EXPERIMENTS WITH THE NEW VALVES

MODERN WIRELESS

1/- MONTHLY

Edited by
NORMAN EDWARDS
M.I.R.E., M.R.S.L., F.R.G.S.

Vol. VIII. No. 10. OCTOBER, 1927.

SPECIAL EXHIBITION NUMBER

COME AND VISIT US AT STANDS NUMBERS 74 and 75

THE "Super-Screen" Four

A special receiver embodying the new shielded valve and the new screening box.

By the "M.W." RESEARCH DEPARTMENT.

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Just consider the amazing efficiency of a valve with all the advantages of the wonderful P.M. filament and the *added* economy of only ·075 amp. filament consumption.

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The new P.M. ·075 Master Valves will get more out of your set and in their great durability prove the most economical valves you can buy.

THE VALVE WITH THE WONDERFUL Mullard P.M. FILAMENT

Visit Stands 164, 165 and 166, National Radio Exhibition, Olympia, September 24th to October 1st.

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10/6

TWO TYPES FOR 4 VOLTS AND 6 VOLTS

THE MULLARD WIRELESS SERVICE CO. LTD., MULLARD HOUSE, DENMARK STREET, LONDON, W.C.2

CONTENTS

Vol. VIII. No. 10. MODERN WIRELESS OCTOBER, 1927

Edited by NORMAN EDWARDS, M.I.R.E., M.R.S.L., F.R.G.S.

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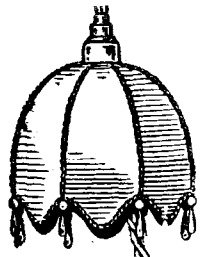


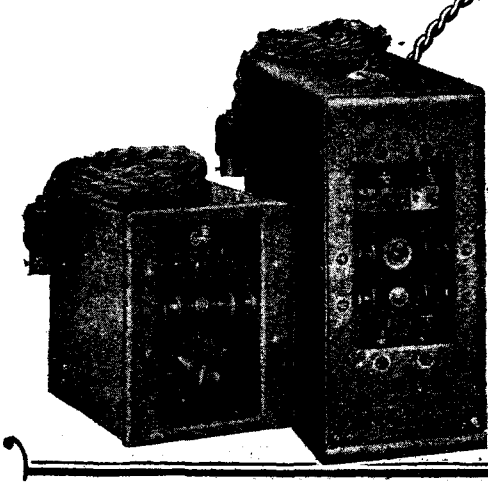
for working entirely off the E.L. Mains

The illustration shows the new Met-Vick 5 with the eliminators contained in the side cupboards. It can be plugged into a lighting circuit just like any other Electric appliance. If used with H.T. and L.T. batteries these can be accommodated in the cupboards. The circuit employs two phase-balanced and stabilized H.F. stages before the detector, and two resistance coupled L.F. stages.

Operation is extremely simple, the local station can be easily cut out and a wide range of alternative programmes obtained.

Special attention has been paid to running costs which are remarkably low.

The Met-Vick 5 is a really beautiful instrument and while a distinct advance on any 1926 model it still remains at a reasonable price. Obtain Leaflet 4117/9 for complete range of prices.



Battery Eliminators

Met-Vick Battery Eliminators are supplied in two models, one for providing filament current and the other for anode and grid currents, by plugging in on electric light mains. *The H.T.-G.B. Model* provides a high voltage (up to 250 V.) for the last valve (ensuring a large volume without distortion). It is fitted with a switch, a protective fuse and a distributor panel enabling it to be used on various supply voltages of 40-100 periods. Grid Bias tappings at 5, 10, 15 and 20 volts.

The smoothing system is of exceptional efficiency. The eliminator can therefore be used successfully with multi-valve and the most sensitive sets even in districts where there are considerable irregularities in the electrical supply.

The L.T. Model gives an output of 5 amperes at 4 volts and a potentiometer ensures complete absence of hum. Obtain copy of List 7117/8.

MET-VICK

(COSMOS)

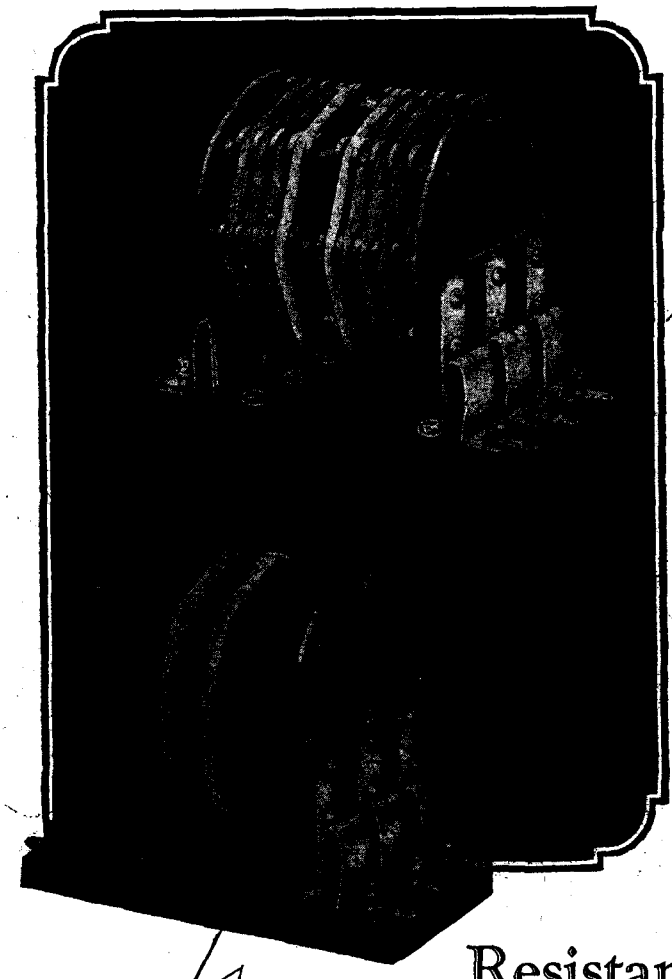
METRO-VICK SUPPLIES LIMITED

(Proprietors: Metropolitan-Vickers Elec. Co. Ltd.)

155 Charing Cross Road - LONDON, W.C. 2

SEE THEM AT THE EXHIBITION : : : STANDS Nos. 155-156

R 2121



A·N·P
(Astatic-Non-Parasitic)
Coils

A CLEVER SOLUTION OF A DIFFICULT PROBLEM.
Patents pending.

Designed to overcome in a simple manner the three difficulties associated with high frequency amplification namely: Magnetic coupling between coils, Stabilisation, and Parasitic Oscillation. The first named is prevented by Astatic winding, obviating the necessity for metal screens with their disadvantages, the second is obtained by centre and quarter-tappings accommodating valves of various impedances, and the third is avoided by balanced self-damping windings, thus dispensing with the expensive double condenser and resistance method previously used.

List 4117/8 gives full details and prices.

Resistance Coupling Units

Thousands of radio enthusiasts are loud in their praises of "Cosmos" (Met-Vick) Resistance Coupling Units. L.F. stages coupled by means of these Units result in clear Loud Speaker reproduction without distortion. The 'V' type unit can now be supplied fitted with the new 'Met-Vick' A.C. Valve Socket for use when building a set for working off the E.L. mains. The A.C. Valve-socket is also supplied separately for panel or baseboard mounting. *Obtain List 7117/8 for full details and prices.*

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MODERN WIRELESS

Vol. VIII. No. 10. October, 1927

The Radio Exhibition—The Opening of 5 G B—Battery Eliminators.

By the EDITOR.

THIS year's wireless exhibition at Olympia again demonstrates the rapid progress made in the short space of twelve months. Compared with the last year's exhibition the critic will notice at Olympia conspicuous signs of all-round improvement in manufacturing design—evidence that the modern amateur demands the highest quality apparatus—and a most satisfactory tendency in the direction of lower prices.

OUR Wireless Exhibition, which undoubtedly marks the opening of what may be called the "wireless season," comes on the heels this year of several interesting developments in British radio—the opening of 5 G B. the inauguration of the short-wave Empire broadcasting experiments of Mr. Marcuse, the reduction in the price of valves and components.

THE radio barometer, in fact, is set at "fair," and looks like continuing to rise, with every indication of a prosperous season for the trade and another year of interesting progress and development for the amateur. During the first ten days this special number is on sale thousands of our readers will visit the exhibition. We can assure them they will be welcome at the stalls of the Amalgamated Press, Ltd., where this journal and its contemporaries, the "Wireless Constructor" and "Popular Wireless," will be on sale.

Reception of 5 G B

WITH the opening of 5 G B listeners over a radius of about 100 miles now have the choice of alternative programmes.

When 5 X X, the original Daventry, is broadcasting a "serious" programme 5 G B will send out something lighter, and vice versa. In some cases listeners with crystal sets able to hear 2 L O will have the choice of three programmes.

Reports of the reception of 5 G B indicate that at Birmingham, where the B.B.C. station has been closed down, reception is very good; at Manchester, to crystal users the reception is poor and not so good as the reception from 5 X X; at Wakefield reception generally is at practically the same strength as that of 5 X X; at Doncaster 5 G B clearly heard, but compared with 5 X X the volume not nearly so good; at Cardiff, reception fair; at Tunbridge Wells, reception excellent; at Bristol, 5 G B a little stronger and clearer than 5 X X; at Portsmouth, satisfactory reception; at Bournemouth, reception very good.

BATTERY eliminators are arousing very great interest this year and, judging by the correspondence received from our readers, most of them are interested in the construction of H.T. and L.T. eliminator units.

"The Times," in a recent article, made some interesting comments on this phase of radio development, and pointed out that the elimination of batteries is by no means an easy business in this country, since there is at present no standardised form of current supply from the lighting mains. In one district the current may be direct; in another alternating. Where direct current is supplied the voltage may be anything between 100 and 250. In places where alternating current is supplied not only the voltages but also the frequencies differ widely. These difficulties will disappear under the standardisation scheme contained in the Electricity (Supply) Act; but as matters are they put great difficulties in the way of designers of receiving sets intended to work directly off the mains.

Awaiting Standardisation

DESPITE the present chaotic state of affairs, however, a great deal of progress has been made. There are two systems to-day which appear to have great possibilities. In the first, valves of standard pattern are used in conjunction with converters or rectifiers which deliver current smoothed, filtered, and at pressures suitable for wireless purposes. The second, which is applicable only to alternating-current supplies, makes use of special valves in which the filament is replaced by a cathode brought, by a heating device, to a temperature favourable for the emission of electrons. The cathode-heating current is obtainable from the mains simply by the use of a transformer; for plate current a rectifying device is necessary.

EXCELLENT results in ordinary broadcast reception are obtainable by either method. Valves have also been designed experimentally to work directly from the mains without intermediate transformers, but at present their use would appear to be forbidden by the Board of Trade regulations.

While we are still awaiting standardisation in the matter of supply from the mains, "The Times" correspondent added, the most satisfactory method of obtaining the current required for the operation of wireless sets was probably to use accumulator batteries and to employ what is known as a trickle charger, a device which is likely to become very widely used in the near future.

AN AUXILIARY AERIAL

"There are few houses in which an indoor aerial cannot be erected quite easily and at trifling cost."

By HUMPHREY PURCELL.

MOST of us, I suppose, use an aerial which is as high and as long as we can manage, having regard to the limitations of our post-office licence, the extent of our back gardens, and the size of the tree or mast which holds up the far end. This is quite the best plan to adopt for listening to the local station or to Daventry. But as even the best of back-garden aerials is imperfect there is always a possibility that for certain work a smaller and simpler aerial might function equally well—or even better.

There are few houses in which an indoor aerial cannot be erected quite easily, and at a trifling cost. One or two lengths of wire strung across the loft, or along an upstairs passage or attic, will do. Almost any kind of wire may be used—even bell wire or D.C.C.—but rubber-covered flex, or "Electron" wire, or frame-aerial wire, will probably be found the most convenient. There is no need to use porcelain or ebonite insulators; the ends of the wire may be tethered by tying short lengths of string to the wire and looping these round nails or small hooks driven into the rafters or walls. As the aerial will always be dry, string is quite a safe insulator.

May Be Better

The lead-in from the aerial to the set should be of insulated wire, but provided it takes a reasonably direct route, it may touch the woodwork and the inside walls of the house, and may even be tacked to the skirting board of the staircase, or along a picture rail. The lead-in, and the aerial itself, should, however, be kept as far away as possible from water tanks and pipes and gas pipes, and should not run close to or parallel with electric lighting wires. It is better, too, not to let the wires come too close to the roof, or to outside walls, which may become damp in wet weather.

The lead-in may, if desired, be kept coiled away in some inconspicuous place except when it is actually in use, and may then be stretched to the point where it is wanted by more loops of string.

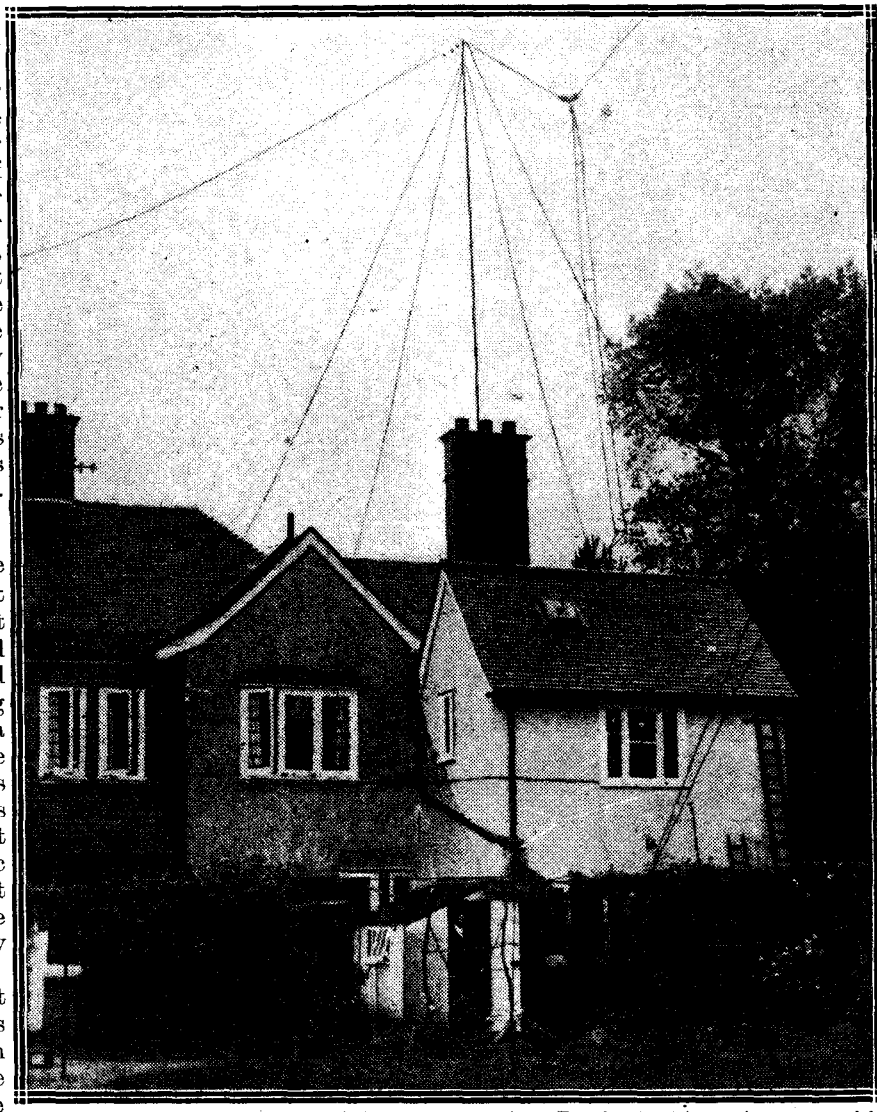
A makeshift aerial of this kind, much lower and shorter than a standard aerial, will often give better results than its big brother on the short waves. On the broadcast band it will probably make for selectivity, and volume may not be seriously affected. For Daventry (5XX) the big aerial will be best.

A Useful Stand-by

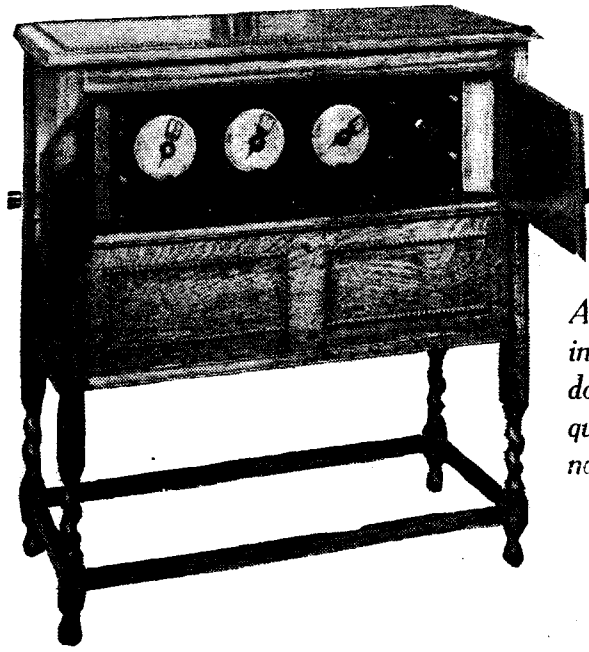
Apart from other advantages, it is quite a good plan to have a second aerial as a stand-by, particularly if it can be erected so that it does not run in the same direction as the main aerial. Accidents happen to even the best aerials in stormy weather, and usually at a time when a quick repair is impossible. A weak halyard is much more likely to break on a wet or snowy evening, and just before the commencement of a particularly attractive programme, than at a more convenient time. If no second aerial is available the programme must be missed, whereas a spare length of wire stretched across the loft would meet the difficulty.

When interference is bad, too, whether from atmospherics or conscienceless neighbours, the small aerial may be found better than the big one. At any rate, it is worth trying.

For the short waves it is quite likely that best results will be obtained without an earth connection at all.



Mr. Gerald Marcuse, the transmitting amateur whose Empire broadcasts have met with early success, can be seen in the above photo standing at the door of his power-house. The transmitter-room is on the right.



The "SUPER-SCREEN" FOUR

A very fine receiver, embodying the latest improvements in valve design. A turn of the dials brings in literally dozens of stations, at full loud-speaker strength. The quality is excellent, and though it is not a set that the novice could build successfully, it is extremely easy to handle when completed.

Designed and described by
G. P. KENDALL, B.Sc.

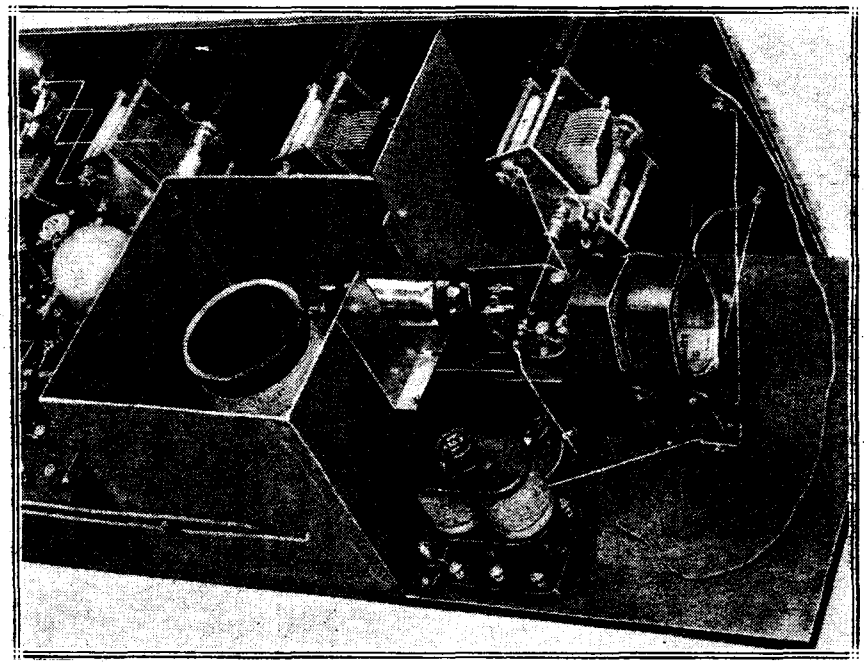
FRANKLY, this is a set for the fairly advanced constructor, with some previous experience of multi-valve sets, and preferably sets with H.F. amplification. It is not advised as a first attempt in valve-set construction, not because there is anything particularly tricky in its operation, but simply because the whole design has been worked out to include special devices which are only likely to appeal to the experienced operator. Further, this is emphatically a set in which it is imperative to make a conscientious copy of the original design, and this calls for a certain amount of experience in constructional work.

This preamble is not intended as a warning that the set is a tricky or critical one, but simply to make it quite clear at the beginning that it has been designed specially for the constructor with a certain amount of experience, who wants a set of only a moderate number of valves, but with a very high performance in point of distance-getting and quality of reproduction.

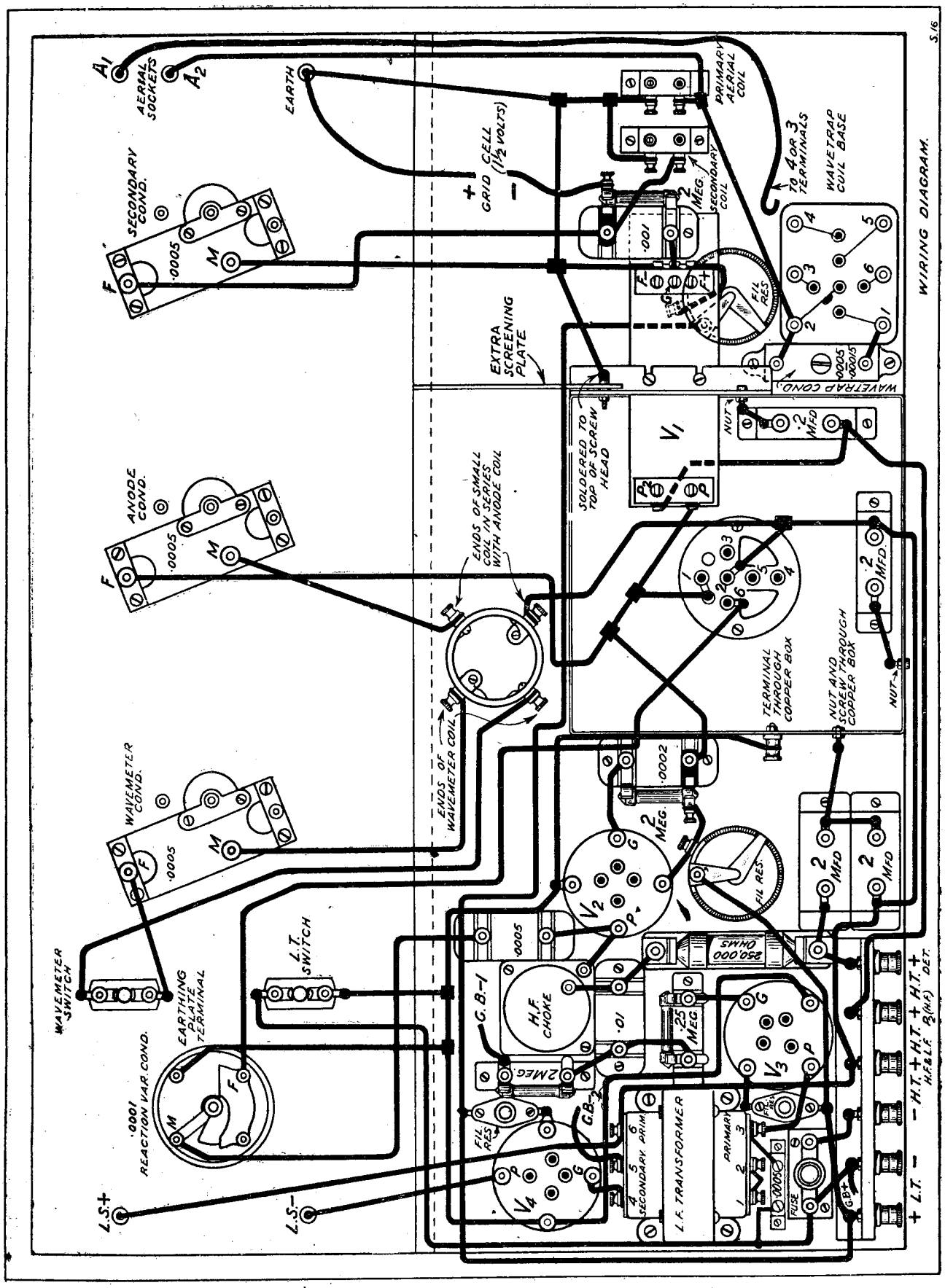
It is, moreover, a receiver incorporating such special features as a fieldless-coil wave-trap and a separate calibration circuit, and other details particularly intended for the constructor who has tried several sets and feels that the time has now come to build one containing sufficient refinements to satisfy him for some time to come. To any reader in this position it is very confidently recommended, since its special features are such that it is not likely to be found seriously out of date for some considerable time to come.

The basic feature of the set is the use of a single H.F. stage employing one of the new screened-grid valves (the Marconi and Osram S.625), this H.F. stage being very carefully screened and arranged to reduce feed-back between plate and grid circuits to extremely small limits. No neutralising scheme is necessary with this valve, of course, and a sufficient degree of stability is given to permit very high amplification to be obtained when proper precautions are taken.

Following the H.F. stage is a grid-condenser rectifier with capacity-controlled reaction, these two features having been decided upon in view of the fact that the set is essentially one for long-distance reception. There is a certain theoretical loss of quality of reproduction consequent upon both these features, but it is extremely slight so long as reaction is not abused, and requires a very critical ear indeed to detect it. As a matter of fact, the faithfulness of reproduction of this set is very good, largely as a result, no doubt, of the fact that it gives a great deal of genuine H.F. amplification, so that very little reaction is required for any except the weakest and most distant stations.



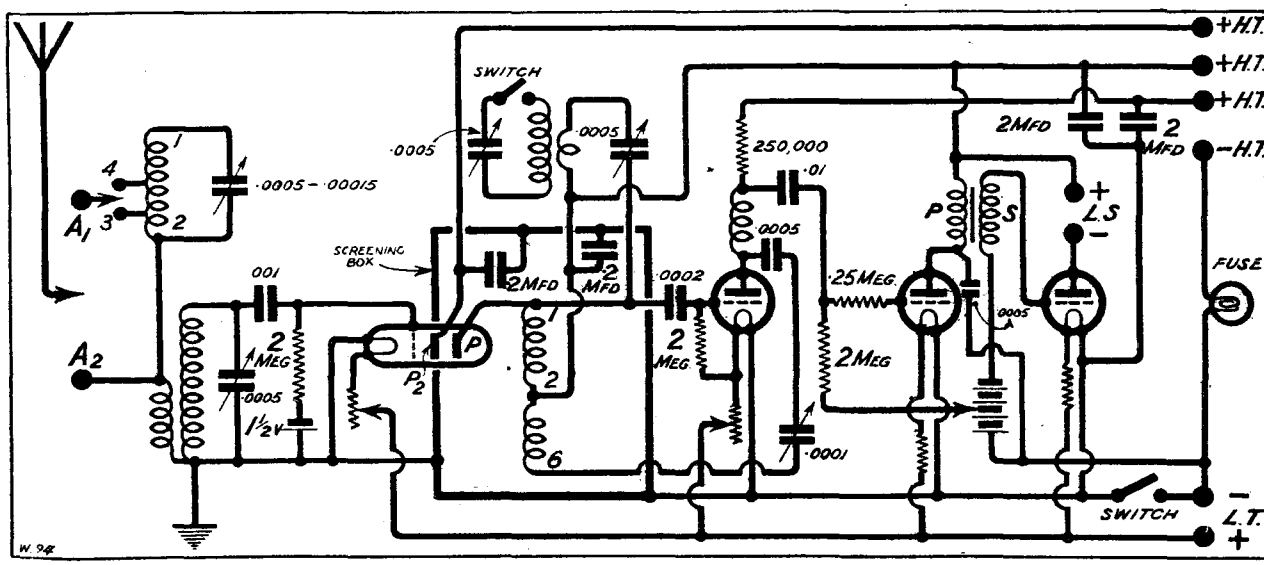
Note carefully the method of mounting the H.F. valve and the screening plate between the tuning condensers.


A1
A2
AERIAL SOCKETS
EARTH
SECONDARY COND.
.0005
F
M
+ GRID CELL (1½ VOLTS) −
PRIMARY AERIAL COIL
2 MEG.
SECONDARY COIL
.001
TO 4 OR 3 TERMINALS
WAVETRAP COIL BASE
EXTRA SCREENING PLATE
F−
F+
FIL RES.
WAVETRAP COND.
.0005
.0003
SOLDERED TO TOP OF SCREW HEAD
V1
NUT
.2 MFD.
ANODE COND.
ENDS OF SMALL COIL IN SERIES WITH ANODE COIL
TERMINAL THROUGH COPPER BOX
NUT AND SCREW THROUGH COPPER BOX
2 MFD.
WAVEMETER COND.
ENDS OF WAVEMETER COIL
.0002
V2
P
G
WAVEMETER SWITCH
EARTHING PLATE TERMINAL
L.T. SWITCH
.0005
H.F. CHOKE
250,000 OHMS
.01
.25 MEG.
G.B.-1
.0001 REACTION VAR COND.
2 MEG.
V3
V4
L.F. TRANSFORMER
SECONDARY
PRIMARY
.0005
FUSE
G.B.+
L.S.+
L.S.−
+ L.T. − − H.T.+ H.T.+ H.T.+
H.F. & L.F. & (H.F.) DET.
WIRING DIAGRAM.
S.16

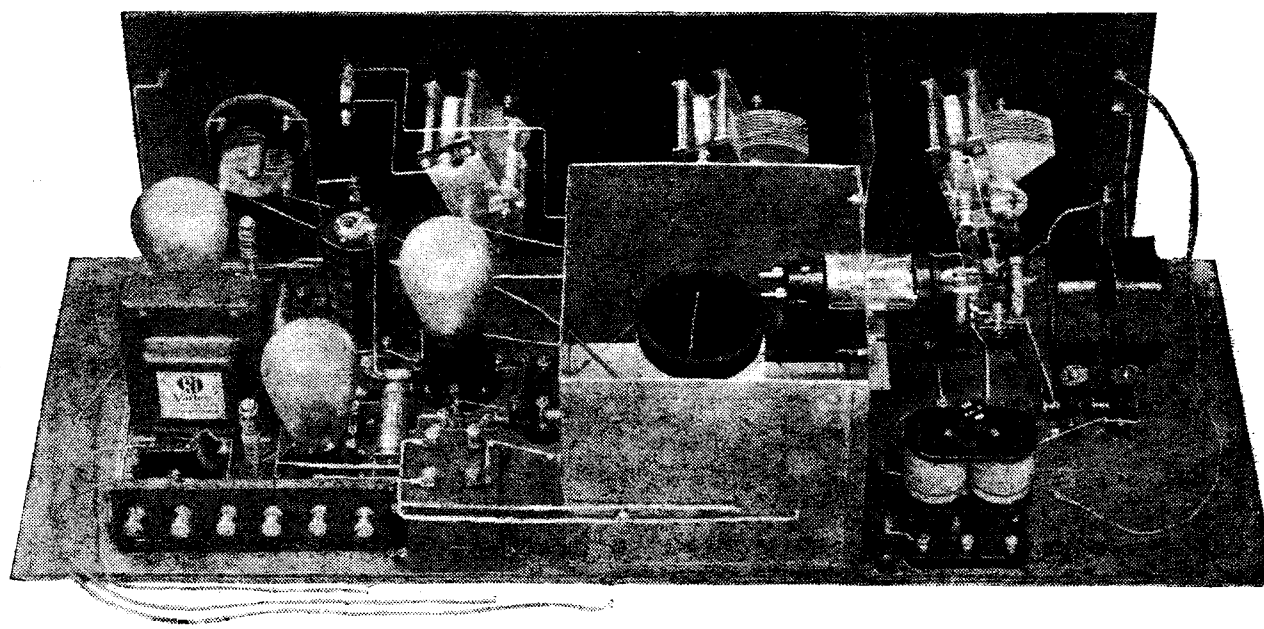
Following the detector are two L.F. stages of quite a standard type, the first coupling being of the resistance-capacity variety, and the second a transformer of one of the latest types, giving reasonably even amplification over the main range of musical frequencies. The usual device of a quarter-megohm leak in series with the grid lead of the first L.F. valve is provided to safeguard against troubles due to the passage of H.F. currents into the L.F. circuits. No output filter is provided for the loud speaker, since it was considered very probable that many constructors of this set will have such a filter already in their possession in the form of a separate unit. It is, of course, very desirable that such a filter should be used, but it should be pointed out that many experimenters have apparently not yet realised the great importance of using an output choke of really low D.C. resistance. This should be of the order of a few hundred ohms only when a modern power or super-power valve of fairly low impedance is used, and this usually means a choke of about 20 henries inductance.

If you use a large inductance choke, such as the intervalve-coupling type, its ohmic resistance is likely to be so high that there will be a large voltage drop across it when used with a low-impedance valve, so that only part of the available H.T. will be actually applied to the plate of the valve.

Turning now to the actual details of the circuit, it will be seen that an inductively coupled aerial arrangement is used, a pair of plug-in coils being placed in fixed sockets side by side to form the necessary primary and secondary. The quality of these coils is very important, for it is obvious that the higher the amplification of the set which follows the greater the difference in results which will be produced by good coils as compared with indifferent ones. It is vital to use really good ones, such as the Lewcos, Gambrell, or Lissen, to mention only three of the makes of satisfactory quality.

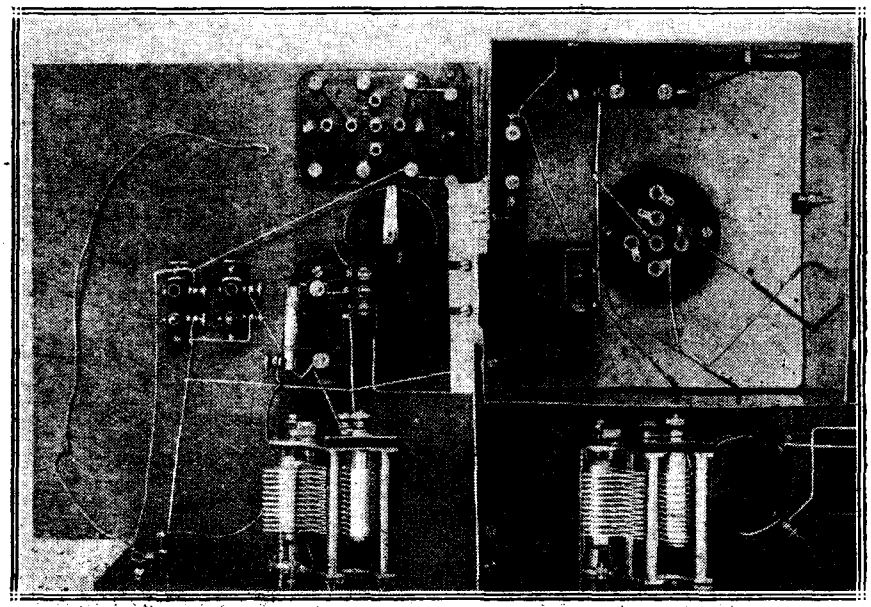


The wave-trap which has been mentioned will also be observed in the aerial circuit. It is of the inductively coupled type, and in order that it might be incorporated in the set without serious risk of interaction with the tuning circuits a fieldless type of coil was used. This is one of the newly introduced Lewcos binocular aerial coils (B.A.C.5), and it is mounted in the usual six-pin socket on the baseboard.



The standard screening box can be obtained from several firms with the special valve holder ready mounted.

The secondary of this coil forms the trap circuit, and is tuned by one of the " screw-down " type of baseboard-mounting variable condensers, known as a " Formo-densor." The capacity of this will depend upon the wave-length of the local station. For 2 L O and all stations of longer wave-length the maximum capacity should be ·0005 mfd, but for stations of lower wave-length a ·0003 is preferable. It will be seen that two sockets are provided at the upper left-hand corner of the panel, and a plug on the end of the aerial lead is inserted in one or other of these to bring the trap into use or cut it out of circuit when not required. From the socket which brings the trap into circuit a flex lead runs to the base of the binocular coil, and this is to be connected either to terminal 3 or to terminal 4, according to the size of the coupling winding required to suit the particular case.



A plan view of the most critical part of the set. A faithful copy is essential to success.

The secondary of the aerial coupling arrangement is tuned by a ·0005 condenser, and the grid and filament of the H.F. valve are connected across this circuit, a grid condenser and leak being interposed for the purpose of applying a negative bias to the grid. There are other methods available for applying this bias, but this one is convenient and will, moreover, be the natural method to adopt when biasing one of these valves in a second H.F. stage with tuned-anode coupling. It therefore seems desirable to adopt it as a standard method, especially since it also provides a means of applying damping to the grid circuit if desired for any special reason. In such a case, all that need be done is to reduce the resistance of the grid leak, but this point will not be dealt with in detail here, since it will not arise with this set in its normal applications.

The output circuit of the valve is a plain tuned anode with reaction from the detector valve, the tuned anode system being the normal one to use with this valve. It is important with this valve to obtain a really high impedance in the anode circuit, and this means that a coil of fairly low H.F. resistance must be used.

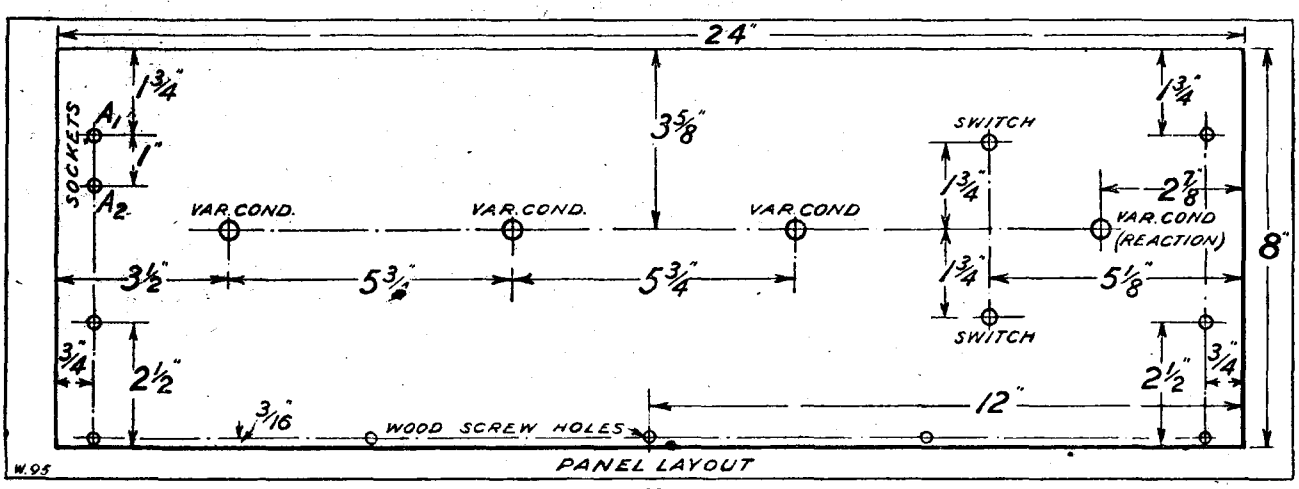
The connections of the six-pin base inside the screening box (this carries the coil in question) are so arranged that a standard split-primary transformer can be used here, when the secondary becomes the tuned-anode winding and the reaction winding is used in the normal fashion, the primary and neutralising windings being left free, To obtain the full results, however, a special coil must be used, and this is wound upon a 3-in. diameter former (the " Colvern " Feather-weight type).

The Special Coil

The anode winding contains 60 turns of No. 24 D.C.C. wire, the end nearest the base being connected to pin No. 2 and the other to pin No. 1. The reaction winding is in the same direction, and consists of 30 turns of No. 34 D.S.C., placed at the lower end of the former, i.e. nearest to the base. The end closest to the beginning of the anode winding is joined to the same pin, i.e. to No. 2, and the other end to No. 6. The coil can, of course, be bought ready wound, if desired.

The calibration circuit, perhaps, calls for a little explanation, since some readers may not be familiar with this device.

It is simply a wavemeter arrangement of the absorption type, which consists of a tuned circuit coupled fairly lightly to one of the receiving circuits. In use it will be found that when this circuit is tuned to the wave-length being received the signals will suddenly die down to quite weak



STATIONS IDENTIFIED IN ONE TEST.

All at Full Loud-Speaker Strength.

Station	Tuned Anode Condenser
Munich	98
Langenberg	83
Barcelona	80
Rome	78
Bilbao	75·7
Frederikstad	75
Frankfurt	73
Berne	69
Glasgow	67·5
Salamanca	67·2
Cork	66·5
Hamburg	65·5
Radio-Toulouse	64·5
Manchester	62·7
Stuttgart	62
Madrid EAJ7	61
Leipzig	58·5
Cardiff	54·2
Barcelona EAJ1	53·5
Naples	51
Koenigsberg	50
Bournemouth	49
Breslau	48
Newcastle	47
Madrid	46
Belfast	44
Hanover	43
Radio-Lyons	40
San Sebastian	38
Stoke-on-Trent	38
Dortmund	31·5
Danzig	29·5
Muenster	26

CONDITIONS OF TEST: Aerial: 100 feet of wire total, 15 ft. high at free end, 12 ft. at downlead end, considerably screened.

Valves: Detector, D.E.8H.F. First L.F., D.E.L.610. Second L.F., D.E.5A, Stentor 6, L.S.5A, etc. Coils, Lewcos.

strength, and may even vanish altogether, reappearing quite sharply as the wave-meter circuit is detuned either side of the absorption-point.

Constant Calibration

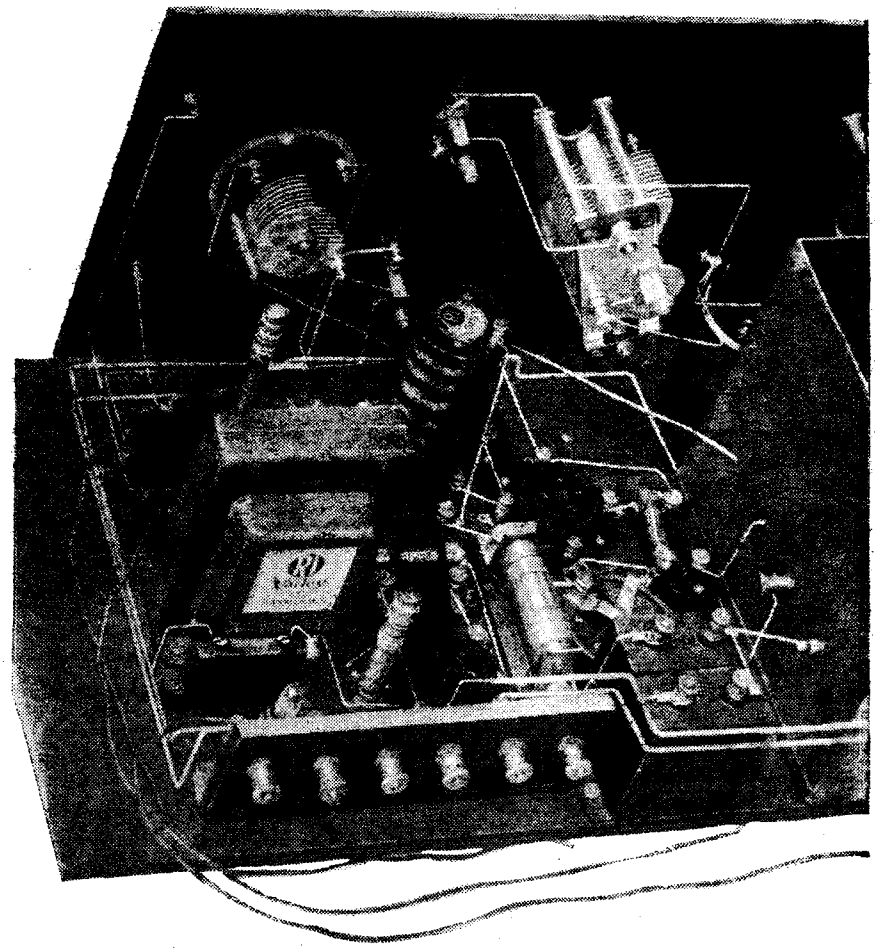
We are thus provided with a very useful calibration circuit actually in the set, and one, moreover, which maintains its calibration independently of changes of valves, reaction adjustment, etc. The details of the use of this meter circuit will be dealt with later in considering the operation of the set as a whole, but it may be mentioned that it can also be used as a wave-trap to assist in separating two distant stations which may be interfering with each other.

The upper of the two on-off switches on the panel is wired in series with the meter circuit so that it can be broken when not required, lest puzzling effects be noticed as a result of this circuit being inadvertently left tuned to some station for which search is being made.

(*Continued on page* 427.)

COMPONENTS AND MATERIALS.

1 panel 24 in. × 8 in. (Any good branded ebonite. Original panel was a "Radion" one).
1 cabinet to suit, and baseboard 10 inches deep.
3 ·0005-mfd. variable condensers (square-law or S.L.F. of any good make which does not project more than three inches behind the panel. Original were J.B. square-law type).
3 vernier dials of any good make. (Those seen on the set are the Ormond D.I. type).
2 6-pin coil bases (Lewcos, Collinson, Peto-Scott, etc.).
2 board-mounting single coil sockets (L. & P., Peto-Scott, McMichael, etc.).
2 on-off switches (Lissen, Igranic, L. & P., Lotus, etc.).
3 sprung valve holders (Lotus, Benjamin, Magnum, Burndept, etc.).
1 standard screening box with hole cut for special valve holder. Most firms will supply this box ready cut. (Burne-Jones, Bowyer-Lowe, Peto-Scott, Efesca, etc.).
1 special holder for S.625 valve.
2 ·2-mfd. Mansbridge condensers (Dubilier, T.C.C., Lissen, Mullard, etc.)
2 2-mfd. ditto.
2 baseboard-type rheostats (Lissen, Igranic, etc.).
1 .0001 midget reaction condenser (Peto-Scott).
1 250,000-ohm anode resistance and base (Dubilier, R. I & Varley, etc.).
2 fixed resistors and sockets (Burndept).
3 2-meg. grid leaks (Lissen, Dubilier, Mullard, etc.).
1 ·25 meg. ditto.
2 grid-leak holders.
1 ·0002-mfd. grid condenser with clips for leak, one to be of the insulating type (Dubilier or Lissen with "Combinator," etc.).
1 ·001-mfd. fixed condenser with clips exactly as above.
1 ·01-mfd. mica fixed condenser (Dubilier, T.C.C., etc.).
1 ·0005-mfd. fixed condenser (Lissen, Dubilier, etc.). Fairly low ratio.
1 ditto of an "edgewise" type such as the Dubilier 620.
1 H.F. choke (R.I. & Varley, Lissen, McMichael, Bowyer-Lowe, etc.).
1 L.F. transformer of good make (R.I.-Varley, Marconiphone, Ferranti, etc., etc.). Fairly low ratio.
1 flashlamp bulb and holder.
1 "Featherweight" 6-pin former (Collinson Precision Screw Co.).
9 terminals and 1 terminal strip.
1 Formo-denser (Arthur Preen & Co., Ltd. See text for capacity).
1 binocular aerial coil (Lewcos).
2 sockets and 1 plug ("Eelex").
1 piece ebonite tube 2 in. × 3 in.



The L.F. side of the set is of a straightforward standard type. Fixed resistors are provided for the L.F. valves, and rheostats for the H.F. and detector.

RADIO THIS SEASON

By the Editor of "Popular Wireless" and "Modern Wireless."

THE wireless exhibition has come to be regarded as the official event marking the opening of the wireless season. Amateurs from all parts of the country, who have returned from their holidays, cleaned up sulphated accumulators, and removed the cobwebs from their radio gear, begin to sit up and take notice—the lure of Olympia has its desired effect.

This year interest has been acutely stimulated, just prior to the opening of the exhibition, in several phases of wireless work—and from this interest it is not unsafe to deduce the fact that short-wave receivers will enjoy a "boom" this winter, while the chance for an alternative B.B.C. programme will spur many people, hitherto apathetic as regards broadcasting, to invest in a receiving outfit. The reductions in valve prices and components will also help to make this winter a record one as regards interest in radio.

It is, therefore, all the more regrettable that the B.B.C. should provide the one fly in this attractive radio ointment. That the fly is there few can deny, when they carefully consider the question of Empire broadcasting.

B.B.C. Should "Get Busy"

There is a widespread desire that the B.B.C. should proceed without delay in the erection of a short-wave broadcasting station, to enable Dominion listeners to hear direct from the Old Country.

Australia has already "got busy," but as these words are written only rather vague promises have emanated from No. 2, Savoy Hill.

This desire has been thwarted by the B.B.C. for several reasons—all of them, on the surface, good ones, but which on closer inspection prove to be specious and, indeed, extremely weak.

The facts are simple. PCJJ, 2XAF, KDKA, 2MB (Australia) and several other well-known short-wave stations have, during the last few months, demonstrated the fact that short-wave broadcasting, although by no means perfect, is sufficiently developed to warrant a series of broadcasts for the benefit of Dominion and colonial listeners.

PCJJ has, for example, on the whole had many striking successes, as thousands of reports from listeners in all parts of the world amply testify. And although PCJJ cannot guarantee a regular service, the engineers, and those responsible for the technical design and operation of the station, have advanced far enough to make it possible for the station to broadcast with average success — greatly to the edification and interest of listeners thousands of miles away. 2MB, the Sydney short-wave station, has also demonstrated this fact.

Naturally, interest in British Dominions has been aroused, as well as at home, and the question, "Why hasn't Britain its own short-wave broadcasts?" has been widely asked.

And the question has been widely answered—but in different ways.

Rattle, Rumble, and Radio. Talking by wireless from one armoured car to others on the move has now been demonstrated successfully.

The B.B.C.'s answer amounts to this: it is waiting for "technical perfection," i.e. until it can guarantee a regular 24-hour service. Until this is possible it considers short-wave broadcasting proposals for an *immediate* service (however experimental, and however important the policy of making a start) premature and unsound, and if adopted likely to prove damaging to the Empire. 2MB, of Australia, obviously thinks just the opposite, and rightly, too.

Other critics strongly disagree. They say, "waiting for technical perfection" is a poor excuse, inasmuch as man never does attain to perfection, and that if the absurdly high standard set by the B.B.C. is adhered to, it will be a very long time before Britain has a short-wave broadcasting system in operation fulfilling the ideals of the B.B.C. engineers.

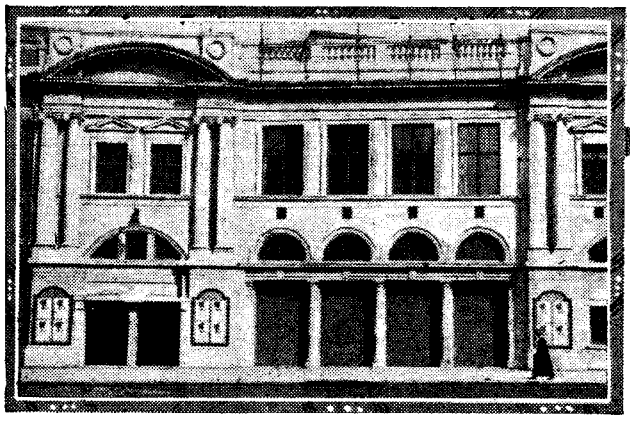
Too Much Talk

Further, this "go slow" policy, if carried out in full, will mean that other countries will reap the propaganda benefit of a short-wave broadcaster, and with PCJJ as an example, the opinion in the Dominions, and in Australia especially, will be that we are not particularly keen on the idea, despite all the talk on the subject.

The trouble is that the B.B.C. is too meticulous; nobody expects a perfect service, but most people expect the B.B.C. to show a little imagination, initiative, and energy, and to subordinate its personal ideas to the demands of the public will.

Captain Eckersley's technical reasons for the non-compliance of the B.B.C. with public demand, are, on the whole, quite sound; but he misses

(*Continued on page* 422.)



The RADIO EXHIBITION

The National Radio Exhibition holds more of interest this year for the home constructor than it has ever done. All readers of "MODERN WIRELESS" should make an effort to go to Olympia at least once.

BROADCASTING in this country is nearly five years old, and each year we have had a wireless exhibition, while each has brought forth its new wonders, but this year tops the lot for really good, solid, useful advancement in the science of radio reception.

We have had all sorts of "wonders" before, but it seems that this exhibition will surpass all others for sheer interest and for attractive staging. It is certainly not a show confined to the enthusiast or constructor. The average man-in-the-street, the ordinary listener, will find much to interest him, and even the womenfolk have been catered for in the provision of a dance-hall in the gallery, which, by means of speakers, will be provided with music from items played by the Royal Air Force String Band, which will play in the main hall throughout the whole exhibition.

The lighting schemes have been greatly improved, while a certain amount of power is available to the holders of stalls, so that the exhibits need no longer present a "museum" appearance, but can be really "live." The only regrettable thing about the show is that the sets cannot be demonstrated—a quite obvious state of affairs, however, for a number of loud speakers all going together would make a most unearthly din.

The main exhibits of the various firms are briefly mentioned in the succeeding pages, but the exhibit of the B.B.C. deserves special mention, for this takes the form of an unusually interesting feature, at one end of the gallery. It is contained on a sort of island, all by itself, and consists of a replica of the control-room of 2 L O, and miniature models of the various broadcasting stations operated by the British Broadcasting Corporation. Of the other exhibits it is difficult to say anything without saying more than could possibly be squeezed into this page, or, indeed, into many pages.

The new screened, or shielded, grid valve will draw great crowds, and rightly so, for these constitute one of the most interesting and valuable of the recent advances in broadcast reception. The valve enables huge improvements in H.F. amplification to take place, and all should make a point of having a close look at it. Other valves on show include the various types of dull emitters and the special indirectly heated cathode valves for operation from A.C. mains.

And talking about mains, you ought to spend some time among the eliminators. These are of all sorts and for all kinds of work, L.T., H.T., "Power" (both L.T. and H.T. and grid bias) all being well represented on many stands, while complete sets using these eliminators and either the A.C. valves or valves of the usual types, are very much in evidence. New loud speakers there are, while the alterations in design of even small components will, in some cases, be of the greatest interest and value to the home constructor. And don't forget to have a look at the new standard screening boxes introduced to our readers by Mr. G. P. Kendall.

Finally, whatever you do, do not omit to come and visit us on Stands 74 and 75. Make that a meeting-point for your friends. The stands are conveniently situated, as you will see by the plan on the next page, and on them you will find a great deal to interest you. Many examples of receivers, the descriptions of which have been published by us and our companion journals, will be in evidence, so that you can see how the original receivers, the photographs of which you will have seen, really look.

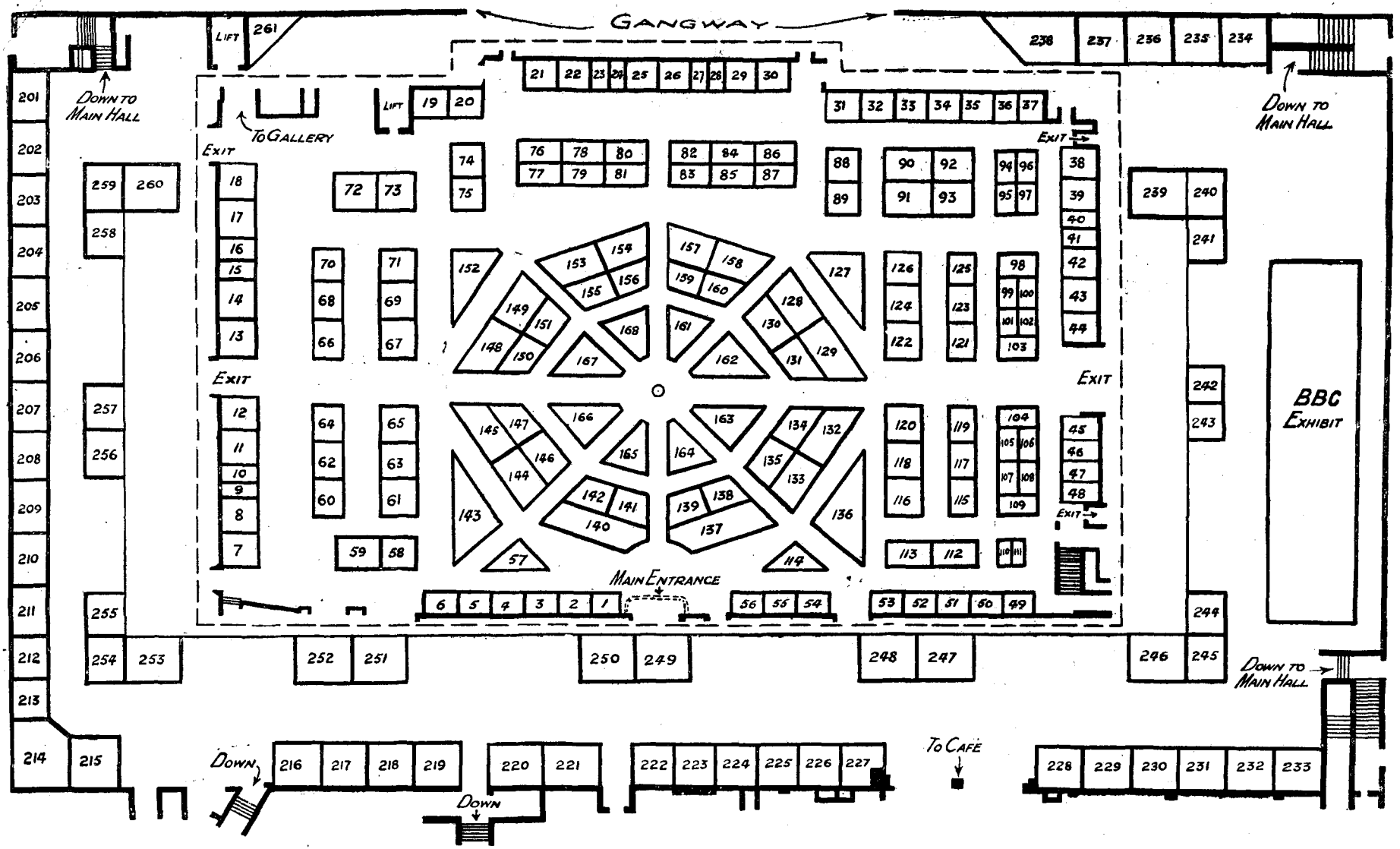
The winning design in the competition recently held for a poster advertising the Radio Exhibition.

The Exhibition opens on Sept. 24th, and will be closed on Oct. 1st. All who can possibly do so should pay at least one visit to Olympia.

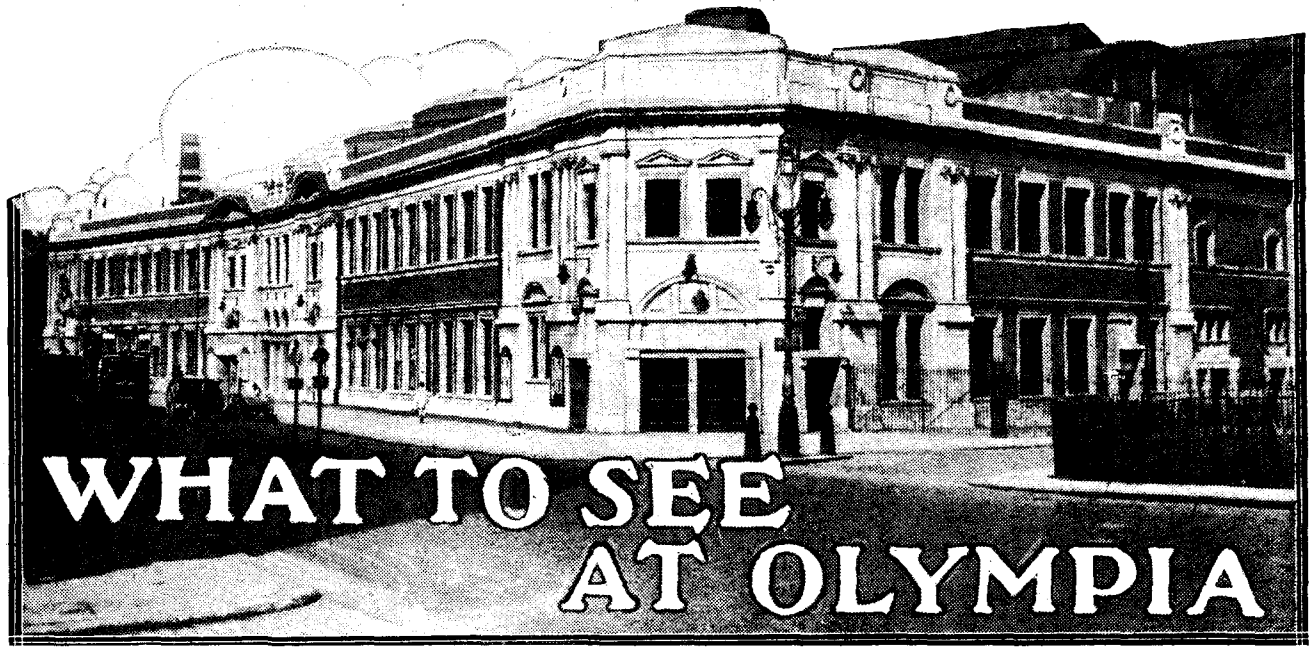
Such sets as the "M.W." Five, the "Spanspace" Four, the "Cube Screen" Three, and the "Universal" Three, will be there for your examination, and all who can possibly do so should make a point of scrutinising them.

The exhibition is easy to reach—the District railway runs through trains (to Addison Road), while a number of 'buses go direct to Olympia. Anyone will tell you how to get there, it is the simplest job in the world, for all Londoners know Olympia. So come up from the country, the suburbs, from all over the kingdom, and those of you who live near bring your friends, and bring them not only once but twice and three times. The "show" is chock full of interest, and you'll need more than a cursory glance here and there if you are to take it all in, and it is worth while "taking it all in."

THIS PLAN WILL HELP YOU AT OLYMPIA.



NOTE:- THE PLAN OF THE MAIN HALL IS SHOWN INSIDE THE DOTTED LINE: THE PLAN OF THE GALLERY WHICH SURROUNDS IT, IS DRAWN TO A SLIGHTLY LARGER SCALE.



WHAT TO SEE AT OLYMPIA

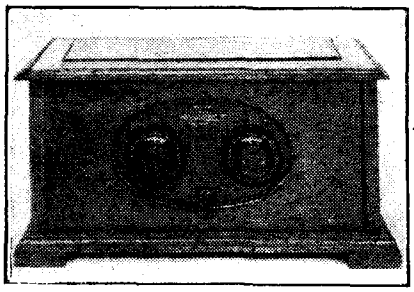
A summary of the main exhibits to be seen at the National Radio Exhibition.

In these pages readers will find a brief summary of the main points of interest to be seen at the National Radio Exhibition which commences on Sept. 24th. The firms mentioned form the majority of those exhibiting and will be found in alphabetical order.

There are so many interesting features that it is impossible to mention them all in the space at our disposal.

AMALGAMATED PRESS, LTD.
Stands Nos. 74 and 75.

All readers should make a point of visiting us and examining for themselves the various original models of receivers which are on view. These receivers have been picked as being the most interesting out of the many sets, the descriptions of which have been published during the past few months in MODERN WIRELESS, "The Wireless Constructor" and "Popular Wireless."



One of the "Peerless" receivers made by the Bedford Electrical and Radio Co., Ltd.

ATKINSON C. CRESWICK.
Stand No. 55.

On this stand a series of receivers is on view, and in many of the sets full-size loud speakers are incorporated.

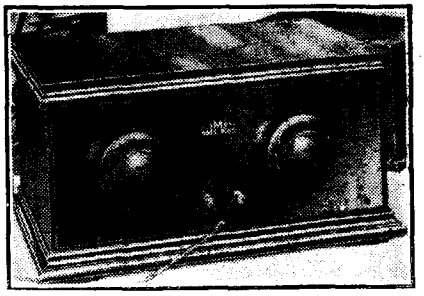
THE AUTOMATIC COIL WINDER AND ELECTRICAL EQUIPMENT CO., LTD.
Stand No. 260.

The "Macadie" automatic coil winder is an interesting item on this stand. It winds coils of any shape from $\frac{1}{8}$ in. to 5 in. in length and up to 4 in. in diameter, with any gauge of wire from 1 mil. to 18 mil., at speeds up to 6,000 r.p.m.

Additional exhibits are an improved "Avometer," combining amps., volts, and ohms in direct reading, and a series of inductance coils which are claimed to give the lowest distributed capacity with the highest inductance values.

An example of the famous "Ekco" battery eliminators.

With a view to inducing visitors to Olympia to test their "Slektun" Coils, the manufacturers are willing to sell a limited number at prices actually below cost, during show days only.



The Climax "mains" receiver.

BATTERIES LTD.
Stand 53.

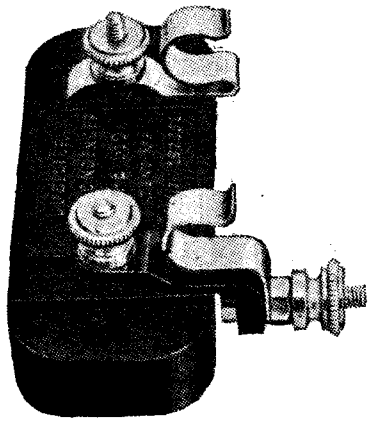
This firm is showing the famous "Nife" batteries, for which an extremely long life is claimed; and all types and sizes are being exhibited. Every battery is claimed to have no self-discharge, while the H.T. batteries are said to last a lifetime.

BEDFORD ELECTRICAL AND RADIO CO.
Stand No. 52.

The makers of the "Peerless" wireless components are putting up an excellent show at Olympia, and it is impossible to mention all the things that are to be seen on this stand. The chief exhibits include a series of complete sets, available to the public at popular prices, which should claim the attention of every reader. All sorts of components are, of course, on view as well.

BELLING & LEE, LTD.
Stand No. 207.

A multitude of interesting gadgets characterises this stand, all types of terminals, plugs and sockets, connectors, dial indicators, etc., being

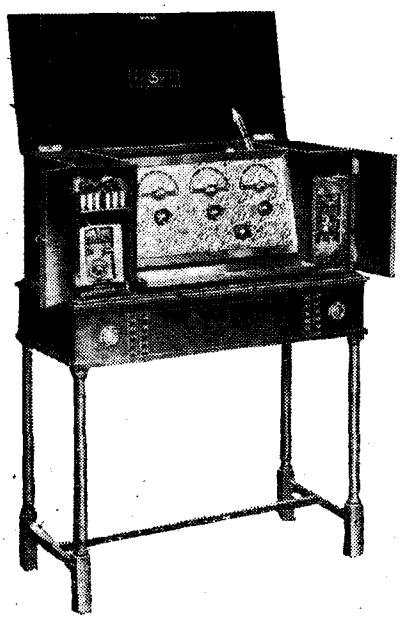


The Dubilier insulating clip in position on a grid condenser.

on view. The principal feature of the stand is a new series of terminals available to the public at an exceptionally low figure.

BENJAMIN ELECTRIC CO., LTD.
Stand No. 79.

Valve holders, coil holders, and many of the hundred-and-one little components required by the home constructor will be found on Stand 79, in addition to a complete range of the well-known Benjamin "Short-Path" receiving valves.



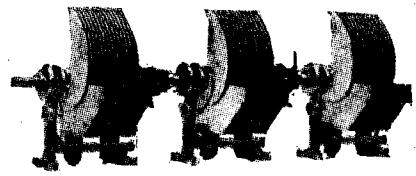
A five-valver made by "Metro-Vick" Supplies, Ltd. It incorporates a battery eliminator for both H.T. and L.T. supply.

SYDNEY S. BIRD & SONS. Stand No. 121.

The makers of the famous "Cyldon" variable condensers have gone one better this year and are exhibiting a new series of thumb-drive and "Panalong" gang condensers. These latter are arranged so that they can be mounted at the back of the panel with the spindle running parallel with the panel in American fashion, the control being obtained by means of a disc projecting partly through the panel.

BOWYER-LOWE CO., LTD.
Stand No. 124.

Among the many interesting things to be seen here are the following new components. The "Whiteline" valve holder, L.F. transformer and choke, vernier dials, screening boxes, etc., and a new wavemeter covering from 150 to 2,000 metres, which will be of interest to every experimenter, and of value to all listeners with multi-valve receivers.



An example of the universal Formo gang coupling and condensers.

BRANDES LTD.
Stand No. 161.

In addition to the lines which were shown last year a new receiver is being staged—the "Brandeset" IIIa. This season Messrs. Brandes are marketing their goods through a new authorised dealers' scheme which should be of benefit to all purchasers.

BRITISH EBONITE CO., LTD.
Stand No. 76.

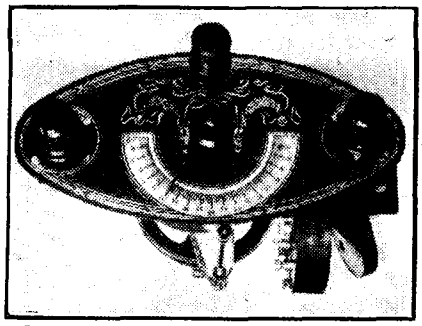
On this stand a full range of ebonite panels and ebonite components may be seen, the various types and grades being laid out to form a most interesting exhibit.

THE BRITISH RADIO CORPORATION, LTD.
Stand No. 59.

Three sets are the main attractions on this stand and deserve careful consideration. They consist of a Long-Range Five, Long-Range Six, and a "Radio Exchange" set.

The Long-Range Five-Valve Receiver consists of two high-frequency stages with a complete range from 200 to 2,000 metres. This instrument is shown in two forms, one with the neutralising method of balancing, the other emboding the new method of overcoming the inter-electrode capacity within the valve itself, making neutralisation unnecessary.

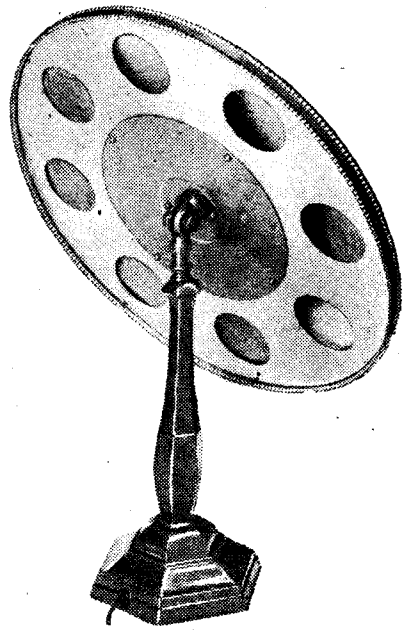
The Long-Range Six-Valve Receiver embodies an entirely new screened high-frequency unit, automatic in its tuning from 200 to 2,000 metres, and embodies the new type of



The Lamplugh panel-plate tuner unit.

screened-grid valve which dispenses with neutralising of any form, thereby giving full and complete stability on all wave-lengths with high-frequency magnification hitherto considered impossible.

The B.R.C. "Radio Exchange" embodies all the interesting features of the B.R.C. six-valver, including the new type screened-grid valves mentioned. A simple switch shows the name of the station by an illuminated indicator operated similarly to the ordinary telephone call-board.

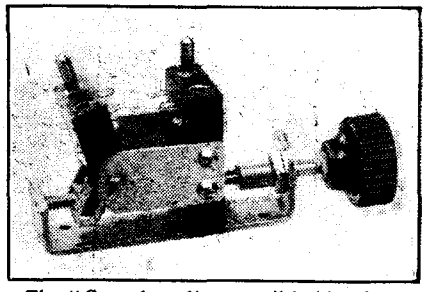


This photograph shows the reverse side of the "Gecophone" cone loud speaker.

A full range of new and interesting components, principally dealing with high-frequency amplification, is on view, together with high-frequency transformers specially suitable for the new forms of high-frequency valves on the market, such as the screened-grid valve, etc.

BROWN, S. G., LTD.
Stand No. 122.

A fully comprehensive display of loud speakers is arranged on this stand, among which we must mention



The "Gecophone" two-coil holder for panel or baseboard mounting.

the new Sphinx speaker, while the new Brown gramophone pick-up is sure to create great interest.

BROWN BROS., LTD.
Stands Nos. 25 and 26.

A fascinating display of goods, complete sets, and components of all types can be seen here.

B.S.A. RADIO, LTD.
Stands Nos. 10 and 64.

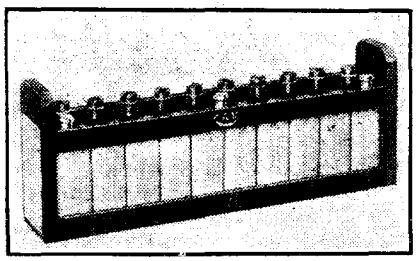
In addition to complete sets, specimens of valves and components, this firm is displaying the famous Kone loud speakers, which are so popular among the British public.

B.T.-H. CO., LTD.
Stands Nos. 138 and 139.

Chief among this firm's exhibits is a complete range of receiving valves and the R.K. loud-speaker equipment. Unfortunately, this latter cannot be demonstrated at Olympia, but we understand arrangements for the public to hear it can be made at the stand. In addition, a very comprehensive collection of components is also being staged.

BURNDEPT WIRELESS, LTD.
Stand No. 127.

Chief among the many things to be seen on Stand 127 are two-, three-,



The HTG2 type H.T. accumulator unit manufactured by C. A. Vandervell & Co.

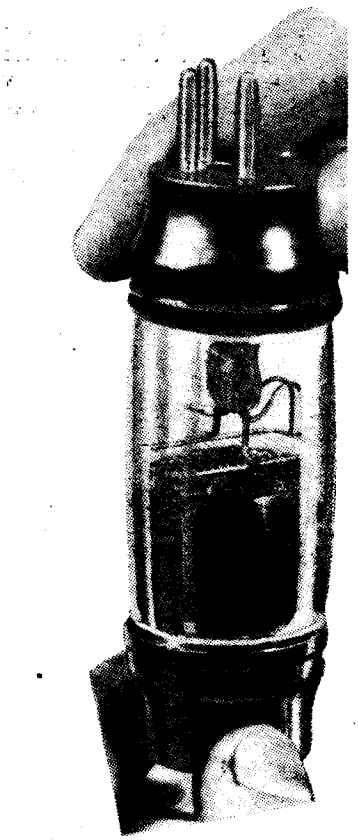
four-, and five-valve receivers, the famous "Ethodyne" Super-Het, and a special three-valver for the ultra-short waves. This latter covers from 12 to 100 metres, and should be examined by all short-wave enthusiasts.

BURNE-JONES & CO., LTD.
Stand No. 123.

Many fine examples of well-made British apparatus are to be seen here, all types of components being on view, from inductance coils, valve holders, etc., to the latest copper screening boxes holding complete H.F. stages.

BURTON, C. F. & H.
Stand No. 37.

The special feature of this exhibit is a new patent straight-line condenser which has a novel friction band brake to prevent backlash. Other exhibits include various types of variable condensers, vernier dials, screens and bases, plugs and jacks, switches, etc.



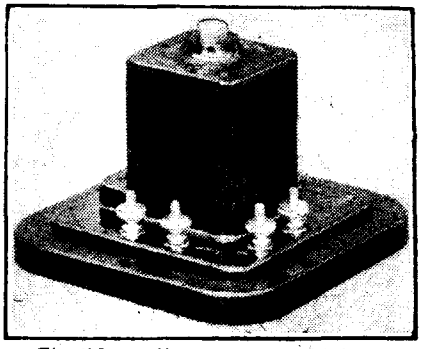
The new shielded-grid valve, the Marconi and Osram S. 625.

CAHILL & CO., LTD.
Stand No. 101.

All types of the "Pelican" range of receivers are to be seen here, forming a most attractive exhibit.

THE CAMDEN ENGINEERING CO., LTD.
Stand No. 96.

Die-cast variable condensers of the single-, dual- and triple-gang types are the chief components to be seen, though metal screening boxes, metal panels, slow-motion dials, and other components are worthy of the attention of the visitor to Stand 96.



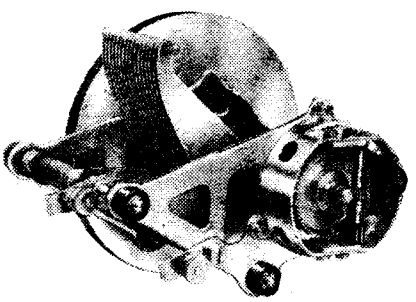
The "Lotus" remote control relay.

CARRINGTON MANUFACTURING CO. LTD.
Stand No. 12.

A full range of cabinets to suit receivers designed and described by the various wireless publications are on view, while a new cabinet, the "Carlton," is worth the attention of all constructors. This not only provides accommodation for the set, batteries, or eliminator, but also has a compartment ready so that any loud speaker unit can be built into the cabinet.

CELESTION RADIO CO.
Stand No. 157.

All types of the famous "Celestion" loud speaker are to be seen, and it will be noticed that the well-known "Radiophone" has been replaced by the new C10 model, which incorporates several important improvements. Models A2 and A3 have been replaced by one model, the C12, which gives greatly improved results. The largest loud speaker, C24, is in a class by itself, utilising a 24-in. diameter diaphragm and a special method of balancing. This is certainly a great advance on the other speakers manufactured by this firm.

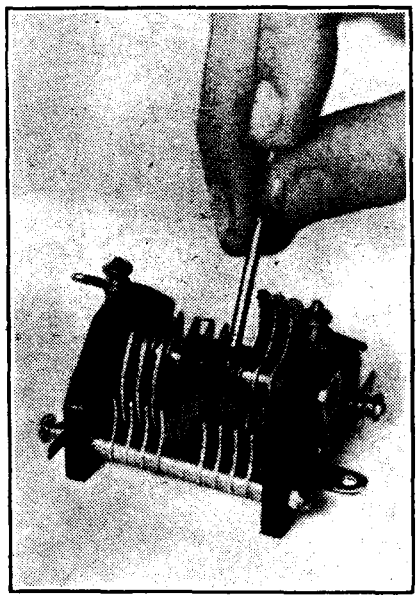


The Ediswan geared variable condenser.

CHLORIDE ELECTRICAL CO.
Stands Nos. 167 and 233.

The famous makers of the "Exide" batteries have on show a full range

of accumulators of H.T. and L.T. types suitable for wireless receivers, in addition to batteries designed for such applications as public address systems, laboratory equipment, tele-



The Peto-Scott double neutralising condenser.

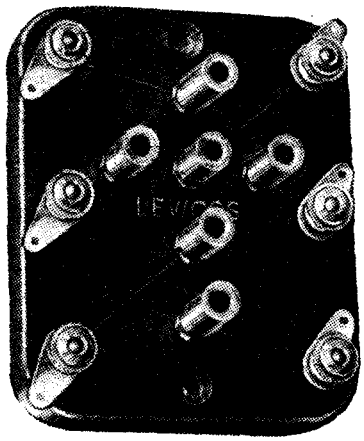
phones, signalling, etc. A wide choice of Exide unspillable cells for portable sets may also be seen.

CITY & GENERAL RADIO CO., LTD.
Stand No. 202.

The exhibition of sets of parts for receivers described by the various radio publications is a feature of this stand, and therefore should be examined by all visitors to Olympia.

H. CLARKE & CO., LTD.
Stand No. 83.

The makers of the famous "Atlas" components have a new addition to their catalogue in the form of a series



The "Lewcos" six-pin coil base.

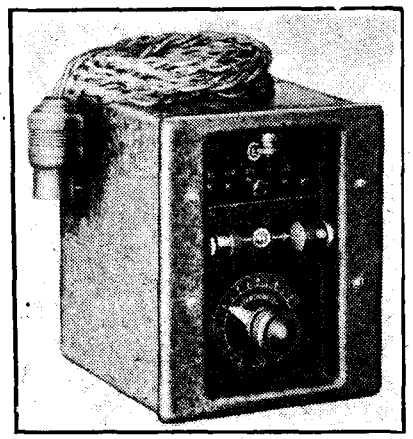
of H.T. battery eliminators in the component section, while the demonstration model of the "Neutro-four" receiver forms an interesting exhibit on their stand. This receiver is an up-to-date four-valve set using a neutralised H.F. stage, detector, and 2 L.F. amplifiers.

CLIMAX RADIO CO.
Stands Nos. 88 and 89.

Several new products mark the exhibits on this stand as worthy of special notice. The most outstanding of these are the H.T. supply units. The D.C. model with ten tappings is no larger than an ordinary valve box, so that it can be easily fitted into the cabinet of the receiver, taking up less space than the average 120-volt H.T. battery.

E. K. COLE, LTD.
Stand No. 11.

Well known for their H.T. battery eliminators, this firm has now proceeded further, and is showing a series of sets for use off the electric-light mains. Worthy of special attention is a compact eliminator for D.C. mains, which measures only 3 in. by 2 in. diameter, and which can



One of the many types of eliminators to be seen at the show. The Metro-Vick L.T. supply unit.

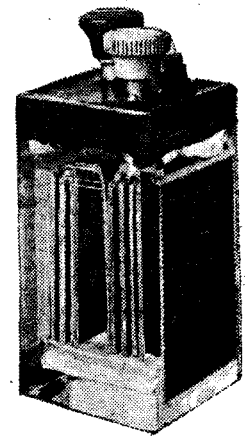
be plugged direct into the electric-light socket, and is capable of supplying H.T. current for one-, two-, or three-valve sets.

COLONIAL TECHNICAL PRESS, LTD.
Stand No. 232.

Upwards of 60 radio publications from all countries are to be seen here, so that the enthusiast will find all he requires in the way of wireless literature.

COSSOR, A.C., LTD.
Stands Nos. 86 and 87.

In addition to a full range of the famous Cossor receiving valves, this enterprising concern is showing a series of valves designed for operation direct from the A.C. mains. These are worthy of very close attention, as they incorporate many interesting and ingenious modifications.



A popular little L.T. battery is this one made by the Oldham Accumulator Co.

D.A.R., LTD.
Stand No. 104.

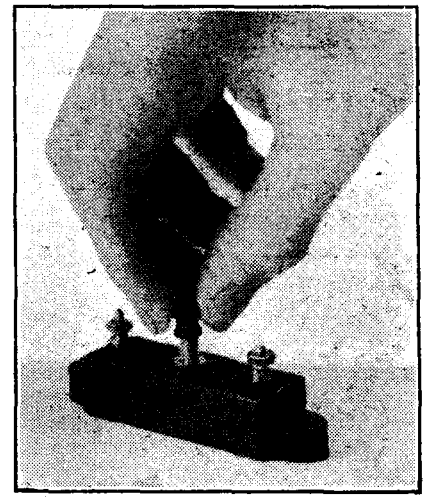
Many interesting examples of the before-and-after type are to be seen at the stand occupied by D.A.R., Ltd., who are the well-known makers of the new "rejuvenating" fluid for sulphated accumulators.

BERTRAM DAY & CO.
Stand No. 51.

This well-known advertising firm is showing numerous specimens of advertisements, catalogues, booklets, etc., and examples of complete publicity campaigns are open for the inspection of all.

DIONOID, LTD.
Stand No. 107.

The principal exhibits here include new designs of L.T. and H.T. bat-



Adjusting the "Formo-densor," a compact and convenient variable condenser.

teries, the cases of which have been specially constructed to prevent creeping of the acid. If required, all batteries

can be fitted with charging indicators of the "sink or swim" type, so that

A five-valve portable made by McMichael's.

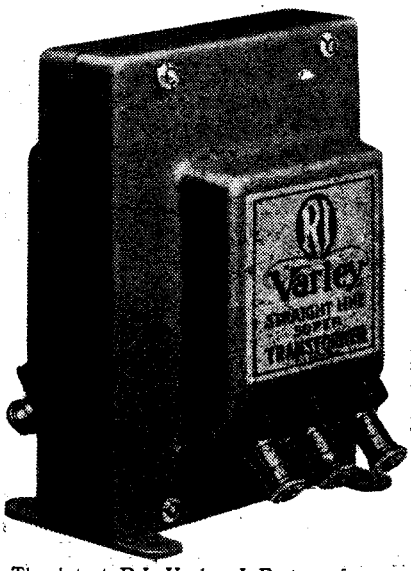
the condition of the cells can be determined at a glance.

DUBILIER CONDENSER CO., LTD.
Stand No. 162.

This firm is introducing a new R.C. unit to the public, in addition to a series of H.T. supply units and many interesting components. The main feature of the R.C. unit which strikes us is the fact that both the anode and grid resistances are easily interchangeable, a most important point for the home constructor.

EAGLE ENGINEERING CO., LTD.
Stand No. 58.

Chief among the new lines to be seen here is a series of sets ranging



The latest R.I.-Varley L.F. transformer.

from the junior two- and three-valve receivers to a portable five-valve Daventry set and a super-het.

J. J. EASTICK & SONS.
Stand No. 245.

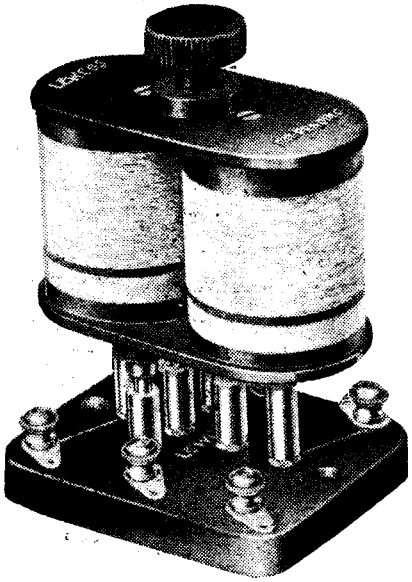
The following new lines have been added to the "Eelex" range:

The "Eelex" Safety Switch, which is a device fitted outside the house and operated from inside, whereby the aerial is shorted to the earth when the switch is in the "off" position, and, in addition, the set is disconnected from the aerial system.

The "Eelex" Multiple Connector, enabling any number of battery cords, up to eight, to be connected at once.

Insulated eyes, pins, and spades, etc., and a number of small components.

The remainder of the exhibit is largely devoted to the "Eelex" Treble-Duty Terminals, "Eelex" Switches and Earth Bowls. Easticks also are showing "Eelex" Lightning Arrestors,



The new Lewcos binocular six-pin coil.

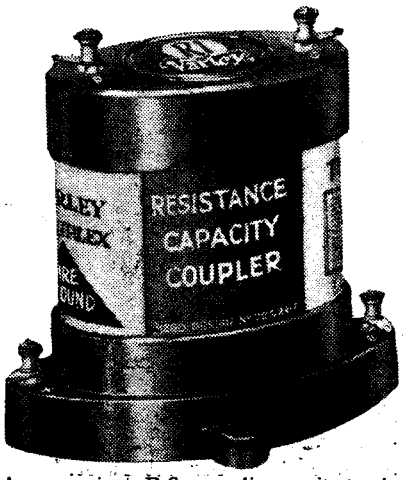
Frame Aerials, Low-Loss Coil Mounts, Knife Switches (medium, giant, and miniature), Standardised Plugs and Sockets, Connectors and Adaptors, which have been shown at previous exhibitions.

EDISON-SWAN ELECTRIC CO., LTD.
Stands Nos. 133 and 146.

A full range of receiving valves, many of which embody the latest improvements in valve design, form the chief exhibits on this stand, though a goodly array of other things may also be seen. Among the components, R.C. units, H.T accumulators, variable condensers, and many of this firm's well-known lines are worth attention.

ELECTRON CO., LTD.
Stand No. 141.

The famous "Six-Sixty" valves now designated by a new system of nomen-

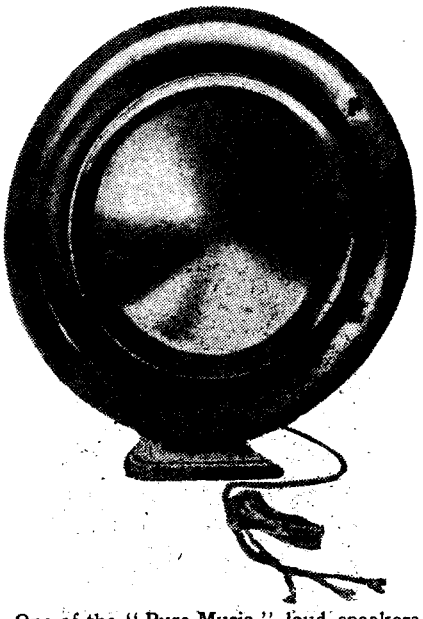


A convenient R.C. coupling unit to be seen on the R.I.-Varley stands.

clature form a most interesting exhibit. These valves need no introduction to our readers, and the majority of them may be obtained in either the ordinary type or in type T, which is an enclosed valve specially designed to be non-microphonic.

ENTERPRISE MFNG. CO., LTD.
Stand No. 259.

A full range of wireless cabinets is to be seen on this stand, which holds many designs of interest to the home constructor.



One of the "Pure Music" loud speakers made by Mullard's.

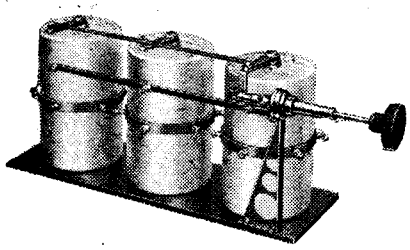
EXCEL RADIO COMPONENTS.
Stand No. 221.

The chief exhibit provided by the Excel people is a permanent detector

popularly known as the oscillating crystal unit.

EXPRESS RADIO & ELECTRICAL CO., LTD. Stand No. 118.

The main exhibits here take the forms of three receivers—a neutralised set covering from 100 to 150 metres known as the "Empress Classic



The Lewcos ganged shielded inductances.

Four"; "The Concert Four" single-dial receiver, and a powerful local set called the "Concert Three."

FALK, STADELMANN & CO., LTD. Stand No. 147.

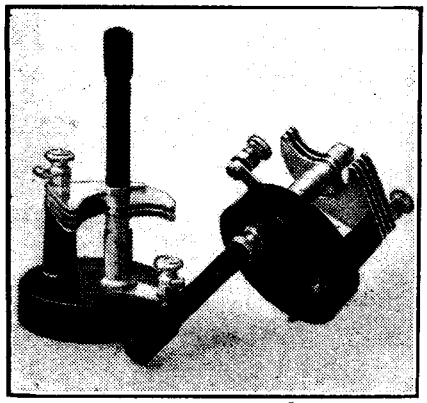
A full range of "Efesca" components and "Efescaphone" wireless sets is being shown. Among the new lines of particular interest are a number of sets specially designed for simplicity in tuning.

FELLOWS WIRELESS. Stand No. 116.

A most comprehensive range of components, batteries, and complete receivers is shown on Stand 116, forming an exceedingly interesting exhibit.

FERRANTI, LTD. Stand No. 142.

In addition to the well-known low-frequency transformers manufactured by this firm is being shown a comprehensive range of output transformers, chokes, loud-speaker attachments, and a complete line of radio ammeters and voltmeters.



The Bowyer-Lowe neutralising condenser for panel or baseboard mounting.

THE FORMO CO. Stand No. 81.

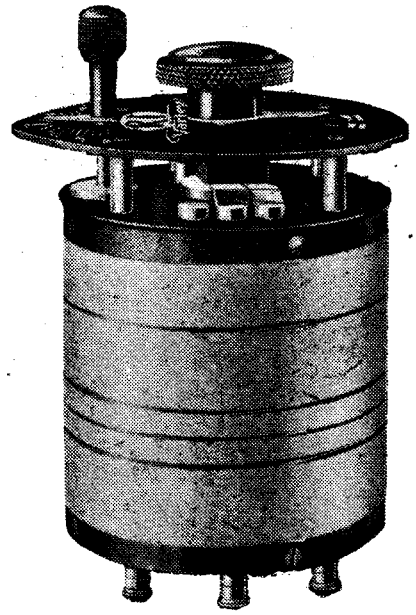
A new type of log condenser is worth consideration here, in addition to the tremendously wide range of inductances, dials, and various little components which are produced by this firm. The stand is most interesting, and should certainly be visited.

A. W. GAMAGE, LTD. Stand No. 69.

A full range of wireless apparatus, including complete receivers and component parts, is being shown by this famous store.

GAMBRELL BROS., LTD. Stand No. 66.

Low-loss coils, centre-tapped coils, a special centre-tapped coil holder, neutro-vernier condensers, neutro-vernier indicating dials, wavemeters, buzzers, etc., are among the many components shown by Messrs. Gambrell Bros., Ltd.



One of the R.I.-Varley reactive tuners.

GARNETT, WHITELEY & CO. LTD. Stand No. 93.

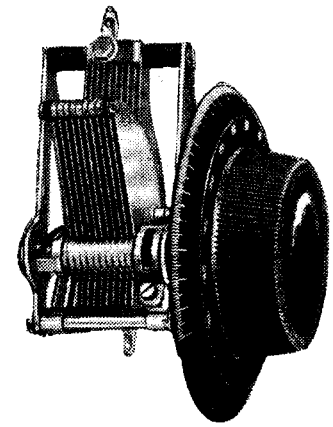
A full range of components may be seen here, the chief one of interest being the new remote-control unit, which will be demonstrated on a receiver with four loud speakers.

A new centre-tapped coil for plug-in holders also makes its bow to the public.

GENERAL ELECTRIC CO., LTD. Stands Nos. 15 and 140.

A complete series of receiving valves is on view, including the new 610 type, the K.L.1 and K.H.1 valves for indirect heating, and the latest H.F. valve with shielded grid—the S.625.

In addition an interesting gramophone pick-up device is being introduced, and a series of receivers of all types completes the exhibit. It will be worth the visitor's while to spend a



An example of the Compact Condenser design now prevailing.

considerable time in examination of these stands.

GORDON, F. J., & CO., LTD. Stand No. 28.

The main exhibit here is the "Electone" automatic programme selector, a device which enables the listener to select the evening's programme ahead, and which ensures his receiving the desired items, cutting out the unwanted sections.

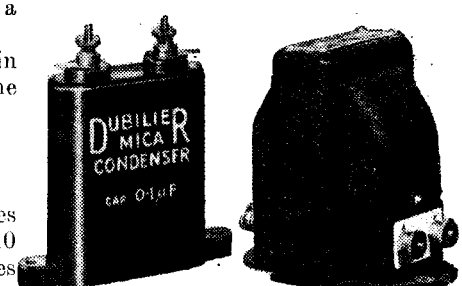
GRAHAM AMPLION, LTD. Stand No. 137.

Many new types of Amplion loud speakers are to be seen on the Graham stand, including the A.C.1, an open cone for hanging on the picture-rail or standing on the table, as desired; and A.C.4, a similar model, but contained in an oak cabinet.

THE GRAHAM-FARISH MFG. CO. Stand No. 218.

In addition to all sorts of components this firm is showing a new line of high resistances of an entirely novel type.

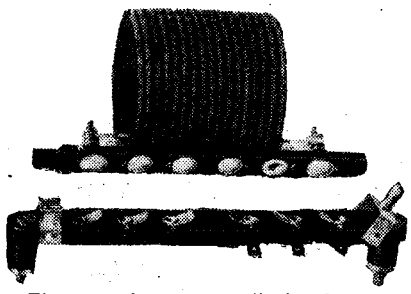
These are known as the "Ohmite" and "Megite," being respectively anode resistances and grid leaks, and will be on sale for the first time.



A Dubilier mica condenser and the G.E.C. L.F. transformer.

These instruments should prove of unique interest, as the element is completely encased in bakelite and

cannot vary with atmospheric conditions in any way. They are said to be a distinct improvement on wire-wound, vacuum, and various other



The new long-wave clip-in Formo inductance.

high resistances extant, and are items which we think well worthy of the attention of all visitors to the Exhibition.

Also, circuit diagrams for resistance-capacity sets of various types will be available for the public.

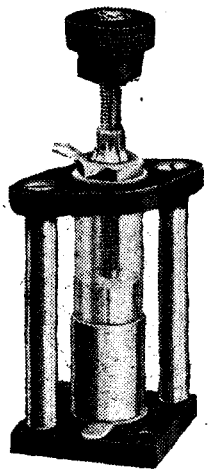
HALCYON WIRELESS CO.
Stand No. 168.

The chief point of interest here is the new five-valver, which needs no outside aerial or earth, and has a Daventry range of 400–500 miles with a local range of 40–50 miles on the loud speaker.

HART ACCUMULATOR CO., LTD.
Stand No. 112.

Samples of the many types of wireless accumulators, in the manufacture of which this firm has specialised for a number of years, will be on show.

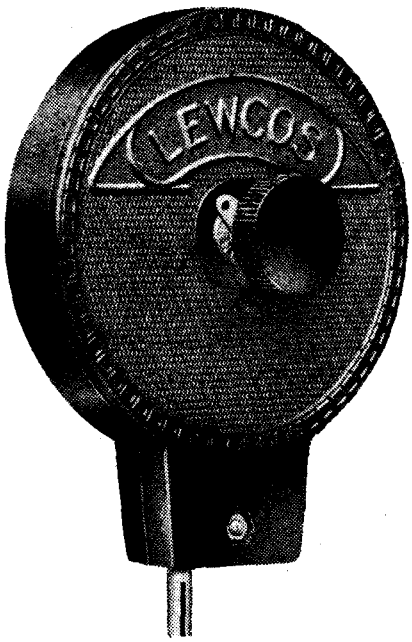
For low-tension circuits, the types designated respectively "Magno" and "Enduro," which are equally suitable for receiving sets em-



A novel design of neutralising condenser to be seen at the Exhibition on the stand held by Messrs. Jackson Bros.

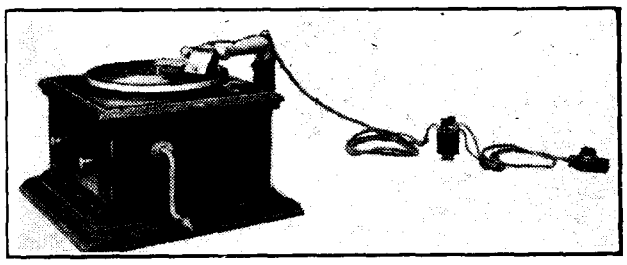
ploying dull emitter or bright valves, should no doubt attract the attention of wireless users who, in ever-increasing numbers, are recognising the many advantages of glass containers. Assembled in specially moulded pressed-glass boxes, these cells are of first-rate quality and attractive appearance. In addition, assembly units for cone loud speakers are also available, while "electrical" gramophone pick-ups can also be obtained from this firm.

For high-tension circuits, the type known as the "PLRG"—the patent for which is held by the Hart Co., will probably have many admirers. In these cells the plates are contained in a moulded box provided with ribs moulded on to the outside of the base and walls, in such a manner that, when a number of the cells are assembled together to form a complete battery, the points of contact are



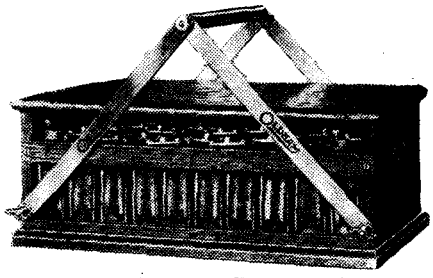
A new centre-tapped coil made by the London Electric Wire Co.

reduced to a minimum, the cells themselves resting upon the edges of the ribs moulded on the case of the container; in this way perfect insulation is obtained.



The Igranic-Pacent "Phonovox" fitted on a gramophone and complete with plug for insertion in the L.F. valve holder of a receiving set.

Other exhibits of the Hart Co. will include hydrometers and similar wireless accessories, together with



The Oldham H.T. accumulator.

samples of the component parts of their different types of batteries; as also of the various forms of crates supplied to facilitate transport of batteries for recharging and other purposes.

HOARE & JAGELS, LTD.
Stand No. 14.

The Rolls portable receiver is shown in many different models, and forms an interesting and attractive exhibit. Many improvements have been introduced, especially with regard to the external portions of the sets.

HOBDAY BROS.
Stands Nos. 19 and 20.

This firm is showing a fine array of radio goods of all descriptions: coils, coil holders, variable and fixed condensers, valves—everything that is likely to be needed by the constructor, while complete receiving installations for the listener are also to be seen.

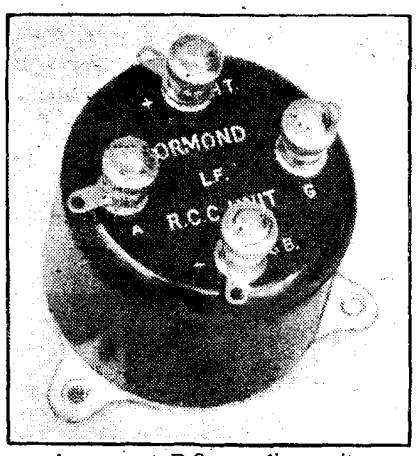
HOUGHTON, BUTCHER, LTD.
Stand No. 61.

Well known as wireless factors, this firm is providing a comprehensive display of apparatus. Everything for the radio enthusiast is on view, and all types of components are represented, while among the sets can be found types to suit every pocket and all requirements.

IGRANIC ELECTRIC CO., LTD.
Stands Nos. 148 and 149.

A full display of all types of radio equipment is being shown on this stand, foremost among the accessories being power transformers for H.T. supply units, smoothing chokes for the same type of unit, potentiometers, and also the new "Phonovox," an

tremely neat gramophone pick-up, which is provided with a tone control and plug which enables it to be plugged straight into the valve holder of any L.F. or detector stage, so that



A compact R.C. coupling unit.

you can use your ordinary set (L.F. end) as the amplifier for electrical gramophone reproducing.

JACKSON BROS.
Stand No. 85.

Various types of well-made variable condensers are to be seen here; the ranges being well covered from ordinary square-law condensers to the triple-gang models and newly-brought-out neutrodyne condenser totally enclosed in a glass tube.

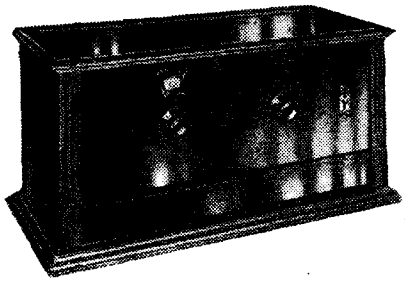
The Precision (Collinson) six-pin coil former with detachable primary.

THE JUNIT MFG. CO., LTD.
Stand No. 230.

Those who dislike the job of soldering should visit the stand of this famous firm. Here a patent self-soldering wire is one of a trio of interesting things on show. The other two main features are the "Peerpoint" soldering iron (which never gets really dirty) and a new solder known as "Elephant" solder, which is said to be much stronger than ordinary solder, and which will flow easily when a fairly low temperature iron is employed.

P. A. LAMPLUGH, LTD.
Stand No. 117.

Many new lines are to be seen here, among which must be mentioned the "Panel-Plate Tuner Unit," a novel scheme consisting of an engraved metal panel on which are mounted a slow-motion condenser, a calibrated inductance covering from 200-2,000 metres, with a switch for changing from low to high wave-lengths.



The R.I.-Varley "Interdyne" five-valve receiver.

LECTRO-LINX, LTD.
Stand No. 227.

Who has not heard of or used the famous "Clix" sockets? Whether you have or not, you should go to Stand No. 227.

All kinds of Clix terminals, sockets, tags, etc., are shown here, while a new feature is the multi-plug, which forms a foolproof method of connecting H.T. and L.T. batteries to a set.

LISSEN, LTD.
Stands Nos. 158 and 160.

A full range of loud speakers of both the horn and new disc types is among the exhibits here, as well as an electrical pick-up device for attachment to any gramophone.

In addition are being shown a very light pair of headphones (this is a new line), new coil holders, a new type of variable condenser, fixed condensers, leaks, coils, coil holders, plugs and sockets, and various additions to the Lissen range of H.T. batteries which have special grid-bias tappings included, so that a separate grid-bias battery is not necessary.

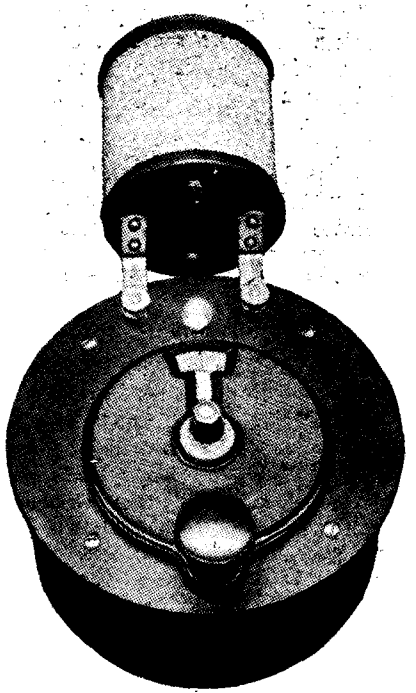
W. T. LOCK.
Stand No. 220.

Here a full range of American-pattern cabinets is on view, including the popular type A/M Cabinets and A/G cabinets, also the following new lines recently introduced, namely, the Type A/F Fall-Front Cabinet,

The C.A.V. three-valve "Baby Grand" receiver.

the Type B/C Battery Container, the "Cabinola" loud-speaker cabinet, and Type A/W "Vignette."

Another line, the "Portola" home construction cabinet and receiver circuit, is a handsome dark-oak portable cabinet fitted with aerial former, loud-speaker horn, and slide baseboard, ready for mounting panel and components. With each cabinet will

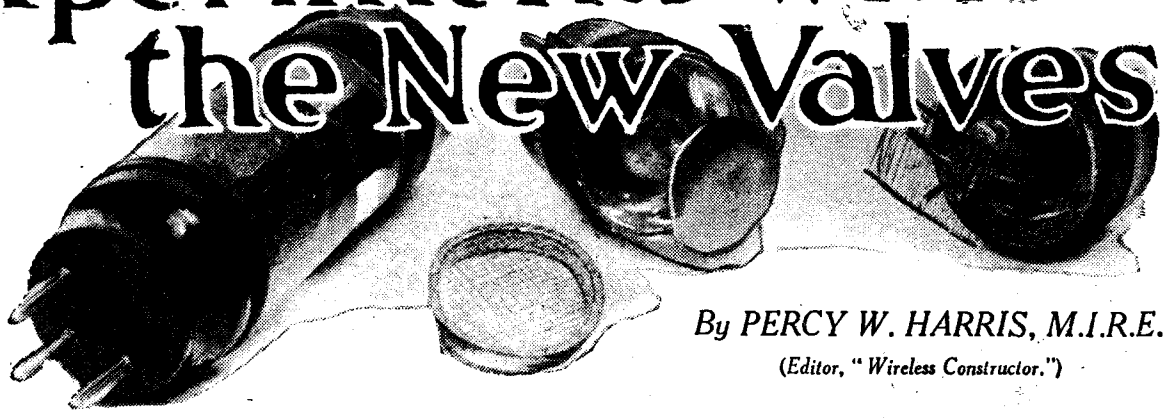


A new Igranic absorption wavemeter.

be supplied a complete set of blue prints and instructions for making the "Portola" five-valve receiver.

(*Continued on page* 410.)

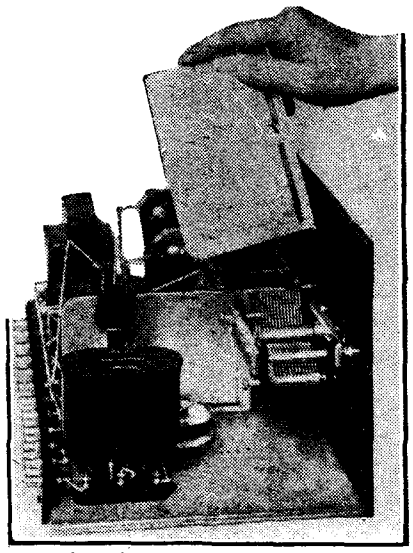
Experiments with the New Valves



By PERCY W. HARRIS, M.I.R.E.
(Editor, "Wireless Constructor.")

Some really practical tests of radio's most recent developments.

In wireless experimenting the description of a new principle opens up a wide new field of exploration. The screened-grid valve, of which particulars have already appeared in this journal, forms no exception, and is arousing extraordinary interest among wireless experimenters all over the country. As the valve itself and its general principles of working have already been described, this article is devoted purely to an account of some experiments I have conducted in my own laboratory for the purpose of evolving designs to suit the new type of "tube."



Removing the screen between condensers permitted a slight feed-back, but not so much as to be detrimental.

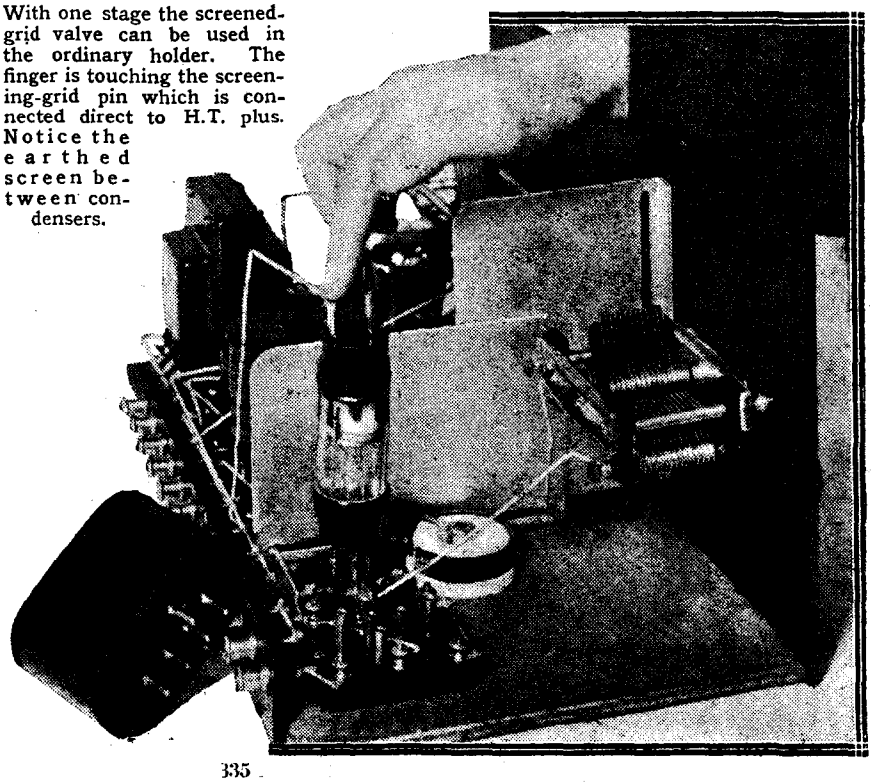
Very High Magnification

We have, first of all, a valve designed as a high-frequency magnifier which is capable of giving a magnification much greater than has previously been possible with any one stage of high-frequency amplification. In addition to this, the chain of troubles which we have had to circumvent in the past, due to inter-electrode capacity in the valve, has been virtually abolished by a very ingenious method. How, then, does the new valve compare with the older types with which we are so familiar? Firstly, there is, of course, no need to adopt the normal neutralising methods. This in itself brings simplification. Secondly, we have a very high "mag" to handle, and all that goes with it. Let me warn experimenters at once that much more care is needed in designing a receiver to include this new valve than has previously been required. The higher the magnification obtainable the greater the influence of any stray fields or back coupling, and as the "mag" obtainable with one of the new valves is about as high as many experimenters have previously obtained with *two* stages, all the precautions normally taken with two stages of high frequency must be taken with one stage with the new arrangement.

"Feed-back" Effects

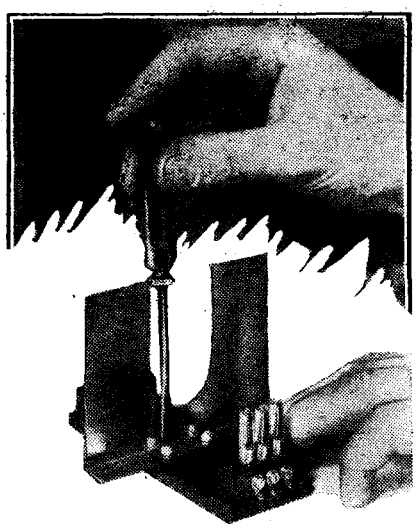
Feed-back occurs in two ways only. The first is via the capacity within the valve, and the second via stray

With one stage the screened-grid valve can be used in the ordinary holder. The finger is touching the screening-grid pin which is connected direct to H.T. plus. Notice the earthed screen between condensers.

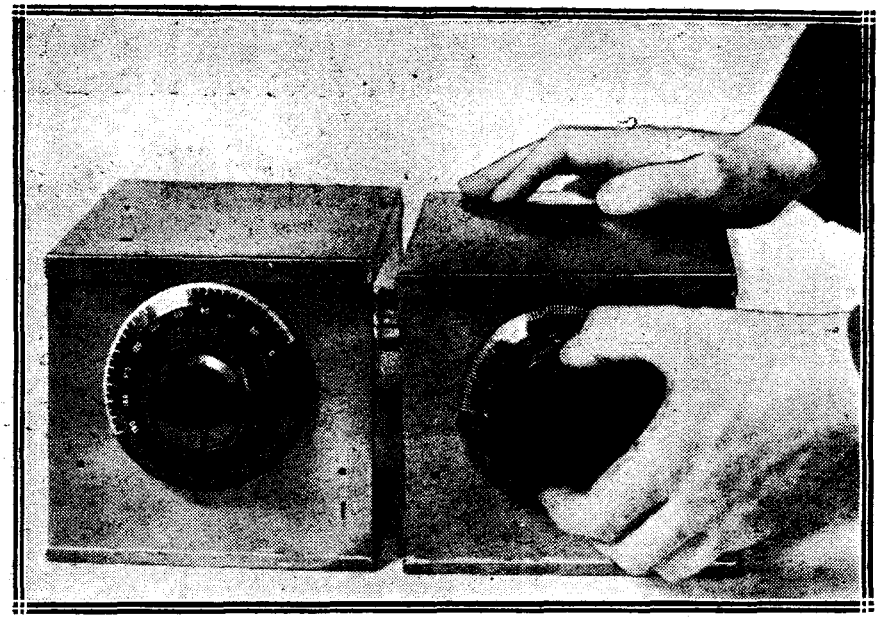


couplings outside of the valve. No matter how perfect our elimination of feed-back effects may be *inside* the valve, unless we eliminate them *outside*, we are no better off than before.

No great difficulty has presented itself in designing a receiver using *one* stage of the new high-frequency coupling, provided reasonable precautions are taken. The first illustration shows my own experimental receiver with one stage of high-frequency, a detector, and one stage of note magnification. As the detector and note-magnifying stages are perfectly normal, and contain no novelties, it has not been thought necessary to illustrate them here.



To modify the new valve holder, first of all unscrew the screen as shown.



When two stages of H.F. with screened-grid valves are used total shielding of the apparatus is highly desirable. Note the valve passing between the two stages.

Notice that I have mounted the valve vertically in the ordinary type of valve holder. To reduce feed-back effects between coils I have chosen these latter of the binocular type, which has a very restricted field, but owing to the high magnification obtainable it was found necessary to interpose, between the two coils a metallic screen connected to earth. All high-frequency wiring was made extremely short, and an extension of the metallic screen was also placed between the two variable condensers which tune the first and second grid circuits respectively. With short wiring, binocular coils, and metallic screens between coils and condensers all undesirable feed-back effects were eliminated, with the result that a very high frequency magnification was obtainable and a good deal of reaction could be applied to the detector stage, thus greatly increasing the magnification possible. As a point of interest it may be stated that with a ·0003 mfd. reaction condenser and a standard Reinartz winding, more than half of the condenser could be used before the set came near the oscillation-point. Furthermore, when the detector stage was made to oscillate no feed-back into the aerial could be detected.

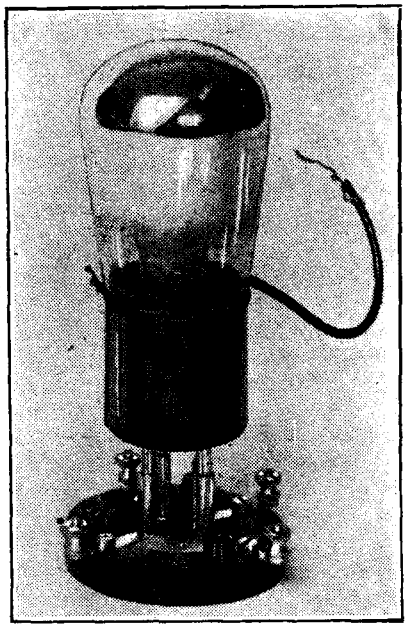
Then saw through the middle of the base with a hack-saw.

Flatter Tuning

The first impression obtainable when operating a receiver of this kind is that the tuning is flatter than usual. The reason for this is that the complete elimination, or virtually complete elimination, of feed-back effects results in the normal damping of the first grid circuit being untouched. The significance of this will not be realised until a little thought is given to the subject. In practically all receivers with which we have previously been acquainted (with the exception of the fully neutralised and properly screened stages) there has been a certain amount of reaction into the first grid circuit, this reducing the damping and therefore sharpening the tuning. There is, however, a more important reason why the tuning is flatter. The new valves depend

for their magnification upon a high impedance in the anode circuit, and the higher the anode-circuit impedance the higher the magnification, within limits. The impedance of the valve is so high that the only satisfactory method of coupling is the "tuned anode," which gives much flatter tuning than is obtained with the transformer type of coupling.

Do not attempt to use the new valve with transformer coupling, for if you do so you will lose a very large amount of the possible magnification. After some experiment with the receiver illustrated, it was decided that, while feed-back between stages had (to all intents and purposes) been eliminated, it would be advantageous to allow some amount of reaction into the first circuit for the purpose of sharpening the tuning. The screening between the condensers was then removed, as shown in the first illustration, when it was found that the tuning of the first stage was appreciably sharper, and although less reaction was required to bring the set up to oscillation-point, it was still a long way below oscillation when no direct reaction was used. The receiver operates with binocular coils and the simple screen between the coils with very satisfactory results.

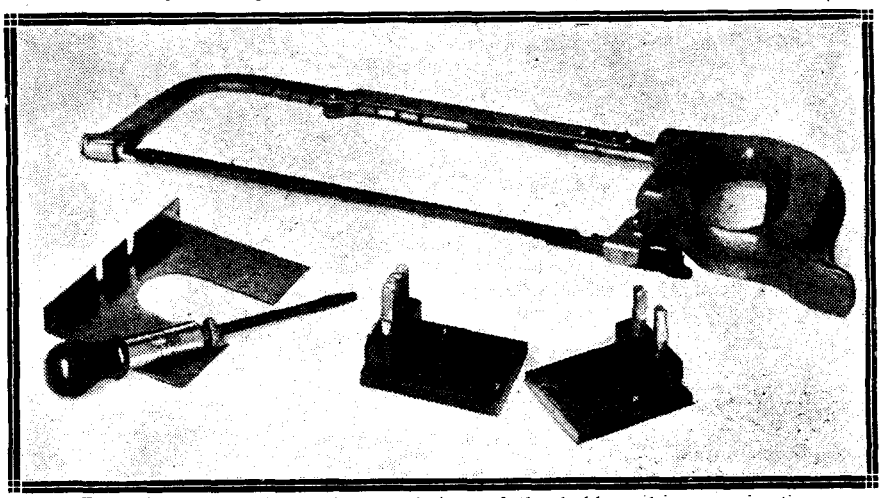


The Robinson valve, showing the flexible lead from the second plate.

Using Two Screened Valves

The next experiments with this valve were in the use of two stages, and here it was found that owing to the enormous magnification possible all feed-back effects of the stray variety had to be eliminated as completely as possible. This meant that each stage had to be completely screened. By cutting a circular hole in the screen it was found possible to place the valve horizontally with filament and normal grid pins in one box and the plate and the shielding-grid pins in the other box. Negative L.T. was connected straight to the box, and the positive L.T. taken through a hole in the box in lead-covered wire which was connected electrically to the box so as to prolong the shielding up to the terminal strip.

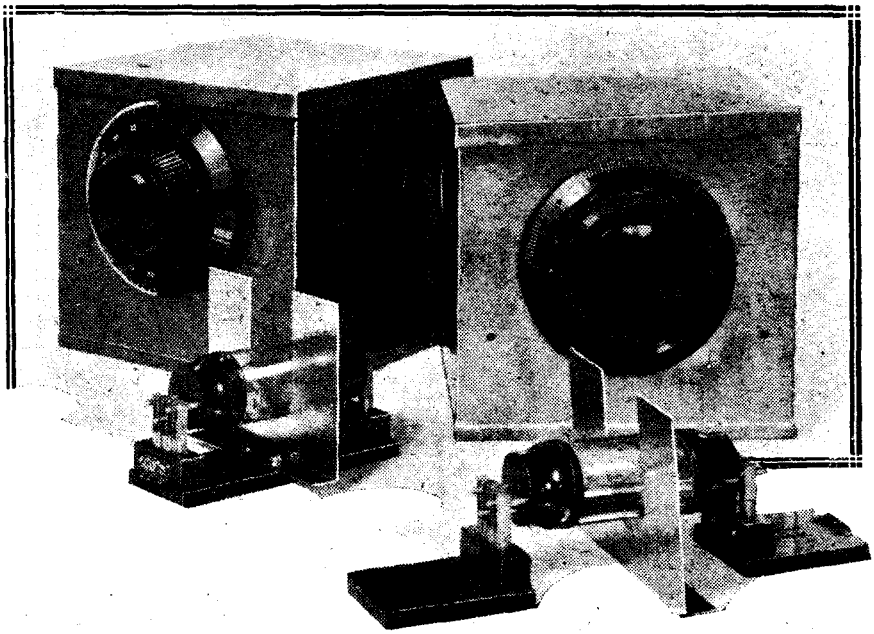
The only other leads that had to be taken out of the box were the H.T. positive and the lead which goes from the screening grid to the 80-volt tapping on the H.T. battery. These two were taken through lead-covered wire similarly connected electrically to the box. In this way a very complete shielding was possible, and while the tuned anode method was utilised the additional stage of high-frequency amplification, together with properly applied reaction to the detector stage, gave all the sharpness of tuning found to be necessary in practice.



This photograph shows the two halves of the holder when separated.

A Modified Holder

A point of interest to the experimenter is a modification which I have found useful in the special holder sold to take these valves. This holder, as will be seen from the illustration, consists of an insulating base which carried in its centre, and screwed to it, a metallic screen. At each end of the base are clips into which the pins of the valve slide. When used with one stage of high-frequency this holder is quite convenient; but, in my own scheme of utilising two stages, I have found it



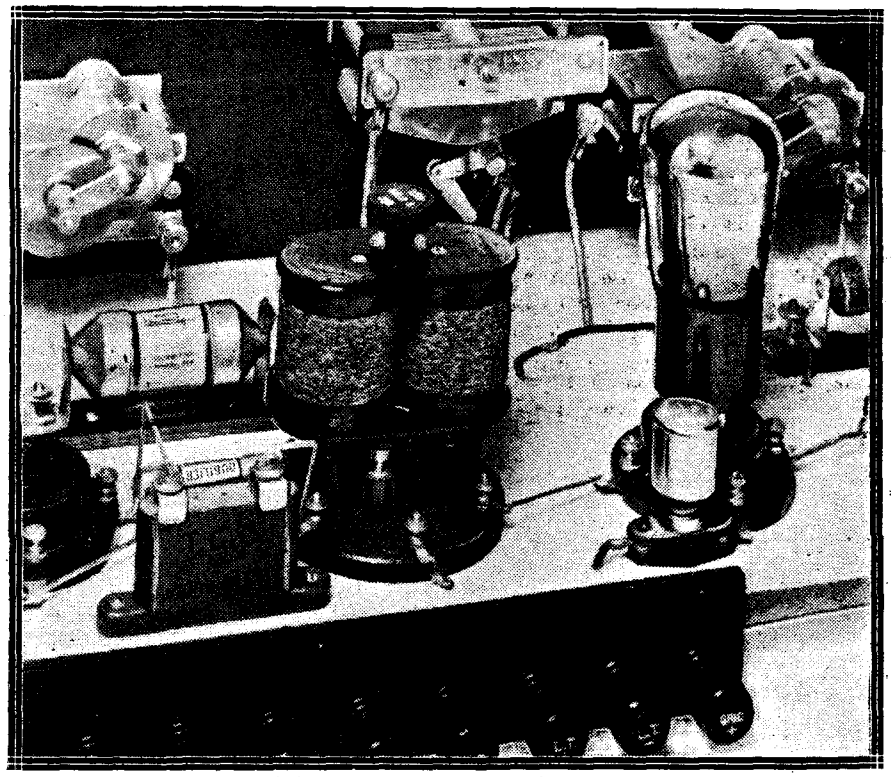
The standard screened-grid valve holder as sold (left), and as modified (right).

rather hinders the complete screening which I have endeavoured to obtain.

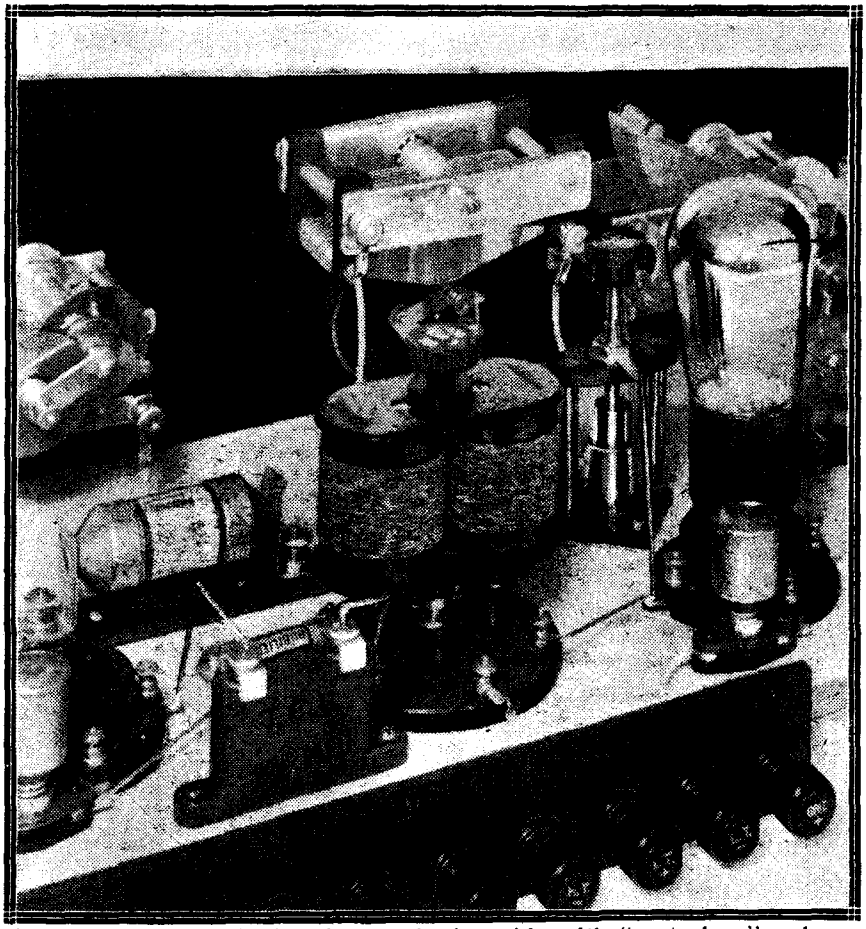
A very simple modification of this holder which every experimenter can carry out for himself is shown in the accompanying photographs. The first step is to undo the two screws securing the screen to the insulating base, and then to saw the insulation in half just against the projecting piece which forms a partial support for the metallic screen. The holder can then be reversed, when it becomes possible to attach the metallic screen provided to any bottom shielding one may have; or, alternatively, the two ends can be placed one in each box and the valve passed through a circular hole.

While it is possible to utilise screening boxes with the condensers outside, these latter occasion feed-back effects between one another, and it is highly advisable that the condensers shall also be screened. For this reason, I have found it possible to use boxes large enough to take coil, valve, chokes, etc., *and the condenser*.

In experimenting with two stages of screened-grid valve amplification, it must not be forgotten that several sources of feed-back, which do not make their presence obvious in normal working, become painfully apparent when high magnification is used. Coupling caused by the common battery, pick-up by filament leads, the feed-back (if any radio-frequency leaks back into the audio-frequency side) to the aerial through the loud-speaker leads, and several other matters become vitally important. A liberal use of radio-frequency chokes and shunting condensers is essential if really high efficiency is to be obtained.



The same set as shown below, but using the Robinson valve. Note that the wire previously connected to the neutralising condenser is now joined to the extra plate of the valve.



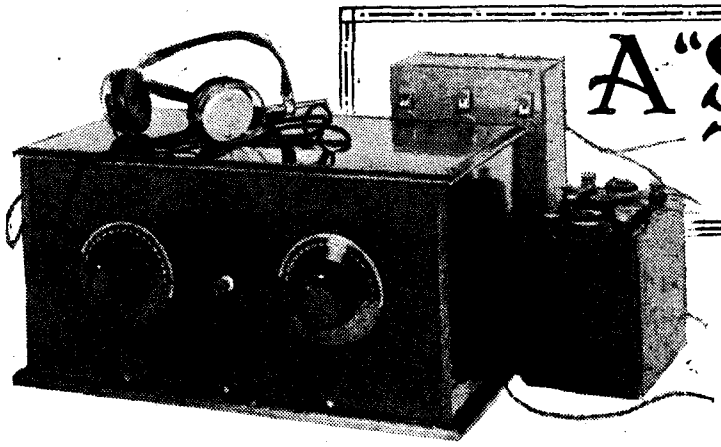
A normal type of neutralised receiver. Notice the position of the "neutrodyne" condenser

Dr. Robinson's New Valve

Another valve with which I have been conducting some interesting laboratory experiments is that invented by Dr. Robinson, and which will shortly be available for the home constructor.

Dr. Robinson is well-known to MODERN WIRELESS readers, and was for some time in charge of all radio work in the Royal Air Force. He was also for some time associated with the research work carried on for MODERN WIRELESS. Dr. Robinson's valve eliminates the trouble due to the capacity between the plate and grid of the high-frequency valve by a very ingenious arrangement of

(*Continued on page* 432.)



A "Straight" Two-Valver

An economical local-station receiver with DX possibilities. Designed and described by L. H. THOMAS.

THERE is little room for doubt that the needs of those who wish primarily to receive the local station at good strength and, secondarily, to receive other stations occasionally, are best catered for by a good two-valve receiver of the detector and low-frequency type, which is economical to run and extremely simple to operate. In fact, the most serious disadvantage of this type of set, in the writer's opinion, is that one does not always realise what it is possible to get out of it, and in consequence is apt to put up with a performance which would be considered poor by the "privileged few."

The Circuit Employed

The chief point to remember, when one possesses a small and essentially simple receiver, is that one should never be satisfied. It seems that so long as one longs for better things there is always a means of effecting a slight improvement without adding further valves or making drastic alterations of any kind.

The receiver described here is the result of an attempt to produce a two-valver which *would* give satisfaction to the writer! All the usual precautions were taken to secure reasonable efficiency, particularly with regard to ease of control, and good selectivity and low initial cost may also be claimed for the set.

The circuit is shown in Fig. 1, and it will be seen that two methods of controlling reaction have been provided. Normally, of course, it is controlled by the condenser C_2 (at the right-hand side of panel). When one is receiving on the longer waves, however, and reaction tends to be somewhat "fierce," the coupling between the coils can be loosened also. As this operation will be performed only on rare occasions, it was not thought worth while to provide a two-way coil holder, which would necessitate another control on the front panel. The latter, therefore, bears nothing but the tuning condenser, the capacity-reaction control, and an on-off switch.

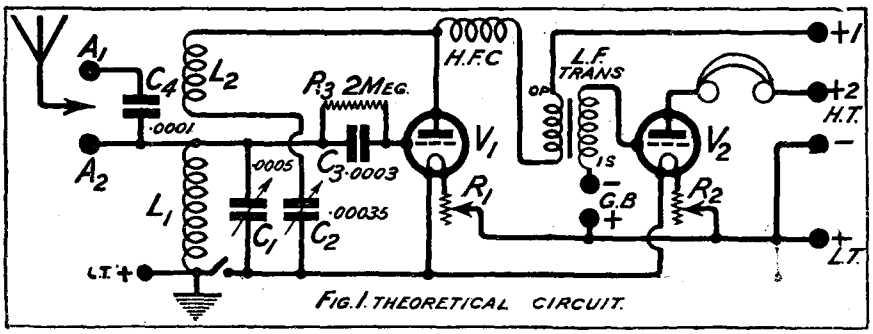


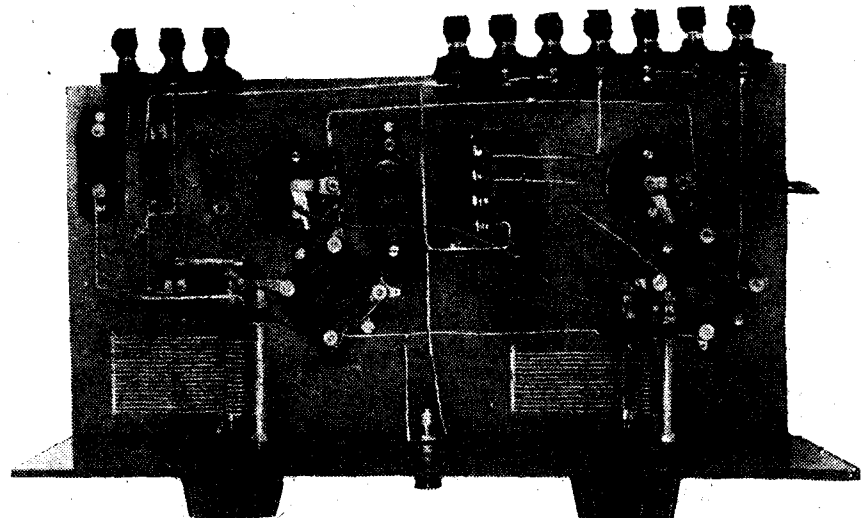
FIG. 1. THEORETICAL CIRCUIT.

The layout has not been cramped, as it is essential with a receiver of this type, from which the greatest possible output is nearly always desirable, that all wiring, particularly that of the grid and plate circuits, should be well spaced and reasonably short. It is a mistake, however, to cramp the components simply for the sake of shortening the wiring by an inch or so. The cabinet used (16 in. by 8 in. by 9 in.) allows ample room for everything, and the grid-bias battery is housed inside at the right-hand or "low-frequency" end.

Easily Constructed

It will be noticed that the grid and anode leads to the detector are each about an inch in length.

With regard to the construction of the set, undoubtedly the easiest method is to leave the panel till last, and to mount all the components in their appropriate positions on the baseboard and wire them up at the outset.



A "bird's-eye" view of the "Straight" Two-Valver which clearly shows the layout of the components on the baseboard.

None of the points is particularly hard to get at, and if the reader dislikes soldering he may take comfort from the fact that the only two points that *need* be soldered are the two tags on the filament switch!

The latter, together with the two condensers, should then be mounted on the panel, which is placed in position. No brackets have been used, and they certainly do not seem an entire necessity with a panel of the size used. The moving plates of each variable condenser are connected to L.T. + and earth, a point which is appreciated when one comes to test the set, on account of the complete absence of any hand-capacity effects.

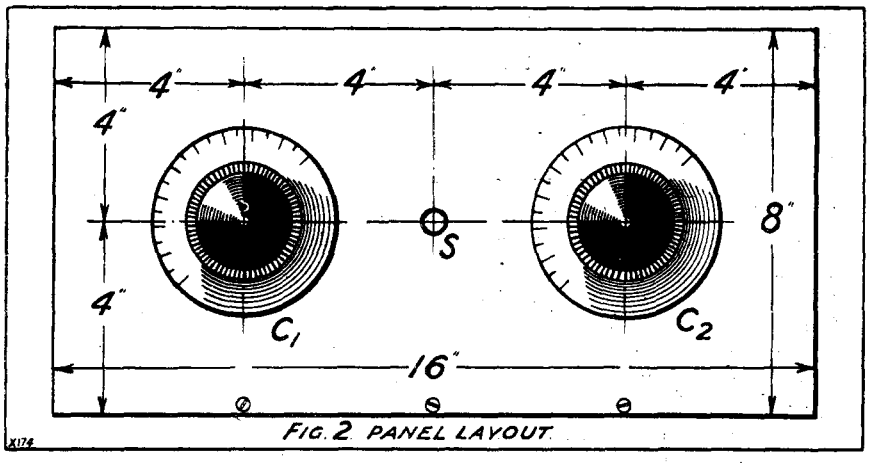


FIG. 2 PANEL LAYOUT

Straightforward Wiring

The fixed plates of the ·0005 tuning condenser are connected to one end of the A.T.I., and the fixed plates of the reaction condenser to one side of the reaction coil by means of a flex lead.

All the other wiring is perfectly straightforward.

The circuit employed may be looked upon either as a modification of the Reinartz, or a straight reaction circuit with "parallel feed." The H.T. is, of course, applied in parallel with the plate and filament of the valve, and for this reason a radio-frequency choke must be inserted in series with the lead from the transformer primary to the anode itself.

Smooth Reaction

The wonderfully smooth reaction control obtainable with this circuit, after a certain amount of "juggling" with values of H.T. and L.T. and coil sizes, makes long-distance reception extremely easy, and it has not been found necessary to employ slow-motion dials, although there is, of course, no possible objection to using them.

Care should be taken to place the two coil sockets in similar positions to those shown in the back-of-panel diagram, as provision has been made for just the right amount of variation in coupling, and they are also in such a position that their magnetic fields are as free as possible.

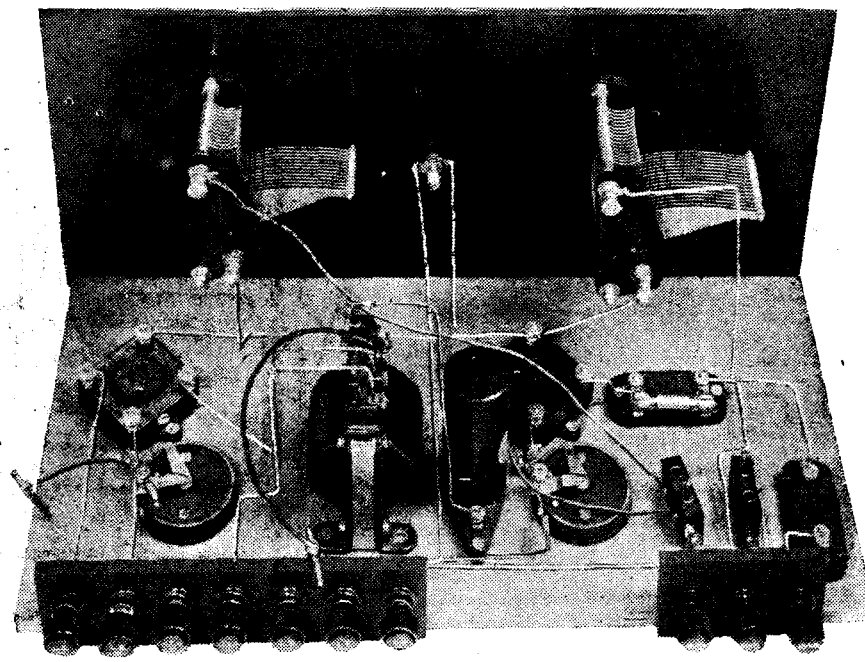
Bare wire has been used for the wiring throughout, but "Glazite" or some other insulated wire might be used without any ill effects.

Normally, the aerial will be connected to terminal 1, i.e. coupled to the A.T.I. through the small series condenser C_1. Provision has been made for connecting it direct (by means of terminal 2) when it is desired to receive only the local station, and selectivity is not important. The reader should remember that, although when searching for distant stations, slightly stronger signals may possibly be obtained by using terminal 2, the selectivity will be poorer compared with that obtainable with the other method, which should be used whenever possible. For *very* small or indoor aerials, of course, terminal 2 may always be used.

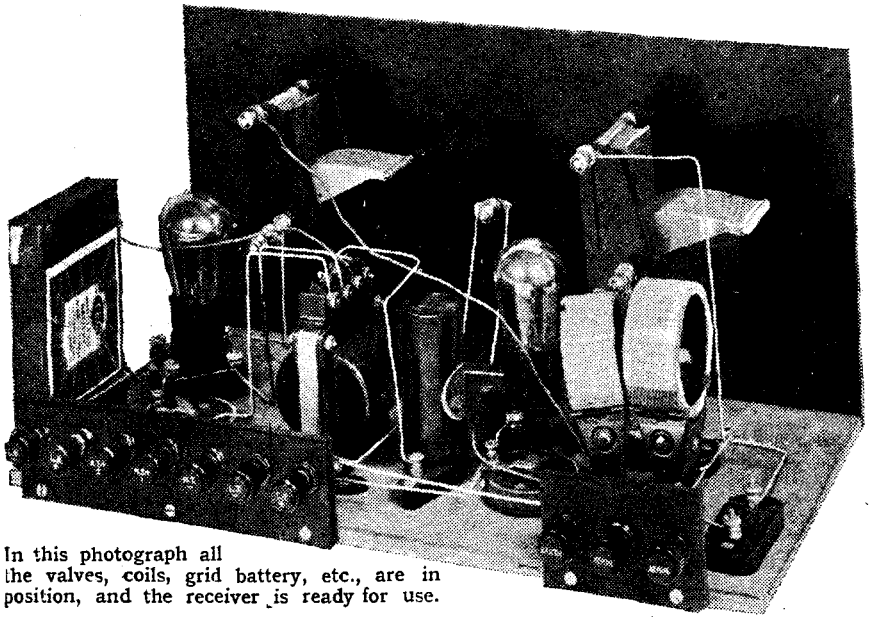
After the wiring has been carefully checked in the usual way—it is advisable to connect up the batteries and to test both sets of filament terminals with a voltmeter—the set is ready for test. A valve with an impedance of 20,000 to 30,000 ohms, with a plate voltage of about 60, is preferable for the detector, although good results will be obtained with a small power valve and 30–40 volts. For the L.F. stage a small power valve should always be used unless one is excessively near the local station, when it is better to use one of the "super-power" class. Little or no advantage would be gained by using

LIST OF COMPONENTS.

- 1 panel and baseboard.
- 1 cabinet to suit.
- 1 ·0005 mfd. variable condenser.
- 1 ·00035 mfd. do.
- 1 on-off switch.
- 2 valve holders.
- 1 ·0003 mfd. grid condenser. } Lissen, Dubilier, etc.
- 1 2-meg. grid leak. } Lissen, Dubilier, etc.
- 1 ·0001 mfd. fixed condenser. } Lissen, Dubilier, etc.
- 2 rheostats for baseboard mounting.
- 1 H.F. choke (Lissen).
- 1 L.F. transformer.
- 2 baseboard-mounting single-coil holders.
- 1 terminal strip and 3 terminals, A_1, A_2 and E.
- 1 terminal strip and 7 terminals, L.T. +, L.T.−, H.T.−, H.T.+ 1, H.T. + 2, L.S.+, L.S.−.
- Wire, screws, etc.
- Panel brackets if desired.


The terminals from left to right are: two for the loud speaker, H.T. plus 2, H.T. plus 1, H.T. minus, L.T. minus, L.T. plus, and on the small strip, Earth, A2 and A1.

one of these valves at a distance greater than five or six miles from a transmitting station. For the usual broadcast band the best results are obtained with a No. 60 coil in the aerial socket and a No. 25 for reaction. The set then goes smoothly into oscillation at about 140° on the dial of the reaction condenser. If it will not oscillate with a No. 25 coil try a 35, but nothing bigger should need to be used if the wiring has been carefully carried out and all the instructions adhered to.



In this photograph all the valves, coils, grid battery, etc., are in position, and the receiver is ready for use.

With these coils the tuning condenser should cover a range of approximately 260–550 metres. 2 L O was received at about 120°, and Langenberg at about 150°, although the readings will be quite different if any type of condenser other than S.L.F. be used.

Results Obtained

With regard to the L.F. valve, about 108–120 volts H.T. is used, with 7½ or 9 volts negative bias. Any necessary adjustment of filament voltage can, of course, be arranged by means of the baseboard-mounted resistors.

As regards the actual results obtained with the set, it will probably be sufficient to say that 2 L O at six miles is received at sufficient strength to work two loud speakers in parallel. The two are really unnecessary, however, since *one* makes itself heard all over the house. Twenty-two foreign broadcasting stations have been logged, using headphones, but the stronger of these, such as Langenberg, may be put on the loud speaker night after night without any noticeable variation in strength. Langenberg and Bournemouth have also been received at very good headphone strength early in the afternoon with a very poor aerial in use.

On the longer waves, using a No. 200 or 250 in the aerial socket, or a No. 150 with the aerial connected direct, and a No. 75 coil for reaction, Hilversum, Daventry, Radio-Paris, etc., have all been received at very good strength. The circuit used is undoubtedly adaptable, for numerous American amateurs working below 40 metres have been logged, simply by using Igranic short-wave coils (Nos. 4, 6 and 9), and inserting a neutralising condenser about "half-in" in series with the aerial.

Needless to say, a good aerial system is an even more useful adjunct to a small set such as this than to a multi-stage and multi-control receiver. The writer has always used an aerial 44 ft. high at the lead-in and 38 ft. high at the other end, with a span of 60 ft. and a downlead of 15 ft. This is used with a buried 5 ft. length of copper pipe for an earth. The capacity of such a system is fairly small, and therefore good selectivity is obtainable without unnecessarily loose coupling. The aerials one sometimes sees, about 100 ft. long, with two or even three wires, erected at a height of about 20 ft., are responsible for more complaints of non-selectivity than the receivers themselves.

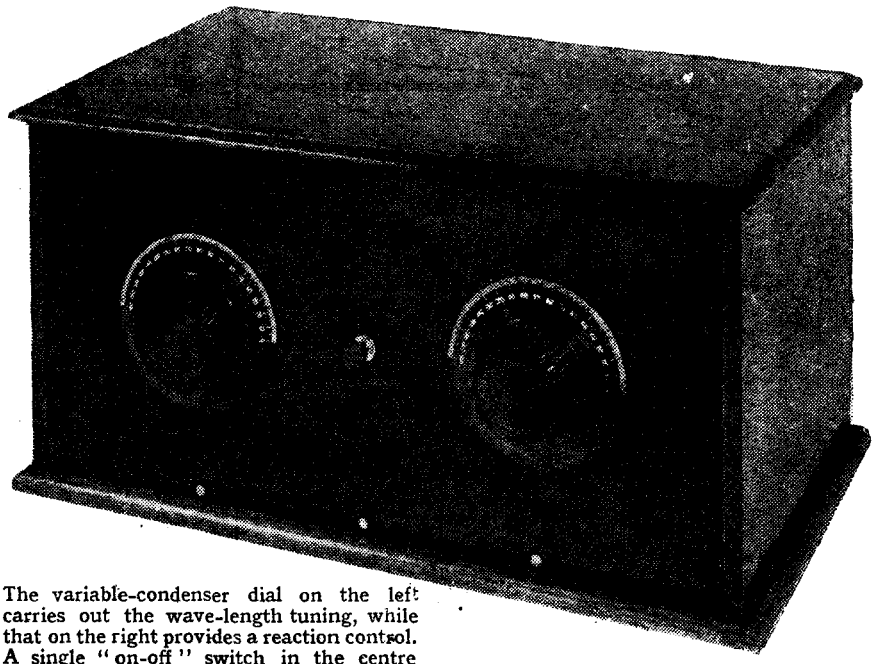
Small Reaction Coil

One has only to try a fair-sized indoor aerial in comparison with one of these to prove it.

There is no reason, however, why the receiver described should not give perfectly satisfactory results with any fair-sized outdoor aerial.

The reader should always bear this in mind. There is *no* advantage in using a larger size of reaction coil than that with which the set will just oscillate when the reaction condenser is "all in." The latter condition undoubtedly produces the smoothest control, and if one uses so large a coil that the set commences to oscillate as soon as the dial of the reaction condenser is moved away from zero, it is sure to go into this condition with a "flop."

With the original set, as has been



The variable-condenser dial on the left carries out the wave-length tuning, while that on the right provides a reaction control. A single "on-off" switch in the centre completes the simple and symmetrical panel layout.

previously mentioned, a No. 60 coil in the aerial socket works perfectly well with a 25 reaction coil. When listening to shipping on 600 metres and Imperial Airways work on 900 metres, a No. 100 coil is used in the aerial socket, and the No. 25 is still large enough for reaction. This depends, however, largely upon the detector valve and the value of H.T. used with it. The reader may possibly find that a No. 35 or even a No. 50 is necessary in conjunction with a No. 100 coil as A.T.I.

It is also a good plan, if one has several grid leaks from which to choose, to try them all with the particular valve which has been decided upon as detector. The writer has in his mind one valve which will not give even passable results as a detector unless it is provided with a grid leak of 5 megohms, although half a dozen or so of the same type work perfectly with the conventional 2-megohm leak. Also some grid leaks, unfortunately, are very noisy in operation.

Additional Amplification

It should be mentioned that, if the set is to be followed by another amplifier for any reason, it would be advisable to by-pass the first L.F. transformer with a fixed condenser of about ·0005 capacity. This has not been done already, since the condenser is usually unnecessary, but it is wise to incorporate it as a precautionary measure if more L.F. stages are to be used, to prevent the accidental passage of H.F. currents through to the amplifier.

In the event of extra L.T. amplification being added it should be seen that the amplifier has H.T.— joined to L.T.—or else the H.T.— terminal should be left unconnected. This will preclude the possibility of shorting the L.T. battery due to wrong connection

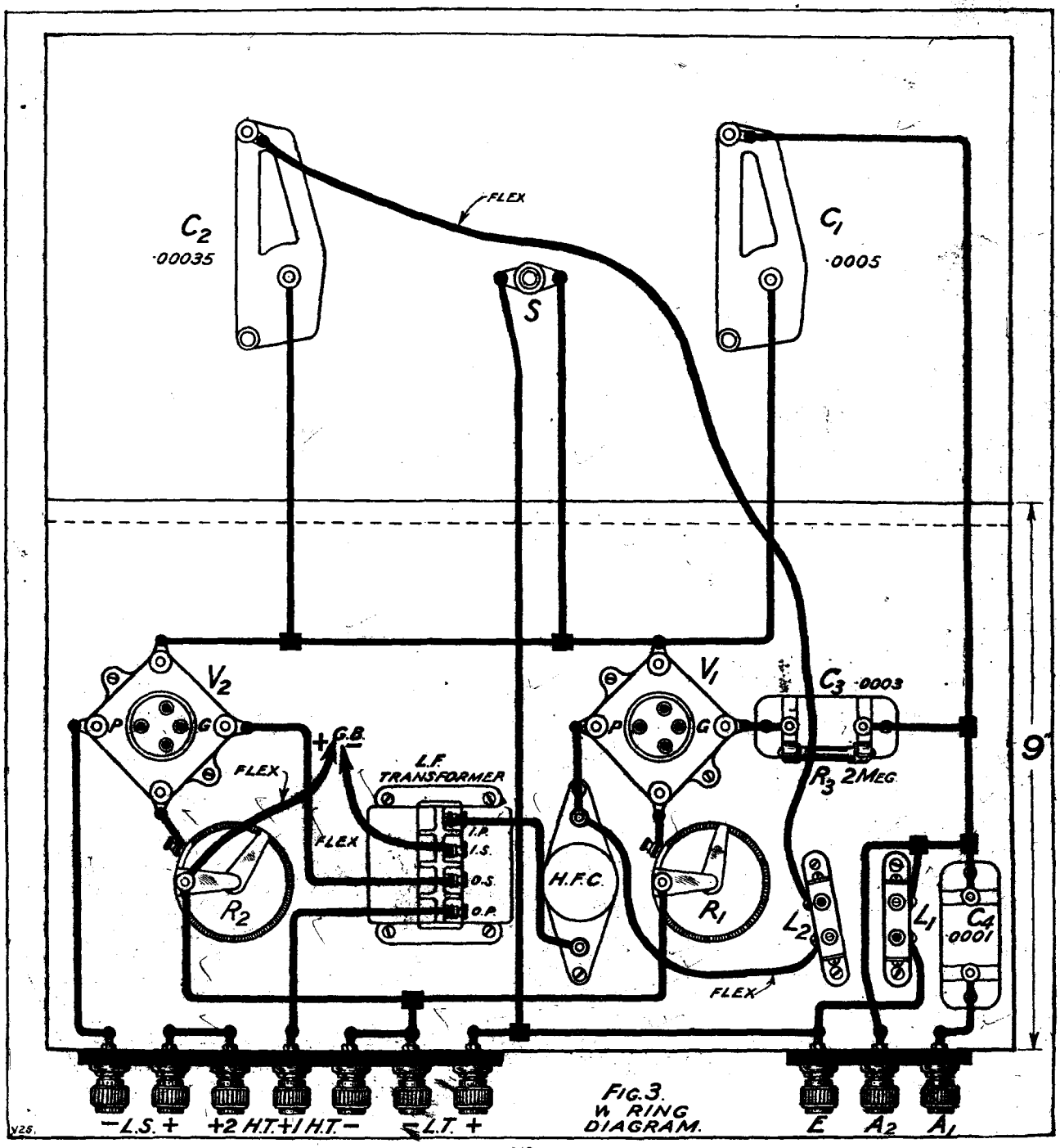
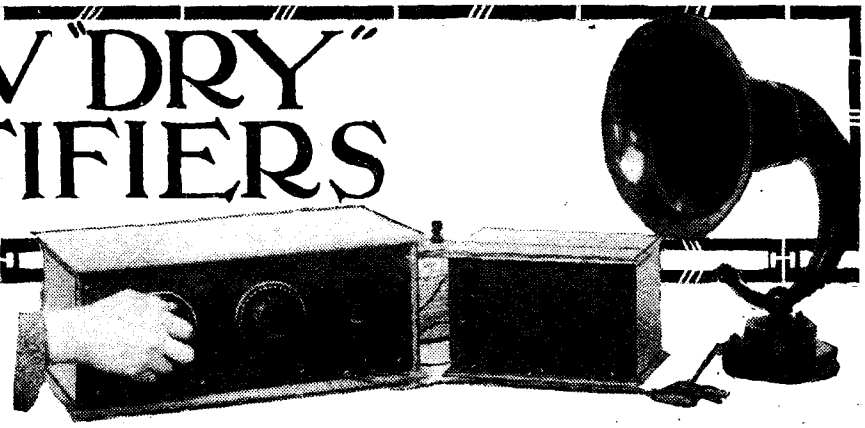


FIG. 3. W RING DIAGRAM.

The NEW "DRY" RECTIFIERS



An interesting article in which our contributor discusses the merits of the various types of rectifiers, with special reference to the new "dry" rectifiers recently developed in America. By Dr. J. H. T. ROBERTS, F.Inst.P.

A RECTIFIER, as probably all my readers know, is a very necessary adjunct to any arrangement for providing direct current from an alternating-current source. The most familiar case is that in which it is desired to charge electrical accumulators from alternating-current electric supply.

Where L. T. batteries are to be charged, it is universal practice to step down the voltage of the alternating current by means of a transformer and then to connect the secondary of the transformer with the battery to be charged and with a rectifier, all three being in series. The rectifier has the property of allowing the alternating current from the secondary of the transformer to pass through it in one direction but not in the opposite direction.

The principal features to be considered in relation to a rectifier are its efficiency, its convenience, and its permanency.

Working Efficiency

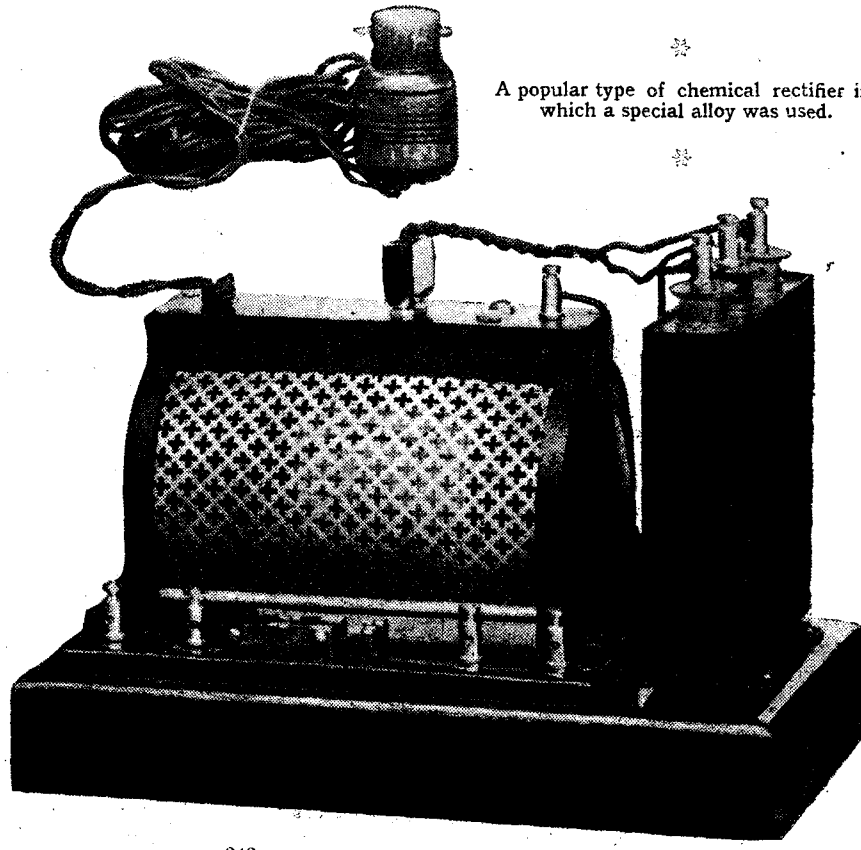
The efficiency of a rectifier may be popularly explained—perhaps in rather an Irish way—by saying that the greater the energy losses in the rectifier the lower the efficiency. If we had a rectifier of zero resistance to the current passing through it in one direction and of infinite resistance to the current attempting to pass through it in the opposite direction, this rectifier would be 100 per cent efficient. In practice, all rectifiers have a certain amount of resistance to the current in the "through" direction, and they allow some current to pass in the "reverse" direction. The current which passes in the "reverse" direction represents waste of energy in that it has to be subtracted from that which passes in the "through" direction, and the resistance of the rectifier to the current in the "through" direction means that extra voltage has to be used in order to drive the current against the resistance of the rectifier, and, therefore extra watts are consumed.

Internal Resistance

There are now, however, one or two rectifiers available which have quite a low resistance in the "through" direction, so low, in fact, that the energy losses in the rectifier are of trifling importance. In actual use, the convenience of the rectifier (that is, its reliability and freedom from trouble) may be much more important than the question of a small percentage of added efficiency. One of the old-fashioned types of rectifier employed aluminium and iron electrodes dipping into an electrolyte of borax, ammonium carbonate, or various other substances of a similar nature, but this rectifier, in addition to having a considerable internal resistance (and therefore becoming heated when passing any reasonable amount of current), also changed its character after continued working, and continually required cleaning and other attention.

The Tantalum Rectifier

At the other end of the scale, so far as electrolytic rectifiers are concerned, stands the tantalum rectifier



A popular type of chemical rectifier in which a special alloy was used.

which appears to be the rectifier *par excellence* of the electrolytic type. This rectifier consists essentially of two electrodes, one of lead the other of tantalum, dipping into an electrolyte of ordinary battery acid (dilute sulphuric acid). The latter rectifier has an extremely low internal resistance, is easy to set up, requires only the occasional addition of a little distilled water, when the batteries are "topped up," and is entirely constant and reliable as well as being noiseless in operation. If the current in the primary circuit of the transformer is switched off, the batteries may still be left connected to the tantalum rectifier without any possibility of damage, as no current can pass through the rectifier in the reverse direction in these circumstances.

The Mechanical Class

There are, of course, other types of rectifier which have their particular advantages, such as the valve, the vibrating reed, the rotating commutator, and the crystal type.

The last is very efficient when used for very small voltages and extremely small currents, and has the advantage of extreme simplicity and cheapness; moreover, it is able to rectify alternating current of very high frequency, and it is this property, amongst others, which makes it so suitable as a detector of radio-frequency currents.

The vibrating-reed rectifier and the rotating commutator belong to what may be called the "mechanical" class of rectifier, and whilst both of them may be very efficient, when properly adjusted, they are not noiseless and they are apt to require a little attention and adjustment from time to time.

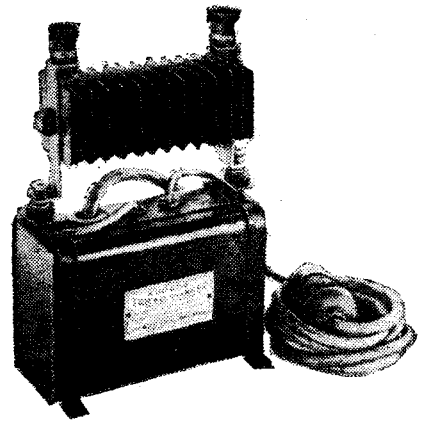
The Valve Rectifier

The valve rectifier is, as a rule, inefficient for two reasons. In the first place, an amount of energy is consumed in the filament comparable with the energy passed through the valve. This applies in the case of gas-filled or ionisation valve rectifiers, whereas in the case of the vacuum type, employed for rectifying alternating current of considerable voltage, the current consumed in the filament may be much greater than that passing through the anode circuit of the valve. The valve rectifier, however, has the advantage that its breakdown voltage—that is, the maximum reverse voltage which it will withstand—may, in appropriate circumstances, be extremely high, more particularly with the vacuum type, and therefore a valve rectifier will rectify at a single operation alternating current of high voltage which might require a number of rectifying units of certain other types in series.

"Dry" Rectifiers

Recently certain developments have taken place in L.T. rectifiers of the so-called "dry" type. The principal representatives of this class of rectifier are the Raytheon "A" and the Kuprox rectifiers, both of which hail from the United States.

The Raytheon "A" is not strictly a dry rectifier, but it is "dry" in the sense that the liquid used is completely sealed within a small metal cartridge about the size of one of the three units of a 4½-volt pocket flash-lamp battery: the unit, in fact, is about 2½ in. long and about ¾ in. in diameter. The comparison between the Raytheon "A" rectifier and the



The "Kuprox" rectifier unit.

flash-lamp battery may help us in another respect. For just as the so-called "dry battery" (an ordinary wireless H.T. dry battery is merely a collection of units of the pocket flash-lamp battery type) is not really dry at all, so the Raytheon "A" rectifier is not dry. In both cases the liquid is sealed in, so that the unit becomes unspillable, and outwardly, at any rate, may be regarded as though it were, in fact, dry internally.

The Kuprox rectifier, on the other hand, is really dry in the true sense of the word, for it consists of a series of small discs of metal, between successive pairs of which is sandwiched a metallic compound, the exact nature of which is a trade secret.

Concentrated H_2SO_4

The Raytheon "A" rectifier has been developed by Monsieur Henri André, the well-known French scientist, together with a number of U.S. scientists working at the Massachusetts Institute of Technology. The container consists of a copper-plated steel tube with a silver anode contact sealed in at one end. The cathode is of a special alloy, the composition of which is not disclosed; whilst the anode is in direct contact with a paste of pure silver powder and concentrated sulphuric acid, the latter having been dehydrated (freed from water) in order to avoid undesired chemical reaction.

The Porous Anode

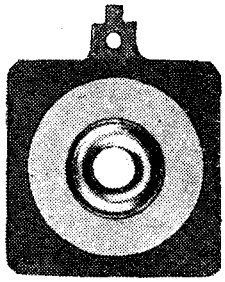
The porous anode contains in its interstices the concentrated sulphuric acid, which has, however, access to the junctions between the metals. The purpose of the concentrated acid is to preserve the various metallic junctions in what has been described as an "oriented" condition, but the actual conduction is through the metals themselves. The "oriented" condition referred to may perhaps be explained in this way. If an alternating potential of 2 volts be applied to a 2-volt accumulator, no current will pass through the accumulator when the applied potential is in the direction opposed to the voltage of the accumulator; but when the applied potential reverses, the 2 volts will be added to the 2 volts of the accumulator, and a total voltage of 4 volts will be available to drive the current round the circuit. The plates of the accumulator may be said to be in an "oriented" condition, in that they maintain, of themselves, a voltage of 2 volts.

The "Oriented" Condition

This explanation is not to be taken as being strictly applicable to the modus operandi of the Raytheon "A" rectifier, but it will serve to explain fairly well what is meant by the "oriented" condition which is maintained in the rectifier by the presence of the concentrated sulphuric acid at the metallic junctions. One of the principal differences is that in the rectifier referred to the passage of current in the direction in which the "oriented" condition helps the current (which is the "through" direction) does not destroy the condition of the metals, as it would do in the case of the accumulator.

The Kuprox rectifier, which has already been briefly described above, seems to depend upon some principle related to that operating in the case of the ordinary crystal detector, although the exact method of operation is not fully understood in either case.

It is claimed for both of these so-called dry rectifiers that they have a very low internal resistance, and that consequently, quite apart from the efficiency, they permit of a "taper" charge being applied to the battery.



One "element" of the Kuprox dry plate rectifier.

In case any of my readers may not quite understand what is meant by a taper charge I may explain the matter in this way. Suppose it is necessary to apply 7½ volts against a 6-volt battery in order to drive through the latter the desired charging current. If the current is alternating, and a rectifier has to be included in the circuit, it will evidently be necessary to increase the voltage in order to drive the same current against the resistance of the rectifier. Suppose the resistance of the latter is so low that an additional 1½ volts is sufficient for the purpose, then a total of 9 volts, applied to the battery and rectifier combined, will bring about the passage of the necessary current.

A Taper Charge

When the battery is in a discharged condition and its voltage is only about 6 volts, there will be a difference of 3 volts available to drive the current. As, however, the battery becomes gradually charged up, and its voltage rises towards a final value of 7½ volts, the excess voltage available for driving the current round the circuit will gradually drop from 3 volts to 1½ volts, with the result that the current will automatically "taper off" to a minimum value. The closer the required voltage (which in this case we are supposing to be 9 volts) to the final fully charged value of the battery, say 7½ volts, the more nearly will the final value of the charging current be reduced to zero. It is asserted by some battery manufacturers that the ideal way to charge a battery is by a fairly heavy initial charge, tapering off as a battery becomes fully charged.

High-Resistance Rectifier

If the rectifier has a high resistance the taper charge will be impossible. For example, supposing the internal resistance of the rectifier is such that it requires 20 volts to drive the desired current through the rectifier against the 6-volt battery, then evidently 14 volts are required to overcome the resistance of the rectifier and battery combined, and when the battery has become fully charged and its voltage has risen to 7½ volts instead of 6 volts, the excess voltage available is 12½ volts instead of 14 volts as it was previously: the percentage drop in the excess voltage being comparatively small, the percentage decrease in the current will be correspondingly small and the current will be nearly the same when the battery is fully charged as it was when the battery was in the discharged condition.

Current Practically Constant

Thus, we see that where a resistance is introduced and a correspondingly higher voltage is provided to overcome that resistance, the charging current is practically constant and unaffected by the gradual rise in voltage of the battery as the latter becomes fully charged; but where the resistance in the circuit is very low and only a small excess voltage is required for driving the current round the circuit, the rise in voltage of the battery as it becomes charged makes a considerable difference to the excess voltage and, therefore, to the charging current.

Reviewing the different types of rectifier which have been referred to, it will be seen that these new so-called "dry" rectifiers have a low internal resistance, but the great advantage which is claimed for them is the fact that they contain no free liquid. Although this may be an advantage when such a rectifier is to be incorporated in a device such as a L.T. battery eliminator (where there is no other liquid-filled component already present) I cannot see what is the advantage of a dry rectifier combined or used with an accumulator which already contains sulphuric acid. It seems to me that the most obvious rectifier to use is one the electrolyte of which, at any rate, is identical with the electrolyte used in the battery itself, namely, battery acid, and from my own experience of the tantalum rectifier (which fulfils these conditions) I have found it extremely efficient, extremely reliable, and in every way satisfactory and free from trouble, as well as being inexpensive to make.

I have not yet had an opportunity of examining these new dry rectifiers referred to, but I should imagine from their rather complicated construction, and also from the elaborate processes which are said to be involved in the making of some of their internal parts, that they would be much more expensive to produce.

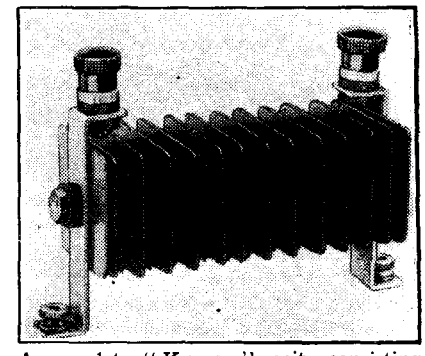
An "Unknown Quantity"

As regards their performance, that is a matter on which one must maintain an open mind until they have been tried and used for a long period. I understand that in some of the original rectifiers of the so-called dry metallic disc type, originally invented by Samuel Ruben, the rectification was in reality dependent upon some obscure electrolytic effect and was, in consequence, very much influenced by the humidity of the atmosphere.

However, as already stated, I have not yet had the advantage of testing these rectifiers, and can only say that whereas the tantalum rectifier is a proved success the new rectifiers are, so far as I am concerned, at present an unknown quantity. By the time this article is in print probably preliminary samples will have reached me for inspection and test.

L.S. EXTENSION LEADS

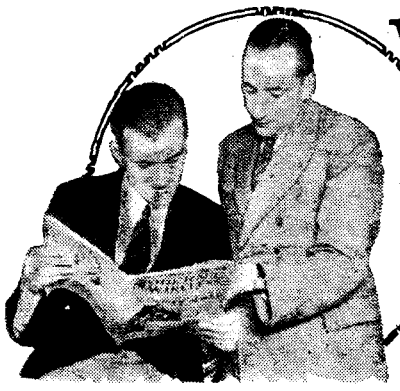
WHEN loud-speaker extension leads are coupled to a receiver not incorporating a transformer or choke-capacity output, extra care should be taken that the long leads used are well insulated



A complete "Kuprox" unit, consisting of a number of plates joined in series.

from everything with which they come into contact. The H.T. current will be passing through the leads, and if allowed to short through a damp wall or other such earthed object will leak away to the detriment of the H.T. battery, or may even return to the set via the earth lead with sufficient vigour to burn out the valves.

Similar precautions should also be taken even if a choke-capacity loud-speaker by-pass scheme is employed.



WHAT READERS THINK

My Most Efficient Receiver

SIR,—Herewith I enclose the hook-up of "My Most Efficient Receiver." Now and then a copy of MODERN WIRELESS reaches me and I study the various hook-ups that are printed in its columns. Rarely do I find lists of stations heard, and sometimes wonder if the British receptionist is sufficiently interested in radio broadcast to construct a real DX receiver.

Being a DX hound myself I used to build about every so-called DX set that appeared in the columns of the magazines, only to find their distant-reception qualities did not satisfy my thirst for real distance.

About ten months ago I built a set similar to the hook-up I enclose, and at that time used transformer-coupled audio amplification. After several months of experimentation with various coils, variable resistances, and transformers I developed what has proved to be a *very efficient DX receiver*, hence this contribution to MODERN WIRELESS.

Among the greater distances heard with my set I have had the thrill of listening to two stations in Japan, one in Australia, Manila, Calcutta, Havana, and Toronto. Three in New York, one in New Jersey, nine in Chicago, five in Canada, besides dozens of others scattered throughout the United States.

Perfect quality of reproduction is obtained through resistance-coupled amplification. You will notice that only the radio-frequency tube has a variable control, all others, including the detector tube, are connected to Amperites. (The Radiotron or Cunningham 201A in the detector is not critical.)

Batteries used are one 6V storage, or "accumulator" as I used to call it many years ago in England, and for the H.T. I use a Special Master Majestic B battery eliminator with an 80M tube made by Q.R.S. While I have not checked the H.T. voltage, I presume I am getting more than 220 volts on the plate, reduced, of course, by the resistance coupling.

Very truly yours,
SEYMOUR HASTINGS.
Late Manager-Announcer,
K F H J, Santa Barbara,
K F I, (The Evening Herald) Los Angeles,
K F V F, Los Angeles and
K N R C, Los Angeles.
Los Angeles, California.

For Alternative Programmes

SIR,—We have now had time to test 5 G B, and I think it is agreed that the quality, strength, and character of the programmes makes this station well worth listening to, and here in the Midlands with 5 X X nicely placed we are assured of two stations being excellently received. My difficulty, however, is that to change from 5 X X to 5 G B necessitates altering three coils (placed inside the set) in addition, of course, to tuning, and as no doubt this applies in the case of many other listeners (probably some will have only two coils), I am wondering whether you would describe a set which constructors could build so designed that to change from one station to the other could be carried out much more conveniently. I would suggest a three-valve set (Det. and two L.F.), one transformer, and one resistance, or preferably both resistance, with anode-bend rectification—a quality receiver and not for DX work. No doubt the set could be made to incorporate other features in the way of simple switching, but I think there must be many listeners in my position who would like to make the change from 5 X X to 5 G B as easily as possible. What do you think?

Yours faithfully,
R. W. T. OWEN.
Stafford.

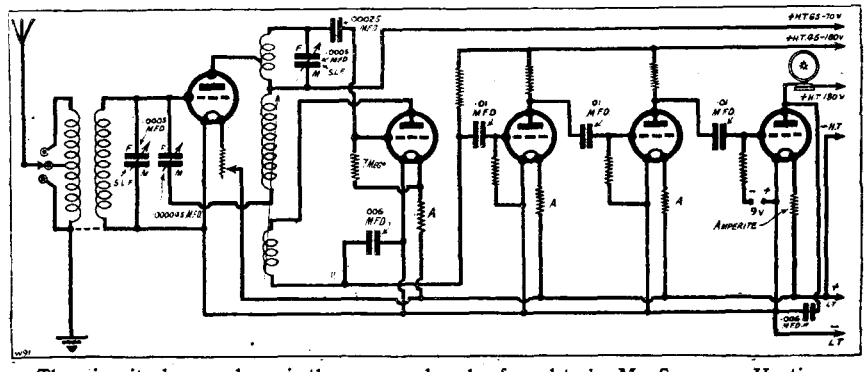
[*Ed. Note.*—It is extremely difficult to design a really efficient set with switching for high or low wavelengths, though simple receivers can be built with this refinement. The three-valver mentioned (Det. and two L.F.) could be designed without much trouble, but a certain amount of selectivity *must* be retained to separate the programmes.

DEP.610 Valve

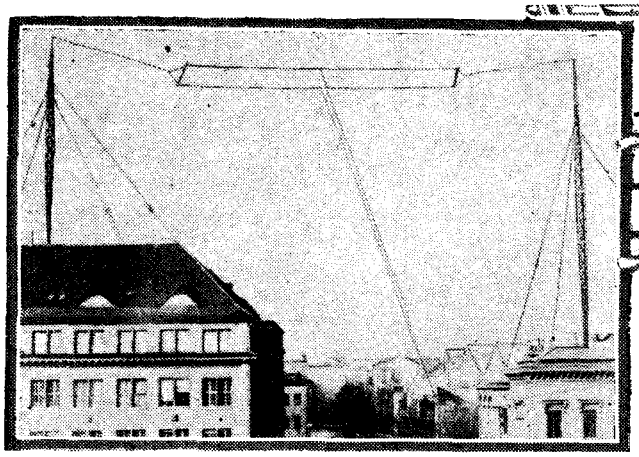
SIR,—We have read with interest the article published on pages 247, 248, and 366 of the September issue of MODERN WIRELESS, written by Mr. K. D. Rogers, on "Recent Valve Developments," but are rather surprised at the report under the heading of "Poor Power Valve" on our new DEP.610 type.

Presumably the author is not quite clear as to the intention behind the design of this power valve. Such is to provide as much undistorted output as possible to the loud speaker, even on a small input. This undistorted output is dependent upon the mutual conductance, sometimes called "goodness factor," or $\frac{m}{R}$ and not upon the "m" factor or grid swing alone.

(*Continued on page* 424.)



The circuit shown above is the one used and referred to by Mr. Seymour Hastings. As mentioned in his letter on this page, he has tuned in Australia, Manila, Calcutta, Havana, Toronto, and dozens of other long-distance transmissions. The reproduction he describes as being "of perfect quality."

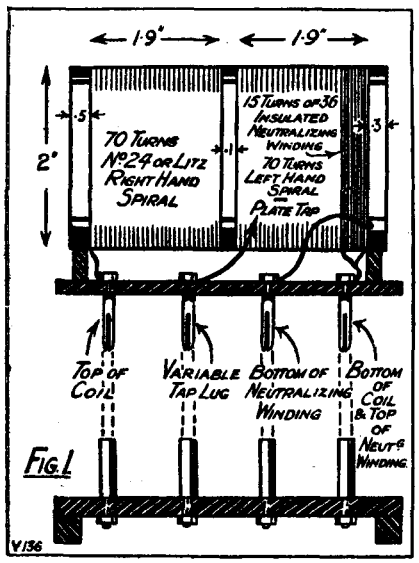


A ONE-VALVE DX UNIT

A useful and easily made H.F. amplifier.

Designed and described by
Capt. H. J. ROUND, M.I.E.E.

By the time this appears we shall be in the state, particularly in London and one or two of the main centres, of having more than one medium-wave station of respectable power. Daventry Junior is already on the air with a wave-length of about 490 metres, but it is not possible to say whether this wave-length is the one which will be finally adopted, so that any decision as to the degree of tuning necessary to separate the local station from Daventry Junior will have to be left until the wave-length question is settled.



H.F. Required

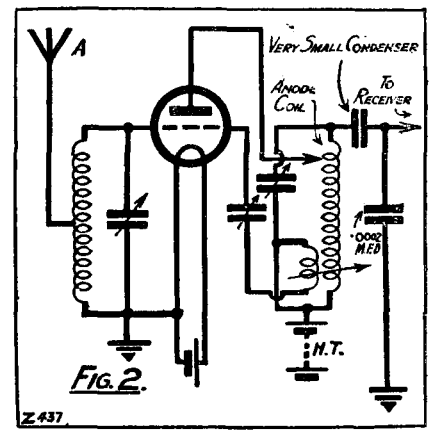
There is no doubt about it that all those who are at present depending on a single rectifying reaction valve and one or two stages of L.F. amplification will not be very happy unless they happen to be some distance from the local station, and the wave-length separation is over 100 metres, and at the same time it is doubtful whether they will, in the majority of cases, have enough strength from Daventry Junior to give them real satisfaction.

It seems such a pity to have to scrap a receiver and construct another one to meet the new circumstances, if by some small modification the extra tuning and extra sensitivity can be obtained. There is no doubt that the best way of meeting the case is to add another valve, and I propose here to describe a simple way of putting such a valve on to the present receiver without altering the set in any way.

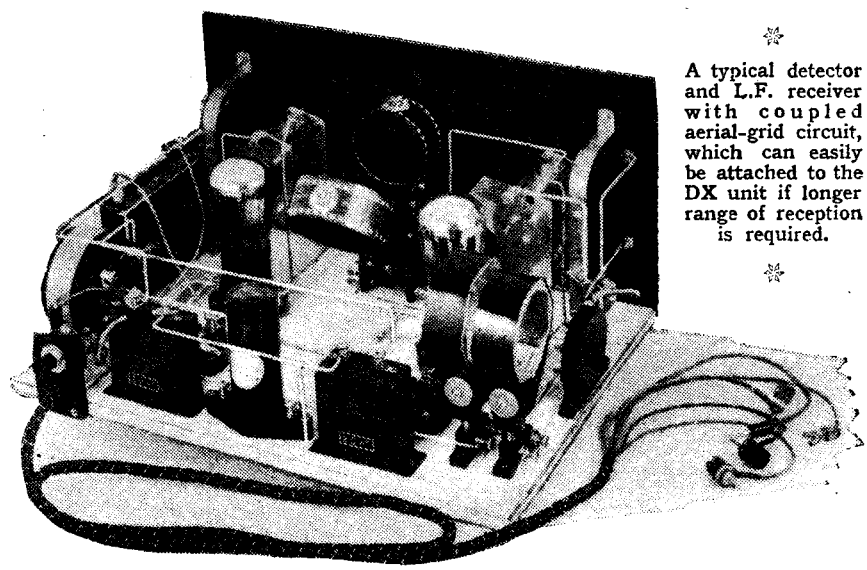
Suits All Cases

In certain cases these valve rectifier and reacting receivers are fitted with tuning coils and condensers and some reaction device, the aerial usually being tapped down the coil. This is the most modern type of circuit, but in other cases cruder arrangements are used, in which the aerial forms the main capacity in the first circuit.

Both cases can be met in the same way with the adapter to be described, but in those cases where a shunt tuning condenser is actually in use it will not be necessary to imitate the aerial capacity, although it will do no harm if we do so. The adapter I am going to describe consists of two tuned circuits with a modern, fairly high μ value valve, and an arrangement for giving condenser coupling to the receiver.



The whole thing can be made up in a case quite independently from the



A typical detector and L.F. receiver with coupled aerial-grid circuit, which can easily be attached to the DX unit if longer range of reception is required.

receiver, and should be placed 6 in. or 8 in. away from the receiver. There will be no serious difficulty in "finding one's way about" on the combination after a little practice, particularly as I think it will be moderately safe to oscillate weakly on the detector when searching for distant stations, provided one keeps off the local stations and Daventry Junior, as these two stations will be very easy to receive without any searching in the heterodyne condition.

The Tuning Coils

It seems rather wicked in these days to suggest oscillating, but as a matter of fact a single stage of H.F. neutralised, connected up as an adapter, carries back an extremely minute amount to the antenna. I doubt if even a super receiver could receive it more than twenty or thirty yards away, and even then the jamming effect would not be as serious as that caused by several supers I know, which have a strong heterodyne which can carry quite fifty yards.

On the question of tuning coils for the adapter, I have a particular preference myself for one type of coil, which I illustrate in Fig. 1. It is astatically wound with a short neutralising winding, wound closely on the bottom, and there is a four-pin socket which can very easily and quickly be made up. The home constructor has the choice of using ordinary wire or Litz for this coil, but there is no need for any expensive material for the coil tubing.

Personally I use dry cardboard, and find it very satisfactory. There would be some advantage to those making their own coils, to make them exactly to the dimensions shown in the drawing, because, using the condenser specified, 550 metres will be approximately at the top of the scale. Two of these coils and a ·00025-mfd. condenser will be necessary in the adapter. The neutralised arrangement which I like to use with the modern valves is a modification, I believe, of one called the Cowper method, and it requires a comparatively large condenser to obtain neutralisation.

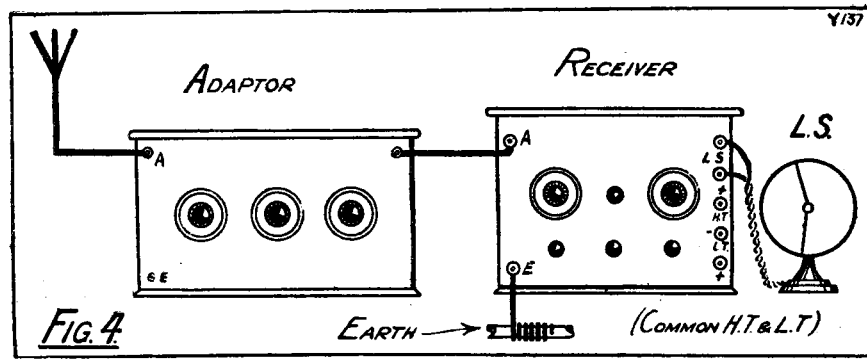


FIG. 4

A Selective Arrangement

The condenser can be one of the two plates rotor and three plates stator type, and one of the cheapest types purchasable is quite good enough for the purpose. There is no need for it even to be of the square-law type, and it can, if required, be mounted on the panel, although this is not essential, as it will not be required to produce reaction.

It is not a bad idea to fix a filament rheostat, because, as I have pointed out elsewhere, it can be used as a strength regulator by dimming the H.F. filaments, although it is unwise to carry this too far when using only one H.F. stage. The advantage of connecting the adapter up by a small capacity to the receiver is that in this way one then gets the full benefit of three tuned circuits, two on the adapter and one on the receiver with reaction.

It would be quite possible to leave out the last tuned circuit on the adapter and to rearrange one's aerial tuning to act as the tuned anode. In this way we should only have two tuned circuits, and, in addition, one would, of course, have partly to dismantle the amplifier.

The diagram of connections of the adapter I illustrate in Fig. 2, and the approximate layout which is advisable and which can be mounted to look neat, is shown in the next figure (Fig. 3). When connected up the reaction on the receiver can be turned well away from the oscillating-point, and the adapter must be checked, to see that it has no tendency to oscillate on its own.

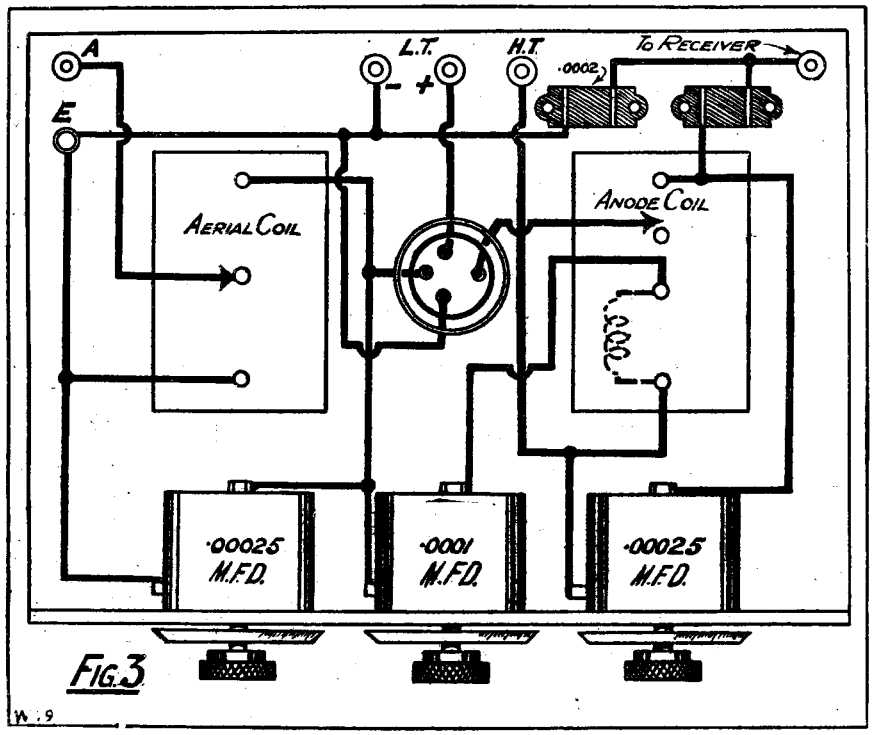


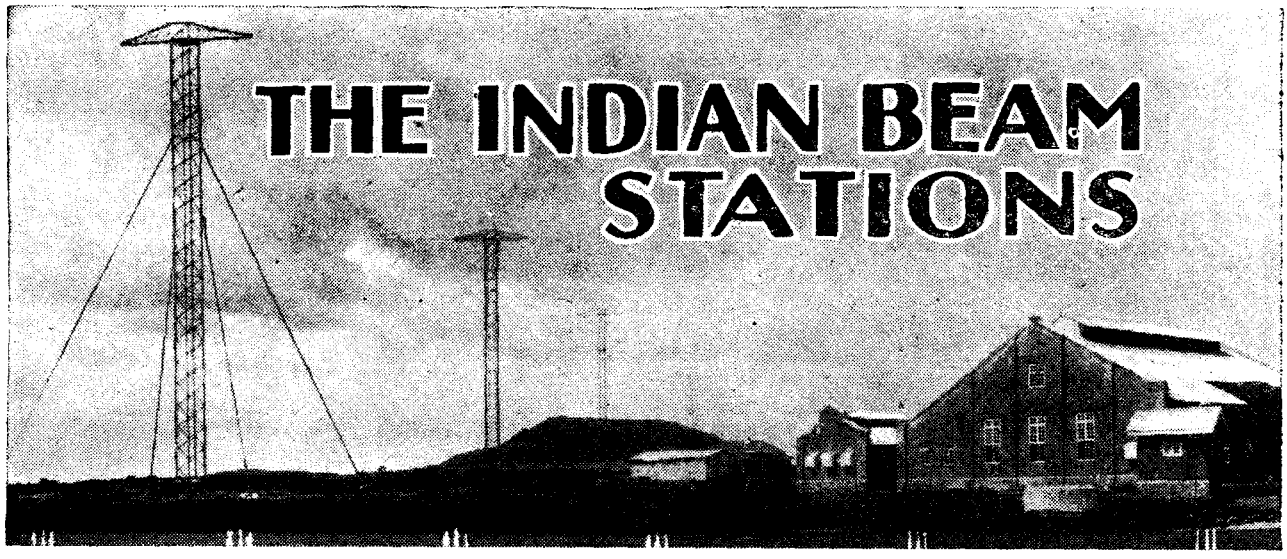
FIG. 3

Neutralising

If necessary, the usual neutrodyne methods can be adopted of tuning up to the local station, disconnecting one filament leg of the valve in the adapter, and turning the neutrodyne condenser to the zero signals, but usually trial and error is sufficient to find the neutrodyne position without any serious effort. Of course, down in the scale there may be one or two troublesome points where it may be necessary slightly to adjust the neutrodyne condenser to get stability when receiving under 300 metres, but a well-constructed instrument should not even show this.

In Fig. 2 I have shown the anode tap on the adapter circuit. This

(Continued on page 430)



THE INDIAN BEAM STATIONS

THE short-wave wireless beam stations which have been built for the General Post Office by Marconi's Wireless Telegraph Co., Ltd., at Grimsby and Skegness, for high-speed wireless communication with India have successfully passed their seven days' official Post Office test, and the Company has been informed by the Post Office that they are issuing the preliminary certificate of acceptance. The scheme to link up Great Britain with Canada, Australia, South Africa, and India by means of high-speed wireless telegraph services, has thus been successfully completed; and the British Empire now possesses the most complete, up-to-date, and efficient wireless telegraph service in the world.

Under the Government contract with the Marconi Company the beam stations for communication with India were to be capable of sending and receiving at the same time at a minimum speed of 100 words per minute during a daily average of twelve hours. During the seven days' official test this guarantee was largely exceeded, the Marconi Company estimating that an average speed of between 130 and 150 words per minute has been maintained during from 18 to 21 hours per day.

Freedom From X's

As a result it is also estimated that the capacity of the Indian beam circuit is about 180,000 words per day in each direction. It is well known that during the monsoon period India is one of the worst countries in the world for atmospheric interference; and the fact that the Indian beam stations have been able to work at high speed for hours on end during the monsoon period is remarkable testimony to the freedom from atmospherics that is obtained by the use of beam receiving aerials.

The achievements of the Indian stations during the tests bear out the experience of the working of the other beam stations. Mr. E. T. Fisk, the managing director of the Australian Wireless Company, has estimated, for instance, that the high-speed capacity of the Australian circuit working in both directions for the four weeks from July 11th to August 7th was 701,200; 642,750; 816,286; and 983,022 words respectively. The circuit capacity shown by these figures is considerably in excess of the total telegraph traffic passing between Australia and England at the present time, and thus demonstrates the enormous possibilities of the beam service between these two countries.

Other Services

Although the South African service has only been opened since the beginning of July the traffic has shown a rapid and continued increase, and is already considerably greater than was expected at such an early date.

The Canadian Beam service, which was opened successfully at the end of last year, continues to deal satisfactorily with a large volume of traffic.

The traffic handled by the beam services operating between Portugal and its colonies, which have only been

The room in India where the British Beam signals are received. It is situated at a place called Dhond, 48 miles east of Poona.

in use for a few months, also show a steady and substantial increase.

Within two or three weeks there will be a further development in the opening, by Marconi's Wireless Telegraph Co., Ltd., of commercial beam telegraph services between England and South America, and between England and the United States of America. The beam stations for direct communication between Canada and Australia are also nearing completion, and this service is expected to be opened in the near future.

Although the erection of the Indian beam stations completes the contract into which the Marconi Company entered for erecting stations for Imperial wireless telegraph communication for the British Government, it by no means completes the immediate prospect of improving communications between Great Britain and her Dominions, experiments having proved the possibility of carrying on wireless telephone conversation by means of the beam stations simultaneously with the operation of high-speed wireless telegraph services. There is every prospect that before the end of next year it will be possible for telephone subscribers in England to call up subscribers in any of the Dominions.

With the development by the Marconi Company of a system of facsimile transmission, specially adapted to the beam system, there is also the prospect of written and printed matter, drawings and photographs being transmitted by high-speed wireless telegraphy, and thus not only expediting the transaction of a considerable amount of business, but also enabling each part of the Empire to take a greater interest in other parts because of the rapid transmission of photographs of contemporary events.

The English transmitting station of the Indian service at Grimsby, and the receiving station at Skegness, are connected, as is the case for the other beam services, by landlines to the Central Telegraph Office at the G.P.O. in London, from which the actual operation of the station is automatically controlled. The corresponding transmitting station in India, which is situated at Kirkee near Poona, 75 miles east of Bombay, and the receiving station at Dhond, 48 miles east of Poona, are similarly linked with the Central Telegraph Office in Bombay, so that the English and the Indian terminal offices are in immediate touch with each other, and messages placed in the high-speed signalling instruments at the G.P.O. in London are instantaneously recorded at the Bombay office, and vice-versa.

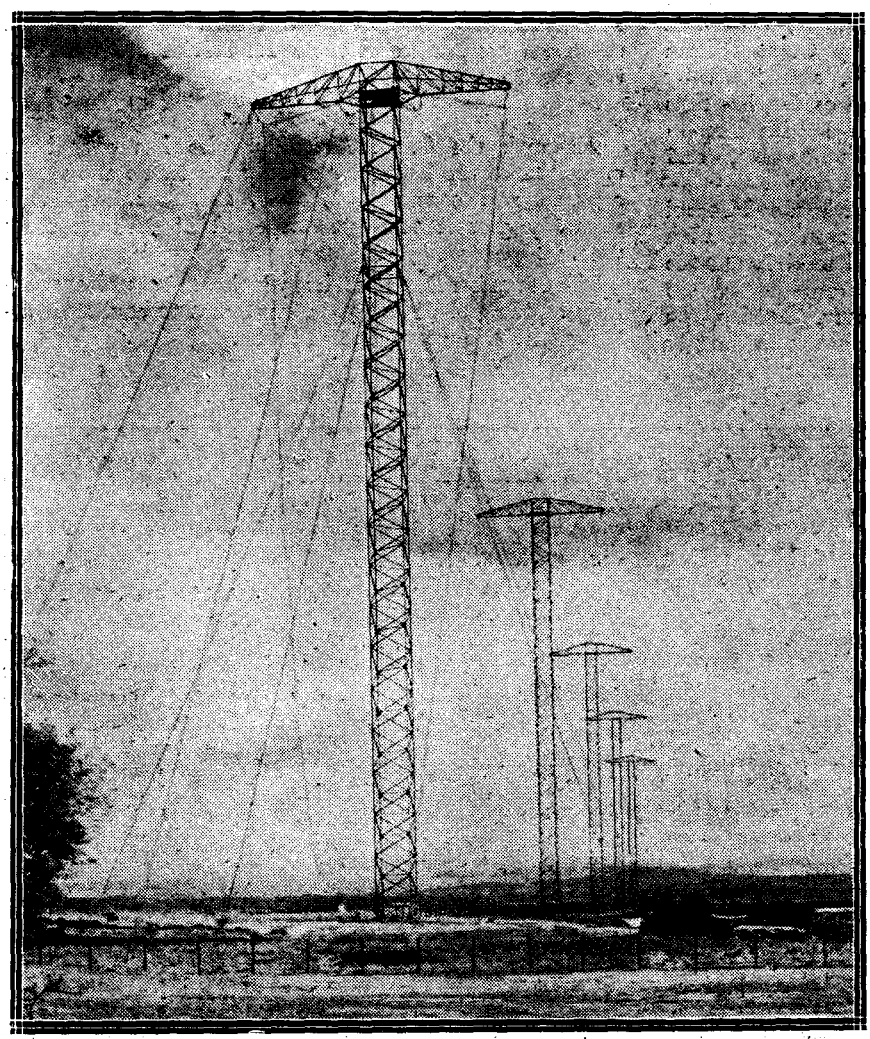
The Wave-lengths Used

The transmitting installation at Grimsby for the England-India service is in the same room as the transmitter for the England-Australia service, but while the Australian transmitter has three panels, as it is designed for working on a single wave-length only alternatively directed in an easterly and westerly direction during different parts of the day, the Indian transmitter has an additional panel to allow for the use of a second wave-length, transmission in this case always being in one direction.

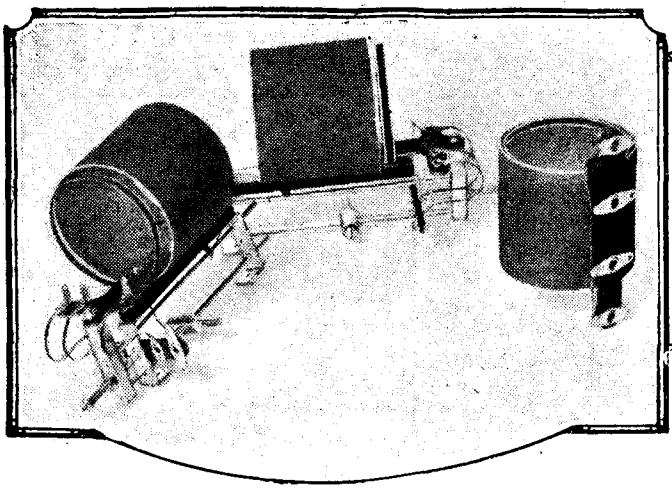
Transmission from England to India takes place on wave-lengths of 16·216 metres and 34·168 metres, and from India to England on 16·286 metres and 34·483 metres. At Grimsby a five-mast aerial system, quite distinct from the three-mast aerial system of the Australian service, has been built. The masts are 277 feet in height, with a distance of 650 feet between them. Two bays are used for one wave-length, and the other two bays for the second wave-length.

The masts are erected in a straight line at right angles to the great circle from the transmitting station at Grimsby to the receiving station in India, and the reflector behind the active aerials focuses the main energy in a south-easterly direction on to the receiving aerials in India. A similar aerial system has been built at Kirkee to carry out the transmissions to this country, but here the signals are concentrated in a north-westerly direction towards England.

The receiving apparatus for the signals from India is installed at Skegness in the room where the receiver for the reception of the signals from Australia is installed.



The Indian end of the British-India Beam service. These five giant masts, erected by the Marconi Company at Kirkee, India, carry the aerial and beam reflector wires.



The "STROBODYNE" RECEIVER

Some interesting details of the latest super-heterodyne circuit.

By J. C. JEVONS.

THE Strobodyne circuit is due to a French inventor named Lucien Chrétien, and may be described as an ingenious modification of the supersonic principle. At the same time, although amplification depends upon the use of an intermediate frequency which is derived from the incoming signal and a local oscillator, the actual method of producing this secondary frequency is distinct from that used in the super-heterodyne circuit.

In the latter case, the incoming signal beats with waves produced by a local oscillator. The two oscillations

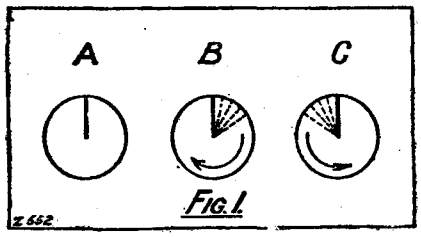


FIG. 1.

are then combined on the grid of a detector valve and a new beat frequency, equal to the difference between the first two oscillations, appears in the tuned output circuit of that valve.

Stroboscopic Effect

In the Strobodyne circuit the lower or supersonic frequency, on which subsequent amplifications take place, is produced by a stroboscopic effect (hence Strobodyne) similar to that employed in the well-known apparatus used for detecting cracks or flaws in flywheels and other rapidly rotating bodies whilst they are actually in motion.

If, for example, a black line is painted on a white disc as shown at A, Fig. 1, it will not be visible, except possibly as a faint blur, when the shaft is rotating, say, at 1,500 revolutions per minute.

Imagine, however, that the source of light by which it is viewed, such as an electric lamp, is switched on and off 1,499 times a minute. During the duration of each flash the line will be visible, and will appear to be practically stationary. Not quite, however, for during the ensuing interval of darkness the shaft will have made one complete rotation, plus 1/1,500th of a turn, so that at the next flash it will appear to have moved forward that fraction of a turn.

The Original Circuit

Under these conditions the observer will therefore see the line move slowly forward in the direction of the hands of the clock, at an apparent speed of one revolution per minute, corresponding to the difference between 1,500 and 1,499.

If the lamp is switched on and off exactly 1,500 times per minute, i.e. at the same rate as the shaft revolves, the white line will appear absolutely stationary, whilst if the lamp is cut out at a still greater speed, the line will appear to move slowly backwards in an anti-clockwise direction.

The manner in which this principle is utilised in the Strobodyne circuit is illustrated in Fig. 2. In the first

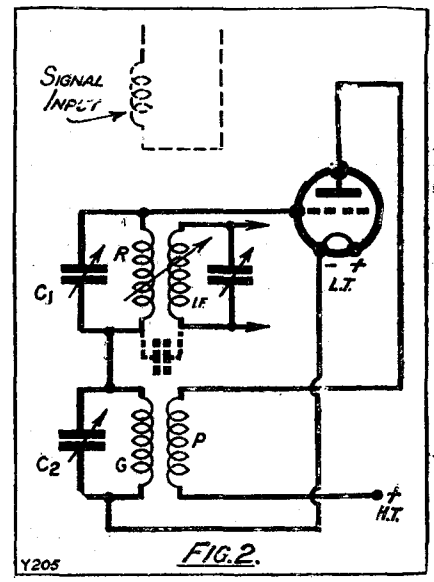
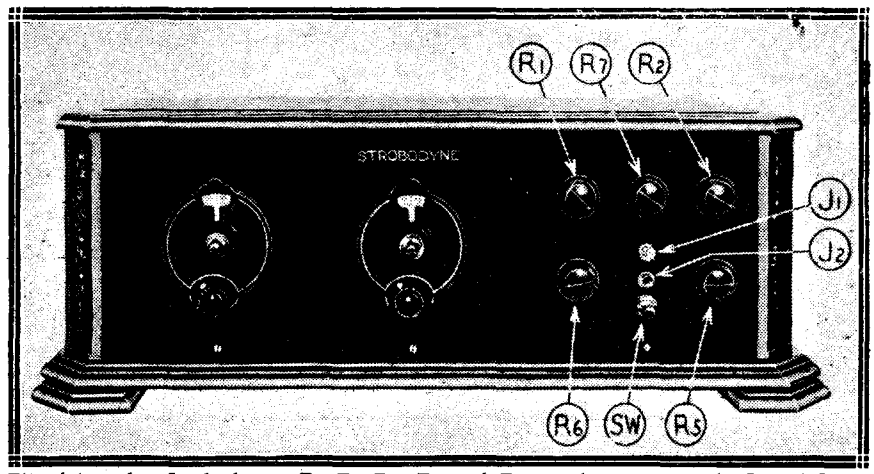


FIG. 2.

place, taking a typical signal frequency of 1,000,000 a second, corresponding to a wave-length of 300



The eight-valve Strobodyne; R_1, R_2, R_5, R_6, and R_7 are rheostat controls, J_1 and J_2 are jacks, while SW is the filament switch.

metres, it is obvious that a switching device is required (corresponding to the lamp switch mentioned above) which will be capable of operation at something approaching this speed.

No mechanical appliance, however, is capable of such intensely rapid movement, but luckily we have the valve as a substitute.

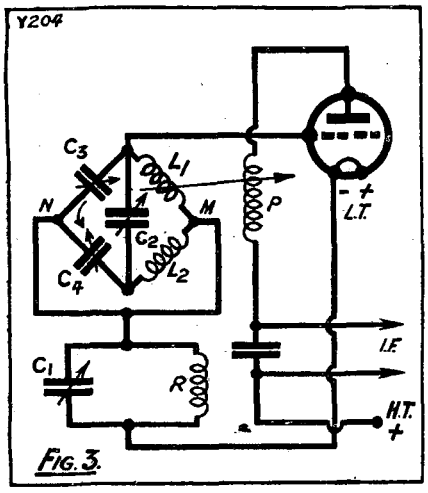


FIG. 3.

When a valve is oscillating the grid is thrown alternately positive and negative. During the positive period the resistance of the grid-filament space decreases. It falls, in fact, to such a low value that it forms a short-circuit so far as applied radio-frequencies are concerned. During the negative period, however, the grid-filament resistance is restored to a high value, and appli d radio signals will be repeated in amplified form in the plate circuit in the ordinary way.

Returning to the arrangement shown in Fig. 2, the circuit R is tuned to the incoming signal waves, and is coupled magnetically (or electrostatically through the condenser shown in dotted lines) to an IF circuit tuned to the desired intermediate or supersonic frequency.

The circuit G is coupled to the plate coil P and therefore serves to set the valve into oscillation at a frequency either slightly above or below the signal frequency, the precise value being determined by the setting of the condenser C_2.

Now the circuit G may be considered to function like the lamp switch in the stroboscope. It acts as explained above, to make the grid-filament space "short" the tuned circuit R (and thus by-pass the incoming signals) except at intervals which recur at a frequency equal to the "difference" between the tuning of the two circuits R and G.

At first sight it appears difficult to draw any clear distinction between the *modus operandi* outlined above and the ordinary "beat" effect obtained in the case of the super-het circuit where the incoming signals are combined with local oscillations on the grid of a detector valve.

No Rectification

The inventor, however, lays stress on the fact that no grid condenser or grid leak is used in the Strobodyne, and that there is, in fact, neither detection as in the standard super-het nor modulation as in the Ultradyne. The intermediate frequency is, he maintains, secured simply and solely by a stroboscopic action.

In practice the simple circuit arrangement, as shown in Fig. 2, is open to objection. For instance, the oscillations through the circuit G would stop at some settings of the tuning condenser C_1, because the local oscillations would then approximate too closely to the received signals. It is therefore necessary to devise an arrangement in which the tuning of one circuit does not affect the other.

Accordingly, the modification shown in Fig. 3 was tried out. Here the tuning and oscillating circuits R, G have been transposed, the latter being arranged as a Wheatstone bridge, with two small capacities C_3 and C_4 shunted across the main tuning

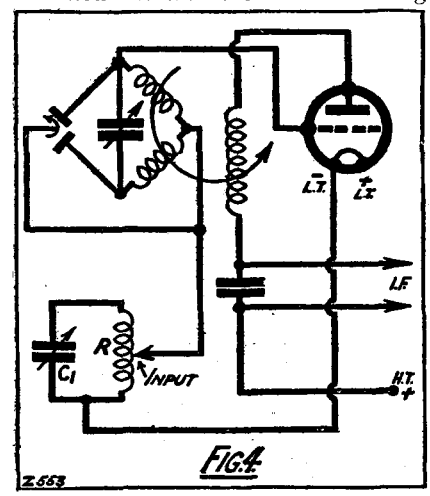


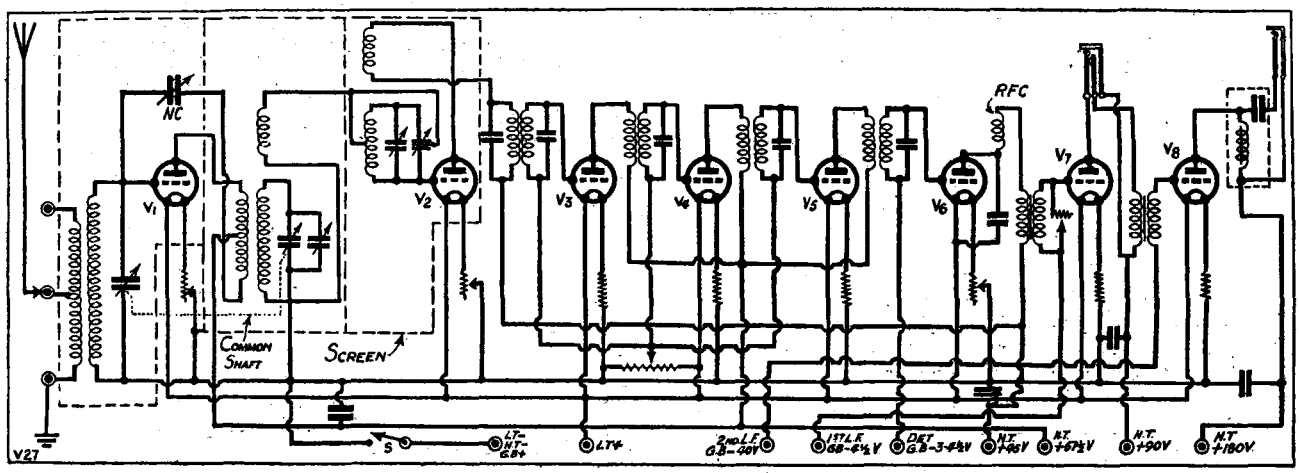
FIG. 4.

condenser C_2. The mid-point of the coil M is tapped across to the junction of these two condensers, as shown.

Unfortunately, it was then found that whilst the distance range was extraordinary the selectivity was poor. This, of course, arises from the fact that the tuning circuit R is largely short-circuited, and is consequently highly damped, a condition which is fatal to selectivity.

Increasing Selectivity

In order to remove this defect the arrangement shown in Fig. 4 was finally adopted. Here only a portion of the tuned input circuit is inserted across the grid and filament of the valve. This does not, as might perhaps be expected, lead to any loss in signal strength. On the contrary, the effective signal voltage is found to be increased, whilst the selectivity is all that can be desired.



This is the full circuit of the Strobodyne receiver. As will be seen, two of the tuning condensers can be "ganged," a small compensating variable condenser being placed in parallel with one of them.

As regards adjustments, it is clear that according to the inventor's theory of working the signals must be suppressed or short-circuited during those half-cycles when the grid is thrown positive by the voltages built up in the oscillating circuit G. This can only take place when there is a fairly high positive potential on the grid, from which it follows that the voltages built up in the circuit G must be fairly strong.

Operating Considerations

On the other hand when the grid is negative, the valve must amplify the incoming signals. This amplification will not, however, take place if the grid potential is made too negative, since in that case the plate current would fall to zero, or at least the operating point would move off the straight-line part of the characteristic curve to a point below the lower bend. It is accordingly necessary to prevent the amplitude of the local oscillations from exceeding this critical value.

In practice a suitable compromise is found by trial, either by adjusting the value of the plate voltage, or the coupling between the plate and grid coils of the oscillator circuit R.

Results Obtained

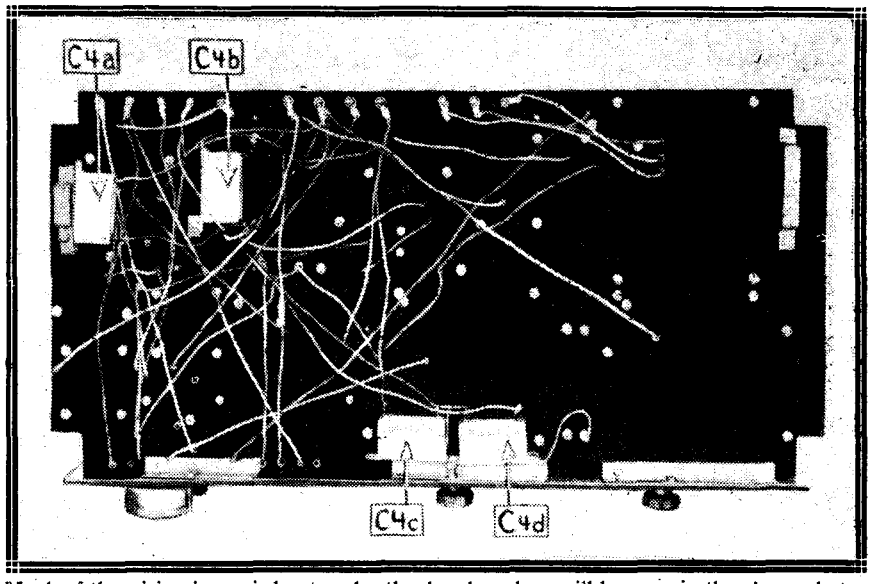
Every time that a pulse of signal energy succeeds in passing through the valve, the intermediate-frequency circuit IF is impulsed by the amplified signal, and as the latter is tuned to this lower or supersonic "impulse" frequency, corresponding signal voltages are rapidly built up by resonance.

At any given instant the oscillations through the circuit will have an amplitude directly proportional to the incoming signal waves. Accordingly, in the case of a modulated input, such as a broadcast carrier wave, the intermediate-frequency oscillations automatically preserve the original signal modulations, so that, as previously stated, only one detector valve is required, i.e. that following the stages of intermediate-frequency amplification.

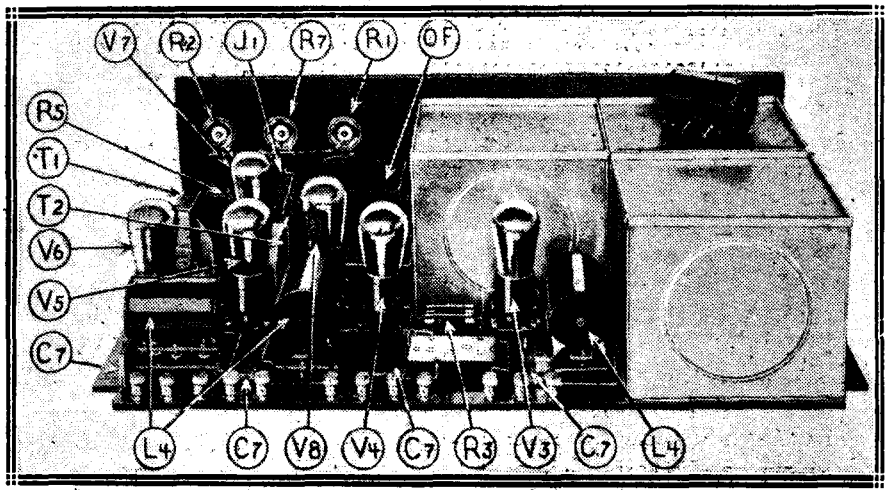
In the ordinary super-heterodyne circuit two detectors are necessary, one before the supersonic amplifiers, and one following them.

Short-Wave Reception

As an indication of performance, the eight-tube "Strobodyne" receiver illustrated has given excellent loud-speaker reception in Paris of most European stations, including Berne, London, Rome, and Prague on an indoor loop aerial only one foot square. The short-wave American programme from Schenectady (W G Y) was also received clearly on the loud speaker when the same set was connected up to an outdoor aerial.



Much of the wiring is carried out under the baseboard, as will be seen in the above photograph. The components indicated by arrows are by-pass condensers.



A rear view of the receiver with one of the long-wave R.F. units on top of the screening box. C_7 are fixed condensers for tuning coils L_4; V_3, V_4 and V_5 are the long-wave amplifier valves, V_6 the det, V_7 and V_8 L.F. amplifiers; T_1 and T_2 are L.F. transformers. R_1, R_2 and R_7 rheostats.

WHERE WIRELESS WINS

Some Instances from Overseas

IN some cases there may be an advantage in listening to a public meeting by wireless rather than in being actually present. At the International Radio Convention held in Ostend, Belgium, which was addressed by King Albert, listeners in the hall, which contained an audience of about 14,000 people, found it almost impossible to hear a word of the King's speech, but listeners by radio, on the other hand, heard every word perfectly. They were, therefore, better off than the people actually in the hall.

The Poor "Mike"

At a recent fire in a dance-hall in Chicago, where a programme was being transmitted via W G N, the microphone transmitted the crackling due to the burning of the wooden platform before the people in the hall realised what was in progress! The orchestra and dancers fled, but the faithful microphone perished in the flames whose advent it had announced to the radio audience before the broadcasters themselves discovered them.

Volume Control

F. H. (HUNTINGDON).—"I wish to employ some form of volume control on the H.F. side of my five-valve receiver. Is there any simple method which can be used with but little alteration to the set?"

Probably the easiest method is to insert a master rheostat in series with the negative filaments of the H.F. valves. For two H.F. stages 10–20 ohms is usually about right for ·1-amp. valves, and 10 ohms for the ·25 amp. type. If only one H.F. stage is employed the maximum value of the resistance must be higher, and for a single ·1-amp. valve 30 ohms is quite effective.

Short-Lived H.T. Batteries

H. D. (GRAVESEND).—"My four-valve set, which consists of an H.F. stage, grid-leak rectifier, and two transformer-coupled L.F. valves, seems to be exceedingly hard on H.T. batteries. The last valve is of the ordinary power type. What should be the total anode current for a set of this description?"

Roughly, 12 milliamps., provided the correct grid bias is used. With such a receiver only the largest-sized dry batteries should be employed. The ordinary small-cell type have a maximum working output of about 5 milliamps., and if this value is exceeded the life of the battery will be very short. With sets employing more than two valves it is a false economy to purchase these small batteries. In cases where shunting condensers are used between H.T. + and H.T. — for by-passing or smoothing purposes, it is as well to examine these in order to make certain that no leak exists, since the presence of such a fault is equivalent to a permanent load on the battery.

Substituting Components

E. S. (BROMLEY).—"I am building a receiver of the 'B.B.C. Five' type, and my stock includes an anode resistance having a value of 100,000 ohms, and also a wire-wound potentiometer which was used for stabilising an old tuned-anode set. Can I use these in my new 'quality' receiver?"

Yes, you could employ your 100,000-ohm resistance in place of the 150,000-ohm resistance used in the original "B.B.C. Five." You would not, however, obtain quite the same degree of amplification. Do not alter the values of the coupling condensers, grid leaks, or the anode resistance in series with the plate of the detector valve. In addition the small ·0001 fixed condenser must not be replaced with any other value.

You can use your existing potentiometer instead of the non-inductive resistance specified, but there is a possibility that some slight alteration in tuning will occur when the wire-wound resistance is varied.

Generator "Hum"

G. N. (HUDDERSFIELD).—"I am troubled with interference from a near-by generator. The symptoms are a loud 'hum,' which commences every evening at about six o'clock, lasting until 10.30 p.m. I believe the trouble originates from the local picture-palace. Is there any method of overcoming this type of interference?"

We are afraid that cases of interference from outside sources, such as electric railways, tramway systems, power mains, electric motors, X-ray apparatus, etc., are extremely difficult to deal with, and in many cases it is impossible to effect a complete cure.

Sometimes, however, a certain measure of relief may be gained by one or more of the following expedients:

(1) Use a counterpoise instead of a direct earth. This should be as nearly as possible a replica of the aerial, erected at a height of 10 or 12 ft., just as much care being exercised over its insulation as over that of the aerial.

(2) Try a *different* earth, e.g. if you are using the water main, transfer to a buried plate, etc.

(3) Connect a small fixed condenser of about ·0002 capacity between the earth terminal and the earth lead.

(4) Use an indoor frame aerial and no earth.

(5) Use aperiodic aerial coupling.

By-pass Condensers

H. G. (GOODMAYES).—"My domestic receiver consists of an anode rectifier followed by two stages of resistance coupling, the value of the first anode resistance being 200,000 ohms. Magnetic reaction is used, and a ·001 by-pass condenser is connected across the 200,000-ohm resistance in order to permit satisfactory reaction control.

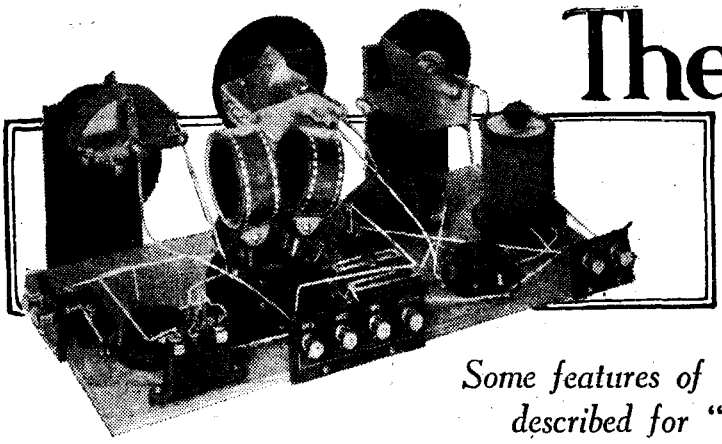
"I am told that this condenser is too large, and that it tends to cut off the higher musical frequencies. Is this correct?"

Yes, the use of a value as high as ·001 is not to be recommended.

In your case ·0001 should be quite adequate for by-pass purposes. In general, the lowest practical value should be employed. Actually any shunt capacity across the anode resistance is detrimental to quality, but for reaction purposes a small condenser must, of course, be used.

Hence, from the point of view of reproduction, the value should be the smallest that will serve the purpose.

In some cases, however, condensers are deliberately used to alter the tone.

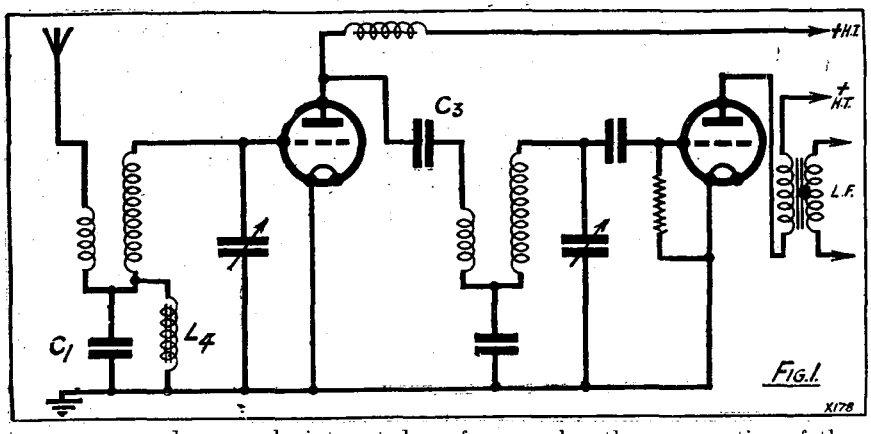


The LOFTIN - WHITE SYSTEM

Some features of the Constant Coupling System specially described for "Modern Wireless" by the Inventor

EDWARD H. LOFTIN.

I HAVE been asked so many times for an explanation as to why the Loftin-White circuit is so selective as a stable circuit compared with other stabilised circuits, that it occurs to me your readers may be interested in the views I have expressed in informal discussions with engineers on this point, but which I have not before this time published.



The simple diagram of our circuit contained in Fig. 1 will probably aid in a discussion. It shows one stage of R.F. amplification, with all the elements necessary to stability of any degree desired, followed by a detector, combined electromagnetic-electrostatic coupling to obtain our so-called "constant coupling" being included between the antenna and R.F. input, and between the R.F. amplifier and detector. The low-capacity choke L_4 permits biasing the grid of the R.F. amplifier around coupling condenser C_1 without affecting its coupling.

No "Lossers" Employed

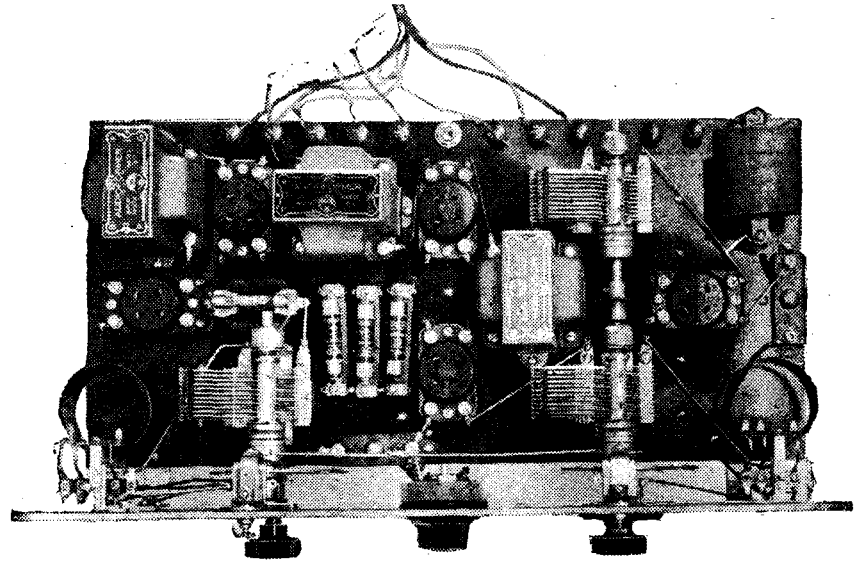
An inspection of this diagram emphasises the immediately obvious fact that it is devoid of any resistors or other "lossers" intended for consuming sufficient energy of amplification to prevent oscillation. In fact, the entire burden of this task is taken by the practically non-energy-consuming phasing condenser C_3, which, of course, has the co-operation of the combined electromagnetic-electrostatic coupling to keep substantially constant with frequency.

Such absence of energy-consuming devices permits maintaining the damping effects on the variable selective circuits at minimum.

The value to selectivity of avoiding additional damping effects over those absolutely necessary for connecting up a vacuum-tube system was forcibly impressed upon me some time ago by some investigations we made of the effect of the internal input impedance of vacuum tubes alone on the selectivity of circuits connected to the grid-filament electrodes. We found that at broadcast frequencies so connecting the average commercial tube to good low-loss circuits reduced the natural selectivity of the circuits in much the same degree as it was reduced by inserting from 50 to 60 ohms resistance directly in the circuits, so that additional elements which result in damping are most undesirable.

For Local Reception

So far there is given no good reason for the Loftin-White selectivity being superior to the selectivity of so-called balanced or neutralised systems; that



A commercial Loftin-White four-valve receiver, as used in the United States.

it is has been demonstrated as a matter of commercial expediency. Several years ago, and before broadcast conditions in New York became jammed as they are now, some of the manufacturers of the then rising neutrodyne type of receiver endeavoured to design a simple neutrodyne receiver having but a single stage of R.F. amplification, to satisfy

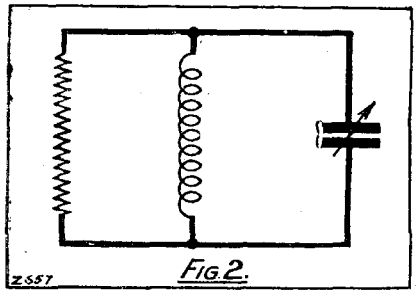


FIG. 2.

a demand for a simple and inexpensive set by those willing to obtain their broadcast entertainment from local stations only.

The resulting designs were so non-selective, even for the conditions then existing, that the single-stage stable R.F. receiver did not remain long on the market. A manufacturer, so satisfied that the Loftin-White circuit meets even the most trying requirements of present-day New York conditions, now has a single-stage R.F. amplifier set ready for the market.

Superior Selectivity

One of the reasons for the superior selectivity is that in the Loftin-White circuit, as will be seen from Fig. 1, there is no coupling between the grid and plate circuits other than the extremely loose coupling introduced by the small internal capacity of the tube, so that the internal and external impedances of the output circuit can have but small effect in the matter of damping the selective portion of the input circuit.

With the so-called neutralised circuit the neutralising condenser con-

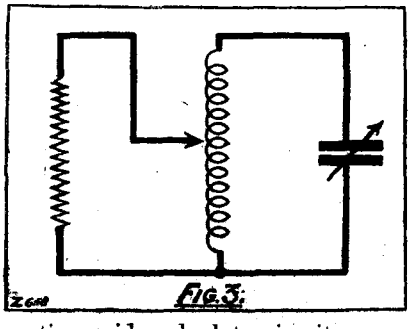


FIG. 3.

necting grid and plate circuits combines with the tube capacity to establish a substantial coupling between the two circuits, and results in the output circuit impedances having through such coupling a substantial influence on the damping of the selective portion of the input circuit, and additive to the effect of the internal input impedance already discussed.

For Long or Short Waves

Another reason is the substantial reduction of the damping effect of the internal impedance of the output circuit on the second selective circuit which is brought about by phasing condenser C_3. This output internal impedance is very low compared with the input internal impedance, and so low for average tubes that if it were connected directly across the selective circuit, as shown in Fig. 2, the selectivity of this circuit would be almost completely nullified. The difficulty is somewhat alleviated in practice by coupling the selective circuit to the output circuit, resulting in an arrangement equivalent to Fig. 3, the effect on the internal output impedance becoming less and less as the coupling is loosened. But in practice the coupling must be kept quite tight for efficient amplification, 40 per cent to 50 per cent not being unusual.

In our circuit, however, the phasing condenser C_3 results in an arrangement equivalent to Fig. 4, and since the reactance of C_3 for stabilising is quite substantial the internal impedance is further isolated from the selective circuit. That is, we may use as tight a coupling as in the neutralised system, which is equivalent to Fig. 3 in the matter of internal impedance effect on the selective circuit, and not suffer as much damping effect because of our equivalency to Fig. 4.

Our "constant coupling," of course, keeps these effects substantially constant throughout the broadcast band, so that a receiver is equally as selective on the short waves as on the long, as compared with the usual plain inductively coupled neutralised receiver, which is broad throughout, but decidedly broader on the short waves than on the long.

The Critical Setting

There is a third reason for our greater selectivity over the neutralised circuit, somewhat more technical than the preceding analysed two, but which is readily followed. Referring to Fig. 1, if the first selective circuit is set at the frequency of the desired signal then there is a setting of the second circuit at which this desired signal, will be loudest, which second circuit setting, however, is not one of resonance, but at that point off resonance where the reaction of the second circuit back on to the plate circuit for the desired frequency currents produces that critical plate-

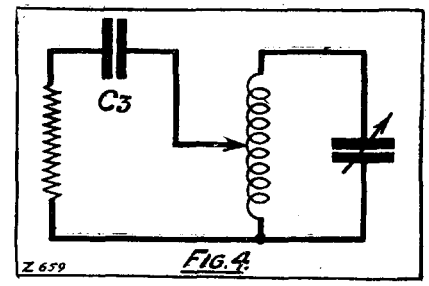


FIG. 4.

circuit reaction through the tube capacity which succeeds in getting back to the grid that combination of current energy phase and strength that gives the maximum reinforcement to the original grid energy of the desired frequency currents.

Non-Reactive Reaction

There is now no dispute that this setting is on the inductive side of resonance, though not removed far therefrom, because an inductive reaction produces the required phasing condition, while the enlargement of the reaction as resonance is approached produces strength of reaction. At resonance, while the reaction is at maximum, it is non-reactive, and though sending large energy back to the grid it arrives in neutral phase and has no regenerative amplification effect. At a point equally removed from resonance on the capacitive side as is the point of loudest signal on the inductive side, the reaction is of equivalent strength,

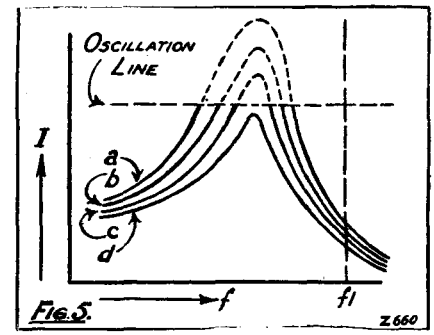


FIG. 5.

but being of opposed phase causes energy to reach the grid through the tube capacity that operates against the original energy, and results in de-amplification.

The phasing condenser C_3, reacting capacitively as it does to all current frequencies, makes the effects of reactions of the selective circuit before passing through the tube capacity less inductive (or even capacitive) when inductive, and more capacitive when capacitive, and all in accordance

with selection of the capacity value of C_3 with respect to the selective circuit and its degree of coupling. These effects are approximately illustrated in Fig. 5, curves *a*, *b*, *c*, and *d* representing effects obtained for different values of phasing condenser C_3 for a coupling so tight that with large capacity values of C_3 the system will oscillate, as indicated by curves *a*, *b*, and *c*, and by reducing the capacity of C_3 oscillations can be prevented and stability produced to any degree desired, as indicated by curve *d*.

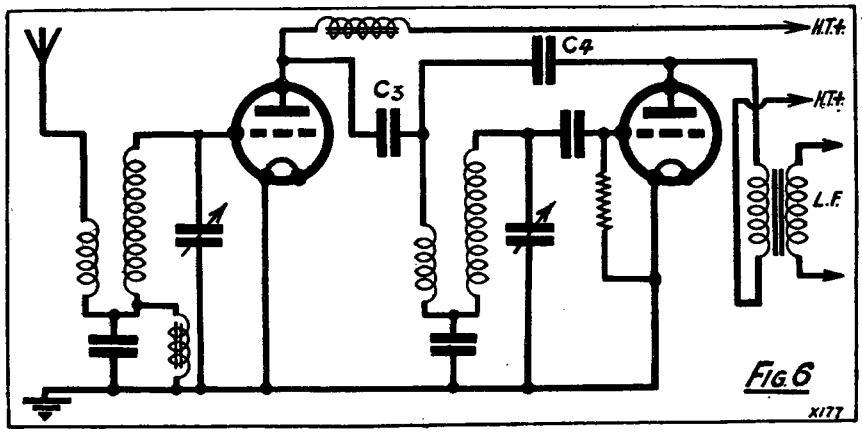


FIG. 6

Lag and Lead

It is therefore obvious that there is that setting of the second circuit just off resonance at which the amplification of the desired signal is at maximum, and that interfering, undesired signals of frequencies on each side of this arbitrary frequency setting of the second circuit are discriminated against in the matter of amplification by reason of the kinds of reactions set up for them by the adjusted second circuit; and that this is even true for that particular undesired frequency, to which the circuit is set to produce the effect for the desired frequency. In other words, this is selectivity by discriminative amplification so proportionately large with respect to any possible resonant effects in this part of the system that such effects are swamped, and of no consequence, for if resonance were of any consequence there would appear a recognisable double hump in the operation of adjustment, one occurring at the adjustment for maximum amplification and one at resonant energy transfer.

I must admit that I was unadvisedly guilty, before analysing this phase of our system, of believing that we obtained a resonant transfer of energy at that adjustment resulting in "non-reactive plate circuit," or non regenerative amplification. While resonant transfer is more nearly approached as the degree of regenerative amplification is reduced, yet it can never be reached even at the non-regenerative state, because at resonance the phasing condenser changes the overall plate-circuit reaction from the resistive reaction due to the resonant circuit alone to a somewhat capacitive nature because of combination with the capacitive reaction of the phasing condenser. It is therefore obvious that maximum amplification occurs when the circuit is sufficiently detuned to create enough inductive reaction to overcome the effect of the capacitive reaction of the phasing condenser.

The Energy Transfer

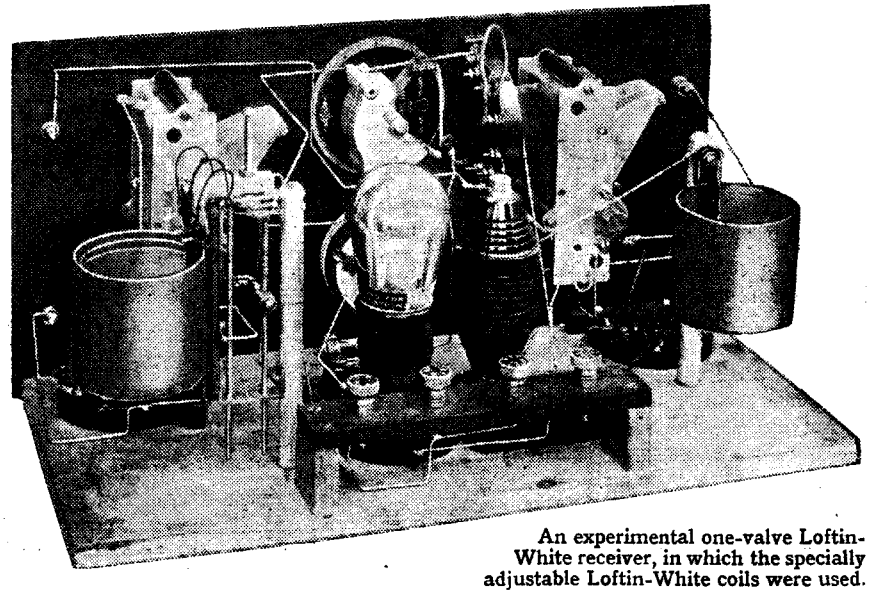
In the neutralised system, however, when fully neutralised, any reaction in the plate circuit tending to act through the tube capacity to change the amplifying ability of the tube is overcome by a reversed or opposed reaction through an auxiliary circuit. If the reaction of the plate circuit is inductive, tending to regenerate, the auxiliary circuit provides an equal opposition for this condition. If the reaction is capacitive, tending to de-amplify through tube capacity action, the auxiliary circuit opposes this action. If the circuit is resonant, and sends a neutral feed back through the tube capacity, it makes no difference in the amplifying ability of the tube whether the auxiliary circuit acts or not, but it does act merely to oppose the non-effective neutral feedback. In all cases, however, there is no selective amplification by reason of adjustment of the selective circuit, and maximum signal is obtained merely by reason of resonant transfer of energy, though there is some possibility of the external plate impedance more nearly matching the internal plate impedance at the high value of external impedance at resonance, thereby making a larger percentage of the energy available externally for transfer at the resonant adjustment; though, of course, this impedance effect could be upset by having a coupling so tight that at resonance the external impedance exceeds the internal impedance and matches at some point off resonance.

Selective Amplification

In any event, due to the damping effect of the internal impedance on the resonance character of the selective circuit, the selectivity obtained by mere resonant transfer is not as high as that obtained by selective change of amplifying ability of the tube accompanied by non-resonant transfer.

For those interested in securing a higher order of efficiency — more

(*Continued on page* 431.)



An experimental one-valve Loftin-White receiver, in which the specially adjustable Loftin-White coils were used.

RADIO ABROAD

A Wonderful "Tube"

SOME wonderful experiments are in progress in the famous laboratory of the American General Electric Company, at Schenectady, in connection with the artificial production of electron streams in the air.

The device which is used is the special type of X-ray tube which was introduced a few years ago by Dr. W. D. Coolidge. This is an X-ray tube which, in principle, is exactly analagous to a two-electrode wireless rectifying valve. It has a heated metal filament for the cathode and a "target" for the anode, the electrons liberated from the heated filament being driven with very high velocity against the target by the application of an electric field of as much as 100,000 volts.

The latest development of this X-ray tube is one in which the target takes the form of a very thin nickel wall which shuts out the outside atmosphere from the vacuum within the tube. This wall is so thin that the high-speed electrons (or some of them) are driven clean through it and so escape into the atmosphere. The tube is thus a source of free high-speed electrons in the air.

Producing New Substances

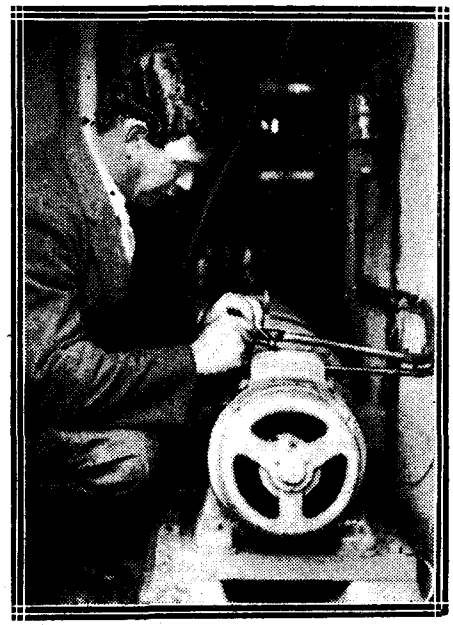
It may then be used for the electronic bombardment of all kinds of different substances, and some very curious results have been obtained. Acetylene gas is changed into a mysterious yellow powder, which it has been impossible so far to dissolve or analyse: castor oil becomes solid under the influence of the electron bombardment: transparent rock-crystal salt is converted into a black substance: fruit flies are killed in a fraction of a second, and living cells have their characteristics profoundly changed.

It is thought that in the hands of the medical profession this new instrument may cure diseases which have hitherto been untractable, whilst again in the realm of chemistry it may be possible to produce all manner of compounds synthetically.

Radio Underground

In a report to the American Mining Congress a radio "cameraphone" was recently described which detected the presence of solid rock, liquids, gases, and minerals in the earth. A giant meteor, which buried itself years ago in Arizona but had never been located, notwithstanding numerous drillings and borings, was discovered by the aid of this new device, buried to a depth of about 1,400 feet. At another point several new veins of a mine were located, and three ancient mining tunnels which were abandoned and sealed up years ago.

This device is in some respects an improvement or elaboration of a rudimentary contrivance which was used in France after the war for locating buried shells.



Mr. Gerald Marcuse, the owner of 2NM, the famous first British Empire broadcasting station, is here shown connecting up one of the new generators he has recently installed.

Short Waves

The remarkable results achieved by the new short-wave beam transmitter between Montreal and London has caused Senatore Marconi to predict that "some day electric waves may be used for the transmission of power over moderate distances, if we succeed in perfecting devices for projecting the waves in parallel beams in such a manner as to minimise dispersion and diffusion of energy into space."

Aeroplane Control

There are many instances in which the transmission of power by wireless waves might be extremely useful without necessarily being very efficient. For example, if we could transmit electric power to aircraft, even with a loss of as much as 75 per cent, the commercial value of aircraft would be enormously enhanced, relieved of carrying fuel supply as a part of the load.

Beam Success

Marconi's short-wave beam system between Montreal and London has a capacity of 200 words per minute, which rivals the capacity of the best submarine cables. Owing to the fact that the energy is localised in a beam the system is, by comparison with other radio systems, very economical of power.

Irish Free State Patents

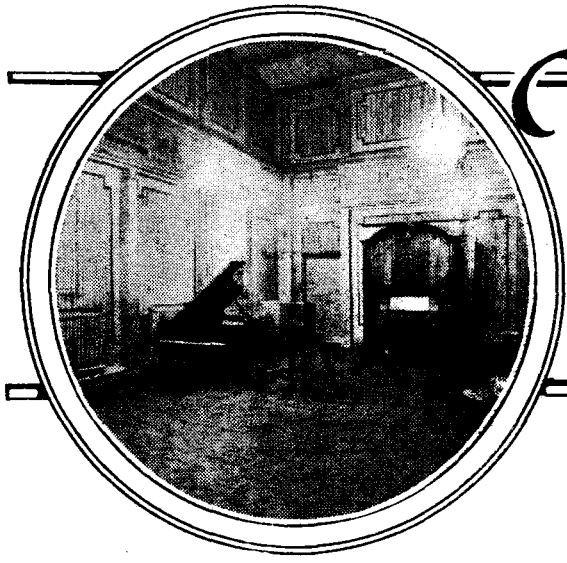
Some new regulations with regard to British Patents and Trade Mark Regulations will come into force with the passing of the Patents and Trade Marks Act in the Irish Free State. All holders of British patents, etc., desiring to retain protection in Southern Ireland will need to take out fresh patents or trade marks there.

There are several other matters of importance to patentees or holders of trade marks, and Messrs. Rayner & Company, 5, Chancery Lane, W.C.2, who have communicated with us in regard to this matter, will be pleased to supply (free of charge) information on this subject to any readers who desire the same.

New French Radio Rule

A recent decree of the French Government requires that all commercial aeroplanes, carrying ten passengers or more, and travelling more than 160 kilometres, and those flying over the sea for more than 12 kilometres from the coast, shall be equipped with wireless apparatus.

When the London-Paris aeroplane, carrying ten passengers, fell into the sea in October last year, it is stated that, but for the good fortune that a fishing smack drew alongside almost immediately, the fate of the passengers, all of whom were rescued, might have been very different. This is pointed out as a proof of the wisdom of the recent French decree.



Windmills

by

A. Corbett-Smith

A trenchant article by a well-known critic, in which the B.B.C. is taken to task both for its omissions and commissions.

OLD DON QUIXOTE, you will remember, rode out upon a day and espied across the plain a score of windmills waving their arms aloft.

"Ha!" quoth he in his madness. "Here is a company of giants, and it becomes me as a knight-errant to rid the earth of such monsters."

So, with lance in rest, he rode full tilt against the nearest, and the sail, whirling aloft, tore the lance from his hand and crashed the old don broken and bleeding to the earth.

And any man who could couch a lance against the windmills and gasbags of a government department is almost certainly doomed to a like fate. The odds are impossible.

Windmills of the B.B.C.

Yet there is no reason why, like Sancho Panza, we may not survey the windmills of H.M. Government's radio service from a discreet distance. And the passing of six months since its nationalisation, together with the provision of the new alternative programmes, suggests the opening.

The only drawback lies in this—there is absolutely nothing new to say. Nothing which, in common with any intelligent observer, I have not already said a thousand times.

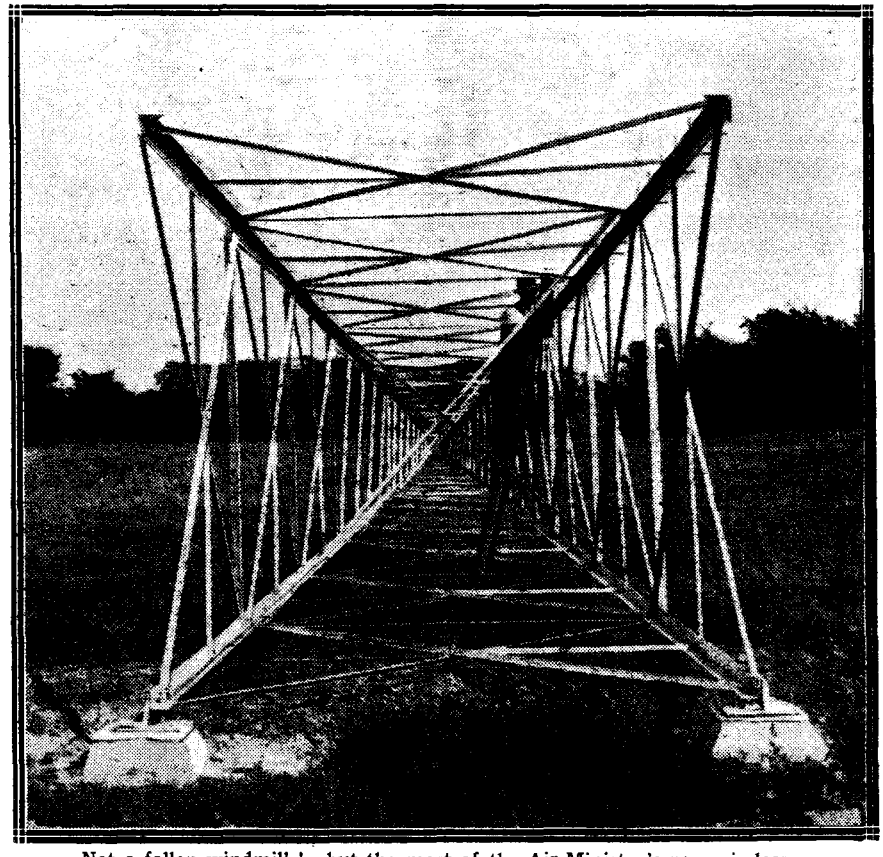
Thus, in brief summary. All the world over the British radio service, as directed by the B.B.C., stands supremely alone. In engineering initiative, resource, and efficiency, in the content and performance of its programmes, and in the general and involved administration, there is not a radio service upon the planet which can even begin to approach it. It is, indeed, a very simple case of the B.B.C. *solus* and the rest nowhere.

This, as one who has ever been the B.B.C.'s sternest critic, I have never failed to remark.

But I have never failed to insist, also, that with its incomparable opportunity of vital national service the B.B.C. must be accounted a failure. In considerably less degree it shares that failure with the only other universal medium of national æsthetic expression, the British cinematograph industry.

Until the B.B.C. dissolved into a government department there was some hope for it. But the moment, in November last, that Parliament turned their thumbs down and decreed State enterprise, and under so grotesque an administration, the doom of the service was sealed. And every sane man and woman in the country who gave the matter a thought saw that it must be so.

The six or seven months' working has merely repeated the experience of



Not a fallen windmill!—but the mast of the Air Ministry's new wireless station at Mitcham.

every nation that has tried to run an artistic enterprise as a government department. (France, for example, with its subsidised theatres.) Initiative, imagination, and enterprise are inevitably killed stone dead. The B.B.C. is no exception. I do not suppose that there exists a single government department in any country in the world where such qualities are allowed to exist. That they should be fostered and encouraged for the public good is inconceivable.

The recent saving of the Promenade Concerts by the B.B.C. has, very properly, been well advertised. Most certainly we are all very grateful. But the saving has nothing whatever to do with any of the three qualities just mentioned. It was a piece of simple business-routine work. The B.B.C. alone was in the position to do a perfectly obvious and needed act. They did it. Had they not done it there would, I fancy, have been trouble. But one might just as well commend a father for taking his son out to dinner when there was nothing in the larder at home.

We glance at the much-boomed new " alternative " service. Well, what of it ? Again, it is but one more feather to the cap of the B.B.C. engineers—a cap which is already ablaze with feathers. But what of the programmes for which, after all, the new service has been evolved ? They are no more than a double dose of those already provided. Instead of being given tea for breakfast one morning and coffee the next, we may have tea or coffee any morning we like. And if a triplicate service were provided we should be offered cocoa as well.

Complete Silence

Nothing, I think, has been more significant than the comments in the public Press upon the new programmes. There have been no comments whatever. Everyone has had something to say about the technical side. But, on the æsthetic side, for which alone the service exists, there has been complete and devastating silence. Indeed, what is there to say ?

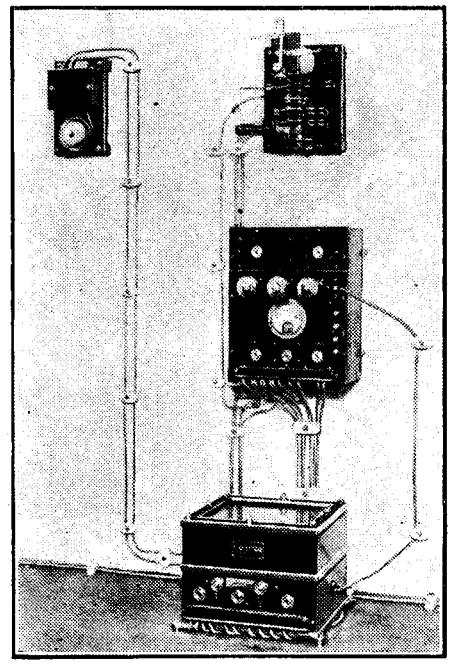
The B.B.C. publishes another of their weighty *pronunciamentos*, crammed full, as plums in a pudding, of the same old promises which they have been making any time these four years whenever the Chief Engineer has evolved some new and startling technical improvement. " I wonder that you will still be talking, Signor Benedick; nobody marks you ! " is one's obvious and weary comment.

There are a score of matters in which the B.B.C. has done excellent service. But these seem to be as pennyweights in the scale against what they could and should accomplish for the community as a whole.

"An Utter Failure"

For the B.B.C. is not serving the community as a whole, except upon some such national occasion as the consecration of the Menin Gate. And that again, you will observe, was but another fine technical triumph. It owed nothing to artistic enterprise.

Perhaps three-fourths of the programmes consist in the routine provision of music. With the gramophone the B.B.C. is undoubtedly effecting a revolution in public taste. We applaud the work. But, after all, music is but a trivial concern in the life of the average man and woman.



An automatic alarm device for ships which is continuously on the watch for distress signals. Designed by the Marconi Co., its aim is the further safeguarding of life and property at sea.

Public libraries report an increased interest in good literature through the B.B.C. lectures. Again we applaud. But again, serious reading can fill but a fraction of a man's workaday week. Radio lectures to schools. Admirable, so far as they go. But the results won are most certainly not equal to the extravagant claims which the B.B.C. asserts.

The sole object of the B.B.C.'s existence is the provision of first-class entertainment of universal " popular " appeal. *Compelling* entertainment. Art, Education, and Entertainment are three inseparables. You cannot possibly have one of any value without the other two. The closer that trinity in unity is brought to humanity, to the prime factors which move all men and women of every race in their everyday lives, the more universal the appeal.

In this, the only thing that really matters, the B.B.C. stands naked as an utter failure. It is completely unhuman, just as every government department is unhuman. And its failure is the more glaring because it is an artistic venture in which the most sensitive and imaginative brains in the country should be at work day and night. It does not matter at the War Office or Board of Trade. And since imagination is the last thing tolerated in a government department the vicious circle is complete.

A Futile Hope

The B.B.C. to-day touches only certain limited sections of the community. Yet its appeal should be of such vivid content and humanity as to reach every household in the Kingdom and, gradually, in the Commonwealth. It has no appeal to offer. When the " alternative " system was given, I wonder how many hundreds or even thousands of the potential millions gave a thought to the entertainments rather than to the new toy which they had to play with.

Here, for good or ill, is the most powerful State department in existence. Beside it armies and navies are flea-bites. And the State, which is the people, leaves it to rust and decay upon the scrap heap. " Lavish with the inveterate unthrift of the English, who are never happy unless they are throwing things away." . And Mr. Rudyard Kipling never spoke a truer word of us.

I spoke last week with the art editor of two great picture papers which are world famous.

" Do you mean to tell me," I urged, " that you or I could not with the greatest ease create a series of big ' popular ' radio entertainments which would swiftly establish our Imperial aviation and make us secure ? "

" Of course," he agreed immediately. " And the problem of Canada, and the coal dispute, and a dozen more."

For my part, knowing the futility of tilting at windmills, I am now resigned. I recognise the hopelessness of looking now for any revolution in our radio programmes.

A Temporary "Post"

OWING to the heat and a certain staleness that one feels just before the summer vacation, I regret to say that not long ago I turned up at the office in a revolutionary frame of mind, and demanded a change. "Why," I asked, "must I always do 'In Passing'? Why can't I do a ten-valve set or answer some letters? I am always *en passant*. I want to sit still and observe

"The letters were all they had been alleged—"

life." Whereupon I broke the typist's teapot and threw the valve expert's slide-rule at a passing director.

The Editor was the only one not afraid to go near me. I'll say that for him, if I never have another cheque. He came round the door an inch at a time, holding out towards me a bundle of papers, much in the same way as a man tempts a mad dog with a poisoned steak.

I Examine the Letters

"What," I snapped, "is this?"

"Letters, my boy," he replied. "The cream of the collection. No fakes or duplicates. We keep them to look at during total eclipses or when the whole office is hung up because the comps. can't decipher your manuscript. Have a good time—and answer any of them you like. The teapot will cost you 3s. 6d. Unluckily you missed your aim with the slide-rule; otherwise we'd see the back of you."

The letters were all they had been alleged; money couldn't buy the whole collection. I spent a very happy morning and came to the conclusion that, however much truth may excel fiction in strangeness, fiction scores for real humour. By your leave, let us look at some of the letters together.

"Readers' Results"

They fall, I find, into a number of well-defined classes, of which we will study first:

The Earnest Strivers. No. 1.—"Dear Sir,—Seeing in your paper about someone who made a wireless a wireless, I said to myself you had better do the same. So, I got on fairly well till it came to those coils, they will keep coming undone. If I fix the end, then the middle bolges forth makes me mad. But I thought I had better let you know."

It is obvious that No. 1 is paying his footing like a man. Pity he hasn't thought of having the ends at the middle; every "bolge" would tighten her up.

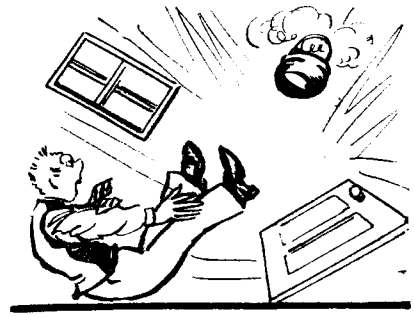
No. 2.—"Dear Sir,—The diagram of the Buzzadyne Three in your January number shows four valves. Can this be an error? Also I and my friend think the connections must be wrong, as we made the set and all it does is to go 'Wee-oo,' also that Morse rubbish all the time, how those ship operators think we can hear I don't know. The B.B.C. don't seem to have much power. What is four valves doing? And can you say whether a battery made from potatoes, pins, and needles would work a set?"

No. 2 is a literal mind. "Three is three, dash it"! That's his motto. Of course, not having been a reader for very long, he could not suspect the devastating and Teutonic thoroughness of our technical birds, who showed—in passing—how another stage of L.F. could be added without producing "Wee-oo." And as between a pin and a needle stuck in a potato (Shades of Ambo!) there is said to be a difference of potential, the answer to No. 2 is, "Sure, if you have the right voltage and capacity. But get your potatoes wholesale."

No. 3.—"Dear Sir,—No doubt your readers will like to hear how I made my crystal set on which I get 2 L O and Croydon, also the electric trains, which are a bother but anyhow show the crystal is O.K. Well, first of all I got a iron pot and in the pot I put some lead and then some sulphur. In the pot. Well, then I put the pot out in the shed and under the pot I put a bouncing burner. (*Can this be "Bunsen burner"?*) to heat the mixture in the pot. When the pot——" (*Here follows much more pot.*) "Next, I got a bottle, not an ordinary bottle, but a bottle all the same size everywhere, for winding on the wire. I put on two (2) hundred (100) tunes (*Turns would do, but No.* 3 *is musical*) and a slider and connected the slider under the rod over the terminal between the ends of the bottle, thence to the bottom of the terminal under the crystal behind the catswhisker" (*Ad infinitum*).

"A Terrifying Man"

I see! You want a pot and a bouncing burner and a bottle all the same everywhere, and then you go over and under and behind and next and between, till you see purple spots floating in the air, and hear two hundred tunes. My word! This science!



"My word! This science!"

Three typical cases! Quite unprintable ordinarily, yet the burning enthusiasm warms one's blood. What would the world do without such sturdy triers with their bolges, pots, and potatoes? We come now to:

The Scintillating Successes. No. 1.—"I built your nine-valver in one

evening, slightly improving the results by adding 0·01 megohm between A and B. (See enclosed diagram.) (*Diagram not enclosed. Left at home, with the date of his letter.*) I have built dozens of sets and can speak highly of this, though a resistance between A and B is an improvement. I get all broadcasting stations in Europe easy and many American. When are you going to publish a set embodying the P—— circuit ? "

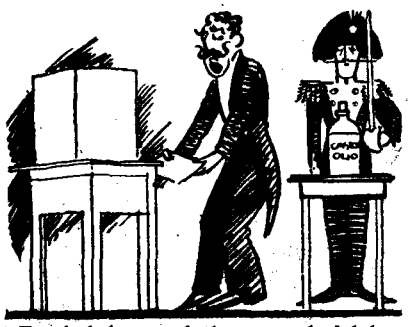
A Varied Assortment

A terrifying man. If MODERN WIRELESS creates this sort of chap, then grave old plodders like me and P. W. Harris and Capt. Round will be looking for jobs. I haven't the heart to write and tell him that his wonderful nine-valver embodies the P—— circuit. It would spoil the fine rapture. It is comforting to know that the 0·01 megohm is an improvement. We cut it out after three months' test. *Quantitative* tests. So No. 1 must have the amplifying ear.

No. 2.—" Just to let you know I made up the ' Megadyne Six.' It is quite good, so far as it goes. I get Eiffel Tower and some station I think is German, though it may be Dutch or even Swissie. (*No.* 2, *I thank thee for " Swissie."*) I will write again and tell you if I get America, though I can't stay up late, being a bad sleeper."

Frankly, I had hoped the " Meg 6 " would have done better, though I begged hard for choke coupling. However, " Swissie," almost compensates for the blow.

No. 3.—" Seeing in your paper a construgtional account of the manner-facture of a four valve set I thought



" Reminded me of those wonderful lectures by Rev. J. Pilkington."

I would try my hand, being an old hand and handy at that, being used to tools, specially turret work. Well I must say your paper is a winner, it goes fine though I felt the positive and miners muddled me a lot but it all comes right when you try first one way and then backwards. (*My note: When in doubt, try the miners backwards —like Mr. Baldwin.*) All the English stations and Rugby are powerful, except Rome, which is scarcely oddable owing to weakness."

No. 3, our handy old hand, has the right stuff in him and knows a good magazine when he sees it. (ADVT.) He is right about Rome, too. Weakness is fatal to good audibility, and Mussolini ought to be told about it.

We now come to a most interesting class, the Flagrantly Impolite, upon which, however, I will dwell lightly. Here is a good specimen. By the way, I saw to-day, on a hoarding—Heavens ! .What in the name of English is a " hoarding " ?—that " Dead fleas do not bite." This letter is several years dead.

No. 1.—Sir,—I bought your magazine. (*My note: Yep! We sell it. Sorry!*) I consider it execrable taste on the part of some writer or writers unknown (*Hem! Legal touch!*) to refer to proceedings which are and/or were *sub judice*, especially when said proceedings were instituted in defence of civic rights not yet proven and legally constituted. I hereby declare that I refuse flatly to subscribe a penny to organised scoundrelism or robbery in shape of license, basing self on Magna Carta and rights of citizen. As for your paper I think it is a pity printers waste ink on it."

And this fellow might be any one of those we bump against in the 'bus. With a wife and a brace of little citizens, too. But in justice to our printers I must say that they don't waste ink. They are most frightfully careful, and the Editor has sometimes to be very sharp with them about our half-tones.

But now for an excursion into the Utterly Irrelevant.

From Irrelevance to Business

No. 1.—" Reading your paper that my son gets for his wireless reminded me of those wonderful lectures by the Rev. J. Pilkington at the Presbyterian Synod in 1876, illustrated by dissolving views on the Marvels of Nature or Eternity laid Bare. You may imagine how I was impressed, as my grandfather was the discoverer of *Bungo Genuflexii*, a blue moth with green antennae and married a third cousin of Professor Huxley's gardener. I expect you will smile but I would remind you of those wonderful words spoken by Dr. Ezra Skillrig in 1890 at the Little Bethel of Palmer's Green, when he said, ' No ! all is not yet, nor shall be.' I often think of that and every day I see it to be truer than ever. Specially when I see Makoni's marvels do I say, ' Out of the depths, thenceforward, and not a little.' "

Righto, daddy ! You've got the idea, sure enough.

We have plenty of business—strictly business—letters. Not much business results, and you shall judge the why and the wherefore.

"—If I ever stop larfing my name's not Elizabeth."

No. 1.—" Dear Mister Editor, Being citizen of British Protectorate ———, I beg to enquire whether you care to foster trade within confines Empire sending at once, cared of Mr. O. Zukee, this port, sale or returned, one doozen garantied radio instruments of reception 2 L O, best condition F.O.B., C.I.F. Against my security, see annex, duly authented by H.M. Consol. Me sending money as and when."

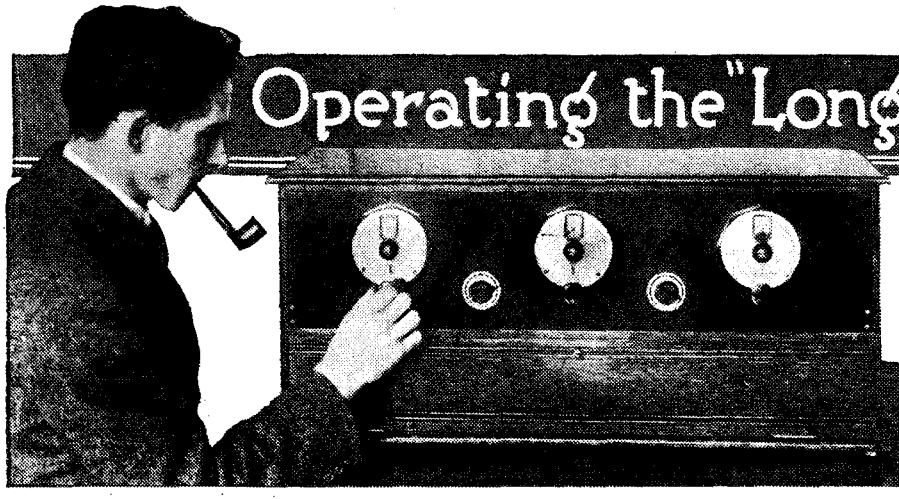
A fair offer, except the " as and when " terms. I trust the trade papers will snap up this cinch. The annex was not annexed.

The Homely Touch

I will conclude with a real soft article, of the sort that makes one think of the old homestead.

" Dear Mr. Editor,—Really, I was surprised when my husband read about what you said about that lovely Miss ———'s singing. So pretty as it was, how could you you were jokking, I suppose. And that funny Mr. ———. Well, I expect your wireless was off that night because we got it fine and I roared when he said how he found the chicken had laid in his vest pocket. The silly man ! I think he is just grand. So don't you be spiteful any more. As I said to Will, he's my eldest, if I ever stop larfing my names not Elizabeth. So no more from E. Pinchin."

But I say ! Would you believe the Editor has such a jolly interesting postbag ? It'll be *years*, I expect, before he lets me dip into his collection again. Next month he will make me be *en passant* again. Editors are tyrants. Gentlemen, I thank you. Oh, and the lady, too.



Operating the "Long Range" Five

Further details concerning the five-valver described in the last issue of "Modern Wireless." The designer of the set here discusses the question of valves and gives valuable hints on the operation of the receiver.

By W. JAMES.

IN the last number I described the construction of the receiver, and concluded with a few remarks on the wiring. The wiring is, of course, a most important matter. Good parts are often no better than poor ones if the wiring is badly done, and in this connection the probable performance of a receiver can be gauged from its appearance. If it is skilfully designed the wires will naturally fall in their proper positions—there will be no long wires with bends and twists to touch other wires and pieces of apparatus. But still, the wiring should be done carefully in spite of its being easy.

Do not forget the wire connected to the screen, and be sure to solder all joins. It is practically impossible to make a mistake in the wiring if the illustrations are followed, but a small point which should be attended to is the ·001-mfd. coupling condenser joining the detector and first L.F. valves. This is of the series-parallel type and should be connected as shown, it being noted that the inside terminal is nearer one end than the other.

Correct Valves Essential

When the set is finished, valves of the correct type must be fitted, and here again the writer would urge that "any old valve" will not do. The H.F. transformers were designed to work with valves of a definite A.C. resistance. The use of valves having a higher A.C. resistance (popularly known as anode impedance) will result in enhanced selectivity at the expense of signal strength, while to use valves of considerably less than the right A.C. resistance will usually materially impair signal strength and selectivity. It should not be understood from this that the transformers will not work with any type of valve, but they were developed for use with valves having certain characteristics in order that maximum amplification for a given selectivity be obtained.

Special Transformers

It is an interesting fact that prior to the time when the writer first published his work in connection with H.F. amplifiers very little attention was given to the question of valve impedance; in fact, it was usual to employ power valves in the H.F. stages. But the writer has shown that a higher amplification for a given selectivity is obtained when using valves having a higher amplification factor and A.C. resistance, and nowadays many writers specify 20,000-ohm valves, assuming that this will give the highest amplification. This is certainly not true in all instances, for the best valve impedance depends on factors too numerous to be mentioned here.

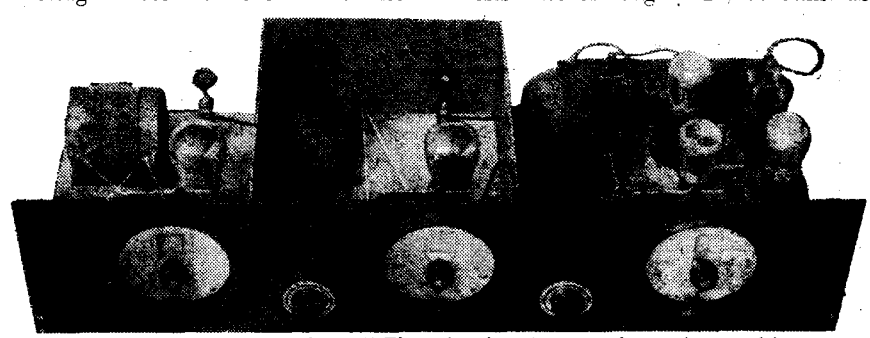
I can say this, however, that when a transformer is properly fitted to a valve as regards matching their impedances at a given frequency, the amplification obtained varies with the voltage factor of the valve used. Thus, if an H.F. transformer is designed for a 20,000-ohms valve, and we use a 2-volt valve having a voltage factor of 10, the amplification actually obtained might be 15, for example. If now we remove the 2-volt valve and use a 6-volt one, having an A.C. resistance of 20,000 ohms as before, but a voltage factor of 20, the actual amplification obtained will be 30.

This question of 2- and 6-volt valves is a most important one, and while it is relatively easy to design a set which gives a useful amount of amplification when 6-volt valves are employed, it is not so easy when the valves used are of the 2-volt type. The set we are discussing, however, functions perfectly with 2-volt valves, because it was borne in mind when designing the set that many users prefer valves of the 2-volt class. Naturally the amplification is increased when 6-volt valves are used, but it will nearly always be found necessary to turn down the signal strength when these valves are used, so great is the magnification.

Two-Volt Valves

We will deal first of all with suitable 2-volt valves, and mention satisfactory ones for the various stages.

The H.F. transformers were designed for valves having an A.C. resistance of roughly 20,000 ohms as the maximum amplification per stage was not required—rather was it necessary in the course of experiments leading up to the final receiver to cut down the amplification by means of the volume control, as most distant stations were received too strongly.



The interior of the "Long Range" Five, showing the screening and general layout.

Bearing this in mind, the best valves to use will be those having approximately this A.C. resistance and the highest voltage factor. Thus, the Cossor 210L.F. valve has a voltage factor of 9 for 22,000 ohms; the Osram D.E.2L.F. has a voltage factor of 7 for 22,000 ohms; while the P.M.1L.F. has a voltage factor of 9 for 18,000 ohms.

Each of these valves is suitable, but the ones with the highest voltage factor will give most amplification. For the detector, a valve of the R.C. type is recommended, and in the first L.F. stage a valve of similar type to those used in the H.F. stages.

In the output stage, use a power valve such as a Cossor Stentor 2 or P.M. 252. A voltage of 120 can be applied to all the valves at H.T. + 1, 2, and 3, but if the best quality is required, with really loud signals, it would be better to apply a little more to the H.T. + 3 terminal for the L.F. and power stages.

Grid-Bias Voltages

The grid bias will have to be set according to the H.T. voltage used, but more than — 1·5 volts for the first L.F. stage at — G.B.2 is not required. For the last stage —G.B.3, put on the highest grid bias the valve will stand without distorting and overloading. A bias of — 9 volts should be tried, or more if the anode voltage is about 120 volts. It is here that the limitation of a 2-volt power valve is felt, for it is difficult to obtain really strong signals without distortion.

With the valves, batteries, and loud speaker fitted connect the aerial and earth. If the receiver is used close to a main B.B.C. station a short aerial is advised, as the magnification provided by the set is very great; the aerial should be connected to terminal A_2. Now tune in the local station, cutting down the volume by means of the volume control, (the left-hand rheostat). The right-hand rheostat should be turned nearly full on and left, as it is merely a master rheostat. Next, remove one of the filament wires to the second valve by unsoldering it, or, alternatively, remove the valve, wrap a piece of thin paper over one of its filament legs, and replace it so that the valve does not light.

Neutralising

The balancing condenser NC_2 should then be turned until the local station is not heard in the loud speaker —or at all events is only heard very weakly. The balancing condenser should be turned very slowly and the circuits be kept in tune with the volume-control rheostat turned fully on until the minimum is found. This point is fairly well defined and can be found in a moment or two.

It is now necessary to restore the stage by removing the piece of paper or by putting back the filament wire. Repeat the process with the first stage in order to balance it. Sometimes it is necessary to balance only the second stage in the manner described, and then with the valves on to adjust the first balancing condenser until this stage does not oscillate. But it is better to do the work properly, for once the receiver is balanced the lid of the cabinet can be shut and the receiver will be perfectly stable for its whole range.

It takes longer to describe the process of balancing than the actual work itself, unfortunately, but that should not make readers think it is difficult.

Having balanced the set, turn the dials to a low reading and notice whether it oscillates. If it does, make a slight adjustment to the balancing condenser, then turn the dials to a high reading, and if the set tends to be unstable make a further adjustment to the balancing condensers.

If the set is carefully balanced in the first place there will be no need to alter the adjustment as just described, and once the correct position for the balancing condensers has been found they should be left alone, and there is absolutely no need to touch them again unless valves of a different type are put into the set. It was *not* intended to use them as a sort of reaction control—that is why they are placed inside the set.

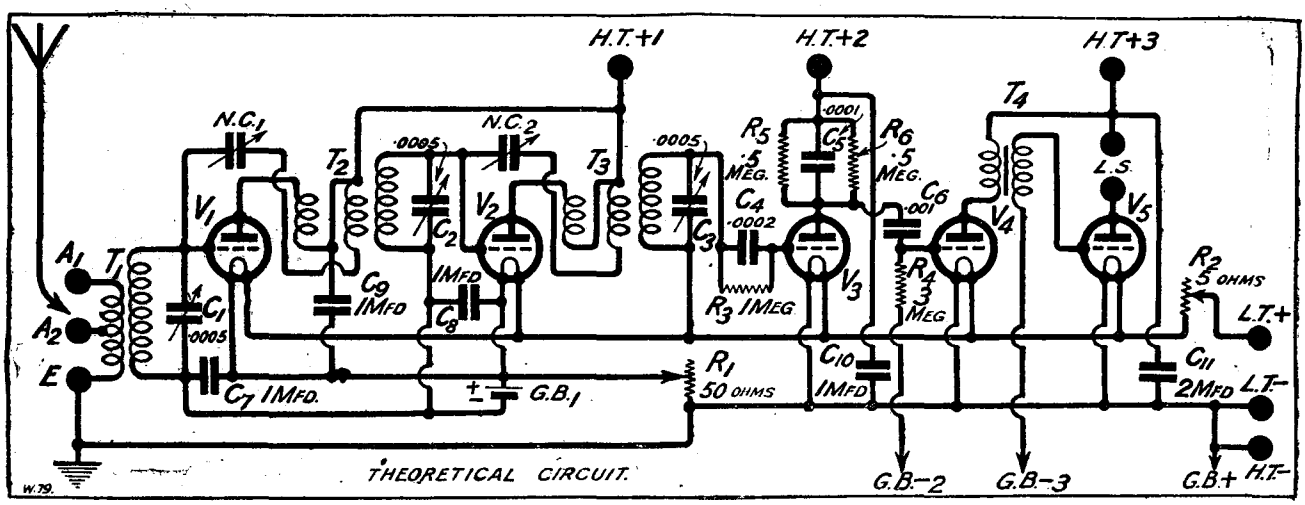
Tuning the Receiver

The set's selectivity and sensitivity depend upon the H.F. transformers and do not have to be increased by making continual adjustments of the balancing condensers.

When tuning, set the right-hand dial to, say, 50 deg. and then move the other two dials together. They should be turned very slowly, as they tune rather sharply when compared with the right-hand condenser, which was deliberately made broadly tuned for ease of handling.

If the circuits had been made more selective than they are distortion would be produced owing to the cut-off of the high frequencies.

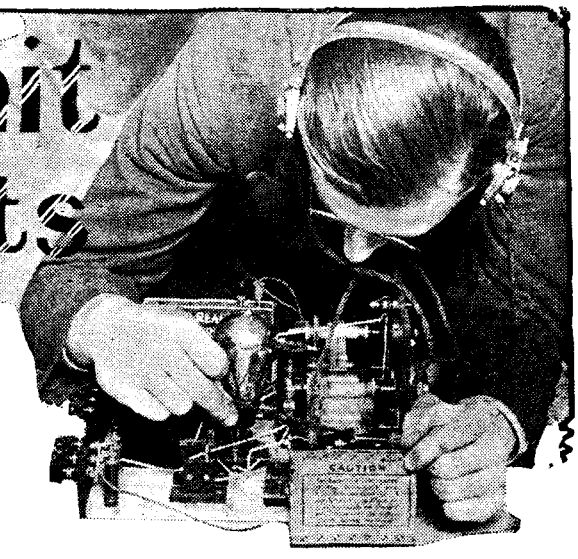
(*Continued on page* 426.)



Theoretical connections of the "Long-Range" Five. The following parts are used:—

T_1, T_2, T_3, Special High Frequency Transformers; T_1, Eureka Concert Grand L.F. Transformer; C_1, C_2, C_3, ·0005 mfd. S.L.F. Tuning Condensers; C_4, ·0002 mfd.; C_5, ·0001 mfd. fitted with two pairs of grid-leak clips; C_6, ·001 mfd., series-parallel type, fitted with grid-leak clips, NC_1 and NC_2, balancing condensers; C_7, C_8, C_9, C_{10}, 1 mfd. T. C. C. Condensers; C_{11}, 2 mfd. T. C. C. Condenser; R_1, 50 ohm variable resistance; R_3, 1 megohm grid leak; R_4, 3 megohms grid leak, R_5 and R_6, 0·5 megohm grid leak; GB_1, Single dry cell; GB_2 and GB_3, 18 volt grid battery.

A Testing Unit for Wireless Sets



Designed and described by W. SHERELIFF, B.Sc.

THIS article is a description of a testing set which the writer has found useful for locating faults in receiving sets. It embodies, in portable form, most of the apparatus usually employed in fault finding.

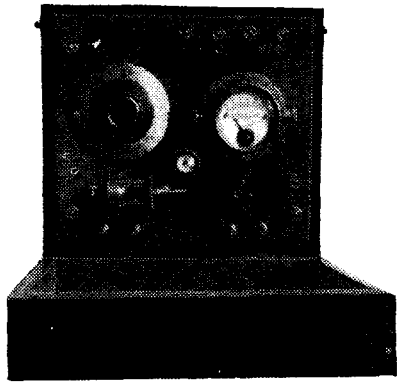


Fig. 1. A panel view of the testing unit, as seen when looking down from over the open lid of the case.

There are three sections in the set.

1. *A Complete Crystal Set,* as this is the quickest way to test the aerial-earth system. This is designed for the Daventry wave-length, but by plugging in a 50-turn coil in parallel with the Daventry coil the other B.B.C. waves are covered.

2. *A Five-Range Volt-Ammeter.* This is a milliammeter so mounted that by varying the connections to four terminals and using a simple plug-in switch five ranges are available: 0 to ·6 milliamps., 0 to ·6 amps., 0 to 3 amps., 0 to 6 volts, and 0 to 60 volts. This enables the experimenter to give a thorough test to L.T. and H.T. batteries and to examine the currents flowing in various parts of a circuit. It is, of course, quite as useful on the experimenter's bench as when overhauling someone else's set.

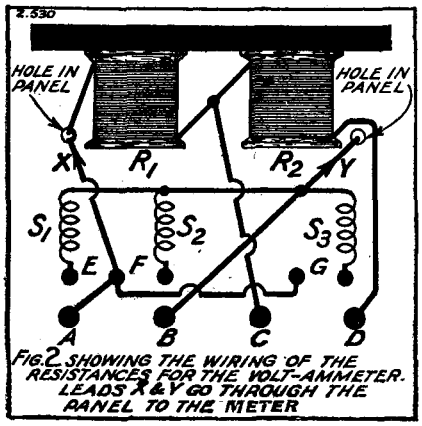
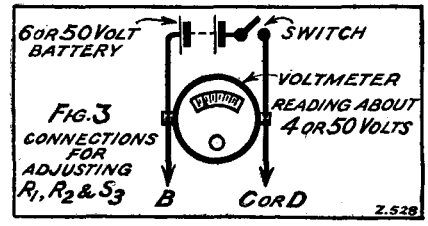


FIG. 2 SHOWING THE WIRING OF THE RESISTANCES FOR THE VOLT-AMMETER. LEADS X & Y GO THROUGH THE PANEL TO THE METER

3. *A Connection Tester,* which embodies a pair of flex test leads, flash-lamp bulb, flash-lamp battery, three-way switch, and a pair of headphones. It can be used to test (*a*) The condition of various sections of the H.T. battery; (*b*) Point-to-point connections in the set to locate faulty joints; (*c*) Transformer, 'phone, or loud-speaker windings for continuity, and (*d*) in conjunction with the milliammeter for calculating the approximate resistances.



The photographs, etc., show the general appearance of the unit, the arrangement of the panel, the compartment for 'phones, leads, etc., and the construction of the containing box.

The drawing Fig. 7 shows the various parts with terminals and plug-switch positions labelled. The same letters are used in the other diagrams.

The Various Tappings

The Crystal Set needs no description. The wiring is shown in Fig. 7 by dotted lines; the Daventry coil, condenser, and sockets for plugging-in the smaller coil in the photographs.

The Volt-Ammeter. The milliammeter selected has a full-scale reading of 6 milliamps. and its resistance is about 5 ohms. It is worth while to get a good instrument, as it then becomes an equally good ammeter and voltmeter.

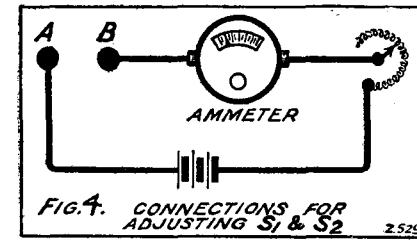
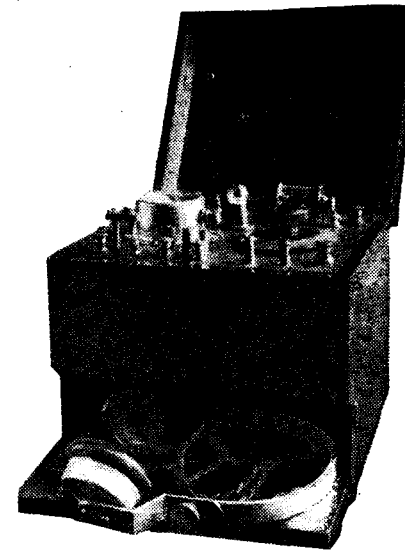


Fig. 2 shows the wiring diagram, and other photographs show the two resistance coils and three shunts. The latter are soldered to the stiff connecting wires, and the bobbins carrying the resistance coils are screwed to a wooden shelf attached to the panel. The connections for the five ranges are as follow:

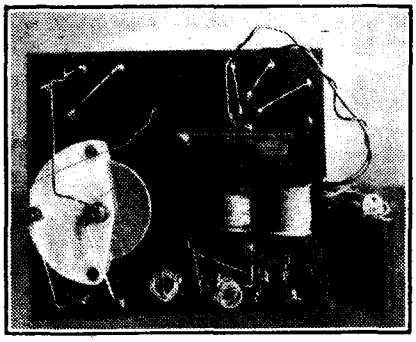


This general view of the complete instrument shows how a compartment can be arranged underneath the case to hold the telephones.

6 *Milliamps.* Use terminals A and B with the shorting plug out.

·6 *Amps.* Use terminals A and B with the plug in position E. Shunt S_1 is now in parallel with the instrument.

3 *Amps.* Use terminals A and B with the plug in position F. Shunt S_2 is now in circuit. Divide the readings by two as the full-scale deflection is adjusted to 3 amps.



The resistance coils and shunts which are referred to in the article will be easily recognised in the above photograph.

6 *Volts.* Use terminals B and C. The resistance R_1 is now in series with the milliammeter. R_1 is adjusted so that a full-scale deflection occurs when 6 volts are applied to B and C.

60 *Volts.* Use terminals B and D and place the plug in position G. Coils R_1 and R_2 are now in series and shunt S_3 in parallel with the milliammeter.

To adjust the values of R_1 and R_2, S_1, S_2 and S_3. R_1 has to be a coil of resistance wire long enough to make up with the resistance of the milliammeter 1,000 ohms. Eureka 36 S.W.G. is suitable, about 70 yards being required. To adjust, if the resistance of the instrument and wire are not known, connect B and C to a standard voltmeter and connect to a 4-volt accumulator. Note the reading on the standard voltmeter. If the milliammeter reads less than this, too much wire is in circuit, and vice-versa. It is better to start with too much wire (the approximate resistance of 36 S.W.G. Eureka is 14·84 ohms per yard).

If you care to wind R_2 up to 9,000 ohms shunt S_3 is not needed. In the instrument as shown R_2 is about

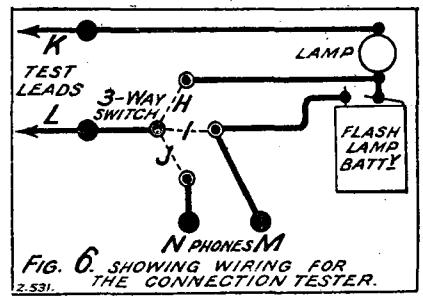


FIG. 6. SHOWING WIRING FOR THE CONNECTION TESTER.

200 ohms and the shunt S_3 is about 4 ohms, being a short piece of the same wire. To calibrate—connect up terminals B and D in parallel with a

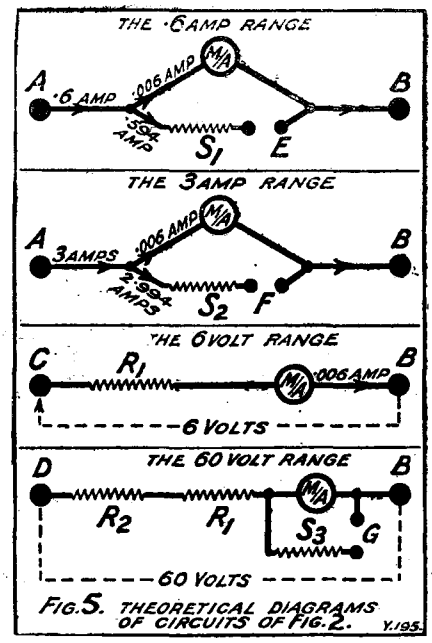


FIG. 5. THEORETICAL DIAGRAMS OF CIRCUITS OF FIG. 2.

suitable voltmeter, make sure that the plug is in position G, and connect to a 50-volt H.T. battery (Fig. 3). Adjust by altering the shunt. If the reading is smaller than that of the standard instrument the shunt has too much of the current and a longer shunt is required. Shorten the shunt if the reading is too big.

Calculating the Resistances

In case any reader who has means of measuring resistances wishes to dispense with this calibration, the formulæ for calculating R_1 and R_2 are: $R_1 = 1{,}000 - A$ (where A is the resistance of the meter), and

$$R_2 = \left\{ \frac{S_3\ (1{,}000 - A)}{A + S_3} \right. - R_1.$$

S_1 and S_2 are both short lengths of copper wire about 30 S.W.G. The lengths depend on the resistance of the milliammeter and connecting leads and there is little point in calculating their values. A borrowed ammeter is required as a standard. Connect this in series with terminals A and B, a filament rheostat, and accumulator (Fig. 4). Place the plug in position E and proceed to try various lengths of wire as S_1. For safety commence with about six inches. Adjust the current to ·5 amps. If the milliammeter reads less than the standard ammeter, a longer shunt is required. Do not forget to switch off before unsoldering one end of the shunt. When the right length is found try various values of current.

Then place the plug in position F and similarly adjust S_2. This will be considerably shorter and may be

(*Continued on page* 428)

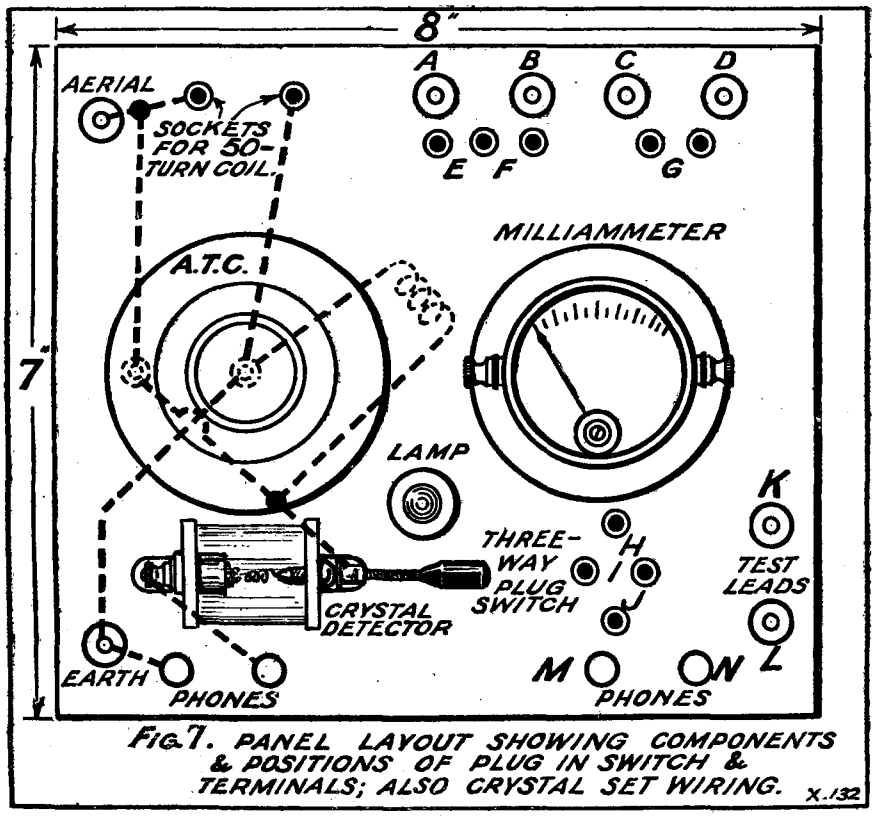
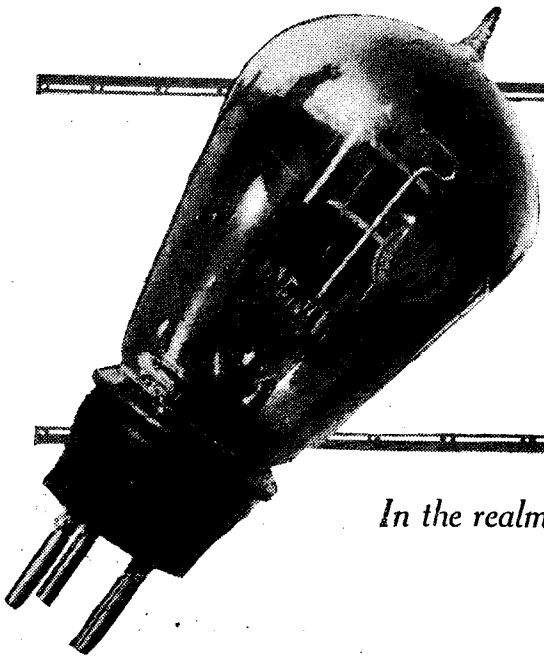


FIG. 7. PANEL LAYOUT SHOWING COMPONENTS & POSITIONS OF PLUG IN SWITCH & TERMINALS; ALSO CRYSTAL SET WIRING.



Progress in Valve Design

In the realm of receiving valves some very important advances have been made during the past year.

By KEITH D. ROGERS.

EVERY year the wireless show brings us new advances in some form or another, but I do not think we have ever had such a galaxy of really important improvements as are placed before us this year. Especially is this so in the matter of receiving valves. During the last twelve months we have seen the gradual growth of the super-power valve, and the birth and development of valves especially designed for resistance-capacity coupling having high magnification factors, and though in some cases I may have shown my dislike of the circuits for which they were to be used, they nevertheless show a definite step forward.

Better Reproduction

We have also seen the introduction and development of the independently heated cathode valve, as typified by the K.L.1, and followed, quite recently, by the K.H.1 for H.F. amplification and detection. Prices have fallen, mains units have come along, and loud speakers have been vastly improved, so that everything is made as easy as possible for the man in the street and doubly interesting for the experimenter and home constructor.

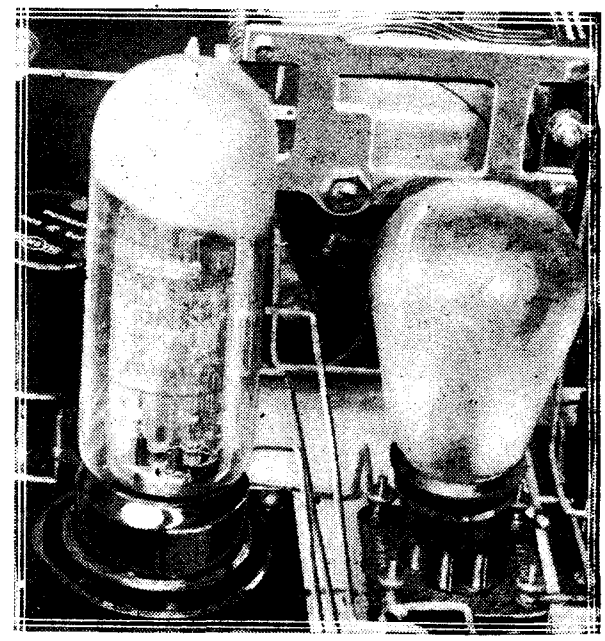
The swing of the pendulum has taken us from the "harmonics" and "overtones" that every one used to listen for in loud-speaker reproduction to the other end of the scale, and a little while ago we wanted to hear drums, more drums, until we were likely to turn up our noses at anything that did not give us bass and plenty of it—regardless of how much the high musical frequencies were suppressed. Now we are steadying up once more, and this "season" bids fair to bring to light some really natural loud-speaker outfits. It is being realised that the loud speaker is not a thing to be ashamed of, to be hidden away and forgotten as far as possible. Speakers are being built so that they make really artistic pieces of furniture, and moreover are designed to give *results* as well as to be pleasing to the eye.

New H.F. Valve

But first and foremost I think I must give the palm for concentrated effort to the valve designers, for they have turned out some wonderfully good things during the past year, finishing up their efforts by a number of "surprises" for the show.

Thus, good as the modern H.F. valve may be it is certainly put in the shade by the new shielded-grid valves, typified by the Marconi and Osram S.625. It has its drawbacks for the average constructor in that its high magnification properties necessitate elaborate shielding, but the results are worth the trouble taken in the design and construction of the receiver concerned.

A good example of a shielded valve circuit of the simplest nature is given in that described in a constructional article by Mr. G. P. Kendall in this issue of "M.W." under the title of the "Super-Screen" Four.



In this photograph is shown the Loewe Det. and 2 L.F. valve incorporated in a set together with a modern H.F. valve of the D.E.H. 612 type. The receiver is then equivalent to an H.F., Det. and 2 L.F. receiver employing resistance-coupled L.F. stages.

Another type of Loewe valve is designed for H.F. amplification and contains two stages.

The "Super-Screen" Four

Further sets will follow, but it must not be thought that the ordinary neutralised circuit is dead. It is certainly not. The S.625 valve is a wonder, but at present it necessitates the used of tuned-anode circuits if the maximum amplification is to be obtained, and this means *flat tuning*, a greater drawback than ever now that 5 G B is on the air. However, these troubles will be overcome, and we can look forward to some really good H.F.

The "self-neutralising" valve seems to be hanging fire a bit, for I have had no definite news of its early appearance on the general market. It is coming along, however, and on test gives quite good results. Whether it will be a serious rival to the ordinary valve plus neutralising condenser I don't know.

A Question of Price

If I might pass an opinion I should say not. As far as I can gather from tests of an early model and the details accidentally dropped by the makers (who, by the way, have kept it exceedingly quiet up to the moment of writing) no further magnification is obtained, and the external connections need more careful arrangement, as they cannot be neutralised, as is the case with the old type of valve.

Unless something is done to alter the construction of the valve so that this drawback does not arise, and so that we can get the same beautiful sharp neutralisation that we obtain with the ordinary split-primary circuit, I shall hesitate before changing over to the "self-balancing" valve.

The question of price is also a very important one. If the new valve is to cost more than the 10s. 6d. H.F. valve, plus a neutralising condenser, then I don't think it will have a very rosy future, unless it gives us more than is apparently the case.

Screening Necessary

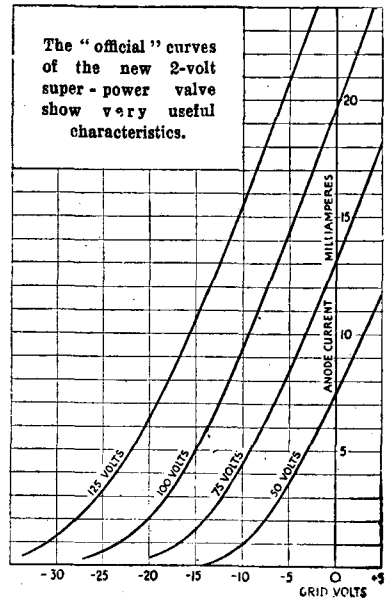
It is early to dogmatise and so I will say no more—we do not know the full extent of the things the valve people have in store for us, and they *may* have something up their sleeves which will make me alter my opinions.

But to be really successful the need for the neutralising of the *external* circuits (carried out automatically by the neutralising condenser in the average circuit) will have to be removed. Neutralisation of the internal valve capacity is not enough by itself, and if screening has to be adopted then I think the S.625 valve with its high magnification will be a serious rival. The new "self-balancing" valve *looks* to me as if it will fall between two stools.

Then this year has brought out the Loewe multiple valve, an interesting amplifier which is used extensively in Germany.

Two-Volt "Super"

And now, just before the show, I have news of a fresh "super" power valve—a TWO-VOLTER. As a matter of fact, I have just completed a series of tests with it, and must congratulate the makers on a really useful effort. The valve in question, the Mullard P.M.252, takes 2 volts, ·30 amp., and has an anode impedance of 3,800 ohms with a magnification factor of 3·8. Its mutual conductance is therefore 1. For the interest of readers



I am giving the "official" curve, which shows that the valve is capable of carrying a considerable volume without distortion, being capable of dealing with a grid swing of 15 volts either way when 125 volts H.T. is employed. The H.T. current consumption is not high, only being about 10–15 milliamps. at 125 volts, and correct bias. This valve is the best thing I have struck since the days of the D.E.P.215 and the S.P.18/R.R.; but the Mullard people do not stop here. Having turned out some exceedingly good and *reliable* valves with filament consumptions of 0·1 amp., they have decided that that figure is too high, and have reduced the filament consumption of some of their valves to ·075 amp. The valves thus affected are the P.M.5B, P.M.5X, P.M.3, and P.M.3A, all of which are the same as before in regard to their other characteristics. As a matter of fact, as I write I have 5 G B on the speaker turning out the Cecilians via a P.M.5B and P.M.5X of the new type, and they are excellent valves; the latter making an excellent H.F. amplifier, its neutralising point being needle-sharp and its power of amplification exceedingly good. It has, of course, an impedance of 19,000 ohms and a magnification factor of 17·5, so that it forms an excellent H.F., L.F., or detector valve.

A.C. Valves

New among the A.C. mains type of valve must be mentioned the Cosmos A.C./G and A.C./R types. These are for general purpose and power work, and operate from the A.C. mains. So sets need not be altered in any respect an adaptor is sold which will fit over an ordinary valve holder and which carries two extra filament terminals for the heating element. The rest of the wiring remains the same, the pins of the valves making contact in the usual way with grid, anode, and cathode (or filament) sockets of the valve holders.

Cossors have also an A.C. valve series which have the heating element connections elsewhere, so that sets need not be rewired in any way.

So what with better valves, better loud speakers, better components, the constructor has no excuse for not getting the best out of radio and turning out better and better sets.

Avoid Inferior Components

We have not reached perfection yet by any means, and we must not rest on our laurels. Good things have been done, but there remains much still to be accomplished, and the constructor can do a great deal to hasten its accomplishment. He should eschew poor apparatus, inferior valves, dud speakers, etc., like the plague. Have the best wherever you can, it's worth it in the long run, and help to get rid of those thousands of sets which are but apologies to radio and which, giving forth the most heartrending sounds from their wheezy and bronchial speakers, do more to hinder the progress of broadcast reception towards universal popularity than any failures on the part of the B.B.C. programmes department. We are moving towards "improved" radio service, so let us see that we do our bit towards the improvement. It's of no use to grumble at the programmes if we mutilate their reception by means of badly designed apparatus.

Engineering Problems in Broadcasting

By G. V. DOWDING, Grad.I.E.E.

A STANDARD B.B.C. transmitter is a very straightforward affair, and once placed in commission it seldom gives trouble, as the absurdly low percentages of breakdowns prove, but the B.B.C. people have had a great deal of trouble with their various aerials. The classical example is that of the London station. This aerial, which as every reader will know, is erected on the roof of a well-known West-end store, was, in its early days, subject to many experiments. First of all, it was found that, owing to the iron in the building, the full parallel length could not be used, so eventually the active aerial was cut down to one of the vertical feeders—merely the downlead, in fact.

Aerial Troubles

But the "get away" was not quite what it should have been with this, so other things were tried. Finally, an ordinary twin aerial was suspended between the two masts, and a pair of feeder wires taken to the centre of this. And that is the aerial that is still in use. It does not look efficient, as the feeder wires run along the roof for quite a distance, and are not many feet above it, but, as results show, this aerial system is really quite satisfactory.

The Belfast station had much the same sort of trouble with its aerial, and after many variations it finally became a tiny little "sausage" suspended between the two power-station chimneys. Aberdeen, Bournemouth, and Daventry all have their own masts erected in fairly open country, and these stations did not have to face the problems that attended the erection of aerials on large buildings and in the centres of masses of bricks and mortar—and iron! It will be appreciated that the effective height of a transmitting aerial is a much more important matter than that of an antenna used for receiving, and also that the question of "earths" becomes vital. Those stations that have plenty of ground space are more fortunate than those like 5 I T, 5 W A, 2 Z Y, and so on, which are tucked away in the centre of towns. However, the B.B.C. engineers have tackled their various problems very creditably, and it cannot be said that any one of their stations has a poor carrying power, all things considered.

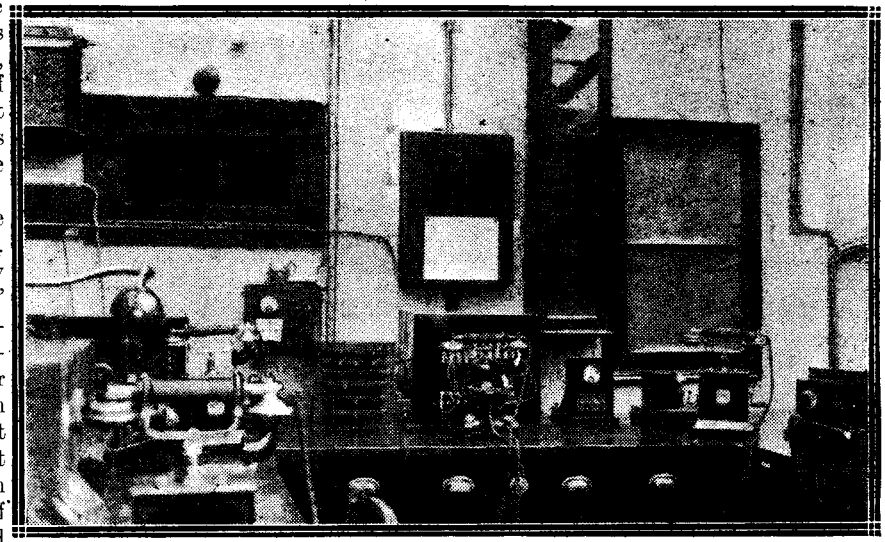
The Knottiest Points

The installation of the B.B.C. transmitters themselves cannot have been, in all cases, such easy tasks as many would appear to think. All sorts of little problems have to be dealt with—for instance, when bedding down generators in buildings previously used solely for office accommodation. Vibration can not only be very annoying but dangerous.

But probably the knottiest points that face the B.B.C. engineers crop up in connection with the relaying of speech and music over landlines and underground cables. It may be news to many readers, but the B.B.C. rent practically all their lines from the Post Office. Even the line from the Savoy Hotel to Savoy Hill, for example, passes through an exchange in much the same way as any ordinary telephone line. The distance between the two places as "the crow flies" is only a matter of yards, but the telephone line involved runs into a mile or so. But the renting plan is the only practical way to arrange matters, for the onus is upon the P.O. people, with their special resources, to see that the lines are kept in good order, and, further, they always have spares available, and can, if necessary, divert the connections through alternative routes.

Line Correctors

The B.B.C. people are, however, provided with "line correctors."



The control-room at the Belfast broadcasting station. On the left of the centre telephone receiver can be seen the "line corrector" which is used in conjunction with the submarine cable.

These are very necessary, as the characteristics of the longer lines vary considerably with different weather and atmospheric conditions. The B.B.C. also arranges all the amplification; it merely has the lines handed over to it in good order, and then tacks whatever it likes on the ends. Thus " B " amplifiers in numbers are to be seen in the control rooms at every one of the B.B.C. stations. A " B " amplifier is a straightforward speech amplifier which collects the energy from the landline or cable and passes it on to the transmitter.

Belfast's Submarine Cable

Aberdeen and other stations situated a long way from London, have lines which pass through repeaters. The S.B. system is, indeed, quite an intricate business. The Gloucester repeater station collects the energy passed on from stations in the West, such as Cardiff and Belfast, and hands it on in an amplified and corrected form for the rest of its journey, while the Leeds station is a similar sort of link with the North.

The twenty-two-mile cable which passes under the sea between the Belfast station and the Scottish coast has always been a thorn in the side of the B.B.C. engineer. The original cable was very unsatisfactory, but even the new one that was laid down is by no means perfect. The B.B.C. stuff passing through it collects all sorts of noises, and when it is amplified up for a further journey across England, the result is a somewhat mushed-up version of the original speech and music. Naturally, the Belfast station can collect sounds from London and Daventry with pretty good results, as these do not have to be amplified up for another trip through landlines as when an endeavour is made to work in the other direction.

The " Radio Link "

This particular problem is no nearer a solution as yet, and that is the reason why Belfast programmes so seldom figure in the S.B. scheme.

By the way, Belfast, as well as other of the stations which normally have to employ very long cables in S.B. relays, frequently takes advantage of a " radio link." When atmospheric conditions are good this can be excellent, and actually preferable to cable working. An overhead landline wire can have a capacity of as much as ·015 mfd. per mile, while submarine cables often reach ·3 mfd. per mile. I believe the average capacity of the Anglo-German cables is some 90 mfds. or so! But a radio link has none of this burden of capacity, and also none of the inductive troubles from which so many of the cables suffer despite elaborate screening and other schemes.

Unfortunately, the " radio link " is sometimes beset with interference in the form of the ubiquitous static, but in the absence of this, as I have said, it is all but perfect, thanks to the employment of first-class receiving sets whose sensitive qualities are subordinated to purity of tone.

But a certain amount of selectivity is necessary in order that the local transmitter shall not interfere, and this seems generally to be accomplished, initially at least, by the employment of very short aerials. At Belfast the receiver is situated in the house of one of the station engineers some four miles away from the control-room, but it can be switched on and off from that point by means of an ingenious remote control.

" O.B.'s," which term covers any microphone work outside the studio, such as the relaying of music from a local concert hall, running commentaries, and so on, frequently necessitate days and even weeks of preparation. Lines have to be obtained and tested, and the microphone and its position generally necessitates much experiment before the high standard always demanded by the B.B.C. is achieved and the word " Go " passed on to all concerned.

Laying Special Lines

Sometimes an " O.B." will necessitate the laying of special lines of miles in length and the tapping of these on to main landlines. The Belfast station, for instance, quite recently had to put down a temporary line across about one and a half miles of country in order to connect a commentator's hut overlooking a motor-cycle race-track to a permanent landline.

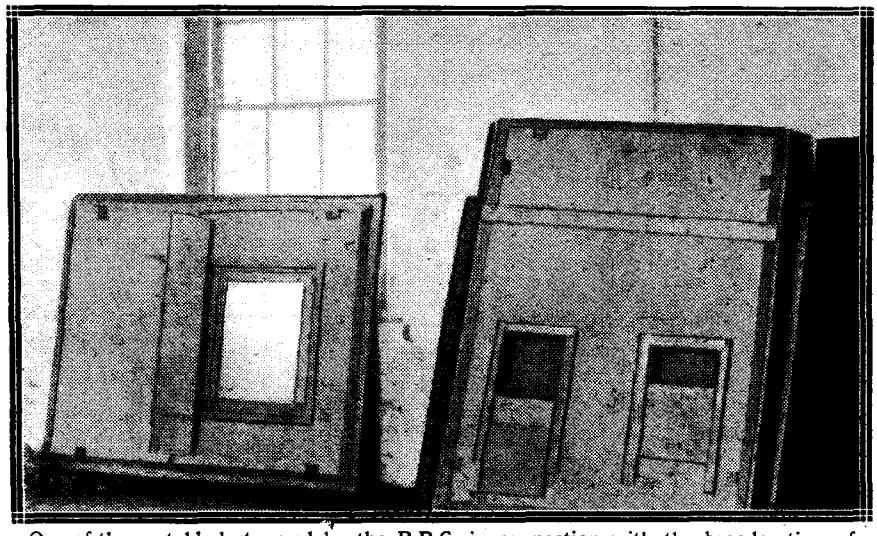
In O.B.'s the " radio link " is often used, an historical example being afforded by the broadcasting of the Boat Race. A small transmitter was in the commentator's boat, and receiving stations were arranged to pick up the transmission from this and pass it on to landlines. And during the recent " Lakeland " broadcasts from Manchester I believe a similar sort of scheme was arranged.

Special Microphones

The placing of the microphone is frequently a serious problem in itself, for not always is it desired to collect all the noises in its vicinity. The cheering of a crowd might be a desired " effect," but also it might not, and the " mike " has to be fixed up so that a choice can be made between the general effect and the voice of the announcer or commentator. In this connection the use of special microphones having limited " pick-ups," and of more or less sound-proof collapsible and transportable huts, etc., are all proof of the enterprise and ingenuity of B.B.C. engineers.

But the real accomplishments of the B.B.C. engineers are evinced in the various studios. As a result of scientific research and of much practical work, studio technique is now reaching the heights of perfection. A modern studio, such as No. 6 or 7 at Savoy Hill, is not a stuffy mass of

(*Continued on page* 428.)



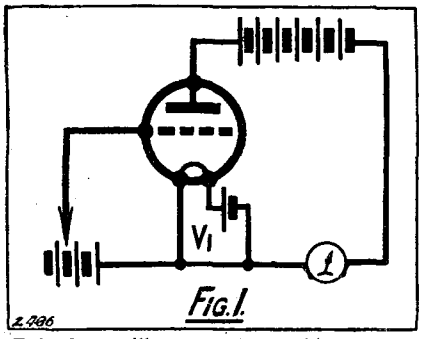
One of the portable huts used by the B.B.C. in connection with the broadcasting of " running commentaries."

The Design of H.F. Amplifiers

A really practical review of modern methods.

By W. JAMES.

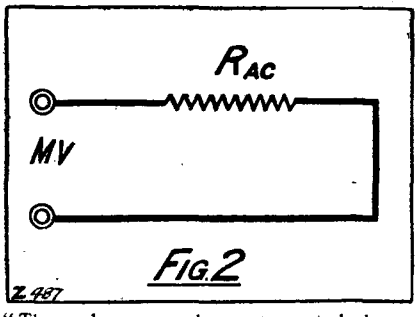
In a recent article I described the causes of instability in high-frequency amplifiers, and pointed out that even where complete screening is used to isolate (electrically) the different circuits there remains the valve-anode's grid capacity which acts to promote instability. It was further



This figure illustrates how grid potential affects plate current, as measured by the milliammeter.

pointed out that the effects of this capacity could be neutralised or balanced by using one of the many well-known systems.

But it must not be thought from this that the evil effects of the valve capacity are completely and wholly eliminated, for they are not with the majority of arrangements. In fact, it frequently happens that a system may be quite well balanced on one wave-length and prone to oscillate on another wave-length.



"The valve can be represented by a resistance RAC."

This does not matter so very much in practice, because a favourable adjustment can nearly always be made, but it is one of those things which has continually to be borne in mind when reckoning the magnification which can be obtained from high-frequency stages.

Imperfect Stabilising Systems

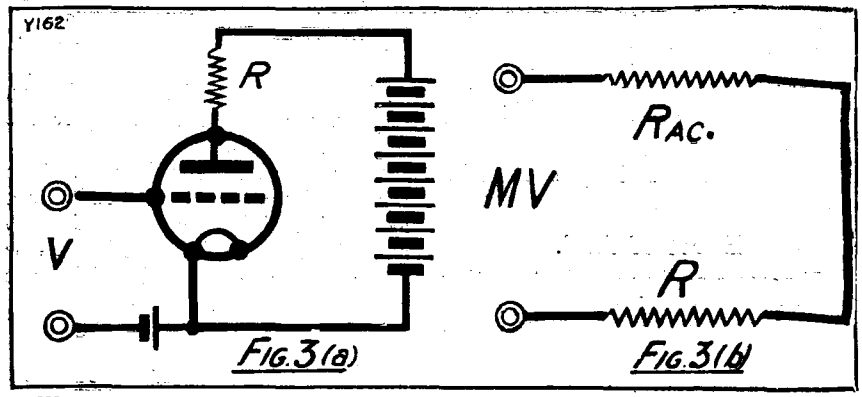
It is not safe to proceed on the assumption that a perfect balance can be obtained even though complete screening is used. The reason for this is well known to experimenters who have made a few measurements, and is due partly to imperfect systems of stabilisation and partly to the use of apparatus which is electrically not quite up to the theoretical standard.

We are not concerned at the moment with the merits of the various systems favoured by different authorities, or in pointing out how many of the published descriptions fail to give correct results through incomplete design. It will suffice for our present purpose if we assume that no back coupling of any sort whatever is present, for on this basis we can proceed to calculate the amplification which we are likely to obtain in practice, and to discuss the factors affecting selectivity, unhindered by regenerative contributions of any sort.

We are quite safe in doing this, for in practice the amplification and selectivity are almost bound to be enhanced by failure to effect a perfect balance, and by the remains of couplings which are not quite eliminated. In fact, a neutralised receiver is often so set that quite a useful regenerative effect is obtained—this with complete stability. But we will return to this later.

Valve Resistance

If to valve V_1, Fig. 1, with its anode and filament batteries, we apply different grid voltages, the anode current will vary. Let us suppose the current is 2 milliamperes when the anode voltage is 120 and the grid bias 1·5. We now alter the anode voltage, reducing it by 20 to make it 100; the anode current has fallen, we will say, to 1 milliampere. Changing the anode voltage by 20 has therefore resulted in a change of anode current by 1 milliampere, and the resistance of the valve is 20 divided by 0·001, or 20,000 ohms.



When a resistance R is placed in the plate circuit of the valve, Fig. 2 can be redrawn as in Fig. 3(b).

We next alter the grid bias (the anode voltage is still 100) and find that when it is −0·5 volt the anode current is 2 milliamperes—the value it had when the grid bias was −1·5 and the anode voltage 120. We are therefore justified in saying that under the conditions of the test we can change the anode current by a milliampere in two ways—by adding or removing 20 volts from the anode battery, or by adding or removing one volt from the grid bias.

Thus a change in grid bias of 1 volt has the same effect precisely as a change in anode voltage of 20; the grid is 20 times more effective in varying the anode current, and the valve is said to have a voltage factor of 20.

In making these tests we must confine ourselves to the straight part of the curves—if tests are made for different average anode and grid voltages, the results obtained will be different. Usually the voltage factor does not vary very much with operating conditions, but the anode's A.C. resistance does, and by a material amount.

Effect of A.C.

If now we apply a small alternating voltage to the grid, superimposing it on the steady negative bias, the anode current will vary accordingly. It is easy to see that if at a given instant the value of the alternating voltage applied to the grid is 0·5 volt then the change in anode current produced in the anode circuit is equal to the effective change in anode voltage divided by the anode's A.C. resistance. Our valve can therefore be represented by a resistance R_{AC} (Fig. 2) connected to which is a generator delivering a voltage of M times that applied to the grid, M being the valve's voltage factor.

If now we connect a resistance R in series with the valve as in Fig. 3(a), it is easy to see by referring to the equivalent circuit Fig. 3(b) that the alternating current set up in the anode circuit will produce a voltage across the two resistances in series. The total value of this voltage is, of course, MV, where V is the voltage applied to the grid, and it should be clear that if the two resistances are of equal value the voltage set up across each of them will be identical in value. In actual fact, the voltage drop over each resistance will be M V divided by 2.

Voltage Amplification

To follow the matter a little further, we may say that if the resistance connected to the anode is increased (the valve's A.C. resistance remaining unaltered by a suitable increase in the anode-battery voltage) a larger proportion of the voltage MV will be developed across it. The voltages, in fact, are shared according to the resistance values.

Thus, when the maximum voltage is required across the added resistance, as it invariably is in resistance amplifiers, the added resistance is made large compared with the valve's resistance. When it is five times as large, five-sixths of the total A.C. voltage is developed across it, and so on.

It therefore follows that in a voltage amplifier it is important so to arrange the circuit values that the ratio of added to anode A.C. resistance is as high as possible, for then the voltage amplification for the stage will be at maximum.

Having dealt with this matter in as brief a manner as possible, we have now to consider another aspect of the problem. We will assume that our valve, with its voltage factor of M and anode A.C. resistance of R_{AC} ohms, has connected to it a pure resistance R ohms. Then the alternating current which flows in the anode circuit as the result of applying A.C. to the grid is given by:

$$I_a = \frac{E}{R_{AC} + R}$$

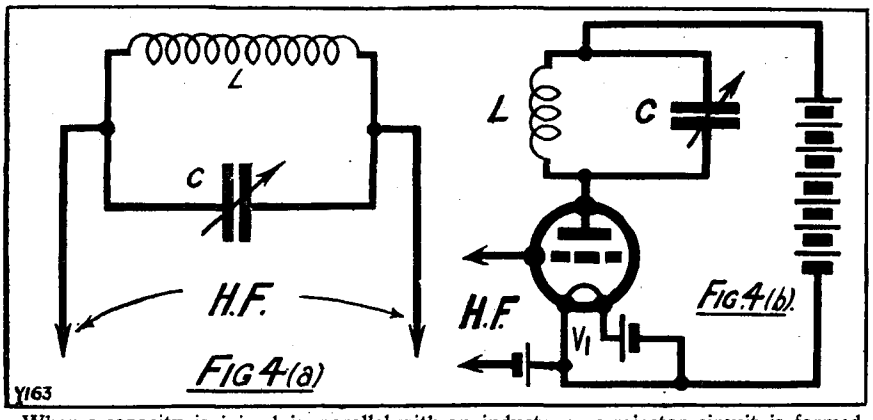
where E is the A.C. voltage developed in the anode circuit and is equal to M times the A.C. grid voltage. Now the power developed in a piece of apparatus is given by the current squared times its resistance; therefore, we have as the power supplied to the added anode resistance

$$P = I_a^2 R \text{ and}$$

$$P = \left(\frac{E}{R_{AC} + R}\right)^2 R$$

If this is worked out for various ratios of anode A.C. resistance to added resistance, it will be found that the maximum power in the output resistance is obtained when they are equal; that is, when R_{AC} equals R. But an important point is this, that very little power is lost by using a ratio of 2 or 3 to 1. That is, the power developed in the added resistance is not very much less than the maximum when the added resistance is 2 or 3 times smaller or larger than the valve's A.C. resistance.

This point is rather an important one, as we shall see when we come to consider the subject of high-frequency transformers.



When a capacity is joined in parallel with an inductance a rejector circuit is formed, Fig. 4(a). In tuned-anode amplifiers, this rejector circuit is in series with the valve.

The Tuned-Anode Circuit

One of the simplest and perhaps most widely used methods of high-frequency amplification (the tuned anode) employs a rejector circuit in series with the valve. A rejector circuit comprises a condenser and coil (with their incidental resistances) in parallel, Fig. 4. For the moment, however, we will assume that the coil and condenser have no resistance losses.

If a high-frequency E.M.F. is applied to the circuit, a current will flow from the source, and it can easily be seen that if the frequency of the E.M.F. is greater than that to which the circuit is tuned more current will flow through the condenser than the coil. On the other hand, if the circuit is tuned to a higher frequency than that of the applied E.M.F. then more current will flow through the tuning coil than through the condenser.

If now the circuit is tuned to the same frequency as that of the applied E.M.F. the current flowing through the condenser will equal that through

the coil (the circuit is assumed to have no losses) and no current will flow from the source of E.M.F. regardless of the magnitude of its voltage.

In other words, the circuit is behaving as though it were an enormous resistance connected to the source of E.M.F. This is the first point we wish to bring out.

this purpose the writer made a coil of No. 30 D.S.C. of 4-in. diameter, and adjusted its inductance at 400 metres to 300 microhenries. It was tuned with an ordinary ·00035-mfd. variable condenser, and measurements were made at various wave-lengths, and the above results obtained.

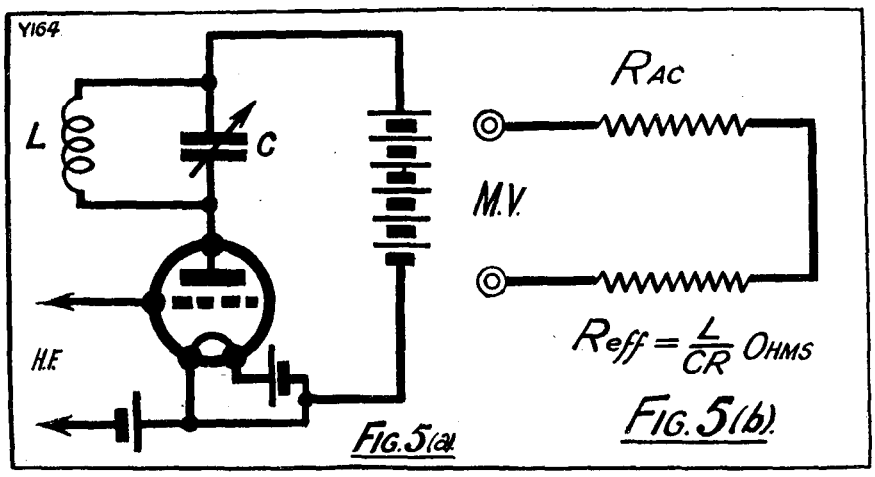
the effective resistance of the tuned circuit varies with the frequency; and it will also be pretty obvious that it depends on the type of the coil used, since this will determine its loss

TABLE 2.

Wave-length.	Circuit's effective resistance. Ohms.
600	170,000
500	210,000
400	270,000
300	360,000

resistance at the various wave-lengths.

Let us now apply our figures to a tuned-anode stage of high-frequency amplification, Figs. 5(a) and 5(b). Remember that we have said there are no stray couplings of any description, so that we do not have to make any allowances for a single thing, except those represented in the diagram.



H.F. voltages are applied to the grid of the valve, and the rejector circuit (tuned-anode) is tuned to resonance with the applied frequency. Fig. 5(b) is the equivalent circuit.

Normal coils and condensers, of course, have resistance. Hence the effective resistance of a parallel-tuned circuit will not be infinitely great, but will have a lesser value according to the losses of the circuit and the values of the coil and condenser.

In fact, the circuit's effective resistance at resonance is given by $\frac{L}{CR}$ ohms, L being the coil's inductance, C the total capacity, and R the loss resistance of the circuit, all measured in equivalent units.

Thus the tuned circuit has the same effect, so far as the current flowing from the source of E.M.F. is concerned, as a pure resistance of this value.

H.F. Amplification

We can now apply this to high-frequency amplifiers, but first we had better get an exact idea of the values of the effective resistance we are likely to meet with in practice. For

TABLE 1.

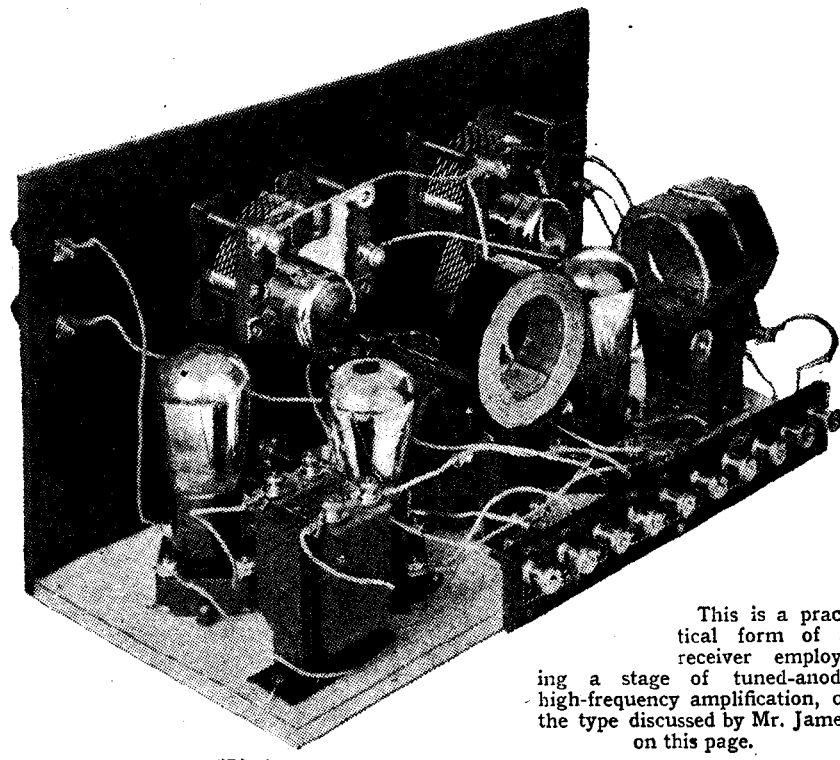
Wave-length.	Loss resistance of circuit.
600	5·2
500	6·2
400	7·5
300	10·0

We can now put the known values in the formula $\frac{L}{CR}$ to find the effective resistance at the various wave-lengths. This has been done, with the results given in table number 2.

We therefore see quite clearly that

Calculating Magnification

We have a valve to whose grid are applied high-frequency voltages, and in the anode circuit of that valve we have connected a circuit which can be tuned to resonance with the applied E.M.F. Let us suppose that the high-frequency voltages have a wave-length of 600 metres. We see from the above table that our circuit offers an effective resistance of 170,000 ohms at this wave-length. It therefore follows that we can work out the amplication in precisely the same way as we did for the resistance amplifiers.



This is a practical form of a receiver employing a stage of tuned-anode high-frequency amplification, of the type discussed by Mr. James on this page.

We will, therefore, assume that the valve used is a typical R.C. one, having a voltage factor of 40 and an anode A.C. resistance of 100,000 ohms. Our equivalent circuit is that of Fig. 5 (b,) where R_{AC} represents the anode's A.C. resistance, R_{EFF} the effective resistance of the tuned-anode circuit, and MV the high-frequency voltage developed in the anode circuit by the grid voltage V. The proportion of the total voltage actually developed across the tuned-anode circuit is therefore $\frac{170,000}{170,000 + 100,000}$, or 0·63.

For every volt of H.F. applied to the grid we therefore have 0·63 M volts developed across the tuned-anode circuit, and in the example considered, where we assume the valve's M is 40, the magnification for the stage is 25·2. One volt of H.F. at 600 metres applied to the grid will therefore set up 25·2 volts across the tuned-anode circuit.

If we make further calculations at the various wave-lengths we shall be able to write down the amplification obtained for the whole tuning range. The amplification varies because the effective resistance of the tuned circuit varies with the wave-length. This is shown by Table 3 below.

TABLE 3.

Wave-length	$\frac{L}{CR}$ Ohms.	Amplification per stage.	
600	170,000	25·2	Valve's M value = 40; A.C. resistance = 100,000 ohms.
500	210,000	27·1	
400	270,000	29·2	
300	360,000	31·3	

Thus at the shorter wave-lengths the amplification is greater than at the longer wave-lengths, which is in accord with practical experience. In practice, however, we often find that an amplifying valve under working conditions has an anode resistance of 200,000 ohms for a voltage factor of 40, this being due to the necessity for using a little negative bias. It will therefore be instructive to work out the amplification for this valve.

Further Results

We obtain the following results:

TABLE 4.

Wave-length	$\frac{L}{CR}$ Ohms.	Amplification per stage.	
600	170,000	18·4	Valve's M value = 40; A.C. resistance = 200,000 ohms
500	210,000	20·5	
400	270,000	23·0	
300	360,000	25·6	

If we use another valve in the H.F. amplifier, having a voltage factor of 20 for an A.C. resistance of 40,000 ohms, we again obtain different amounts of amplification, the actual figures being given in Table 5.

TABLE 5.

Wave-length	$\frac{L}{CR}$ Ohms.	Amplification per stage.	
600	170,000	16·2	Valve's M value = 20; A.C. resistance = 200,000 ohms
500	210,000	16·8	
400	270,000	17·4	
300	360,000	18·0	

The three tables giving the amplification for different valves indicate quite clearly the tendency for the magnification to increase at the shorter wave-lengths. To minimise this effect with the specific coil and condenser at our disposal we can use a valve of fairly low A.C. resistance as shown by Table 5. For this valve, which has a voltage factor of 20 as compared with 40 for the other two, we have a much more uniform amplification. It is lower over the whole range, however, and we might inquire as to whether we cannot redesign the coil so as to level out the amplification.

Examination of the formula $\frac{L}{RC}$ reveals the fact that the effective resistance, and therefore the amplification, would be uniform if only we could make the product of C and R constant. The capacity C we have to vary, of course, in order to tune the circuit, so that what we have to do is so to arrange the coil that its resistance falls off when the capacity is increased by such an amount as to keep their product constant.

I have had this problem in mind for a long time, and have fortunately found the way to construct a coil giving the desired effect—not that it is considered strictly necessary to have uniform amplification, although it will be agreed that it is quite desirable.

Uniform Amplification

There are one or two ways of dealing with the matter: One is to sacrifice amplification on the shorter wave-lengths; and the other, and bolder, plan is to endeavour to raise the amplification on the longer wave-lengths to equal that given on the shorter wave-lengths. We have to redesign the coil, and it is absolutely essential so to construct it that its loss resistance on the longer wave-lengths is reduced to a low value.

To do this we may wind with a thick copper wire—or, better still, use H.F. cable of suitable construction. A coil was therefore wound with Litzendraht, and the following values of loss resistance were obtained:

TABLE 6.

Wave-length	Loss-resistance Ohms.
600	2·4
500	3·1
400	4·3
300	6·9
200	12·5

From the known values we can now find the effective resistance of the circuit at various wave-lengths, and the results are given in the next table (Table 7).

(*Continued on page* 420.)

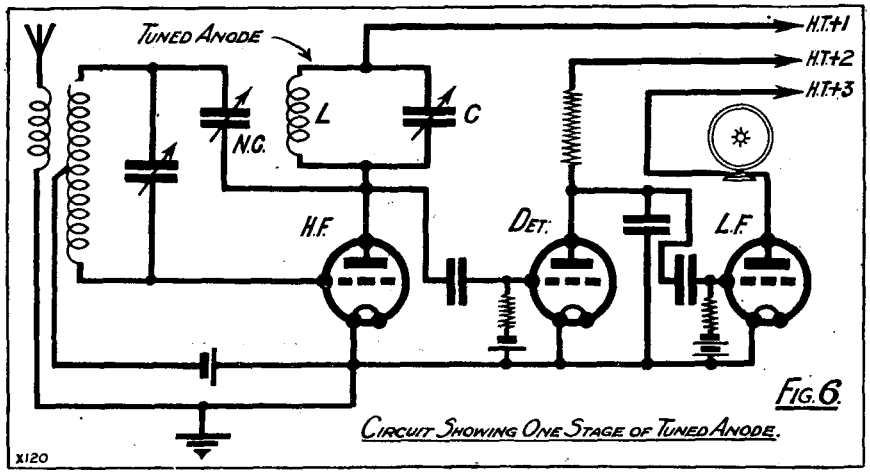


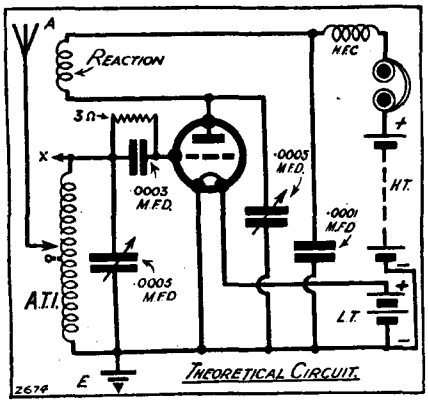
FIG. 6. CIRCUIT SHOWING ONE STAGE OF TUNED ANODE.

For the sake of clarity the filament connections have been omitted from this diagram, which shows the circuit of a receiver employing a tuned-anode stage of H.F. amplification, detector, and resistance-coupled stage of low-frequency amplification.

The NEW MIDGET ONE VALVER

Designed and described by A. S. CLARK.

THE original "Midget" single-valve set was published over two years ago. It proved a very popular set, and even at the present time many readers are using it



and prefer it to other single-valve receivers. In view of this, it was considered that a modern single-valve set which was compact and even more efficient than the original Midget one-valve set would be welcomed by many.

The receiver described in this article is not only intended for reception of local and near stations, but also for fairly long distance work, it being capable of bringing in many Continental stations at good telephone strength.

Regeneration Control

Now, any set intended for receiving distant stations, and particularly a single-valve receiver, must have really smooth reaction control. This is necessary in order to work the valve at its most sensitive point—namely, just before oscillation occurs—and it is desirable that oscillation should build up so gradually that it is impossible to say exactly when the valve begins to oscillate.

The Circuit

This satisfactory state of affairs has been obtained in the set under consideration by means of a new method of reaction control. Reference to the circuit diagram will enable the reader to follow the method.

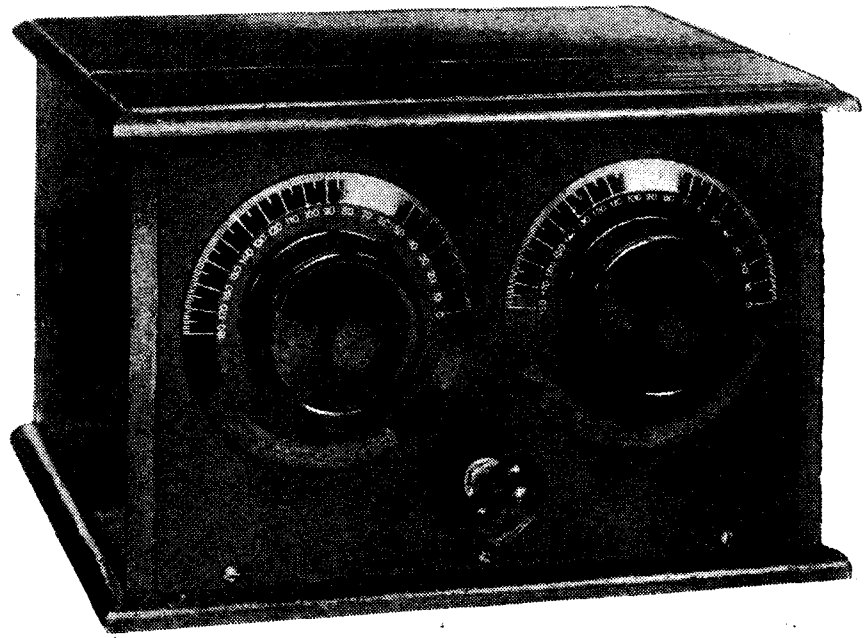
A reaction coil is connected in the plate circuit of the valve in the same manner as for ordinary swinging-coil control. The coupling between this reaction coil and the tuning coil is, however, fixed, a fairly tight coupling being obtained by mounting the coils side by side in two ordinary coil mounts. The reaction circuit is completed through the fixed condenser of ·0001 capacity, while the direct current flows through the H.F. choke, and thence on to the telephones

Reaction Condenser

A variable condenser of ·0005 capacity is employed for control. As will be seen, it is connected between the plate of the valve and L.T. – ; it therefore forms a parallel path for the

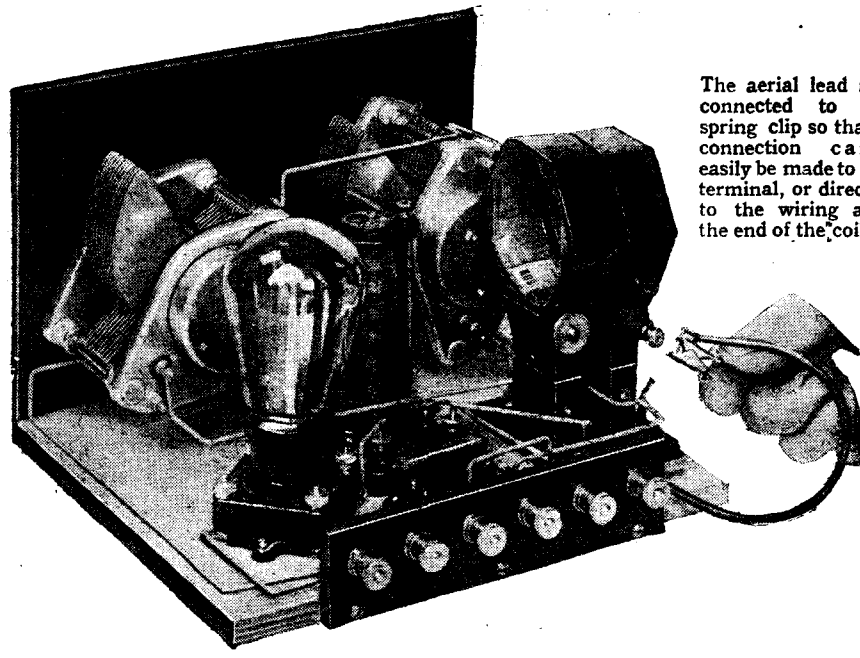
COMPONENTS REQUIRED.

- **Ebonite panel 9 in. × 6 in. × ¼ in.**
- **Cabinet to suit same, with baseboard 8 in. deep.**
- **Terminal strip 6 in. × 1 in. × ¼ in.**
- **6 ordinary terminals.**
- **2 ·0005 variable condensers with vernier (Pye).**
- **Single-circuit open filament control jack (Lotus).**
- **Plug for same (Lotus).**
- **H.F. choke (R.I.-Varley).**
- **Anti-microphonic valve holder (Benjamin).**
- **2 single-coil mounts (Success).**
- **·0001 fixed condenser (Dubilier).**
- **·0003 fixed condenser with grid-leak clips (Dubilier).**
- **3-megohm grid leak (Dubilier).**
- **Glazite wire and screws.**
- **One spring clip.**



The "New Midget" one-valver has an imposing appearance when completed and placed in its cabinet.

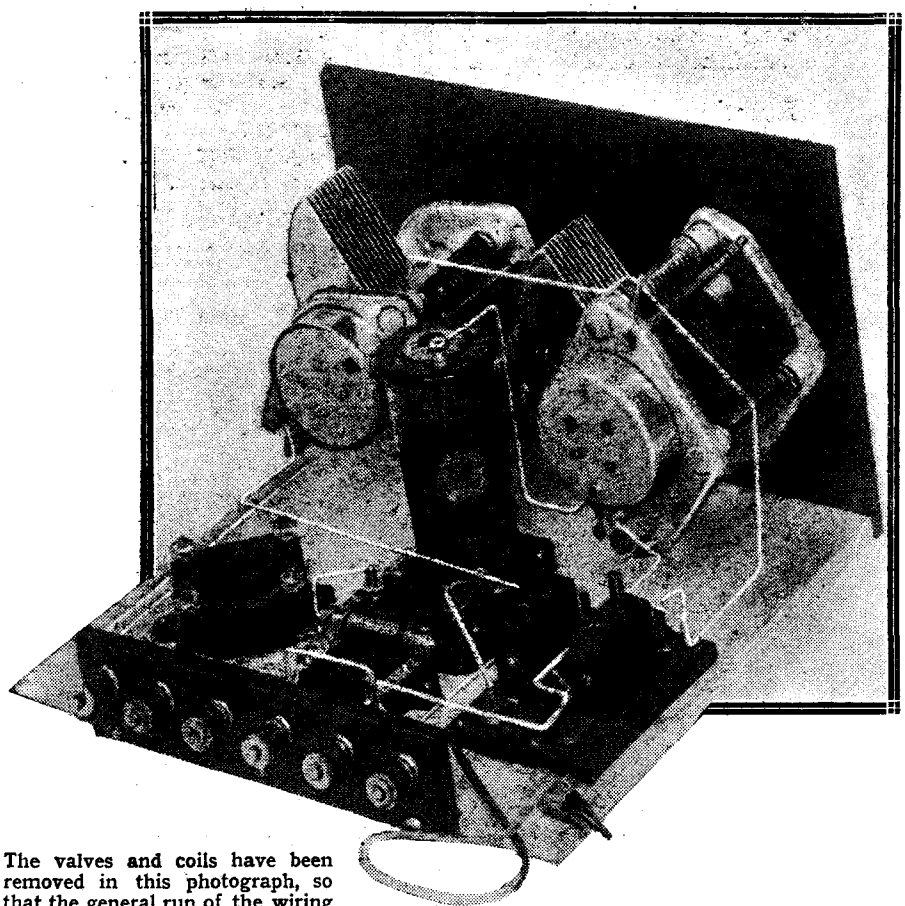
H.F. currents, and as its capacity is increased so less and less H.F. current will pass through the reaction coil, until a point is reached at which the set ceases to oscillate. A ·0005 variable condenser is employed, so that when this condenser is at its maximum it provides a path of very much lower resistance to the H.F. currents than the path through the reaction coil and the ·0001 fixed condenser. If a smaller variable condenser were used, or a larger fixed one, a sufficiently large variation of reaction control would not be obtained, and it would be difficult to obtain a suitable size of reaction coil. Also, reaction control would not be obtained round the whole tuning-condenser range for a given coil without changing reaction coils.



The aerial lead is connected to a spring clip so that connection can easily be made to a terminal, or direct to the wiring at the end of the coil.

The H.F. Choke

As the capacity of various pairs of telephones varies it is not satisfactory to put the ·0001 fixed condenser across them, as their capacity would be added to it and its effective value would vary with different telephones. The H.F. choke was therefore provided so as to make a completely separate path for the L.F. currents. If a ·002 fixed condenser could have been used, it could have been put straight across the telephones, since with such a large condenser the capacity of the 'phones could have been neglected. But it has already been shown that a ·002 fixed condenser could not be used since it would not allow adequate reaction control.



The valves and coils have been removed in this photograph, so that the general run of the wiring may be seen. Note particularly that the pins of the coil holders are placed towards the panel, and that very short grid leads are employed.

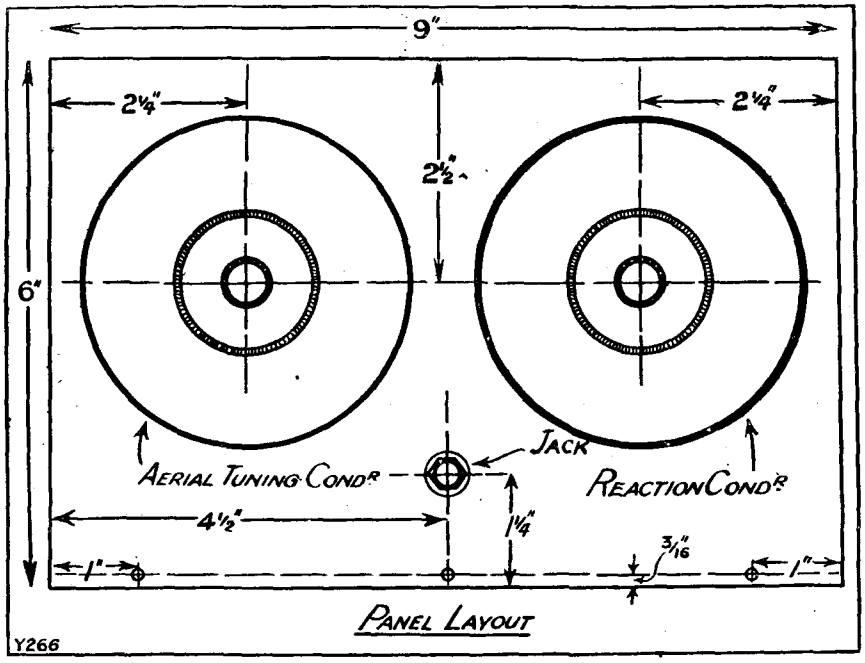
Aerial Coil Arrangements

If reception of other stations than the local one is desired while the local station is transmitting a set must be more or less selective according to the proximity or otherwise of the local station. The set is so arranged that varying degrees of selectivity may be obtained. By taking the aerial straight to the point X, direct doupling is employed. This is advised for the local station, since a slight loss in signal strength must always be expected when selectivity is obtained.

The aerial may also be taken to the centre-tap of a centre-tapped coil, or to one of the taps on an X coil, according to the degree of selectivity required. For those living about 10 miles from the local station the centre-tapped coil provides a good compromise between selectivity and signal strength. Those about 10 miles from 2 L O will find a cenfre-tapped coil all that is required to separate 2 L O and 5 G B.

The grid is given the same potential as the negative side of the filament, by connecting earth to L.T.—. It is certainly more usual to take the earth to L.T. positive with a detector valve, but taking it to L.T.— was found definitely to improve reaction control without producing any noticeable loss of signal strength, which is the usual reason for connecting to L.T.+.

If desired, the effect of connecting the opposite way round may be tried by merely reversing the L.T. leads to the L.T. terminals.



General Design

A vertical panel with baseboard has been employed, the panel being kept as clear as possible. All that is to be seen on it are the two variable condensers and the jack for the telephone plug. This jack is arranged to switch the set on and off as the telephones are plugged in and out. All battery terminals, and the aerial and earth terminals, are carried on a strip of ebonite at the back of the set.

No filament resistance has been employed, since practically all of the valves on the market at the present day may be run direct from 2, 4 or 6 volts, and very often a quite considerable voltage drop is obtained in the L.T. battery leads. Sometimes when a resistor is employed this drop in the battery leads causes the valves to be run at a lower voltage than they ought, which naturally materially upsets results.

Components

A list of the components required to build this set is given, together with the names of the makers of those used in the original set. It is not necessary, however, to keep to these makes so long as parts of good quality, and ones which will fit into the space available, are chosen. With reference to the variable condensers, the vernier movement is not indispensable, but is very useful and helps to make the tuning of weak stations easy. Before commencing the actual constructional work of the set it is advisable to gather together all the parts that are required.

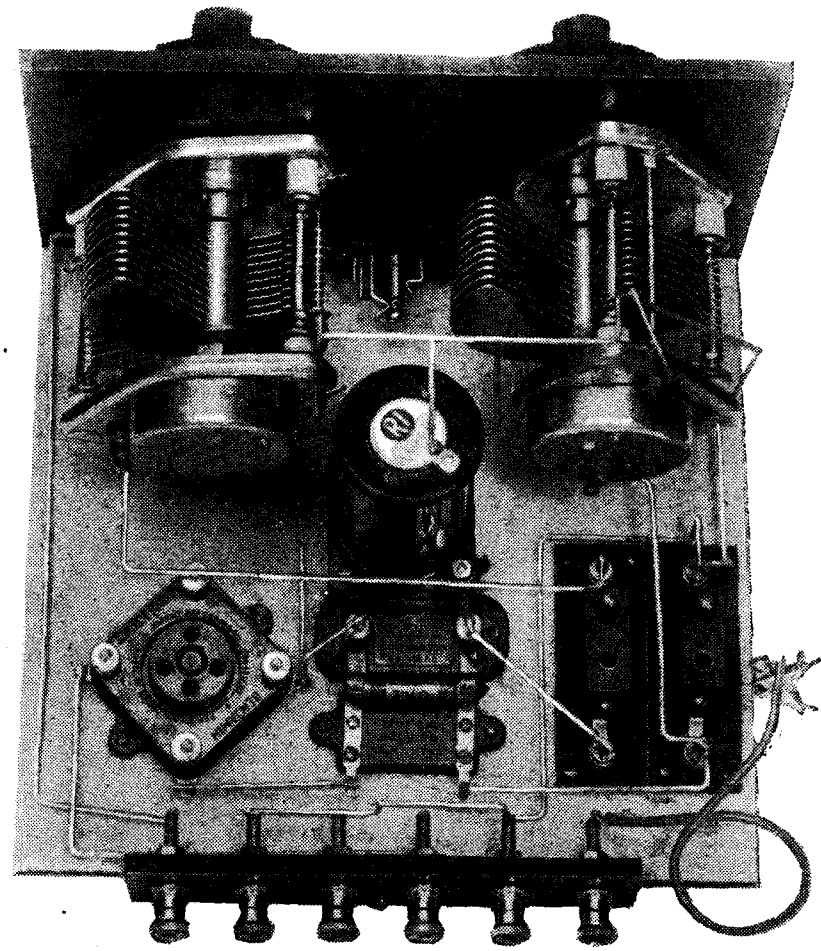
Drilling Operations

Having done this, the work may be proceeded with, the first job being to drill the panel. This has to be done in accordance with the drilling diagram, on which all the dimensions necessary for marking out the panel are shown. All points where holes are to be made should be centre-punched before drilling is carried out. No diagram of the drilling of the terminal strip is needed, since all that is required is six holes equally spaced, to take the terminal shanks, and three small holes to take the wood screws for securing to the baseboard.

Mounting the Components

Now mount the components which go on the panel, and also fit the terminals to the terminal strip. After this tin all points on the above to which soldered contact will be made, and then fix the panel and terminal strip to the baseboard. This should be done with the baseboard, panel, and terminal strip fitted into the cabinet, so as to ensure that they are in their correct relative positions.

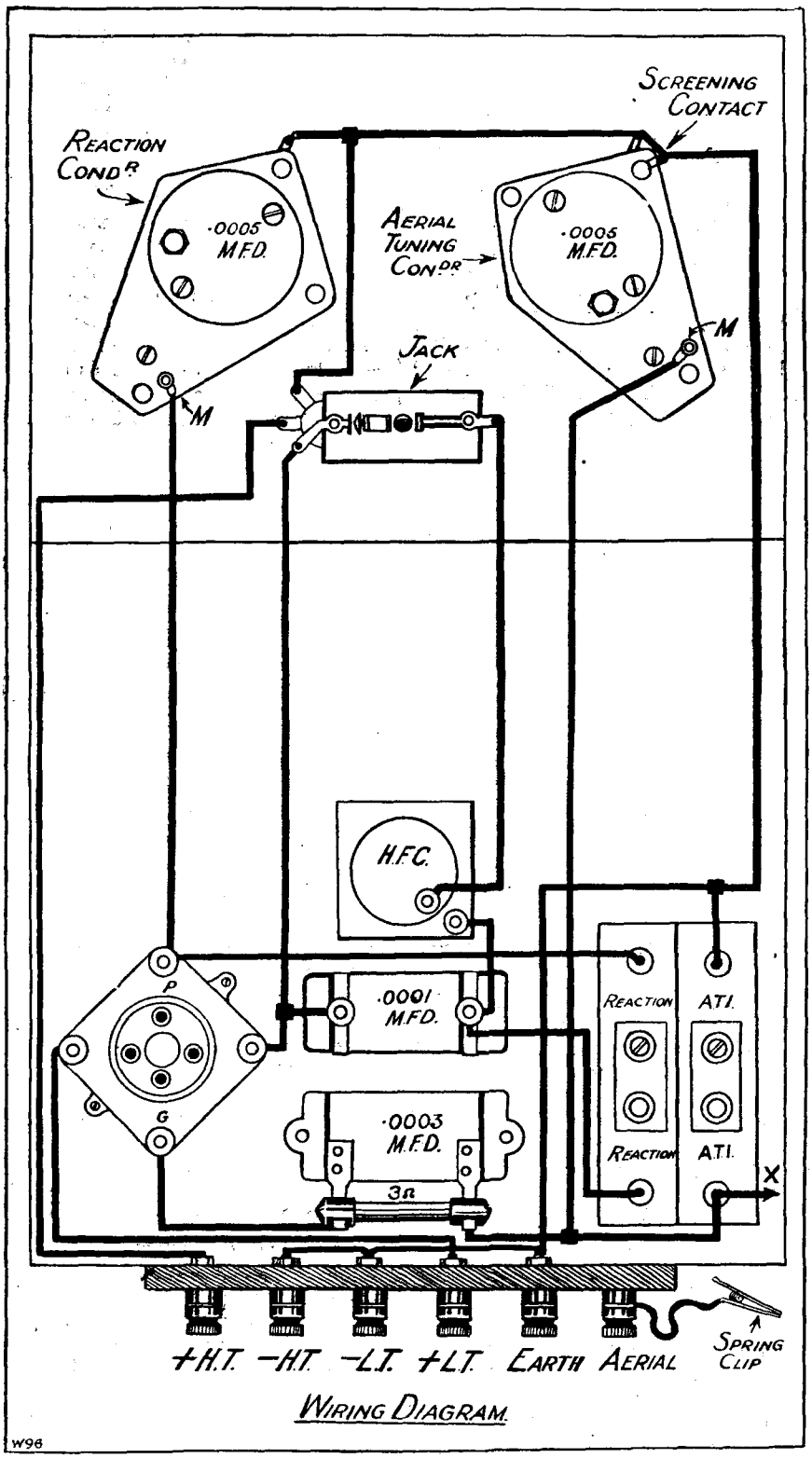
After tinning the necessary points on the remaining components, these can be screwed to the baseboard, after which the set is ready for wiring.



This photograph of the connections should be compared with the wiring diagram on another page.

Wiring Up

In doing this, the wiring diagram must be followed. This will not be found difficult with the aid of the back-of-panel diagrams.



WIRING DIAGRAM.

First of all, connect up the jack, taking care to take the leads to the correct tags. This jack has not been shown on the theoretical diagram for the sake of simplicity. If another type of jack is employed it will not be difficult to find out the correct springs. The two which make contact with the telephone plug will be obvious, and it is quite immaterial which way round they are connected. The remaining two are in series with the filament of the valve, and once again it does not matter which way round they are connected.

Aerial Tapping

A piece of rubber-covered flexible wire is joined to the aerial terminal, at one end of which is a spring clip. This is the clip which connects to the tappings on the aerial coil, or a small length of wire left projecting at the point X, when employing direct coupling. In order that the connections shall be correct for an X coil, the pin of the aerial-coil mount has to be connected to earth. Therefore, arrange the pins and sockets of the two coil mounts the same way round as indicated, when not only will the aerial coil be properly connected but the reaction coil will be the correct way round for obtaining reaction effects.

Accessories Required

It is really immaterial what valve is employed with this set, but one of the valves of moderate impedance intended principally for H.F. work will probably give the best results. The voltages of the accumulator and of the H.T. battery naturally depend on the valve, but a fairly high H.T. voltage in comparison with the maximum allowed for the particular valve should be used. The more sensitive the telephones, the better, so it is as well to use reasonably good ones.

Testing the Set

When the receiver is completed it may be tested very quickly. Connect up the H.T. and L.T. batteries to their respective terminals, put the aerial and earth on their terminals, and plug in the telephones after inserting the valve. Direct coupling should be used at first, and a No. 35 or No. 50 coil employed in the aerial coil mount, with about a No. 30 or 40 for reaction. These coils are for the lower broadcast band, but in all cases such a size of reaction coil must be used as will allow the reaction condenser to stop the set oscillating on all positions of the tuning condenser before it is at its maximum setting.

The amount of reaction required will depend on the wave-length, and as the tuning condenser is increased in capacity, so the reaction condenser should have its capacity decreased. When the local station has been tuned in, and the feel of the reaction control obtained, searching for other stations may be undertaken. A centre-tap coil should be tried first, and if sufficient selectivity is not obtained with it an X-coil can be tried.

(*Continued on page* 420.)

RADIO IN SUNRISE LAND

Some interesting details of the broadcasting station at Tokyo.

From a Special Correspondent.

THE celebrated poet responsible for the lines:

"For East is East, and West is West,

And never the twain shall meet"

—or words to that effect, at any rate—reckoned not with the future science of radio, and its essentially humanising propensities. The Eastern nations, it is true, have ideas and modes of living which are far removed from those of the Western world. Yet the yellow races of the civilised Eastern regions have their own radio, and in this one instance they have an interest almost completely in common with our own.

The Tokyo Station

Japan—"The Land of the Rising Sun"—whose progress in the art and science of broadcasting these few notes and illustrations are concerned with, is, of course, a nation quite as civilised as our own. The populace of that country, although it follows its own philosophies and religions, is one whose industrial pursuits and activities follow closely on those of the Western nations. Japan—or, at least, the modern portions of that country—is no longer a land of innumerable Madame Butterflies and lavishly attired people. On the contrary, its people are up to date in the extreme, and attentive to the affairs of modern everyday life and commerce.

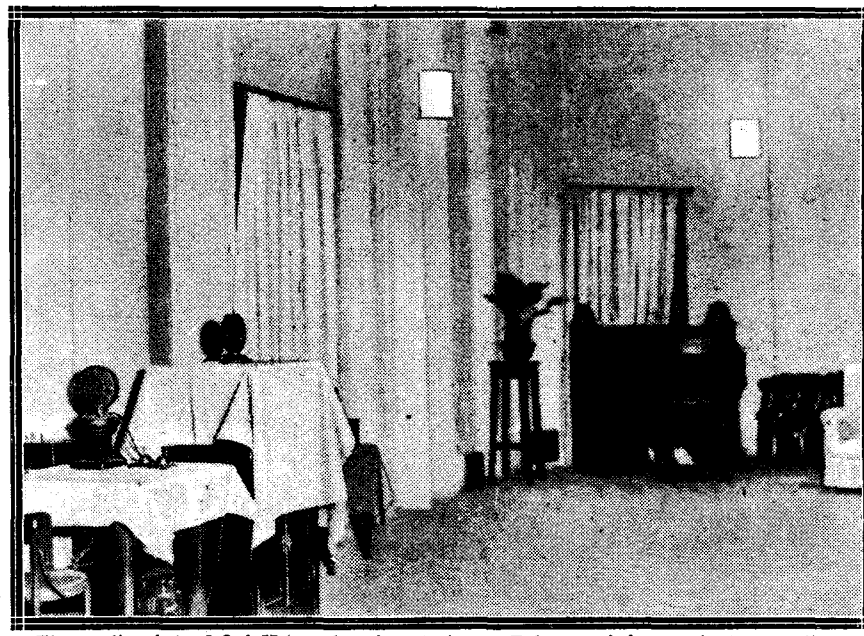
What is more likely, therefore, than in this land of thriving industry a broadcasting station—that modern signpost of civilisation's most social attainment—should spring up. Tokyo, the modern capital of Japan, has had its wireless station for some time, but it is only within recent years that the broadcasting station in that city has been erected.

The present station at Tokyo was erected three years ago, and it serves for the whole of the island. Rated at one kilowatt, the Tokyo station, J O A K, transmits on a wave-length of 375 metres. The whole apparatus has been designed and erected by a local concern, the Annaka Electric Manufacturing Company.

The usual broadcasting microphones of Western Electric pattern are employed in the studio, the current from these being stepped up by means of a three-stage amplifier before being fed into the oscillating unit of the transmitter.

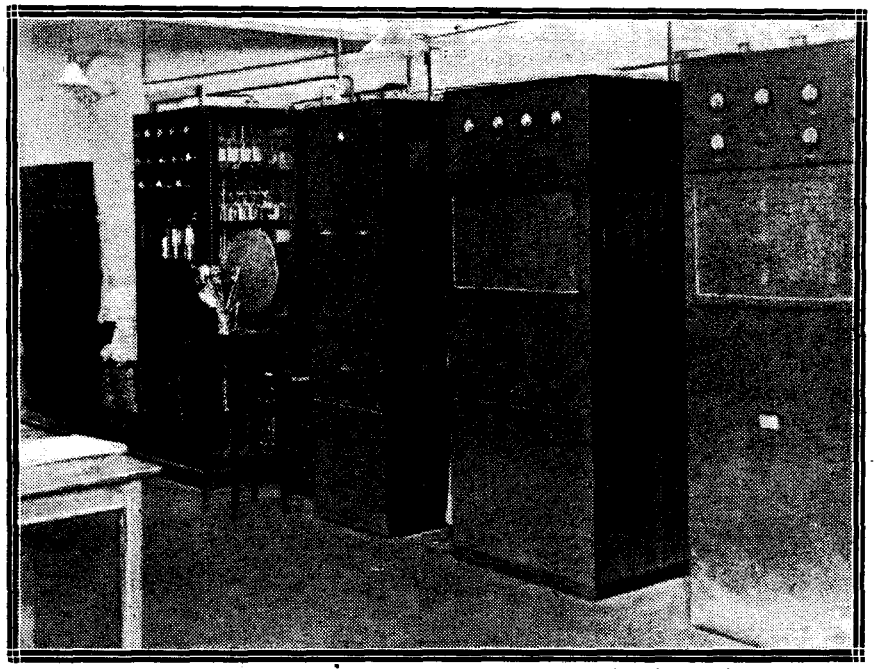
No Earth Connection

The transmitter itself is of the usual conventional pattern, affording a final



The studio of the J O A K broadcasting station at Tokyo. A feature is the very light drapery used for "blanketing" purposes.

aerial current of approximately 8·5 amps. The aerial itself is of the inverted L type, and it is suspended between two entirely self-supporting steel towers at a height of 150 ft., the length of aerial wire actually in circuit being rather short.



The transmitting apparatus used at the J O A K broadcasting station.

Of especial interest are the earthing arrangements of the Tokyo station. No direct earth is employed. For some reason or other the Japanese engineers at J O A K station seem to have pinned their faith to the employment of a counterpoise earth. This counterpoise consists of eight lengths of wire, each 30 ft. long, arranged horizontally in parallel at a distance of 3 ft. above the roof of the station and directly underneath the transmitting aerial.

The counterpoise earthing arrangements are certainly effective, and it is claimed that greater freedom from static storms, which are of so common occurrence in Eastern districts, are thereby obtained.

The Power Supply

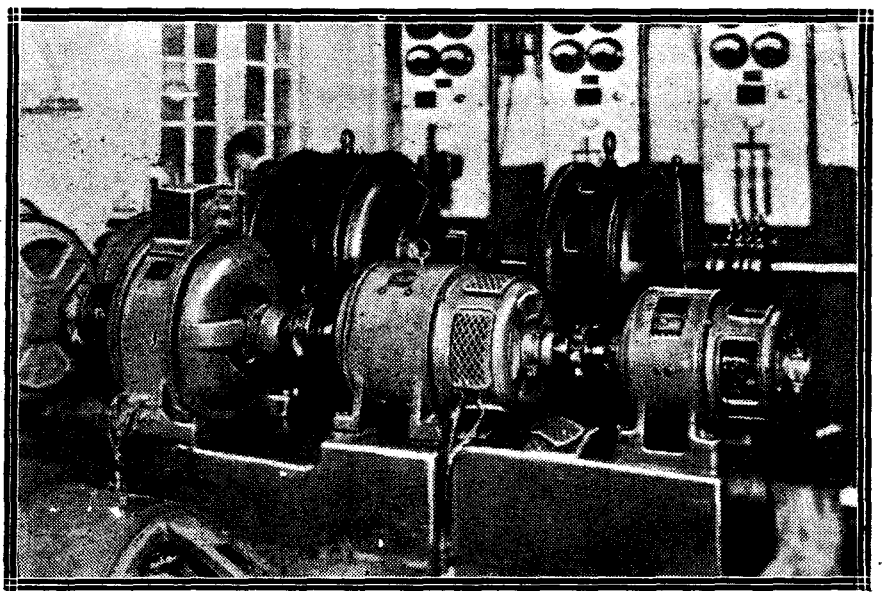
The Japanese station, J O A K, takes its current from its own special plant installed in the power station of the Tokyo municipal electric station, and also in the generating station of the Tokyo Electric Light Company. Quite a feature of interest concerning the Tokyo broadcasting station is that, in addition to these two main sources of power, it possesses an auxiliary or emergency reserve of power consisting of a 580 amp. storage battery which is capable of supplying a current for ten hours of continuous broadcasting.

As regards the programmes sent out from the Tokyo station, these are of the usual type, modified, of course, according to local requirements. The station effects quite a number of what we term over here "outside broadcasts." It relays from outside sources the speeches of local celebrities, and, in fact, it does everything which an ordinary up-to-date and perfectly efficient broadcasting station is nowadays expected to do. In February last, station J O A K broadcast certain events in the funeral procession of the late Emperor of Japan. A speech by Prince Chichibu was also broadcast at the time.

It is, as yet, far too early to say what will be the effect of broadcasting upon Japan. The nation that awoke so suddenly to civilisation, and broke with its tradition and history in the remarkable way that modern Japan did, may have many more surprises in store. Although the present broadcasting equipment installed in Tokyo is of the type standardised by Western civilisation, it is inevitable that both the programmes and the apparatus will have distinctive local influences bearing continuously upon them. Thus the special problems of Japan may call for a new broadcasting technique, and we of the West may in turn benefit from the development of radio in Sunrise Land.

Although the Japanese radio fan has his super-hets and other receivers of the "hot-stuff" variety, crystal enthusiasts are to be numbered in the districts around Tokyo in their thousands. For these latter individuals there exists no problem of interference, the Tokyo station being the only one of any importance for hundreds—nay, thousands—of miles around.

The Tokyo transmissions, whilst being seldom received over here, are well known in the western districts of America, and also in Australia. They are claimed, also, to have been received in Ceylon and in various parts of India. But it is for medium-short distance work that the Tokyo station exists, and there is no doubt that it performs its allotted functions in this sphere in an admirable manner.



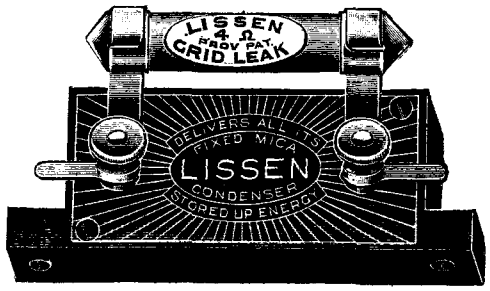
Some of the generators are installed at the Tokyo municipal electric generating station.

WHEREVER RADIO PARTS ARE WANTED—USE LISSEN—

NO matter what may be mentioned or used in any circuit of any booklet or periodical you may be building from, remember that the best parts have not necessarily been used. There are many advertising manufacturers—all expect a share in the use and mention of their products, and they usually get it. **LISSEN** gets a share, too, but obviously it is not possible for the periodical to use all one maker's parts, although they may be known to be the best. Remind yourself of that when building—remember, too, that the best parts are LISSEN, and that if you build with them you will use all the energy available, and get louder, clearer signals from near and far in consequence.

FACTS OF IMPORTANCE ABOUT LISSEN PARTS—

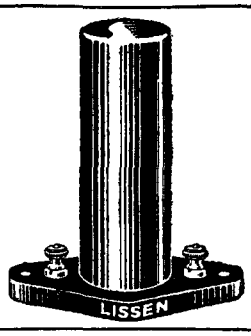
LISSEN FIXED CONDENSERS



Fixed condensers should be leak-proof, and if they are **LISSEN**, which **DELIVER** *ALL* **THEIR STORED-UP ENERGY** *ALL* **THE TIME,** nothing is lost. Note the case in the **LISSEN** condenser, how it can be clipped into the **LISSEN COMBINATOR** in resistance circuits, how it can easily be used upright or flat. Then the price of **LISSEN FIXED CONDENSERS** is half what it was a year ago. The plates are properly laid in a **LISSEN** —they are homogeneous with each other, and cannot move or come apart.

Capacities ·0001 to ·001, **1/-** each (much reduced).
Capacities ·002 to ·006, **1/6** each (much reduced).

DEMAND LISSEN FIXED CONDENSERS.



LISSEN H.F. CHOKE

Previously 10/-

NOW 5/6

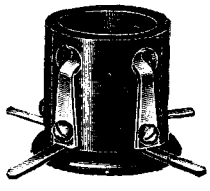
LISSEN FIXED GRID LEAKS

1/-  **1/-**

They do not alter—they are perfectly silent. You can put a **LISSEN** half-megohm leak in circuit direct on to a 220-volt supply and leave it on indefinitely—it will not alter. It can then be put straight into a critical radio circuit—it will be absolutely silent. **LISSEN** grid leaks have been further tested by exposure to rain and sun on the roof of the **LISSEN** factory. They never altered, never varied. Patented.

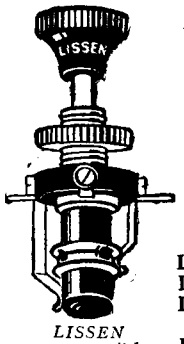
All resistances—Previously 1/8, **NOW 1/-** each.

LISSEN VALVE HOLDER



Has both low losses and also low capacity, twin virtues found in few valve holders. Sent out ready for baseboard mounting, but can also be used for panel mounting by bending springs straight.

Patented, previously 1/8, **NOW 1/-** each.



LISSEN 2-way switch

LISSEN SWITCHES

There is one for every switching need in radio. Designed for radio work where currents are small—they will not waste current. They fit easily—take up little room. **LISSEN ONE-HOLE FIXING, OF COURSE.**

	Previously.	**NOW**
LISSEN 2-way	2/9	**1/6**
LISSEN Series-parallel ..	3/9	**2/6**
LISSEN Double Pole Double Throw	4/-	**2/6**
LISSEN Key Switch ..	2/6	**1/6**

HOW TO MAKE H.T. BATTERIES LAST LONGER

Every ordinary H.T. battery can be made to yield more energy if a **LISSEN** 2 mfd. (or 1 mfd. but the larger capacity is the better) is put across it. It will absorb all the noises when the battery gets old. Your dealer will be pleased to show you how to connect it easily.

LISSEN (Mansbridge type) Condenser

2 mfd. **4/8**; 1 mfd., **3/10**

·01	**2/4**	·1	**2/6**
·025	**2/4**	·25	**3/-**
·05	**2/4**	·5	**3/4**

Specially moulded case makes it impossible for the condenser to short circuit on to case—a feature exclusive to **LISSEN.**

BASEBOARD RHEOSTATS

Reduced from 2/6 to 1/6

To popularise baseboard mounting resistors, **LISSEN** has now just reduced the price. Baseboard type are without knob dial, and pointer, which are not needed for baseboard.

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Prices 7 ohms	2/6	**1/6**
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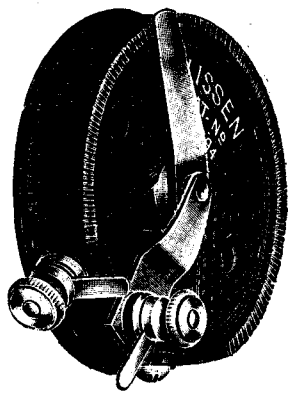

Quality Rheostats for Panel Mounting previously 4/- NOW 2/6

LISSEN quality—look how they are made, and note the irresistible appeal of price.

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LISSEN 7 ohms, patented ..	4/-	**2/6**
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LISSEN ONE-HOLE FIXING, OF COURSE

USE ANY CIRCUIT BUT ONLY LISSEN PARTS, NO MATTER WHAT ELSE MAY BE NAMED, and you will gain in volume and eliminate distortion. LISSEN PARTS—WELL THOUGHT OUT, THEN WELL MADE.

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Managing Director: THOMAS N. COLE.

L.259a

The Round Island Radio Beacon

NEW installations for the assistance of navigation, known as wireless beacons, are now under construction by Trinity House at various points around the English coast. The purpose of these beacons is to send out distinctive wireless signals at regular intervals, enabling vessels fitted with wireless direction finders to take bearings on the beacon stations and accurately to determine their position. These installations form a valuable addition to the aids to navigation for ensuring the safety of life at sea, and are expected to prove of the greatest assistance to marine navigation when ships are approaching land, particularly during darkness and in foggy weather.

Special Call-Sign

The first wireless beacon station to be put into regular commission by Trinity House is situated at Round island in the Scilly Islands. This set has a power of 500 watts, and is operated on a wave-length of 1,000 metres, which is the specified wave-length for wireless beacon stations. Each beacon station is to have a special call-sign, and that at Round Island is the letters G G G in Morse code.

The beacon transmitter has been designed by the Marconi Company to the specifications of Trinity House, and the whole equipment is automatically controlled by a master clock for transmitting groups of I.C.W. signals at predetermined intervals.

Precautions Against Breakdown

Every possible precaution has been taken to ensure that risk of breakdown inherent in automatic operation shall be reduced to a minimum, and all running machinery is duplicated throughout, whilst a spare set of wireless valves is fitted on the main transmitter, with automatic switching arrangements, so that should a valve burn out another immediately comes into use, and a suitable warning signal notifies the attendant. The master clock and character machine are also supplied in duplicate, so that any possibility of failure of the apparatus has been obviated as far as practicable.

A wireless mast, consisting of a steel lattice tower, 60 ft. high, has been erected on the island, and the aerial, which is of the multi-wire inverted L variety, is supported between this steel tower and the lighthouse gallery —the aerial having an average height of about 50 ft.

The whole of the transmitting circuits are mounted on a panel of robust construction, and there is easy access to all parts.

Suitable chokes, condensers, resistances, voltmeters and ammeters are provided, and there are four valves, type T.250, two of which are actually in use, the other two being "stand-by" valves.

Should either of the two valves in use burn out, a relay mounted on the panel automatically brings the "stand-by" pair into operation, and at the same time a loud-speaker alarm circuit is completed, for warning the attendant that one of the valves has become defective.

The filaments of the valves are heated by means of a step-down transformer from the main motor alternator.

The circuit used in the transmitter is that commonly known as the "back-to-back", and consequently the note actually heard in the receiver corresponds to a frequency twice that of the alternating-current frequency.

The transmitting unit is itself enclosed by an expanded metal case, rubber matting being provided to avoid risk of shock.

The high-frequency apparatus provides for coupled-circuit working, and consists of two cabinets, one of which contains the aerial tuning inductance, variometer, coupling coil, and aerial ammeter, whilst the other contains the closed-circuit inductance, reaction coil, closed-circuit condenser, and closed-circuit ammeter.

The high-frequency apparatus is designed to work most efficiently on the wireless beacon wave-length of 1,000 metres.

A Master-Control Clock

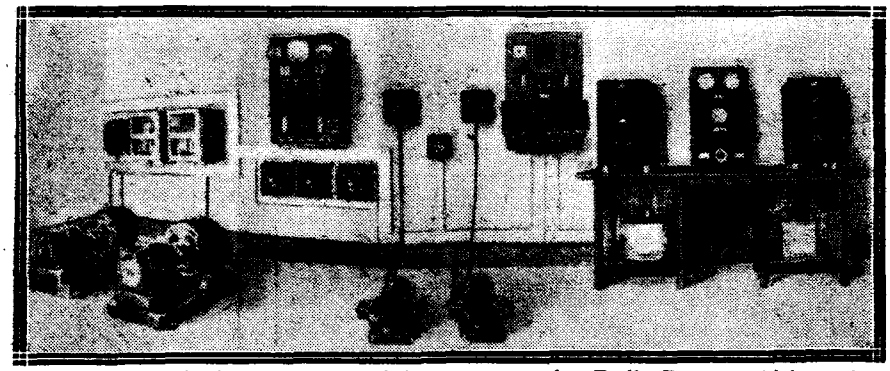
The signalling apparatus consists of two main parts:

The master-control clock which determines the periods when the beacon is to come into operation, and the character wheel which actually transmits the call-sign of the station.

The duplicate master clocks are mounted on a switchboard, which also incorporates a relay operated by the clock for starting up the motor driving the character wheel.

The signal for "Fair" weather periods consists of the call-sign G G G repeated at the rate of 15 words per minute for 47 seconds, followed by a prolonged dash of 10 seconds duration, and terminated by one repetition of the call-sign, the whole transmission taking 60 seconds

(*Continued on page* 425.)



This photograph shows the transmitting apparatus of a Radio Beacon, which sends out wireless signals to assist navigators. These automatic safeguards for seafarers are now being fitted by the Trinity House authorities at various points all round the British coasts.

A CHEAP GRAMOPHONE PICK-UP

Constructional details of an interesting loud-speaker device

By C. A. J. MEADOWS.

A GREAT number of wireless enthusiasts possess gramophones also, and many of them would like to be able to have the gramophone music capable of treatment similar to that received on the set; in other words, to run extensions to different rooms in the house. Providing that one is sufficiently wealthy to pay several pounds for the factory-produced "pick-up," this is a comparatively simple matter. If, on the other hand, finance plays an important part in the affair, the construction of a cheaper, but nevertheless efficient, instrument at home is a far more acceptable proposition.

The Parts Required

The items which are necessary for the assembly of such an instrument are as follows: One gramophone reproducer, one Skinderviken Button microphone, one special transformer for same, two large dry cells, some small terminals, and a few feet of flex.

It is, of course, assumed that there is available a two-valve L.F. amplifier or a set having two L.F. valves. (If extreme volume is not required one power valve may suffice; but this is a matter of personal taste.)

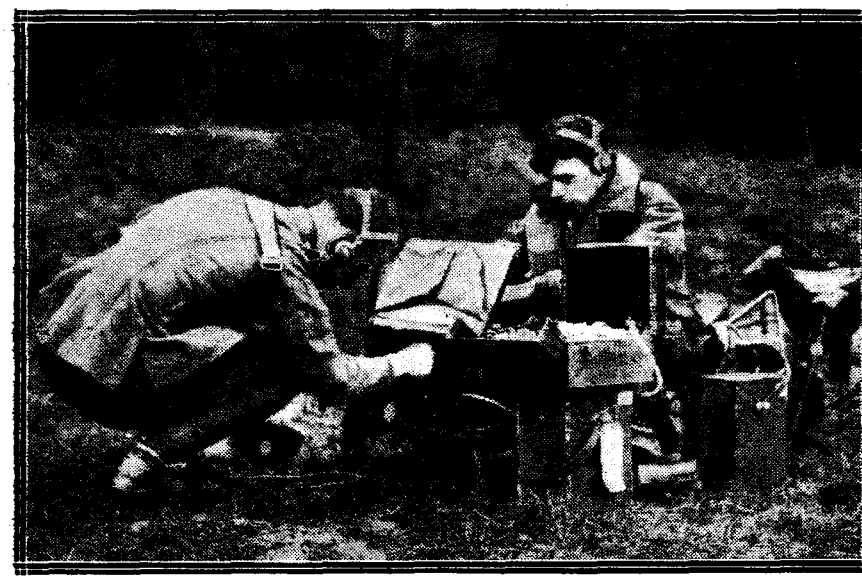
The sound-box purchased for the pick-up need not be an expensive one, as it will have to be partly dismantled to attach the microphone; quite a good model may be obtained for less than five shillings. The mica diaphragm must first be drilled to take the microphone, and this will entail the removal of the diaphragm from the body of the sound-box, which is usually accomplished by taking out the screws from the back plate.

Fitting the Microphone

It is advisable to detach the stylus bar and needle holder with the diaphragm, and great care must be taken when releasing the small screws and springs at the base of the rim, as if any were lost the efficiency of the sound-box when reassembled would be seriously impaired.

Only a small hole is required to take the mounting screw of the microphone, and this is fortunate, as mica is very tricky stuff to handle—it is really a job where assistance is needed. The diaphragm should be laid on a perfectly flat surface, with a piece of wood or a small box to support the needle holder and prevent undue strain on the diaphragm.

A cleaner hole will result if a punch is used for the purpose, and, if anything, this is less tricky than drilling. The punch must be dead-round and absolutely true, and it should have no point. Find a drill of equal diameter and drill into a piece of soft iron for about ¼ in., and be certain that the punch will just fit this hole.



Wireless and the Army Manoeuvres. With a "fishing-rod" aerial and a bayonet for earth this portable transmitting station can be erected and in use in less than ten minutes.

The centre of the hole being carefully marked on the diaphragm, place it over the hole in the iron and get someone to hold it. Get the punch dead true and tap lightly with a small hammer. The resultant hole will probably be clean and sharp, without any bubbles round the edge.

The microphone may now be attached, and the connections made before the sound-box is reassembled. One lead will have to be inside, so that a small hole must be drilled in the casing, preferably on the rim. Replace the diaphragm and stylus bar in the sound-box casing, bring the inner flex lead through the hole drilled for it, and restore the sound-box to its usual position on the tone arm. The two flex leads had better be twisted round the tone arm, to ensure that there will be no interference with the sound-box while playing.

Simple Switching

All that now remains is to connect the microphone, batteries, and transformer, and the secondary of the transformer to the set. Take one of the leads from the microphone to one end of the primary winding of the transformer, the other to one battery terminal, the other battery terminal to the remaining end of the transformer primary. It is a good plan to include a switch in this part of the circuit, as if left on for any length of time the battery will soon be run down, and disconnecting one of the leads each time the set is switched off is a tedious performance.

The leads from the secondary of the transformer are connected to the grid of the first L.F. valve and L.T. negative or G.B. negative respectively. Provision should be made for switching in the pick-up or the set, and a good plan is to make use of a plug and jack of the double-circuit type. Otherwise, to simply connect the output terminals of the pick-up transformer to the set without breaking the circuit of the existing L.F. transformer leaves its secondary winding in parallel with that of the pick-up.

FOR THE CONSTRUCTOR

A Stand-By Slow-Motion Device—Refilling Engraving—A Tapped Plug-In Coil

A Stand-By Slow-Motion Device

WHEN ordinary plain dials are used for operating the tuning condensers on a receiver, difficulty is sometimes experienced on tuning-in a station owing to the "coarseness" of the condenser motion. This may arise from the incorporation of a dial with too small a diameter, or the condenser shaft may be a little stiff in its bearings, making the motion a trifle jerky, and tuning therefore erratic. Of course, with the use of a vernier or slow-motion dial the trouble would not have arisen; but since it is not

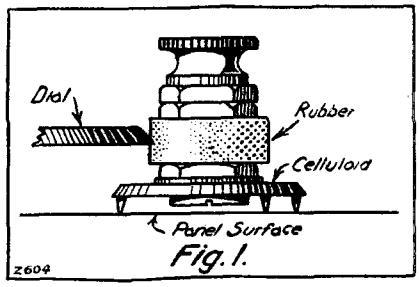


Fig. 1.

always convenient to fit these dials, or perhaps their full benefits are only occasionally required, it is a good plan to have a stand-by slow-motion attachment. This can be made quite simply in a manner that enables it to be pressed into service as desired and then removed when the station is satisfactorily heard.

One form of such a device is illustrated in Fig. 1. Procure a draughtsman's celluloid centre—a small disc of celluloid with three pin feet, and normally used to prevent the compass point from damaging the drawing paper when a large number of circles are being made from the same centre—and drill a hole in its centre large enough just to clear a 4 B.A. screw thread. File down the head of a 4 B.A. brass screw so that its final thickness is about half the length of the pin feet (as indicated in Fig. 1), pass the screw through the hole in the celluloid, and hold it in place by means of a washer and *thin* nut, so that it can just turn round. Having found the best pressure of the nut to allow a smooth motion, fix it to the screw by running a little solder between the top of the nut, which is preferably recessed, and the 4 B.A. screw thread. Now attach a piece of cylindrical rubber to this screw, squeezing it in place by a pair of locknuts. The addition of a small ebonite knob or milled nut completes the job.

To use this arrangement, simply place it on the ebonite panel so that the rubber presses against the edge of the condenser dial. By pressing lightly on the knob the pins will bite sufficiently into the panel surface without causing damage, and the dial can then be rotated slowly by turning the small ebonite knob or milled nut. The friction grip between the periphery of the condenser dial and the rubber cylinder will allow a fine motion to take place.

Refilling Engraving

IT often happens that, after a time, the white filler used in the engraving on panels, dials, and so forth, becomes discoloured and very dry, in many cases falling out or becoming rubbed out when the set is dusted. It takes some time to become noticeable, but when it does it is a perpetual eyesore. It is, however, quite a simple matter to clean out and refill the engraving with different material.

The removal of the remaining old filler must be done very carefully, as if any marks are made by the tool used for the purpose they will show up after the refilling process has finished. A fine bradawl will do fairly well, or the point of a pair of compasses. The old filler must be thoroughly cleaned out before attempting to use the new, and in the case of a dial this is not as easy as it sounds.

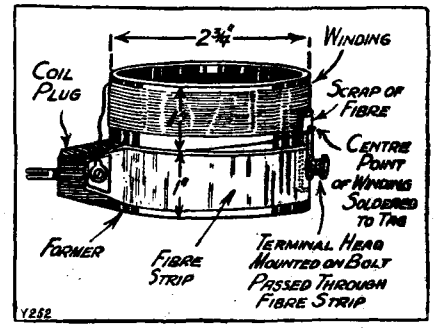
If the engraving on the dial is very fine a smaller point will be required than for a panel, a hatpin being far more suitable than a bradawl. Every line and figure must be well scraped to ensure the complete removal of the original mixture. It is not advisable to try damping it first, as the insulation of the panel might be impaired, or if petrol were used the polish would probably suffer.

The filler which is to be employed depends upon the choice of the constructor. White wax may be used, but it is difficult to handle; a cream composed of plaster of Paris and water is good, but may need renewing within a few months. By far the best is Process White, which is obtainable in small bottles from most art or photographic stores, and costs about 1s. per bottle. It should be rubbed well into the engraving and used freely, as the residue will come off the panel when rubbed lightly with a damp cloth.

A Tapped Plug-In Coil

AN efficient plug-in coil with a centre tapping which may be used for auto-coupling is illustrated below. Here a 2-inch length of ebonite tube, $2\frac{3}{4}$ inches in diameter, is wound in solenoid style with the desired number of turns (about 55 for the broadcast band), a space of $\frac{1}{4}$ in. being left in the winding at the point where the tapping is to be taken. The coil is mounted on an ordinary plug-in mount by means of a length of fibre or celluloid strip, which is passed round the coil near to one of its edges (care being taken that the plug is mounted the right way round so that the coil will fit into the coil holder with the additional length of tube protruding away from the coil mounted in the other socket of the holder).

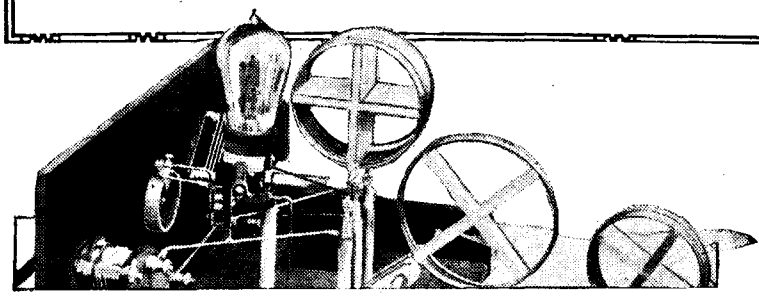
Before affixing the fibre strip, a 4 B.A. bolt is passed upwards through a hole in the fibre and secured with a



nut and terminal head, to which the aerial will be connected. A soldering tag is placed under the nut. A scrap of fibre or celluloid, about 1 in. by $\frac{1}{2}$ in. is slipped under the head of the bolt, in order to insulate it from the winding immediately below. The strand of wire at the point of tapping is bared for $\frac{1}{4}$ in. and lifted over the end of the soldering tag, which projects at the edge of the fibre strip, and soldered thereto.

The winding for the coil may be made with No. 28 D.C.C. for the broadcast band, but a finer wire, such as No. 36 D.S.C., will be necessary for a Daventry coil of 200 turns made on these lines.

BARE WIRE "DX" COILS



THE following method of building and mounting interchangeable low-loss skeleton coils for short-wave reception will be found a great improvement on the orthodox and

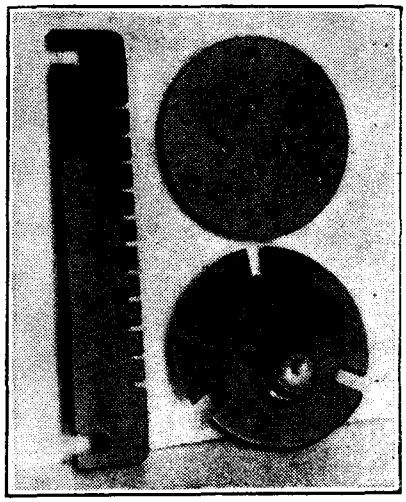


Fig. 1. Old transformer bases will do for the discs.

laborious method of "worming" the helix through holes in ebonite spreaders, and fitting plug connections to the fragile frames. The first problem, rigidity without loss of efficiency, has been overcome by building up the frame, or former, from two $\frac{3}{16}$-in. ebonite discs and three $\frac{3}{16}$-in. ebonite strips, these being slotted as in Fig. 1, and then interlocked in the manner shown in Fig. 3.

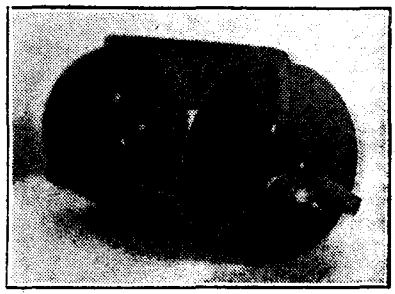


Fig. 3. The strips interlock as shown.

The discs (as shown in the upper right-hand corner of Fig. 1) are ordinary valve-holder or transformer bases, and are about 2 in. in diameter. The slots are cut down to the three accurately-spaced fixing holes, and the "grid" hole of each disc is fitted with a small terminal. The strips are $\frac{3}{4}$ in. wide and the slots for the winding are spaced $\frac{1}{4}$ in. apart.

Staggered Slots

The length of the strips will, of course, depend upon the number of turns required. In the present example they are 4 in. long (for 10 turns). They should be placed in the vice in the manner shown at D in Fig. 2, so that when assembled the slots will be slightly staggered as at E.

The No. 16 tinned-copper wire is wound tightly round a 2-in. diameter tube, and then allowed to spring free

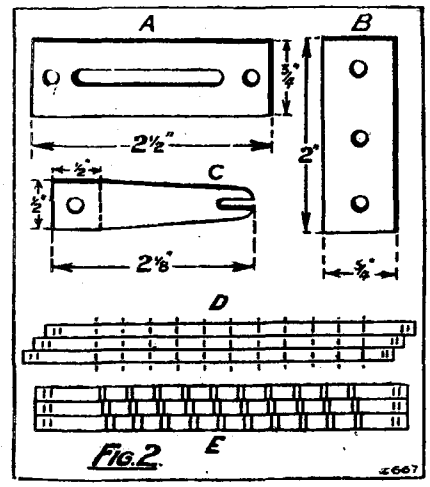


FIG. 2.

of same, when the diameter of the helix will be about $2\frac{1}{2}$ in. It is now only necessary to slip the helix over the assembled former, solder one end to one of the terminal shanks, and then lightly press each turn down to its "unsprung" diameter, and at the same time place it into the appropriate slots. The other end is then soldered to the other terminal shank.

The holder, which may be adjusted to take coils of various lengths, is made up from two ebonite strips A and B (Fig. 2), two sheet-brass clips C, two terminals, and four spacing sleeves, these being arranged as shown in Fig. 4. The clips C are bent to right angles at the dotted line, one being clamped permanently to the centre of the ebonite strip B, and the other well soldered to its terminal shank, so that by placing a milled nut on the lower end of the shank, under the slotted strip A, the clip may be adjusted and clamped in any position.

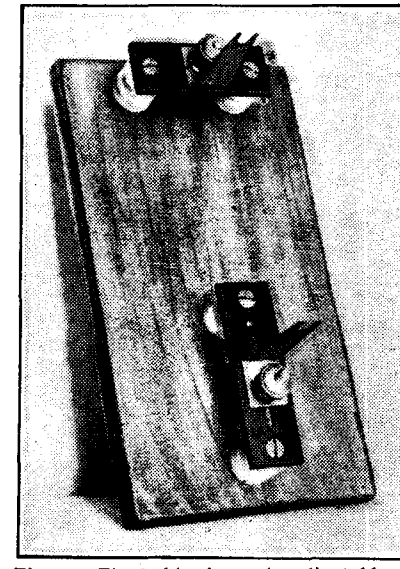


Fig. 4. The holder is made adjustable to take coils of different lengths.

Fig. 5 shows a side view of the complete coil and mount. The spacing sleeves consist of small porcelain insulators as used for indoor aerials, etc., but other forms of sleeves may be used if desired, the idea being to keep the terminal nuts clear of the baseboard, and to allow sufficient space for manipulating the milled nut under the slotted runner. This latter may be made much longer in order to accommodate a wider range of coils.

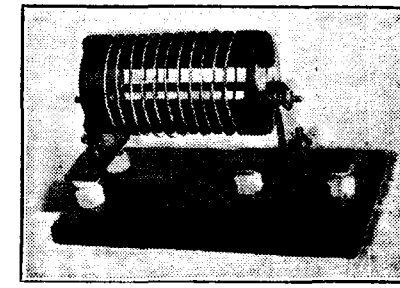
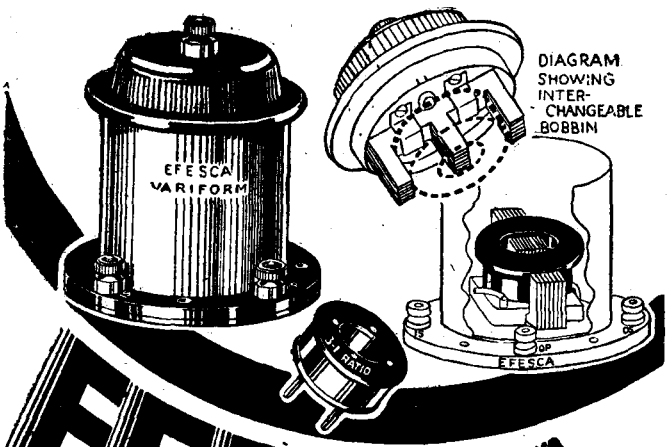


Fig. 5. The complete coil and mount.



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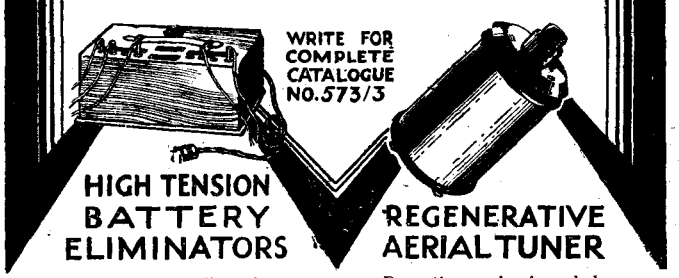

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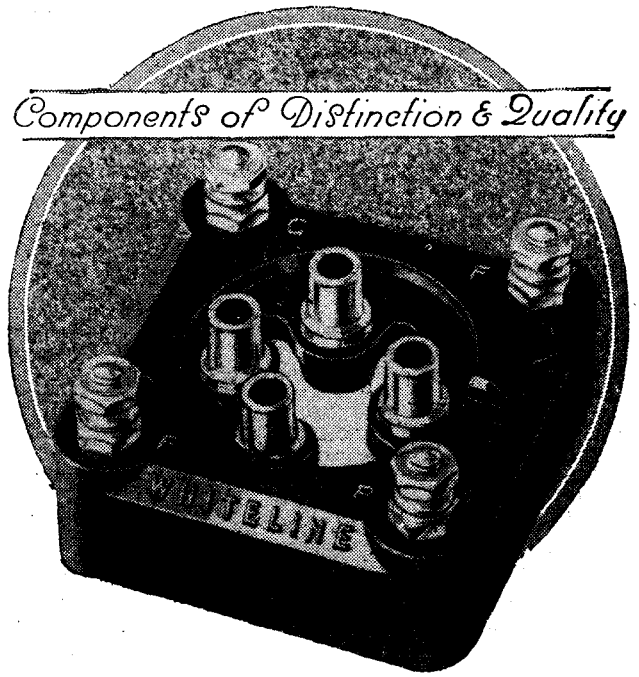

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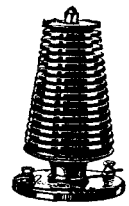

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My Broadcasting Diary

Under this heading month by month our Broadcasting Correspondent will record the news of the progress of the British Broadcasting Corporation, and will comment on the policies in force at B.B.C. headquarters.

Better Talks at Last

THERE is a marked improvement in the variety and quality of the talks planned for this autumn and winter by the B.B.C. As one of that numerous body of listeners who have hardly ever tolerated talks, I am actually looking forward to some of those being advertised for the new season. For instance, the psychology series on the Development of Mind and Character, handled by Dr. H. Crichton Miller, supported by Professor Cyril Burt and Dr. W. A. Potts, should be of absorbing interest.

Mr. St. John Ervine's course on "The Modern Drama" should have a big and appreciative audience. Then Mr. Anthony Asquith is to deal with "The Art of the Cinema." To the technically minded, Professor Cramp's course on "One Hundred Years of Electrical Engineering" should be acceptable. While there is still too much bad programme material in the talks syllabus, it is undoubtedly much more closely related to actuality than any previous outline of the kind.

I am in a position to say that the whole of the credit for the considerable improvement is due to Miss Hilda Matheson, who took over the Talks some nine months ago, and has effected what is little short of a revolution. Miss Matheson brought to her new task not only wide interests but also the advantage of the numerous and catholic contacts secured while she was political secretary to Viscountess Astor, M.P. More strength to her elbow! In just over half a year she has accomplished what seemed impossible twelve months ago.

Success of the Governors

The B.B.C. Governors, after nine months in office, may be said to have justified themselves. They have avoided the pitfalls of numerous and insistent temptations. First of all, they have been careful not to upset or derange the delicate machinery entrusted to their care for ten years. Secondly, they have kept themselves as much in the background as does the executive staff of the service. There have been no attempts to secure personal publicity through B.B.C. association.

Such criticism is due either to malice or ignorance. Lord Clarendon and his colleagues, Lord Gainford, Mrs. Philip Snowden, Sir Gordon Nairne, and Dr. Rendall have shaped into a well-balanced team, and have settled down to withstand all the bowlers that may care to come along. I understand that they meet frequently, and that there is quite enough honest divergence of view to enliven their proceedings and to protect the essential interests of the public.

Short-wave reception has been exceptionally successful of late. With the receiver shown above the Dempsey-Sharkey fight broadcast was picked up direct, and such sets are able to receive Australian programmes without difficulty.

Thirdly, they have studied hard and have mastered most of the work for which they are now responsible. On the constructive side they have given consistent support and encouragement to their Executive deputies. There is bound to be occasional criticism of the Governors because of their alleged incapacity or indifference.

The Short-Wave Transmitter

Captain Eckersley has promised to have ready his Empire short-wave transmitter about the middle of October. After some preliminary tests, the B.B.C. engineers will engage in a series of experiments bo

in transmission and in reception to and from the United States and the British Overseas possessions. The B.B.C. held out against this move much too long, but they were wise in the end to bow to public opinion gravely concerned both in the matter of prestige and in that of Imperial consolidation.

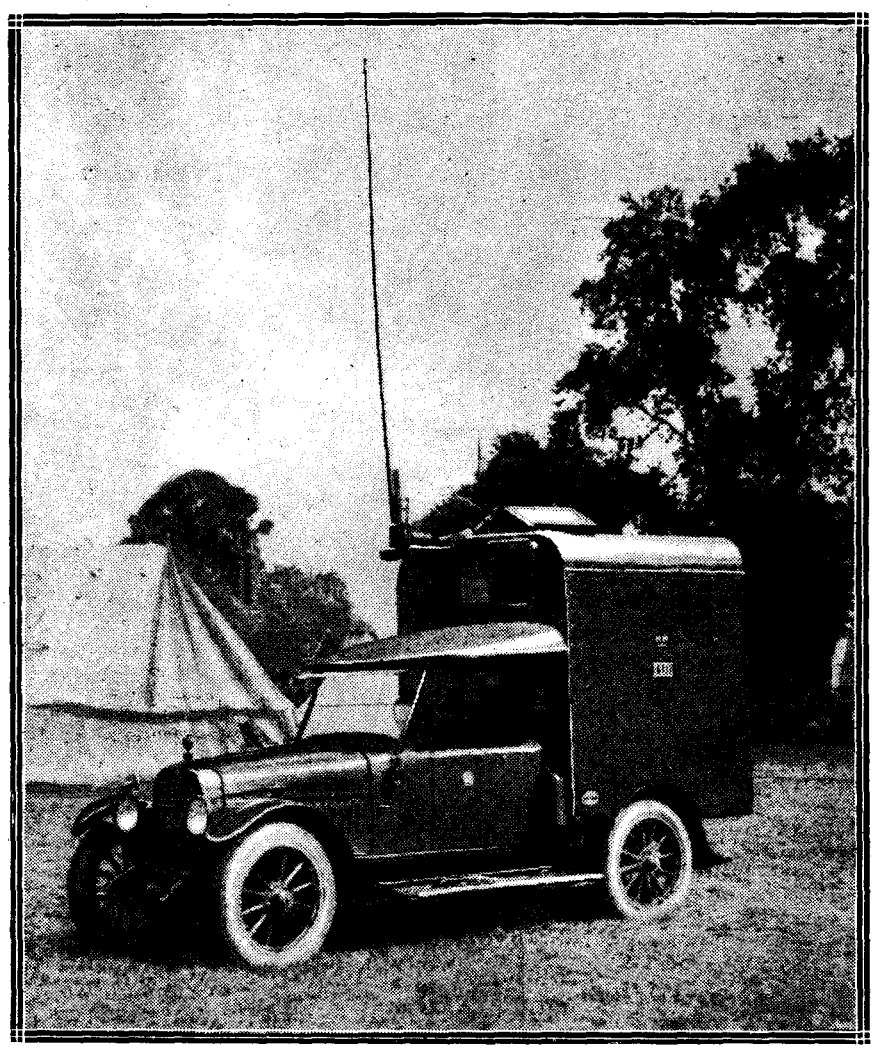
National Wireless Week Uncertainties

National Wireless Week, again planned to synchronise with the B.B.C. Birthday Week in November, is in danger because of the trouble between the B.B.C. and the wireless trade. Difficulties have arisen because of the B.B.C. attitude to reception and attempts to influence the policy of the manufacturers. Surely this private quarrel might be allowed to run on its own sweet course without disturbing National Wireless Week.

The latter is an enterprise which will help all concerned: trade, B.B.C., and listeners. Let's have it, by all means. If it should not take place, the public will want very good reasons. Incidentally, the trade will be the chief sufferer.

"Advisory Committee" Trouble

The Wireless Organisations Advisory Committee is very peeved and upset about its treatment at Savoy Hill. True, a very charming and complimentary official report of the first half year's work has been issued; but it is notorious that this does not represent the individual views of the majority of the Committee.



An Army Portable Wireless Station. Armoured cars are now being fitted with wireless, and the above photograph shows the Headquarters Car, with its mast erected.

It would be a pity if the Committee sinks into coma or breaks up, because, despite its limitations and some of its mistakes, it has been of real help to the B.B.C., and has actually influenced programme policy in several directions. The basic trouble, of course, is that the Committee forgets what is implied by its self-imposed "Advisory" status.

In this capacity it is quite at the mercy of the B.B.C. If it exercised the complete independence of the Trade Committee on Broadcasting, then its power might be considerably greater. On the other hand, however, it would not have the same free access to confidential information which is now granted. The possible incorporation of the several listeners' organisations would have the effect of strengthening the Committee, as its constituency would be then more representative.

Dressmaking by Radio

Miss E. R. Hambridge, of Needlecraft House, on September 29th, will begin a new series of six dressmaking talks on Thursday afternoons—2 L O, 5 X X, and relays. The experimental series of dressmaking talks in the spring was acclaimed successful, and the idea is now being followed up.

After 5 G B, What?

Time is getting on and it appears that there is still doubt at Savoy Hill as to how much of the Regional Scheme to apply as the first instalment. Really, 5 G B is not an instalment at all, because after it has served its experimental purpose it will probably be moved elsewhere.

The cautious school at Savoy Hill appear disposed to limit the first real instalment of the Regional Scheme to the twin station at Manchester, so that expenditure will not be incurred on the others until it is known that the right lines are being pursued.

The confident school of thought, on the other hand, would put in hand simultaneously the twin stations for the West Country, the Pennines, and Scotland. The latter contend that there has been so much delay in the initiation of the scheme that it is justifiable to take some risk with money and gain experience as the scheme develops.

If the issue were put to a referendum of listeners there is no doubt that the vast majority would vote for the ambitious scheme. What the listening public wants is the establishment of all the new transmitters with the minimum of delay. Adjustment there must be at both ends. But every intelligent listener is satisfied that he will gain tremendously from the Regional Scheme when he has adapted himself to it.

Therefore, it would appear wise for Savoy Hill to take the plunge and get on with the big job, even if the technical risks are considerable.

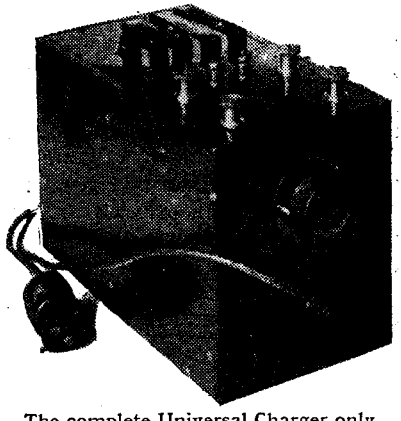
A UNIVERSAL BATTERY CHARGER

We give below the first published account of a useful new invention by our Scientific Adviser. This new device enables direct current to be stepped down or up in voltage for battery charging or other purposes, thereby making a considerable saving in electricity cost.

By J. H. T. ROBERTS, D.Sc., F.Inst.P.

IN this article I want to describe what I believe to be an entirely new device, which enables anyone whose electric supply is *direct* current to save 90 per cent to 95 per cent of the cost of charging his batteries from the electric-light mains, or, in simple commercial parlance, 18s. to 19s. in the pound.

Probably every reader of this article is aware that the device known



The complete Universal Charger only measures 7 in. by 5 in. by 4 in.

as a "battery charger," which is now so very familiar, consists of (1) a step-down transformer, and (2) a rectifier. The purpose of the step-down transformer is to reduce the voltage of the current from the 200 or 250 volts of the electric-light mains own to a voltage approximating to twice that of the storage battery to be charged; if the battery is a 6-volt battery, the output voltage of the transformer will be, as a rule, from 10 to 15 volts.

It is to be noted that since a battery-charger includes a transformer it is intended to be operated from *alternating*-current electric supply as, of course, a transformer will not operate from ordinary continuous current. If you connect a battery-charger, of the type just mentioned, to a source of *direct*-current electric supply, the current will merely pass through the primary of the transformer and nothing whatever will happen in the secondary, therefore nothing will be delivered from the charger.

Why Transformers Save Money

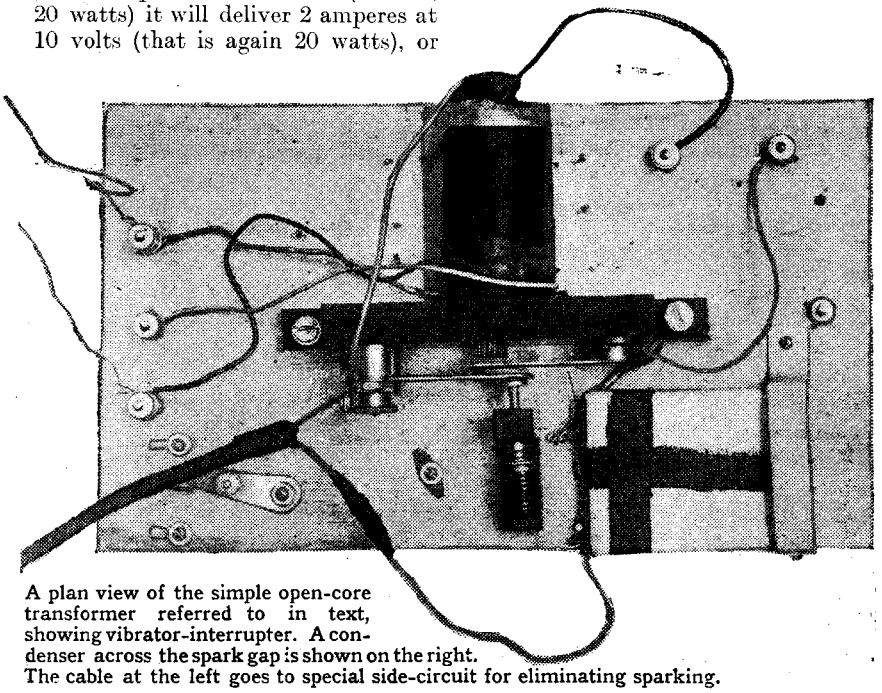
First of all, before going any further, let me explain the great advantage of the transformer step-down principle, and why *direct-current* electric-light supply is so disadvantageous for battery-charging.

Let us suppose, for the sake of simplicity, that the transformer—which consists simply of two separate coils of wire upon an iron core—is theoretically perfect in its efficiency: as a fact, a well-designed transformer may attain a very high efficiency, 95 per cent or more. In such a case, the energy taken into the primary of the transformer from the electric-light mains is equal to the energy delivered from the secondary or low-tension winding of the transformer. Thus, if the transformer draws $\frac{1}{10}$th of an ampere at 200 volts (that is, 20 watts) it will deliver 2 amperes at 10 volts (that is again 20 watts), or 1 ampere at 20 volts (again 20 watts), and so on.

Now suppose we want to charge a battery of 6 volts at 1 ampere, and suppose we require 10 volts to drive the current of 1 ampere through the resistance of the battery and the rectifier (which we must include in series). Then we have to arrange for 1 ampere to be delivered at 10 volts, that is, for a power of 10 watts. Therefore, we have to draw 10 watts from the electric-light mains at 200 volts in the primary of the transformer, that is a current from the mains of $\frac{1}{20}$th of an ampere. So the current drawn from the mains is $\frac{1}{20}$th of an ampere, whilst the current delivered from the primary of the transformer is 20 times as much, namely 1 ampere.

Agrees With Theory

Perhaps I ought to point out that this is in no way contrary to the well-known principle of the Conservation



A plan view of the simple open-core transformer referred to in text, showing vibrator-interrupter. A condenser across the spark gap is shown on the right. The cable at the left goes to special side-circuit for eliminating sparking.

of Energy, for the energy is proportional to the watts, and although the current in one case is much larger than in the other, the *voltage* (or pressure) at which that current is supplied is correspondingly smaller where the current is larger, so that the wattage is the same in both cases. As a matter of fact, of course, in practice (owing to the transformer not being 100 per cent efficient), the wattage output will always be rather less than the wattage input.

Wasteful Present-Day Method

If the transformer were not used, and the current of 1 ampere were drawn direct from the electric-light mains at the voltage of 200 volts, the total amount of energy would be 200 by 1, that is, 200 watts, instead of being only 10 watts. The charging of the battery would be exactly the same, for that depends upon the current which is passing through it and the time during which it passes. In order to permit of the battery being charged direct from the mains, it would be necessary to introduce a series resistance, and *for every* 10 *watts of energy put into the battery* 190 *watts would be dissipated, or lost, in the series resistance.*

By using the step-down transformer, however, this series resistance, with the consequent enormous percentage loss of energy, is entirely avoided, and we only draw from the electric-light mains practically the same amount of energy that we put into the battery.

In the simplest possible language, or in terms, so to speak, of pounds, shillings and pence, this means that, whereas we might spend—say, for the sake of simplicity—10d. in charging a certain battery, using a step-down transformer, the same charge given to the battery, if we drew the current direct from the 200-volt mains by means of a series resistance, would have cost us 200 pence, or 20 times as much. A 1s. worth of electricity put into the battery under ordinary conditions by a step-down transformer would have cost about 20s. if a series resistance had been used, the other 19s. worth being wasted, as already explained, in the series resistance.

I think this will now be quite clear, and I have explained it in rather considerable detail for the benefit of those of my readers to whom it may not have been previously, perhaps, quite familiar.

The very great advantage of stepping-down the voltage to a value somewhere near that required for the purpose in view is so universally recognised that, where alternating-current supply is available, no one would dream of adopting any other method.

Connecting In Mains

Now, where the electric-light supply happens to be direct or continuous current, the transformer principle is not available, and amateurs or experimenters (apart from those who put themselves to the inconvenience of taking their accumulators to a garage to be charged) generally employ a set of lamp resistances in order to charge their batteries from the electric mains. In some cases, more ingenious or technically-minded amateurs will arrange for the batteries to be introduced into the main supply circuit with electric lamps of the house, so that when the electric lights are in use the same current which lights the lamps is passing through the battery. This, however, is usually very inconvenient, and it means that the batteries can only be put on charge when the electric lights happen to be in use. Moreover, interference with the main electric supply is contrary to regulations, and is attended with a considerable amount of risk.

£1 instead of 1s.

Where any form of resistance, such as that of electric lamps, is used in series with the battery, the conditions are extremely wasteful, as has already been explained above, and for every shillingsworth of current you put into your battery you are obliged to throw away about 19s. in the resistance, whether lamps or otherwise.

If the step-down transformer principle could be made available for those whose electric-light supply is D.C., it would mean that the convenience and very great economy which are possible with *alternating* current would be possible also with *direct* current.

The device which I will now proceed to describe is an extremely simple one, and it in effect converts a battery charger which is available for alternating current into one available also for direct current.

I have already said that if continuous current be passed into the primary of a transformer nothing is delivered from the secondary.

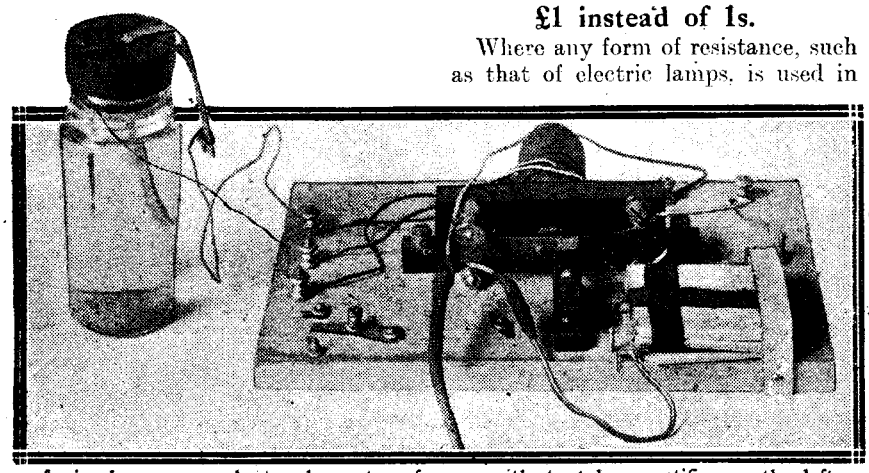
Working Transformer on D.C.

If, however, the continuous current can be automatically and regularly interrupted, so that, although the current always passes in one direction, it does so in a series of short impulses, *then alternating potentials will be induced in the secondary of the transformer and an alternating current will be delivered.* With suitable arrangements of the interrupter the step-down ratio can be made practically the same for the interrupted direct current as for alternating current, and therefore the battery charger will deliver practically the same current through a battery whether the transformer be supplied from, say, 200 volts A.C. or 200 volts D.C.

My readers will appreciate that this is a very important and valuable feature, as not only does it give the D.C. user all the advantages of step-down voltage, but it makes the battery charger suitable for use on *either type of electric supply* (i.e. alternating current or direct current).

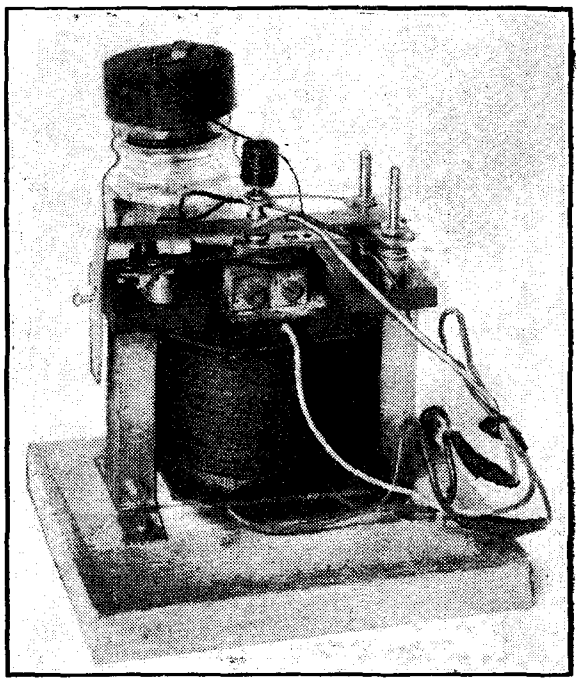
Various Interrupters

Having now explained the fundamental principle of this new device, you will have no difficulty in appreciating that various types of interrupter may be used. The vibrator interrupter is perhaps the first to suggest itself, whilst I have used also electrolytic and rotary interrupters. An interesting type of interrupter circuit in the primary is the neon-lamp type, with resistance and condenser, but this is (as regards the battery-charger) only of theoretical interest, since it is limited in its application



A simple open-cored step-down transformer with tantalum rectifier on the left.

in certain special ways, which it would take too long to enter into in the present article. I have also made some interesting experiments with a special type of oscillatory circuit in conjunction with the primary of the transformer, but that, again, is not of immediate importance in connection with the present purpose of the invention.



A special semi-open-coil transformer fitted with vibrator-interrupter, and connected to tantalum rectifier on the output low-tension side. Note the gap in transformer coil which is made so that part of the transformer field is available to operate the interrupter.

The obvious and most practically convenient interrupter is the vibrator.

With a very rough "hook-up," using a vibrator of the Ford-coil type, I was able to obtain very promising results in the first experiment on this subject. A photograph of this device is shown herewith, and it will be seen how very rough the trial really was. The "transformer" consisted of a small coil, with an open core of about $\frac{3}{8}$in. in diameter, filled with iron wires of about 3 in. in length.

The amount of iron in the circuit was, therefore, very small, and the transformer correspondingly inefficient, owing both to the smallness of the iron core and to the fact that the transformer was open cored. The primary consisted of 5,000 turns of No. 36 enamel wire, and was connected in series with the vibratory interrupter. The latter was fitted with special tungsten contacts, and a rather ingenious side circuit was arranged (which I shall describe later on) for reducing the spark at the contacts until it was practically invisible even in the dark.

Efficiency 10 to 1

With this preliminary device, and without any special precautions other than those indicated above, *an efficiency of more than* 10 *to* 1 was immediately obtained. Using a single-wave tantalum rectifier in series with the low-tension secondary of the transformer, an output of just over 1 ampere was obtained with an input from the mains of rather less than 100 milliamps (that is, below one-tenth of an amp.). The reading of the ammeter on the low-tension side was absolutely steady—as steady as if the device had been operating on alternating-current supply.

Higher Efficiencies

Since this first trial various other models have been made, using closed-core or semi-closed-core transformers, and correspondingly higher efficiencies have been obtained. Where the vibrator is mounted direct upon the transformer I have found that it is necessary, for the proper working, to use a core which is not entirely closed, as with a fully closed core the magnetic leakage is insufficient to operate the vibrator reliably.

Transformers of the hedgehog type have also been used successfully, but in this case, owing to the geometrical irregularity of the core (and also to the fact that it is very efficiently closed), I have introduced the vibrator as a separate unit in series with the primary, the interrupter in this case being of a special low-resistance type.

A Special Research

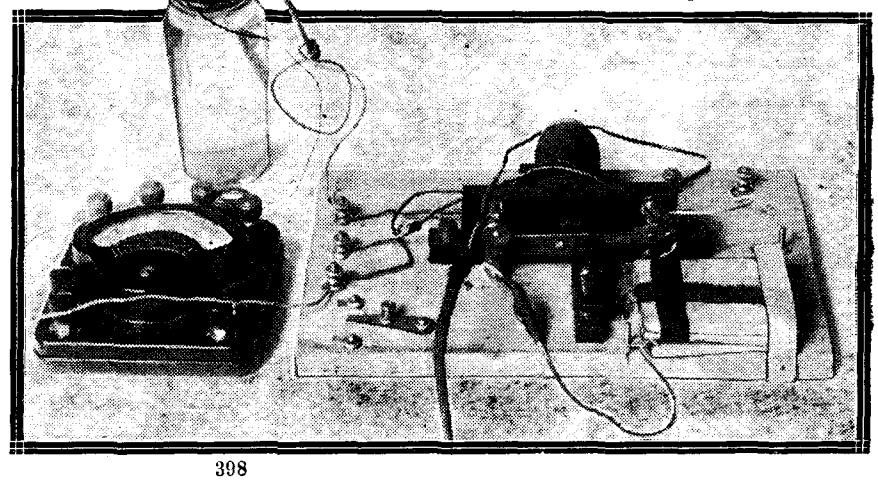
The interrupter which I have used has been specially developed for the purpose; the ordinary interrupters used with induction coils are quite unsuitable, being far too large, and designed to work on a minimum current of about 10 amperes and making a great amount of noise in the process. The interrupter is practically silent, and operates with a current of the order of one-tenth of an ampere.

Where a rotary interrupter is used it is a simple matter to arrange separate contacts in conjunction with the rotor or commutator, and to rectify the alternating current from the low-tension side by means of the *same rotor* which creates the interruptions on the high-tension side.

The Rectifier

A special case, which calls for mention also, is that in which a vibrator interrupter is used, having extra contacts mounted thereon, these extra contacts being used for rectifying the low-tension alternating current. It will be obvious that the frequency of the low-tension current will be equal to (or a multiple of) that

A step-down D.C. charger with tantalum rectifier and D.C. ammeter in the low-tension output side.



of the interruptions, and therefore *the interrupter which breaks up the primary current is eminently adapted to rectify the secondary current.*

In another case, I have used a special transformer with two separate vibrators mounted, in one case side by side, and in another case at opposite ends of the core, the first vibrator creating the interruptions in the primary current and the second one rectifying the alternating current from the secondary.

Universal A.C. or D.C.

So far, the arrangement which I find quite simple and very practical is one in which a vibrator interrupter is used, mounted direct upon the transformer, the low-tension alternating current being rectified by means of a tantalum rectifier. This arrangement has the very practical advantage that it may also be used on alternating-current electric-supply by the simple process of connecting the input leads direct to the terminals of the primary of the transformer, thereby leaving the vibrator out of circuit. If it is desired to use the charger on *direct*-current electric supply it is only necessary to remove one of the input leads and connect it to a third terminal, which brings the vibrator in series with the input.

H.T. Supply for L.T. Battery

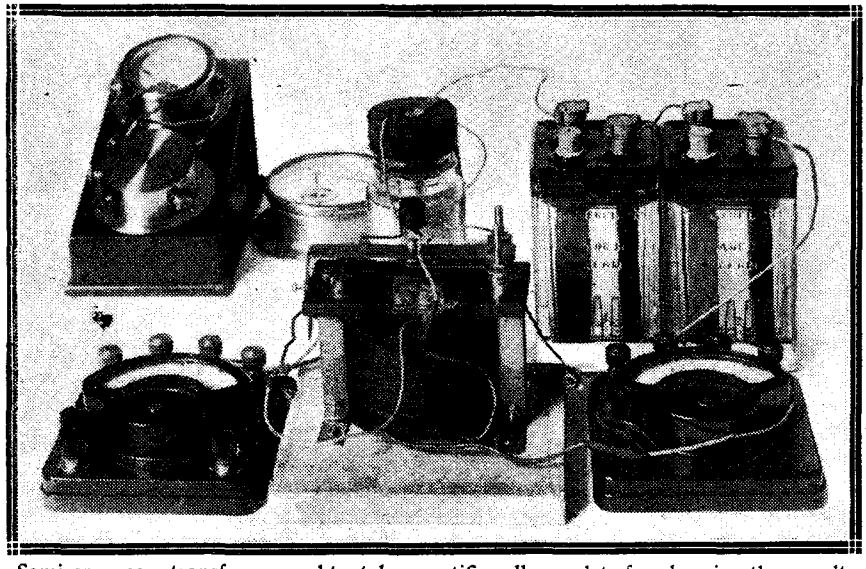
A device on somewhat similar lines to the foregoing has also been used for providing the high-tension plate supply for a wireless receiving set from the low-tension battery. In this case, however, a special form of interrupter is used, which gives a more or less regular wave form, and a special type of rectifier was used on the step-up or high-tension side, with chokes and condensers for smoothing out the H.T. direct-current output.

A carbon-microphone type of interrupter has given good results in simpler experiments, with crystal rectification.

For Experimenters

Whilst these experiments have been proceeding, enquiries have been received from manufacturers desirous of placing this universal A.C.-D.C. charger upon the market, but further particulars in that direction will be announced in due course.

I should add that patents have been applied for some considerable time ago in connection with this device, and these are expected shortly to be issued, but in the meantime, so far as I am concerned, bona fide experimenters are welcome to make up the device for their own private use, and I am sure, from the experience gained with the many models which I have used experimentally, that those who use this new device, whether of their own making or of the commercial variety, will find it a great time and money-saver. So far as I am aware, it is the first time that a step-down *direct-current* charger has ever been made available (apart from a motor-generator, which is an "engineering job"), and I believe it is quite the first time that a *universal A.C.-D.C. charger* has been put forward.

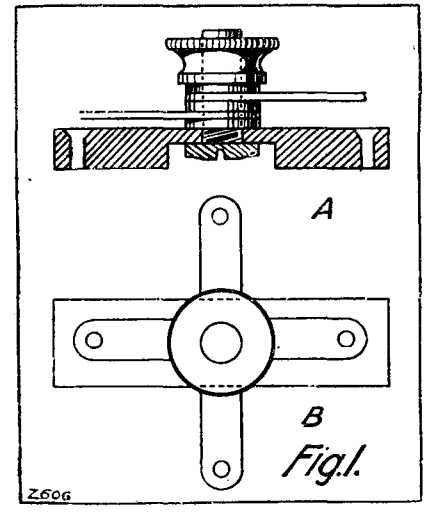


Semi-open-core transformer and tantalum rectifier all complete for charging the 4-volt battery, with D.C. milliammeter in the input circuit and D.C. ammeter in the output circuit.

JUNCTION "PILLARS"

By H. J. B. C.

WHEN wiring up sets, frequently it is necessary to make two, three, or sometimes four, connections to one particular point. This happens generally at a position where the wiring is already congested, and consequently makes the work somewhat difficult. Under circumstances such as these it is a good plan to choose a more or less clear space on the baseboard, centrally disposed and within easy access of the points where connections have to be made, and mount a small junction pillar.



A simple form is shown in Fig. 1, A and B, consisting of a small rectangular ebonite base recessed to accommodate the screw-head of a small terminal. This ebonite mount can be made fast on the wooden baseboard by two screws. The wires are joined to soldering tags placed fanwise and held under the milled nut of the terminal (see B). This will save a lot of bother, tend to keep the wiring short, and result in a neat, workmanlike finish to the wiring of the set.

Best to Solder

The soldering of terminal tags to the ends of flexible leads in a set enables good electrical connections to be made between these wires when occasion demands, for they can be held together by a nut and screw, and are readily disconnected if desired. This is preferable to the practice of twisting the wires together, for this results in broken strands. A greater use of soldering tags in little jobs of this nature is a practice to be commended to the attention of all home constructors.

Another triumph for LEWCOS!

THE LEWCOS DUAL-SCREENED COILS have been designed to facilitate the change from the 250-550 Broadcast Band to the longer waves used by Hilversum, Radio Paris, and Daventry. The change is effected by a switch incorporated in the coils and operated by a single panel control in the case of multi-coil sets and a lever in the case of the single Reinartz Aerial Coil.

The two and three gang sets are perfectly balanced before leaving the factory, and are suitable for use with dual or triple gang condensers.

Ref. No.		Each
DRA/1	**Single Coil Units** Reinartz Aerial Coil - - - - - -	£1 12 6
	Multi-Coil Units	
Ref. No. DSP/2	The SP Aerial Coil and one split Primary HF Transformer with Reinartz Reaction - - - - - -	Per unit £3 7 6
Ref. No. DSP/3	One LP Aerial Coil and two split Primary HF Transformers, the last with Reinartz Reaction - - - -	Per unit £5 0 0

Note.—Multi-Coil Units are supplied complete with panel control as shown.

Obtainable through all wireless dealers. Full particulars from

The
LONDON ELECTRIC WIRE COMPANY & SMITH'S LTD.
Playhouse Yard, Golden Lane, London, E.C.1

***No* coil changing!**

***No* removable screens!**

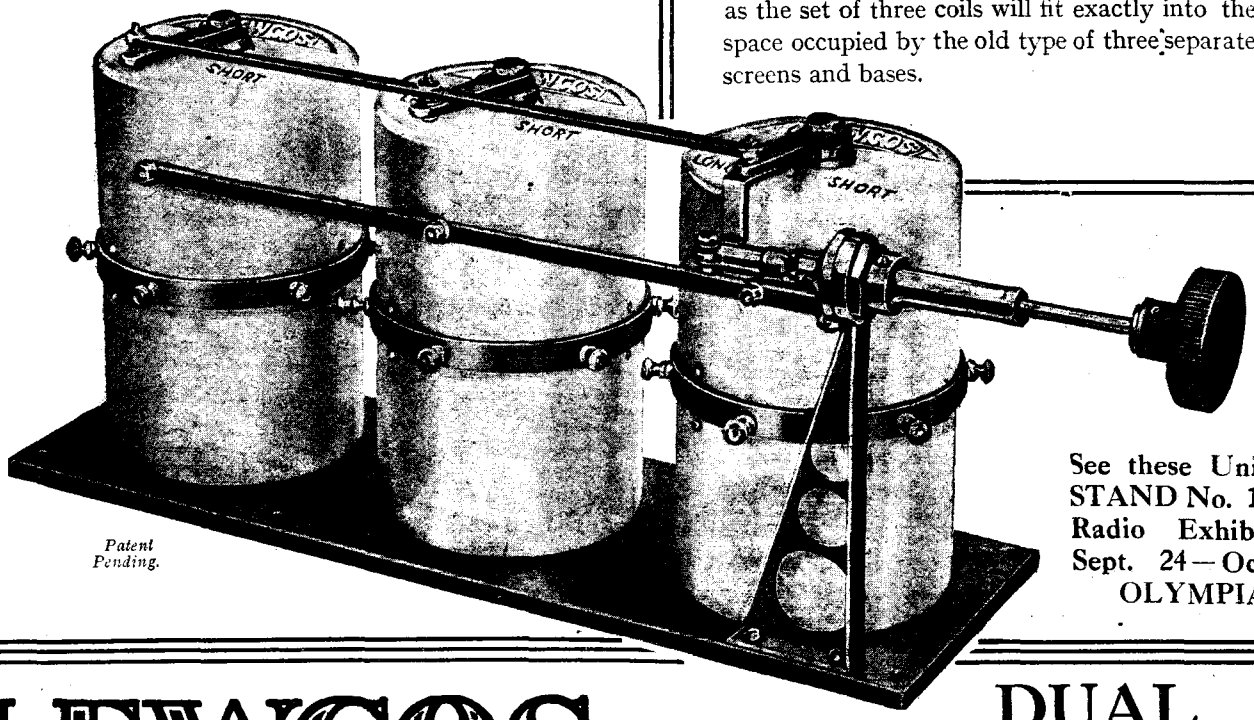
***Perfectly balanced* coils!**

Panel Control
On multi-coil units!

Wavelength range
250/550 and 1,000/2,000 metres in one unit!

CONVERT YOUR EXISTING SOLODYNE

The set of coils DSP/3 is particularly suitable for the conversion of existing Solodyne Receivers as the set of three coils will fit exactly into the space occupied by the old type of three separate screens and bases.



Patent Pending.

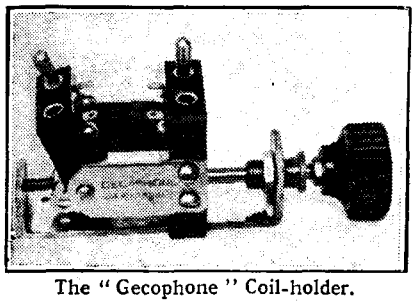
See these Units at STAND No. **113**, Radio Exhibition, Sept. 24—Oct. 1, OLYMPIA

LEWCOS
(Regd. Trade Mark)

DUAL SCREENED COILS

Gecophone Coil Holder

A FIRST-CLASS two-way coil holder at 5s. would have been a boon indeed a year or two ago. Nowadays " swinging coils " are seldom incorporated in receivers, but where such are necessary the Gecophone two-way coil holder claims attention. As we have mentioned, besides selling at a very attractive price, it is of high quality and must be produced on mass-production lines,



The " Gecophone " Coil-holder.

although it is in appearance a perfectly finished article. The design is excellent and in its simplicity makes for robustness. The movement is a backwards and forwards one and the gearing is a practical compromise between " vernier " and direct. The moving holder cannot possibly move independently of the control knob even when a heavy coil is in it. The accompanying photograph clearly shows the clean lines of the assembly of the coil holder and it will be noted that the component can very easily be mounted upon a panel.

The " Flatplate " Aerial

Messrs. A. H. Hunt, Ltd., of Croydon, England, recently sent us one of their new " Flatplate " aerials. Consisting of a length of copper sheeting bent on an insulating support, it is designed for fixing to the top of a pole or by brackets to any fairly high point. It is supplied complete with 50 feet of insulated down-lead wire at 20s.

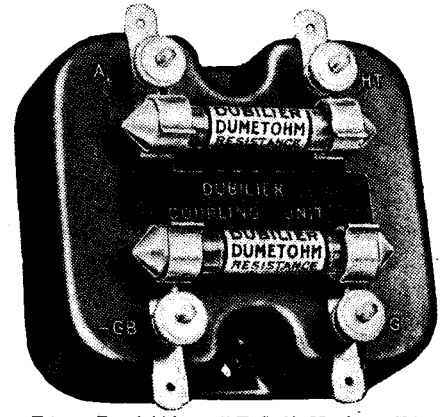
It is not unsightly in appearance and is of robust construction. On test we found that it has good " pick-up " qualities, provided that it is erected at a fairly high point. We fixed it to the sill of an upper window, carrying the down-lead through a lower window, and even in these circumstances it provided good results. It should prove a useful fitment for people who have not room for the erection of the usual suspended type of aerial, or who consider wires running across gardens disfiguring.

A Novel Rheostat

It would seem an obvious sort of thing to have an adjustable stop on a filament rheostat so that a minimum amount of resistance can be arranged for, but it is one of those obviously necessary things which hitherto seems to have escaped the attention of the appropriate designers. However, an adjustable stop is the feature of a filament rheostat which is now being manufactured by Messrs. Rooke Bros. Undoubtedly, had such a component been in general use in the past many a thoriated dull-emitter would have been saved the ignominy of having to be run at a white heat in order to obtain the necessary emission subsequent to that fatal overrunning, and, further, no doubt many valves would have been saved a complete burn-out through a similar cause. The Rooke rheostat can be obtained with two sections, one of low resistance and one of high resistance, or with the one winding, but in either case in a very simple manner the stop can be arranged anywhere between minimum and maximum. It is a triumph of mechanical simplicity, in fact, and it is a source of wonder to us that no one has thought of the scheme before. In other respects the rheostat is quite conventional, having a dial and pointer and means for one-hole panel mounting. It is well made and operates smoothly and should, considering the stop feature, prove popular where such components are in demand this coming season.

An Efficient R.C. Unit

The new Dubilier R.C. Unit, a sample of which was recently sent us by Messrs. Dubilier, consists of a small base having a mica condenser moulded into it and two of those familiar and efficient " Dumetohm " resistances. Four terminals are provided for connecting purposes. The Dumetohms supplied with the unit have resistances of 1 and 3 megohms for the anode and grid respectively; but, as the makers point out, other values can easily be inserted to suit individual requirements. The advantage of the



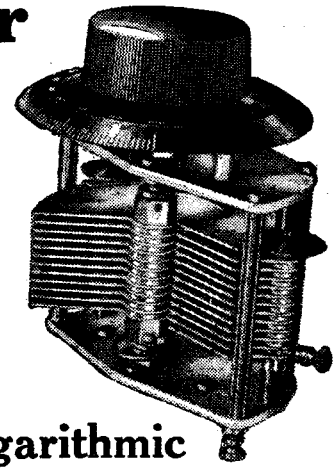
The Dubilier "R.C." Unit. The " Dumetohms " are, as will be seen, easily removable.

" Dumetohm " type of resistance is that it has negligible capacity or self-inductance, and it has been proved to have reliability and constancy even when carrying fairly high voltages.

With a coupling unit having resistances of the above-mentioned values it is necessary to employ one

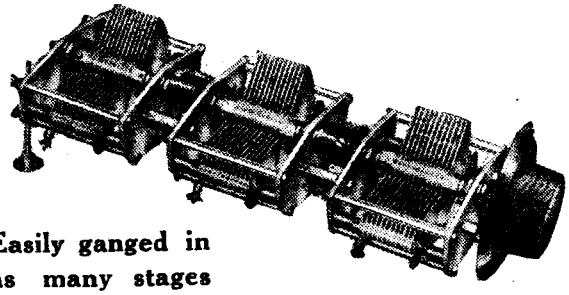
Here is the Condenser you want for your new Receiver

Adaptable to different circuits... Easily ganged together... Plates insulated from frame .... Vernier adjustment .... Rigidly constructed.



The New Keystone Universal Logarithmic

Square-Law Type also available (same prices)



Easily ganged in as many stages as needed

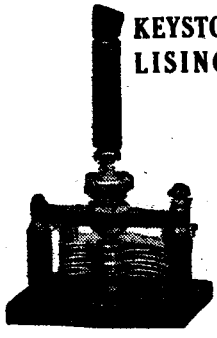
HERE is a Condenser which has several unique features that you have been wanting. It is adaptable to different circuits—a great advantage. Two or three single condensers can be ganged together to form a double or triple gang, in a few moments, with the aid of only a spanner. Both fixed and moving plates are insulated from the frame — another unique feature! A patented vernier adjustment is provided, enabling the capacity to be varied to fine limits. Rigidly constructed from finest materials.

Prices:

Single, ·0005 mfds.	13/6
Single, ·0003 mfds.	12/6
Twin gang, ·0005 mfds.	27/6
Triple gang, ·0005 mfds.	42/6

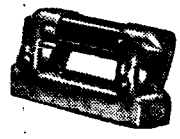
Less dial in each case. Spare spindles, couplers, distance pieces, etc., for ganging purposes available at low prices.

KEYSTONE NEUTRALISING CONDENSER



Suitable for neutralising the electrode capacities of all types of valves. Low minimum capacity. Wide spacing of vanes renders accidental "shorting" impossible. Board mounting (as shown) **5/-**

Panel mounting, **6/3**



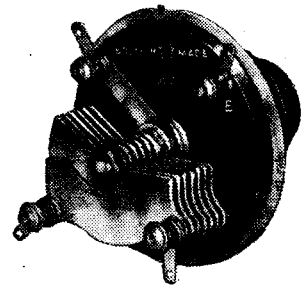
Keystone Fixed Resistors

No. 4 for ·25 amp. valves with 6-volt accumulator. No. 17 for ·06 amp. valves with 4-volt accumulator. And in many other values. Price - - - - - **2/6**

Resistor only **1/9**. Base, **9d.**

KEYSTONE 'MIDGET' REACTION CONDENSER

Ideal for the many positions where a small capacity condenser is required. Aluminium shield prevents hand-capacity effects. Special taper bearing giving smooth movement. Capacity ·0001 mfd. Price **5/6**

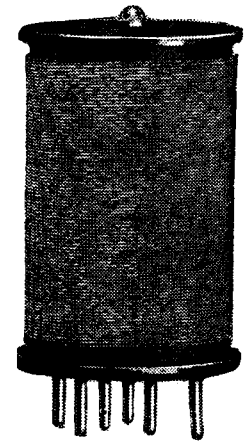


Write to-day for our new illustrated catalogue of components and accessories

PETO-SCOTT CO., LTD.

77, City Road, London.

BRANCHES:—62, High Holborn, London, W.C.1. 4, Manchester St., Liverpool.



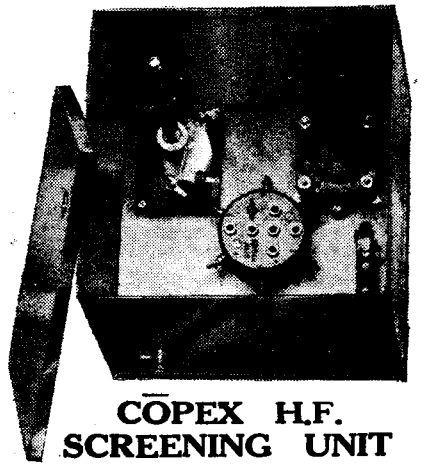
CŌPEX COILS

—famed for their remarkable efficiency

Copex coils are being used by all principal wireless publications by reason of their remarkable efficiency. All Copex coils are wound with the best quality LITZ wire to ensure the lowest possible H.F. resistance and highest amplification. All Copex coils are matched within 1 metre, and their manufacture from start to finish is supervised by a qualified engineer whose name is a household word among readers of "Modern Wireless."

PRICES:

	250-550 metres	1000-2000 metres
Aerial Coil - - - - - - - -	6/-	6/-
Split Primary H.F. Transformer -	10/-	10/-
Split Secondary H.F. Transformer	10/-	14/-
Reinartz Type Coil - - - -	10/-	14/-
Six-pin base with terminals arranged for easy accessibility -	2/9	



CŌPEX H.F. SCREENING UNIT

(as used in the "Modern Wireless" Five and in the "Wireless Constructor" "Twin-Tune Five.")

Copex Standard H.F. Screening Unit, as illustrated, assembled and wired ready for use **25/-**

Standard baseboard (with components, comprising Keystone Neutralising Condenser with special long handle, Copex 6-pin base, vibratory valve-holder, and Keystone Fixed Resistor), assembled and wired **13/-**

Copex H.F. Screening Box (without baseboard or components) .. **12/6**

of the very high "mu" valves, and we prefer not to do this more than once in a receiver. We tested the Dubilier unit in a set having one stage of transformer coupling, and the necessary one stage R.C., and results were excellent. We subjected the "Dumetohms" to abnormally high voltages, and then tested them with a megger and found their resistances still closely adhering to their ratings.

The unit is very well made and occupies very little space on a baseboard. And, as additionally it certainly operates satisfactorily and gives every evidence of being perfectly reliable, we have no hesitation in saying that we consider it very reasonably priced at 7s.

"Ebonart" Station Log Chart

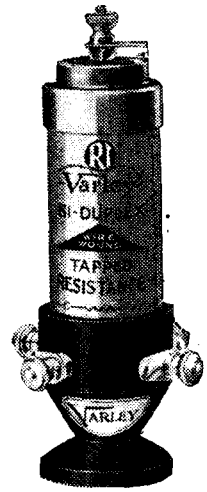
With every "Ebonart" panel sold Messrs. Redfern's Rubber Works, Ltd., are providing a neat station log chart. This can be fixed in the lid of the receiver, and should prove most useful.

R.I.-Varley Components

The fusion of the R.I. and Varley interests has, as was universally anticipated, resulted in the introduction of several new components of a very high standard. Both of the original concerns were noted for their high-grade designs, and the cumulative effect of the amalgamation is

This is the R.I.-Varley Multi-Cellular H.F. Choke. It has an abnormal wave-length range covering both high and low frequencies and retails at 9/6.

most marked. For instance, we now have available a range of tapped resistances wire wound in accordance with the familiar and efficient "bi-duplex" principle. These resistances are most useful in modern circuits and we have had several of them in use for some time now, and have found them in every way satisfactory. They accurately correspond with their various ratings, and are as dependable and reliable and as constant in operation as they possibly could be. On this page is illustrated one of these tapped R.I.-Varley resistances suitable for use in R.C. amplifiers. As will be seen, it has a series of terminals around its base and these correspond with a useful range of resistances, the other connection being at the top of the component. Resistances covering various ranges of values are obtainable, and there is a type available



And here is the R.I.-Varley Bi-Duplex Tapped Resistance. It is only one of several types, and in this case the various values are obtained by varying the position of the one lead on the bottom terminals.

which is provided with but two terminals, the variations of resistance being obtained by turning the body of the article round. A switch is incorporated in the base.

The R.I.-Varley multi-cellular H.F. Choke is also illustrated on this page. This, again, is a most efficient component and one that no constructor need fear will let him down in a special receiver where the H.F. choke is called upon to do vital work. It has an abnormally low self-capacity and ample inductance. It is provided with a substantial base and the windings are protected by a transparent covering. It will be noted, too, that the connecting terminals are widely separated and are very accessibly placed. In conclusion, modern sets demand components of scientific design and of high standards of electrical efficiency, and for this reason the various R.I.-Varley components should attain an even greater popularity than was rightly gained by the productions of the two individual firms.

Some "Etherplus" Components

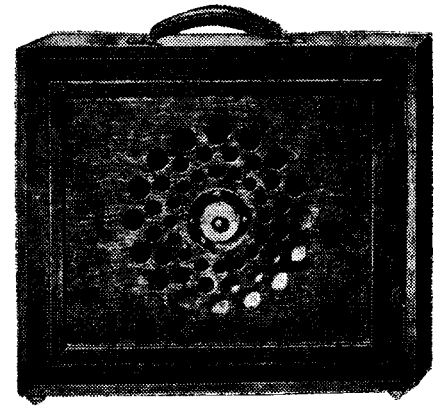
Messrs. M. and A. Wolff, of Whitecross Street, London, E.C.1., recently sent us several of their "Etherplus" components. Of these the straight-line frequency variable condenser appeals to us particularly as being an excellent production. One of ·0005 mfd. capacity sells at 12s. It is of sound design, and is very nicely assembled. The moving vanes are earthed to the frame, and this has a small surface area, but is of considerable mechanical strength. A "pigtail" is provided, and the two terminals are widely separated but accessibly placed. The movement embodies a ball race and a cone bearing, and is most effective, being positive, smooth, and entirely free from harsh spots or backlash. The vanes are made of aluminium, but are rigidly bolted together. A four-inch dial is provided, and this has a large milled centre which facilitates adjustments. This "Etherplus" variable is, in fact, an excellent example of modern practice in condensers, and should achieve popularity at the prices asked for the various capacities.

The "Etherplus" panel bracket is 5 in. in height, and is a simple aluminium stamping. But it is substantial and quite satisfactory for use with any size of panel. A pair of these brackets costs 6d.

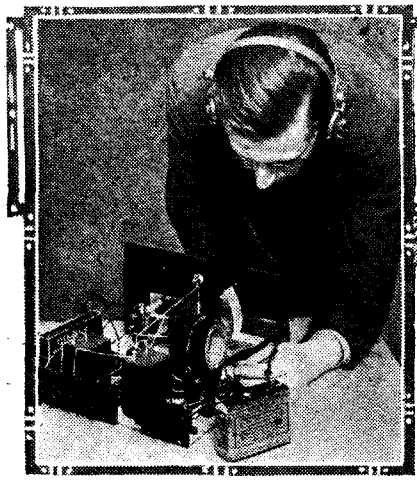
The "Etherplus" lightning arrester is a combination of an aerial lead-in tube, an aerial earthing switch, and a lightning arrester. A set is therefore protected when one of these devices is used, even although the earthing switch be not brought into operation during a thunderstorm. It is a well-made article, and should stand hard wear and the effects of the weather for a long time. It is available in 6-, 9-, and 12-in. lengths at 4s., 4s. 6d., and 5s. 6d., and a £100 free insurance against damage by lightning is included.

Useful Beginner's Book

"Easy Lessons In Wireless," by R. W. Hutchinson, M.Sc., A.M.I.E.E. (Price 1s. 6d., University Tutorial Press, Ltd.). This is an excellent little text-book and covers the elementary principles of radio in a very readable manner. The author has assumed that his readers have no knowledge at all of electricity or mathematics.



A completely self-contained receiver produced by the Marconiphone Co.

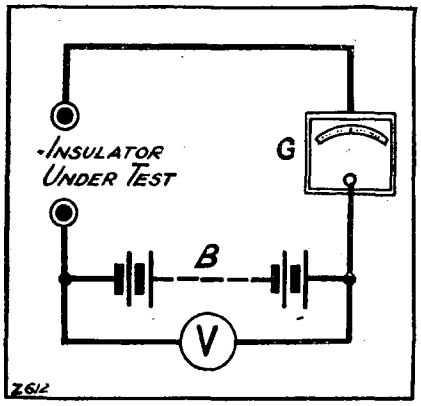


IS THERE AN INSULATOR?

Some interesting figures are given concerning the current carrying capacities of many materials known and used as insulators.

By E. A. ANSON.

WE never seem to be content in wireless. One moment we want badly a perfect conductor and the next a perfect insulator. Insulators and conductors are partitioned out into watertight compartments as if



The simple testing circuit employed.

the one really did insulate and the other really did conduct perfectly.

But do they? Particularly when does an insulator cease to be a conductor and became an insulator?

There is an instrument called a "megger," used for measuring the resistances of insulators. It is almost foolproof and is graduated in megohms. A megohm means a million ohms. There is a portion of its scale optimistically marked "infinity," where it gives up trying. But it is not really so simple to reach the infinite as all that in this world of ours today.

Leakage Everywhere

Just think. Through an infinite resistance no current can flow except it be urged by an infinite pressure. When the megger gets to infinity it is not really anywhere near it, for with delicate instruments it is possible to detect minute current flowing even in the best insulators.

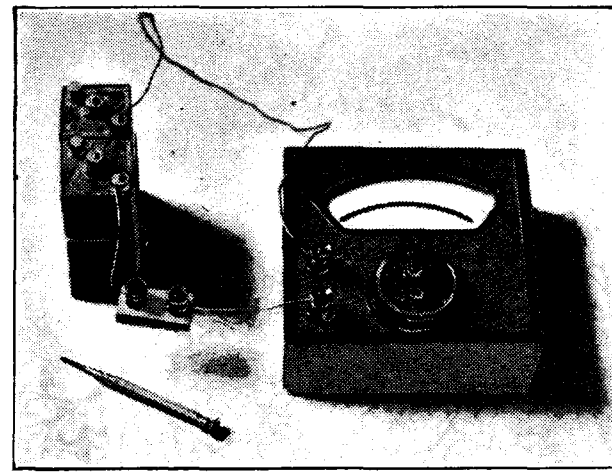
Of course, the resistance is very high indeed.

The fact is, we get currents flowing in our wireless sets in all sorts of unexpected places where they are not wanted. Streams of electrons can be detected jostling their way through our panels from H.T. plus to L.T. minus, and from valve socket to valve socket. But the better the materials we employ the better they behave as insulators, and the smaller these currents.

Grid Leak Tests

Our insulators do not obey the laws of electricity as regards conducting so nicely as conductors. Ohm's Law tells us that if we divide the pressure in volts by the resistance in ohms we get the current flowing in amperes. But for some insulators the result varies with the pressure. This is seen with that half-conductor half-insulator, the grid leak. The older types behaved like this when tested for resistance at various voltages:

Test Voltage	Megohms of Grid Leak
120	1·0
60	1·2
14	1·24
2	1·26



Measuring the current flowing through a piece of wood. The material under test can be seen just above the small screwdriver.

They are, in fact, crude forms of detector like a crystal. But the more modern metallised leaks behave like this:

Test Voltage	Megohms of Grid Leak
120	1·0
60	1·0
14	1·0
2	1·0

When the voltage is doubled the current doubles, too, and the resistance remains constant.

In order to discover exactly how much current was actually leaking through various materials, the following simple circuit was rigged up:

The measuring instrument G is the important part of the circuit. The instrument used for these tests was a unipivot galvanometer made by the Cambridge Instrument Co. It is of the moving-coil type, with a coil resistance of about 1,000 ohms.

A Sensitive Galvanometer

A full deflection is obtained for 24 millionths of an ampere. A thousandth part of an ampere is called a milliampere, whilst a millionth of an ampere is called a microampere or μA. So the instrument gives full deflection for 24 μAs.

The scale is subdivided into 24 μA, and each microamp. is further divided into ·2 μA. It is possible to read by interpolation to ·1 μA and less, or the ten-millionth part of an ampere. This is an extraordinarily minute

Advertisements

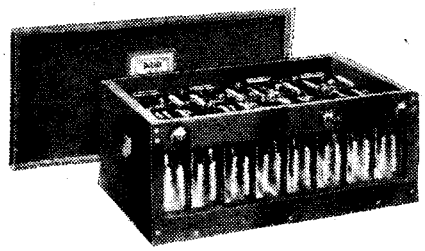
As far as possible all advertisements appearing in "M.W." are subjected to careful scrutiny before publication, but should any reader experience delay or difficulty in getting orders fulfilled, or should the goods supplied not be as advertised information should be sent to the Advertisement Manager,

"Modern Wireless," 4, Ludgate Circus, London, E.C.4.

current quite undetectable by most instruments we use.

The voltmeter V reads the exact voltage across the battery B, which may be increased to any amount from a few dry cells to 600 volts or more. The voltmeter V was a surplus government instrument by Elliott's which had been overhauled recently by the makers.

As a test I put my fingers across the gap for the resistance. This gap, by the way, was supported in air by stout conductors. At four volts the galvanometer needle hit the other



Insulation between the cells of an H.T. accumulator is very important, but it cannot be perfect !

side with a bang and had to be shunted, for a current of 70 μA was flowing through me. I had a resistance of only ·057 megohms. Considering that a current of 100 milliamperes is generally fatal, it will be seen that 6,000 volts would have had this effect.

However, do not go killing yourself on the domestic mains, and then come grumbling to me that they were only 240 volts ! For the human body does not, for one thing, obey Ohm's Law, and, for another, its resistance does not remain constant. After a hot game of tennis I had dropped to only 6,000 ohms.

Some Comparative Tests

Our staple insulator is ebonite. But tests were made on other materials in order to discover if they made good substitutes for ebonite. In our wireless sets we often employ grid leaks from the grid of the detector to L.T. plus. These leaks vary from about 3 megohms to 1 megohm or less. It is obvious that unless the resistance from the grid socket to the other sockets is very high, our grid leak may appear to play us false, for it will be in parallel with other leaks through the panel.

I found that for satisfactory results the resistance of the panel must be at least ten times higher than the grid leak—the higher the better. Also the resistance of the panel must remain constant and not vary in damp weather by absorbing our climate in small but deadly doses.

For these tests small pieces of materials were cut to a standard size of 2 in. by 1 in. by $\frac{3}{8}$ in. thick. If of wood, they were planed smooth, but not otherwise treated. All wood used was well seasoned. Holes were drilled in each blank exactly $2\frac{1}{8}$ in. apart, centre to centre, and 2B.A. Burndept terminals inserted. This left a leakage gap from terminal to terminal of $\frac{1}{2}$ in. The ebonite tested was the best quality obtainable, about twelve months old.

Here is the result :

Material	Volts	Current μA	Megohms
Ebonite ..	100	·1	1,000
Oak	100	2·2	45·5
Pine	100	20·8	4·8
Deal	100	20	5
Mahogany ..	100	·6	176

It is obvious from this that ebonite is far and away the best insulator of the lot.

But these tests were made under ideal conditions, with everything perfectly dry. So the materials were soaked in water for twelve hours and then allowed to dry for twelve hours. They then felt quite dry ; but look how the wood has gone to bits as an insulator, whilst the ebonite remains unchanged :

Materials	Volts	Currents μA	Megohms
Ebonite ..	100	·1	1,000
Oak	18·4	5	1·7
Pine	8·4	16·4	·52
Deal	8·4	18·2	·46
Mahogany. .	8·4	1·2	7

The wood—! hopeless, Mahogany was the best.

It is obvious that water is the fiend that spoils the insulating properties of many otherwise tolerable insulators. Curiously enough, perfectly pure distilled water is a better insulator than even ebonite. But the slightest trace of impurity, dissolved salts, etc., makes water a good conductor.

Improving Insulation

Next, the samples were boiled in paraffin wax. For an hour they all bubbled furiously (the ebonite was not subjected to this treatment), showing that large quantities of moisture were being driven off. When all bubbles ceased they were removed and allowed to drain and cool. Now look what good insulators they have all become. Better than ebonite ! But, remember, that they were all, so to speak, brand-new dessicated samples from which all moisture had been forcibly removed and wax had taken its place.

Materials	Volts	Current μA	Megohms
Oak ..	100	·05	2,000
Pine ..	100	·05	2,000
Deal ..	100	·02	5,000
Mahogany	100	·02	5,000

Next came the water test : twelve hours soak, twelve hours drying—then test.

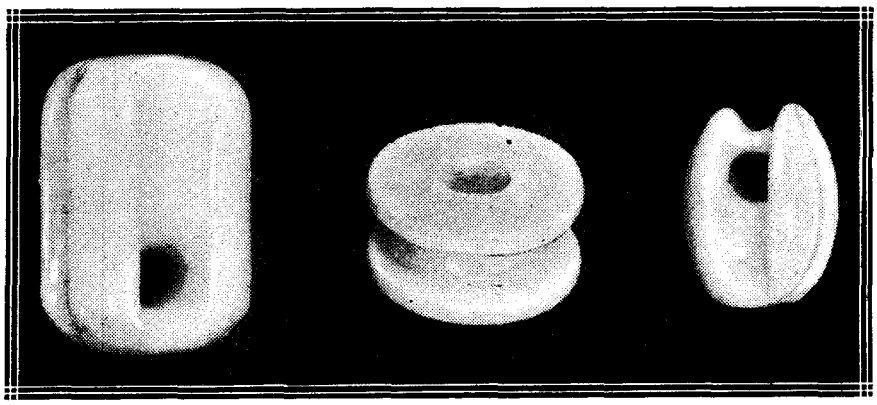
Material	Volts	Current μA	Megohms
Oak ..	100	1·0	100
Pine ..	100	1·4	72
Deal ..	100	5	20
Mahogany	100	·8	125

With the exception of deal results were good enough to pass the materials for panel work. It is unlikely that a panel would ever get soaked for twelve hours.

But there are still a few disadvantages. Wood requires considerable work done on it, planing, sand-papering, boiling in paraffin wax for at least two hours. In addition, wood warps and is unsuitable for tapping, although the homely wood-screw will be quite easily fixed. However, a piece of mahogany, well finished, certainly looks nicer than ebonite.

The effect of dust was tested by sprinkling liberally the ebonite test piece with dust found on a shelf.

(*Continued on page* 429.)



Some aerial insulators of the type tested by Mr. Anson. Wet or dry, an " egg " (right) was found to have the extremely high resistance of above 100,000 megohms.

A Genuine Spare-Time Business

PATENT - PROTECTED ARTICLES YOU CAN MAKE AT HOME.

Good Profits Guaranteed!

IF you are interested in any way in Wireless, here is a wonderfully interesting way of making money in your spare time. Simply write for particulars and by return you will be given full details how to make at home a most marvellously improved article which reduces the upkeep costs of all valve sets, gives splendidly efficient service, contains no harmful ingredients whatever, and which is in enthusiastic demand all over the country.

Is your spare time wasted time? Why not turn it to good account and change the whole of your future life for something better and bigger.

NO "PLANT" NEEDED

—The Kitchen Table or Any Small Out-building Can Be Your "Factory."

The work is fascinating. You can put in just as many or just as few hours work per week as you desire. The children can help. There is no mess, no smell, nothing disagreeable whatever, nor is there any inconvenient demand on space. A spare room, an outhouse, or even your kitchen table can be used as your "factory"—a factory without machinery or plant or electric current. The few simple tools needed you are shown how to make yourself, or buy for a shilling or two.

OUTPUT EASILY SOLD

Each article you make is protected by Royal Letters Patent so that your rights cannot be infringed. The market is immense and only one person per 50,000 of the population is granted a licence to manufacture, thus giving you a huge field for sales at a very big profit. The articles you can produce without any mechanical skill or talent are **manifestly** superior in quality and value for money to anything on the market, and if you have the least difficulty in disposing of your output to friends, private owners of wireless sets, wireless or electrical dealers in your district, arrangements will be made to take it off your hands, thus **guaranteeing your profits!**

Think of what you could do with pounds extra per week! Think of the delightful hobby you can pursue instead of finding time hang heavily on your hands! Think of the new and most interesting field opened to you as a responsible "master man"!—and do not delay a single moment in sending the coupon below!

Why not make money this easy, fascinating way? Remember that profits are guaranteed, and that the coupon below brings you FULL particulars FREE!

Send this form now for full particulars.

"MAKE-MONEY-AT-HOME" COUPON

To THE ENGLAND-RICHARDS CO., 102, KING'S LYNN, NORFOLK.

Sirs,—Please send me at once, and FREE, full details as to how I can Make Money at Home in my spare time. I enclose 2d. stamps for postage.

Print your name and address boldly in capital letters on a plain sheet of paper and pin this coupon to it.

"Modern Wireless," Oct. 1927.

WHAT TO SEE AT OLYMPIA

—*continued from page* 334

THE LONDON ELECTRIC STORES, LTD.
Stand No. 221.

The well-known West End wholesalers, Messrs. The London Electric Stores, Ltd., are exhibiting at their stand No. 221 representative examples of branded radio components and also their own particular specialities. These latter include the L.E.S. earth tube, L.E.S. M.11 coil holder, L.E.S. Elot Poly-wave coil, L.E.S. semi-fixed resistors, etc. An interesting component is the radio control clock, for which the London Electric Stores Ltd. are acting as sole concessionaires. The listener can set the clock to a given time at which a broadcast item is due to appear, and the set is automatically switched on at that time. Similarly, the receiving set can be switched off at any predetermined time set by the clock.

THE LONDON ELECTRIC WIRE CO., & SMITHS, LTD.
Stand No. 113.

Among the famous lines for which the "Glazite" people are noted, visitors to this stand should make a point of examining the new "Lewcos" coils and coil units on show. These include six-pin binocular coils, the gauged ond screened coil units, centre-tapped coils, and sundry six-pin coils and bases. The various types of wire made by this company are also worth considerable attention, the whole stand forming a most attractive exhibit.

MARCONIPHONE.
Stands Nos. 128 to 135.

Marconiphone are showing a larger and more interesting range of exhibits than ever before.

The stands are in two large blocks, comprising Nos. 128–131 and 132–135. Features are the elimination of batteries entirely on several receivers, the mains being the source of H.T. and L.T. energy; the new and powerful super-heterodyne model "82"; constructors' sets, three and four-valvers, which can be operated entirely from the mains; L.T. units and H.T. units, and combined "power" units, including very cheap models for small receivers; new Marconi Economy valves; indirectly heated cathode K valves, and the new Marconi screened four-electrode valve S.625.

L. McMICHAEL, LTD.
Stand No. 120.

The famous "Dimic Three" receiver, which appeared last year, is again being shown, but with many internal improvements. Other exhibits include some new receivers, notably four- and five-valve portable sets, and a series of sets for home construction. Other lines to be seen include H.F. chokes, Dimic and Unimic coils, semi-aperiodic H.F. transformers, semi-fixed resistors, two ranges, 0–6, 0–30, multiple switch, L.F. choke, Dimic metal screening box, H.F. transformers.

C. D. MELHUISH.
Stand No. 231.

A three-speed vernier dial is one of the most interesting exhibits on this stand, ratios of up to 500 to 1 being obtainable.

METRO-VICK SUPPLIES, LTD.
Stands Nos. 155 and 156.

Ranges of Cosmos Short-Path valves, Cosmos sets and components are on view, and form an attractive array of well-made apparatus.

Among the new valves are two new ones for operation from A.C. mains with special adaptors so that they can be used in any set without alteration of the wiring. These valves correspond to the Cosmos Red and Green spots for detection and general purpose work in the case of the latter, and for last stage and L.F. work in the former type. New valves appear in the "ordinary" types in the forms of the S.P.16/B, a low-consumption, general-purpose valve, and S.P. 18/.RR (Double Red Spot), a 2-volt power valve. Also S.P. 50/B and the S.P. 50/R (Red Spot). This valve is especially suitable for use as a last-stage power valve, and is also an excellent valve for use in reflex circuits.

M. P. A. WIRELESS.
Stand No. 57.

A complete new range of loud speakers is the chief attraction of this exhibit, though the well-known "transportable" sets are also well in evidence.

THE MULLARD WIRELESS SERVICE CO., LTD.
Stands Nos. 44, 164, 165 and 166.

Each of these stands will be of interest to the radio public, inasmuch as they reveal many interesting developments in valve construction, wireless accessories, and speakers.

The exhibits comprise a complete series of P.M. valves covering every possible operation for 2-volt, 4-volt and 6-volt L.T. supplies. This P.M. series has new features that will prove of intense interest to all valve users.

In several valves, notably the P.M.3, P.M.3A, P.M.5B, and P.M. 5X, the filament consumption has been reduced from 0·1 to 0·075 amp., while a new 2-volt "super" power valve is making its first appearance. This valve, the P.M. 252, will carry a grid swing of 15 volts, and is a real "super" power valve. It takes 0·3 amp. at 2 volts for filament consumption.

Two models of the Mullard Pure Music Speaker are being shown, while the P.M. resistance-capacity coupling unit will appeal to those who favour resistance-capacity circuits.

THE NEW LONDON ELECTRON WORKS, LTD.
Stand No. 70.

Famous for its Electron wire, this firm is showing in addition to that wire a special extension wire, an earth mat, strip aerial, and two types of loud speaker, one of the horn variety and a cabinet model.

OLDHAM & SON, LTD.
Stand No. 71.

As would be expected, this stand is devoted solely to accumulator exhibits, all types and classes of secondary batteries being on view.

ORMOND ENGINEERING CO., LTD.
Stands Nos. 72 and 73.

This firm is now offering a new R.C.C. unit which has been produced for valves of the high "mu" type. Fixed resistors are also being shown, and a new logarithmic condenser, available in three capacities. The usual, and many improved models of, slow-motion dials for which this firm is famous may also be seen.

PETO-SCOTT, LTD.
Stand No. 163.

The exhibits on this stand include a wide range of new radio receivers, while there is also a complete range of the well-known Keystone components and Copex screened coils and screening devices.

PORTABLE UTILITIES CO., LTD.
Stand No. 94.

This firm has many new lines on view, and the stand is well worth a visit. The famous "Eureka" transformers, both H.F. and L.F. types, are, of course, in evidence.

PRECISION SCREW CO., LTD.

The exhibit on this stand consists mainly of Collinson inductances and.

(*Continued on page* 412.)

WHAT TO SEE AT OLYMPIA

—continued from page 410

formers suitable for all purposes. In addition, a special set of five short-wave coils is on view, and also a new R.F. choke of novel design so that three different values are obtainable.

W. G. PYE & CO.
Stand No. 136.

The new range of Pye sets for this season is noticeable for the meticulous attention given to mechanical details. This has resulted in a series of receivers that make a special appeal to all who have only a limited or even non-existent knowledge of the technicalities of radio. An additional advantage is that speaker, batteries, and aerial are all included, each receiver being completely self-contained.

In addition are being shown series of chokes and L.F. transformers for which this Cambridge firm is famous.

RADI-ARC ELECTRICAL CO. (1927).
Stand No. 3.

The chief exhibit here is the "Liberty" two-stage R.C. coupled unit. This forms a neat little unit at an attractive price, and is for incorporation in any kind of receiver utilising resistance-capacity coupling. Suitable valves are, of course, easily obtainable.

REDFERN'S RUBBER WORKS.
Stand No. 84.

The famous "Ebonart" radio panels forms the main exhibit, while next comes a special coil former which is designed to give maximum efficiency for single-layer windings.

REGENT RADIO SUPPLY CO.
Stand No. 257.

A series of mains units, of all types and sizes, form the "main" exhibits here. These consist of L.T. and H.T. "power" units, or separate battery eliminators, and are also shown incorporated in complete "mains" receivers. Other items include transformers and chokes for battery eliminators and a series of rectifying valves.

R.I.-VARLEY.
Stands Nos. 5 and 143.

The outstanding exhibit shown by this go-ahead firm is a receiver designed for the new double-plate H.F. self-balancing valve. The set shown is known as the Interdyne (illustrated on page 334), and has five valves. It is claimed that results equal to those from a good eight-valve set are obtained with this new system. Other lines include the new straight-line L.F. transformer, the new H.F. choke, resistance-capacity units, and many other well-made and efficient products of the fusion of two famous firms.

SIEMENS BROS. & CO., LTD.
Stand No. 150.

Siemens Brothers & Co., Ltd., exhibit on Stand 150 concerns primary batteries for H.T., L.T., and grid-bias purposes.

The H.T. dry battery is still the most popular form of H.T. current supply used by the general public, and therefore a considerable portion of the exhibit is devoted to this form of battery.

Prominent among the H.T. batteries are the new types at low prices, of which the "Power" batteries are worthy of special attention from those who prefer large-capacity batteries but have not so far used this type owing to the somewhat high cost.

A. J. STEVENS & CO., LTD.
Stands Nos. 27 and 159.

Two new lines are being shown by A. J. S., Ltd., namely, a cone loud speaker, and a two-station portable receiver. Other exhibits include two-, three-, five-, and seven-valve receivers of up-to-date design.

STRATTON & CO., LTD.
Stand No. 77.

The new lines here shown comprise the following:

A three-valve short-wave receiver tuning from 18-120 metres, capable of loud-speaker reception of the American short-wave stations, and also adaptable for use on the broadcast band.

A new four-valve receiver (called the "Eddystone Scientific Four") with screened and neutralised H.F. stages and interchangeable transformers, which provide for full efficiency on high and low wave-bands.

Other items are short-wave tuning units for 18-120 metres, forming the complete grid inductance and reaction portion of a short-wave receiver, and a new high-frequency choke for 25 metres–3,000 metres retailing at 6s. 6d.

Special aerial and H.F. transformers on special low-loss paxolin formers.

SYLVEX, LTD.
Stand No. 228.

"Sylverex" and "Reactone" crystals, permanent detectors, variable condensers, inductance coils, etc., are being shown, while an interesting and unusual exhibit is a case showing all the ingredients used in the manufacture of synthetic crystals of the galena type.

THE TELEGRAPH CONDENSER CO., LTD.
Stand No. 115.

The exhibits of this well-known firm are mainly confined to fixed condensers, but a full range of these will be on view. Some complete A.C. and D.C. eliminators are also to be seen, and are worth close examination.

TUNGSTONE ACCUMULATOR CO., LTD.
Stand No. 98.

A wide range of batteries is to be seen here, with H.T. models varying from 12–96 volts. These have an actual capacity of 3 amp. hours, and are of vital interest to the users of multi-valve receivers.

C. A. VANDERVELL, LTD.
Stands Nos. 157 and 212.

Among the new lines well worth attention at these stands are the two complete sets, the three-valve portable receiver and the three-valve Baby Grand.

The latter is a very handsome piece of work, as will be seen from the illustration on page 334.

WALKER BROTHERS.
Stand No. 99.

A full range of all wooden loud speakers and horns is seen here, together with portable and self-contained cabinets for the construction of wireless receivers.

WATMEL WIRELESS CO., LTD.
Stand No. 1.

Among various exhibits the following new lines are of interest to the home constructor. A fixed grid leak, fixed grid condensers, and earthing clips; while the ordinary listener will be attracted by a new two-valve set for broadcast reception.

THE WET H.T. BATTERY CO
Stand No. 16.

The Standard Wet H.T. Battery Co. is showing a new type of Leclanche wireless battery.

Batteries of different voltages will also be shown in sizes to suit from one-valve receivers to nine-valve super-heterodyne sets. An interesting demonstration will be that of a seven-valve super-heterodyne being supplied with H.T. current from a No. 3 size 91-cell Leclanche battery.

WHITTINGHAM, SMITH & CO.
Stand No. 97.

Two new receivers form the main exhibits under the trade name of "Portadyne" sets. The first is a "standard" five-valver and the other

(Continued on page 414.)

WHAT TO SEE AT OLYMPIA

—continued from page 412

is an attache-case model, also employing five valves but being completely portable.

WILKINS & WRIGHT, LTD.
Stand No. 95.

A series of "Utility" components is to be seen here and many lines make their first appearance. The additions include a new on-and-off switch designed to act as a main switch for cutting off L.T. supply. Its design is of the push-pull type and in order to reduce electrical resistance to a minimum contact is made through twelve points.

Other items have among them the new Micro-dial and some new logarithmic condensers. These include the well-known feature of ball-bearings, etc., so long employed by the manufacturers of "Utility" products.

WRIGHT & WEAIRE, LTD.
Stand No. 253.

Among many exhibits mention must be made of a new automatic dual coil holder which takes three ordinary plug-in coils, for high and low range, the centre coil being the reaction coil. When swung over to the right the set is ready for 5 X X, and when to the left the "local" is received; when the coil is dead centre the set is switched off, the aerial and earth being shorted and the filaments turned off. Other novel and interesting devices too numerous to mention here are to be seen, and the reader should certainly pay a visit to Stand No. 253.

AMERICA'S RADIO PROGRESS

MORE than 182 broadcasting stations under construction in U.S.A. have been obliged to suspend operations until they have obtained a permit from the Federal Radio Commission.

A report of the Department of Commerce shows that the Federal Radio Commission will have 733 stations on its hands which, if permitted to continue operations, must be squeezed into 89 wave-lengths. If the waves were divided equally this would mean about eight stations on each wave-length. Since the breakdown in regulation last year there have been 230 new stations licensed; 50 stations have changed their position; 197 stations have changed power; 111 stations have changed wave-length; 182 stations are under construction and 78 stations are planning to increase their power!

Piano Speaker

A new principle in connection with the reproduction of radio is brought forward by the International Radio Corporation of Pacific Electric Building, Los Angeles, California, who have recently placed on the market a loud-speaker reproducer unit which is not provided with any horn or other sound-producing channel, and which is adapted to be screwed on to the back of the sounding-board of a piano or underneath a grand piano. In this way the vibrations from the reproducer unit are communicated to the piano sound-board which is eminently adapted for the reproduction of different tones, and it is claimed for this instrument that, used in this way, it takes advantage of the acoustical properties of the piano sound-board which are aided by the presence of the whole set of strings of the piano acting as a sound reinforcer. This instrument is known as the Rotofor Radio Piano Speaker.

RADIO NOTES AND NEWS OF THE MONTH

A feature in which our Contributor brings to your notice some of the more interesting and important Radio news items of the month.

Conducted by P. R. BIRD.

Let's Go To Olympia

So much has now been written about the National Radio Exhibition at Olympia that there is a danger of our not seeing the wood for trees. Here, however, are a few really *important* tips :—

FOOD :—Cafe open all day.

FEMININITY :—Admitted with pleasure, and will find plenty of interest.

EXERCISE :—Dodging people you don't want to see ; also

DANCING :—Royal Air Force string band. (Good floor.)

ROUTE :—District or Met., change at Earl's Court ; many direct 'buses.

RADIO :—All sorts, at all stalls, all prices, all alive-o !

What Next?

Now that the Post Office, after exhaustive tests, has approved and accepted the new wireless beam stations, the engineers who built them are free to carry out further beam tests with telephony. Apart from those stations comprising the Empire wireless chain the Marconi Co. has a beam station of its own at Dorchester. This is for telegraphic work with South America, and it is understood that speech and music are to be superimposed on the Morse signals, to see if the service can "carry double." If so, the other beam stations would doubtless follow suit, and the Empire Wireless Chain would be threaded with pearls of speech.

Empire Broadcasting

Contrary to the expectations of the B.B.C. tremendous enthusiasm has greeted the too-long-delayed inception of Empire broadcasting. The Postmaster-General has granted the necessary licence to Mr. Gerald Marcuse, of Coombe Dingle, Caterham, Surrey. Programmes from this well-known amateur station (2 N M) are now being regularly despatched to all parts of the Empire. And there is a widespread conviction that the programmes could not be in better hands

2 N M's Great Experiment

As at present arranged, Australia and New Zealand are to get an hour's programme at 7 a.m., and at 7 p.m., every Sunday. Tests will be made to discover the best hours for transmission to Africa, Canada, Straits Settlements, and other far-flung outposts of Empire, and upon these tests the times and wave-lengths of future transmissions will be based. 32·5 metres is the wave-length that Mr. Marcuse has been using for 2 N M's pioneer Empire programmes. Good luck to him !

A Sign of the Times

Have you noticed that already there is a very marked improvement in long-distance reception, due to the darker days ? Not only do the Continentals come in earlier in the evening, but they have developed a delightful daylight punch that speaks well for winter reception.

(*Continued on page* 418.)

RADIO NOTES AND NEWS OF THE MONTH

—*continued from page* 416

And speaking of daylight programmes, have you tried for Hilversum lately? If not, take a stroll along 1,060 metres one afternoon at 4.30 p.m.—you'll find a fine concert in full swing there.

Proof From 5 G B

Above all the discoveries that are emerging or have emerged from the first few weeks of the Daventry 5 G B Experimental transmissions, one fact stands out supreme. And that is the fact that alternative programmes are not a luxury, but a proved necessity. Every set ought to be a double-programme puller, and every listener in the country ought soon to be in a position to turn the dial and take his choice of entertainment. Along this road to brighter radio and alternative programmes 5 G B is the first milestone.

Daventry's New Aerial

For some reason, 5 G B's first aerial took a dislike to Yorkshire, and listeners out Malton way had great difficulty in picking up the programmes. The B.B.C. is now getting a new aerial rigged up, and probably it will be in use before October. From a mere 100 feet, Daventry Experimental's aerial will go up to a height of 325 feet, and no doubt reception will go up accordingly.

World's Radio Regulations

Amongst the important radio events of October pride of place undoubtedly belongs to the International Radio Conference, for which the delegates are now assembling at Washington.

Every nation naturally claims a place in the ether, not only for its broadcasting, but for its ships, aeroplanes, and all other wireless transmitters and receivers. And the Washington Conference has to hear all the claims and suggestions, and then work out a scheme for all the world's wireless. Some job!

Ships That Jam In the Night

The last International Radio Conference, which gave us the S O S signal, put the world's ships and coast stations upon a satisfactory basis. But since then the position has been highly complicated by the arrival of broadcasting, aeroplane wireless, short-wave discoveries, radio direction finding, wireless beam services, and television!

Clearing wave-bands for all the various classes of ether traffic will be no easy task, but Washington must attempt the feat, to save the world from the chaos of ever-increasing congestion in the ether.

Our Nearest Neighbour

Which foreign broadcasting station lies nearest to the English coast? Not many listeners know it, but this distinction belongs to the new French station at Lille. It was opened only about a couple of months ago, and at the time of writing is transmitting upon a wave-length of 285 metres. The distance from Dover is less than 90 miles.

Como Commences

To celebrate this year's centenary of Alessandro Volta, the Italians arranged an Electrical Exhibition, and backed it up by a temporary broadcasting station to "tell the world." This has been on the air at Como, on 500 metres. So if you have picked up an unfamiliar voice round about there you were probably listening to the ether-monument of the man who gave the volt to the world, and who died only one hundred years ago.

THE DESIGN OF H.F. AMPLIFIERS

—continued from page 374

TABLE 7.

Wave-length.	Effective resistance. Ohms.
600	370,000
500	410,000
400	460,000
300	510,000
200	640,000

If these values are now included in the amplification formula, we find that the amplification actually obtained is much more nearly uniform, being considerably higher than it was for the first tuned circuit. The calculated amplification for the three valves specified comes out as follows :

TABLE 8.

Wave-length.	Valve 1. M=20 R_{AC} = 40,000	Valve 2. M=40 R_{AC} = 100,000	Valve 3. M=40 R_{AC} = 200,000
600	18·0	31·5	26·0
500	18·2	32·0	27·0
400	18·4	32·8	28·0
300	18·6	33·5	29·8
200	18·8	33·4	30·5

The amplification with the new coil is therefore much more uniform, and it should be noticed that we have not sacrificed any desirable features, but rather, having improved the coil immensely, have levelled out the amplification over the tuning range. Table 8 should be compared with Tables 3, 4, and 5. Clearly the new coil proves its value in two ways—first by increasing the magnification at all wave-lengths; and, secondly, by providing reasonably uniform amplification. Messrs. Loftin and White had better look out. If they had attended to the design of their tuning coils there would probably have been no need to use coupling condensers and special circuits, with their enhanced losses!

A Summary

The points brought out above may be summarised as follows :

1. For a given valve maximum amplification will be obtained when the tuned anode circuit has the lowest possible losses.

2. The amplification can be made sensibly uniform by paying attention to the design of the tuned circuit, and particularly to the coil.

3. The amplification for a given tuned circuit is less for a valve having a high A.C. resistance than for one having a lower value of resistance.

The information given above serves to bring out one or two points which have to be considered when designing tuned-anode H.F. amplifiers. There are many other things of interest, such as the effect of tapped coils, and the amplification which it is safe to design for in practice; but these will have to be dealt with in a future article, as will the question of selectivity, the ratio of inductance to capacity in the tuned circuit, and other things of vital importance.

THE "NEW MIDGET" ONE-VALVER

—continued from page 378

Results

The results obtained with this little set were quite up to expectation. London at eight miles was received at good 'phone strength on 9 ft. of wire, and no earth; 5 G B could also be heard on this aerial, and also the carrier wave of Langenberg. On an outside aerial 2 L O was strong enough to give small-room loud speaking.

(Continued on page 422.)

THE "NEW MIDGET" ONE-VALVER

—*continued from page* 420

With a No. 60 centre-tapped coil in use, several stations other than the local were received in daylight, whilst after dark on the same coil the stations came in at varying strengths all round the tuning dial.

On the Pye condensers employed it does not matter which set of plates is at low potential, since both are completely insulated from the end plates and the dial spindle. The fixed plates were taken to the low-potential points in order to simplify wiring. In the case of the tuning condenser the end plates are connected to earth in order to act as a screen to overcome a slight hand-capacity effect which was experienced.

Should, for any reason, the reaction coil be connected round the wrong way, different symptoms to usual are experienced. The set will still oscillate, but it will not be possible to resolve carrier waves, and reaction control will be very ploppy. Also, signals will be distinctly poor from the local station.

RADIO THIS SEASON

—*continued from page* 324

the point and underestimates the value of stations like P C J J or 2 F C coming into operation this winter.

If we had a station like P C J J, the public is sufficiently well informed these days to understand that its service would be more or less experimental—but nevertheless its experimental broadcasts would be keenly watched, and progress would naturally be made as experience and experiment proceeded. This is certainly the idea held by the Australian broadcasting people.

But no, the B.B.C. have their own ideas, and so it has been left to Mr. Marcuse, the well-known Caterham amateur, to inaugurate an experimental service of his own; while in the Antipodes 2 F C—a powerful short-wave station—gets on with the job and starts an experimental service which, so far, has proved successful. Perhaps it is better so.

Mr. Marcuse—providing he is not hedged in by too many Post Office restrictions—has the right adventurous spirit for an undertaking of this kind. He is not a rule-of-thumb man, and, whatever the results, his experiments will be watched with sympathy and interest wherever the English language is spoken. You see, he is *trying*; he is not afraid of taking a chance, nor is he inclined to grow a long white beard in waiting until he has reached "technical perfection." No; he is getting on with the job. Good luck to him!

Alternative Programmes

As an offset to the B.B.C.'s attitude in connection with the Empire Broadcasting scheme, the opening of 5 G B has done much to encourage fresh interest in British broadcasting.

Daventry Junior, indeed, marks the beginning of a new epoch in broadcasting. For over four years listeners have been asking for an alternative programme service. When 5 X X was opened, it was hoped that this widely-expressed public wish would be met, but 5 X X proved to be only a glorified relay station after all, and until recently the public had almost resigned themselves to a one-programme service. 5 G B, however, starts its service at a most appropriate time, and with every promise of fulfilling its appointed destiny.

(*Continued on page* 424.)

RADIO THIS SEASON

—continued from page 422

For one thing, "talks" will not be broadcast from that station, a fact which should go far to enhance its popularity with that vast majority of listeners who chiefly desire amusement and not a second-rate educational course. If, by chance—as rumour has it—this policy is altered, the B.B.C. will be making a very unpopular move. If 5 G B and 5 X X broadcast strongly-contrasted programmes—and "strongly-contrasted" they must be if the original idea of an alternative programme service is to be maintained—then a new lease of life will be given to British Broadcasting—a new lease, by the way, which (it is no good blinking at facts) has been made necessary by the widespread discontent with regard to the past programme policy of the B.B.C.

The Regional Scheme, indeed, starts off under favourable circumstances—and so far we have no reason to suppose that it will not be carried to a triumphant and wholly successful completion.

Full of Possibilities

With regard to the amateur, the season is full of possibilities, and the scope offered to the experimenter has probably never been greater. "Set-building" is no longer an amusing pastime—it is a serious and valuable hobby, requiring, for its best results, a sound knowledge of radio technique and a skill which no other hobby in the world demands to such a high degree.

I have said nothing of the probable developments of television, of four-electrode valve circuits, and have but barely touched the fringe of that vast and fascinating subject, short-wave radio, but enough has been written to show, I think, that the latter part of 1927, and the year 1928, will not be lacking in material and subjects for controversy, which, in themselves, will prove the truth of that trite saying, "Radio is still in its infancy."

WHAT READERS THINK

—continued from page 346

It is noted that the mutual conductance, or "slope" of the DEP.610 valve is as high as 1·55 m.a. per volt for an "m" value of 7. If you refer to the well-known D.E.5 power valve, you will find that this valve has a mutual conductance of ·88 m.a. per volt for a similar "m" value of 7. Thus both valves should deal with the same input, but the Osram DEP.610 has the advantage of a much greater output for the same grid swing, and, in addition, a reduction in current consumption of from 0·25 ampere to 0·1 ampere.

The aim in valve design is to construct a valve with as high a mutual conductance as possible. If then we retain the impedance at a sufficiently low value to provide the requisite anode current for driving a normal type loud speaker in popular use, the "m" value will increase. The advantage of this is that it will provide more volume from a weak input from distant stations, and if receiving loud signals from a nearby station, some form of volume control in front of the power valve will reduce the input to the same magnitude and provide the same volume of undistorted output.

It must be appreciated, of course, that the DEP.610 does not fall within the Super-Power Valve class, the purpose of which is to deal with a very much greater input, and it is admitted at once that for a large input requiring a swing up to about 20 volts a valve of the Osram D.E.5.A. class becomes essential in the last stage.

We shall be greatly obliged if you can see your way to correct the impression which your article must have created concerning the new DEP.610 valve, by giving publicity to this letter in your next issue.

Yours faithfully,

F. E. HENDERSON.

Valve Dept.,
General Electric Co., Ltd.

THE ROUND ISLAND RADIO BEACON

—continued from page 382

exactly. This transmission, followed by a silent period of three minutes in each case, is repeated three times, covering a total of nine minutes every half hour.

This sequence is carried out by the clock in the following manner:

Just prior to the beginning of the transmission, contacts on the clock start up the main alternator which provides the whole of the power required for the transmitter. A second pair of contacts then energises the motor of the character wheel, and the actual periods of transmission are governed by mechanisms incorporated in the character wheel. At the end of the third transmission the clock contact opens and the current to the main alternator is switched off until the next half-hour period is required. In fair weather the cycle is repeated every half hour.

As much of the information given in the columns of this paper concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and the trader would be well advised to obtain permission of the patentees to use the patents before doing so.

In foggy weather a hand-operated switch is turned to short-circuit the alternator contacts, and the whole signal, consisting of the one-minute transmission and three-minutes silence, is then repeated continuously.

In addition to the clock switchboard mentioned above, switchboards are provided for the main power plant. These switchboards mount all the necessary instruments, switches, etc., for controlling the respective running machinery.

The motor alternators supplied with this station consist of a shunt-wound 1½ kw. D.C. motor designed to run off a 50-volt supply, and coupled to a separately excited alternator, 100–150 volts, 400–600 cycles, single phase, both mounted on a cast-iron bedplate. Suitable field regulators and automatic starters are also provided, and the frequency of the alternating current can be varied within the limits of 400 and 600 cycles.

The battery supplied, of the glass-cell permanent type, is of ample capacity to run the complete station for a period of twelve hours without recharging.

(Continued on page 426.)

THE ROUND ISLAND RADIO BEACON

—continued from page 425

A special automatic battery-charging plant is installed which automatically starts up the engine and proceeds with the charging of the battery directly the battery discharges itself below a predetermined level. Immediately the voltage of the battery has reached the required level the engine is automatically switched off.

A feature of the charging plant is that the line voltage is kept constant and the automatic control switchboards are so arranged that at every charge the engines are used alternatively. If one engine fails to start when required, the battery, after a few seconds, is automatically switched to the other engine. Should this fail to start, the plant switches itself off altogether, and rings a bell to warn the lightkeeper.

The range of the station, assuming a normal ship's D/F receiver, is capable of giving accurate bearings up to a range of 70 to 100 miles. Under favourable conditions of atmospherics and jamming this range will, of course, be increased.

OPERATING THE "LONG-RANGE" FIVE

—continued from page 364

When 6-volt valves are used much more amplification is obtained because, speaking generally, 6-volt valves have twice the voltage factor for the same A.C. resistance as 2-volt valves. When using 6-volt valves, therefore, we can afford to use in the H.F. position types having an A.C. resistance of about 30,000 ohms, for by so doing we shall gain in selectivity and at the same time have plenty of amplification.

The Valves to Use

We therefore recommend for the H.F. stages two Osram D.E.5b valves, two D.E 8H.F. valves, or two of the new D.E.H.612 valves. In the detector stage fit a Cossor 6-volt R.C. valve, and in the first L.F. position a Cossor 610H.F. valve ; put a Stentor 6 in the output position. These valves can all be used with an anode voltage of 120. The grid bias of the first L.F. stage should be —1·5, and of the power stage about —12. If valves having a lower A.C. resistance than 25,000 to 30,000 ohms are used in the H.F. position, it will be found that an anode voltage of 60 to 90 for the two H.F. valves will be ample.

It is, of course, very difficult to describe with any accuracy the performance of a set of this type. It can be said quite definitely, however, that the amplification obtained is all that anyone is likely to require when 6-volt valves are used, even if the set is used in a flat where only a small aerial can be fitted. Any station which is producing stronger voltages in the aerial than the mush and atmospherics will be received on the loud speaker.

As regards selectivity, the position of the set with regard to a main B.B.C. station will, of course, be an important factor, but in judging selectivity the question should be, not "Can I cut out London working on 830 kilocycles and receive Cardiff working on 850 kilocycles?" but, "How many stations can I receive all told clear of interference?" The answer to the latter question will, of course, depend upon the magnification given by the receiver. If the magnification of the set is cut down in order to provide selectivity, such that a station working 20 kilocycles away from London can be received at a place two or three miles from the latter station, then probably the amplification will be such that ten to fifteen stations only will be received altogether at full loud-speaker strength.

When, however, a reasonable amount of selectivity and magnification is obtained we may find that we cannot receive the station working on the frequency of only 20 kilocycles from London, but because the set has much more magnification we shall find that we can receive many more stations all told. The latter is, therefore, the better set for normal use. It certainly will give the better quality, owing to less distortion in the H.F. circuits.

The receiver illustrated has been designed to provide excellent quality by suitable design of the detector and L.F. circuits, but its enormous sensitivity and its selectivity are essentially due to the design of the H.F. transformers. Care should therefore be taken that the correct H.F. transformers are used.

Its total anode-current consumption is well within the capacity of the large type of dry battery, and as ample by-pass condensers are used there is no fear of distortion unless the batteries are very run down.

THE "SUPER-SCREEN" FOUR

—continued from page 323

The meter circuit is composed of a ·0005-mfd. variable condenser and a winding of 80 turns of No. 34 D.S.C. on a 2-in. ebonite tube. This tube is three inches long and carries also the coupling winding of two turns of No. 24 D.C.C., which is placed about one-eighth of an inch away from the upper end of the other coil. This is wired up in series with the tuned-anode circuit, as the diagrams show, and to make a neat job the ends of these two windings were brought out to four small terminals arranged round the upper end of the tube. The whole is mounted in the position shown by means of two small brass brackets.

For the constructor who is likely to build this set no very detailed instructions are likely to be needed for the constructional work, but there are just one or two points requiring explanation. First, it will be observed that the grid condenser and leak for the H.F. valve is mounted on the end of the valve socket, and this is done by means of a small platform of ebonite screwed to the underside of the valve base and projecting beyond the end far enough to carry the condenser. The dimensions of this platform are $1\frac{3}{4}$ in. by $2\frac{1}{2}$ in.

It will be noted that there is an extra screening plate between the two tuning condensers, and this may be cut from thin sheet copper or aluminium and secured by means of two screws through the lower edge into the baseboard, about half an inch of the plate being bent through a right angle at the bottom for the purpose. One edge of this plate makes contact with the screening box, being either soldered at a suitable point or secured under one of the screws which hold the screening plate of the valve holder to the box. (This will be quite clear when you examine the box with the valve holder duly mounted. Many firms supplying the parts for this set will provide the box with the valve socket mounted ready for assembly in the set.)

The actual results obtainable from this set will be found rather impressive when the number of valves is taken into account. The sensitivity is not very far short of the "M.W.5," the impression being that the one H.F. stage of the "Super-Screen" Four is about equal to one and a half of the two stages of the "M.W.5."

ENGINEERING PROBLEMS IN BROADCASTING

—continued from page 370

fabrics, but a bright, cheerful room, artistically built and artistically decorated and furnished. Ordinary wallpaper and pictures and fireplaces figure in the new studios, and the microphone ceases to become an austere-looking piece of electrical apparatus. But behind the wallpaper is a special sound-absorbing substance, and the pictures, where such are used, are not only decorations, but also play their parts in the acoustic adjustments of the studio.

In the older studios some of the engineers had most unhappy times. The problems of echo and resonance were always cropping up. Draperies were made variable, and the fabrics covering ceilings arranged in panels so that they could be juggled about, and in some cases extreme measures, such as the tearing away of parts of the actual ceiling, have been resorted to.

Balancing Sounds

At Belfast a very knotty problem was once encountered in the studio. A very pronounced resonance at a certain frequency was noticed, and for days the engineers were at a loss to explain it. Various things were tried without success, and for a time it appeared as though the task of locating the source were hopeless. However, it was eventually discovered that one of the several pillars that supported the ceiling of the studio was vibrating!

Belfast, by the way, is probably to have one of the new double-height "undraped" studios, and no doubt in due course every one of the stations will also be equipped in a similar manner.

With their new studios the B.B.C. people can do practically anything they like in the way of "balancing" the sounds. A special microphone can be employed to pick up the music and speech and pass it through an echo room, eventually to be combined with that collected by another microphone; "effects" can be faded in and out, and any sort of acoustic illusion can be produced. The listener can be carried in effect from a tiny little room in a private house to a large concert hall or to the centre of a mighty desert, all by the twisting of little knobs and dials and the operation of switches.

Yes, our B.B.C. engineers have faced many difficult and queer problems, and to their credit let it be emphasised that they have reduced the art of the microphone to a concrete science. There is every indication that the day of expediencies and rough hook-ups has finally passed, and, with few exceptions, "stunts" can now be mapped out with mathematical precision. And this is the result of a combination of enterprise, enthusiasm, and hard work. Otherwise how could so much have been achieved in so short a time?

A TESTING UNIT FOR WIRELESS SETS

—continued from page 366

made of thicker wire. A longer length of thicker wire is really preferable, as with copper the resistance alters as the wire heats up, and the more copper there is the less the rise of temperature. Fig. 5 shows the theoretical circuits for the various ranges.

The third section of the instrument is simple, and Fig. 6 shows the wiring. The four valve sockets used with the same shorting plug make a simple three-way switch. With the plug in position H the lamp is in series with the test leads from terminals K and L.

With the plug in position I the lamp and battery are in series with the test leads, and with the plug in position J, lamp, battery, and 'phones attached to terminals M and N are in series with the leads. These arrangements serve purposes *a*, *b*, and *c* mentioned earlier in the article. If M and N are connected to A and B, the current through a transformer winding can be read and its approximate resistance calculated from Ohm's Law, assuming the battery voltage to be four volts.

The flashlamp battery is fixed on the bottom of the box and connected up by flex wires to the panel. The shorting plug is a small piece of ebonite with two valve legs connected together by a brass strip. It appears in the photographs, and when used to convert the milliammeter for the ammeter ranges should make very good contact.

The instrument as described has served the writer well on many occasions when called out to locate trouble in the receivers of his friends and kinsfolk, and it also does duty in various guises during experiments at home. It is well worth the trouble and cost of construction.

IS THERE AN INSULATOR?

—continued from page 408

Whilst dry there was no alteration in resistance. But as soon as the dust was gently breathed upon, and made slightly moist, the resistance fell rapidly to as low as 2 megohms. Therefore, beware of dust—it will surely let you down on a damp day. In fact, a little dust nicely damp will cause crackles and take all the life out of a lively and sensitive receiver.

The ebonite was then hung in a sunny spot in the garden for an exposure test. But after three weeks' exposure to rain and sun there was no alteration in the resistance.

Egg insulators were next tested. Wet or dry these insulators had a resistance above 100,000 megohms. It is, however, a good plan to make the leakage path as long as possible by connecting the aerial to the eye nearest it, and the rope to the other eye. Soot is the enemy of outside insulators. A well-sooted egg insulator had a resistance of 20 megohms when damp, but normal when dry.

An Aerial's Insulation

A single-wire aerial on a dry day had an insulation resistance higher than could be measured. But on a wet day it had fallen to 330 megohms.

Such things as headphones and transformers had a resistance of 10 megohms from the windings to the frame. One pair of headphones was as low as 3·3 megohms. The accumulator H.T. in glass cells had a leakage resistance to earth of 74 megohms. Most people disconnect the H.T. and the L.T. leads when closing down for the night. With the L.T. disconnected there was a flow of ·3 μA in the H.T. + lead in a four-valve set with numerous 2-mfd. H.T. condensers. Thus the difference in resistance compared with when the filaments were alight was 330 megohms to about 6,000 ohms. Provided good materials are used and there are no leaky condensers installed, a leakage current of ·3μA would not cause much wastage of H.T. Switching off the L.T. only would appear to be sufficient, provided somebody does not lay a pair of scissors across the H.T. terminals.

These tests do show the advisability of spring cleaning the wireless set, overhauling the aerial, and generally making sure that leaks are not creeping in where least expected.

Above all, beware of dust!

A ONE-VALVE DX UNIT

—continued from page 348

anode-tap position depends very much on the valve to be used and on the efficiency of the coil. I suggest trying a tap two-thirds of the way down with a valve of 20,000 ohms impedance such as the modern D.E.L. type. If one of the older D.E.3 types is used, try the same position for this, although, of course, the magnification will not be quite so large as with a modern valve.

If a valve of lower impedance, such as 8,000 or 10,000 ohms, is the only one available, tapping still further down is of advantage, between, say, a third and a fifth of the way. If the tap is too high up it will show up as flat tuning on the anode coil of the adapter, and above a certain tap there will be no noticeable gain of signals, although the tuning will be flatter.

Tapping the Coil

By the way, when tapping Litz for the anode tap, it is not at all necessary to bare the whole of the Litz, one or two strands bared is quite sufficient, because this connection to the anode only has to carry the minute feed current, and the resistance factor does not enter. When making taps on enamelled wire be very careful to lift the wire and slip a piece of mica under before soldering the joint, because a short-circuit due to solder is fatal in the case of a coil.

It is not a bad idea in this anode coil to make taps at a fifth, a quarter, a third, and half the way up the coil, and possibly to use a tie clip to the anode for testing out the best position. The series condenser connecting the top of this anode coil to the receiver can be a very small one indeed. One of the very small neutralising condensers is almost too big. Three inches of wire with a piece of sistoflex slipped over it and another piece of wire wrapped over this sistoflex will usually be ample capacity. If this capacity is too big it will show itself as flat tuning on the anode coil, and the set will not be quite so easy to work.

Operating the Amplifier

The aerial tap again depends on whether Litz or ordinary wire is in use, and to some extent on the condition of the aerial, but tappings can again be made on the aerial coil the same as I have suggested for the anode coil, and the clip used again, till an average position is found which will be satisfactory for all wave-lengths. If required, a lower position for the short waves can be arranged for by a switch mounted on the panel.

Taking an average aerial as being about ·0002 mfd. capacity, it is quite a good idea to put in a condenser of this value, as I have shown in the figures, because it does no harm when there is a shunt-tuning condenser on one's receiver, and it actually supplies the missing aerial in the case where there is no shunt condenser.

To operate, set up the normal receiver with the aerial on, and tune to the local station. Set up the adapter by the side of the receiver, and connect the H.T. and L.T. batteries to the adapter. As, of course, these batteries will be common to both the adapter and receiver, there will be no necessity for more than one extra connection between the adapter and the receiver.

The next operation is to take the aerial off the receiver, put it on the adapter, and then tune the adapter to the local station. Very often you will be able to receive the local station with quite a tiny aerial, say a few yards of wire, and this will enable you to play about with the tuning on quite weak signals. Mark the position of the local station on the tapped anode coil on the adapter and on the receiver, just noting approximately the position of the aerial tuning condenser. If later you can also get Daventry Junior, you will now have two wave-lengths which you know.

Mark these on the scale, and if the tuning condenser being used is of the straight line wave-length type, the calibration over the whole scale will be very easy to determine. In this operation of setting to the local station with a yard or two of wire, you can incidentally determine whether the neutrodyne condenser is set correctly.

THE LOFTIN-WHITE SYSTEM

—continued from page 357

distance—and selectivity with our system, I suggest trial of the simple modification of Fig. 1 shown in Fig. 6.

Increasing Amplification

It is seen that this modification amounts to the simple expedient of connecting a small condenser C_4 between the plate of the detector tube and the coupling side of phasing condenser C_3 selectively to increase the amplification of the detector tube. The reaction of the audio-frequency transformer in the plate circuit of the detector tube is capacitive, and acting through the tube capacity destroys the amplifying ability of this tube even when the audio transformer is shunted by a so-called "by-pass condenser," though to lesser degree with the by-pass condenser, because its presence reduces the capacitive reaction. The C_4 connection provides for selectively overcoming this reverse feed-back by reason of the connection to the selective input circuit through the "constant coupling," and by choosing C_4 of proper value (between 20 and 100 m.m.f.), depending upon conditions, the detector tube can be made to amplify selectively to any desired degree below the oscillating state with a most substantial improvement in selectivity and distance. If the coupling is right, a variable condenser C_4 will soon find a value which can be left fixed without producing oscillations in the broadcast band.

Substantially Improved Results

It is not necessary that the arrangement be used with transformer-coupled audio. It will work equally well for resistance-coupled audio, and is more important with resistance coupling, because the coupling resistance, combined with the distributed capacity of the output circuit, produces a capacitively acting reaction that is particularly effective in destroying the amplifying ability of the detector tube.

We have used this connection with most substantial improvement in results, particularly in the case of resistance-coupled audio, where a by-pass condenser cannot be used to lessen the capacitive reactance of the plate circuit.

EXPERIMENTS WITH THE NEW VALVES

—continued from page 338.

a second plate. When used with the split-primary method of neutralising, the ordinary type of valve is connected up so that its plate goes to one end of the primary winding, the other end being taken to a neutralising condenser connected to the grid, while the centre-point of the primary is joined to H.T. positive. By this means the potentials developed across the capacity between the plate and the grid of the valve are balanced out by equal and opposite potentials in the neutralising condenser, the value of which is adjusted to be approximately equal to the interelectrode capacity of the valve. With Dr. Robinson's valve, in the form I am now describing (incidentally, there are other forms of great interest), one end of the primary winding is joined to the normal plate, the other end being joined, instead of to a neutralising condenser, to the second plate, which has the same capacity to the grid as the first plate.

The centre tapping of the winding is taken, as usual, to the H.T. positive.

Now, the capacity between the normal plate and grid is identical with that between the extra plate and the grid, so that the valve is self-neutralising by means of the equal and opposite potentials developed across the second plate and the grid. Only the first plate receives the electron flow. The actual appearance of the valve does not differ materially from that of the normal type, for nothing of the internal arrangement can be seen through the silver coating, and the only external difference is the flexible lead coming from the second plate.

One of the photographs shows a neutralised receiver with neutralising condenser in position. When a circuit is of the split-primary type it is only necessary to remove the ordinary valve *and the neutralising condenser*, substituting the Robinson valve, the flexible lead from the second plate being joined to the lead which previously went to the neutralising condenser. We can thus dispense with the neutralising condenser and attendant wiring, and there is no need to fiddle with any adjustment in order to get a proper balance.

Of course, in the Robinson valve, as in the screened-grid valve, one must guard against feed-back effects exterior to the valve; but, provided adequate precautions are taken, the Robinson valve will give at least as good results as the normal H.F. valve in high-frequency magnification, but with the advantage that all need for neutralisation by means of a neutralising condenser is dispensed with. The magnification obtainable with this particular model is not so high as with the screened-grid valve, as the screening grid not only eliminates the internal-capacity effects in the valve, but also reduces the internal impedance so appreciably that a very much higher magnification can be obtained than would be possible without it.

The new screened-grid valve which is now being sold is not the first screened grid valve to be produced, as Dr. Hull, in America, has already described a valve which gives the same general effects. In my opinion, considerable developments will come along these lines, and I should not be surprised to see several further makes produced in the near future, although they will probably differ from one another very considerably in the mechanical arrangement of the parts, just as the new British screened-grid valve differs from the American form, which electrically it so closely resembles.

LISTENERS ABROAD

Four or five years ago broadcasting was known in Scandinavia by name only, and it was scarcely thought by the people of Denmark, Norway and Sweden that broadcasting was destined to play so great a part in their everyday life as is to-day the case.

In Denmark, with a population of 3½ million, there are 150,000 licensees, 35 per cent. of whom are valve-set users.

In October probably Soroe will be replaced by an 8-kw. station at Gisseloere. On account of Motala on 1,305 metres, and the coming German station at Zeesen (1,250 metres, with a power of 100 kw.), Gisseloere may come down to 337 metres, which may make it possible for American listeners to hear Danish programmes.

Czecho-Slovakia

Broadcasting in Czecho-Slovakia did not commence until 1923, when a 1-kw. transmitter was erected at Kbely, the principal aerodrome near Prague.

There are now half a million listeners' licences issued. "Radio Journal," the Broadcasting Company, was organised by the radio manufacturers in 1923 with a capital of 500,000 k.c. (crowns, not kilocycles), or about £3,000.

INDEX TO ADVERTISERS

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