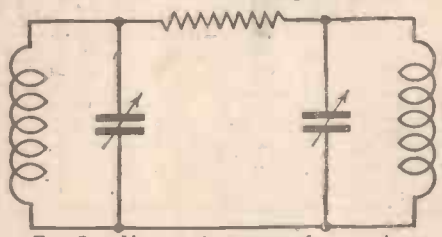


Fig. 3.—Using a resistance for coupling purposes.

as a peculiar form of interference has been found to be due to the coupling condenser offering considerable reactance at the frequency of certain long-wave stations.

The Super-het Principle

An efficient form of band-pass filter used in conjunction with a superheterodyne

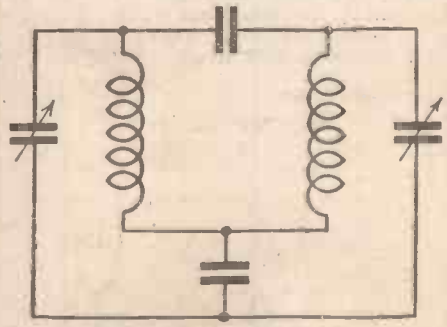


Fig. 2.—Still another method of providing coupling.

circuit, constitutes one of the most selective and sensitive receivers known, and in view of the popularity which the super-heterodyne is now enjoying, it is thought that some explanation of the principles underlying this circuit may be of some interest. It must, however, be clearly understood that no attempt is being made to put forward a mathematical exposition of the circuit—on the contrary, every endeavour has been made, so far as possible, to avoid technicalities.

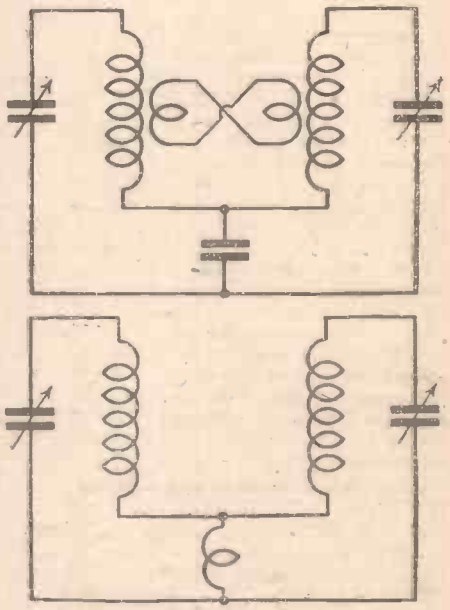


Fig. 4.—Inductive coupling between circuits.

The superheterodyne principle was, of course, evolved many years ago, and attained a fair measure of popularity. There were, however, several serious disadvantages, chief among which was the high current consumption of a multi-valve set in those days. The advent of the dull-emitter and mains valves has, however, effectively removed this objection. Other disadvantages were, second-channel interference, high background level, sideband-heterodyning, etc., all of which difficulties have now been either overcome entirely, or very considerably reduced in effect.

The superheterodyne consists fundamentally of five stages, these being: the first-detector, oscillator (or mixer), intermediate-amplifier, second-detector and output. The first two of these may be contained in a single valve, such as the recently introduced "bi-grid," or even in a triode, which latter arrangement is, however, very unsatisfactory owing to the large number of powerful harmonics generated causing the same signal to be tuned in on several different readings. There may be two I.F. stages and, of course, two or more L.F. stages. Also, it is possible to incorporate one or more H.F. stages before the first detector, thus obtaining greater overall magnification and perhaps greater

selectivity. It must, however, be remembered that an ordinary S.G. valve tuned to a powerful nearby transmitter is likely to cause that unpleasant form of interference known as "cross modulation," or partial H.F. rectification, due to the sharp curvature of the G.V.-A.C. characteristic. The recently introduced variable-mu valve largely overcomes this trouble, but for all normal purposes sufficient selectivity can be obtained by a carefully designed band-pass aerial circuit, and adequate overall magnification can be obtained without H.F. amplification.

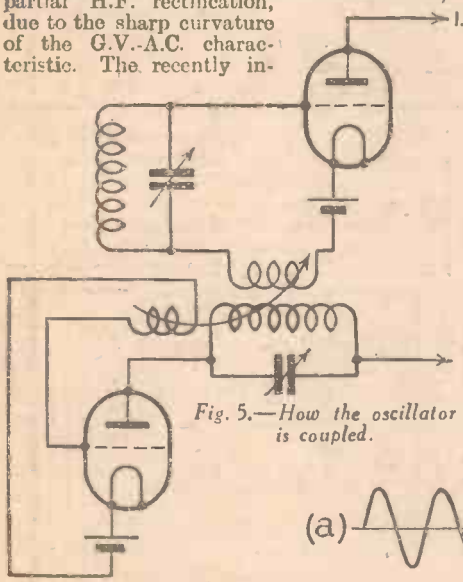


Fig. 5.—How the oscillator is coupled.

Beat-frequency

The superheterodyne circuit differs from the ordinary broadcast receiver in that the oscillations of the incoming signal are converted to a pre-determined lower frequency before further radio-frequency amplification, thus enabling a high degree of selectivity and amplification to be obtained. The alteration in frequency is obtained by utilizing the well-known heterodyne method of producing a "beat-frequency," *i.e.*, where two H.F. currents flow in one circuit, another and separate current is produced whose amplitude varies at a frequency exactly equal to the difference between the two original oscillations. The frequency of this modulation is the "beat-frequency."

Upon referring to Fig. 3 it will be observed that:

(a) Represents the incoming signal oscillations.

(b) Represents the local oscillations produced by the oscillator valve. These two, upon heterodyning, produce the modulated H.F. oscillation shown in

(c) Which modulation is then rectified by a detector valve in the usual way.

The "beat-frequency" in a super-heterodyne receiver is arranged so that it has a definite supersonic value, somewhere between the frequency of the carrier wave and the lower audio-frequencies. Usually, the "beat-frequency" is between 110 and 125 kilocycles. It will thus be seen that no matter what the wavelength of the incoming signal may be, by tuning the oscillator so that its frequency is 110 kc/s below or above that of the incoming signal, the modulated beat-frequency passed on to the intermediate-frequency stages is always the same, *i.e.*, 110 kilocycles. The succeeding stages are, therefore, designed so that they are most efficient at this frequency, thus gaining a high degree of selectivity and amplification. An example of the earlier form of frequency-changer is shown in Fig. 5, in which separate valves are used for detector and oscillator.

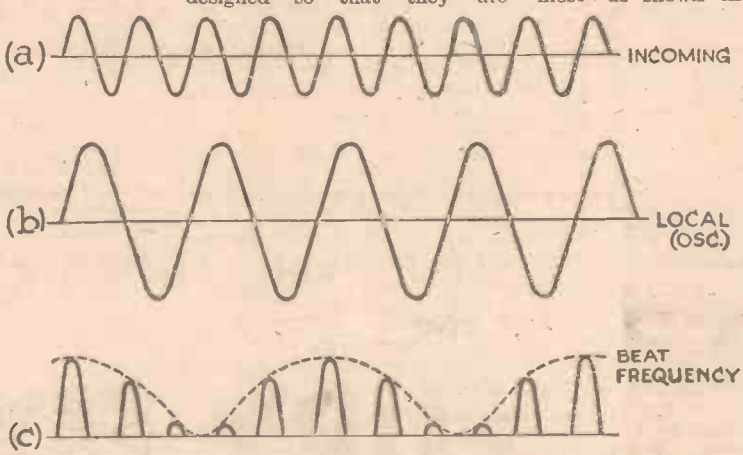


Fig. 3.—A graphic representation of the separate oscillations making up the signal.

S.G. Valve as an Anode-bend Rectifier

It will be appreciated that, in a super-heterodyne circuit, it is necessary to prevent the oscillations of the frequency-changer from getting into the aerial circuit and re-radiating, and until recently this has made the use of an H.F. valve before the first detector almost essential. Recently, however, a new circuit has been evolved in which a S.G. valve is used as the first detector, operating as an anode-bend rectifier. The oscillator valve, however, is not coupled to the grid of this valve, as in earlier circuits, but to the *anode*, as shown in Fig. 6. Thus, the screen-grid prevents the frequency-changer oscillations from reaching the tuned-grid circuit of the valve and re-radiating.

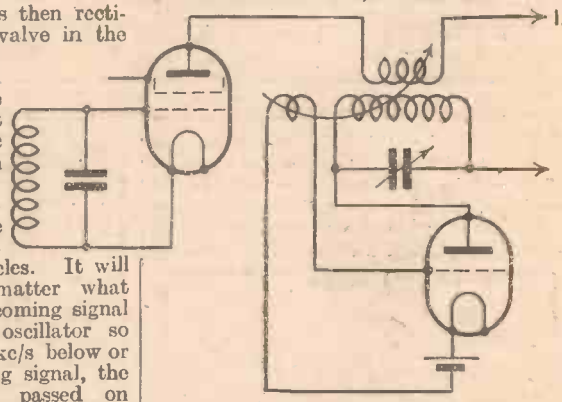


Fig. 6.—Using an S.G. valve as anode-bend detector.

The I.F. valves are coupled to the first and second detectors and to each other by means of transformers, permanently tuned, of course, to the pre-determined "beat-frequency." Here again band-pass tuning can be used if desired. The modulated "beat-frequency" produced in the frequency-changer circuit is, therefore, amplified by one or more I.F. stages and then rectified by the second detector. It will be appreciated that the amplitude of the signal on the grid of the second detector may be very considerable, and, therefore, this valve is usually designed to operate as a "power-grid" detector, which arrangement is capable of handling a fairly large grid-swing without distortion. This rectified signal is then, of course, further amplified in the note-mag. stages and passed in to the L.S. in the orthodox manner.

If you are collecting our Data Sheets you need our Self-Binder. See page 1002 of last week's issue

A Policeman's Lot is Not a Happy One

NEW YORK detectives belonging to the radio homicidal squad fully earn their weekly wage. They must understand Morse signals, pass a test as crack shots with rifle or revolver, must be capable of handling a machine-gun, give first aid, and be expert tear-gas bomb throwers. All other "parlour tricks" are acquired in their spare time!

That Photo-electric Cell Again!

A FRENCH engineer claims that he has invented an instrument comprising a photo-electric cell by which it is possible to establish the relative freshness of so-called new-laid eggs. It is claimed for the invention that if the eggs, placed on a moving band, pass before the cell, according to the rays emitted, the age of the egg can be confirmed. All bad eggs are automatically thrown aside. It is not stated what happens to the operator.

ROUND THE WORLD OF WIRELESS

(*Continued from page* 1028)

Dublier Radio Service

DUBILIER Condenser Company, Ltd., have just concluded arrangements with the National Radio Service Company, of 15, Alfred Place, London, W.1, to take over the servicing of all Dubilier Receivers, as from January 1st, 1933. There is no need to emphasize the efficiency of this organization, and clients of Messrs. Dubilier will receive the best possible service.

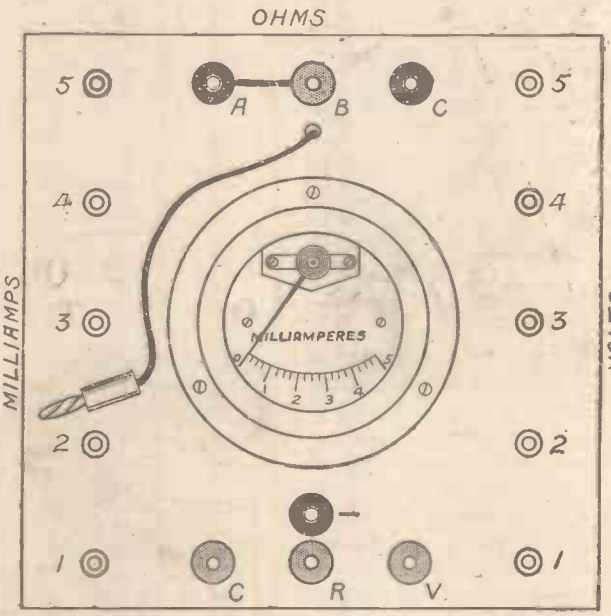
HOW TO USE

THE PRACTICAL WIRELESS MULTIMETER

The Application of the Useful Meter which was Described Last Week

By W. J. DELANEY

IF you have finished the construction of the meter which I described last week, you have probably tried it out and found out for yourselves how the various tappings work. For the benefit of those who, however, have not yet completed the instrument, or are not fully aware of the use of the meter, the following notes have been written. First of all look at the diagram on this page. This is a sketch of the panel of the instrument, and each socket has been given an identification number or letter. On the right-hand side of the panel, the sockets are numbered from 1 to 5, and these are for the voltage range. On the left-hand side, the sockets are similarly numbered, but these are for the current range. The three red sockets at the lower edge are lettered C, R, and V, standing for current, resistance and volts.



Measuring Voltages

It is, of course, quite obvious, that the red plug of the testing prod must be inserted into the appropriate red socket at the lower edge, and therefore, if you wish to take a voltage reading of any sort, the first thing to do is to insert the red plug into the socket nearest the voltage side of the panel. This is the one marked V on the sketch. It is understood, from what was said last week, that the negative test-prod always goes into the black socket at the bottom (marked — on the sketch). The small chart which was printed at the foot of page 972 is divided into three parts, and it will be seen that the upper part is lettered "Volts," and that there are five rows of figures, with columns beneath the five numbers of the meter scale. Now suppose the voltage which we wish to read is known to be about 30 volts. A glance at the chart shows that the figure 30 may be obtained at 3 on the meter scale (in conjunction with socket No. 3), or between 1 and 2 on the meter scale (in conjunction with socket No. 4). Whenever a meter is used for several purposes, as in this case, it is always preferable to use the largest deflection of the needle, in order to reduce the amount of error present. Therefore, we must use socket No. 3. The small selector lead referred to last week must therefore be plugged into the central socket on the right-hand side of the panel, and then when the two test prods are joined to the source which we are measuring, the needle will swing across the scale to somewhere between 2 and 4. If the voltage is, say 25, the needle will rest half-way between 2 and 3, whilst if the voltage should chance to be as high as 40, the needle will stop on the division marked 4. There is, of course (due to the internal resistance of the meter), a slight discrepancy in this reading, but as this only totals roughly one-quarter of a volt, this need not be of any importance, except on the very lowest range of the meter. This is the procedure for reading any voltage, and the only point to bear in mind is, in case of doubt, use the very highest reading first of all, and so get some idea of the voltage which is being read. In this way you will not damage the meter.

Reading Currents

When it is desired to measure the current flowing, the red test-prod plug is moved to the socket marked C, and the method described above is carried out, only this time using the second table on the chart. There will be no error to worry about here, as you adjusted the meter with the short lengths of resistance wire to give exact readings, and therefore the resistance of the meter itself is automatically compensated for. The same precaution is necessary, however, and that is—in case of doubt plug into socket No. 5 and get some idea of the amount of current flowing, before coming down to the correct socket.

Measuring Resistance

Inside the meter case you must include a 1.5 volt battery, and although there is not much wear likely to be imposed upon this, it is preferable to get a fairly large one, so that there will be little error in measuring small resistances. If you are not likely to want to measure values higher than about 1,500 ohms, you can leave the meter as it is and simply plug the selector lead into socket C and the red plug into socket R. If, however, you anticipate that you may want to measure resistances higher than this, you must join a wire (underneath the panel) from socket A to socket B. Then, when measuring values up to 1,500 ohms the plug is still inserted into socket G, but if higher values are required, this plug must be moved over to socket A, and two additional flexible leads must be inserted into sockets B and C. The lead from the black socket (C) should then be inserted into the negative socket of an H.T. battery, and the lead from the red socket (B) should be inserted into a positive tapping according to the value of the resistance being measured (see table 3 on the chart). This may sound a little complicated when you read it, but if you take the meter before you and carry out the instructions, you will find that in a few minutes the idea will become quite clear, and that it is extremely simple to use this handy meter for the various tests which become necessary from time to time.

Stick the chart inside the lid of the box, and it will then be handy for reference when measurements are to be made, and no calculations will be necessary. It is, of course, quite obvious from a study of this chart, that all the values are related to each other. For instance, in the voltage table, each row of figures is double that of the row above (except in the case of the first row, which is only one-fifth of the second). In the milliamp range the figures are also doubled in each succeeding row. There is no necessity to trouble about this factor, however, as the chart may be used simply as an addition to the scale printed on the meter, and this will be found of great convenience to the reader who simply requires to take a reading without any troublesome calculations.

As for the actual purposes for which the meter may be used, there should not, of course, be any need to mention these. Testing the voltage of the accumulator, the voltage of the high-tension battery, and the voltage of the grid-bias battery, is a procedure which should definitely be carried out each week. In this way a very good idea of the working of the set will be obtained, and you will know whether or not the capacity of the different batteries is high enough for the discharge rate of your own set. A fault, such as a short-circuit, would also be revealed in this way, as a sudden drop in voltage of H.T. or G.B. battery would indicate for certain that a sudden discharge has been given to the battery, and if no alteration has been made to the circuit, obviously a partial or complete short-circuit has developed somewhere.

The inclusion of the meter, to read on the milliamp range, in the anode circuit of each valve, will indicate overloading, oscillation, etc. Remember that the L.F. valves should give a practically stationary needle whilst signals are being received. This does not, of course, apply to valves which are working on the quiescent push-pull system, unless the volume is reduced to a very faint signal.

With all L.F. valves, the needle should remain steady when tuning in, and a sudden drop will indicate oscillation.

50,000 Volumes already

Only a limited number of copies of this edition now available

RESERVE YOURS TO-DAY

At the urgent request of many of our readers who availed themselves of our recent Gift Offer, we are repeating it so that their fellow-enthusiasts to whom they have shown this truly invaluable Work of Reference may themselves possess it.

Many thousands have been distributed and we have been inundated with letters of appreciation and thanks—a few are reproduced on the opposite page, and they are the best indication of the amazing value and helpfulness of this comprehensive and up-to-date work.

It only remains for us to add that this offer is open to all readers, old and new, who fulfil the simple conditions set out on this page. Seize this wonderful opportunity TO-DAY.

★

READ THESE SIMPLE CONDITIONS

If you are not a regular reader place a standing order with your Newsagent for PRACTICAL WIRELESS for 13 weeks.

Affix to the Subscription Voucher which we post to you 6 Gift Stamps cut from the bottom left-hand corner of the back page of PRACTICAL WIRELESS for 6 consecutive weeks commencing this week. (Gift Stamp No. 21.)

When your Subscription Voucher is complete, send it, together with a Postal Order for 2s. 4d., to include registration, postage, packing, insurance, etc., to PRACTICAL WIRELESS Presentation Department, and your copy of Newnes' Wireless Constructor's Encyclopædia will be despatched to you immediately.

No reader may qualify for more than one copy of Newnes' Wireless Constructor's Encyclopædia.

This offer applies to persons residing in Great Britain and Ireland. Readers in the Irish Free State must pay any duty imposed.

dispatched to Subscribers!

TRIBUTE FROM READERS

BELOW are reproduced some typical letters from the thousands received from delighted readers who now possess their copies of Newnes' "Wireless Constructor's Encyclopædia." Read them carefully and you will realise how useful this new authoritative and up-to-date Work will be to *you*.

Having received my "Wireless Encyclopædia" yesterday and by this time well examined it, I feel I should write and congratulate you on being able to offer such a fine volume at such cheap rates. I am more than satisfied—I am delighted.
C. Jones (Liverpool, N.).

I received my copy of your Presentation Volume, "Wireless Constructor's Encyclopædia," for which I wish to express my admiration for such a fine book, so well put together, and the illustrations are a fine example of much thought. *The completeness of the volume leaves nothing to be desired.* E. Scriven (Sheffield).

It is really a splendid book, both with regard to the reading matter and the binding. The book will be of great value to the amateur wireless constructor.
E. Boans (Leeds).

Thank you sincerely for a most interesting and instructive book.
R. Taylor (W. Norwood).

I can assure you that it is a great book, and, though I do not understand wireless technique, I will soon be able to pick it up from this book. *It exceeded my expectations in all respects*, and those that did not go in for one have missed a real good thing.
A. C. Valentine (London, W.12).

I have been so interested that I have not had time to write before. It is a storehouse of Wireless information, those who have not subscribed do not know what they have missed.
E. W. Cooke (Birmingham).

I am pleased to say that I have received my Wireless Encyclopædia quite safely, *and I really think that it is all you claim it to be.* F. Brayne (Tunbridge Wells).

Just a few words of appreciation concerning your wonderful Encyclopædia which I received safely. I think it is a great piece of work and a need for every wireless enthusiast, amateur or professional.
F. W. Salt (Long Eaton).

I thank you for your Encyclopædia which I have just received. I have had a glance through it, and you are to be complimented on producing such a valuable work. It is well illustrated, and the circuit diagrams are, I think, a good addition to the book. F. W. Sewell (Sheffield).

I hope that you will put the Encyclopædia on the market for the benefit of those who were unfortunate not to qualify for its presentation. Geo. E. Driffield (York).

I am delighted with the "Wireless Constructor's Encyclopædia." It is a splendid book, full of information for everybody interested in Wireless, and owing to its lack of padding, a boon to busy people. I have only been in possession of my first valve set a few months and the book is specially valuable to me. Many thanks for sending me the best New Year's gift I have received this year.
William J. Grundle (Glasgow).

Allow me as a contributor and reader of "Practical Wireless" to congratulate you upon the production of "Newnes' Wireless Constructor's Encyclopædia," which I have received under your gift scheme. *A more concise, useful and accurate collection of data, circuits, and radio information I have never seen.*
Alf W. Mann (Middlesbrough).

I thank you for your "Wireless Encyclopædia," which *I think is an admirable and comprehensive book.*
B. C. Kerlogue (Catford).

I have to thank you for my copy of the "Wireless Constructor's Encyclopædia," received on Tuesday last. I have found it a most interesting and useful book, containing everything the Amateur is likely to want to know. P. J. (West Croydon).

Permit me to thank you for the splendid Encyclopædia just received, it certainly is well worth the trouble of saving the coupons and small fee charged.
E. W. Anderson (Norwich).

It's a splendid book, and I must congratulate you on compiling such a valuable work, *which should be in the hand of every wireless "fan."*
A. H. Keyse (Birmingham).

Allow me to congratulate you on the "Wireless Constructor's Encyclopædia."
F. W. Allott (Rotherham).

IMPORTANT. This truly indispensable work can only be obtained by regular Readers of PRACTICAL WIRELESS.

All you have to do to obtain your copy is :—

(a) Read the simple conditions. (b) Complete the Forms alongside in ink. (c) Post Form No. 1 and stamped address label. (d) If not already a regular reader hand Form No. 2 to your Newsagent.

On receipt of Form No. 1 and the address label, we will send you a special Subscription Voucher on which to qualify for your Presentation copy of Newnes' Wireless Constructor's Encyclopædia. Your volume will be reserved for you, and will be despatched immediately we receive the completed Subscription Voucher

POST THESE FORMS NOW

2 If you have NOT placed a standing order with your Newsagent for the regular delivery of PRACTICAL WIRELESS, hand him the order form below without delay.

PRACTICAL WIRELESS
ORDER FORM for Newsagent

To .....
(*Newsagent*)

Address .....

Please deliver (or reserve) PRACTICAL WIRELESS for me weekly for 13 weeks and until further notice.

Name .....

Address .....

Date .....

PLEASE WRITE IN CAPITAL LETTERS.

1

POST THIS FORM IMMEDIATELY TO

No. 2

PRACTICAL WIRELESS
Presentation Department,
39, King Street, Covent Garden, London, W.C.2

In accordance with the conditions of your special offer please send me a SUBSCRIPTION VOUCHER on which to qualify for my Presentation Encyclopædia. I have asked my Newsagent to deliver PRACTICAL WIRELESS regularly every week for 13 weeks.

Reader's Name .....

Full Address .....

.....

Newsagent .....

Address .....

Leave blank.

Reader's Signature .....

Fill in this form and the label on left in Block Letters. Stamp the label as directed and post both of them in an *unsealed* envelope (½d. stamp only required)

If undelivered please return to Geo. Newnes, Ltd., London, W.C.2.

½d. Stamp must be affixed here.

Name .....

Street .....

Town & County .....

.....

Valuable Hints on

IMPROVING YOUR RECEIVER

An Article Written Especially for Readers with Detector 1- or 2-L.F. Sets, and for Those Who Are Adding the Variable-Mu H.F. Unit Described in February 4th issue.

By A. E. OAKLEY

IN the Feb. 4th issue of PRACTICAL WIRELESS we described an excellent H.F. unit, to be used with any set having at present no high-frequency amplifying stage. At the same time it was pointed out that to get the best possible results from such a combination the main set should be good also. Your particular set may lack several features which would improve its selectivity, volume, or quality. On the other hand, it may be a thoroughly modern apparatus, and you may regard it as 100 per cent. efficient. Even so, it is worth looking over to see if it *really is* all that could be desired, and entirely suitable for the addition of an H.F. stage. If you will follow me, therefore, we will run through the set, so that you can check up on its details and see how far alterations are desirable.

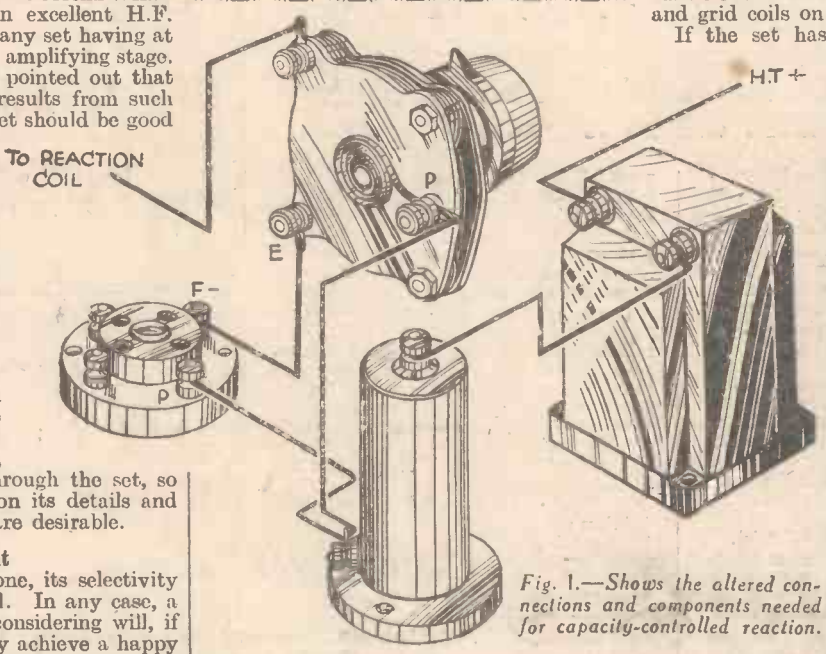


Fig. 1.—Shows the altered connections and components needed for capacity-controlled reaction.

Selectivity Most Important

If your set is an old one, its selectivity may be very poor indeed. In any case, a set of the type we are considering will, if it is well designed, merely achieve a happy compromise between selectivity and sensitivity: one cannot have the maximum of both. Bear in mind that the addition of an H.F. stage will add tremendously to the sensitivity, and you can, therefore, afford to sacrifice some of this in order to get greater selectivity. The worst form of tuning from this point of view is that shown diagrammatically at Fig. 4, where a tuned grid coil has its ends connected to aerial and earth respectively. The simplest improvement on such an arrangement is to tap the coil for the aerial connection about two-thirds from the grid end. Tappings a little below this position should also be tried. The improvement in results is often remarkable. Remember that the object to be achieved is to reduce the aerial coupling to the minimum possible consistent with reasonable volume. The ideal tuning arrangement is probably that shown at 5, using an aperiodic aerial winding not too tightly coupled to the grid coil. (I purposely exclude band-pass tuning because of the difficulties in its application to an existing set and the considerable expense.) With an otherwise efficient set the aerial winding may be as small as one-sixth the number of turns in the grid coil. If both are wound on the same former, a space of 3-16in. should be left between the windings. The arrangement for a dual-wave winding and switching, with reaction, is shown in Fig. 6. It will be seen that the windings are in six sections, all wound in the same direction. I have numbered these for ease of reference, as under :—

No. 1, aerial, medium wave.
No. 2, grid, medium wave.
No. 3, reaction.
Nos. 4 and 6, grid, long wave.
No. 5, aerial, long wave.

Nos. 1 and 2 are single-layer windings; 3, 4, 5, and 6 may be wound in ¼in. slots, if a ribbed former is used, or in channels formed with cardboard rings glued on to a paxolin former. A 5-16in. space is left between 2 and 3, the other sections being spaced ⅛th. Nos. 4 and 6, the long-wave grid-coil sections, are wound continuously, the finishing end of No. 4 being passed through a hole in the former, as is also the beginning of No. 6, the two ends being soldered together inside the former. It will be noted that this plan permits a suitable ratio to be observed between aerial and grid coils on both wavebands.

If the set has plug-in coils, you may change to the type suggested purely for the sake of neatness and avoidance of coil-changing. But on the score of efficiency you can stick to your plug-in coils, so long as you adopt the same circuit and are careful to get exactly the right ratios and positions for the individual coils. Suitable ratios for the medium waveband are: aerial 20, grid 60, reaction 35; and for the long waveband, 100, 200, and 75 respectively. These sizes are subject to slight variation, for the aerial itself, and the characteristics of the set, are not always alike, while different makes and types of coils differ appreciably in their inductance values. It will, of course, be understood that the "aerial" winding referred to above is the "input" or primary winding, to which the output from the preceding H.F. valve or unit is connected. If the unit is used, then the preset condenser shown in Fig. 4 is not needed, as there is already a small condenser in the output lead.

(*Continued on page 1047.*)

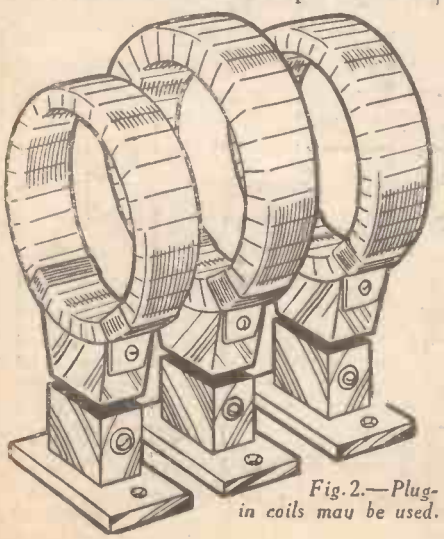


Fig. 2.—Plug-in coils may be used.

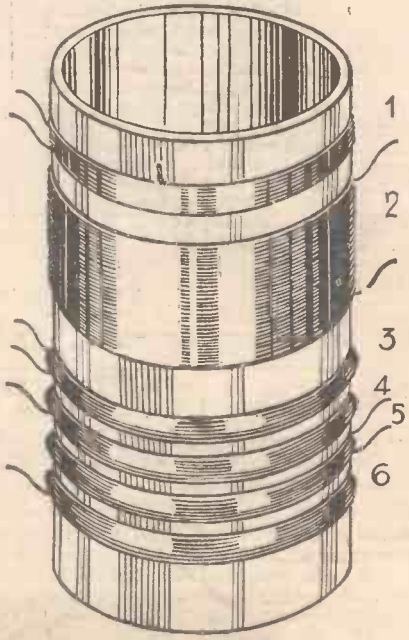


Fig. 3.—A finished dual-range coil as shown in Fig. 6.

Improving your Receiver

(Continued from page 1044.)

Your tuning condenser is, perhaps, of the directly-operated type. In this case a geared drive or slow-motion dial must be fitted, for the increased sharpness of tuning will make it well nigh impossible to handle foreign stations otherwise. For those who want a ready-made coil which embodies the features described, the Telsen dual-range screened coil is suitable, and includes the necessary double switch combined in the one instrument. If you are making the unit, it is a good plan to purchase a pair of these matched coils, as this will make tuning easier, particularly if you can arrange to use similar condensers for each of the tuned circuits. Personally, I should prefer a rather less aerial coupling than is provided on these, and most other commercial coils, but it is for the constructor to decide whether he cares to experiment by removing a few turns of the aerial winding or not. So much for tuning.

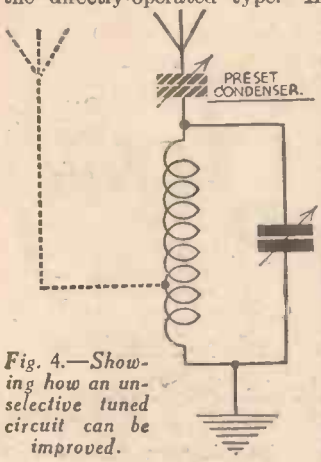


Fig. 4.—Showing how an unselective tuned circuit can be improved.

If this is not fully effective, and easily controlled, you cannot get the highest selectivity or sensitivity. If you have the old swinging coil in the detector anode circuit, you must cut this out in favour of capacity controlled reaction on the Reinartz plan. The connections and additions required are clearly shown in Fig. 1. A differential condenser of .00025 or .0003 has its moving vanes connected to the detector anode, one set of fixed vanes to the earth side of filament lead, and the other fixed vanes to the reaction coil, the other end of the latter, of course, going to earth. The H.T. feed comes through the primary of L.F. transformer as before, and then through an H.F. choke. This latter is preferably screened. This plan makes for stability, particularly if the tuning coil is unscreened, because the high-frequency currents are diverted to earth, either directly, or through the reaction coil. An ordinary condenser instead of a differential may be used, but in this case a fixed condenser of .0001 or .0002 must be connected directly between detector anode and earth. The differential condenser, however, will generally give a better reaction control.

Valves

We come now to a subject which raises many issues; a subject so wide that I have but space enough to touch on the high spots. Very largely the efficiency of your set is that of the valves, and this again naturally divides into two main considerations. First, are the valves at present in use good ones, and suitably chosen for their respective jobs; second, are they being operated under conditions which enable them to do their best? Unfortunately, it is rather the exception than the rule to find both good modern valves and correct operation in an old set. First is the matter of using correct voltages. Look up the maker's particulars, and see that you are working them all at correct voltages. If your output valve, say, is rated 100 to 150 volts, then see that it gets at least an honest 120, and then bias in proportion. Your detector voltage should be varied experimentally. Best results may lie between 40 and 70 volts. There is no point in overdoing the voltage here. Make sure that the detector grid is getting a positive bias (if you are using the usual leaky grid rectification). It is possible that your grid leak, marked 1 or 2 megs., may show infinity on test. It is worth trying one or two other leaks down to ½ meg. and observing results. The type of detector valve used is important. The general purpose valve often used (although it may tend to stability) has not generally the characteristics required to give the best amplification in the detector position, and is better used as a first L.F. amplifier. Probably the best all-round detector for our purpose is a valve of the H.L. type, such as Cossor 210 H.L., Mullard P.M.1 H.L., etc. With either of these a grid condenser of .0001 should be used. In many sets the improvement on fitting one of these valves in place of an older, or lower impedance type, is startling. The output valve may be a small power or pentode in a two-valve set, and preferably a super-power type in a three valver.

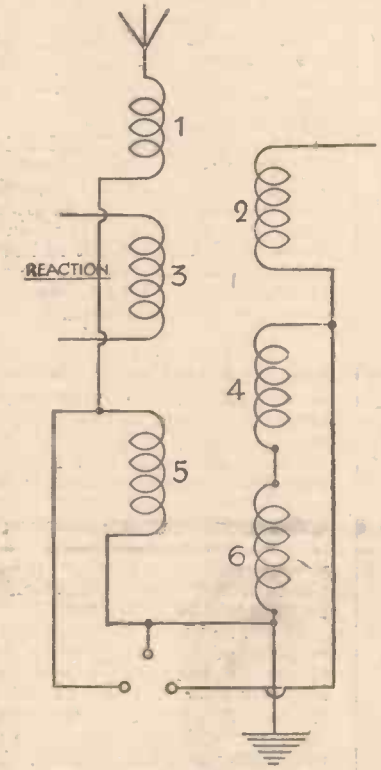


Fig. 6.—A selective dual-range arrangement.

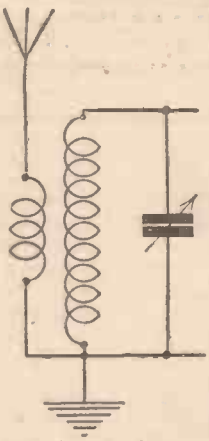


Fig. 5.—A better arrangement for improving an unselective tuned circuit.

Decoupling

In a modern set this is effected by inserting resistors in the valve anode circuits, and connecting a condenser of 1 mfd. or more between earth and a suitable point in the H.T. positive lead. The connections and values of resistors required have several times been given in the pages of PRACTICAL WIRELESS, and I recommend the reader to turn up the articles which have already been written on this subject.

Now a word about stability. The set may be stable enough now, but when you pull up its efficiency, and add the power of another stage, it may just upset the balance of things, and "over she goes." So if putting in a new detector, use a "metallized" one, screen the choke, and see that the grid and anode wiring is well separated, short, and direct. That peculiar form of L.F. oscillation known as "motor-boating" is due to interaction, largely magnetic, between components following the detector, particularly the transformers. Proper decoupling will prevent it; or reversing the connections on the primary of *one* transformer, or altering the relative positions or angles of the transformers will often do so.

I AM sure you all appreciate the wonders of the Rugby station of the Post Office, as would anyone who listened to the New Year broadcast from all over the world. Most of this came through the Rugby high-power station, which is now the telephone exchange of the world, and British engineering skill has made the station the last word in efficiency. The transmitting valves operate on a wavelength of 18,000, 5,000 and 4,500 metres, and are supplied with an anode current of 12,000 volts! When we started putting a voltage of 200 and upward on our anodes we thought it high, and we still call our anode batteries "high tension"! What, then, would we think of 12,000 volts?

High-Power Generators at Rugby

Four sets of generators supply this high voltage direct current, and they are in the form of motor generators. This means that the power for driving the D.C. generators is obtained from a powerful motor operating on alternating current, and not from an oil or other internal combustion engine. The motor and generator are direct coupled, and the armature of both are wound on what is virtually the same shaft. Both run at the same speed, and in this way the current supplied to the valves is as ripple free as possible and at a constant voltage. The generating sets were made by the B.T.H. people, who have just completed the work on the fourth and last set, which has satisfactorily completed its trials and tests. As the high voltages are naturally dangerous the sets are enclosed by a metal screen connected to the main station earth, and the doors in the screen cannot be opened while the generators are running. As no operator is allowed inside the screens, only visual attention can be paid to the bearings, and the old method of feeling the bearings for overheating by hand is not possible. This being so, a thermostat is fitted which lights a lamp, rings a bell, and shuts down the generator whenever the bearing temperature exceeds a certain safe point.

THE SET WHICH RECEIVES OVER ONE HUNDRED STATIONS

TUNING-IN WITH—

The Fury F

How to Operate, and Get the Utmost Out of This Wonder Receiver Which is Being Made in Its Thousands.

BY means of the Free Gift Blue Print and the full constructional details given in last week's issue, you should have my "Fury Four" by this time almost complete. Upon connecting up the speaker (presuming that you have wired the set correctly), you will find the quality of reproduction leaves nothing to be desired. The "Fury" will reproduce with true fidelity everything your aerial picks up—even the Scottish "wurruld" of Ramsay MacDonald (particularly hurtful to the ears of an Englishman), and the slurring "Sitooation" of Lord Snowdon. Fortunately, you cannot blame the "Fury" nor the B.B.C. for that!

A few words about the W.B. speaker. It is true that a speaker cannot correct bad reception and that it can only pass on what is given to it. But this is only a half

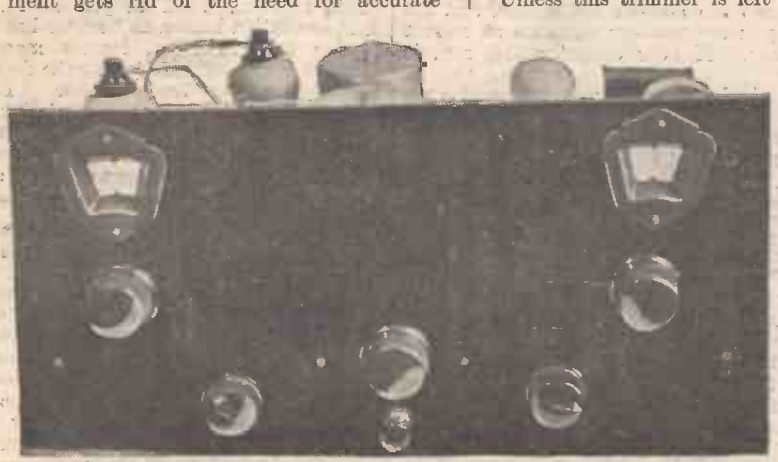
POWER WITH PURITY!

truth, for however good a receiver may be a poor speaker cannot do it justice. The speaker selected for this set is a Rolls Royce in its line. It has "tick-over" and "acceleration," and, like a good car, it has flexibility. Every reader with any knowledge of car driving will appreciate what I have in mind, and this speaker, to which I must accord full marks, faithfully reproduces over the entire range of audio-frequencies without rattle, distortion, distress, or signs of overload. Its inertia is low, and it is therefore delightfully responsive, even to weak signals.

For the benefit of the new reader, I should like to go over the controls again. The left-hand knob is the aerial circuit tuner, and it should be operated in conjunction with the secondary tuner on the right of the panel. It will be noted that the dial readings for a particular wavelength are almost coincident, although on some stations there may be a slight difference. This arrangement gets rid of the need for accurate matching of the condensers. The central knob is the wave-change switch; when turned to the right, the long-wave coil is switched into circuit, and when turned to the left the receiver will operate on the medium waves. The lower central knob is the on-off switch. The left lower knob is the potentiometer (controlling the voltage applied to the screening grids), whilst the right lower knob is the reaction condenser. Having tuned in the particular station required it will be found, by striking a balance between the adjustment of the potentiometer and the reaction condenser, that a position will be found where best results are obtained. These two controls also function in an admirable manner in avoiding interference, for if interference is experienced the potentiometer knob should be turned to the right, which will reduce signal strength and cut out the unwanted station; the required station can then be built up to the requisite volume by rotating the reaction knob to the right. On some of the more distant stations it may be necessary to adjust the Sovereign pre-set condenser, and a few moments' work in familiarising yourself with the controls will be amply repaid.

It will be necessary to match up the two sections of the double-gang Lotus condenser by tuning in a weak station on approximately the centre of the scale (on the medium waves), and then to rotate the star wheel remote from the panel until maximum volume is obtained. This operation should be carried out with the star wheel nearest to the panel set to its minimum position. Unless this trimmer is left in its minimum position (that is to say, screwed right out), the condenser will not tune down to 200 metres or low enough to receive, say, Fécamp.

SELECTIVITY WITH SENSITIVITY!



Front View of the "Fury Four" showing the controls. Top left: aerial tuning condenser, top right: secondary tuning condenser, top centre: wave-change switch, bottom centre: on-off switch, lower left: screening grid potentiometer, lower right: reaction condenser.

LIST OF STATIONS RECEIV

(Excluding 23 S

LONG WAVES.

KAUNAS.
HUIZEN.
LAHTI.
RADIO-PARIS.
KONIGSWUSTER-HAUZEN.
DAVENTRY NATIONAL.
MOSCOW
EIFFEL TOWER.
WARSAW No. 1.
MOTALA.
MOSCOW.
BODEN.
KALUNDBORG.
MINSK.
OSLO.

MEDIUM WAVES.

RIGA.
VIENNA.
BRUSSELS No. 1.
FLORENCE.
PRAGUE.
NORTH REGIONAL.
LANGENBERG.
BEROMUNSTER.
ROME.
STOCKHOLM.
BELGRADE.
BERLIN WITZLEBEN.
RABAT.
DUBLIN.
KATOWICE.
SOTTENS.
MIDLAND REGIONAL.
BUCHAREST.
LEIPZIG.
RADIO TOULOUSE.
LWOW.
SCOTTISH REGIONAL.
HAMBURG.
RADIO LL.

THE SET WHICH CARRIES THE DESIGNER'S PERSONAL GUARANTEE

Four

By F. J. CAMM

A few adjustments may be necessary to the grid-bias battery to find the best tapping. I have found that 4½ volts grid bias yields best results, although this value is absolutely dependent on the valves.

You are relieved, as I have mentioned before, of any H.T. battery adjustments, by means of a special arrangement (which serves the dual purpose of providing adequate decoupling) by means of the Erie resistors which act as voltage droppers and decouplers, and which are already included in the circuit.

You will notice on the back of the speaker, by the way, that four alternative ratios are provided; I found that the 45 to 1 ratio yielded best results, although this is largely a matter of personal taste.

There is one other point about which I should like to write before leaving you to probe the ether on the Fury, and that is the question of tone. You may have noticed that the output circuit of the Pentode valve in this receiver employs no tone-compensating device whatsoever. There is a reason for this. The particular Output Choke which is employed, together with the choice of the coupling condensers in the anode circuits of the two last valves, renders the bass response unusually good, and the result is that the usual high-pitched reproduction which is usually associated with a Pentode valve is conspicuous by its absence. It may be, however, that the loud-speaker reproduction will not please you—or you may already have bought a loud-speaker and have no wish to exchange it for the model which I recommend. The orthodox tone-compensating circuit may therefore be fitted as an external adjunct, or may be included in the receiver itself in quite a simple way. As you know, the only components required for tone-control are a resistance and a condenser, and by employing a T.C.C. condenser of the "S" type, having a value of .01 mfds., and a Dubilier metallized resistance of a value between 20,000 and 50,000 ohms, the addition may be carried out in less than five minutes. One wire of the Dubilier resistance is joined to one terminal of the condenser, and then the remaining wire of the resistance is joined to the terminal on the Pentode Output Choke marked '1.' A short piece of Glazite is then attached to the remaining condenser terminal, and the Glazite is attached to the Pentode Output Choke terminal marked '3.' In other words, across the Pentode Output Choke, a resistance and condenser are joined in series. The value of the resistance will determine the amount of the high-note cut-off, and you may care to experiment with a view to ascertaining the best value to suit your own requirements. As already pointed out, however, the quality of the reproduction, with the components and loud-speaker I have recommended, is of such a high order that this additional tone-control device is totally unnecessary, but as it is necessary to cater for the needs of everyone, I have thought it advisable to mention this fact before leaving you to enjoy what I hope will be many hours, or even years, of music from not only the English broadcasting stations, but from all the principal stations in Europe.

SIMPLE YET SUPER!

VED ON THE "FURY FOUR"

(ations Unidentified)

HELSINKI.	VIBORG.
BERGEN.	SCOTTISH NATIONAL.
ALGIERS.	BRATISLAVA.
STUTTGART.	HEILSBERG.
LONDON REGIONAL.	TURIN.
GRAZ.	RENNES.
BARCELONA.	BARI.
STRASBOURG.	LILLE.
BRNO.	MORAVSKA-OSTRAVA.
BRUSSELS No. 2.	LONDON NATIONAL.
MILAN.	FRANKFURT.
POSTE-PARISIEN.	HORBY.
BRESLAU.	GLEIWITZ.
GOTEBORG.	TRIESTE.
NAPLES.	BELFAST.
MARSEILLES.	BEZIERS.
GENOA.	NURNBERG.
PTT.	CORK.
NORTH NATIONAL.	FECAMP.
TALLINN.	NEWCASTLE.
HILVERSUM.	ABERDEEN.
KOSICE.	

Another view of the "Fury Four," which will assist you in wiring.

"SKYSCRAPER" RADIO

YOU BUILD IT YOURSELF FROM A TO Z

YOU SAVE POUNDS & YOU GET BETTER RADIO

This new Lissen "SKYSCRAPER" Kit Set is the only one on the market that you can build yourself employing a Metallised Screened Grid Valve, High Mu Detector, and Economy Power Pentode. Around these three valves Lissen have designed a home constructor's kit the equal of which there has never been before. Why be satisfied with whispering foreign stations when you can BUILD WITH YOUR OWN HANDS this Lissen "SKYSCRAPER" that will bring in loudly and clearly distant stations in a profusion that will add largely to your enjoyment of radio?

CONSTRUCTIONAL CHART FREE!

Lissen have published a 1/- Constructional Chart, giving the most detailed instructions ever printed for the building of a wireless set. You can't go wrong—every part, every wire, every terminal is identified by photographs. Everybody, without any technical knowledge or skill, can safely and with COMPLETE CERTAINTY OF SUCCESS undertake to build this most modern of radio receivers from the instructions given and the parts Lissen have supplied. You can get the Lissen "Skyscraper" Chart FREE from any radio dealer, or by posting the COUPON below direct to factory.

GREAT LISSEN CHART FREE

TELLS EXACTLY WHAT TO DO WITH EVERY SINGLE NUT & SCREW

YOURS FOR ONLY 8/6 DOWN

To-day you can buy the LISSEN "SKYSCRAPER" KIT on Gradual Payment Terms. "Skyscraper" Chassis Kit, complete with Valves. CASH PRICE 89/6. Or 8/6 down and twelve monthly payments of 7/6.

POST COUPON BELOW

"Skyscraper" Kit complete with Walnut Cabinet and in-built Loudspeaker as illustrated, £6 5s. Cash. Or 11/6 down and twelve monthly payments of 10/6.

COUPON

To LISSEN, Ltd., Dept. P.R. 37 Worple Road, Isleworth, Middlesex.

Please send me FREE copy of your 1/- "Skyscraper" Chart.

Name .....

Address .....

LISSEN

"SKYSCRAPER" KIT 3

COMPLETE IN CABINET WITH LOUDSPEAKER £6 5s *or 11/6 down and twelve monthly payments of 10/6*

THE DEVELOPMENT OF THE TUNING COIL

The Third Article of a Short Series Explaining the History and Applications of Various Types of Tuning Coils

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

NOW, although shop-bought coils are so satisfactory and reliable, and are almost a necessity if ganged circuits are to be used, there are numerous applications in which home-wound coils will prove in every way satisfactory. With care in making, these amateur efforts can even be satisfactorily ganged, and a friend of mine has been successful in obtaining really good results from a pair of home-made band-pass coils, screened in ordinary half-pound tins, normally accommodating a well-known proprietary article. Readers will be able to see for themselves what these look like by referring to Fig. 1.

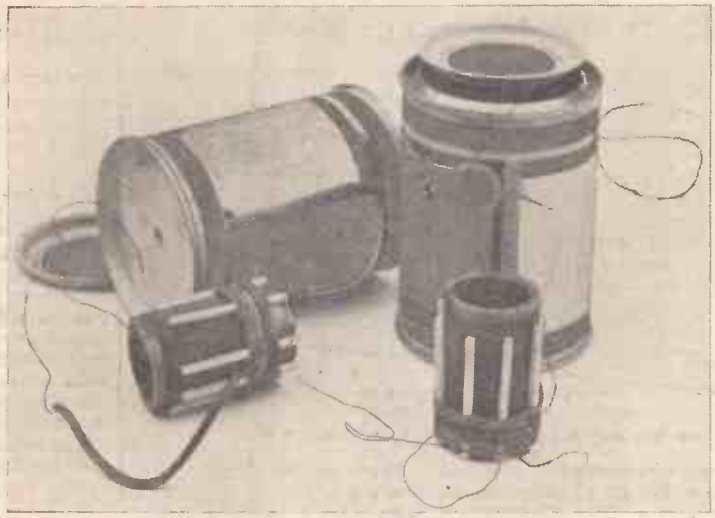


Fig. 1.—A home-made form of screened coil.

It will be of interest, therefore, to set out some tables later on, giving the correct windings for various types of coils and a few hints on home manufacture. Before so doing, however, a few more words on the principles of coil design are, at this juncture, very essential.

Coil Design

It has already been pointed out that the wavelength to which a coil will tune depends upon two factors—the inductance of the coil and the amount of capacity in the circuit, including, of course, the coil's self-capacity. The usual value for the capacity of the tuning condenser is .0005 mfd., and on this basis it is possible to work out the inductance required for different wavelengths. We will not bother about mathematical formulæ, but just state right away that a coil having an inductance of between 175 and 200 milli-henries will, with the normal .0005 mfd. variable condenser, cover the medium-wave broadcasting band, and a coil of from 1,600 to 2,000 milli-henries will cover the long-wave band. In the latter case, the 1,600 milli-henry figure is for an untapped aerial or an anode coil, and the higher figure is advisable if the aerial coil is tapped near the bottom end for selectivity purposes.

It follows then that the first step in coil design is to so proportion the windings that the coil shall have the desired number of milli-henries inductance. The correct winding can be calculated from rather complicated formulæ, but it is a very tedious process, and it will be sufficient to say that the inductance of a coil depends upon the number of turns of wire, the length of the coil, its diameter, and the ratio between the length and the diameter. These several factors have a bearing on the size of wire which can be used on a given size of former or tube, and in the tables which have been compiled and appear later, all these items have been taken into account.

Fig. 2.—A single layer coil undergoing some special tests.

Dynamic Resistance

In the two previous articles of this series, it was pointed out that the efficiency of a coil was affected by its self-capacity, and that, for this reason, it was desirable to keep the self-capacity as low as possible. This will be appreciated better from the statement that the efficiency of a coil in a resonant circuit depends upon what is called its "dynamic resistance," that is to say, upon its effective resistance to the high-frequency currents which pass through it. The dynamic resistance governs the losses in the coil, and it is of importance, therefore, to keep this dynamic resistance and hence the losses as small as possible.

Now the dynamic resistance of a coil is high if its self-capacity is high and, if the resistance of the winding is high, in order to ensure low losses we must so design our coil that the self capacity is low, and we must use wire of the right type and gauge to ensure a low resistance. Factors which increase self-capacity are wires "bunched" together or wires having high capacity dielectrics between them. A coil with the wires well air spaced would have a lower self-capacity than one which had been soaked in paraffin wax, or had been heavily shellacked after completion.

Formers

It is evident, however, that we must employ some kind of insulating former on which to wind our coils and the individual turns must be insulated from each other. The best practical compromise, in the case of a medium-wave coil, is to use a single layer of double silk-covered wire on a smooth cylindrical former. The number of turns for such a coil is not excessive, and they can all be accommodated on a tube of reasonable dimensions. A coil of this character is seen in Fig. 2, on the left-hand side of a two-valve receiver undergoing some special quantitative tests for data purposes.

When we come to long-wave coils, however, which require several hundred turns, a single layer winding becomes out of the question or, at least, awkward. On the other hand, if the windings were put on haphazardly, considerable high-frequency differences of potential might exist between adjacent turns, and the capacity losses would be excessive. This difficulty may be overcome to a great extent by winding the long-wave coil in several sections, the former having a number of slots each containing a proportion of the turns. The long-wave coil windings given later are intended to be wound in five sections.

Table 1 shows a series of windings for medium-wave coils on various sizes of formers, ranging from 1½in. in diameter

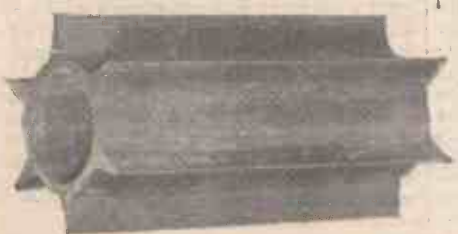


Fig. 5.—A commercial ebonite former, with ribs to enable the winding to be airspaced.

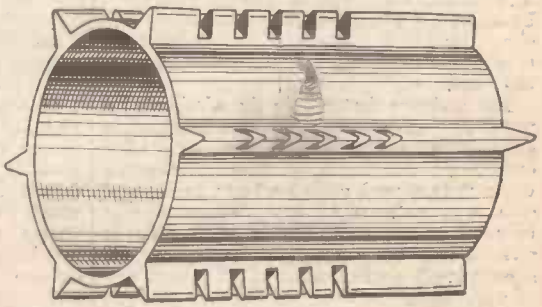


Fig. 3.—How a ribbed ebonite former may be slotted to accommodate the long-wave winding.

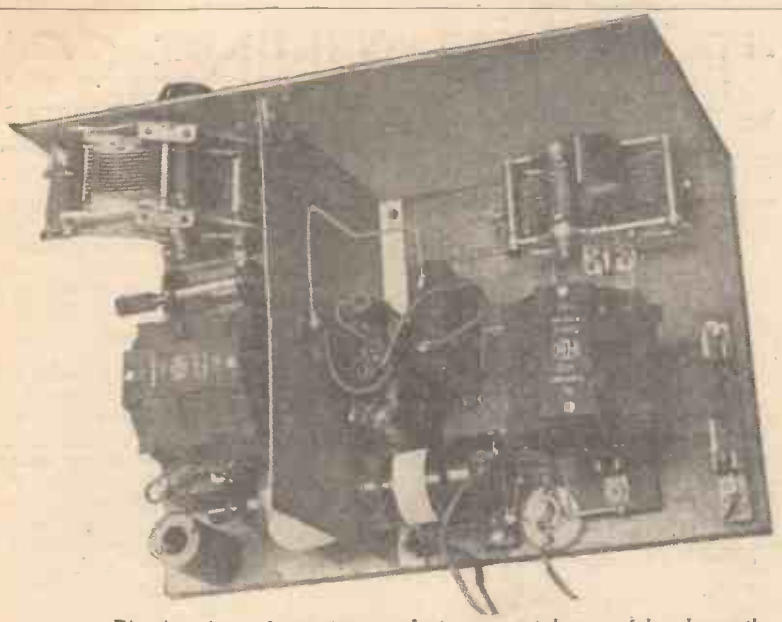


Fig. 4.—An early receiver employing a special type of low-loss coil.

to 3in. in diameter. Where two windings are given for the same diameter the first has an inductance of approximately 175 milli-henries, and the second about 200 milli-henries. The figures cannot be given more accurately than this as all coil design is something of a compromise if standard sizes of wire are to be employed on standard sizes of former.

Winding Data

In every case the winding has been calculated for double silk-covered (D.S.C.) wire, which most constructors can obtain readily and will find more convenient to handle than enamelled wire. The winding is intended to be a single layer with the wires touching, that is to say, no gap is to be left between the adjacent turns. The figures in the second column indicate the length of the wound portion of the coil when all the turns are in position, and it will be as well for the constructor to check up on this when he has finished his coil, for the ratio between the length and diameter, as has already been indicated, affects the value of the inductance of the coil. It is particularly important to check the length if two or more coils are being wound, and it is intended to gang them.

TABLE 1

Medium-Wave Coils

Diameter in inches	Length in inches	Number of turns	Gauge of wire (D.S.C.)
1¼	1.4	90	30
1¼	1.5	100	30
1½	2.25	94	28
1¾	1.2	68	28
1¾	1.25	72	28
2	1.0	58	28
2	1.2	64	28
2¼	2.0	64	24
2¼	2.3	72	24
2½	1.9	58	24
2½	2.0	64	24
3	1.9	50	22
3	2.0	54	22

Long-Wave Coils

The next table, Table 2, gives the windings for a number of long-wave coils, two windings being specified for each diameter. The first winding for each size of former gives an inductance of about 1,600 milli-henries, and is the "general purpose" winding, while the second has an inductance of approximately 2,000 milli-henries, and should be used if the coil is to be a tapped aerial coil.

It will be observed that no instructions are given for coils of a greater diameter than 2in. It is recommended that the long-wave coils be wound on the popular six-ribbed formers, such as that shown in Fig. 3, the ribs being cut or filed in such a way as to form five slots about 1/16in. wide and ⅛in. deep. Readers may remember that the McMichael Dimic coils of bygone days were built up on ribbed formers, and as an example of their use a reference can be made to Fig. 4. This is a high-frequency and crystal detector unit, and, in addition to the fact that single-range coils are used, it is interesting to compare the style of lay-out of these earlier efforts in set design with, for example, the modern to the minute "Fury Four," which has just been featured in these pages. Reverting to our long-wave coil former, a portion of the rib must be left between adjacent slots to the extent of about ⅛in., as shown in the diagram, Fig. 3.

TABLE 2

Long-Wave Coils

Diam. in inches	No. of Sections	Turns per Section	Total Turns	Gauge of Wire (D.S.C.)
1	5	70	350	36
1	5	80	400	36
1½	5	52	260	34
1½	5	60	300	34
2	5	38	190	34
2	5	44	220	34

In the final article of this series I shall give one or two coil constructional hints and then deal with possible future developments in coil design. I shall also deal with the latest type of tuning coil, which employs a solid metallic core—namely, the Ferrocart coil.

CHOOSING AND USING YOUR LOUD-SPEAKER

(*Concluded from page 959, Feb. 4th, issue.*)

IN the case of a normal set and correctly matched speaker, it is desirable to arrange the position of the latter so that all listeners come within the area subtended by the angle of the cone. This will be more easily understood by making reference to the sketches given previously, two positions of the speaker are represented. In each case the listeners should be situated in the unshaded part of the room, because there will be a decided reduction in high-note strength in the areas shown shaded. The latter phenomenon might, however, be made use of when reproduction is rather shrill, by turning the speaker so that the listeners are outside the area subtended by the cone.

Fig. 5 shows that nearly the whole of the room is "covered" when the speaker is situated in a corner (as shown at (*b*)), whilst only a comparatively small area is covered when it is placed with its back towards a side wall (shown at (*a*)). Other things being equal, it will thus be preferable in most instances to arrange the speaker in a corner. This has the further advantage of making better use of the reflective properties of the walls and often gives the impression of increased volume.

Height of Speaker

A number of people believe in the rule that for best results the axis of the speaker should be in line with the ear, that is, about two-feet-six high, when the listener is in a normal sitting position. Whilst I do not subscribe to this or any other definite rule, I suggest that the position is a good one as a basis for further trials. As a matter of fact, I have frequently found that better reproduction could be obtained by suspending the speaker in a corner at a fair height from the floor, and so arranging it that it pointed downward towards the diagonally opposite corner. But, on the other hand, I have on very rare occasions been able to obtain a better performance by putting the speaker very low down or even on the floor. In every case, the position must be governed by the acoustic properties of the room and its furnishings. For this reason a fair amount of care must be exercised in ascertaining the best position for the speaker in a room having a large amount of window space; conditions are quite different when the windows are bare to when the curtains are drawn. Generally speaking, it is best to keep the speaker at some distance from large windows, partly for the reason just given and partly because the glass might resonate at certain frequencies, and so cause a form of distortion.

Built-in Speakers

So far we have considered only the loud-speaker which is separate from the set, but the problem of finding the best position is a good deal more difficult when speaker and set are built into the same cabinet. In the latter case, the position of the complete outfit is governed very largely by the facilities available for the aerial lead-in and earth wire. This often means that the speaker *must* be near to a window; our only hope is thus to place the cabinet in or near a corner and rotate it so that the back is more or less parallel to the window. Further improvements can often be effected by making a slight alteration to the positions of the various pieces of furniture.

The BEST SET OF THE YEAR SPEAKS FOR ITSELF

The Fury Four carries a definite performance guarantee by Mr. F. J. Camm and Direct Radio, Ltd. And now you should add your own verdict. Come and operate the Fury Four yourself and test its performance against other sets at the *Practical Wireless* Official Demonstration Room at 159, Boro' High Street, London, S.E.1. But even if you cannot come along you can order with perfect confidence, as every Direct Radio Kit is guaranteed to give the same outstanding results as the official demonstrated model openly offered to *Practical Wireless* readers for test and criticism.

Official Demonstration of the FURY FOUR *by special arrangement with Mr. CAMM, Editor of* PRACTICAL WIRELESS *at*

159, BORO' HIGH ST.

ACCESSORIES FOR THE "FURY FOUR."

	£ s. d.
SIEMENS 120-volt H.T. battery, standard capacity ..	13 6
OLDHAM type 0.50 L.T. accumulator	9 0
SIEMENS 9-volt G.B. battery	1 0
BLOCK L.T. accumulators, 80 ampere hours capacity	11 6
OLDHAM 120-volt wet H.T. accumulators. (Or 12 monthly payments of 7/6)	4 1 0
ATLAS A.C.244 H.T. eliminators	2 19 6
ATLAS D.C. 13/25 H.T. eliminators for D.C. mains ..	1 19 6
ATLAS A.K. 260 H.T. eliminator, with trickle charger. (Or 12 monthly payments of 8/6)	4 10 0
SPECIAL CELESTION PPM Soundex permanent magnet moving-coil speaker, with input transformer	1 7 6
W.B. PM4 permanent magnet moving-coil speaker, with input transformer.. ..	2 2 0

EXTRA SPECIAL

Two matched CELESTION PPM Soundex speakers. Mounted on new type double packed non-resonant baffleboard. This arrangement eliminates booming, chattering, and directional effects and gives wonderfully lifelike reproduction. Suitable for any battery or mains-driven receiver. (Or 10 monthly payments of 8/6) 3 17 0

BOWYER LOWE AED Mark III pick-up	1 10 0
Volume control	3 0
COLLARO double spring gramo motor, automatic stop	1 13 0
"159" type radiogram cabinet in walnut	3 10 0

FURY FOUR SPECIFICATION

	£ s. d.
1 Lissen Three-gang Coil Unit type LN5162	1 6 0
1 Erie 2-megohm Grid Leak with wire-ends	0 1 0
1 J.B. Unitune two-gang screened condenser .0005 mfd., with disc drive	0 18 6
1 J.B. Nugang Single screened condenser with disc drive ..	0 9 6
1 Ready-Radio .0003-mfd. Differential Reaction Condenser ..	0 3 0
1 Varley Pentode Nichoke	0 12 6
1 Erie 100,000 ohms resistance ..	0 1 0
2 Erie 30,000 ohm resistances ..	0 2 0
1 Erie 5,000 ohms resistance ..	0 1 0
4 Erie 1,000 ohms resistance ..	0 4 0
1 Set of 8 Erie Resistor coupling links	0 1 0
1 pair Panel Brackets	0 0 6
1 Ready Radio fuse holder and fuse	0 1 0
1 Wearite screened H.F. Choke Type HFPA	0 4 0
1 Ready Radio 3-pt. switch ..	0 1 6
1 Ready Radio S.G. H.F. Choke ..	0 5 6
1 Kinva standard screened H.F. Choke	0 2 9
2 Dubilier .1-mfd. C.T. Condenser type B.E.31	0 6 0
3 Dubilier 1-mfd. Condenser type B.S.	0 6 0
2 Dubilier .0003-mfd. Condensers type 665	0 1 0
1 Dubilier .0002-mfd. Condenser type 665	0 0 6
1 Lewcos 50,000 ohm Potentiometer	0 3 0
1 Sovereign .0003-mfd. Preset condenser	0 1 3
1 Ready Radio 3-1 ratio L.F. Transformer	0 8 6
2 Belling Lee Wander plugs G.B.+, G.B.—	0 0 4
3 Clix sub-baseboard valve holders 4-pin	0 2 0
1 Clix sub-baseboard valve holder, 5-pin	0 0 9
1 Belling Lee 4-way Battery Cord	0 1 9
3 Belling Lee terminal mounts ..	0 1 6
6 Belling Lee terminals A.E.P.U., L.S+., L.S.—	0 1 3
1 Permcol Panel 16" x 8" drilled to specification	0 5 6
1 Drilled and foil covered baseboard 16" x 10" x ⅜", and 2 side strips 10" x 2"	0 4 0
1 Direct Radio "159" "Fury Four" Cabinet in Walnut ..	1 1 0
4 Valves to specification	2 17 6
Connecting Wire, Screws, Flex, etc.	0 0 8
	£10 17 9

KIT Model 1

As detailed specification, less Valves and Cabinet. **£6:19:3** or twelve monthly payments of 12/9.

KIT Model 2

As detailed specification (with Valves less Cabinet) or **£9:16:9** twelve monthly payments of 18/3.

KIT Model 3

As detailed specification (with Valves and Cabinet) **£10:17:9** or twelve monthly payments of 20/-.

KIT Model 4

As detailed specification, with "159" Fury Four Walnut Consolette Cabinet and Celestion PPM Soundex Permanent Magnet Moving Coil Speaker **£13:0:0** or twelve monthly payments of 24/6.

BARGAIN KITS

Direct Radio 3-Valve, detector, two L.F. circuit, complete kit of components, 15/-. An easily built three-valve receiver, giving huge volume on local stations and many foreigners.

Direct Radio All-wave Kit, 21/6. A three-valve kit covering ultra-short, medium and long wave-bands. Wonderful world-wide reception, with excellent volume and quality.

Britain's Super Kit. Complete kit of all specified components. £4/12/6. A 5-valve, super-heterodyne receiver, best super-het ever designed, full instructions and blue-print with each kit.

Cosmic dual-range coil, list price 6/6, our price 3/11. Cosmic short-wave coils, list price 4/6, our price 2/11. Cosmic duotune extenser condensers, suitable for use in all extenser circuits, and particularly for Cosmic type triple-wave circuits, list price 15/6, our price 8/6.

TO OVERSEAS CUSTOMERS. We specialise in Radio for Export. Goods to your exact specification are very carefully packed and insured, all charges forward. Terms: Cash with order, or deposit one-third with order. Balance C.O.D.

THE BEST OF ALL THREE VALVERS—DIRECT RADIO SELECTONE KIT DESCRIBED IN PRACTICAL WIRELESS, JANUARY 7th & 14th.

Kit 1.	£4 2 0	12 monthly payments of 8/-
Kit 2.	£5 4 9	12 monthly payments of 10/-
Kit 3.	£6 4 9	12 monthly payments of 11/6
Kit 4.	£8 7 6	12 monthly payments of 15/6

Direct Radio

QUIESCENT PUSH-PULL ACCESSORIES

Varley D.P.36 Quiescent Input Transformer	0 17 6
Varley D.P.37 Quiescent Output Transchoke	0 18 6
Varley D.P.38 Quiescent Output Transchoke	0 16 6
Varley D.P.39 Quiescent Output Transchoke	0 16 6
R.I. Type Q Quiescent Input Transformer	0 16 6
R.I. Type Q Quiescent Output Choke	0 12 6
Sound Sales Quiescent Input Transformer	0 15 0
2 Matched Mazda Pen 220A Pentode Valves for Quiescent stage	1 15 0
Drydex 130 Volts H.T. Battery Type H.1060 for Quiescent Working	0 12 6

T.C.C. A.C. POWER UNIT KITS

Exact to T.C.C. Booklet specification with all necessary components, screws, wire, baseboard, terminals, mains plug, etc.

Power Unit No. 1— £3 7 6—10 monthly payments of 7/6.
Power Unit No. 2— £5 5 0—12 monthly payments of 10/-.
Power Unit No. 3— £5 10 0—12 monthly payments of 10/6.
Power Unit No. 4— £5 5 0—12 monthly payments of 10/-.

Full constructional details of these units are contained in a book entitled "The Design and Construction of Radio Power Units," obtainable, price 6d., from The Telegraph Condenser Co., Wales Farm Road, North Acton, W.3.

CASH, C.O.D., and EASY PAYMENT ORDER FORM.

To Direct Radio, Ltd., 159, Boro' High St., London Bridge, S.E.1.

'Phone: Hop 3000. *'Grams: "Dirrad, Sedist, London."*

Please dispatch to me at once the following goods .....

.....

(a) I enclose
for which (b) I will pay on delivery } Cross out line not applicable } £ .....
(c) I enclose first payment of

NAME .....

ADDRESS .....

Practical Wireless, 18-2-33.

—BEGINNER'S SUPPLEMENT—

HOW YOUR SET WORKS

(Part 1.—TUNING)

The First of a Series of Articles for the Very Beginner—the Man who has not even an Elementary Knowledge of Wireless.

By W. B. RICHARDSON

Fig. 1.—A simple water analogy of the effect of wireless signals.

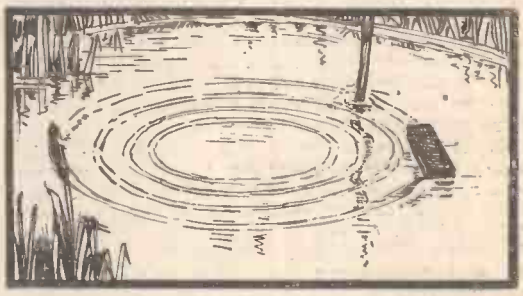


Fig. 2.—How the "aerial" receives the "waves."

Figs. 1 and 2.—Wireless waves may be likened to the waves caused by a stone dropped in a pond.

WITH radio, as with many other technical subjects, it has always been very difficult to explain the mysteries of the science to the absolute novice—to the man with no knowledge of the subject whatsoever. If he has even an elementary knowledge, or perhaps an understanding of the simpler principles of electricity, it is not so difficult, but when he knows no more than that the pressing of a knob starts his set going it is rather a puzzle to know just where to begin. However, there are apparently numerous readers who are in exactly this position.

Some of them have already made tentative shots at grasping the subject but have failed owing to their inability to understand the technical terms accompanied by unintelligible graphs which are usually used in explanation, while others have yet to make the attempt. It is for such readers that this article is intended, and I shall endeavour here to give them some idea—not necessarily a complete understanding—of the functions of a typical receiving set in language which they can understand.

First of all if you are one of these readers I must crave your indulgence if my explanations are not always immediately clear. The subject is of such a highly technical nature that it is sometimes almost impossible to give a "simple" explanation of certain points. Again, technical terms, I am afraid, will have to be brought in here and there, but I will explain their meaning in each case before introducing them.

A Three-valver as an Example

In order to explain how your set works I shall assume you have a typical three-valve receiver of what is known as the "detector and 2 L.F." type. This means a set in which the first valve acts as a "detector" of the wireless waves, that is to say, it converts them into electric currents capable of producing audible sounds, while the second and third valves are both amplifiers which magnify these currents produced by the first valve and pass them on to the loud-speaker.

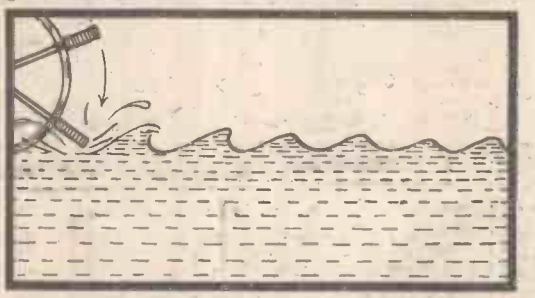


Fig. 3.—An illustration of continuous waves.

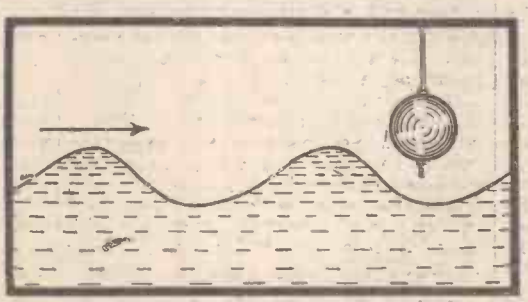


Fig. 4.—The analogy of the pendulum. The waves correspond to wireless waves and the pendulum to your receiver.

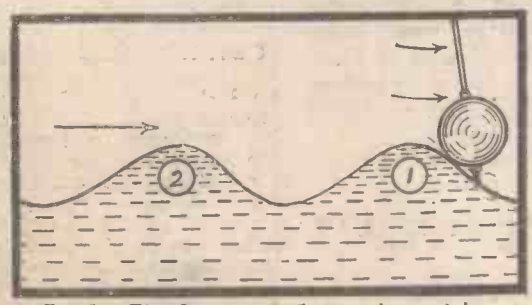


Fig. 5.—The first wave affecting the pendulum.

Figs. 5, 6 and 7.—The action of the pendulum when struck by the waves.

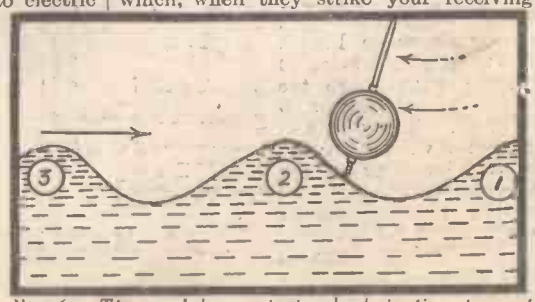


Fig. 6.—The pendulum swinging back in time to meet the second wave.

Wireless Waves

Before dealing with the set itself it is just as well to try to get some idea of how the energy radiated from the transmitting station is able to affect our sets. Let us use an analogy. Imagine a pond of clear, untroubled water. Floating on the surface near the edge is a piece of wood. It is motionless. Now suppose we throw a stone into the centre of the pond. It makes a splash and little waves radiate in ever-widening circles from the spot where it entered until they reach the shore, as in Figs. 1 and 2. Now if you observe the piece of floating wood you will notice that as the first wave strikes it it tilts and rises above it. It then sinks as the wave passes, only to rise again with the next one. And so it goes on—rising and falling as each wave passes under it. Now the stone corresponds to the wireless transmitting station, the water to the ether (that mysterious medium which is supposed to exist everywhere), the waves to the wireless waves, and the piece of wood to your own receiver. In the same way as the stone entering the water causes the radiation of waves which in turn strike the piece of wood and make it move up and down, so the transmitter radiates waves which, when they strike your receiving

aerial, cause an up-and-down movement. This is not, of course, a mechanical movement, but an electrical one. Electric currents move up and down the aerial until the wave ceases.

Their Nature

Now the waves produced by the transmitter are not haphazard emissions like those from the stone in the pond. They are carefully controlled. When the transmitter is switched on, but before any music or speech is broadcast, the waves are emitted in a continuous even stream. Each wave as it is produced is the same size as the previous one, and each one follows at the same interval of time. Actually a broadcast transmitter is more like a paddle wheel beating the water at a regular speed than a stone entering the water, since the waves are continuous and do not die down. This is illustrated in Fig. 3. Of course, there are certain transmitters which, like the stone, produce a succession of gradually diminishing waves, but we will not concern ourselves with these as they are only used for telegraphy. It is the broadcast transmitter with which we are concerned.

Tuning

We have just seen that the wireless waves, on striking the aerial, cause electric currents to oscillate up and down it. Now the aerial is connected to the *aerial coil* and the *tuning condenser*, the whole comprising what is known as the *aerial circuit*. It is really this aerial circuit in which the electric currents oscillate or vibrate. If carefully adjusted or "tuned" it will oscillate very readily in sympathy with the incoming waves, but if it is out of tune it will not respond to anything like the same extent, if at all.

Perhaps this question of *tuning* will be more readily understood if we use a further analogy. Let us consider the example of the paddle-wheel producing a succession of waves on the surface of the pond. These are illustrated in Fig. 3. They are moving in a steady succession from left to right. Now suppose for a moment a pendulum were suspended above the water as shown in Fig. 4. The first wave is shown approaching. The next instant it strikes the pendulum as in Fig. 5 and sends it swinging to the right. Wave number one passes on and the pendulum swings right back to the position shown in Fig. 6. Just as it reaches its highest point to the left a second wave strikes it and swings it over to the right again. This is shown in Fig. 7. Thus the process is repeated and the waves keep the pendulum swinging continuously. This is like your aerial when it is tuned to the incoming waves. The continuous rhythmic swinging of the pendulum is dependent on its being of a suitable length so that it swings back at just the right speed to be in the correct position when it receives the impact from the next wave. If the pendulum were too long it would move slowly and quite likely be still on the return swing to the left when the second wave arrived. Its swinging would then be stopped rather than helped. In the same way, if it were a very short pendulum it would naturally be much quicker in its movements and in that way get out of step with the waves.

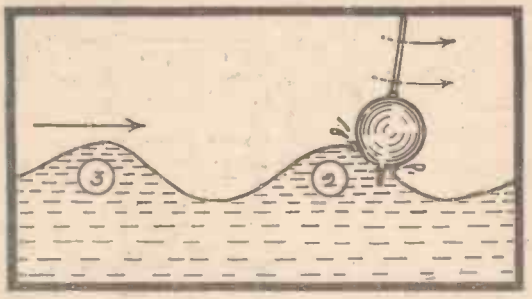


Fig. 7.—A further impetus is given to the pendulum by the next wave.

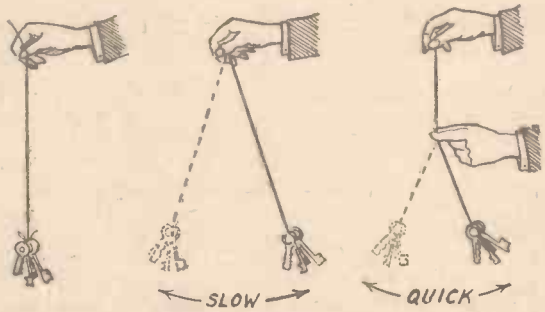


Fig. 8.—A quick way of verifying one of the laws of the pendulum.

The Law of the Pendulum

By the way, if you are in any doubt about the difference in behaviour between a long and a short pendulum you can easily make a little experiment for yourself. Tie a bunch of keys to a piece of string, as in Fig. 8, and set it swinging. Then while it is still swinging catch hold of the middle of the string with your thumb and finger so as to stop its motion at that point. In effect you will have halved the length of the string. At the same time you will notice the motion of the pendulum suddenly increase in speed. It will oscillate to and fro at a much faster rate than previously. Similarly if you suddenly increase the length of the string while the pendulum is moving it will slow it up. This experiment shows that the natural speed at which a pendulum will swing depends on its length.

In our illustration the pendulum corresponds to the aerial circuit of the receiver. If the pendulum is the right length it will swing in harmony with the waves, but if it is not it will get out of step. Likewise, if the aerial circuit of your receiver is accurately tuned it will resonate in sympathy with the incoming wireless waves, but if it is not then it will no longer resonate.

Why you do not hear all stations at Once

It is because a set has to be tuned to the waves being received that it makes it possible to have a number of transmitting stations all broadcasting at the same time, while only one can be heard by the receiving set. Of course, each broadcasting station sends out waves, but they are not all of the same length. One station will radiate long waves and another one short waves. Naturally, if your receiver is tuned, or in step as it were, with one station it cannot also be in step with the other. Take the example of the pendulum again. In Figs. 5, 6 and 7 it is shown swinging in unison with the waves of the water. The crest of each approaching wave strikes it at just the right point in its course to keep it swinging continuously. Now suppose that suddenly the waves came along crowded much closer together, so that before the pendulum had time to swing back from the first stroke it was hit by another wave. Obviously the swing of the pendulum would be upset. It would not respond to the waves. In the same way if the waves were "longer" than those shown, that is, if their crests were further apart, the pendulum would still not respond.

These three conditions—the first where the waves are just the right length, the second where they are too short and the third where they are too long—correspond to the conditions prevailing when your set is tuned to a particular station while two other stations are also transmitting, one on a shorter and the other on a longer wavelength. Only one station would be received—not three! To pick up either of the other stations the aerial circuit would have to be re-tuned in the same way as the length of the pendulum would have to be altered if it were to keep in swing with shorter or longer waves than those shown in Figs. 5, 6 and 7.

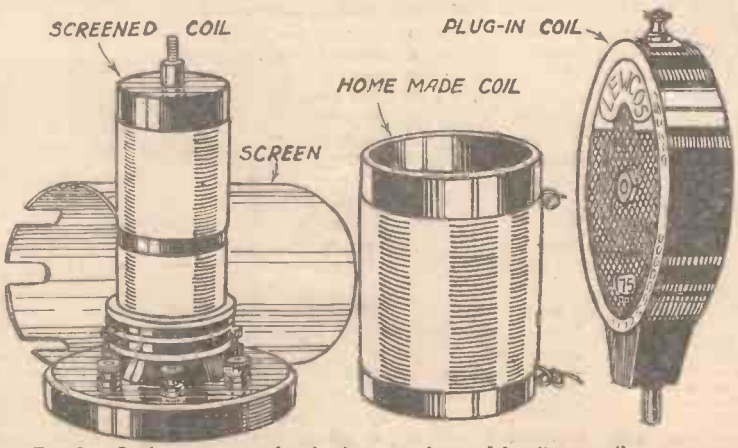
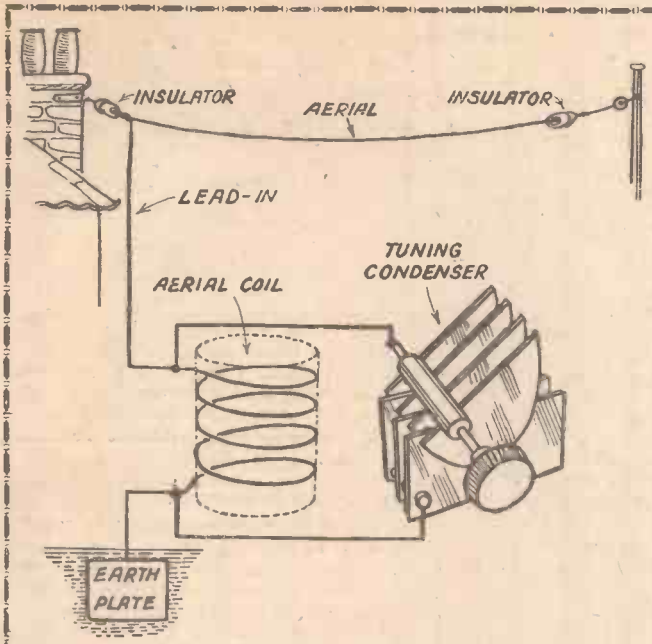


Fig. 9.—Different types of coils that may be used for "tuning" your set.

The Aerial Tuning Coil

Now for practical details! You may think I have been writing rather glibly of aerial coils and tuning condensers without explaining what actually they are, but the idea was for us to get some grasp of the general principles of tuning first of all. Well, now let us



[Fig. 10.—Essential parts of the aerial circuit shown diagrammatically: See text.

take the aerial coil. No doubt you have seen plenty of examples even if you have not recognized them as such. It usually consists of a coil of copper wire wound round a tube of cardboard or bakelite, or in the case of some plug-in coils the wire is wound in such a manner as to be self-supporting. Sometimes the coil has a metal cover like a cocoa tin, in which case the wire cannot be seen until the cover is removed. Three typical examples of coils are given in Fig. 9.

The wire used for the coil is covered with silk or cotton. This is called the *insulation*, and is necessary in order to compel the electric currents in passing from one end of the coil to the other to go round every turn and not to jump across from one turn to the other, as would happen if the bare copper wire were used with each turn touching its neighbour. You see, electric currents always take the path of least resistance. However, they cannot travel through silk or cotton, and so must travel the whole length of the wire. Incidentally, some small coils have the turns of wire spaced wide apart so that there is no risk of their touching one another. With these silk or cotton insulation is not necessary, and bare wire is used, but this arrangement is not usually practicable with the larger ones.

The simplest way of connecting the aerial coil is shown in Fig. 10. One end is joined to the aerial, and the other to the *earth*. This latter may be a metal plate or rod buried in the ground or may be a water pipe or some similar piece of metal in connection with the earth. The tuning of the aerial circuit is dependent on the size of the aerial coil and the tuning condenser. If the aerial coil has a large number of turns of wire it will be suitable for receiving long-wave stations. If it has a few turns it will tune to the short waves.

The Tuning Condenser

The use of the tuning condenser is to make the final adjustments. The coil is wound with sufficient turns to receive the shortest waves required, and the condenser is then used to increase its range to include higher wavelengths. This obviates the necessity for adding to or removing turns from the coil.

The condenser, as you can see, consists of two distinct sets of metal plates. One set rotates on a spindle so that they can pass between the other set. The two sets do not actually touch one another, but are brought near together or separated at will by rotating the spindle. This is how the final adjustments of tuning are carried out. By rotating the knob you can make your set respond to various wavelengths. It is similar to being able to adjust the length of the pendulum we have been referring to. If you wish to receive a station using a comparatively short wavelength, then you set the plates wide apart, but if the station required uses a longer wavelength, then the plates have to be brought nearer together. As soon as they are in just the right position your aerial circuit will resonate in sympathy and so you will be able to receive the signals.

Next week I shall show what happens after you have "tuned-in," how the music and speech are carried by the waves and explain the use of the first of the three valves in your receiver.

Loud-speakers and Frequency Range

A VERY interesting paper was read before the Institution of Electrical Engineers recently by Dr. McLachlan on "Loud-speakers." Much of the substance was of a highly technical nature and demonstrated the vast amount of research work the reader had given to his subject. He said that there was no mathematical formula for the vibrational frequencies of a cone, these having to be found by experiment, but single speakers had been found to have a cone giving a range up to 4,000 or 5,000 frequencies per second. Of course general broadcasts rarely have passages of music exceeding this frequency, but some instruments can go well over this if desired. Dr. McLachlan found, however, that by the use of another loud-speaker in conjunction it was possible to extend this range up to 7,000 per second, this making the reproduction much more pleasing and natural, at the same time offsetting to a great extent the masking effect of the low tones. Improvement in efficiency and a greater damping of resonance would follow with the use of stronger magnetic fields and improved magnet design, it being preferable to use electro-magnets. The speaker said he had obtained good results from a horn speaker operated by a 6in. diaphragm, the bass response and the high note reproduction being satisfactorily balanced. Emphasis was given to the point, often overlooked, that sound had size, and that a full orchestra needed a reproducer of larger area than that of a solo instrument. Something like this has been at the back of my mind for some time, because it seems

FROM HERE AND THERE

unreasonable to expect a full concert orchestra, occupying the best part of the platform of a large hall, to satisfactorily reproduce from the small speakers we are in the habit of using. It is the business of those responsible for the transmission to see that by careful disposition of several microphones we get a fair balance of tone, and it is up to us to handle it on the instruments at our aerial end. That is why I like to use as many loud-speakers as I can get hold of when I want to listen to a particularly good concert. If you have any near-by radio friends, try the experiment one night of borrowing all their loud-speakers or getting them to come along and join in, and placing the speakers in different places all round the room. The sound in this way loses the effect of coming all out of one "spout," and the room seems to be full of sound and echo that is a near replica of the effect prevailing in a concert hall. There is no need for tremendous volume, and a number of speakers working at rather below medium strength sounds much better than one being forced. Another point raised by the lecturer was that commercial manufacturers of radio sets rarely allotted a sufficient proportion of the total cost of their apparatus to the loud-speaker, and it struck me that in many cases this was true. Too often do we see really fine sets of superb workmanship spoilt by a poor loud-speaker, often of inferior make. This is all the more strange when we consider that the whole performance of the set is judged by what issues from the speaker. For this, I think, the problem of space has been the greatest deciding factor, for which, I think, we should blame feminine influence to a large extent. I say this in all seriousness, for it is true that lately more and more sets have been designed to catch the eye of the housewife, who hates all unsightly wires and whose heart warms to the compact sets with self-contained speaker of the transportable type. My own opinion, however, is the opposite, and I wonder how many of you agree? I like the set and the speaker to be separate units like a cart and a horse; lots of interaction and "singing round the ring" troubles are obviated, and one can do justice to a good speaker by giving it plenty of cabinet room or a full-sized baffle.

Inventions' Competition at Paris Trade Fair

Those of you who are of an inventive turn of mind may be interested to know that a competition for new inventions will be held in connection with the Paris Trade Fair, to be opened in that city on May 13th. Inventions will be collected into five groups, one of the groups being devoted to radio and electrical inventions, and each group will be judged separately, and independently. Handsome prizes, automatically made more attractive by the rate of exchange, will be given, and the London office of the Fair is at 143 Fleet Street.

A STAND-BY TWO-VALVE RECEIVER

A Simple and Original Type of Receiver for Emergency Use

By H. R. NEWTON

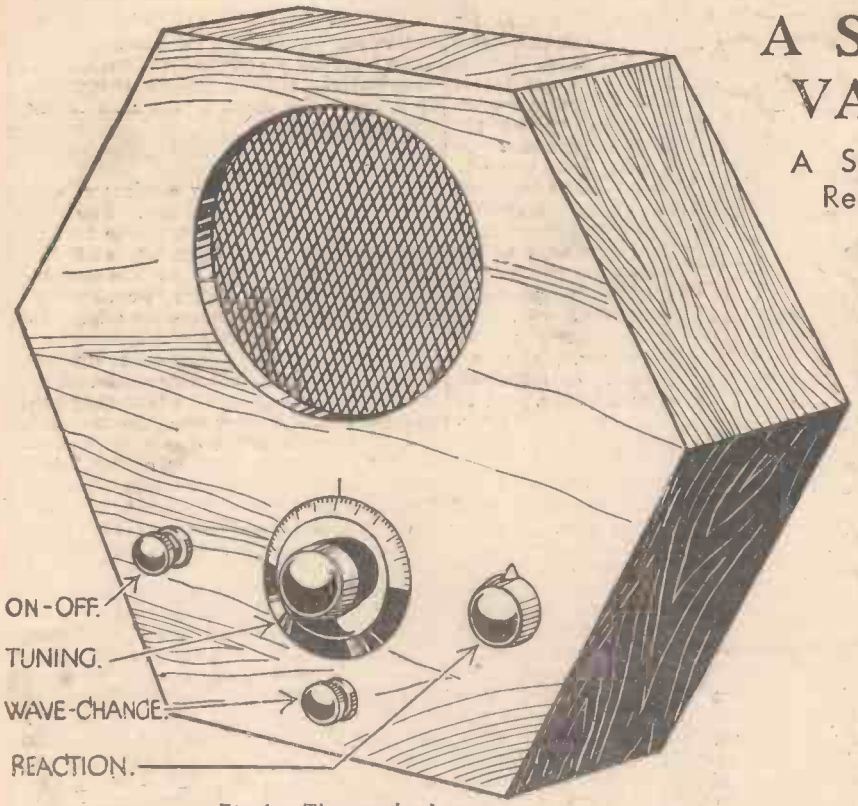


Fig. 1.—The completed receiver.

THE receiver described below was primarily designed for use as a stand-by set, and mainly came into operation when the author's own more ambitious receiver was undergoing alterations and improvements. When first built, it consisted simply of a baseboard upon which components were mounted, a panel, and a separate loud-speaker unit in a cabinet. The receiver was in the work-room, and the speaker installed in the living-room, and connected to the receiver by extension leads. Later, however, it was thought desirable to move the whole receiver into the living-room so that it could be operated by any member of the family at will.

Accordingly, the whole set was redesigned, the receiver and loud-speaker being incorporated in one cabinet, space for L.T. and H.T. batteries being found inside the cabinet as well. Fig. 1 shows the completed receiver.

Details of Construction

The construction of the cabinet presented little difficulty. Fig. 2 shows the baseboard, upon which the components are mounted, and the front panel, to which the variable condenser, reaction condenser, wave-change, and on-off switches are attached. As will be seen from Fig. 1, the front panel fulfils the dual purpose of control panel and loud-speaker cone support, or "baffle." This panel is fastened to the baseboard by means of four wood screws, passed through the front.

There is nothing unusual about the circuit, which incorporates a leaky-grid detector, followed by a transformer-coupled output valve. The tuning-coil is of the usual dual-range type, and is wound with fifty turns of 30-gauge D.S.C. wire on a former 2in. diam. by 3in. long. Half an inch below this comes the reaction coil, twenty turns of the same gauge D.S.C. wire, and approximately ⅜in. below this is wound the long-wave section, consisting of 150 turns of 30 D.S.C. wire. The construction of the coil is clearly shown in Fig. 3. In the case of the long-wave winding, which is hank-wound, it was necessary to wind the wire tightly on the former, in order to prevent it becoming slack later.

Mounting the Components

The L.F. transformer has a 5 to 1 ratio, and the valves used in my case were general purpose and small power valve. The layout and wiring is exactly as shown in Fig. 4, which is self-explanatory. The front panel consists of a piece of 3-ply, cut to shape, with a hole in centre for speaker cone, and this was covered with a piece of silk gauze, gummed to back of panel. The sides of the cabinet were cut from ⅜in. plywood, and the ends were shaped to fit neatly. The speaker unit was screwed to a strip of wood screwed to rear of cabinet, and the cone was adjusted so that it touched the rear of the front panel.

The process of cutting out and shaping the cabinet sides may present some diffi-

(Continued on page 1061)

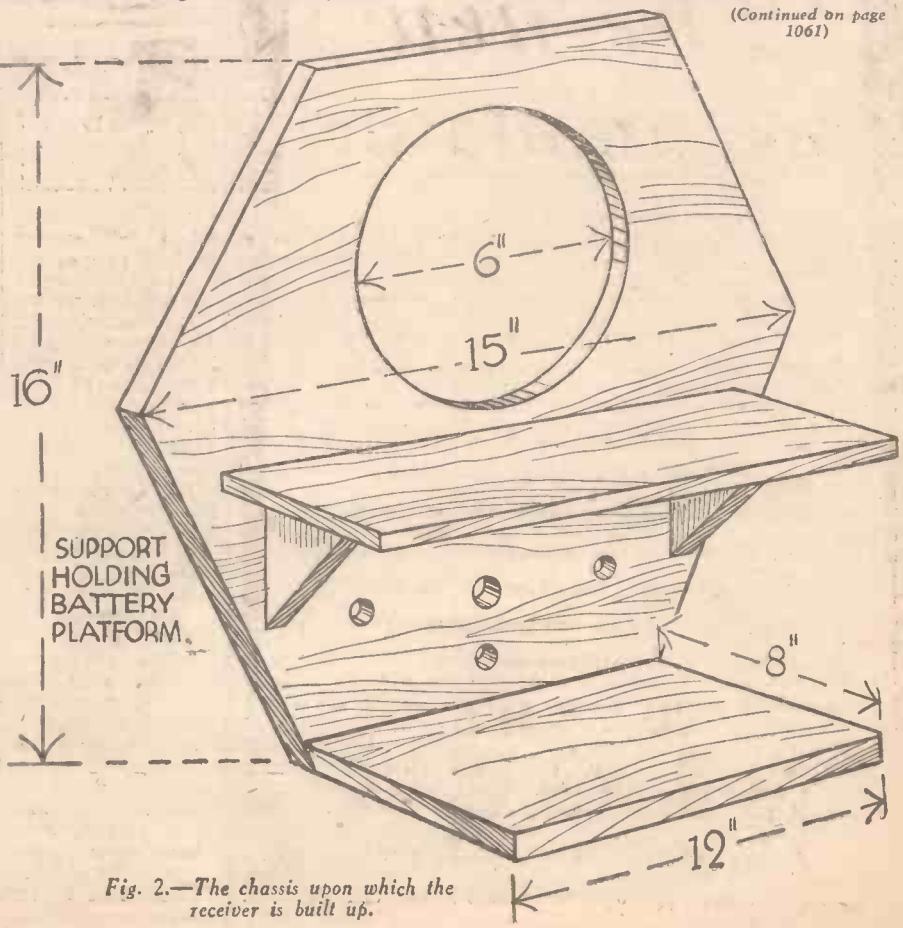


Fig. 2.—The chassis upon which the receiver is built up.

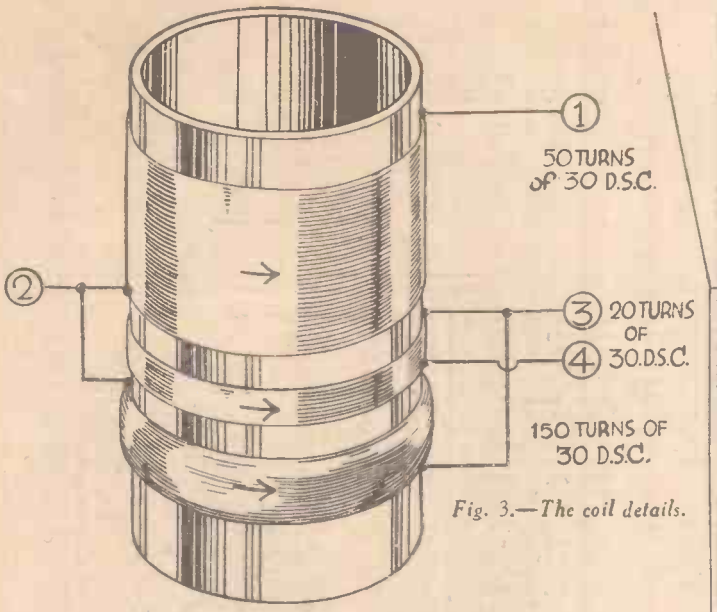


Fig. 3.—The coil details.

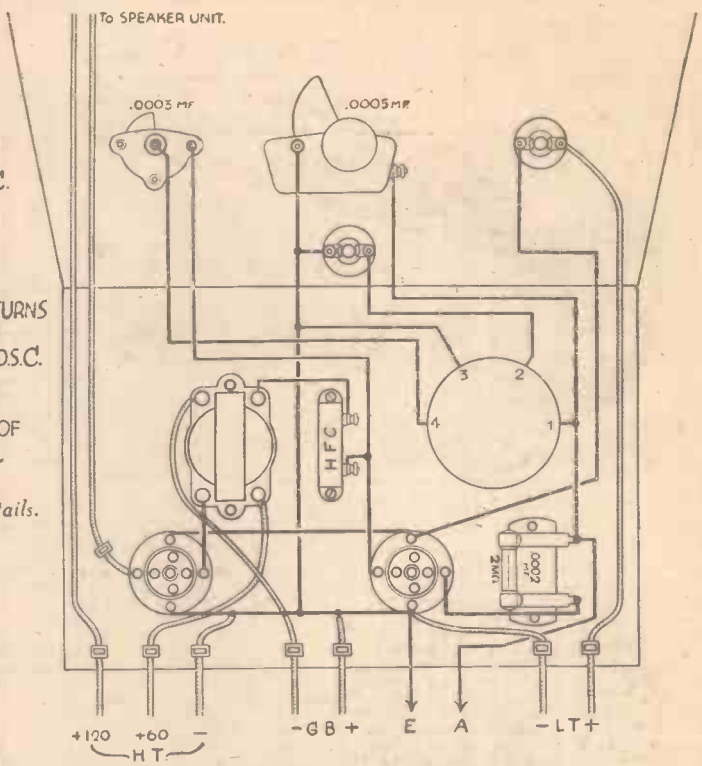


Fig. 4.—Wiring diagram of the Stand-by Two.

(*Continued from page 1058.*)

culty to anyone not accustomed to this work, and in such a case, any wood-shop will cut and shape the wood to specification for a very moderate sum. The appearance of the completed set is very satisfactory, and it is worth while going to some small trouble in order to have a set that is pleasing to the eye as well as to the ear.

I have not followed usual practice in one respect, and that is, in place of the usual terminal strip I have taken flex leads direct from components on the baseboard to the batteries, the leads being fastened at edge of baseboard by means of small rubber insulated cleats. The batteries are placed on a shelf inside the cabinet, the shelf being fixed in position above the components on front panel. This does away with unsightly leads from the set to the batteries.

On test, the set received National and Regional programmes with more than sufficient strength, using an indoor aerial about 20ft. high and 14ft. long. I used approximately 60 volts on the detector anode and 90 to 120 volts on the power-valve, with grid-bias 6 to 9 volts negative.

FOLLOW THE SIGNAL THROUGH THE RECEIVER

A Simple Explanation of How a Signal Passes Through a Typical 3-valve Receiver.

(*Continued from p. 976, Feb. 11th issue.*)

The Det. also "separates," to a certain extent the high- and low-frequency currents, because the former are no longer required. Both kinds of current pass into the anode circuit of the valve, but the high or signal frequencies are prevented from passing into the low-frequency amplifier by the insertion of a high-frequency choke. The choke offers practically no resistance to currents of low frequency, but forms a complete barrier to high frequencies. Of course, the high frequencies have to go somewhere, so a fixed condenser is joined between the plate of the detector valve and high-tension negative, so that they can leak away to earth. The condenser must only have a small capacity, up to .0003 mfd. or so, or else it will also allow some of the low frequencies to leak away as well.

Feed-back

For reasons of economy it is usual to make the detector valve perform the function of an amplifier as well as that for which it is nominally intended. To enable it to do this we apply what is commonly known as "reaction," although for some reasons I prefer to call it "feed-back." The idea is that some of the high-frequency current in the anode circuit is returned to the grid circuit. This is again passed through the valve and amplified, returned to the grid circuit again, amplified again, and so on. It will be seen from this that the valve acts both as a high-frequency amplifier *and* a detector. There is a limit to the degree of amplification which can be obtained in this way, for when the feed-back exceeds a certain amount the valve falls into a state of self-oscillation and signals become distorted.

Reaction or feed-back can be provided in two or three ways, but the most common is to connect the plate of the detector valve (through a variable condenser) to a coil or winding placed near to the tuned grid or tuned anode coil. The H.F. currents, therefore, pass into the tuning coil from the reaction coil by magnetic induction, and the amount of current passed on in this way is controlled by the variable (reaction) condenser; the larger its capacity the greater the degree of feed-back, and vice versa. It might be mentioned that for the reaction effect to take place the currents passed back must be of the same phase, or flowing in the same direction, as those in the tuning coil, and therefore the ends of the reaction coil must be connected in a particular way. Thus, when the reaction and tuning coils are wound in the same direction, and the "beginning" end of the tuning coil is connected to the grid of the valve, the "finishing" end of the reaction coil must go to the plate (through the reaction condenser).

The Low-frequency Transformer

We now come to the low-frequency transformer. This consists of two windings, of several thousand turns of fine wire each, mounted side by side on an iron core. The first of these windings, the primary, has fewer turns than the other (called the secondary) and the effect is that signal voltages applied across the primary appear in amplified form across the ends of the secondary. Theoretically the degree of amplification is proportional to the ratio of the number of turns on the secondary and primary windings.

The low-frequency voltages from the detector valve are passed to the primary of the transformer, and are thus fed to the grid of the low-frequency valve from the secondary winding. Let us go back to the primary for a moment; besides dealing with the low-frequency currents it has also to carry the direct current from the high-tension supply to the plate of the detector valve. This introduces a slight complication because the low-frequency currents are free to leak into the high-tension supply. Provided the resistance of the high-tension battery or eliminator is fairly low this does not matter, because the currents can leak away to earth through it. But if the resistance is high they will probably attach themselves to the high-tension voltage and so be applied to the plates of other valves.

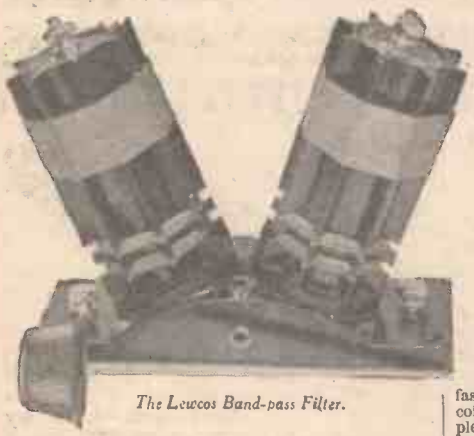
What we Found..

WEARITE CHOKES

WE have already commented upon the excellency of the Wearite H.F. Chokes, which are made in two types. Both are screened in small aluminium screens, but one is provided with an armoured pigtail. The new models of these chokes are now finished in gilt instead of the usual aluminium, and this naturally makes the component look much more imposing. It was not this point, however, which impressed us so much as the fact that at last it would appear that component manufacturers are becoming alive to the fact that the home-constructor experiences great difficulty in assembling the average receiver owing to the multiplicity of screws that are required to fit the holes in each individual component. Inside the box which contains the Wearite choke there now appears a small transparent envelope containing two ordinary wood-screws thin enough to fit the base of the choke. If all manufacturers carried out this simple idea, the path of the constructor would be made much simpler. The choke is 3s. 6d.

LEWCOS BAND PASS FILTER

WHERE it is desired to construct a really efficient and selective aerial input circuit, there is no doubt that the Band Pass Filter is the method to adopt. The illustration below shows the new Lewcos Band Pass Filter, which is an extremely neat and



The Lewcos Band-pass Filter.

efficient form of tuning coil. Two moulded ebonite formers are arranged on a base so that they form an angle and so avoid interaction between the two coils. Although small in diameter, these coils are extremely efficient. The medium-wave winding is carried in solenoid fashion at the upper part of the former, and the long-wave winding is pile wound in slots at the foot of the former. The switch passes through the base and operates two spring contacts for wave-changing. The necessary aerial coupling condenser is also housed inside the base. To complete the band pass circuit an additional .01 mica condenser is necessary, and if required a high resistance may also be used. There are, of course, several alternative methods of wiring up the band pass circuit. The coils are designed to give a flat-topped response curve with a width of roughly 9 kilocycles, so that the separation of most stations is possible, without any trace of interference. The price of this component is 12s.

MEGGER TESTING SETS

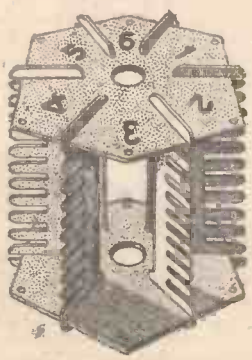
IN our recent Data Sheets we included one which gave the percentage error which is desirable in various forms of instrument. Included in these was the Megger, for which was given 2.0 to 4.0 per cent. We are informed by Messrs. Evershed and Vignoles that the word Megger is a registered trade-mark, and that the percentage error is somewhat misleading. It is, of course, quite true that the word "Megger" is a registered trade-mark, but it is a term which is used quite generally in electrical engineering as a measurer of high resistences, and a direct referance to Messrs. Evershed and Vignoles' particular instrument was not, of course, intended. The instruments were given as a class, and no reference to any particular firm was intended. We are, however, very glad to mention this fact herein, and also to bring to the attention of our readers that a number of Physical Laboratory Certificates which have been sent to us show that six instruments taken from stock and submitted for test, contained no error whatsoever. We are assured that owing to the special method of calibration employed human inaccuracies are eliminated so far as is possible.

KONDUCTITE

READERS have no doubt noticed that we now favour the chassis method of construction for our receivers. This is undoubtedly more efficient than the flat baseboard type of receiver, and lends itself much better to neater wiring and arrangement of components. Whilst the aluminium method is the better, ordinary wood may be used. For screening the new metallic paper bearing the name "Konductite" will be found to convert the wooden chassis into what is virtually an all-metal chassis. "Konductite" consists of ordinary thick paper, upon which is deposited extremely thin aluminium foil. The result is an easily workable screening medium which may be fixed to wood with ordinary adhesive or drawing pins, etc. By turning over the edge a join may be made which is almost as good as an electrical connection and it is thus a simple matter to build up screening boxes, vertical screens, chassis, etc., which have all the virtues of a solid metal arrangement, without any of its working difficulties. Electrically, there is no difference between the metallic surface of "Konductite" and sheet aluminium as usually employed. We shall undoubtedly employ this medium for future receivers where screening is necessary. The price is 2s. for a sheet 30ins. by 20ins. and it is obtainable from the City Accumulator Company.

"EWEBEC" COIL-FORMER

THE home-constructor who wishes to build up a simple coil, without going to the trouble of slotting ebonite, etc., will find the Ewebec coil former a very useful aid. The former is made from stiff bakelised card, and two hexagon end plates are slotted to accommodate six side strips which are toothed similar to a comb. The coil windings may be wound in solenoid or pile fashion, and the result is a neat, low-loss and efficient coil at a minimum of expense. The former, complete with instructions, costs 1s. 3d., and a Dual Range coil may be accommodated on one former at the expense of 2 ozs. of 28 D.S.C.



The Ewebec Coil Former assembled.

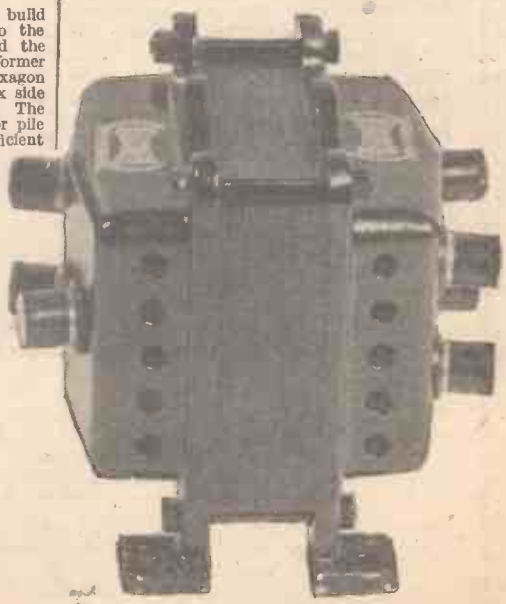
DIFEED TRANSFORMER

RADIO Instruments, Ltd., continue to produce low-frequency coupling components, and the latest produce is the Difeed Transformer. The Parafeed is, of course, well known, and the name is an abbreviation of the term "parallel feed," signifying that the transformer is intended primarily for use in a parallel fed L.F. stage. The Difeed is an abbreviation of "direct feed," and signifies that the transformer is intended to be connected direct in the anode circuit of a valve. This is a miniature transformer, having a nickel iron series "K" metal core, and a high-inductance primary designed to carry up to 4 m/A without saturation. The complete transformer is very little larger than a match-box, and costs only 7s.

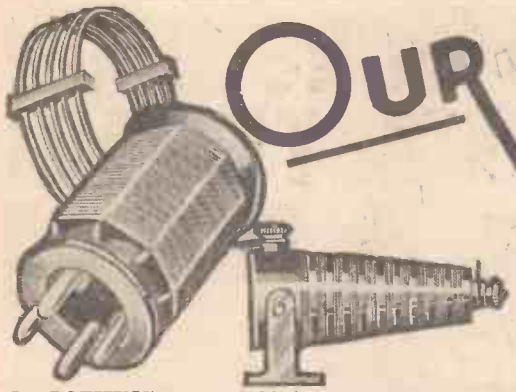
The R.I. Difeed L.F. Transformer.

HEAYBERD TRANSFORMER

SOME time ago we reviewed in these pages the Heayberd Model 723 Low Tension Transformer. This has now been redesigned, and the new model is shown below. This has similar characteristics—namely, an output of 2+2 volts at 3 amps., with input terminals to suit all mains voltages. It may be used to supply the heaters of from one to three 4-volt indirectly heated valves, and the price is 12s. 6d. This transformer is enclosed in the new type metal case, and we understand that it is now ready for distribution to the public.



The Heayberd Type 723 Low Tension Transformer.



OUR SHORT-WAVE SECTION

NOTHING is more likely to try the patience of short-wave enthusiasts than the possession of a receiver which refuses to "stay put" on any adjustment. Any little fault which passes muster in an ordinary broadcast set assumes enormous proportions when one delves into the "wavelets." It will repay us to examine a few of these points in some detail. It is hardly necessary to go over old ground in emphasizing such essentials as good and rigid connections, and the avoidance of rickety coils. In short, one must be absolutely satisfied that the mechanical side of the set is above reproach. When we come to the electrical side of things, matters are not quite so straightforward.

No article of this nature would be complete without the mention of that bugbear of all short-wave fans, hand-capacity. In a previous issue of PRACTICAL WIRELESS the author described a useful method of alleviating this trouble. However, the old adage that prevention is better than cure is as true as ever. In broadcast receivers it is generally thought essential to earth the set: one has only to remove the earth connection to prove this; everything immediately becomes horribly unstable. It is not, however, such a serious omission in connection with short-waves. If it is found impossible to obtain a good short run to earth, the chances are that it will be all the better to omit the connection altogether. In any case a long straggling lead is definitely taboo, as it is certain that the receiver will not be at earth potential in such a circumstance. No hard and fast rule may be laid down, however, and it is as well to try a little experiment in this direction. Whilst on this matter it may be remarked that a sluggish receiver will often regain its liveliness by the removal of the earth wire. The damping effect of the latter is often quite serious, especially when the detector valve takes a little coaxing to oscillate.

SHORT-WAVE RECEIVER INSTABILITY

By ERIC JOHNSON

The discussion of hand-capacity immediately raises the old controversy of metal *versus* non-metal panel. Here again it is difficult to make any definite assertions, but unless one can be sure of a really good earthing system the advantages of a metal panel are questionable; even then it will often be found that part of the panel remote from the earth wire is not at zero potential. The writer really fails to see the necessity for metal, providing good variable condensers are used, preferably those type which have their moving vanes connected to metal end-plates, the latter, of course, being earthed. If hand-capacity is still troublesome extension handles may be fitted to the condensers, as recommended in the construction of the "Empire Short-wave Three."

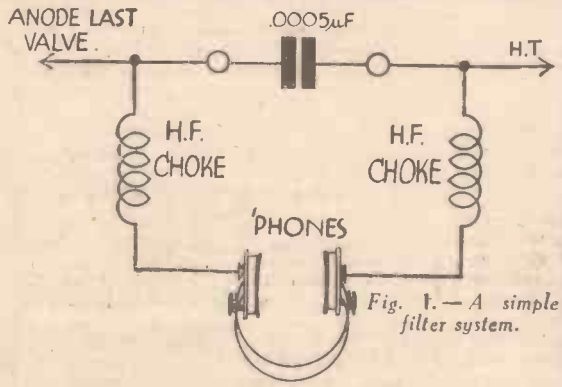


Fig. 1.—A simple filter system.

Filter Systems

In spite of these precautions it may still be found that the set is terribly unstable. More often than not the trouble is due to H.F. currents finding their way into the L.F. part of the set. It is extremely exasperating to tune in a station nicely, only to find that the slight movement of one's head causes serious "wobbling" of the signal. Presence of H.F. in the 'phone leads is responsible for this. In an emergency the trouble may sometimes be alleviated by connecting a small condenser, .0002 mfd. or thereabouts, across the 'phone terminals, and thus forming a low resistance path for the unwanted currents. By far the best method, however, is to incorporate a proper filter system. The details may be seen from Fig. 1. The H.F. chokes in each lead are very simple, and may be quite easily made by winding about 100 turns of 28 d.c.c. on 1in. formers. Any commercial short-wave choke will, of course, suit the purpose. These chokes offer a very high impedance to the H.F. currents which are compelled to take the easy low-resistance path formed by the condenser. It need hardly be said that the speech currents are in no way impeded, as the inductance of the chokes is far too low to have any appreciable effect at audio-frequencies.

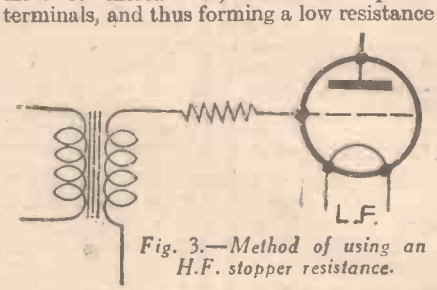


Fig. 3.—Method of using an H.F. stopper resistance.

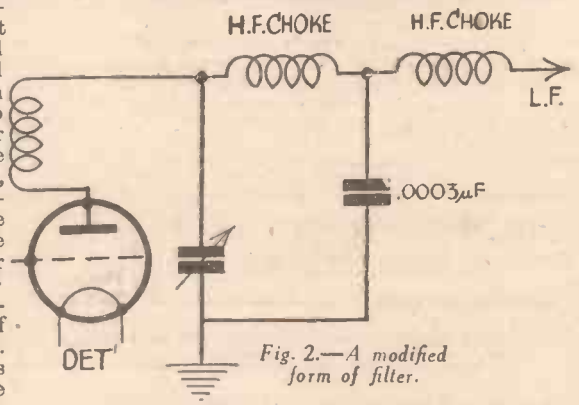


Fig. 2.—A modified form of filter.

Perhaps the most commonsense way of approaching the matter is to prevent H.F. currents from entering the L.F. part of the receiver at all. Here again some sort of filter is most effective, the one shown in Fig. 2 being commonly used. Quite often it will be found that a combination of several schemes must be used to ensure complete stability. Quite a popular system employed nowadays is the H.F. stopper resistance inserted in the grid-leak of the L.F. stage. A variation of this is a combination of choke and condenser; both arrangements are shown in Fig. 4. The writer is more inclined to favour the grid resistance for this reason: if there is any tendency to overloading the grid potential will sweep down to the bottom bend of the valve characteristic in one direction, into the grid-current region in the other; now, no brief is held for permitting this to happen, but it is a well-known fact that distortion due to grid current flowing is far worse than quite a severe amount of bottom bending. The presence of the grid stopper tends to limit grid current because, should any flow, the fall of potential along the resistance tends to increase grid-bias; to make this really effective the stopper should be at least ½ megohm. If we make it too high we shall find, however, that there is a tendency for high-note cut-off; in a short-wave receiver this may be tolerated, as quality is seldom so good to warrant sacrificing other advantages. If one is really critical, and the extra complications

are not objected to, a stage of tone-correction may be incorporated.

No receiver worth its place is complete nowadays without decoupling. In short-wave sets motor-boating is often intolerable because of this omission. If a battery set, trouble is often unnoticed when the H.T. is new. After a few months' use, however, the internal resistance increases and forms an impedance common to all valves. Violent instability is the result. With

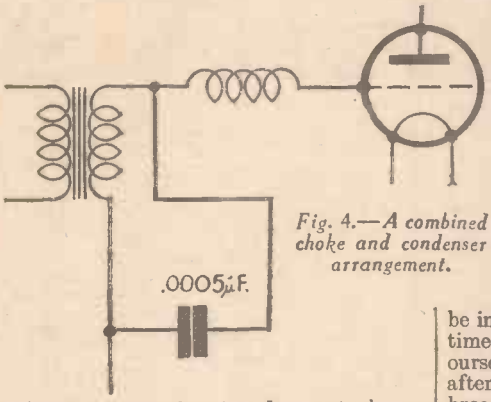


Fig. 4.—A combined choke and condenser arrangement.

mains sets motor-boating does not always manifest itself; the trouble is present right from the start as a bad hum which no extra amount of smoothing will cure. In each of these cases adequate decoupling of the anode circuit will effect a cure.

WORLD TOURS ON SHORT WAVES

I SPANNED the globe with abandon. Africa, India, Australia, and America slipped silently beneath my fingers. There seemed to be nobody else in the book department. But I was just approaching the west coast of Ireland when an assistant started from his ambush behind a pile of cheap editions and asked if he could help me. A few minutes later I was on my way home with a globular package under my arm, and the best part of ten shillings gone from my pocket.

That globe, standing on the table beside my short-wave set, suggested a cheap, rapid, and interesting way of touring the world. Why not hop from continent to continent by wireless, planning your route by broadcasting stations and their schedules instead of the time-tables of railway and steamship companies?

At first I thought I would be able to make a complete circuit of the globe in ten minutes or so, until I remembered various tit-bits of physical geography I had picked up at school and dismissed at the time as useless. One of these was that when you travel round the world you gain or lose a whole day, according to your direction, which means that when touring by wireless, you sooner or later reach a country at a time when all good announcers are in bed, and are held up for some hours before its programmes start.

As an example, let me quote my World Tour Number One. Travelling in what is practically a straight line from London, you can go to Berlin, Moscow, and then right across Russia to Khabarovsk. Jumping the Pacific to Vancouver, the way home lies through Winnipeg, Bowmanville, and any of the familiar east coast American broadcasters.

Across America

But, in practice, it is not as simple as that. Starting in the very early morning and travelling westward, it is possible to hurry through America to its Pacific coast. But you will now have to wait until after breakfast to hear Khabarovsk. Nor are your troubles over then, for you must cool your heels in this chilly Siberian town for several hours before you are released by the Moscow programmes starting up in the afternoon.

Having looked at our journey on the map, let us now consider how we have travelled in time. Suppose we started at five-thirty in the morning on Saturday. Somewhere between New York and Winnipeg we would catch up yesterday's midnight, and at Vancouver it would only be half-past nine on Friday. Going back at this rate it looks as though we should be in Khabarovsk in time for Friday's tea-time programmes, instead of which, we find ourselves there at half-past two on Saturday afternoon, with three hours to wait before broadcasting starts!

Australia, *via* Paris and South Africa

In mid-Pacific we turned the corner of our journey and crossed the International Date Line. As we are going westwards we have got a day ahead instead of a day behind.

A far more rapid tour can be made on a Sunday afternoon, starting at about half-past three. Cross the Channel first to Paris, and listen to Radio Coloniale on 25.2 metres. Your route now lies through Africa, and involves you in difficulties. Rabat has closed down, and Nairobi and Johannesburg do not start work for an hour or more. If you wait for them you will miss the connection for Australia.

However, you can square matters with your conscience by listening to a little island off the north-west coast of the continent. I refer to Madeira, which is represented by Funchal, on 26.83 metres. You can now legitimately follow the sea route round the Cape of Good Hope and straight across the Indian Ocean to Australia, and Sydney, which you reach just before it closes down at four. This brings you to the severest test of your set. You must strike out across the Pacific and try to pick up Bogota, capital of the South American Republic of Colombia, on 48.35 metres. That is admittedly a tall order in daylight, but remember how we used to hear Saigon on the same waveband, and take courage.

The rest of the way is easy going. The afternoon programmes from Bound Brook and Pittsburgh, on 16.87 and 19.72 metres respectively, bring you to the United States, and then nothing remains but the hop across the Atlantic to the Empire transmitter at Daventry.

These two suggestions by no means exhaust the possibilities of radio world-tours. With an atlas and a list of short-wave station schedules you can plan them almost endlessly. But remember that the seasoned wireless traveller, like his counterpart on land and sea, says good-bye to his family before he starts, and does not commit himself so far as to state when he expects to be back.

RADIO RAMBLINGS

Materials Used in Radio Apparatus

HAVE you ever considered when listening to stations situated perhaps all over the world, that these stations are as scattered as the places of origin of the various materials from which radio apparatus is made? While we owe the principles of radio to a handful of scientists and inventors, the chief of them being, of course, Marconi, the high state of development that our receivers and transmitters have reached to-day is in a large part due to the work carried on by our manufacturers of radio apparatus and components. For instance, if you take the average wireless set, costing anything from ten to twenty pounds, the actual material cost of the raw stock that goes to make the set as a whole might only be about ten to fifteen shillings, not including, of course, the perhaps costly wood from which the cabinet is made. Perhaps the most costly substances in a set are the rare metals from which the valve filaments are made. The most common of these is tungsten which, while being fairly malleable, has the great advantage of being melted at only very high temperatures. It is a dull white in colour, and beside being used for electric lamp and valve filaments, is used in the manufacture of ceramic glazes, and also is alloyed with steel. In the latter its addition to steel in quite small quantities greatly increases the hardness and cutting properties of the metal. Other rare metals with proprietary names are used with varying success.

The glass of the valve bulbs is of a very high quality, but the very improved methods of manufacture during the last fifty years has made good glass one of our cheapest materials; I wonder more use is not made of it in modern radio manufacture. Certain minerals occur in a glassy state, but modern glass varies greatly in composition, according to the use for which it is intended. Sheet and plate glass are mixtures of sand, soda, and lime, with sometimes toughening agents, such as boric acid and borates added.

Copper

PERHAPS the next best substance in order of importance is copper. This metal is as ideal for the purpose for which it is used as it is possible to conceive, it being comparatively cheap, and is extremely malleable and ductile. In addition, it possesses remarkable electrical properties, and is the best conductor of electricity in the whole range of common metals, while at the same time it is non-magnetic. It can be cast, stamped and punched, and drawn into fine wires no thicker than a human hair. It does not easily corrode or rust and can be soldered with ease. It can be alloyed with practically any non-ferrous metal, and is indeed the basis of most modern non-ferrous alloys with the exception of those of the aluminium range. It is found mostly in America in a virgin state in the form of metallic crystals, in the neighbourhood of Lake Superior, and in the state of copper ore elsewhere in the continent. Nearly half the world's copper comes from the United States, although Great Britain was at one time rich in this valuable metal. It has played a bigger part in the development of electrics and radio than any other substance.

JOTTINGS FROM MY NOTEBOOK
BY "DETECTOR"

Nickel

ANOTHER metal that has been used in increasing quantities of late is nickel. This is refined from ores found chiefly in Canada, and the method of refining it is a chemical one as opposed to the more usual method of smelting, the most common ore used being magnetic pyrites. Nickel has a fairly high melting point and is not easily tarnished or corroded. It is a good conductor of electricity and, due to the high finish that can be obtained on it by polishing, is used to a great extent in the electrical depositing or plating of metal articles. In radio it is used for plating terminals and components, as a cat's-whisker for certain crystal combinations for crystal detectors, and sometimes as the contact points of Morse tappers. Alloyed with iron it increases the magnetic permeability of that metal and, as such, the alloy has been used largely for the cores of transformers.

Rubber

ALMOST as important in radio as the means of conducting the currents we utilise are the substances we use as insulators, to guard against the short circuits of the current we pass through the wires and parts. Of these, rubber is the most important and is derived from the sap of certain trees grown mostly in tropical districts. South America, India, Ceylon and Africa all contribute to the world's large appetite for rubber, and when mixed with sulphur and other substances it is made into ebonite, vulcanite, and other convenient forms of insulators. At one time it was the chief form of insulating material in electricity and wireless, but its place has been largely taken in some directions by the more easily formed bakelite. The latter substance is the last on our list, but besides being the youngest of the materials, it is becoming one of the most important, as far as radio receiving sets are concerned. It is made from phenold and formaldehyde, the latter substance having become of great importance in the manufacture of synthetic resins and plastic substances, and the name bakelite comes from its discoverer, a chemist named H. Baekeland. It is a material of great convenience for mass production as, while the plant for moulding it is extensive and expensive, when once this is acquired moulded objects can be turned out cheaply and rapidly. It is familiar to all of you in the form of cases for transformers, condensers, chokes, etc, and is being used more and more for radio cabinets of the console type and for electrical switches and plugs.

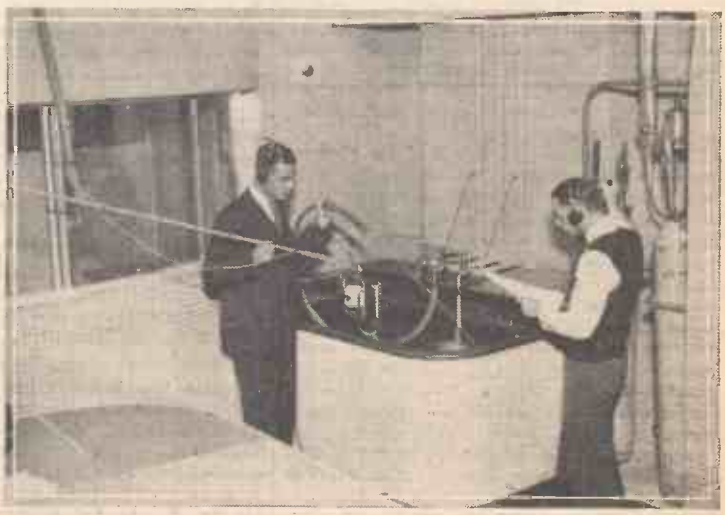
This little survey of the materials we use will enable you to realise the hundreds of trades and professions that go to make the modern radio set, and when you look over your set you will realise that I have only skirted the subject.

Hints on Wiring a Set

WHEN you are making a new set in what order do you proceed? Constructors have many different ideas on the

(*Continued on page 1067.*)

NOISES OFF!



We expect that readers have read plenty of matter about noises off! Here is an illustration showing the "wind-and-water" section, used for ships at sea, sirens, engine-whistles, and so on.

subject, and our set-designers rarely have the space to spare in their descriptions of the set to go over each operation step by step, and these thoughts of mine were prompted by the experience I had recently of watching a band of commercial set-builders at work. In the receivers being constructed a large amount of the wiring was done before all the components were fitted to the panel or chassis, and it seemed to simplify matters considerably. I expect you have all experienced the difficulty of fixing the last few wires in a set after all the components have been fitted, and have felt the need for three or four hands to successfully start and screw-up a terminal nut in an inaccessible place, while at the same time holding several wires under the nut. I have found it a good plan to mark out on the baseboard the position of all the components with a pencil-mark scribed around the base of the parts themselves, after they have been placed as near to their correct positions, as determined by the blue-print or wiring diagram. After this, I screw them all down in their proper position and afterwards remove the largest of them like transformers, coils, chokes and large fixed condensers until the wiring procedure warrants their being put back again. By this means one can go ahead with the wiring with much more "elbow room," while at the same time, there is no danger of fouling a component with the wiring so long as the joining-up wires are kept within the bounds of the pencil marks. In the case of a foil-covered baseboard, the components can be marked round with the tang of a small file, or the point of a knitting needle, as long as great pressure is not exerted which will tear the foil. When the wiring is nearing completion, it is a good plan to insert in the valve-holders a number of old obsolete or burnt-out valves which will ensure that the wires will not prevent the insertion of the valves—an occurrence I have seen happen more than once—while the effect of an accidental knock or a fatal touch with the hot soldering iron on the glass of the valves would not be so expensive as if the new valves were used. The panel can usually be the very last thing to add if the fixing brackets have been placed in position beforehand, and the fixing holes already drilled. This allows of all the wires running underneath the reaction and tuning condensers, and the volume control and switches, being neatly positioned without trouble. Finally, when the job is finished, I always stick a few of those handy flash-lamp circuit testers in each of the filament sockets of the valve-holders before inserting the valves themselves. The H.T. and L.T. is then connected up and if the flash-lamp bulbs glow with normal brilliancy it is fairly certain that everything is O.K., and no mistakes, which can be quite expensive in radio-set building, have been made. In testing a mains set it is as well to put in as many lamp testers as there are valves, as if only one is used the voltage delivered by the filament transformer or tapping may be sufficient to burn out the small flash-lamp bulb, due to the small load being taken.

A Point About Terminals

I SHOULD like to see an improvement made in the terminals supplied for wireless use, for not only are they generally too small for the purpose, but their design rarely allows of a really tight connection being made. Much of the trouble lies in the washer which has a bad habit of going round with the nut when it is screwed up.

Practical Letters from Readers.

The Editor does not necessarily agree with opinions expressed by his correspondents

Another Bouquet

SIR,—Although long overdue, I wish to thank you for the "Wireless Constructor's Encyclopædia" which I received some time ago. It is a splendid book and the information it contains is both comprehensive and easily understood by the amateur. I, myself, am only a "rooky" in the great army of wireless amateurs, and the encyclopædia will be invaluable to me. I raise my hat to you and the technical staff of the PRACTICAL WIRELESS. I also want to thank you for the excellent Binder for the Data Sheets which has just come to hand.—A. R. I. (Tooting).

Praise from a Novice

SIR,—Please allow me to thank you for your very amazing, interesting and instructive journal. I have taken it since Number 1, and would not miss it for anything. Before I started reading PRACTICAL WIRELESS I could not understand a word of the jargon, but now I am picking up wonderfully. Every article is easily understood and explicit in its instructions. Long live PRACTICAL WIRELESS, and all who contribute to its success.—WILL MOORE (Manchester).

"Topping Accumulators"

SIR,—In reply to Mr. Brown (January 21 issue), may I be allowed to disclaim any attempt, or desire, to convey the impression that the accumulator is difficult to install or maintain. The main object of my letter was to suggest a simpler and safer method of "topping up" than one appearing in a previous issue. This was followed by the reiteration of a warning that has appeared many times in various journals, regarding the care necessary when dealing with strong chemicals, etc. These warnings are primarily intended for the guidance of the unwary or careless members of the community, and are liable to over-emphasis, as in this case, in regard to the "amount" of heat developed by the process of adding water to the acid, instead of acid to water. In conclusion, I should like to thank Mr. Brown for the data his experiments provide, and hope that, having exploded the "great" from "heat developed," he will further enlighten your readers in regard to deleterious effects, if any, on "pasted" plates in other kinds of accumulators.—W. BURCHELL (Westcliff-on-Sea).

A Reader's Appreciation : and a Suggestion

SIR,—So many new brooms sweep clean for a week or two, and then lapse into a state of humdrum monotony, that I have held over any complimentary remarks on PRACTICAL WIRELESS, in case they should prove unwarranted. I am, however, convinced that my action was unnecessary. The paper itself I wait for as keenly each week as a schoolboy for his *Scout*, and when I get it I have a paper full of useful knowledge, without any frills or trimmings in the shape of descriptions of artists' eyebrows, etc. Well, that's what I call a "practical wireless" journal. Then the Encyclopædia. Well, I expected a fairly good book for my 3s. 6d., but to get such a volume as I actually did was not in my mind. I can only say that evidently the cover and the contents vied with each other to be best, and finished dead-heat, both establishing a record. Of the weekly data sheets, and evidently other good things in store, what man would not be happy with such handy material?

As regards suggestions, most of my proposed suggestions are either already catered for or else receiving attention. I still have one, however. Can you find it possible to "diagnose" some of the "gadgets" that come on the market, with free and unbiased opinion and advice to the man of short pocket as to whether he is justified in spending a few shillings on a certain component? In conclusion, just keep up the standard of PRACTICAL WIRELESS in its present form and your circulation will continue to grow.—"HEFTY" (Twickenham).

Tantulum Rectifier

SIR,—I consider the article by Mr. Champion on the Tantulum Trickle Charger very interesting, and I can vouch for such a rectifier functioning satisfactorily, besides being remarkably cheap. There is one great difficulty in making this unit up, and that is the inability to obtain tantulum strip, which appears to be a rare metal. Other readers who may be experiencing the same difficulty might like to know that they can obtain strips 2½ins. long by about 1-16in. wide and of the right thickness, at 1s. each, from Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, E.15. May I take this opportunity of thanking you for PRACTICAL WIRELESS, which I have read from its first number, and await eagerly each week.—W. E. RYALL (Honor Oak Park).

Wonderful Volume

SIR—Thanks for "Wireless Constructor's Encyclopædia," which I think is wonderful. Congratulations on the production of such a useful book: it certainly makes difficult things easy, and contains a whole pile of practical and useful information. Without exaggeration, I think it safe to say that this is easily the best value ever offered by any journal.—H. J. DAVIES (Barry).

Those Impossible Optical Standards

SIR,—As a reader of your journal, PRACTICAL WIRELESS, who is a consulting optician, the editor of the *British Journal of Physiological Optics*, and lecturer in Physiological Optics at the Manchester College of Technology, I must confess I felt some injustice at your hands when in your article on January 21st last, announcing your "Fury Four," you made the statement: "Opticians, for example, set up impossible standards, and proclaim that everyone needs glasses who falls short of them."

I feel sure that in arriving at this opinion your information as to optical standards must be entirely erroneous. Opticians recognize that there is no such thing as a normal individual. A blonde may be equally as healthy as a brunette. One person of 5ft. 9in. in height and weighing about ten stone may be just as efficient

CUT THIS OUT EACH WEEK.

DO YOU KNOW?

—THAT the metallic coating on a valve must be connected to earth to be efficient as a screening device.
—THAT a high-inductance choke may be used in place of a decoupling resistance, if insufficient voltage is available in the anode circuit.
—THAT a D.C. receiver should have an input transformer for a Pick-up, and the latter should not be joined direct to the grid.
—THAT the hum frequency which is heard on a set is twice that of the mains frequency if a full-wave rectifier is used.
—THAT the hum frequency is the same as that of the mains if a half-wave rectifier is employed.
—THAT the grid bias for valves in Push-pull is the same as that required for a single valve.
—THAT the anode circuit of a Pentode valve should never be broken, unless the filament circuit is first disconnected.
—THAT the heterodyne whistle which may be heard on many foreign stations has a frequency between 6,000 and 9,000 kilocycles.
—THAT an accumulator should not be charged whilst it is still in position in a receiver, especially in a portable set.

NOTICE.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of Letters Patent.

as another who exceeds 6ft. and tips the scale at twelve and a half stone. It is impossible to say which of the two individuals is the more normal. Similarly, in regard to vision, clerical workers, especially those who are compelled to make use of artificial light for long hours each day, have much less keen visual perception than outdoor workers, whose eyes are usually trained upon objects at long distances.

The standard of keenness of vision, therefore, which is internationally adopted by opticians, is an average standard, to which any person should attain if he can be reasonably expected to undertake the normal requirements of business life. This standard is represented as 6/6ths, the particular digits of the fraction being selected because the usual standard testing distance for sight is conducted at six metres. It is the aim of every optician, in dealing with patients possessing defective vision, to bring the standard of their vision to 6/6ths, by means of suitable glasses, though, quite frequently, individuals are found to possess a keenness which is more than double this average. For example, Duckworth, the English wicket-keeper, a few years ago, I am informed, had a visual acuity of 6/3rds, or twice normal. Frequently, sea captains, ships' officers, and others whose eyes are usually adapted by training for long-focus work, show a visual acuity of 6/4.50ths, or one and a third times normal. When the standard chosen permits of classification of cases in such a manner that a fair proportion of persons are deemed to be super-normal, it surely cannot, with fairness, be described as an impossible standard. As one of the best-known opticians in Europe, who has held practically every position of honour that English *confrères* can confer upon me, I think I can authoritatively state that I know of no other more reasonable standard which might be set up, and I feel that the statement that you have promulgated casts a very unfair and very unnecessary slur upon the work of sight-testing opticians, a body of men who are as mathematically exact and scientific in their daily work as any other traders in the country. It would be very interesting to know upon what evidence you have based so sweeping an assertion.—W. B. BARKER (Manchester).

[*My statement was not intended to cast any slur upon opticians. But if optical standards are not impossible standards, how else can one explain the plague of horn-rimmed spectacles with plain glass which has become a cult to-day? I examined fifty glasses worn daily by people in various professions, and of these over forty were plain glass. One can only presume from this, either that opticians have prescribed spectacles unnecessarily, or that the purchasers have wished to wear them to impart an owl-like and professorial veneer, preferring to rely upon effect rather than ability. It is noted that the cult of the long pipe is frequently used in association with horn-rimmed spectacles. I readily agree, of course, that a qualified optician should not prescribe spectacles unless they are absolutely necessary, and that the wearing of plain glass spectacles is definitely harmful to the sight. I write as one with more than the average knowledge of the eye, spatial perception, and optics. But what has all this to do with wireless?*—F. J. C.]

A Reader's Surprise and Thanks

SIR,—This is my first letter to you, and I write after reading the current issue of PRACTICAL WIRELESS. I have had them

(*Continued on page 1070*)

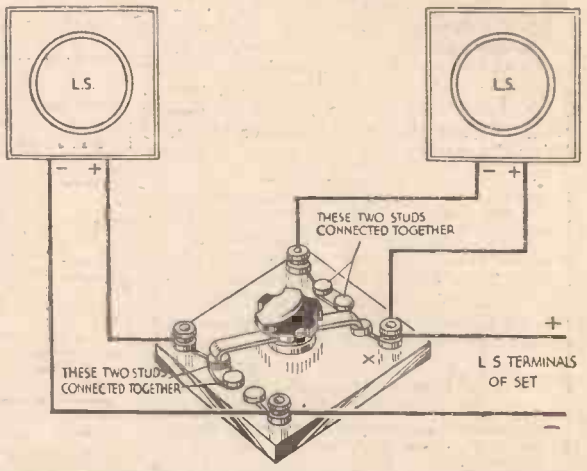
Practical Letters from Readers

(*Continued from page 1069*)

all and have enjoyed them. Like many others, I was doubtful, very doubtful, that the excellent No. 1 issue could be duplicated so many times. Perhaps I should have known better of Messrs. Newnes, having subscribed to "Motor Repair," "Home Mechanic," and the current work "Complete Wireless." I am more than surprised at the way each week there is always something "I didn't know." Even the most ordinary radio ideas have been expanded from a smattering to a very much larger understanding, on a good many occasions. My own particular line of experimentation is, at the moment, in regard to selectivity. May we hear more about this in the future? It seems to me that most folks to-day need a tuning device that will *positively* separate any two adjacent transmitters when working. May I suggest an article, constructional if at all possible, of an absolutely knife-edge type of tuner? For those of us who have no objection to changing coils, probably an interchangeable unit would be most satisfactory. May I thank you for, so far, nineteen weekly pleasures, and also for your data sheets; not forgetting, of course, the Encyclopædia. —ELAND J. THORNTON (Winchester).

Loud-speaker Switch

Owing to a draughtsman's error a wrong connection was shown in the illustration which appeared under the above heading on the Radio Wrinkles page in our issue for January 28th. The two bottom studs on the left-hand side of the switch were shown connected, instead of the top two studs. The accompanying illustration shows the correct connections.—ED.



RADIO CLUBS & SOCIETIES

SLADE RADIO

A lantern lecture on "Automatic Telephones" was given by Mr. R. G. St. George at a recent meeting of the above society. After giving an outline of the manual, he went on to give a thorough description of the automatic system. Slides were shown of the automatic dial, ringing and receiver circuits, and also an operating diagram of a 25-line private exchange. The lecture proved of great interest, especially when details were given of how the routing and selector switches operate. The society still has room for more members, and the Hon. Sec. will welcome inquiries from anyone interested.

Another new idea was carried out at a recent meeting of the above society. As Mr. Linton was unable to give his lecture, Mr. Peck offered to fill the vacancy, and as no subject had been fixed it was left to the members to make suggestions. Five subjects were proposed, two of which were chosen by vote. The first was screened grid valves as detectors, and details were given of coupling, rectification, quality, amplification and reaction, a number of questions being raised. The second subject was quiescent push-pull, and in this case details were given of the circuit, also the questions of transformers and use with eliminators were dealt with. Then followed a description of Class B amplification, also the difference between this and quiescent push-pull was explained. The evening proved very interesting, and will be followed by others of a similar character at an early date. Full details of the society may be obtained from the Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

CROYDON RADIO SOCIETY

For the last meeting, a member gave the second talk in his series of "What We Hear," at the headquarters, The Horse and Groom, Cherry Orchard Road, East Croydon. He first explained about the variation in intensity of the instruments in an orchestra, and to what extent the B.B.C. reduced this before transmission. He spoke of every musical note being made up of its fundamental plus series of harmonics, and how these distinguished between the notes played on, for instance, a piano and violin. In an orchestra, the frequencies ranged from 30 to 20,000 cycles, but the B.B.C cut off soon after 9,000 cycles, due to higher frequencies containing the all too well-known heterodyne whistle. In gramophone records the range was only 100 to 5,000 cycles, due to the limitations of the groove, and needle scratch coming in at higher frequencies. The lecturer dealt thoroughly with wind and brass instruments, and the effect on notes from them when different air pressures were used, which he demonstrated practically. A particularly interesting demonstration concluded the evening, as the lecturer put on a record of a Beethoven symphony on his radio gramophone, and actually synchronized it with the same item then being received *via* wireless from a Promenade Concert. Thus were useful comparisons made, it being noted how relatively good was the record version.

The normally rather dry subject of transformer design was made interesting by Mr. F. G. Sawyer, chief of technical and design department of Partridge, Wilson and Co., at a recent lantern lecture to the society at The Horse and Groom, Cherry Orchard Road, East Croydon. He first outlined the theoretical principles of transformers, passing on to consider their losses, such as those of iron and copper. The latter were obviated by low-resistance winding, and the former, which caused eddy currents, were largely overcome by having a laminated iron core. A very important feature of a transformer was that its output voltage should be the same whether on load or not. Elaborate lantern slides showed the actual processes of manufacture of a Davenset transformer, from the winding of its bobbin to the completion of the specially made terminal top. Mr. Sawyer finally considered many applications for transformers, one of the most novel being whereby 80,000 volts was periodically applied to a section of the land, causing death and destruction to all slugs in its path. Shovelfuls of electrocuted vermin had thereby been collected at a time, said Mr. Sawyer, amidst a shudder from the meeting.

Hon. Sec.: E. L. Cumbers, 14, Campden Road, South Croydon.

THE SOUTHALL RADIO SOCIETY

The use of meters and their adaption for radio purposes was the title of the lecture given by Mr. W. Ancrum (chairman of the society) to members on Tuesday, January 31st. In the course of his lecture he described the functioning of various types of meters and explained how they could be adapted to give measurements of different values higher than the range for which they were calibrated. The lecturer was preceded by Mr. Stephens, who gave a short beginners' talk on detector valves. Hon. Secretary: H. Rayner, 114, North Road, Southall, Middlesex.

RADIO CLUB FOR WEST HARTLEPOOL

Keen amateurs, especially members of the Anglo-American Radio and Television Society, are invited to write to Mr. R. W. Stewart, 9, Kilwick Street, West Hartlepool, with a view to forming a radio club in this district.

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

REPLIES TO QUERIES and ENQUIRIES

by Our Technical Staff

The coupon on this page must be attached to every query.

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent must bear the name and address of the sender. Send your queries to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton St., Strand, London, W.C.2

SPECIAL NOTE

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.

Please note also, that all sketches and drawings which are sent to us, should bear the name and address of the sender.

FRAME AERIAL

"Whilst I was reading through a general radio catalogue the other day I saw an illustration of a frame aerial wound with two halves across each other. It seems to be different from the ordinary arrangement, so will you please inform me whether there is any specially important principle which is introduced to have the frame split up in this way."—(M. V., Bexley Heath.)

The Frame Aerial which you have seen illustrated is a Dual Range aerial. In the usual arrangement the two sections (medium and long waves) are wound in series on the same frame. That is to say, the frame aerial winding consists of one large winding sufficient for the highest wavelength which is required, and the portion which is not needed when receiving the medium waves is short circuited when this part of the tuning range is required. The result of this is that the short-circuited section acts as a partial shield and may, in some cases, interfere with good reception in certain directions. If, however, two rectangles are enclosed, one within the other, at right angles, the long-wave winding may be wound on one, and the medium-wave winding on the other, and no screening effect will take place.

SOLDERING ALUMINIUM

"I am making up a mains receiver, and have met with a little disappointment in the aluminium chassis. Owing to carelessness I have cut the bottom out wrongly, and do not want to buy another piece of aluminium. I cut the remainder to shape and tried to solder it, but do not seem to be able to get the parts to join. Is there any secret or special flux needed for this job. I am trying with ordinary paste flux, but it seems to have no effect."—(S. T., Merton Abbey.)

Aluminium requires special treatment owing to its readiness to oxidize. When the hot iron is brought into contact with the metal a film rapidly forms on it and this prevents the solder coming in contact with the aluminium. If, therefore, you can keep the surface of the metal clean (or free from oxidization) you will find it easy to solder. One way of doing this is to put a large quantity of solder, with resin flux, on the part to be joined, and then when the hot iron is pressed on the solder and it turns liquid, insert the point of a pen-knife through the molten solder and scrape the aluminium underneath it. This sometimes results in a good joint. The most satisfactory method, however, is to purchase one of the special aluminium soldering preparations and to carry out the instructions given with the preparation.

MUTUAL CONDUCTANCE

"Amongst the valve details given on the valve box the term 'Conductance' appears. I should like to know, in non-scientific terms, what this means. It does not appear in an ordinary dictionary, so I conclude that it is a 'coined' word."—(T. G., Bangor.)

The word is synonymous with Slope, and this latter word is, in fact, more often used than the longer term "Mutual Conductance." It is the change in anode current divided by the change in grid volts. For instance, if a certain valve gives an anode current of 10 m/A with 2 volts Grid bias, and this current drops to 6 m/A when the grid bias is increased by 2 volts, then the Slope (or Mutual Conductance) of that valve would be 10—6÷2=2. This figure is usually expressed in this way—Slope 2 m/A Volt. Another term for this figure, and one which is much more expressive for the non-technical man, is the "Goodness Factor." The higher the goodness factor, the better the valve.

TELEVISION LAMP

"I am constructing a Television receiver after reading the articles in your journal, but I find from reading a catalogue that the lamp for the picture will cost too much for my pocket. As I have spent a long time making the other parts of the set, and these have cost me only a few shillings, I should be glad if you could assist me by informing me how to make up a lamp instead of buying one. Can Neon gas be obtained separately and is it possible to get it into a lamp at home? I am handy with tools and would like to try and make the lamp so that I can say I have made all of the receiver."—(H.T., Croydon.)

Even if you could purchase the Neon gas, you would find it beyond your powers at home to make the Neon lamp. However, you need not be deterred in your experiments, as there is a very simple solution. It is the use of an ordinary sign lamp, or night-light, which employs Neon. You may have seen the illuminated advertisements in shop-windows, where bulbs only as large as the ordinary electric lamp are caused to glow with the characteristic neon orange colour, and a letter of the alphabet is fitted inside the bulb. These lamps are obtainable at a good electrician's and cost only 3s. 8d. The letters "H" and "M" are most satisfactory for your purpose. The beehive pattern night-light is also suitable, if mounted so that the end of the lamp is behind the receiving disc. The resistance which is included in the base of the lamp may be removed by standing the base in methylated spirit for a night, and then unsoldering the two leads. After removing the resistance, which is wound on a small fibre former, connect a short length of wire and remake connection to the base of the lamp. It must not be connected to the mains after removing the resistance.

DATA SHEET No. 22

Cut this out each week and paste it in a notebook.

RESISTANCE COLOUR CODE

BODY	TIP	DOT
0 Black	0 Black	None Black
1 Brown	1 Brown	0 Brown
2 Red	2 Red	00 Red
3 Orange	3 Orange	000 Orange
4 Yellow	4 Yellow	0000 Yellow
5 Green	5 Green	00000 Green
6 Blue	6 Blue	000000 Blue
7 Purple	7 Purple	
8 Grey	8 Grey	
9 White	9 White	

EXAMPLE: Resistance is coloured green, with red tip and orange spot. Value is therefore 5 plus 2 plus three noughts=52,000. A 30,000 ohm resistance would have orange body, black tip and orange spot.

HOME-MADE COILS

"I am still using basket coils which I made six years ago. Would I gain anything by changing these for modern coils made at the shops? I get such good results on these coils that I have hesitated all this time to change them, but I seek your advice after seeing from your pages how you really cater for the non-technical listener such as myself. I have already had many good hints from your pages, and should now like to hear your answer to this query."—(L. H., Chester.)

So much depends upon the use of the coils in your circuit, that it is rather difficult to give a straightforward answer. If, for instance, you only employ one basket coil, in the aerial circuit, then a modern coil will not be any better. If, however, you have to change coils for medium and long waves, a modern Dual Wave coil will save you the trouble of changing the coils. If you use more than one coil, in an H.F. stage, for instance, you may find that a pair of modern screened coils will be much more efficient, chiefly owing to the removal of the surrounding metallic bodies from the field of the coil. We imagine you have kept the original circuit with your coils, and if this is the case, we would say, without doubt, that a modern circuit, with modern coils, will prove a big advance on your present set.

HOME-MADE COILS

"I am going to build up a S.G. Detector and Pentode receiver, and am thinking of making my own coils. The method I have thought of using is one which was very popular some time ago, and consists of making end rings of ebonite with rods of the same material across to form a large cylinder, say 4ins. in diameter. The wire will be wound round this, using 20 gauge D.C.C. I believe they were called Squirrel cage coils. Could you give me the number of turns and connection for two band pass coils on these lines, and an intermediate grid coil with reaction, all coils to cover both medium and long waves?"—(F. P. G., Cleethorpes.)

The coils you refer to were extremely efficient—provided only one was used. The external field of a low-loss coil wound on the principle you mention is very large indeed, and to employ three you would require a baseboard about 3ft. long, and screens would be very difficult to arrange in order not to nullify the good effects obtained by the low-loss coil arrangement. It would, of course, be impossible to screen the individual coils.

USING A PENTODE

"I have a small, home-made two valver, employing a Detector and L.F. valve. I am only new to wireless, so my questions may seem rather silly, but I want to know whether I can use a pentode with this set. If so, what alterations will I have to make, and how must the Pentode be connected in the circuit? I hope I am not wasting your time in asking what may seem a simple question."—(J. D., Kentish Town.)

No question is too simple, J. D., and we cater both for the absolute novice and the advanced amateur. To use a Pentode, you need only remove the present L.F. valveholder, and in its place fit a five-pin holder. The centre pin should then be joined to a wander plug and flex, and this should be inserted in the H.T. battery at a tapping slightly lower than is at present used for the L.S. tapping, which should be the maximum voltage. Then a Pentode valve should be plugged into this valveholder. We would not advise you to try and use the Pentode after the present L.F. valve, as there would be danger from overloading. You may find it necessary to use a Pentode Output Matching Transformer in order to get a good quality of reproduction, and it may also be necessary to fit a Tone Control as has been shown in these pages, to cut down some of the brilliancy which the Pentode gives. You must bear in mind that the Pentode will consume more H.T. than your present valve, but it will give a greatly increased output.

FREE ADVICE BUREAU

COUPON

This coupon is available until Feb. 25th, 1933, and must be attached to all letters containing queries.

PRACTICAL WIRELESS 18/2/33.

To save readers trouble, we undertake to send on catalogues of any of our advertisers. Merely state, on a postcard, the names of the firms from whom you require catalogues, and address it to "Catalogue," PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8/11, Southampton St., Strand, London, W.C.2. Where advertisers make a charge, or require postage, this should be enclosed.

HANDBOOK OF TUNING COILS

WE have received from the British Ebonite Co., Ltd., a useful handbook on the construction and winding of various types of coils as used in present-day practice. All the coils described are wound on the well-known Becol Ebonite Formers, and the clear explanatory diagrams in the book make the task of coil winding a comparatively easy matter for the amateur. Amongst the coils dealt with are a Universal Dual-range Tuner, H.F. Chokes, Band-Pass Tuner, a Matched Dual-range H.F. Tuner, and a Triple-range Oscillator Coil. A handy table of wire gauges and turns per inch is included in the handbook, a copy of which can be had for 6d. post free. The address is Nightingale Road, Hanwell, London, W.7.

GRAMPIAN LOUD-SPEAKERS

A USEFUL range of loud-speakers is given in the latest leaflet issued by Grampian Reproducers, Ltd., Kew Gardens, Surrey. Although the name "Grampian" is comparatively new, the experience behind it dates back to the beginning of radio. Amongst the models listed are permanent magnet moving-coil and electro-dynamic speakers at prices ranging from 25s. to 39s. 6d. There is also a useful cone chassis with balanced armature unit listed at 10s. 6d.

FERRANTI POWER UNITS

THE construction of mains units calls for a certain amount of technical knowledge and experience. Messrs. Ferranti, of Hollinwood, Lancs, have specialised in such apparatus for years, and have prepared an interesting and valuable folder, No. Wa. 522. This contains constructional details for several different types of mains units, with theoretical diagram, wiring diagram, chart of D.C. output, list of components, and valuable technical details. In addition, there is a chart showing at a glance the value of resistance required to drop practically any voltage at any current. Copies of this folder may be obtained by readers by sending threepence in stamps to Messrs. Ferranti.

ERIE GRID LEAKS

THESE grid leaks and resistors are composed of a solid carbon and rare earth composition having the property of carrying a high load without any tendency towards open circuiting. The wire leads are soldered to copper which is forced into the ends of the resistor under intense heat. It is claimed for these resistors that they are absolutely silent and stable in use. A simple colour code is used to designate resistance values, and in addition, the resistance value is indicated on a small label. Particulars of the full range of these components are given in a folder we have received from The Radio Resistor Company, 1, Golden Square, Piccadilly, London, W.1.

BLUE SPOT LOUD-SPEAKERS

THE latest pamphlets from the Blue Spot Company give further details of this company's loud-speakers. The most interesting model is the permanent magnet moving coil Type 99 PM. This is an outstanding example of first-class workmanship, with cobalt steel magnet, covered in magnet to avoid the entry of dust, etc., into the gap, and cadmium plated pole pieces. An output matching transformer is included with the speaker at the inclusive price of 59s. 6d. For the smaller set, and for the man who wishes to make up an ordinary type of speaker, the 66R Unit is splendid value for money. This is a powerful balanced armature with very substantial magnets and costs only 35s. Other models include a splendid cabinet permanent magnet at 87s. 6d., a permanent magnet at 75s., a cabinet speaker including the 66R unit at 52s. 6d., as well as receivers and pick-ups.

Broadcast Query Corner

UNDER the above title, with the assistance of a recognized authority on foreign broadcasting matters and a regular contributor to wireless publications both at home and abroad, we are inaugurating a special Identification Service, which should prove of great assistance to our readers. When tuning in well-known stations it happens frequently that listeners pick up wireless transmissions of which they fail to recognize the origin. It is to solve these little problems that the *Broadcast Query Service* has been organized.

In order that a careful search may be made it is essential that certain data should be supplied to the best of the inquirer's ability and knowledge. When sending such queries to the Editor the following rules should be followed:—

1. Write *legibly*, in ink. Give your full name and address.
2. State type of receiver used, and whether transmission was heard on headphones or on loud-speaker.
3. State approximate wavelength or frequency to which receiver was tuned, or, alternatively, state *between* which two stations (of which you have the condenser readings) the transmission was picked up.
4. Give date and time when broadcast was heard. Do not forget to add whether *a.m.* or *p.m.*
5. Give details of programme received, and, if you can, some indication regarding the language, if heard.
6. State whether and what call was given and/or kind of interval signal (metronome, musical box, bells, etc.) between items.
7. To facilitate publication of replies, append a *nom-de-plume* to your inquiry.

All inquiries should be addressed to *The Editor*, PRACTICAL WIRELESS, 8-11, *Southampton Street, Strand, London, W.C.2.*

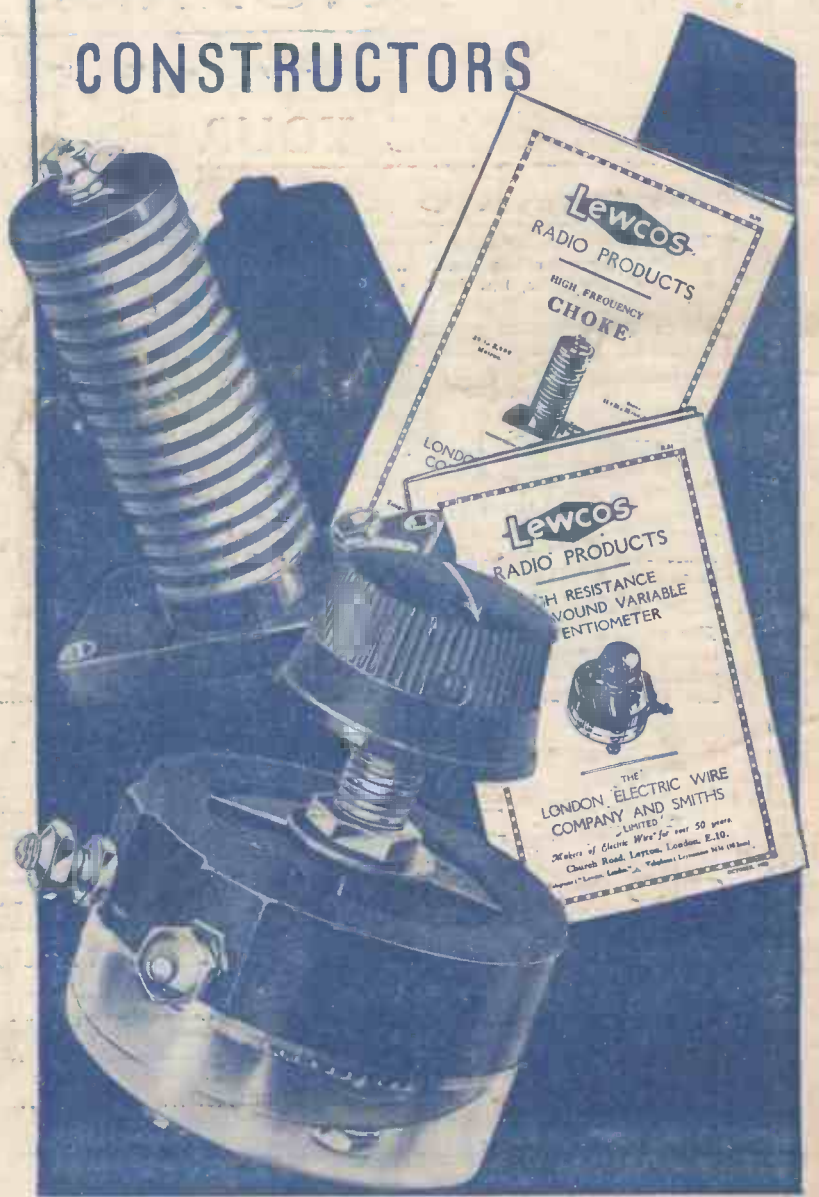
Replies to Broadcast Queries

ONE VALVE (Letchworth): Cannot confirm, but possibly Bratislava; altered programme. NUCASNIT (Otley): YVIIBMO, Maracaibo (Ven.), on 48.95 m. (6,127 kc/s), as no other Spanish transmitter on that wavelength. BABY (Kent): Most of your call signs are mutilated or incomplete; it is essential for identification to get them correctly. You would do well to write to Radio Society of Great Britain, 53, Victoria Street, London, S.W.1. We can trace the following: G5PM, Royal Military College, Sandhurst, Camberley; G5MO, C. Morton, 27, Bristol Avenue, Belfast; G6PA, H. C. Page, Plumford Farm, Ospringe, Faversham. 2 VALVE (Gorton): HB9R is the call sign of an experimental amateur transmitter, Robert Monnier, Pestallozzistrasse 58, Zurich 7 (Switzerland). DOUBTFUL (W. Bridgford): Reykjavik; Icelandic local time is one hour behind G.M.T. TRANS. SEARCHER (Walthamstow): Possibly Marconi Co. (Chelmsford), G2BS (750 m.). HAM (N.2): Bandoeng (Java); Public Telephony Service with Kootwijk (Holland) on 16.81 (17,850 kc/s). W. GRAHAM (Gateshead): As this was a test by Radio Toulouse, no details of the programme were published. We would advise you to write to Emissions de la Radiophonie du Midi, Villa Schmitt, Toulouse (France); for reply you would do well to enclose with your letter an International stamp coupon, obtainable at any British post office. S. T. 400 (Brighton): Your wavelength apparently wrong; this was Radio Luxembourg testing. SUPERHET (North Wales): (*a*) LR4, Radio Splendid, Buenos Aires (303 m.); (*b*) Valencia (Spain) on 267.1 m.; (*c*) Radio Luxembourg testing.

ADVERTISEMENT INDEX

A 50,000 OHM LEWCOS POTENTIOMETER, AS ILLUSTRATED AT THE BOTTOM OF THIS PAGE, IS SPECIFIED FOR THE "FURY FOUR" DESCRIBED IN THIS ISSUE.

SEND FOR THIS VITAL INFORMATION FOR HOME CONSTRUCTORS



Write for the new series of leaflets describing the complete range of Lewcos World-famous Radio Components.

Brilliant in design and performance, the two Lewcos precision-made components illustrated—the Super H.F. Choke (Price 6/-) and the Potentiometer (Price 3/- to 8/-)—are fine examples of the high quality and reliability of all Lewcos Radio Units.

Descriptive of these components illustrated Refs. W78 and W79 are included in the series now available.

Lewcos
REG'D

RADIO COMPONENTS

THE LONDON ELECTRIC WIRE COMPANY AND SMITHS, LIMITED, CHURCH ROAD, LEYTON, LONDON, E.10

P.W. Gift Stamp No. 21

Printed by NEWNES & PEARSON PRINTING CO., LTD., Exmoor Street, Ladbroke Grove, W.10, and published by GEORGE NEWNES, LTD., 8-11, Southampton Street, Strand, W.C.2. Sole Agents for Australia and New Zealand: GORDON & GOTCH LTD. South Africa: CENTRAL NEWS AGENCY, LTD. *Practical Wireless* can be sent to any part of the world, post free, for 17/4 per annum; six months, 8/8. Registered at the General Post Office for Transmission by Canadian Magazine Post.