BATTERY MODEL WIRELESS WORLD FOUR

The Wireless World

AND RADIO REVIEW

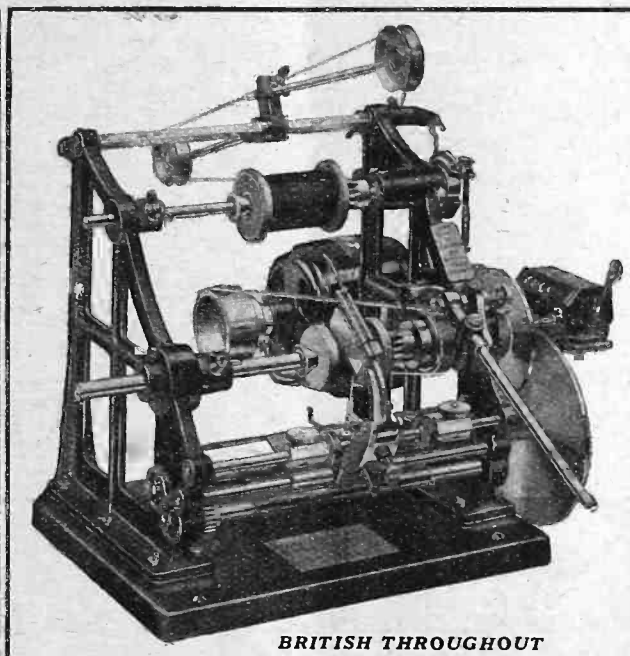
4D

The Paper for Every Wireless Amateur

Wednesday, December, 17th, 1930.

No. 590. Vol. XXVII. No. 25.

COIL WINDING with DOUGLAS AUTOMATIC COIL WINDERS



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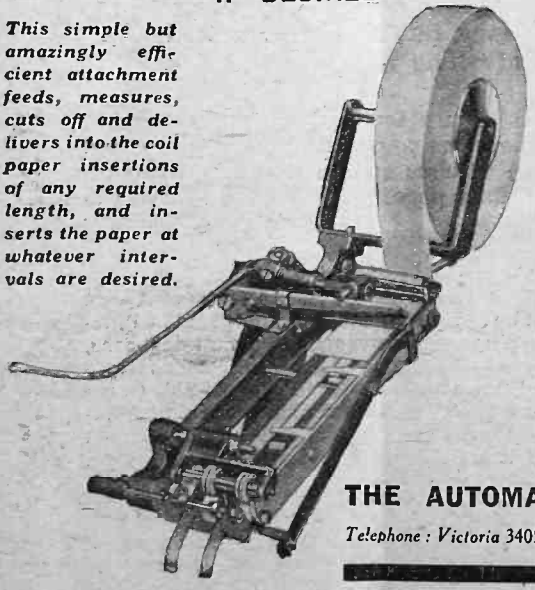

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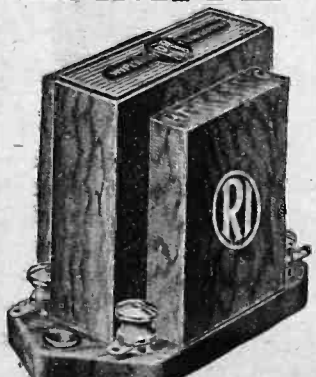

Inductance primary 50 henries.
Resistance primary D.C. 1,000 ohms.
Resistance Secondary D.C. 6,000 ohms.
Ratio 3½ to 1.

12/6

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AMPLIFICATION FACTOR 15!

NOTE THESE FIGURES

Filament Volts– – 2.0
Filament Amps – 0.2
Amplification factor 15
Impedance – 3,900 ohms
Mutual conductance 3.85 MA/volt.
Anode Volts – 150 (max.)

APPROX. OPERATING DATA

Anode volts – – – 125
Grid bias – – – – – 4½
Anode current – – 6 M.A.

STUDY THESE CONVINCING FACTS

1. A power valve with an amplification factor of 15—a hitherto unheard of figure.
2. Mutual conductance 3.85 milli-amps per volt—the highest valve efficiency yet achieved irrespective of type.
3. Stage gain thus comparable under working conditions to that given by a pentode.
4. Impedance only 3,900 ohms—a figure perfectly matching the average speaker.
5. Provides reproduction of exceptional quality without the sacrifice of volume from distant stations.
6. It is the supreme output valve for portable and most battery operated sets.
7. Strictly economical in current consumption—H.T. current only 5–6 milli-amps under normal conditions.

10/6

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1. A genuine super power valve with an amplification factor of 7.5—a figure previously considered impossible!
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3. Mutual conductance 3.5 milli-amps per volt.
4. Impedance only 2,150 ohms, ensuring reproduction of ample volume and perfect quality.
5. Ideal for the moving coil enthusiast who requires 6 volt results from 2 volt equipment.
6. Minimum current consumption compatible with highest efficiency—a most important point to the listener with battery equipment.

NOTE THESE FIGURES.

Filament volts – – – – – – 2.0
Filament amps. – – – – – 0.2
Amplification factor – – – – – 7.5
Impedance – – – – 2,150 Ohms
Mutual conductance – – 3.5 MA/volt.
Anode volts – – – – 150 (max.)

APPROX. OPERATING DATA:–

Anode volts – – – – – – – 125
Grid Bias – – – – – – – – –9
Anode current – – – – 12.5 M.A.

PRICE 13/6

G. Marconi

USE THE VALVES THE EXPERTS USE!

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The Wireless World AND RADIO REVIEW

(18th Year of Publication)

No. 590. WEDNESDAY, DECEMBER 17TH, 1930. VOL. XXVII. No. 25.

Editor : HUGH S. POCOCK. Assistant Editor : F. H. HAYNES.

Editorial Offices : 116-117, FLEET STREET, LONDON, E.C.4. - - Editorial Telephone : City 9472 (5 lines).

Advertising and Publishing Offices : DORSET HOUSE, TUDOR STREET, LONDON, E.C.4.
Telephone : City 2847 (13 lines). Telegrams : "Ethaworld, Fleet, London."

COVENTRY: Hertford St. Telegrams : "Cyclist, Coventry." Telephone : 5210 Coventry.
BIRMINGHAM : Guildhall Bldgs., Navigation St. Telegrams : "Autopress, Birmingham." Telephone : 2970 and 2971 Midland.
MANCHESTER : 260, Deansgate. Telegrams : "Iliffe, Manchester." Telephone : 8970 City (4 lines).
GLASGOW : 101, St. Vincent St., C.2. Telegrams : "Iliffe, Glasgow." Telephone : Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates : Home, £1 1s. 8d. ; Canada, £1 1s. 8d. ; other countries abroad, £1 3s. 10d. per annum.

European Broadcasting Problem.

FOR some years past we have become accustomed to look upon the United States as being in the unfavourable position of having an over-congested ether with innumerable broadcasting stations so closely related, both geographically and in the matter of their kilocycle separation, as to cause mutual interference, and we have been inclined to regard ourselves in this country, and in Europe generally, as more fortunate because the number of stations was more limited. But at the rate at which progress—if we can so term it—is being made in Europe, it is becoming more and more apparent that conditions here are not so happy as we were formerly disposed to believe, and, in fact, there is a serious risk that reception conditions in the Continent of Europe will degenerate into something very much worse than has ever been experienced in the United States.

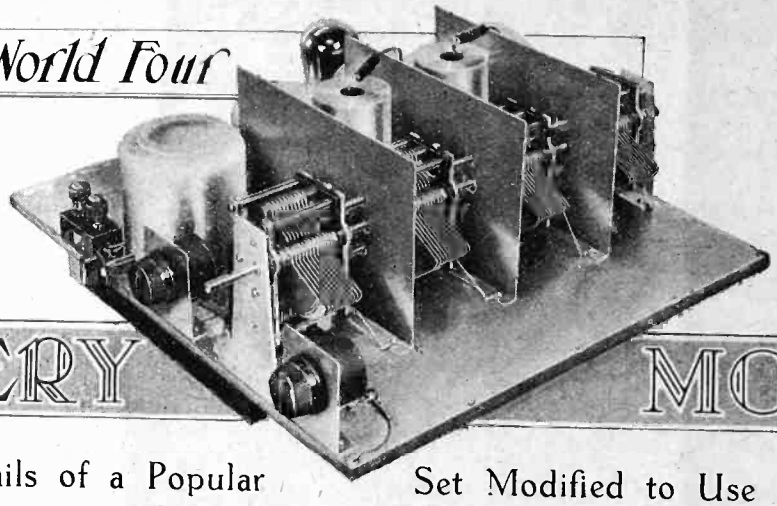
The reason for this pending calamity is not far to seek, for although we have an international understanding, so to speak, in Europe on various matters connected with broadcast development, we have no central body which is really in the position of being able to *dictate* and *control*, and, moreover, there are still certain countries which do not even respond to the recommendations of our European Broadcasting Conferences. In the United States, on the other hand, there is, after all, one central authority appointed by the United States Government, and disobedient or inefficient transmitters can be prohibited from broadcasting without much formality, so that, however numerous may be the individual stations and individual controls, there is the central body with dictatorial authority. In the States, too, the possibility of friction due to disagreement on political issues between two nations does not come into the picture.

Just recently we have had instances of the sort of trouble which may be expected to occur more frequently in Europe in the future, and these warnings should be sufficient to give great concern to the authorities involved. We have had within the last few weeks the first experience of really serious interference caused by the German high-power station, Muhlacker, interfering with one of our own transmissions because of the close proximity of the two wavelengths, and it is only because of the happy relations existing between the German and British broadcasting authorities that there is no need to anticipate that this difficulty cannot be quickly overcome. If relations were not so friendly, matters might be quite different. Again, without entering into a discussion of politics, we have had the instance of a broadcast from one country being interpreted as unfriendly to another country, resulting in the necessity for a protest.

These incidents, trivial as they may seem at the moment, may foreshadow more serious troubles in the future, unless more satisfactory arrangements can be entered into whereby the international aspects of broadcasting are more adequately controlled.

In This Issue

Wireless World Four BATTERY MODEL



Constructional Details of a Popular Set Modified to Use Battery Valves.

By F. H. HAYNES.

NOT long ago it was customary to design sets for battery working, indicating later, modifications necessary for mains conversion. This procedure is now reversed, and the Wireless World Four* which was developed as an all-A.C. set is now described for use with batteries. The revised design is suited for use where the supply is D.C. Conversion from this modified design back to the original all-A.C. set has been taken into account, so that when the A.C. supply is eventually available the set can be rebuilt as an A.C. model with the minimum of trouble, and making use of most of the existing components. It is unnecessary here to repeat the various considerations leading up to the adoption of the circuit and the specification as given for the original set which are retained in all respects excepting in regard to mains operation. Removal of the mains equipment has been the aim in the present design, making as little change as possible to the values of the remaining components. Certain changes are unavoidable.

SPECIFICATION.

Selective band-pass tuning. Single dial control without trimming condensers.
Pre-H.F. volume control. Critical regulation of regeneration at point of maximum amplification.
Complete coil and valve screening. All H.F. above baseboard with distribution circuits immediately beneath.
Tuned grid intervalve couplings. Ganged wave change switching. Distortionless power grid detection. Compensated pentode output. Complete smoothing and decoupling with a minimum of apparatus.
Readily convertible for all-A.C. mains operation. 2v. battery valves. 180 volts. H.T. Total H.T. current 30 mA.
Provision for gramophone and designed for housing in a standard radio-gramophone cabinet.
Easy access to all components and straightforward wiring so that but few leads appear above the baseboard.
No components to be home constructed. Lowest possible cost.

Indirectly heated valves give superior performance to battery types, and a careful selection of valves has been made in this battery model so that the results may be comparable with those of the mains-operated set. Unfortunately the best H.F. valves fall in the two-volt class, while output valves are best chosen from among those having six-volt filaments. The set might have been arranged to combine the use of both two-volt and six-volt filamented valves, but this would prove either wasteful with L.T. battery power, or unduly complicated as a result of running the first three valves with their filaments in series, while the use of a generous six volt power output valve would result in an excessive discharge rate from an H.T. battery.

[1] In the issues dated October 15th and 22nd, 1930.

In order to make the distant-station-getting properties of the receiver as great as possible the coils have been modified. Whereas tapping points were provided in the A.C. set at several turns down from the top of the coils in order to prevent regeneration, connection from the valve anodes is now made to the top of the coils owing to the fact that the residual grid-to-anode capacity of the valves used is somewhat lower than was the case with the mains valves. With this modification the amplifier is still perfectly stable, and the amplification may yet be further increased before the full effects of regeneration are obtained. To effect this the size of the coils has been increased so that the inductance value when under the screening covers becomes 200 microhenrys as against 160 microhenrys.

Stray capacities in the tuned circuits balance out very well, and are sufficiently close for all condensers to be lined up and the use of trimmers avoided. It is only by omitting trimming condensers that these coils of high inductance can be used, as the throwing of a small fixed capacity across a coil will considerably raise the wavelength obtained at the zero of the tuning dial. The lead to the power grid detector is taken from a point near the centre of the coil, not only to prevent the tuned grid circuit being unduly loaded by the detector, but to reduce the amount of capacity which the detector throws on to this circuit. The position of the tapping point was fixed from considerations of ganging. It is not unduly difficult to convert the coil windings, in the event of changing over to the A.C. model, by removing the excess number of turns and making the required tapping points by slipping a piece of mica under the turn to be tapped and soldering on a lead. The tuning range of the coils is from 200 to about 630 metres, and on a 100 division dial 300 metres falls at

Battery Model.—

36, 400 metres at 56, 500 metres at 74, 550 metres at 83, and 600 metres at 90.

Fortunately it is permissible to adopt the same values of feed resistances in the anodes and screens of the H.F. valves. Owing to the lower maximum anode voltage the fixed resistance in the screen volts control has been reduced, while the value of the potentiometer has been increased in order that it may pass but little current. Grid-bias in the H.F. stages is by 0.9 volt cell, the potential being fed through 1 megohm resistances so that grid current, due to overloading of the H.F. valves, increases the negativeness of the grids by the voltage drop through these high resistances.

Detector requirements fix the minimum value of H.T. potential that can be adopted for this set. Power grid detection demands a high voltage at the anode of the detector valve together with generous decoupling. Filter feeding of the L.F. transformer is desirable so that both feed and decoupling resistances are necessary. Lower values of feed and decoupling resistances to those shown cannot be adopted, and these result in the throwing away of about 80 volts. Thus the maximum H.T. potential has been assessed at 180 volts derived from three 60 or two 90-volt batteries. This value is equally suited for use with D.C. supply, in that some 20 volts is invariably lost in smoothing.

Owing to the absence of A.C. ripple potentials the value of the feed condenser to the primary of the inter-valve transformer has been increased to the normal value. The arrangement of the pentode output is normal, although it has been necessary to introduce a feed resistance of 1,500 ohms and to reduce the value of the resistance in the pentode screen lead to 5,000 ohms.

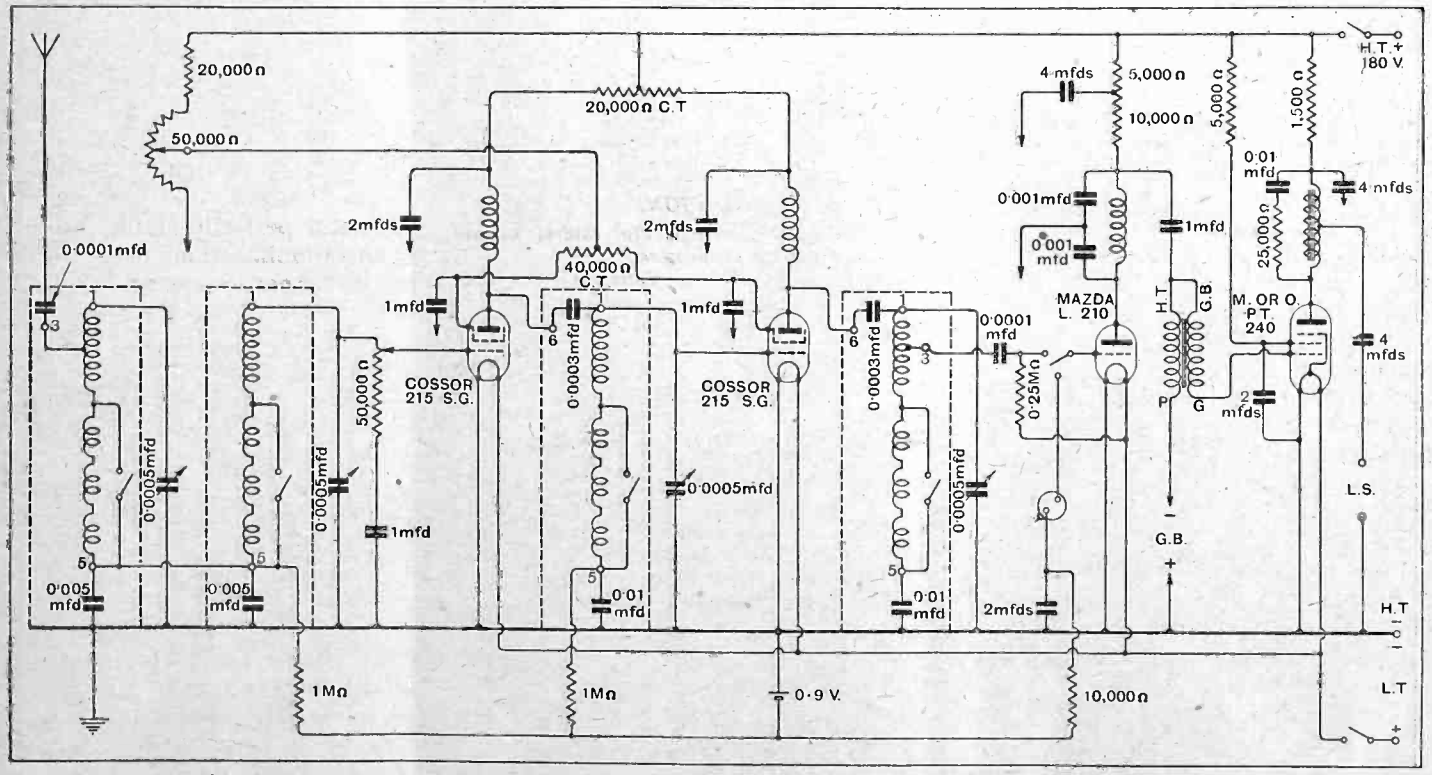
Constructional details already having been given at length reference should be made to the original article as well as the practical hints and tips in last week's issue. In that the various types of screen grid valves vary in their overall dimensions valve screens cannot be standardised, and adaptors have been made to reach down to the lower anode terminals of the battery valves. A modification in the type of condensers used in association with the coils removes the danger of contact between fixed condenser terminals and coil-screening covers.

Current and Voltage Values.

As a guide to fault finding the value of the current passing in the various paths from the H.T. battery is as follows:

H.F. anodes, 2.5 mA., when 180 volts is applied at the H.T. terminals. This gives 120 volts at the anodes.

Screen voltage potentiometer with contact arm lifted, or with H.F. valves removed and measured on the earth side, 2.6 mA.



As far as possible the values given for the various components have been retained permitting of easy conversion for use with A.C. supply. The types of valves used are indicated.

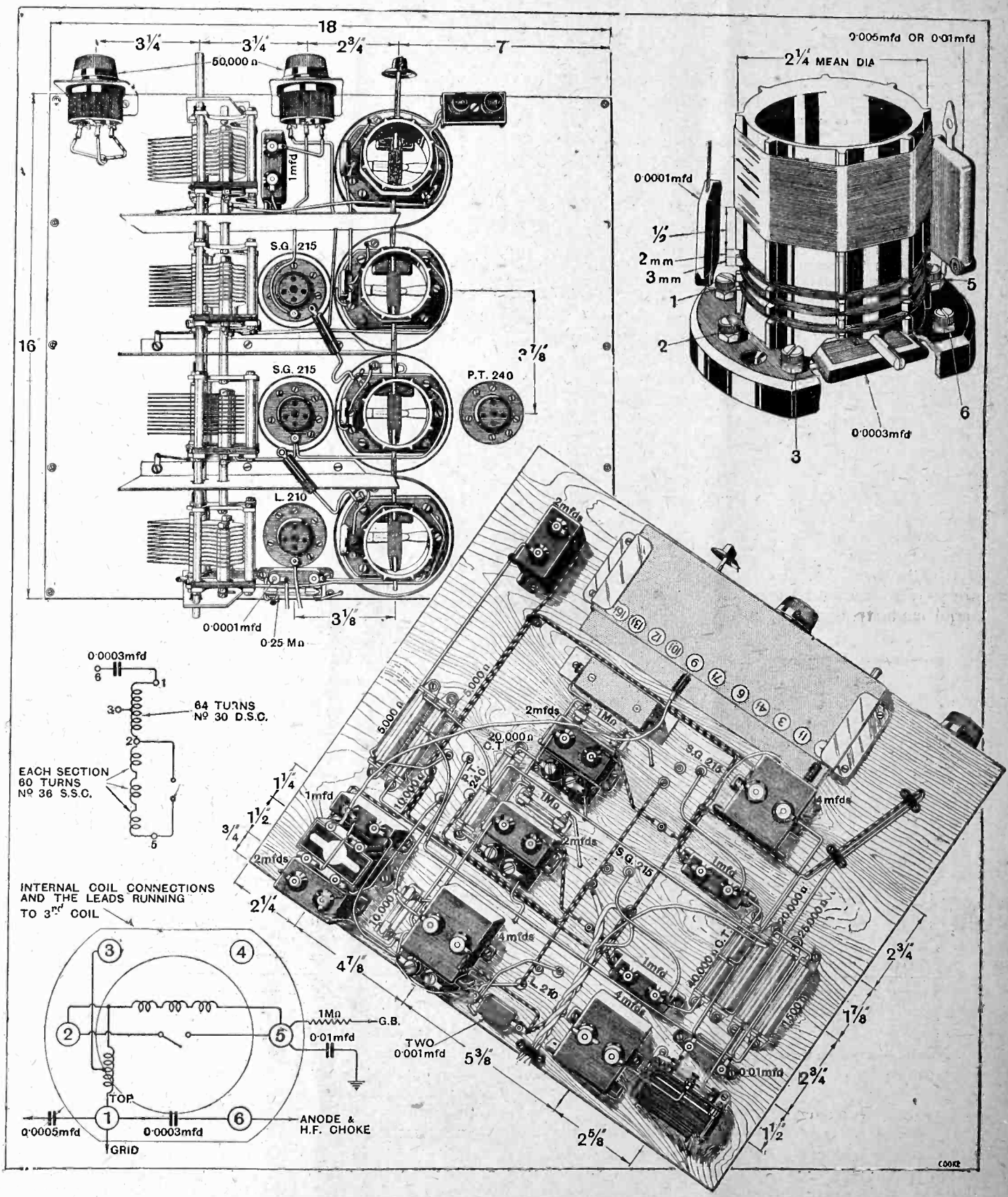
In the lead to the two screens, 1.6 mA. or 0.8 mA. to each valve.

Average detector current, 6 mA.

Pentode anode current, at 9 volts bias, 12 mA., so that about 5 volts are dropped in the 450 ohm choke, and nearly 20 volts in the 1,500 ohm resistance, thus giving 155 volts at the anode.

Pentode screen current 3.8 mA.

These currents total up to about 30 mA., representing the load taken from the H.T. battery. Some economy in H.T. current has been effected by slightly reducing



Top and underside views of the chassis baseboard giving all essential dimensions for positioning the components.

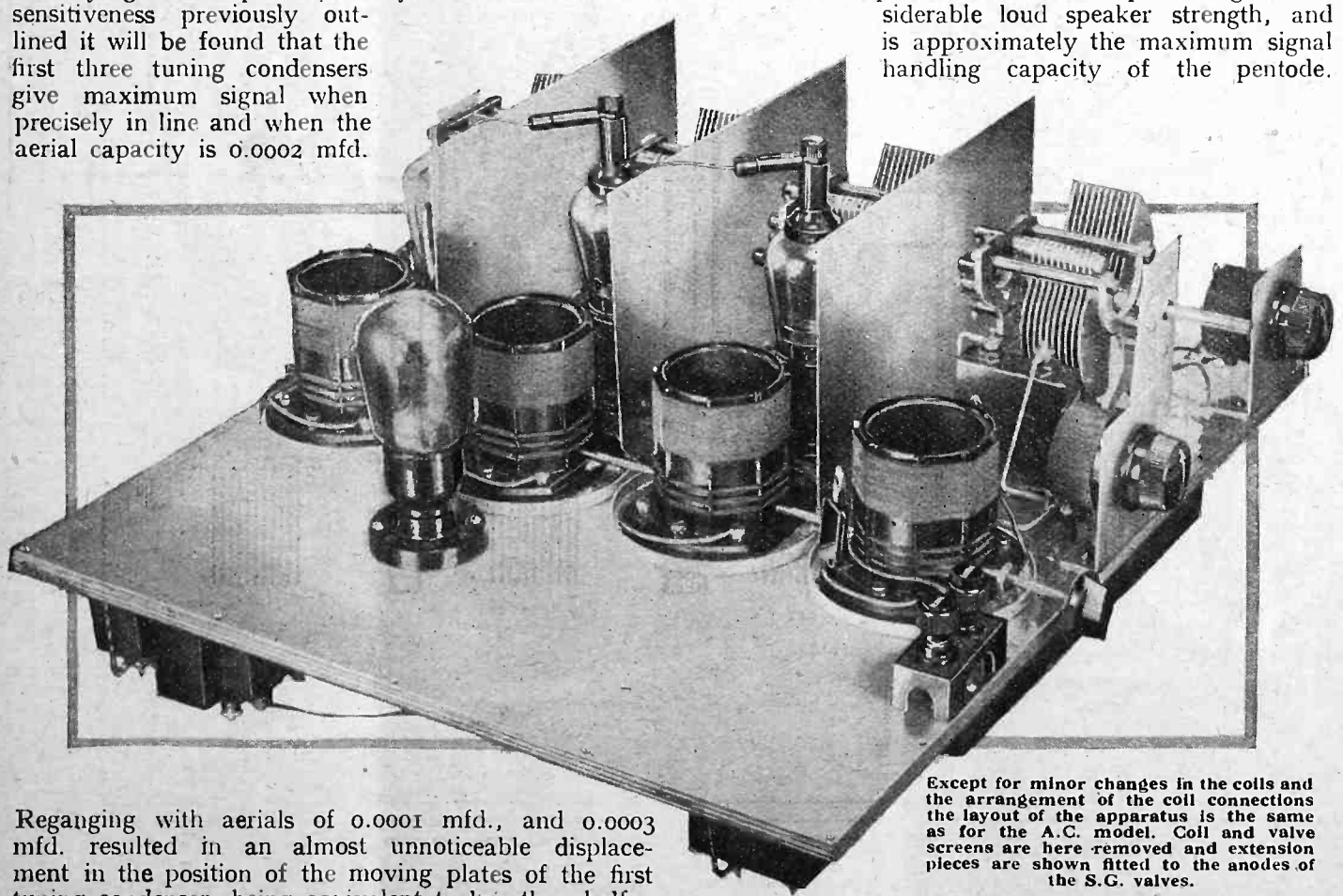
LIST OF PARTS.

2 Potentiometers, 50,000 ohms (Colvern).
1 Resistance, 20,000 ohms (Colvern).
1 Resistance, 20,000 ohms C.T. (Colvern).
1 Resistance, 40,000 ohms C.T. (Colvern).
1 Resistance, 25,000 ohms (Colvern).
1 Resistance, 15,000 ohms, tapped 5,000 ohms (Colvern).
1 Resistance, 5,000 ohms (Colvern).
1 Resistance, 1,500 ohms (Colvern).
3 Fixed condensers, 4 mfds., 400 volts D.C. test (T.C.C., Type 61).
4 Fixed condensers, 2 mfds., 400 volts D.C. test (T.C.C., Type 50).
4 Fixed condensers, 1 mfd., 400 volts D.C. test (T.C.C., Type 50).
1 Fixed condenser, 0.0001 mfd., mica (T.C.C., Type 34).
2 Fixed condensers, 0.005 mfd. (T.C.C., Type M).
2 Fixed condensers, 0.01 mfd. (T.C.C., Type M).
2 Fixed condensers, 0.001 mfd. (T.C.C., Type M).
1 Fixed condenser, 0.0001 mfd. (T.C.C., Type M).
1 Fixed condenser, 0.01 mfd., 400 volts D.C. test (T.C.C., Type 40).
4 Coils (Colvern, TGB).
4 Coil Screens (Colvern CCS).
2 Grid leaks, 1 megohm (Loewe).
1 Grid leak, 0.25 megohm (Loewe).
1 Grid leak, 0.01 megohm (Loewe).
4 Porcelain grid leak holders (Bulgin).
3 H.F. chokes (McMichael, Binocular Junior).
1 Variable condenser, ganged four-section each 0.0005 mfd. (Cyldon).
1 Two-pole switch in battery leads (Colvern, S.2).
2 Valve screens (Loud Speaker Co., Ltd.).
4 Valve holders, five-pin without side tags (W.B.).
1 L.F. choke (R.I. Pentomite).
1 L.F. transformer (R.I. Hypermu).
1 Grid cell, 0.9 volt (Siemens).
1 Grid bias battery, 16½ volts (Siemens, G3).
1 Reduction gear dial (Burndept, Ethovernier).
1 Terminal block (Belling Lee).
2 Ebonite shrouded terminals A and E (Belling Lee).
2 Wander plugs (Clix).
2 Hook terminals (Clix).
2 Anode connectors (Clix).
Sleeving, wood, tin, wire, flex, screws, etc.

In the "List of Parts" included in the descriptions of *THE WIRELESS WORLD* receivers are detailed the components actually used by the designer and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed, and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

the screen potential of the pentode, this having been adjusted to the point where grid current is just avoided when the second H.F. valve is fully loaded and the signal limiting effect of the feed resistance in the grid of the screen-grid valve takes effect.

Carrying out the process of adjustment to maximum sensitiveness previously outlined it will be found that the first three tuning condensers give maximum signal when precisely in line and when the aerial capacity is 0.0002 mfd.



Except for minor changes in the coils and the arrangement of the coil connections the layout of the apparatus is the same as for the A.C. model. Coil and valve screens are here removed and extension pieces are shown fitted to the anodes of the S.G. valves.

Reganging with aerials of 0.0001 mfd., and 0.0003 mfd. resulted in an almost unnoticeable displacement in the position of the moving plates of the first tuning condenser, being equivalent to less than half a division in the middle of the scale. Interchanging various detector valves resulted in a maximum displacement at the centre of the scale of 1½ divisions, so that one can safely accept the working condition of all condensers in line, though testing for individual ganging is a good way of revealing faults.

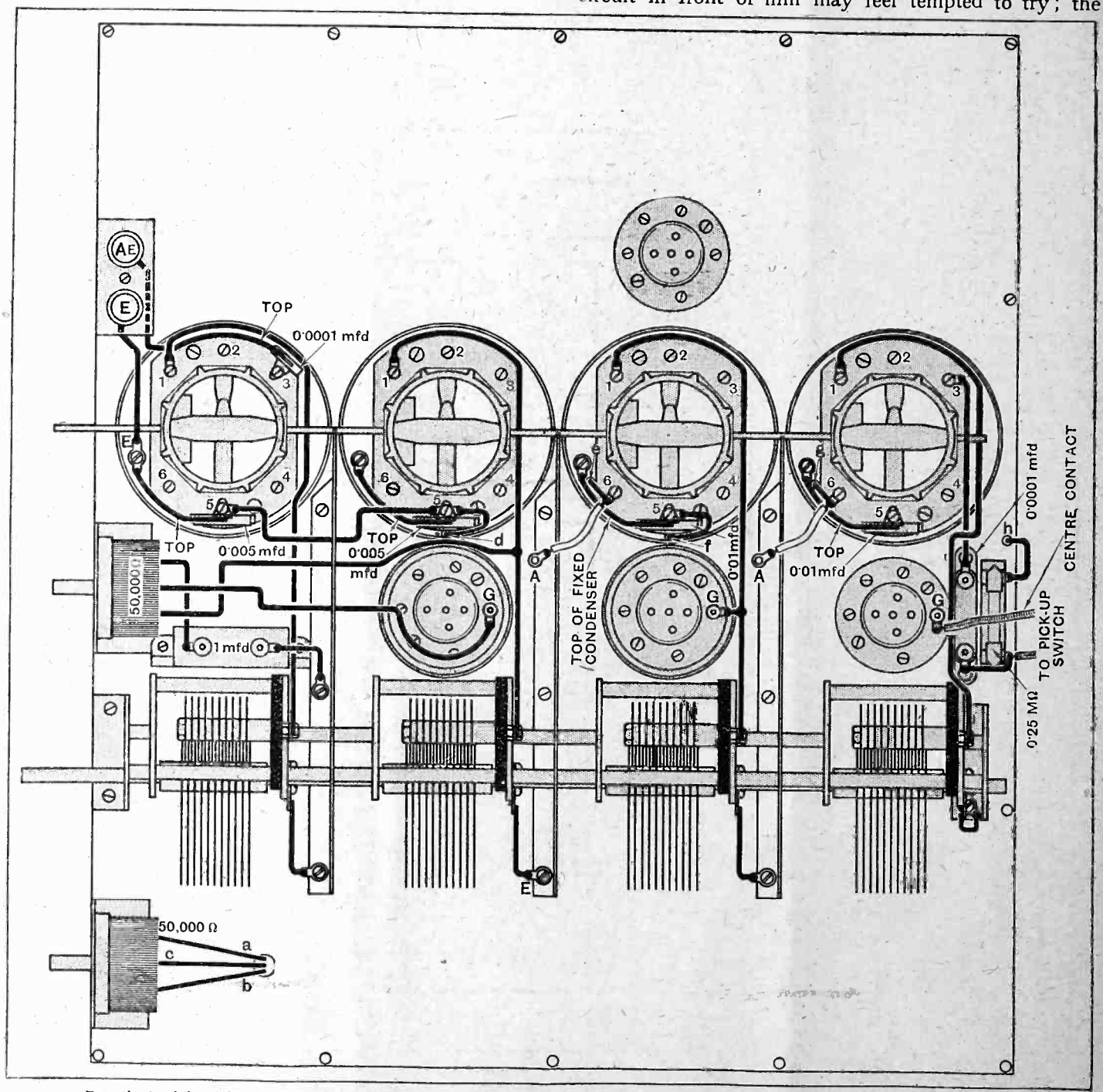
Testing the receiver on a 40ft. aerial reception from Budapest gave 450 milliwatts output into a 4,000 ohm load on the output terminals, this representing a considerable loud speaker strength, and is approximately the maximum signal handling capacity of the pentode. This was produced by a fall in the detector current due to the signal of 0.25 mA. By feeding a signal directly into the detector normally passing 6.4 mA. it was found

Battery Model.—

that the pentode gave grid current when the reading dropped to 5.5 mA., this information being helpful to those who are in the habit of using a 10 mA. meter in the anode circuit of the detector. Such a meter should be connected in the lead running to the 10,000 ohm resistance.

20,000 ohm coupling resistance to each valve that just over 80 volts is the maximum that can be applied to the screens. The optimum value of 70 volts falls near the middle of the potentiometer setting.

Brief reference might be made to another modification which the enthusiast with the Wireless World Four circuit in front of him may feel tempted to try; the



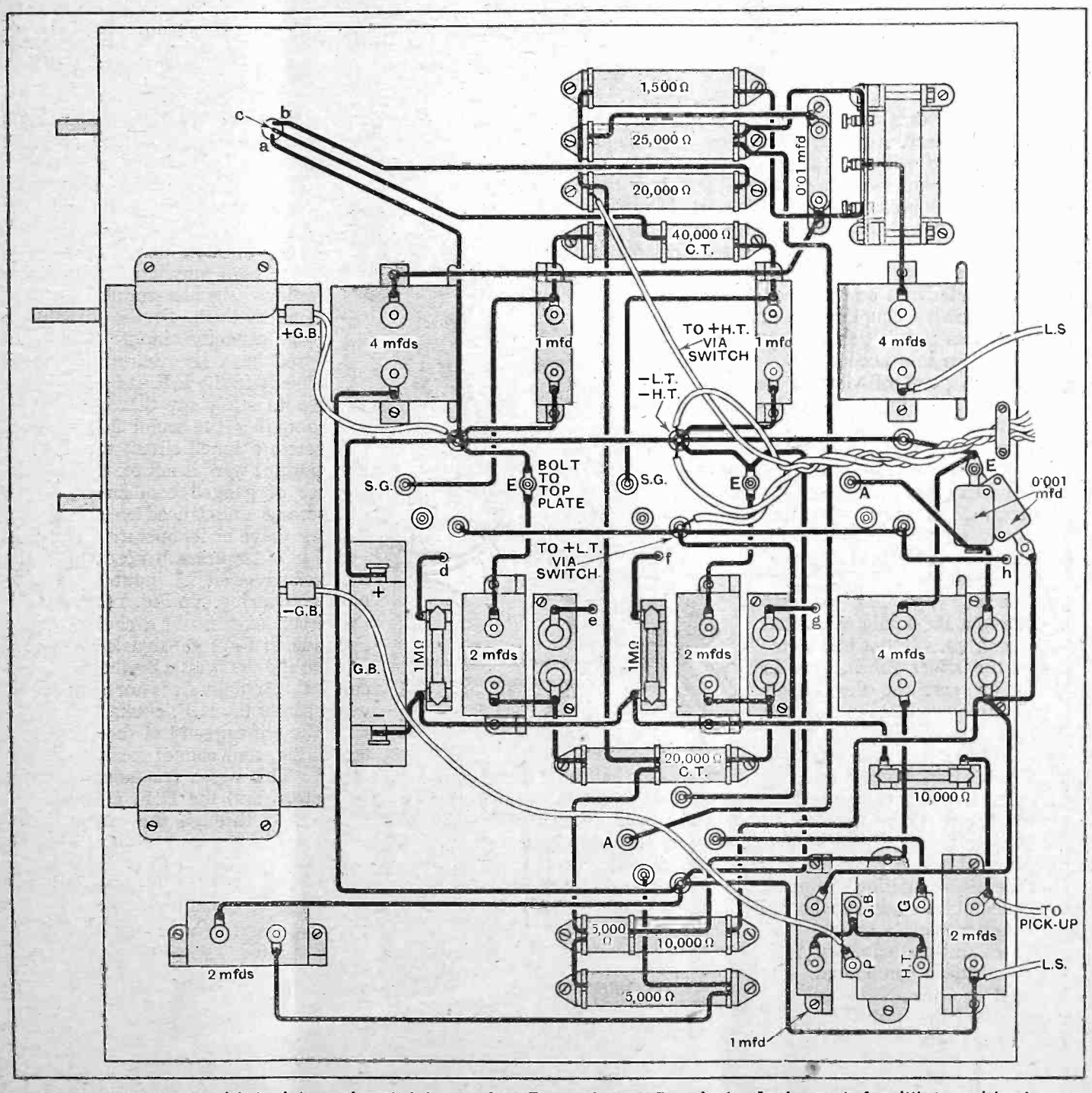
Practical wiring diagram showing the running of the leads between the components on the upper side of the baseboard.

Screen voltage control conveniently adjusts regeneration, for it will be seen that with 4.2 mA. through the 20,000 ohm resistance in series with screen-grid potentiometer about 80. volts is dropped, and with another 16 volts lost as a result of 0.8 mA. passing through the

ready conversion of the set to make use of three H.F. stages. This is done by substituting 0.01 mfd. condensers for the 0.005 mfd. condensers fitted in the first two tuned stages and wiring in another screen grid valve between the two coils exactly as is done in subsequent

Battery Model.—

stages. Regeneration is adjusted by tapping down the lead from the feed condensers between each stage to a point near the middle of the coils, which is easily carried out by lifting the turn to which the connection is to be soldered and slipping in a piece of mica. Used with a small aerial of some 20ft., the three H.F. stage set will completely separate stations 8 kilocycles apart, while 54 stations have been tuned in on a single rotation of the dial on the broadcast band. Screen grid voltage control will, however, need to be operated in conjunction with the tuning dial, as the tendency to regenerate declines with increase in the capacity of the tuning condenser. Many suggestions have been made by way of modifying the radio gramophone assembly as originally described, and it is learned that the Carrington Manufacturing Company have produced a table model cabinet to accommodate receivers of the Wireless World Four class. (*The Battery Model Wireless World Four can be inspected at* 116, *Fleet Street, London, E.C.*4.)



The under baseboard wiring. A two-pole switch breaks the L.T. + and the H.T. + leads. In the event of omitting provision for gramophone pick-up the grid condenser is joined directly to the point G on the top side of the baseboard, while the 2 mfd. condenser and 10,000 ohm leak shown in the bottom right hand corner of this diagram are no longer required.

Interesting Valve Development

Amplification and Detection with an Experimental Low-impedance Screened Valve.

By W. I. G. PAGE, B.Sc.

ELEVEN years ago an American physicist named Miller wrote a paper describing a phenomenon connected with the three-electrode valve, which is still of fundamental importance and has become known as the "Miller Effect." The article referred to explains the cause and effect of the input impedance of a valve, and shows that any simple calculation of stage gain based on a knowledge of the valve characteristics and the constants of the intervalve couplings is practically worthless unless this all-important effect is taken into account.

From the point of view of forming a condenser, the input electrodes of a valve, that is, the grid and filament, look innocent enough; in fact, measurement shows the likely static capacity between them to be about 5 micro-microfarads. However, when the valve is actually amplifying, for instance, in an L.F. resistance-coupled stage, the harmless 5 micromicrofarads may become 250 $\mu\mu f$ (0.00025 mfd.), and a stage gain calculated to be, say, 20, without consideration of the Miller Effect, may in reality be zero at the higher audible frequencies due to the shunting effect of the extra capacity. This is only one example of input impedance and its important effect.

Experimental valve of low A.C. resistance and negligible input impedance. It contains the screening of a screen grid valve and a third earthed grid as used in a pentode.

Every valve in a receiver, due to its amplifying action and to the presence of internal anode-grid capacity, has an input impedance—the small condenser formed by the grid and anode provides an A.C. path back to the input for the alternating component in the anode circuit. As a generalisation it can be said that across the grid and filament of a valve there is always a capacity and a resistance component representing the Miller Effect, which, unfortunately, cannot be anticipated from an examination of the values of the coupling components shown in an ordinary circuit diagram. The resistance component is negative, that is to say, there is a reaction effect on the input if the anode load is inductive, and an anti-reaction or damping effect if the anode load is capacitative, and it must be remembered that the input capacity is present whichever sign is taken by the resistance component.

SUCH limitations are imposed on amplification and detection by the input impedance of the three-electrode and pentode valves that it was thought worth while to conduct some experiments with a screen grid valve of low impedance. A specially designed valve has been constructed for "The Wireless World" having a third grid to allow high screen voltages without secondary emission effects. In addition to interesting results in aperiodic H.F. amplification and detection, it appears that one of the most important uses of such a valve is in a tuned H.F. stage where the chances of cross-modulation are very considerably reduced owing to the large available grid swing.

In low-frequency amplifiers the resistance component is of the order of 5 to 10 megohms, and can be neglected, but in high-frequency stages and detectors using triodes this resistance may be sufficiently high to modify profoundly the performance of the receiver, and may, in fact, cause a valve of quite high amplification factor to reduce signals rather than to amplify them. On the other hand, the capacity input component produces its harmful effects chiefly in the L.F. stages, and one could safely say that in the H.F. amplifier the small added capacity across a tuned circuit was entirely unimportant were it not for the increasing use of ganged condensers, which can become unbalanced on changing a detector valve or its operating voltages.

A few examples will no doubt make the serious effect of input impedance more convincing. In Fig. 1 (*a*) is shown the circuit diagram of a choke-coupled aperiodic H.F. stage, signals being supplied to the first valve by the tuned circuit L.C. Actually C_1 is not a condenser wired across the H.F. choke, but represents the self-capacity of the choke and the wiring, and cannot easily be made less than, say, 20 $\mu\mu f$. This has a reactance of about 8,000 ohms at 300 metres, and the H.F. currents will prefer this path to passing through the much higher reactance of the choke. The anode load is, therefore, capacitative, and by the rule given earlier the input impedance will consist of a small capacity, which will alter the tuning condenser C only by a degree or so, and of a positive resistance (or negative reaction element) across the tuned circuit L.C. Measurements of this load have been taken by A. L. M. Sowerby and published in a recent article entitled "Aperiodic H.F. Amplification."

A typical modern triode was found to have a damping effect equivalent to shunting the input by about 5,000 ohms, so that if L.C. were designed to possess a dynamic resistance of 120,000 ohms at resonance, this would actually drop to something over 9,500 ohms when followed by the aperiodic stage. Obviously, due to

Interesting Valve Development.—

input impedance, signals would be greater if the stage were omitted, unless reaction were deliberately used and pressed to the limit.

The case of the L.F. resistance amplifier is shown in Fig. 1 (*b*). Here we neglect the resistance component of the input impedance and only consider the capacity effect. Assuming the *effective* amplification A of V_2 to be 20, and its anode-grid capacity to be 10 $\mu\mu f$, then the working capacity between grid and filament represented as C_a becomes $(A+1)10\,\mu\mu f = 210\,\mu\mu f$. This is shunted across the anode load R_1 of the preceding valve V_1, which already has its own parallel capacities C_a. At low frequencies, signal voltages will be built up across R_1 and amplified in the usual way, but at the higher speech frequencies C_a will reduce the total anode load to a very low figure, and signals will be lost. Here, again, stage amplification is seriously limited by input impedance, since A—the effective amplification—must be maintained as low as possible to keep the capacity of C_a small.

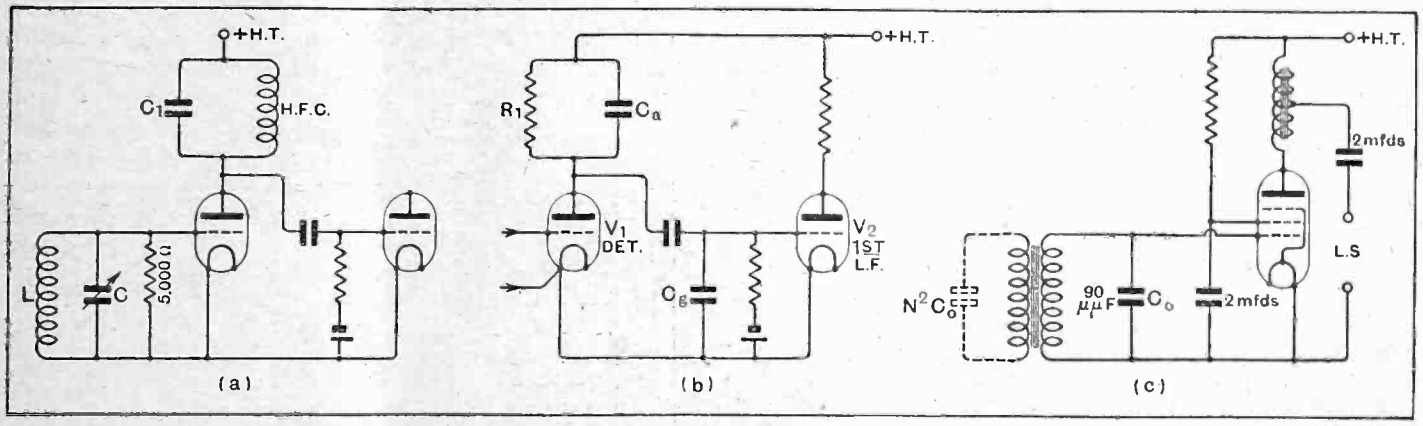


Fig. 1.—Showing the effect of input impedance with various valves. (a) Aperiodic H.F. amplification; the tuned circuit may become loaded with a shunt of 5,000 ohms. (b) Low-frequency resistance coupling in which high notes will be lost unless the stage gain is kept low. (c) A transformer-coupled power pentode which may throw a very large capacity component across the primary winding.

The pentode, in spite of its earthed grid, has quite a large anode-grid capacity, and was shown by John Harmon[1] to possess an input impedance C_o (capacity component) of about 90 $\mu\mu f$ (see Fig. 1 (*c*)). If this valve is preceded by a transformer of ratio N, there will be shunted across the primary a capacity N^2C_o, or, in the case of a 6 to 1 step-up ratio, no less than 3,000 $\mu\mu f$, or 0.003 mfd. Transformers are generally designed to a specification, which includes a certain maximum shunted capacity, but certainly not such a high figure as this which is likely to upset the frequency-response characteristic.

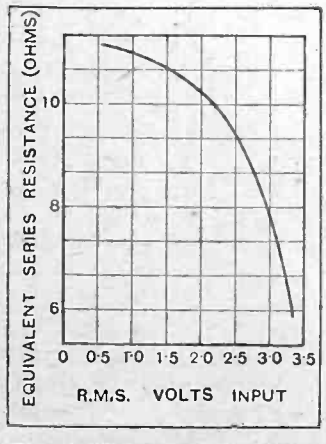


Fig. 2.—Variations of equivalent series resistance of a typical anode-bend detector with signal strength. Due chiefly to input impedance, this type of rectifier is insensitive to weak signals.

Detectors which, under working conditions, have a high-frequency component in both grid and anode circuits must be considered as H.F. valves from the point of view of input impedance. The load on the grid is always of the positive kind, which damps the tuned circuit, because the anode load, be it a transformer, choke, or resistance, is always capacitative as far as H.F. is concerned. Fig. 2 shows the input load with change of signal strength for a typical three-electrode anode-bend detector.[2] It is evident that, due to anode-grid capacity, the input impedance is greater the weaker the signal. This is one of the reasons why this type of detector is not popular for distant station reception. The distortionless rectifying properties of the power-grid detector would be even more attractive if less input damping existed. It was shown by W. T. Cocking[3] that the input load of an AC/HL valve acting as a high-voltage grid detector was as low as 50,000 ohms (see Fig. 3), although that due to grid current and other losses was only about 200,000 ohms. In the same way a conventional leaky-grid detector damps its preceding tuned circuit more by reason of input impedance than by the flow of grid current.

So far we have avoided the tuned H.F. stage where the input impedance takes the form of negative resistance and causes self-oscillation as soon as the circuit losses are reduced to zero. Because of this effect, a stable amplification with triodes of only about two per stage was possible until the advent of the neutralised circuit, and later the screen-grid valve. Summarising, we can say that, although eleven years have elapsed since the undesirable effects discovered by Miller were pointed out, only for one special function—namely, tuned H.F.—has a valve been produced with a negligible input impedance. We are still left with anode-bend, leaky-grid, and power-grid detectors, which damp the input and reduce selectivity; with resistance-coupled stages in which the stage gain must be made very low, otherwise high notes will be lost; with pentodes which throw back harmful capacities across the L.F. transformers preceding them, and with no single valve which will amplify satisfactorily in an aperiodic H.F. stage.

[1] See "Quality Reception," *The Wireless World*, October 15th, 1930.

[2] See "Improving Detector Efficiency," by W. B. Medlam. *The Wireless World*, May 22nd, 1929.

[3] "Detector Damping," *The Wireless World*, July 30th, 1930.

Interesting Valve Development.—

It was felt that it would be worth while to try some experiments with a low-impedance screened valve, so that the various forms of detection and amplification already discussed could be carried out without the limitations imposed by input impedance. The possibilities of such a valve were mentioned in casual conversation to Mr. E. Y. Robinson, of the Mazda Valve Laboratories, who kindly consented to design a few specimens having the screening arrangements of the AC/SG, and a third grid as in the AC/PEN. Inter-electrode capacity between anode and grid has been estimated at about 0.05 $\mu\mu f$, and the input impedance (H.F. positive resistance component) was measured to be 500,000 ohms—a negligible shunt across a tuned circuit. For power detection and L.F. amplification quite large grid swings are likely to be handled, and as these require high screen voltages it was found necessary to avoid any region of negative resistance by having a third grid at earth potential.

Screen-Grid Valve Without Cross-modulation.

Employed in a two-stage aperiodic H.F. amplifier with a triple-gang pre-selector, two of these valves gave an overall stage gain of rather more than 100—a greater amplification than could be obtained from any two ordinary S.G. valves on the market. The selectivity was reasonably good, and the quality of reproduction excellent. Any further development in this direction would

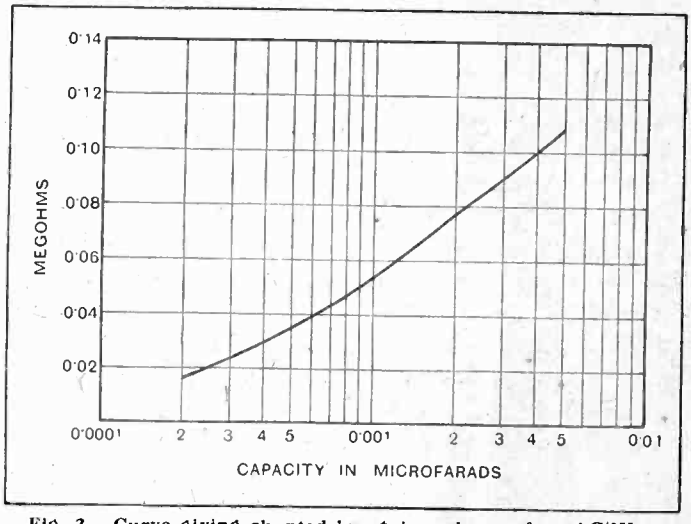


Fig. 3.—Curve giving shunted input impedance of an AC/HL. valve acting as power-grid detector. With an 0.001 mfd. anode shunting condenser the damping of 50,000 ohms is serious. The load due to grid current is only 200,000 ohms.

seem to be in designing valves of even lower A.C. resistance and paying special attention to stray capacities. As a power-grid detector, one found that the valve was highly sensitive and that the selectivity of the preceding tuned circuit was not impaired. The absence of input impedance in this case should be of importance where ganged tuning is used. Resistance coupling and anode-bend detection were not attempted, because the valves, as at present designed, passed rather too heavy an anode current. With full screen and anode volts the valve becomes a screened pentode having negligible input impedance. Why is not the anode of an ordinary pentode brought to the top of the bulb?

Perhaps the most interesting use of the valve is in a tuned H.F. stage, for, owing to the absence of a negative resistance "kink" (which is shown as a shaded area in Fig. 4 for a normal type of S.G. valve) and to

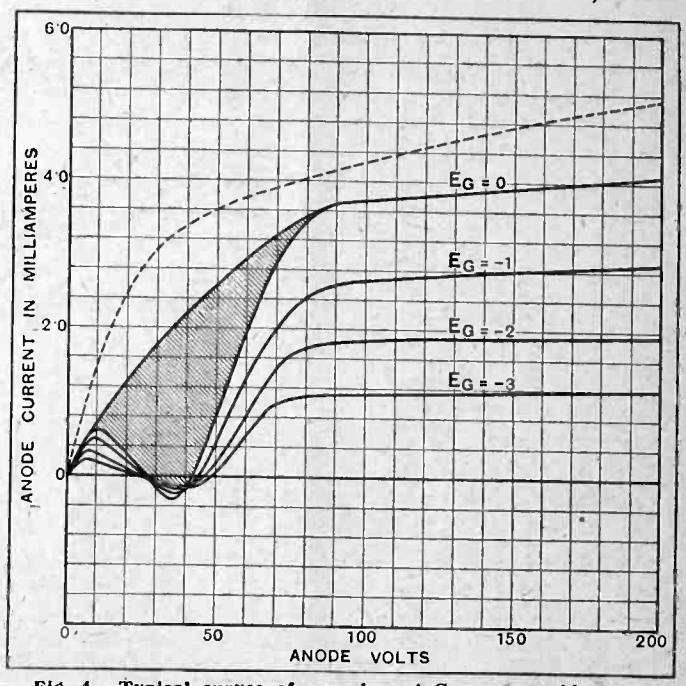


Fig. 4.—Typical curves of a modern A.C. screen-grid valve. The negative resistance or secondary emission area is shaded. The dotted curve gives the desirable $E_g = 0$ characteristic for a low-impedance screened valve with a third grid. The increased grid swing minimises the risk of cross-modulation.

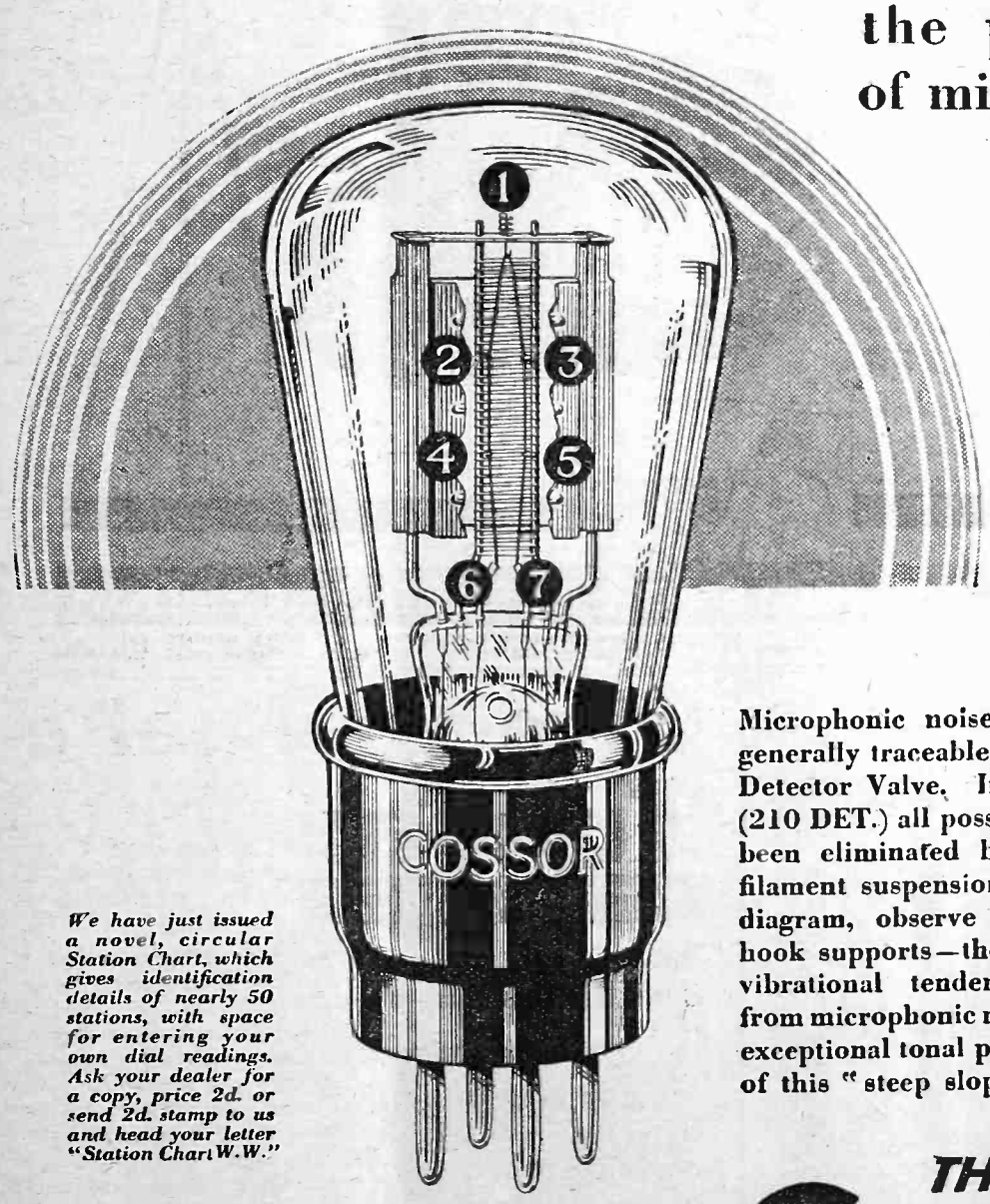
the lower impedance, a very much larger grid swing can be handled without rectification or cross-modulation. Furthermore, screen voltage is not critical, and oscillation does not take place when the screen voltage approaches the anode voltage. It would seem accidental that modern screen-grid valves have A.C. resistances from 200,000 to 1,000,000 ohms. It must have been assumed that these valves would be used with the tuned anode scheme where the whole impedance of the coupling is in the anode circuit. Many designers wishing to make use of the more attractive properties of transformers have found that although a step-down ratio gives optimum coupling according to theory, actually a step-up ratio is required to give anything like adequate selectivity. The result is a somewhat chaotic situation, in which signal strength is thrown away by the use of couplings with various non-optimum ratios, and valve curvature results from high A.C. resistance.

The dotted line in Fig. 4 gives the type of curve to be expected with a low-impedance screened valve having a third grid. There is less risk of cross-modulation due to increased grid swing, and if residual electrode capacity can be made negligible there should be quite a wide application both in detecting and amplifying stages. With a valve of 50,000 ohms A.C. resistance in a tuned H.F. stage where the dynamic resistance R of the secondary of the transformer was 120,000 ohms, the optimum ratio N would be $\sqrt{R/R_o} = 1.55$ to 1 step-up, and the stage gain $\frac{1}{2}\mu N = 116$, assuming a mutual conductance of 3. Selectivity should be improved appreciably both on the input and output sides.

Seven point suspension

definitely prevents filament vibration

the primary cause of microphonic noises



We have just issued a novel, circular Station Chart, which gives identification details of nearly 50 stations, with space for entering your own dial readings. Ask your dealer for a copy, price 2d. or send 2d. stamp to us and head your letter "Station Chart W.W."

Microphonic noises in a Receiving Set are generally traceable to filament vibration in the Detector Valve. In the new Cossor Detector (210 DET.) all possibility of this vibration has been eliminated by the special seven point filament suspension employed. Examine the diagram, observe the four *extra* insulated hook supports—these effectively damp out all vibrational tendencies. Complete freedom from microphonic noises and great volume with exceptional tonal purity are ensured by the use of this "steep slope" Cossor Detector Valve.

Cossor 210 DET., 2 volts, .1 amp. Impedance 13,000. Amplification Factor 15. Mutual Conductance 1.15 m.a./v. Normal working Anode Voltage 90-150. *Price* 8/6

THE NEW COSSOR DETECTOR VALVE

DEFINITELY FREE FROM MICROPHONIC NOISES

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CURRENT TOPICS

News of the Week in Brief Review.

WHY NOT WEEK-END LICENCES?

For working a wireless set without a licence, George Cashmore, of Chadwick End, near Knowle, has been fined 40s. at the Solihull Police Court. The defendant explained to a Post Office official that the set was used only at the week-ends.

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BIRMINGHAM'S LOUD SPEAKERS.

The Home Office has approved a bylaw for Birmingham forbidding the use of loud speakers in public places to the annoyance of passengers or occupants of any premises.

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THE HIGHEST WIRELESS STATION?

The Wireless World recently recorded the claim of France as possessing the highest wireless station in the world, viz., that on the Pic du Midi (3,000ft.).

"I regret to disillusion them," writes a correspondent in Peru. "The record is held easily by the broadcasting station of La Paz, Bolivia, the world's highest capital, with a height of 10,500ft. above sea level."

France must now think of a crushing reply.

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EDUCATIONAL BROADCASTING IN FRANCE.

After a long interruption the Paris P.T.T. station has resumed the broadcasting of the various lectures of the Sorbonne and the Collège de France. These are said to be much appreciated by the educated classes in Paris.

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GERMANY'S "BIG THREE."

To co-ordinate broadcast programme efforts throughout Germany a Council of Three has been formed, consisting of Dr. Flesch, director of the Berlin Station; Herr Ernst Hardt, of the Cologne-Langenburg stations; and Dr. von Boeckmann, of the Munich station. By joining forces the broadcasting authorities will thus be enabled to give German listeners the widest possible variety of talent with a minimum of overlap.

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WHISPERS FROM MOSCOW.

To its manifold activities at Christmas time the Post Office now adds the exciting task of tuning in Moscow on 1,304 metres on Tuesday to intercept propaganda in English. Shorthand writers attend the P.O. experimental station near St. Albans, and their transcript (if atmospherics, pronunciation, etc., permit of any) is sent direct to the Foreign Office.

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A PERIPATETIC STATION.

Radio-Vitus, Paris, has just terminated another of those spasmodic ether periods which its name goes so far to suggest. The station left its listeners guessing during October but resumed transmissions from a new site at Romainville on November 2nd. Unfortunately, in their eagerness the officials had overlooked the necessity for the Postmaster-General's permit, learning too late of an imminent order to close down. This they anticipated on December 1st, 48 hours before it arrived, and listeners are waiting for the next spasm.

NAVAL WIRELESS PIONEER.

It is stated that Lieut. R. H. W. Westcott, who has died at Dawlish, Devon, was the first wireless warrant officer in the Navy.

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"ULTRA-SHORTS" FOR TELEVISION?

Television experimenters in America are to be allotted the ultra-short wavelengths for their experiments. It is understood that the Federal Radio Commission is consenting to the allocation of 6.97 metres to the Milwaukee Journal, which has already experimented with 13 metres, and intends to discover whether still shorter waves are not more suitable for television.

WHY PARISIANS HATE MÜHLACKER.

The new German station at Mühlacker can be heard perfectly in France, and it is not more welcome on that account writes our Paris correspondent. Owners of unselective sets complain that the station prevents them from hearing Radio Algiers and Barcelona, and that—worst of all—it "makes London almost completely disappear." The Paris Press protests against a super-station on the frontier, describing it as a "nuisance."

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"SMALL ADS." AT CHRISTMAS.

The approach of the Christmas holidays makes it necessary to close for press earlier than usual with our issue of December 31st. Miscellaneous advertisements for inclusion in this issue can be accepted up to the first post on December 22nd.

The Wireless World dated December 24th will be on sale on Tuesday, December 23rd.

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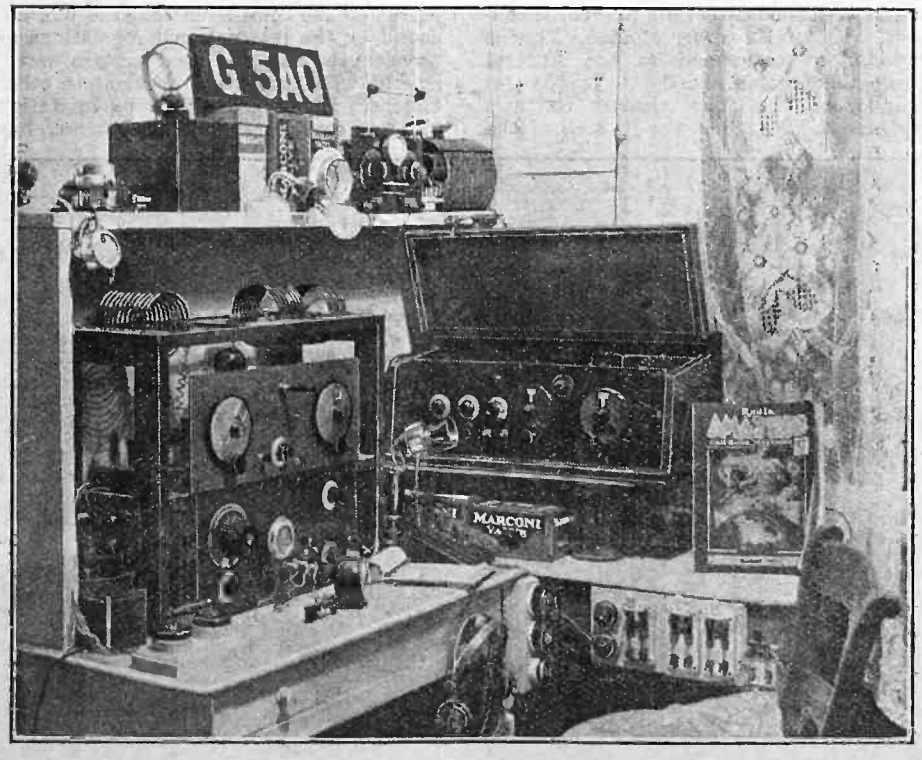
PHYSICAL AND OPTICAL SOCIETIES' EXHIBITION.

Wireless instruments will be included in the display at the Twenty-first Annual Exhibition of Electrical, Optical and other Physical Apparatus to be held by the Physical and Optical Societies on January 6th, 7th and 8th next at the Imperial College of Science and Technology, South Kensington.

In addition to the Trade Section, there will be a Research and Experimental Section arranged in three groups: (a) exhibits illustrating the results of recent



AN ACTIVE TRANSMITTER. G5AQ, owned and operated by Mr L. A. Carter at Putland Cottage, Heathfield, Sussex. The 10-watt transmitter consists of a crystal oscillator controlling a TP-TG oscillator. Choke control is used for telephony. The receiver shown is an O-V-2. Up to the end of September 37 countries had been worked on CW and most of Europe on telephony. Mr. Carter works regular schedules (phone and music) every Sunday from 9.30 to 10.0 a.m.

physical research; (b) lecture experiments in physics; and (c) historical exhibits.

Invitations to the Exhibition have been sent to numerous societies. Those who are not members of a society may obtain tickets on application to the Secretary, 1, Lowther Gardens, Exhibition Road, London, S.W.7. No tickets are required for January 8th.

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EX-R.E. DESPATCH RIDERS.

It is proposed to hold a reunion dinner of ex-R.E. despatch riders early in the New Year. For further details interested readers are asked to communicate with Mr. E. R. Gilbert, Gilbert Advertising, Ltd., 14-18, Holborn, London, E.C.1.

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A PIONEER.

The staffs of the Marconi Associated Companies have marked their appreciation of the services of Mr. Henry W. Allen, who is retiring under the age rule, by presenting him with a radio-gramophone and cabinet with records. The Marchese Marconi, in making the presentation last week, referred to the valuable assistance rendered to him by Mr. Allen when he first visited England in 1896, and in the formation of the Wireless Telegraph and Signal Company (now Marconi's Wireless Telegraph Company) in the following year.

On the formation of that company Mr. Allen received the appointment of secretary, and subsequently he occupied the position of joint general manager and deputy managing director.

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POWER BATTLE IN U.S.

The question of high power broadcasting in America is on the knees of the gods, writes our Washington correspondent. Chief Examiner Ellis A. Yost is expected to recommend to the Federal Radio Commission shortly that the remainder of the four cleared channels designated for high power in each of the five zones, or 20 channels in all, be filled by stations seeking 50 kilowatts which he will designate.

This means that only nine of the 26 applicants for 50 kilowatts will achieve their purpose unless the Commission decides to open up the other four cleared channels in each zone, or 20 more, to high power also. Whether the Commission will do this apparently rests with Congress.

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LONDONA LOUD SPEAKERS.

We learn that Londona permanent magnet loud speakers are now supplied through Londona, Ltd., 66, Hatton Garden, E.C.1. Telephone: Holborn 5713.

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WIRELESS AT WESTMINSTER.

By Our Special Correspondent.

Two Questions.

An important statement on broadcasting was made in the House of Commons last week by the Postmaster-General in response to Capt. Hacking, who said that there had been a good deal of complaint from the south-east of England of interference caused by certain Continental stations. He hoped the Postmaster-General would make representations to those stations that they should use wavelengths which would reduce interference to a minimum. He hoped also that the Postmaster-General would deal with broadcasting from Moscow.

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Russian Broadcasting.

Mr. Lees-Smith said that as Russia was not invited to the International Radio Conference held in Washington some years ago she considered that she was not bound by the international regulations of wavelength, and she used certain wavelengths which were inconvenient to other nations. Russia did attend by invitation the last conference held at Prague, but while agreeing to come to a certain extent within the general international regulations she insisted on operating some of her previous wavelengths. It was through one of those wavelengths that on certain nights for weeks past she had been regularly transmitting messages to this country. It was now many months ago since he began to take some interest in those messages from Russia. For some time they were so exceedingly uninteresting, and therefore harmless, that the supervision was relaxed, but as the character of the messages had recently changed the supervision would now be resumed.

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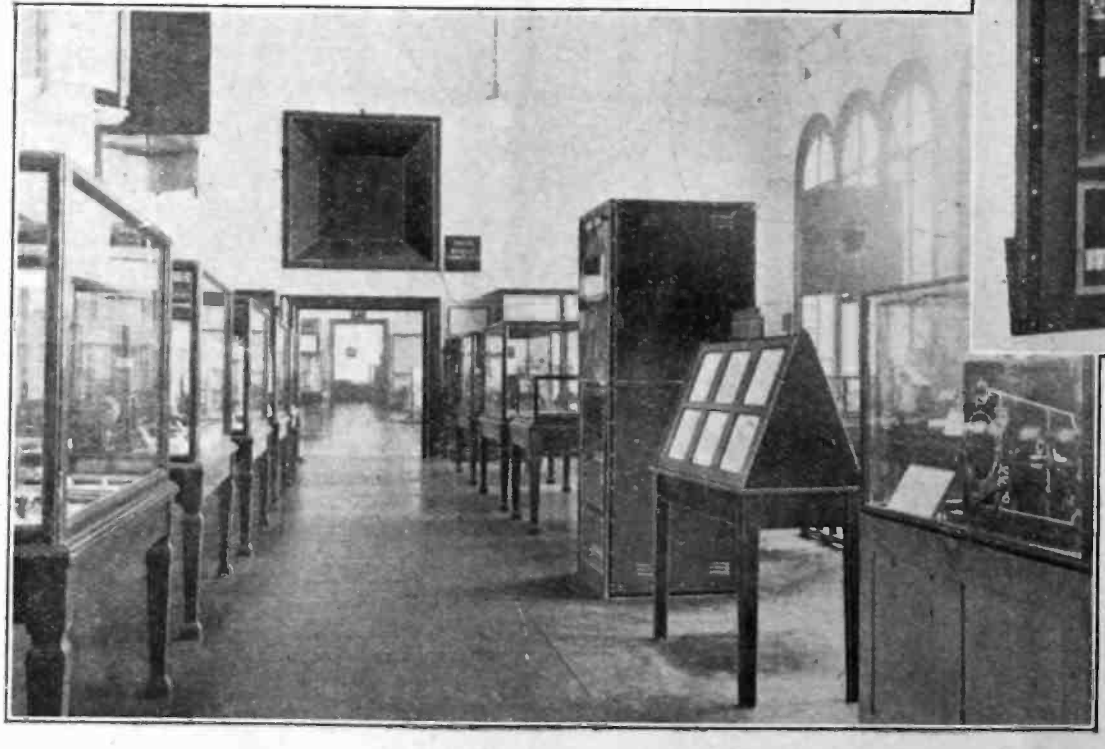
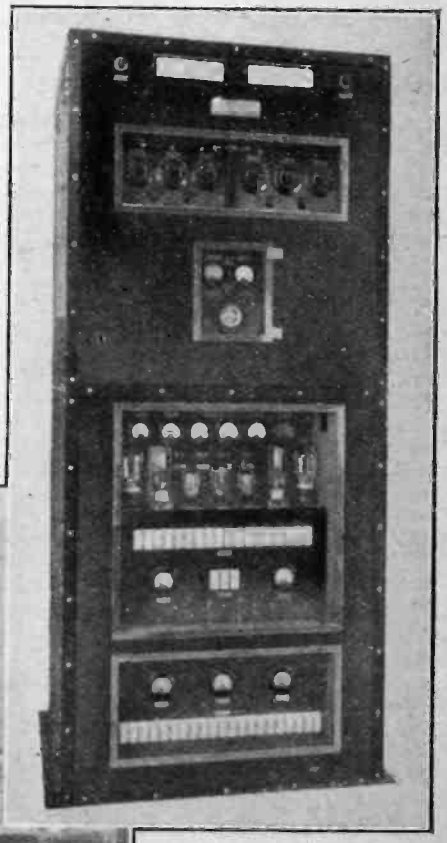
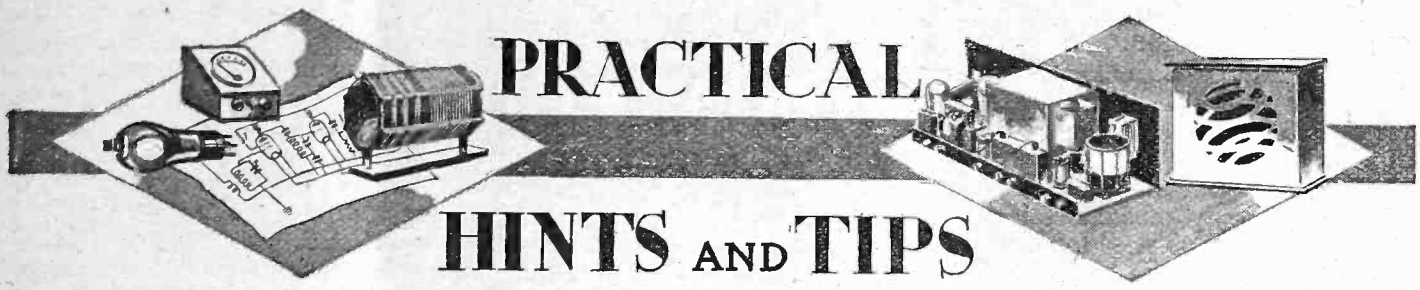
Stuttgart.

The Stuttgart station was observing the international regulations, but having lately greatly increased its power it could frequently be heard behind the London National programme. The matter could only be settled by negotiations, which were proceeding.





THE LAST WORD? Perfect reproduction of local programmes was the ideal sought after by the designers of the new demonstration receiver installed in the Science Museum, South Kensington, and fully described in our issues of July 30th and August 6th last. The upper photograph gives a near view of the receiver with the duplicated valves providing the two separate H.F. stages for the National and Regional transmissions. In the larger photograph can be seen the 27ft. exponential horn, the flare of which measures 7ft. sq.



PRACTICAL HINTS AND TIPS

Simplified Aids to Better Reception.

"MUSIC MAGNET FOUR" GRAMOPHONE ADAPTION.

A number of those who have assembled the Osram Music Magnet Four "kit" set will doubtless be interested in the question of adapting this receiver so that it may be operated with a gramophone pick-up. Theoretically, at any rate, there is no difficulty in making the necessary circuit alterations, and the simplest way of doing so is shown in Fig. 1.

But in actual practice the problem is not quite free of pitfalls. It must be remembered that we are dealing with a highly specialised form of receiver, with ganged tuning control,

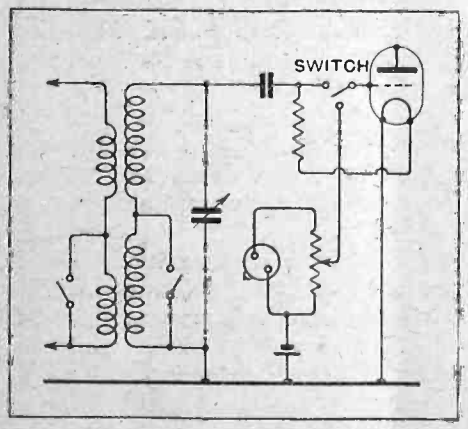


Fig. 1.—How to connect a pick-up (with volume control potentiometer) in the detector grid circuit of the "Music Magnet Four."

and that the indiscriminate addition of stray capacities at a danger point—the high-potential end of the detector grid circuit—is likely to have an adverse effect on its normal function of radio reception; apart from the danger of affecting the tuning system, there is a possibility that stability may be destroyed by the introduction of incidental couplings between circuits.

If any form of "switch-over" change be adopted the greatest care should be taken to reduce stray capacities to a minimum; the switch itself should have as little solid material as possible in its construction, and a component with insulation of ebonite or some other substance of similar dielectric properties should be chosen.

It will be remembered that the detector-grid condenser of the Music Magnet is mounted directly on the valve-grid terminal, and so must obviously be provided with some other form of support; it may be found convenient to secure it to the switch.

The important point is that incidental capacity across the detector grid should not be appreciably different from that allowed for by the designer. It might be possible to restore the balance by using a "skeleton" valve-holder; if this were done there would be less need to pay special attention to the switch or its mounting.

The view of the manufacturers, who have been consulted on this question, is that the average constructor is hardly likely to take these special precautions, and it is recommended that a plug-in adaptor should be used. In this way all technical difficulties consequent on the fitting of a switch are avoided, but the change-over from "radio" to "gramophone" is rather less convenient and takes more time.

A plug-in adaptor is a simple and inexpensive arrangement of suitably mounted pins and sockets, and is interposed between the detector valve-holder and the valve itself. Electrical connections (shown in Fig. 2) are normal with regard to plate and filament circuits, but the grid circuit is interrupted so that the pick-up, in series with a bias battery, may be inserted.

It will be obvious that, whatever method of conversion is adopted, it will be necessary, as an economy measure, to make provision for breaking the filament circuits of the H.F. valves. For the benefit of those who find difficulty in tracing theoretical circuit diagrams, it may be stated that the necessary switch should be inserted in the lead numbered 37 in the original wiring plan.

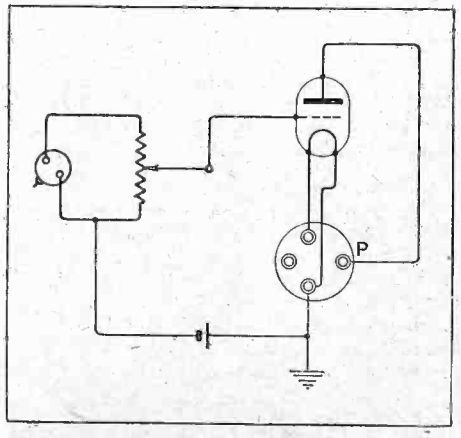


Fig. 2.—The result of interposing a gramophone pick-up adaptor between the valve and its holder: anode and filament connections are unchanged, but the grid circuit is interrupted.

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OUTPUT ANODE VOLTAGE.

It is not always realised that very high momentary voltages are liable to be developed on the anode of a super-power output valve—1,000 volts is by no means an impossible figure, even when the H.T. voltage applied does not exceed some 200 or so. To prevent the risk of a breakdown, and consequently of an H.T. short-circuit, it is wise to pay rather special attention to insulation in the output anode circuit, and, in particular, any by-pass condenser that may be joined between anode and earth should have a reasonably high factor of safety as regards its dielectric strength.

D.C. MAINS AND POWER GRID DETECTION.

With hardly a dissentient voice the power grid detector has been accepted, by those best qualified to express an opinion, as the most practical and generally satisfactory rectifier of deeply modulated H.F. energy. There is no need to enlarge here on its advantages—or even on its disadvantages, beyond saying that this method of rectification would probably be even more generally used if it were more economical of anode current, had less tendency to introduce L.F. reaction, and, most important of all, could be made to operate on a lower anode voltage.

Access to an unlimited supply of volts enables us more or less summarily to dispose of the other difficulties. If we have a sufficiently high voltage it is unlikely that an extra three or four milliamps will make any appreciable difference to upkeep cost, and further, the existence of a surplus will allow us to be lavish with regard to decoupling, thus disposing largely of interaction troubles.

Some practical ways and means of overcoming these drawbacks when dealing with A.C. mains-operated receivers were discussed recently in *The Wireless World* under the heading of "Low Voltage Power Grid Detection." Most of the suggestions made there may be applied to sets drawing their anode current from D.C. mains, and, in particular, the push-pull output scheme described in that article is to be recommended, as none of the detector anode voltage need be dissipated in a decoupling resistance.

Those who are forced to content themselves with a less pretentious arrangement must generally be prepared to make some sacrifice in other directions; it is for the reader himself to judge whether the advantages of a sensitive and practically distortionless detector are sufficient to compensate for some loss in L.F. amplification, both with regard to its quantity and quality. Quantity does not matter greatly, as it is almost always easy to get sufficient magnification fully to load the average output valve; with regard to quality, losses are likely to take the form of a slight falling off in proportional amplification of the lower frequencies. It must be remembered that comparatively simple decoupling arrangements are capable of providing adequate magnification, does not give, like a transformer, what may be, in the circumstances, an embarrassingly high stage gain.

The detector valve itself is rather a problem in a D.C. receiver. Few of us feel inclined to supply an ampere of direct current for heating the type of A.C. valve that is customarily used, but fortunately it is possible to employ many of the ordinary "L" or "D" battery valves, with impedances in the order of 10,000 ohms or so. Under usual "power grid" operating conditions these valves may be slightly overrun, with a consequent reduction in their working life, but with care this matter need not be serious, and several of the manufacturers have given official blessing to the use of their products in this way.

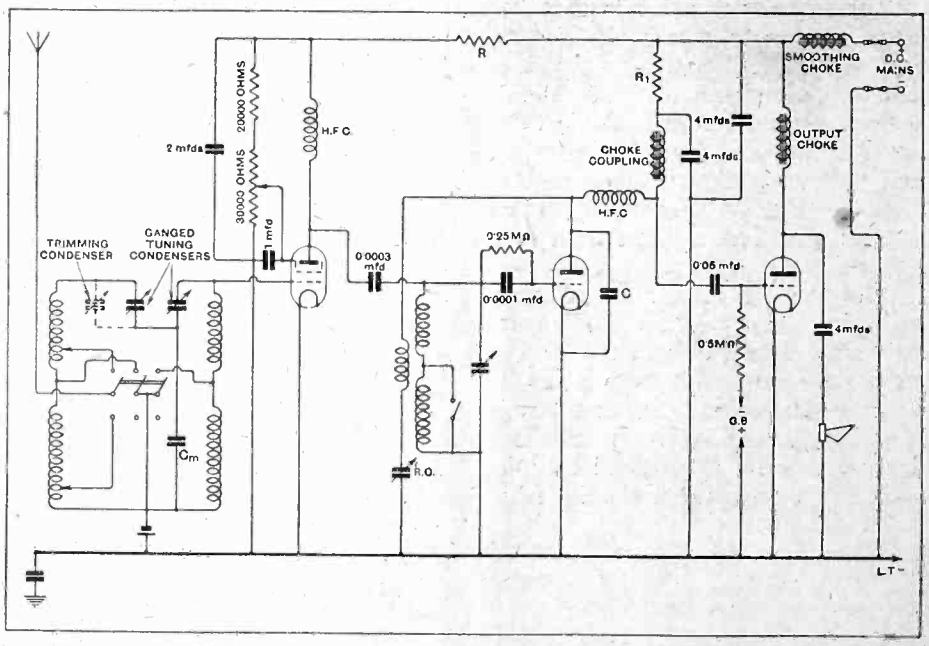

Fig. 3.—Power grid detection applied to a receiver deriving its anode current from D.C. mains.

Choke Coupling.

Hints as to how the foregoing suggestions can be put into practice may be gleaned from the accompanying diagram, Fig. 3, which shows the circuit of a 3-valve H.F.-det.-L.F. set embodying many of the features included in recent *Wireless World* receivers. A capacity-coupled input band-pass filter is included, and the H.F. stage is coupled by the "tuned-grid" system. Choke coupling is used between the power grid detector and the output stage. Values of most of the components are indicated, except where they are either obvious or dependent on comparatively unimportant features of the design. R is a voltage-absorbing resistance for the H.F. valve anode circuit, while R_1 is the detector decoupling resistance, which should have as high a value as possible consistent with the maintenance of a sufficiently high anode voltage—at least 100 volts, and preferably 120 volts. The by-pass condenser C should be made as large as possible without bringing about high-note loss.

An L.F. choke inductance of less than 80 henrys must be regarded as minimum unless a fairly considerable falling off in low-note reproduction can be tolerated.

Somewhat sketchy smoothing arrangements are indicated; if the mains supply happens to be "rough" extra smoothing will be needed.

BROADCAST BREVITIES

By Our Special Correspondent.

Christmas Present for Scotland?—"Art Gallery" in Portland Place.—B.B.C. and Mühlacker.—A Pickwickian Hour.—Test Words.

Scotland in the News.

Scottish broadcasting is beginning to figure in the news once again. The opening of the new headquarters in Edinburgh has had a tonic effect on the public attitude to broadcasting north of the Tweed, and it would not surprise me if the B.B.C. were to continue the treatment with another dose before Christmas.

oooo

A Christmas Announcement?

The new potion will take the form of an announcement that the Wester Glen site, on the Falkirk-Slamannan road, has been duly acquired for the erection of Scotland's Regional Station.

Some mystery has attached to the negotiations concerning this particular piece of land, due, I believe, to certain manifestations of native caution.

oooo

The Weather.

Now, subject to one or two formalities, the land is available for the preliminary spade work. If the B.B.C. are to justify their private slogan, viz., "a Regional station a year," the whole of the work ought to be completed in the early part of 1932. Possibly it will, but much may depend on the weather. As a frequent visitor, I always associate the Falkirk area with rain.

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"Music and Dancing."

"Broadcasting House" is reaching the "interesting" stage that characterises early childhood. I still await news concerning the filling of the niche over the entrance, but the suspense is partially mitigated by other items of information. A "music and dancing" licence for the giant studio has been applied for, though precisely why is not revealed.

oooo

A B.B.C. Art Gallery.

Again, I hear that the pioneers of British broadcasting have been attending Savoy Hill in person to have their photographs taken. These are to be "hung" in a special vestibule at "Broadcasting House"—a miniature art gallery which modern exponents of the broadcasting art "seeing, may take heart again."

oooo

Interference with London Regional.

At the time of writing, there is a distinct change for the better in regard to the interference caused to London Regional by the new German station at Mühlacker.

It is to the credit of the German authorities that they have taken immediate steps to limit the amount of overlap, by investigating the possibilities of readjusting the modulation system.

oooo

Will Bergen Oblige?

The proposal has been made that Mühlacker should exchange wavelengths with Bergen, which is 9 kilocycles below the German station and therefore 18 kilocycles from London. The Germans have no objection, but the Norwegian authorities, not unnaturally, are a little doubtful as to what benefit they would derive from a change which would sandwich their station between London and Mühlacker.

A NEW MICROPHONE. In this condenser microphone now used at the Munich broadcasting station the "A" amplifier is incorporated in the instrument.

Mr. Pickwick to Broadcast.

A Dickens' dream fantasy, entitled "A Pickwick Party," will be broadcast on the National wavelengths on December 29. It has been written by Stanley C. West, with music by Marjorie Broughton.

Most of the well-known characters in Dickens' works will come to life, the scene being the Marquis of Granby Inn and the time Christmas Eve. Here will congregate Sam Weller (Kingsley Lark), Mr. Pickwick (Stanley Cooke), Mrs. Micawber (Gladys Palmer), Dora (Elsie Griffin), Jingle (Bernard Ansell), Mr. Wardle (Robert Chignell), Mr. Micawber (Joseph Farrington), Sairey Gamp (Lena Maitland), and many others. Howard Rose, the B.B.C.'s senior producer, will direct the "Pickwick Party" production.

oooo

Tests for Gift Sets.

Last week reference was made to the special programme of gramophone records to be broadcast on Christmas Day from 12 noon to 3 p.m., to enable the lucky recipients of wireless sets to test them on every conceivable kind of music. It is now learnt that the transmission will be made from London Regional, not Midland Regional, as stated.

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A Christmas Day Appeal.

The Christmas Day appeal will be made again this year by Mr. Winston Churchill on behalf of the National Institute for the Blind. Mr. Churchill will speak at 7 p.m.

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"The Worth of Science."

From the nineteenth conference of Educational Associations, on December 31st, Sir Richard Gregory's presidential address on "The Worth of Science" will be relayed to London Regional.

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A Victorian Melodrama.

"The Silver King," one of the best-remembered of Victorian melodramas, one in which Wilson Barrett distinguished himself and one which brought its author, Henry Arthur Jones, a fortune, is to be broadcast in Christmas week, on the Regional wavelengths on December 26th and nationally on December 27th.

oooo

A Few Words.

One of the severest tests to which radio receiving apparatus can be submitted is being tried out during the school broadcasts on Wednesdays, Thursdays and Fridays. The test takes the form of a recital of a number of specially selected words, each having no connection with the others. The words are listened to by eight selected schools in London and by observers at the B.B.C., all using different receiving apparatus.

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Comparisons.

To identify every one of the words indicates the possession of an unusually good reproducer, and the results are already giving the authorities valuable information on the merits of the various instruments in use.

The test words have been selected in collaboration with the Telephone Research Department of the Post Office. Some of them are real "teasers."

The H.S.P Screened Grid Four

Long Range Reception.

THE receiver which forms the subject of this review is a representative example of modern practice in portable receiver design. An examination of the figures provided by the Buyers' Guide in a recent issue reveals that the majority of portables are of the four-valve type with a single screen-grid H.F. stage. Further, slightly more than half the portables on the market at the present time are fitted in suitcase containers. Both these features are items of the specification of the H.S.P. Screened Grid Four.

The layout follows conventional practice, and the valves are sunk in a well in the control panel which runs along the front edge of the case. Behind this is the usual battery compartment with detachable cover. The lid of the case contains the frame aerial windings and a Celestion cone loud speaker chassis.

The frame aerial is wound in two sections, which are separated by a space of about 1 inch, and the turns of the low-wave winding are spaced. A switch in the left-hand bottom corner of the lid short-circuits the long-wave section of the winding. The same switch carries contacts for switching off simultaneously the H.T. and L.T. circuits. It is important to remember that this switch is essentially the "On-Off" control of the set and not the switch on the control panel, as is usually the case. The latter switch merely controls the H.F. anode and reaction coils, and does not carry any battery contacts. The fact that both L.T. and H.T. circuits are broken when the set is switched off prevents the possibility of damage should the L.T. leads accidentally fall onto the H.T. battery sockets while changing the accumulator.

Circuit Details.

The anode circuit of the screen-grid H.F. valve is decoupled, and the screen grid, for which a separate H.T. tapping is provided, is by-passed by a condenser of the non-inductive type. Tuned anode coupling is employed, separate inductances being provided for long and short waves. The coils are of small diameter, and each is wound in two sections in a slotted ebonite former. The reaction windings are interposed between the two halves of each anode coil.

Reaction, which is capacity controlled, is taken from the anode of the leaky-grid detector. Apparently no provision is made to prevent leakage of stray H.F. currents into the H.T. supply circuit and L.F. amplifier other than the inductance of the L.F. transformer. The provision of three by-pass condensers in the output stage would seem to indicate that H.F. does leak through the L.F. amplifier. But for these condensers, instability would result from the close proximity of the loud speaker leads with the frame aerial in the lid of the case. No doubt the makers have some very good reason for tying down H.F. in this rather special way, as it is usual to restrict H.F. currents to the detector anode circuit by means of a H.F. choke, by-pass condenser, and, in some cases, a series resistance in the grid circuit of the first L.F. amplifier.

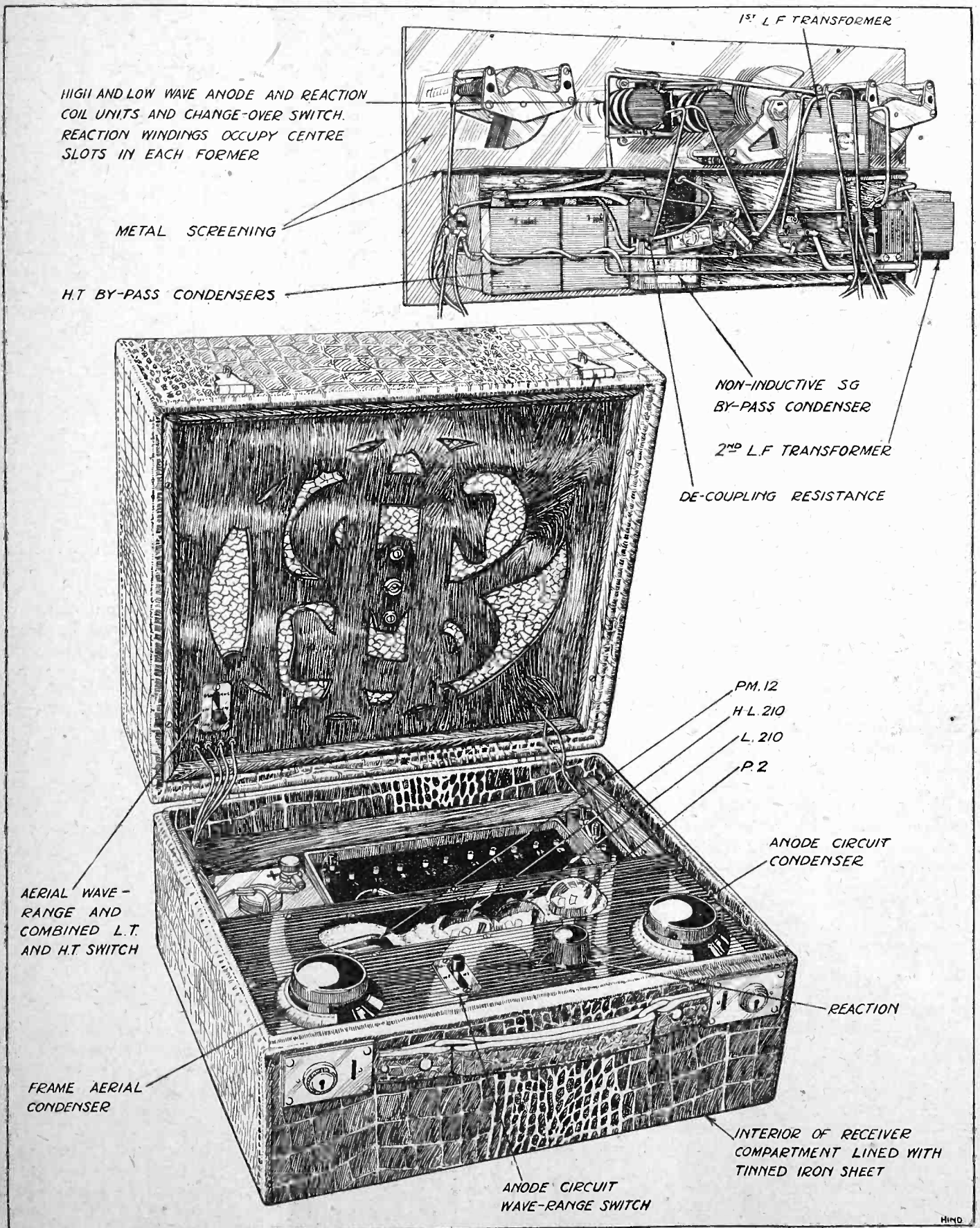
Economical H.T. Consumption.

Both L.F. valves are transformer coupled, the first transformer being a Mullard "Permacore," and the second an R.I. "Hypermu." The output valve, a Marconi P.2, working at about 99 volts H.T., feeds directly into the Celestion loud speaker unit. In addition to by-pass condensers in the grid and anode circuits of the output valve, the metal frame of the loud speaker is also tied down to H.T.+ by a small condenser fitted inside the lid.

High Frequency Response.

One would expect, with so many by-pass condensers in the last stage, to find a serious deficiency of high frequencies in the acoustic output from the loud speaker. In practice, however, this is far from being the case, and the quality is characterised by a clarity and crispness not often found in portable receivers. In particular, the reproduction of speech is natural and unforced. At full volume a slight buzz was noticed at certain frequencies, but this was probably located in the ornamental fret, and, in any case, the volume available before the buzz made itself manifest was more than adequate for normal requirements.

The set was tested in Central London, and again, under more severe conditions as regards selectivity, at a distance of five miles from Brookmans Park. In London a narrow band of two or three degrees between the two stations is left entirely free of background, but near Brookmans Park the fringe of one station just overlaps that of the other. Thus the foreign stations recorded on short waves, were all received in the upper half of the tuning range. In all, eleven stations other than the B.B.C. stations were received on short waves, and of these six were at full programme strength. In daylight no difficulty was experienced in picking up

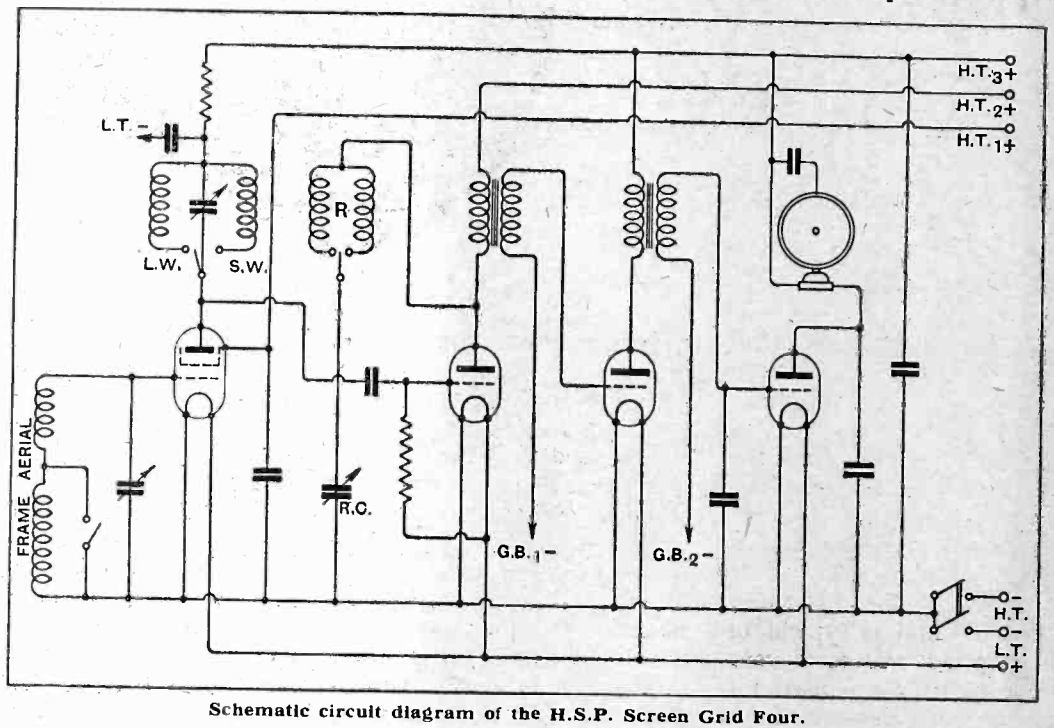


Chassis details and layout of controls in the H.S.P. Screened Grid Four portable.

The H.S.P. Screened Grid Four.—

Langenberg, in spite of strong local electrical interference. Under normal conditions the background noise is extraordinarily small for a receiver of such sensitivity, and distant stations stand out in strong relief.

The long-wave performance maintains the standard set by the short-wave band. Nine stations—all at good programme strength—were received in addition to 5XX.



Schematic circuit diagram of the H.S.P. Screen Grid Four.

Of these Radio Paris, Eiffel Tower, Motala, Moscow, Kalundberg and Oslo were exceptionally good. Königswusterhausen also came in well between Daventry and Radio Paris. It is necessary to make use of the directional properties of the frame when receiving Königswusterhausen, but Radio Paris and 5XX are easily separated in all circumstances. It is also gratifying to note that, even at five miles from Brookmans Park, the Regional Station did not break through at the bottom end of the long-wave scale, as sometimes happens. The reaction control, however, was somewhat erratic at this point, and as much as 90 degrees of backlash was experienced. Possibly this is due to the absence of H.F. stopping devices in the detector stage, as already noted.

The set is economical to run, and the total anode current of the particular receiver tested was 7.3 milliamps. The H.T. battery was new, and no tendency to L.F. oscillation was evident under working conditions, but instability would be provoked by inserting a resistance of 60 ohms in the common −H.T. lead. As the increase of internal resistance of the battery may exceed this figure, more extensive decoupling might have been employed with advantage.

Judged from the point of view of performance, however, we have nothing but praise for this set, particularly in relation to its range and sensitivity, silent background, clarity of reproduction, and economy.

The makers are The H.S.P. Wireless Company, Langford Works, Weston-super-Mare, and the price of this particular model is 19 guineas.

PRINCIPAL TIME SIGNALS OF THE WORLD.

Particulars of signals from other important stations are included from time to time. Rugby, GBR, and Nauen, DFY (Germany) were included in our issue of Sept. 17, 1930

PARIS—EIFFEL TOWER, FLE.

Wavelengths: 113 kilocycles (2650 metres) and 9231 kilocycles (32.50 metres).

Times of Transmission: 07.55-08.06 and 19.55-20.06 G.M.T., on the long wavelength and at 09.25-09.30 and 22.25-22.36 G.M.T. on the short wavelength.

Preliminary Signals. Attention call CT −·−·− followed by B.I.H. −··· ·· ···· (Bureau International de l'Heure) and groups of − − − with one 5-second dash ending at the 30th second of the minute preceding the

International Time Signal from the Paris Observatory. Followed by **Rhythmic Signals** (see Rugby, GBR, p. 292, Sept. 17th, 1930).

Bordeaux, Croix d'Hins, FYL, and **Issy-les-Moulineaux, FLJ,** on 15.87 kc. (18900 m.) and 9231 kc. (32.5 m.) also transmit these signals at 07.55-08.06 and 19.55-20.06 G.M.T.

LENINGRAD DYETSKOE SELO, RNO.

Wavelength: 86.33 kilocycles (3475 metres).

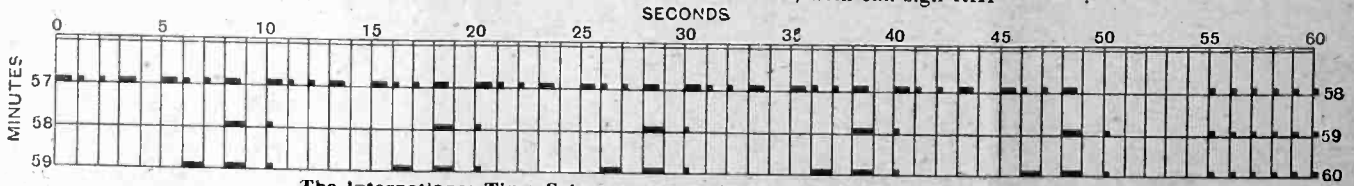
Times of Transmission: 21.55-22.06 G.M.T.

Preliminary Signal: Call-sign RET ·−·−·

Russian Ordinary Time Signals (from Central Russian Astronomical Observatory).

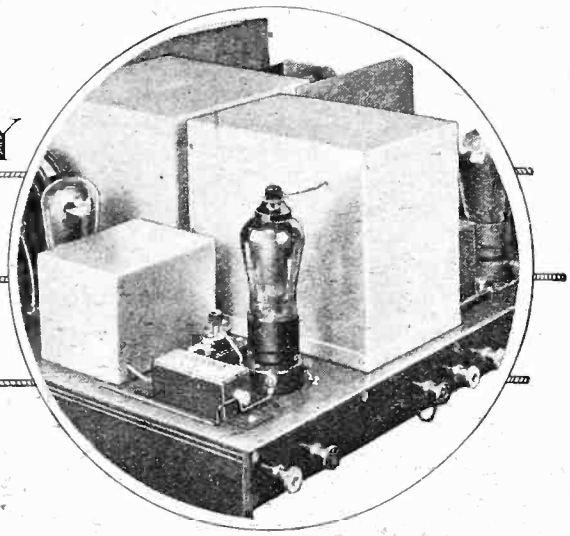
A series of single dashes terminating with six dot-seconds.
A series of double dashes terminating with six dot-seconds.
A series of triple dashes terminating with six dot-seconds.

The last of the six dots coming at 21.58, 21.59 and 22.00 respectively. Followed at 22.01 G.M.T. by **Rhythmic Signals** (see Rugby, GBR). Also at 15.55-16.06 G.M.T. from **Moscow Oktyabrskaya, RAI,** similar signals on 5769 kc. (52 m.) with call-sign RAI ·−·−··.



The International Time Signal as transmitted from the Paris Observatory.

The Intermediate Frequency Amplifier of the Superheterodyne



The Causes and Prevention of Distortion.

By A. L. M. SOWERBY, M.Sc.

THE advances made in amplification at radio-frequencies, and the new valves that have been made available since the time when the superheterodyne was a popular receiver, will be manifest in all parts of a modern superheterodyne, but it is in the intermediate-frequency amplifier that the greatest improvements can be made. This point can, perhaps, best be seen by a glance at an intermediate-frequency amplifier designed about half a dozen years ago.

The circuit shown in Fig. 1 is that of the "Haynes-Griffin Simplified Superheterodyne," and is typical of the designs of its time. Ordinary triode valves of very low efficiency ($\mu=8$, $R_0=12{,}000$ ohms) were used for all purposes, and as a consequence three stages of intermediate-frequency amplification were required. The gain was probably about 20 per stage, neglecting reaction. Since the frequency-changer contributed practically nothing to amplification, the overall gain would thus be about 8,000 or 10,000 times from frame aerial to the grid of the second detector. This would be inadequate even in these days of high-power transmitters, and was doubly so six years ago; reaction, therefore, had to be used to increase the signal strength. In the receiver shown this was achieved by designing the amplifier in such a way that it was inherently unstable (due to feed-back through the anode-grid capacity of the valves used) and then controlling the tendency to oscillate by applying positive grid-bias to the valves by means of the potentiometer shown. By careful adjustment of this potentiometer the intermediate-frequency amplifier was balanced precariously on the verge of oscillation, in which condition the receiver as a whole became very sensitive and performed prodigies of long-range reception on a frame aerial.

Now it is an easily demonstrable fact that the longer the wavelength to which a set is tuned, the more marked is the deterioration in quality brought about by the use of reaction. It will therefore be understood that though distant stations could readily be received when the intermediate amplifier, tuned to 3,000 metres or more, was nearly oscillating, the loss of sidebands was far greater than would be tolerated at the present time. It is largely this reliance upon reaction, in place of pure amplification, that has earned the supersonic heterodyne

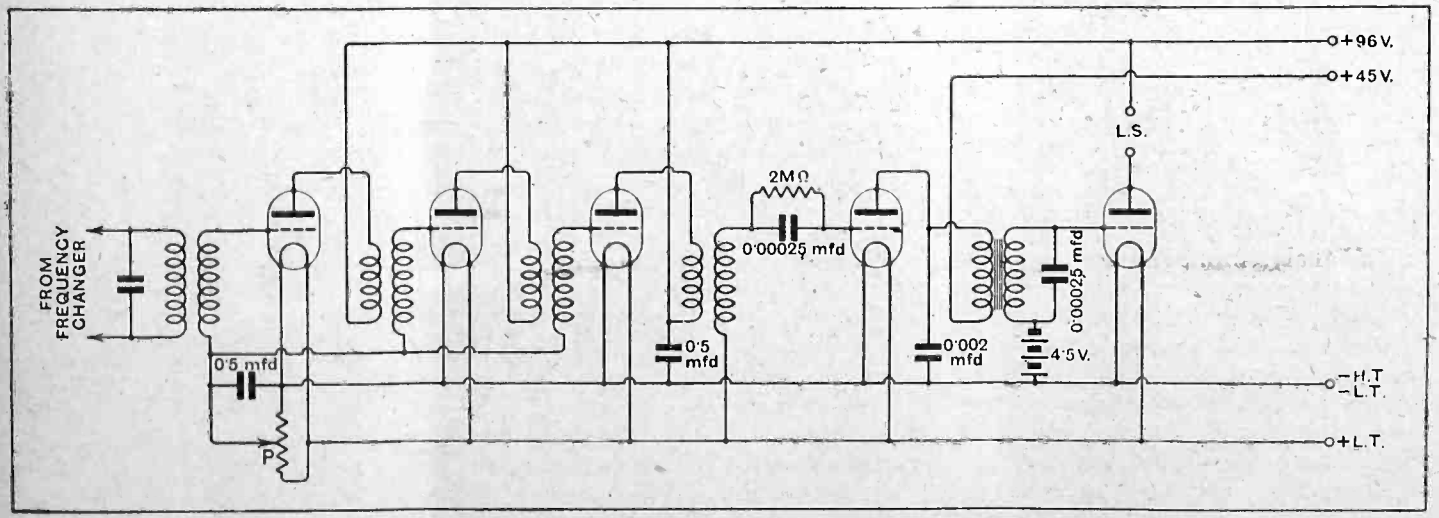


Fig. 1.—Circuit diagram of 1924 superheterodyne, omitting frequency-changer. Note: (1) Potentiometer P for putting *positive* bias on grids of amplifying valves. (2) Complete absence of all decoupling or stabilising devices of modern type. (3) The enormous capacities across primary and secondary of the L.F. transformer. (4) That the valves used had an amplification factor of 8 and an A.C. resistance of 12,000 ohms.

The Intermediate Frequency Amplifier of the Superheterodyne.—receiver its very unenviable reputation for delivering signals of bad quality. This fault, however, is a matter of design only, and is not in any way bound up with the principles of the circuit.

The resonance curves of the intermediate-frequency transformers made for the set of Fig. 1 have been roughly

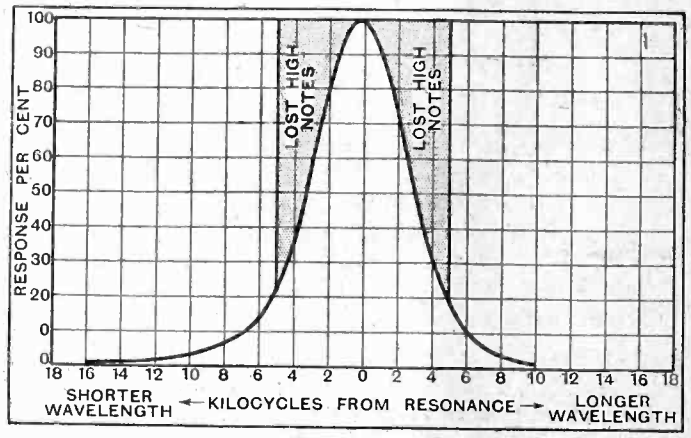


Fig. 2.—Overall resonance curve of the intermediate frequency amplifier of Fig. 1, on the assumption that no reaction effects of any kind are permitted to occur.

measured; neglecting reaction, the overall resonance curve of the intermediate-frequency amplifier is shown in Fig. 2. The loss of sidebands, brought about in the tuned circuits, even when reaction is not used, is seen to be quite appreciable, while with the amplifier nearly oscillating for the reception of a distant station the high notes would be almost entirely lost.

At the time when the receiver was designed the lower notes also were generally left to look after themselves. As a sample of the standard of quality that was then considered really good, a curve showing the amplification afforded at different frequencies by a first-class transformer-coupled L.F. stage is shown in Fig. 3. Details of the source from which the curve was taken are given below the diagram. If this curve is combined with the tuning-curve of the long-wave transformers, the overall performance curve that results is that shown in full line in Fig. 4. With extra high-note loss due to reaction this would be replaced by some such curve as that shown dotted on the same diagram. It will be appreciated from this that the old superheterodyne receivers very well deserved their reputation for poor quality of reproduction.

Dynamic Resistance on Long Waves.

The analysis that has been made of the causes of this bad quality gives us a very clear guide to design, for we see that we have to arrange that the tuning is flat enough to preserve the high notes and the L.F. transformers good enough to reproduce the low. The latter point is met, simply enough, by choosing a good modern transformer and using it in conjunction with a suitable valve; the conditions to be fulfilled are exactly those arising in any ordinary set. The question of the proper design of the tuning circuits, however, is a little more difficult—if only because few of us are accustomed to handling wavelengths of the order of 3,000 to 10,000 metres, and so have not the solid foundation of practical experience that helps to smooth out perplexities when dealing with the broadcast wavelengths.

The main difference, apart from the high inductance required, between long-wave tuning coils and those for the broadcast band is that even the most inefficient long-wave coil we can make has a very high dynamic resistance indeed, so that we are at once offered the possibility of very high stage-gain when using modern screen-grid valves. We are only limited in our ambitions by the danger of finding that the tuning has become too sharp for quality, even if reaction, accidental or deliberate, can be entirely avoided.

When Quality begins to Suffer.

If, for example, we stipulate that an amplifier built for a frequency of 50 kc., and including three tuned circuits (two stages of amplification), shall cut down 5,000-cycle notes by not more than 30 per cent., then if we use tuning coils of 50,000 microhenrys and tuning condensers of 0.0002 mfd., each coil must have a high-frequency resistance of 5,750 ohms in addition to the damping imposed by the preceding screen-grid valve. The dynamic resistance of the tuned circuit would then amount to no more than 43,000 ohms, while the stage-gain, using a battery-heated screen-grid valve, would not exceed 45 times.

It would be very easy to construct a coil of inductance 50,000 microhenrys with a high-frequency resistance not exceeding 250 ohms at 50 kc., thus giving a dynamic resistance over twenty times the maximum permitted by the requirements of quality, and yielding an amplification of over 350 times in a single stage. With possibilities of this sort dangled invitingly before our eyes, it would be absurd to put up with the meagre 45 times

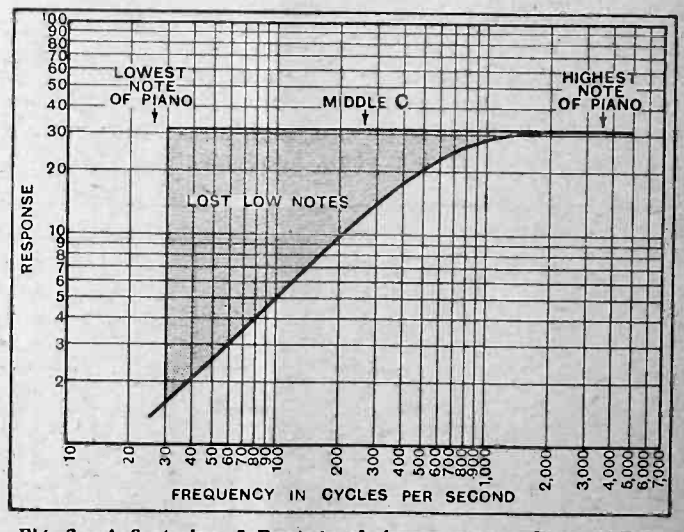


Fig. 3.—A first-class L.F. stage of six years ago. From N.P.L. curve of R.I. low-frequency transformer (1924 pattern), used with valve of that date. (*Experimental Wireless*, Vol. 1, p. 745, September, 1924.)

per stage that is the most that can be obtained from single tuned circuits before quality begins to suffer.

We abandon, therefore, the prospect of using several successive flatly tuned circuits, and turn our attention to the possibilities of the band-pass filter as an inter-stage coupling. If we work out the shape of the reson-

The Intermediate Frequency Amplifier of the Superheterodyne.—ance curve to be expected from a filter built up from coils of resonably low resistance, we find that the filter has two very high and sharp peaks, even if the inductance of the coils is taken as high as is practically possible.

A curve of this kind is shown in Fig. 5, in which the response is seen to be more than five times greater for sidebands removed by 4 kc. from the carrier fre-

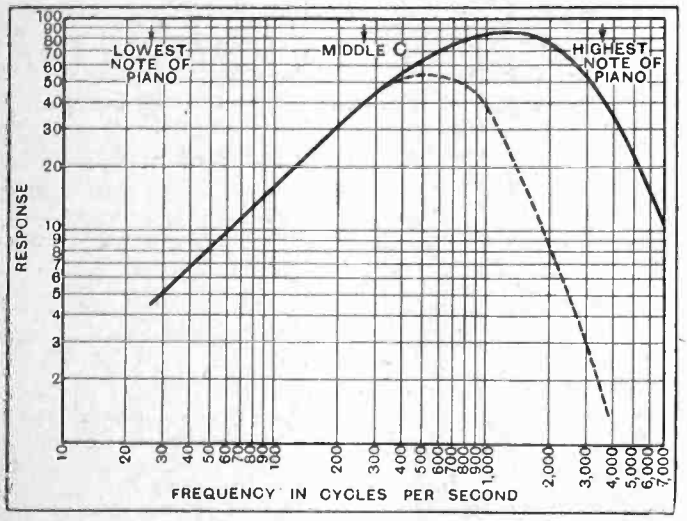


Fig. 4.—Composite curve of overall L.F. reproduction of 1924 superheterodyne, with no reaction, and only one transformer-coupled L.F. stage. In practice, the defects of the above curve were enormously exaggerated by reaction, as the dotted line suggests.

quency than it is for the carrier frequency itself. A wide flat-topped curve can be obtained only by raising the resistance of the individual coils of the filter to a very much higher value.

Where Band-pass is almost Essential.

It would appear, then, that the band-pass filter offers the possibility of no higher stage-gain than can be attained, for the same standard of quality, with simple tuned circuits. In a sense this is true, but the fact that the band-pass filter built up from low-resistance coils accentuates the sidebands almost as much as the simple tuned circuit accentuates the carrier frequency suggests that a combination of the two would be very profitable. A band-pass filter might well be used between the frequency-changer and the intermediate-frequency amplifier, the latter using single-tuned circuits throughout. The amplifier would then be designed for high stage-gain, without much regard for quality, and the filter that precedes it would be so calculated that sidebands were accentuated in the filter to the same extent that they are lost in the amplifier. The resulting overall curve, while not quite perfect, would be such as to give reproduction of very satisfactory quality, and would probably be distinctly better than the tuning curves of the average set. Fig. 6 gives the overall tuning curve of an amplifier which reduces 4 kc. sidebands to $\frac{1}{5}$th of the fundamental frequency, used in conjunction with the filter of Fig. 5.

By a combination such as this it becomes possible to use long-wave tuning coils wound to give high amplification without sacrificing the quality of reproduction.

In passing, it may be worth while to remark that by "coils wound for high amplification" we do not mean single-layer solenoids wound with Litzendraht. The coils used in calculating the filter whose very peaky tuning-curve is given in Fig. 5 are slab coils, wound with very fine enamel-covered wire; for all their high inductance they are only equal in diameter to a half-penny, and are, perhaps, twice as thick. Regarded as tuning coils, they are about as inefficient as they could possibly be, but the shape of their resonance curve is such that they fall, all the same, into the category of "ultra-low-loss coils."

Since dielectric losses become negligible at the low frequencies with which we have to deal in the intermediate-frequency amplifier, the high values of dynamic resistance derived from a consideration of the copper losses of the tuning coils may safely be used as a basis of design. Apart from valve damping due to grid-current or negative reaction effects one is safe in assum-

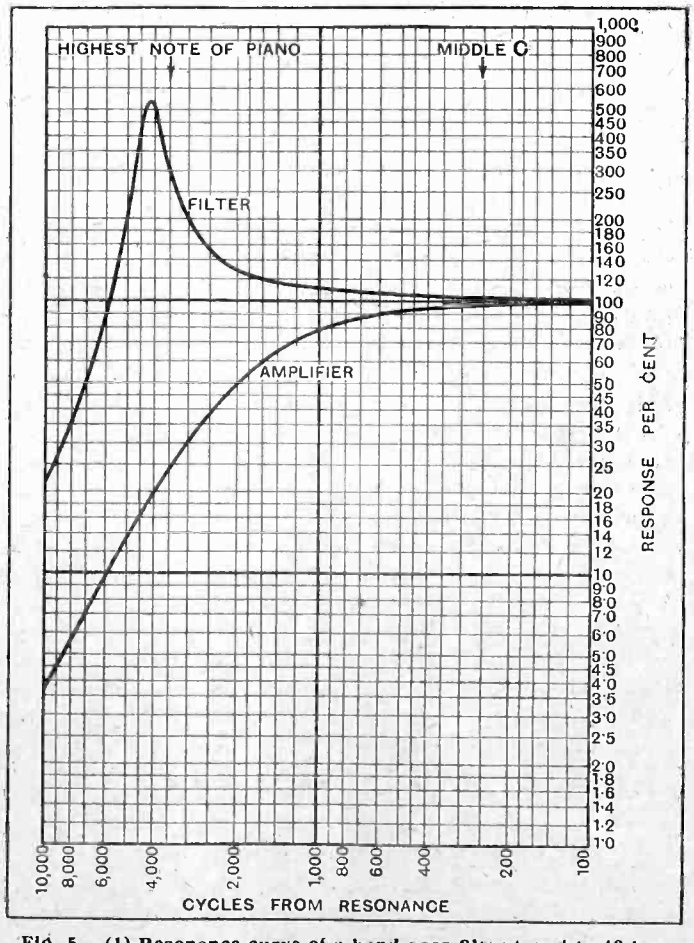


Fig. 5.—(1) Resonance curve of a band pass filter tuned to 40 k.c. Coils 150,000 microhenrys, resistance 700 ohms. Coupling, either 0.0005 microfarads common capacity, or 32,000 microhenrys common or mutual inductance. (2) Resonance curve of sharply tuned amplifier which, used alone, would give a very serious loss of high notes.

ing that the high-frequency resistance of the tuned circuit will not be more than double the direct-current resistance of the tuning coil—a simple rule that, while approximate, is very useful. Since a dynamic resistance of a megohm or more can easily be attained, one may hope for a stage-gain not far short of 400 times from

The Intermediate Frequency Amplifier of the Superheterodyne.—the best of the battery-heated screen-grid valves, while theory indicates that even with so high an amplification perfect stability is very easy to attain.[1]

Practical experience, however, shows that two tuned-anode stages designed to give an amplification of this order oscillate continuously and mercilessly, though if step-up transformers of ratio about 3 to 1 are substituted for the tuned-anode connections no difficulties whatever are found. The writer does not wish to dogmatise on the reasons for this unexpected state of affairs, but is inclined to attribute it to the difficulty of finding a condenser of capacity large enough, and resistance low enough, to "earth" the screening-grids of the valves as perfectly as is assumed in the simple theory used for the calculation. If, through imperfect earthing, any intermediate-frequency voltages are allowed to appear on the screening-grids, the effectiveness of the internal screening of the valve is at once lessened, which appears to explain, qualitatively at least, the divergence between theory and practice. From the purely constructional point of view the effect is not very serious as long as one is forewarned, for even with step-up transformers of ratio high enough to ensure stability an overall gain approach-100,000 times can be attained with two stages without trouble from self-oscillation.

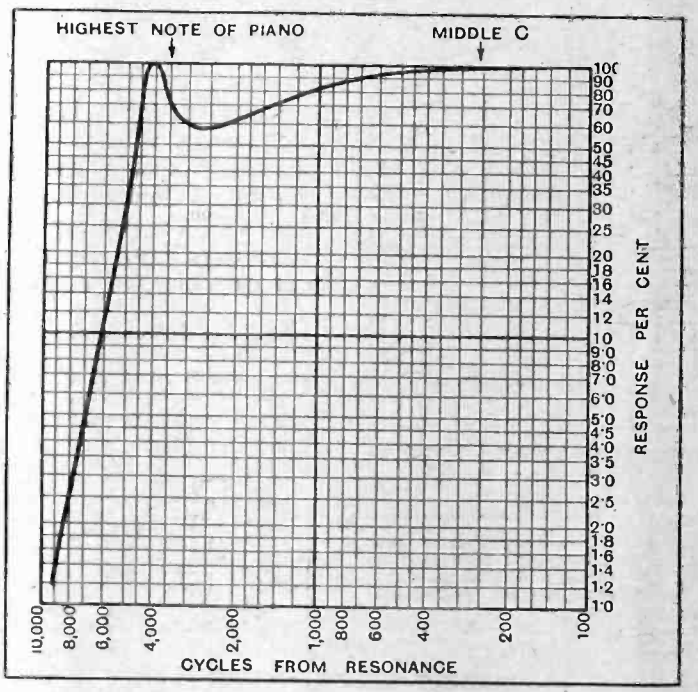


Fig. 6.—Overall response curve of the filter and amplifier whose curves are shown separately in Fig. 5. The response within the audio range (to 5,000 cycles) is reasonably even, while the extremely rapid falling off outside this region indicates very high selectivity. This type of curve is not difficult to realise in a practical amplifier.

The writer has actually had in operation a superheterodyne receiver in which, at a conservative estimate, there was an amplification in excess of one million times from frame aerial to grid of second detector. As might be expected, no aerial was too small, and no station too distant for such a receiver; the signals from Langenberg, in daylight, heavily overloaded the second detector when using a small tuning coil as frame aerial, even with stray pick-up almost entirely eliminated. On paper, this sounds the ideal receiver, but in practice it proved utterly useless owing to the one defect that is inherent in the basic principle of the superheterodyne.

Everyone who has handled a receiver which contains no high-frequency stage has, at some time or another, permitted the detector valve to oscillate, and will probably have observed that as long as oscillation continues a distinct "hiss" is heard in telephones or loud speaker. In an ordinary receiver, with which reception is possible only when the set is not oscillating, this hiss is, of course, quite harmless. In a superheterodyne, on the other hand, the continuous oscillation of a valve in the frequency-changer is an essential feature of the set, so that the "hiss" is being produced all the time. Where but moderate amplification follows the frequency-changer this hiss is not serious, and will probably pass completely unnoticed; in the experimental receiver just mentioned there was sufficient amplification to exalt the faint hiss into a continuous rushing sound that almost completely drowned the signals being received when anything like full amplification was employed.

Since the hiss given by the frequency-changer is approximately a constant quantity, not depending greatly on the strength of the signals being received, it is apparent that it will be necessary to limit the intermediate frequency amplification to an amount insufficient to bring the hiss up to noticeable strength. The writer's recent experiments have brought him to the conclusion that the fullest amplification that a single intermediate-frequency stage will yield leaves the hiss still at a low enough level to be quite harmless, while two such stages, even if made inefficient, are inclined to have too much background noise.

A receiver consisting of a frequency-changer followed by a single intermediate stage, second detector, and pentode, therefore, provides about the greatest usable amplification that can be attained from a superheterodyne; the amplification of such a set is high enough to receive Langenberg in daylight at audible loud speaker strength on a frame aerial 2ft. square. A receiver of this kind makes a very pleasing alternative to the usual three-valve set used with an open aerial, differing from such a set only in its immensely enhanced selectivity. If really reliable distance-getting properties are required, however, the amplification is hardly high enough, and, since the hiss of the oscillator precludes further amplification at the intermediate frequency, one can only add a further stage of ordinary high-frequency amplification before the frequency-changer. While adding an extra tuned circuit, making three tuning knobs in all, there is at least the compensating advantage that a small indoor aerial (consisting perhaps of a few feet of wire strung across the room or thrown on the floor) can be used in place of the more cumbersome frame without risk of annoying one's neighbours by radiation from the oscillator.

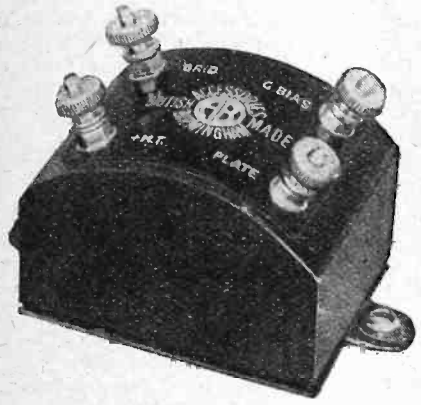
(To be concluded.)

[1] "The Stability of the Tuned-Grid Tuned-Plate Amplifier. Beatty, *Experimental Wireless*, January, 1928, p. 3.

Laboratory Tests on New Apparatus

A.B. L.F. TRANSFORMER.

Made by Accessories (Birmingham), Weaman Street, Birmingham, this L.F. transformer is priced at 7s. 6d., the ratio being 3.5 to 1. A nickel-iron core is used, and the measured inductance at



A.B. L.F. transformer made by Accessories (Birmingham). The ratio is 3.5 to 1.

50 cycles with no D.C. flowing was found to be 27.2 henrys. With 2 mA. of D.C. flowing, this falls to 18 henrys, and with 4 mA. to 13 henrys. Best results will be obtained with a preceding value of some 8,000 ohms impedance, and for preference using the resistance capacity method of coupling to deflect all D.C. from the transformer.

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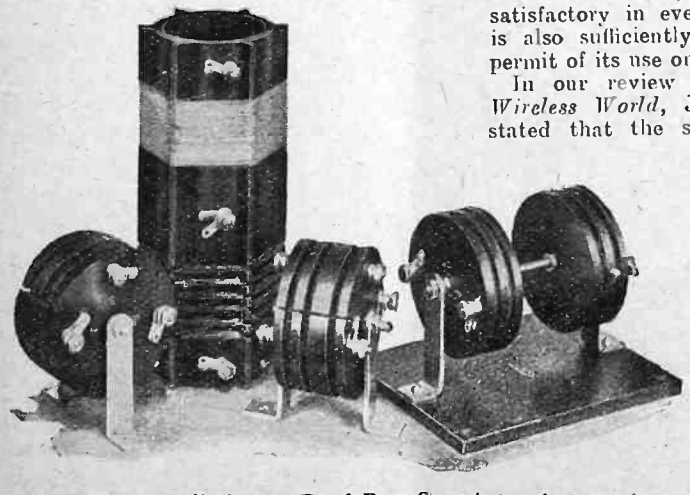
COILS FOR BAND-PASS SUPERHETERODYNE.

A set of coils for the Band-Pass Superheterodyne receiver constructed to specification so far as the winding is concerned, but wound on ebonite bobbins in the case of the I.F. filter and oscillator coils, has been sent in by Wright and Weaire, Ltd., 740, High Rd., Tottenham, London, N.17. To facilitate connecting



Set of Wearite coils for the Band-Pass Superheterodyne receiver.

the various coils, the terminals and soldering tags are marked to correspond with the lettering on the constructional drawings in *The Wireless World* of November 12th last. The price of the complete set is 30s.

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MAGNUM DE-COUPLING RESISTANCES.

Made by Messrs. Burne-Jones and Co., Ltd., Magnum House, 296, Borough High St., S.E.1, these small wire-wound decoupling resistances are available in two values, viz., 600 ohms and 1,000 ohms, the price in each case being 1s. 6d. The wire is wound in two grooves, the turns in one being wound in the opposite direction to those in the other, thus forming a non-inductive winding. A single wood screw serves to fix the component to the baseboard.

Magnum decoupling resistance, available in 600- and 1,000-ohm sizes.

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BURNDEPT A.C. ALL-POWER UNIT.

In the Burndept Universal Screened-Five receiver the H.T., grid bias and L.T. for the A.C. valves are obtained from a separate unit, in which is included also the necessary smoothing equipment, the whole of this apparatus being housed in a metal container with a small external platform for the valve. This unit is now available for incorporating in home constructors' sets, and since it is a well-tried unit, should prove entirely satisfactory in every respect. The H.T. is also sufficiently free from ripple to permit of its use on the ultra-short waves.

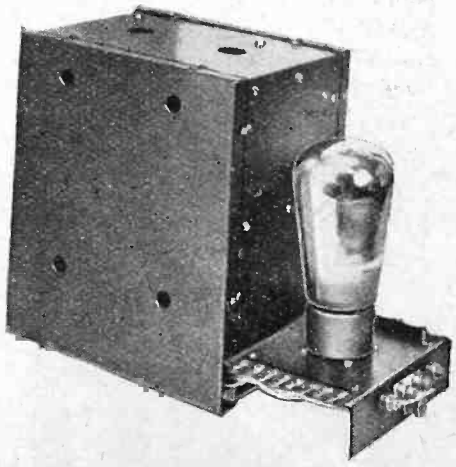
In our review of this receiver—*The Wireless World*, June 18, 1930—it was stated that the set functioned without hum down to 18 metres.

A sample unit was recently sent in for test, and we were thus able to obtain some measurements of the output voltages. A Phillips 506 full-wave rectifying valve was used. Two H.T. tappings are provided; one is intended for the power stage, and is rated to give 200 volts at 40 mA., while the intermediate tapping, the output from which is more completely smoothed, provides 180 volts, nominally at 5 mA. The output voltages are naturally interdependent, since they are derived from a common rectifier, so for purposes of test a fixed resistance was connected between the intermediate output tapping and the H.T.—and the output from the power tapping measured under various current loads, the voltage at the intermediate tap being noted at the same time. The results are tabulated below.

H.T. OUTPUT FROM BURNDEPT POWER UNIT.

Power Tapping.		Intermediate Tapping with Fixed Resistance in Circuit.	
Current.	Voltage.	Current.	Voltage.
10 mA.	295	8.5	270
20 ,,	270	7.8	244
30 ,,	245	7.0	215
40 ,,	220	6.4	195
50 ,,	192	6.0	178

Grid bias is derived from a separate winding on the transformer, a Westinghouse metal rectifier being employed. Thus the grid bias potentials are entirely independent of the H.T. and cannot cause undesirable coupling. Two G.B. voltages are provided, one fixed at 3 volts and the other adjustable to 30, 35 or 40 volts, according to the method of interconnecting four small terminals on the front of the valve platform. These voltages remain sensibly constant irrespective of the H.T. and L.T. load.



Burndept A.C. all-power unit for incorporating in receivers and supplying H.T., grid bias, and L.T. for A.C. valves.

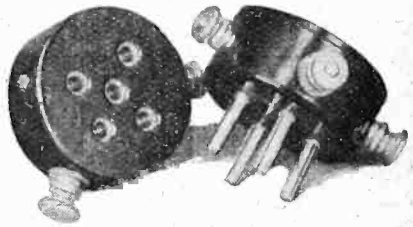
An L.T. supply of 4 volts at 4 amps. is available for A.C. valves, this winding carrying also additional turns brought out to a separate terminal which allows 6 volts to be drawn at 0.5 amps. for the filament of a 6-volt directly heated output valve. When the full 4 amps. are taken from the heater winding the H.T. voltages are lowered by the small amount of 2 per cent.

The makers are Burndept Wireless (1928), Ltd., Aerial Works, Blackheath, London, S.E.3, and the price is £9, excluding valve.

SIX-SIXTY GRAMOPHONE PICK-UP ATTACHMENT.

These adaptors are sensibly the same as the valve adaptors reviewed in these pages on June 25th last, the main difference being that additional terminals have been fitted to the two units. The centre pin on the 5-pin A.C. unit is brought out to a terminal, and a terminal has been provided affording a direct contact with the grid pin and socket.

The D.C. 4-pin unit has, also, a terminal contacting with the grid pin, thus enabling a gramophone pick-up to be employed without disturbing a single wire in the set.



Six-Sixty gramophone attachments for use in battery-operated and A.C. sets.

These units cost 2s. each, and the makers are Six-Sixty Radio, Ltd., 17-18, Rathbone Place, Oxford Street, London, W.1.

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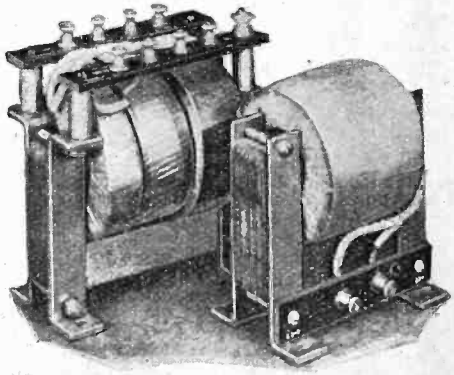
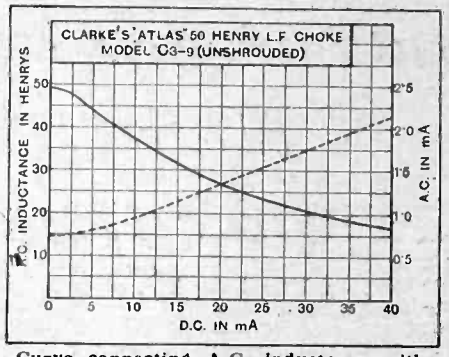
CLARKE'S "ATLAS" MAINS EQUIPMENT.

Messrs. H. Clarke and Co. (Manchester), Ltd., Atlas Works, Eastnor Street, Old Trafford, Manchester, have introduced recently a range of unshrouded L.F. chokes and mains transformers which are intended for use in sets where a shielded component is not essential. The particular samples tested comprise a 50-henry choke and a transformer rated to give 180+180 volts and 2+2 volts. Normally this would be used in conjunction with a valve rectifier of the 4-volt type, but under certain conditions a metal rectifier could be utilised, and the 4-volt winding employed to supply the heaters of A.C. valves.



Clarke's "Atlas" 50-henry L.F. choke and mains transformer type 1553F-7.

The inductance of the choke was measured at 50 cycles with various amounts of D.C. flowing, the results being plotted in the form of a curve connecting A.C. inductance with D.C. milli-

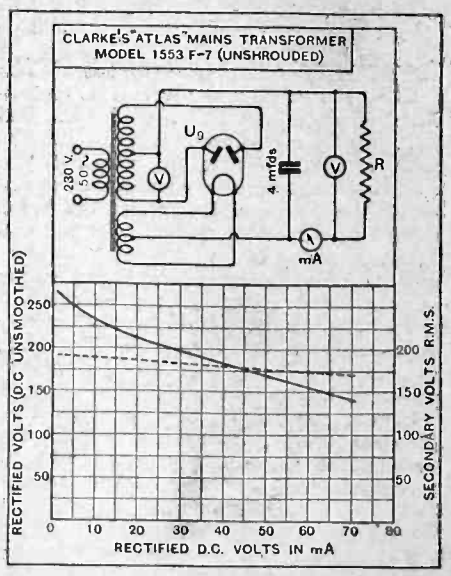


Curve connecting A.C. inductance with D.C. through the winding is given in the full-line curve and the superimposed A.C. in mA. in the broken-line curve—for Clarke's "Atlas" 50-henry L.F. choke.

amps. through the winding. This is the full-line curve on the graph. The broken-line curve shows the 50-cycle A.C. component in mA. flowing through the coil.

The D.C. resistance of the 50-henry choke was found to be 850 ohms, and the price is 30s.

For the purpose of test the mains transformer, model 1553 F-7, was used in conjunction with a Marconi U9 full-wave rectifying valve, since this operates on 4 volts, the test circuit being quite orthodox, and, as shown on the graph, a 4 mfd. reservoir condenser is used. Other makes of rectifiers can be utilised if desired, provided a 4-volt type is chosen; the Osram U9, Mullard DW2,



Output curves from Clarke's "Atlas" mains transformer, type 1553F-7, when used with a Marconi U9 full-wave rectifier.

and the Philips 506K, to mention a few only of the alternative types that are suitable.

The unsmoothed rectified output is shown by the full-line curve, while the broken-line curve shows the A.C. voltage (R.M.S. values) across one-half of the H.T. secondary winding during the time of test. The input voltage was 230 at 50 cycles. The primary winding is not tapped, but it is stated as being suitable for all mains voltage of from 200 to 250 volts, 40-120 cycles. The rectified output will be greater or less than that shown on the graph, according to the relationship between the available mains supply and that used for the purpose of our tests. The filament voltage for the rectifier will vary also.

The price of the model illustrated is 30s.

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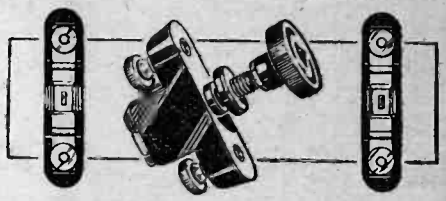
"BUSCO" BATTERY SWITCH.

The body of this switch consists of a bakelite moulding, the centre of which is hollow and forms a guide for the moving contact. This takes the form of an inverted "U," the two arms sliding into spring contacts when in the "on" position. The contacts are, therefore,



"Busco" battery switch with moulded base and self-cleaning contacts.

self-cleaning. A single-hole fixing bush is provided, and, although the spindle is "live," the switch can be fixed to metal panels, as the bush is provided with an insulating collar and washer.

The makers are Messrs. Busby and Co., Ltd., Price Street, Birmingham, and the price is 1s. 3d.

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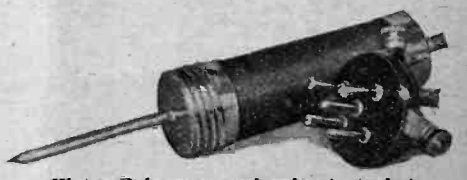
WATES POLYSCOPE AND VALVE TEST PLUG.

Used in conjunction with the Wates 3-in-1 meter, the Polyscope enables continuity tests and measurements of resistance to be made. It consists of an insulated container with metal end caps; one carries a long prod, and the other a split socket to take the contact point of the meter. The container is designed to accommodate an Ever Ready No. 8, or similar size, dry battery.

An instructional leaflet explains fully the method of use and gives a table showing the meter readings for resistances of from 14 ohms to 2,800 ohms. The price is 3s.

The valve test plug is of the 5-pin type with a similar number of sockets mounted above. All sockets, with the



Wates Polyscope and valve test plug.

exception of the anode connection, are joined to their corresponding pins. The anode socket and its pin are each brought out to two small terminals, thus enabling a milliammeter to be inserted in the circuit for the purpose of measuring the current. The price of this adaptor is 2s. 6d. The makers are the Standard Battery Co., 184, 188, Shaftesbury Avenue, London, W.C.2.

Bon Marché Screened Grid Eight.

A Low-priced Radio-gramophone of Exceptional Range and Selectivity.

THE receiver-amplifier chassis which forms the nucleus of this instrument is of American origin, and follows the best modern practice. It is designed for A.C. mains operation throughout, and there are three screen-grid stages tuned by a triple gang condenser, with accessibly placed trimming condensers. No reaction is employed, and the detector is followed by two low-frequency stages, the first resistance-capacity coupled, and the second transformer-coupled to two power valves in push-pull. The output is matched to the moving-coil loud speaker, which has been designed specially for use in conjunction with this chassis. The output transformer is mounted in the loud speaker unit, and a five-way multiple cable is used to connect the two units. Three of the leads are for the push-pull output, and the remaining two supply the field winding, which serves also as a smoothing choke for the H.T. supply to the receiver.

There are four controls: a central tuning knob with illuminated drum dial, on the right a combined radio volume control and gramophone switch, on the left an "on-off" switch, and above the escutcheon plate a push-pull wave range switch. A small two-way switch on the chassis gives alternative mains input voltages.

The gramophone motor is of the induction type, and the pick-up is a B.T.H. Gramophone volume is controlled by a compression-type resistance in series with the pick-up, and a separate push-button switch is fitted to the left-hand side of the cabinet for starting the gramophone motor.

Bon Marché Screened Grid Eight radio-gramophone. The specification includes three screen-grid H.F. stages, push-pull output and a moving-coil loud speaker.

The whole equipment is housed in a cabinet of imposing appearance, the dimensions of which are: Height 2ft. 11½in., width 2ft. 2½in., depth 1ft. 9in. The back is left open to obviate box resonance.

The performance on the radio side is most impressive. Without any concentration or close adjustment of controls, twenty-five foreign stations were received on short waves and eight on long waves at full loud speaker strength. In the case of thirteen of these stations it was necessary to make use of the volume control in order to prevent overloading of the output stage. In spite of the high degree of sensitivity, however, the background noise is commendably low.

The set was tested on an outdoor aerial 50ft. in length with an average height of about 18ft. at a distance of only five miles from Brookmans Park. Nevertheless, five Continental stations were received between the two Brookmans Park transmitters, and ten degrees of the dial between these stations were absolutely clear of interference. The very complete screening of components contributes materially to this result. With the aerial detached, the volume control has to be turned up to maximum to get the local transmitters, but if a 2in. length of wire is connected to the aerial terminal, the control has to be turned almost to minimum to keep the volume within bounds.

The long-wave selectivity is satisfactory, but does not equal the standard set on short waves. Königswusterhausen can be received clear of Radio Paris, but is overlapped by Daventry. On the other hand, interference from the Brookmans Park transmitters is limited to a few degrees at the bottom of the long-wave range.

Quality of reproduction is of a high order, particularly on the radio side, but the high-note response in gramophone reproduction appeared by comparison to be slightly curtailed. Tests with standard frequency records, however, showed that the gramophone response is good up to 3,000 cycles. We understand that a potentiometer volume control will replace the series resistance in future models.

In the matter of price, the makers, Bon Marché, Ltd., Brixton, London, S.W.9, undoubtedly live up to their name; for the oak cabinet model costs only 39 guineas, while the mahogany and walnut models are priced at 42 guineas and 45 guineas respectively.

The cabinet work in the instrument illustrated is constructed with a solid frame, panelled with oak-faced, three-ply wood. In the models now in production, however, the woodwork, including the panels, has been considerably strengthened. A further improvement is that the gramophone motor switch is now mounted on the motor board instead of on the outside of the cabinet.

Letters to the Editor.

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

CIRCUIT DIAGRAMS AND SERVICE.

Sir,—I have read with much interest your Editorial comments *re* diagrams being supplied with sets as sent out by manufacturers. This is certainly a long-felt want, though in my opinion the full and correct solution to the problem of servicing is, to supply as an integral part of the set, by permanently affixing to the lid or other suitable part of the set, a pictorial diagram showing the listener how to connect the batteries, and a circuit diagram for use of the service man.

Another very essential feature is that the wiring should be carried out on a colour scheme, in order to simplify the identification of each section of the circuit.

It seems as though designers have been lacking in these respects, when we remember that much simpler electric apparatus is provided with these advantages. Take, for instance, the house telephone, which has diagrams permanently attached to prevent their loss or wrong diagrams being used. The colour scheme in this case is in the connecting wires.

If this system were adopted it would considerably lighten the troubles of the service man, who has quite enough to contend with and cannot be expected to remember all the circuits, and also would prevent the dabbler from soldering that loose wire on to the terminal to which it *looks* as though it belongs.

It would also help to solve some of the Chinese puzzles set for the repair man by the amateur *expert* who has tried to make a Meccano three out of a Super-Regenerative, and having failed, gives the set just as it is to a friend, who takes it to the wireless shop to get it put right, and who complains bitterly because he is charged a few shillings because the set had to be rewired.

I say, therefore, definitely, let us have diagrams and colour schemes which will benefit everybody concerned.

A. DE VILLIERS,
Hon. Organising Secretary,
The National Federation of Radio Retailers.

THE SUPERHETERODYNE.

Sir,—The writer has been much interested in Mr. Sowerby's articles on the superheterodyne, and must congratulate him on the design of a really remarkable set in the "Band-pass Superheterodyne."

Whilst this set would probably satisfy the requirements of the majority of listeners, the writer is of the opinion that the stenode radiostat principle offers still greater possibilities in the matter of selectivity with good quality.

It has been recently announced that a broadcast model of the stenode radiostat has been evolved which gives a very high degree of selectivity without the complications of the quartz-crystal gate. This new circuit, the writer assumes, utilises a sharply tuned I.F. amplifier, with an L.F. amplifier designed to compensate for the loss of high notes.

By using several low-loss circuits in the I.F. amplifier, the writer imagines that the response at 9 kc.s from resonance should be reduced to a very low value, completely eliminating even the immediately adjacent transmissions. Whether the side-bands of the local transmission would interfere with the reception of adjacent stations remains to be decided by a practical test, but, from a theoretical examination of the subject, the writer thinks that even this interference should be eliminated by a really sharply tuned I.F. amplifier.

There are disadvantages to this type of set, it is true, some of which may be mentioned. The chief one is the extra L.F. amplification required. Sufficient amplification would have to be provided following the detector to restore the high notes to their original relative strength. The L.F. gain required may easily be as much as 100,000, depending on the selectivity and high-note response desired.

Another disadvantage is the extremely critical tuning of the oscillator, and the probable variation of quality with slightly different settings of this control. Also, slight frequency modulation at the transmitter may be found to spoil reception completely.

On the other hand, it should be possible with a set of this type to separate stations differing in frequency by only 5 kc.s, whilst still retaining good reproduction of high notes. If one is content with 9 kc. separation, then better high-note reproduction should be possible than with the alternative band-pass method.

WM. J. HOLROYD.
Halifax.

MUHLACKER.

Sir,—The remarks on page 599 of your issue of November 20th were, of course, written before this station began to transmit on 70 kilowatts.

Since then the London Regional transmission has been practically blotted out in the South of England, and if double this power is really contemplated we can say good-bye to the excellent programmes which so many thousands of us have appreciated since the new Brookmans Park station came into being.

Doubtless some means will be found of altering the respective wavelengths of the two stations so that they may be separated by at least six metres, which appears to be the minimum within which an ordinary set can avoid interference.

To my mind—and I am sure it must occur to many others—the most distressing feature of this interference incident is the utter lack of foresight on the part of the B.B.C. engineers. They have had many months' notice of the intended transmission, and instead of dealing with the matter in advance they have apparently done nothing. I am a great admirer of the B.B.C. and its wonderful organisation; I appreciate all that it gives us; and, knowing something of Continental broadcasts, I can assert that we have the best all-round programmes in the world. Is it not regrettable, therefore, that they should spoil a good record by allowing such a blunder to be committed?

A. HOARE.
Hindhead.

SERVICE.

Sir,—With reference to the letter you publish in the issue of December 3rd under "Service," it may interest your readers to know that we have had quite a number of people in our shop who are entirely dissatisfied with the "service" they get for 6s. per annum. We have explained that real service *cannot* be given for 6s. per annum, and it strikes us that it is really another form of salesmanship, as in most cases the existing set has been condemned and a new one suggested.

We think it misleading to suggest that real and adequate service *can* be given for 6s. per annum. In one case we know of there is not a technical man on the board of directors, and the service charge is merely an introduction to the house with the object of selling a set of well-known manufacture from whom this firm are able to get factors' terms.

As we do not wish to advertise the real service we do give we sign ourselves,

"RADIO DEALERS."
West Ealing, W.13.

PITCH OF THE HUMAN WHISTLE.

Sir,—Messrs. Seymour Pile and Vernon Coombs are correct in thinking that the tone of 32 and 16ft. organ flue pipes is principally fundamental, "strings" excepted.

This is purposely so in order that a limited number of these stops—which are very expensive—shall form a passable bass for the varied tone colours of the manuals.

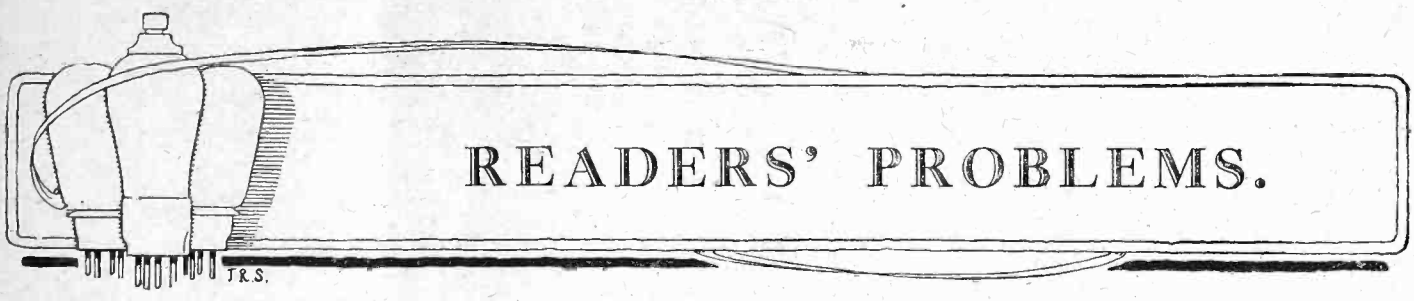
Because of the preponderance of fundamental, these low notes are seldom reproduced properly by loud speakers; but directly pedal reeds, which have a greater harmonic development, are drawn the pedal department becomes alive.

Probably the missing fundamental is suggested to the ear by the harmonics.

A trick of this kind is practised in the "Acoustic 32ft.," where 16ft. tone pipes suggest a 32ft. note, although there may be no 32ft. pipes in the organ.

Anyone with a wireless set which reproduces the whole range of organ notes from 32ft. upwards in proper proportion has something to be proud of!

WM. A. RICHARDSON.
Ashford, Kent.



"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below.

Why an Input Volume Control is Necessary.

It has been suggested on more than one occasion by contributors to your journal that an input volume control is desirable, if not actually necessary, when band-pass tuning is employed. But surely it would be unnecessary to add this refinement to an unpretentious det.-L.F. two-valve receiver? A set of this nature seldom gives excessively loud signals, and it would appear to be superfluous to make provision for reducing detector input. I should like to have your views on this matter. F. M. B.

We think it is a mistake to assume that a det.-L.F. set is unlikely to stand in need of an input volume control when it includes an input filter. It is well known that signal voltages of from 5 to 10 volts may easily be developed across the grid circuit of such a receiver at distances of a few miles from a powerful broadcasting station; H.F. voltages of this order are more than high enough to overload a grid detector of the type customarily employed. As a filter cannot operate properly unless its circuits are accurately tuned, it is clearly impossible to obtain satisfactory results unless some means either of regulating input from aerial to filter or from filter to detector are provided.

We do agree, however, that it would be wasteful to fit a control of this sort if the receiver is to be used under such conditions that detector overloading will be virtually impossible; in such cases a post-detector control—which is simpler and less expensive—is perfectly adequate.

o o o o

A Four-element Filter Circuit.

On page 519 of your issue dated November 5th there is published a circuit diagram of a double filter with four variable condensers: I should like to do some experimental work on these lines, and would be obliged if you would give me details of the various tuning coils and coupling inductances. It is intended to confine operations to the medium broadcast waveband only. P. C. P.

As implied in the article to which you refer, these cascade filters, intended to give constant frequency width over the tuning ranges normally covered, are still in the embryonic stage. We have not yet sufficient practical data to give a definite answer to your question, and fear that the subject cannot be treated adequately in a limited space. It is hoped that this matter will be treated exhaustively in the near future.

o o o o

Listening to Harmonics.

In the early days of broadcasting I was often able to hear the second harmonic (one-half the fundamental wavelength) of several transmitting stations, but now I notice that these harmonics are much more difficult to find and are much weaker. As there has been a general all-round increase in transmitting power, this seems rather surprising. Can you tell me what is the explanation? J. D. W.

The radiation of harmonics by a transmitting station has always been recognised as undesirable, and for some time past a good deal of work has been done in devising means whereby the generation of subsidiary frequencies—or, at any rate, the radiation of these frequencies from the aerial—may be minimised. Considerable advances have been made, and now very few stations are bad offenders in this respect.

L.T. Accumulator Charging.

Will you please show me how to charge my 2-volt L.T. accumulator from 220-volt D.C. mains? I believe that it is possible to do this without expense by joining the battery in series with the household lighting system, but am not quite clear as to where connection should actually be made.

I am sending you a rough sketch of my main switchboard, and should be obliged if you would indicate the correct connections. A. B. T.

An accumulator can be charged in the way you suggest; the only disadvantage is that the mains voltage will be reduced to an extent equivalent to the back-E.M.F. of the battery. In your case this will be quite negligible, and there will be no apparent diminution in the brilliancy of the lamps.

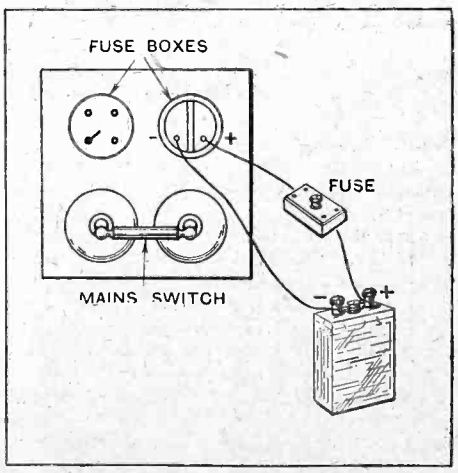


Fig. 1.—Charging an accumulator cell from D.C. lighting mains.

The most convenient way of joining the accumulator to your switchboard is shown in Fig. 1. One of the fuses (preferably that connected in the earthed main lead) should be removed, and the accumulator should be connected to the fuse terminals.

It should be pointed out that the cell may be damaged if your consumption of current for lighting purposes exceeds its maximum safe charging rate. By counting up the number of lamps likely to be in use at any one time, and allowing roughly ¼ amp. for each 60-watt lamp and ⅛ amp. for each 30-watt lamp, you will be able to estimate whether this charging rate is likely to be excessive.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

(2.) Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."

(3.) Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.

(4.) Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.

(5.) Practical wiring plans cannot be supplied or considered.

(6.) Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.

(7.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.

Power Transformer Modification.

With reference to the power transformer described in your issue of January 22nd, 1930, will you please tell me how to modify the filament winding for a rectifier valve taking 2 amps. at 4 volts? D. R.

A suitable winding would consist of 24 turns of No. 18 double cotton covered wire, 12 turns being wound on each bobbin.

o o o o

Converting an Old Receiver.

I have a somewhat out-of-date four-valve set with two H.F. stages coupled by the tuned-grid method, and a grid detector. This has never been really satisfactory, and I am inclined to build a new set for long-distance work, modifying the existing receiver for local station reception (my nearest transmitter is about forty-five miles away).

The old set has ganged tuning control, and, if possible, I should like to eliminate one of the H.F. valves and to make the first two tuned circuits act as a filter. Do you think that this could be done without much trouble? A. T. R.

It so happens that your set should lend itself quite readily to alterations on the lines suggested. Although you do not send a diagram, we expect that its circuit arrangement is very much on the lines shown in Fig. 2. If this is so, the first two circuits can be made to form the elements of a filter merely by removing the input H.F. valve, and, after breaking the second grid lead at the point marked X, inserting a variable coupling condenser between the high-potential ends of the two circuits. This condenser should be very small, with a maximum capacity of not much greater than fifteen micro-microfarads, and it should be possible to find an adjustment for it that will give proper filter tuning.

You must not lose sight of the fact that by removing the valve and by isolating the second tuned grid coupling the stray capacity values across these circuits will be changed appreciably, and it will be necessary to readjust the ganged condensers.

o o o o

Cost of Filament Current.

I have just completed an H.T. eliminator for feeding my three-valve set from the D.C. supply mains. Results are entirely satisfactory, and I am now thinking of attacking the L.T. problem. It has been stated that it is extravagant to feed valves connected in the ordinary way (i.e., in parallel) from the mains, but it would appear very much easier to do so than to join all filaments in series as is generally recommended. Will you tell me for what length of time a single unit of electricity should be capable of supplying filament current? The valves consume a total of 0.55 amp., and the main supply is at 240 volts. T. C. E.

The filaments of your valves will consume $240 \times 0.55 = 132$ watts. This means that one unit of electricity (1,000 watt-hours) will feed the circuit for slightly over 7½ hours.

If your current is supplied at a low rate it is quite possible that the cost of running the set in this way will be low, in spite of the fact that the greater part of the energy used will be dissipated in the form of heat. But there is another disadvantage: it must be remembered that when valves are connected in parallel with a limiting resistance in the feed leads, the removal of part of the load, due to withdrawal of one valve or to failure of its filament, will bring about a considerable rise in voltage, which may easily be sufficient to damage the filaments of the remaining valves in the receiver.

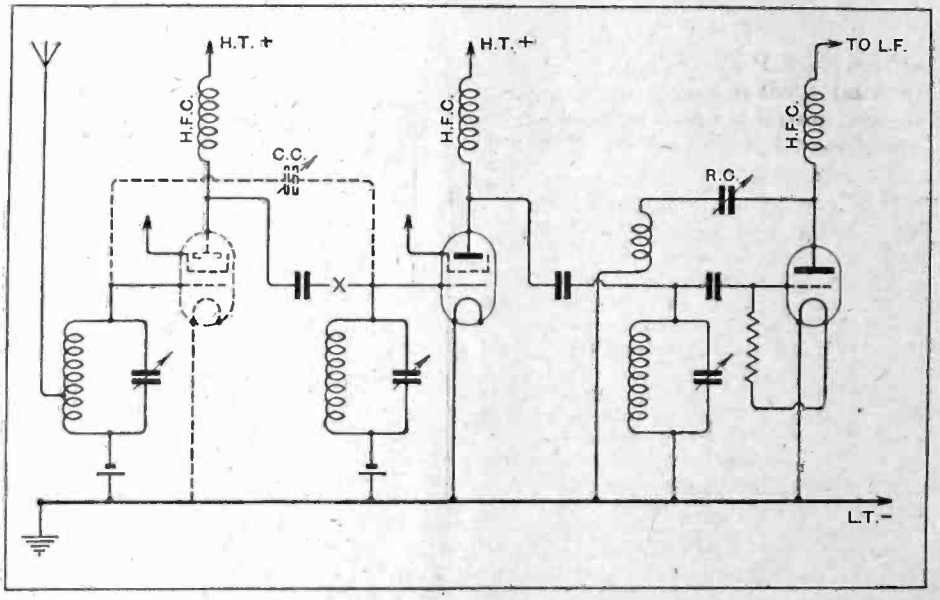


Fig. 2.—An easy conversion: a "2-H.F." set modified for band-pass tuning by eliminating the first high-frequency valve, and adding a coupling condenser, of which the connections are shown in dotted lines.

Two Eliminators; One Receiver.

Is it possible to use two entirely separate A.C. eliminators for feeding a single receiver? I ask this question because I have an opportunity of obtaining an instrument at a low price, which, I believe, on a light load, will give sufficient voltage and current for operating a power grid detector which I propose to use. My existing eliminator would be used for feeding all the valves except the detector; this would be supplied by the new instrument, which, I am told, will maintain a voltage of well over 250 when supplying 8 milliamps. M. L.

On theoretical grounds, no objection can be raised to this plan, which, indeed, confers the advantage that undesirable interaction cannot be introduced in the eliminator circuits between the detector and other valves.

Of course, it seems rather extravagant to employ a complete eliminator, with its own rectifier and smoothing circuit, etc., for feeding one valve.

o o o o

Combined Choke and Transformer Output.

My receiver includes an output choke; would it be possible to operate it without alterations or additions in conjunction with a low-resistance moving-coil loud speaker which embodies a built-in step-down transformer? J. R. L.

It is quite likely that your set would work well with this loud speaker, but it is impossible to give a definite answer to your query, as each case of this sort must be considered on its own merits, and with regard to the design of the output transformer, the inductance of the output choke, and the capacity of the feed condenser. In general it may be said that one runs a certain amount of risk in connecting a choke across a transformer *via* a condenser; this is virtually the effect of doing as you propose.

FOREIGN BROADCAST GUIDE.

SEVILLE (EAJ 5)

(Spain).

Geographical position: 37° 23′ N. 6° 0′ W.

Approximate air line from London: 1,018 miles.

Wavelength: 368 m. Frequency: 815 kc. Power: 1.5 kw.

Time: Greenwich Mean Time.

Standard Daily Transmissions.

14.00 G.M.T., light concert or relay; 21.00, main evening programme.

Frequently relays Madrid (EAJ 7).

Male announcer. Call: (phon.) *Ay-ah rhota thinko* (EAJ 5) *oo-nay-own rah-dee-owe Say-ville-e-ya.*

Closes down with Spanish National Anthem followed by good-night greetings: *Buenas noches, Senoras y Caballeros.*

EVERYTHING The G.E.C. your guarantee ELECTRICAL

TWO NEW STARS

For 2-volt users

OSRAM L.P.2 and P.2

Power Valve *Super Power*

— with characteristics and performances unexcelled by any 2-volt valves in the world and designed for specific improvements in battery sets.

The OSRAM L.P.2 is a most efficient loud speaker valve for 2 valve sets, portable sets, and all cases where highest amplification is required with least possible H.T. consumption. The OSRAM L.P.2 will give you *more* amplification with *less* H.T than other valves of similar type.

The OSRAM P.2 is a super-power valve particularly suitable for 4 valve sets (including portables) and all cases where a large undistorted volume is required. The P.2 will produce wonderful quality of reproduction with the least expenditure of current. **Note carefully the characteristics.**

Characteristics L.P.2.

Filament volts . . 2
,, current .2 amps.
Max. Anode volts . 150
Amplification factor 15
Impedance . 3900 ohms.
Mutual conductance 3.85

10/6

Characteristics P.2.

Filament volts . . 2
,, current .2 amps.
Max. Anode volts . 150
Amplification factor 7.5
Impedance . 2150 ohms.
Mutual conductance 3.5

13/6

Osram valves

MADE IN ENGLAND

Sold by all Wireless Dealers

EXTRA QUALITY — WITHOUT EXTRA COST

Advt. of The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2

 Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.

MISCELLANEOUS ADVERTISEMENTS.

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is :

12 words or less, 2/- and 2d. for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue : 13 consecutive insertions 5% ; 26 consecutive, 10% ; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to FIRST POST on THURSDAY MORNING (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on WEDNESDAY MORNING at the Branch Offices, 19, Hertford Street, Coventry ; Guildhall Buildings, Navigation Street, Birmingham ; 260, Deansgate, Manchester ; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made ——— & Co. ——— payable to ILIFFE & SONS Ltd., and crossed Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box ooo, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. ooo, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes ; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged ; on transactions over £10 and under £50, the fee is 2/6 ; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post.

RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain's Radio Doctors. — Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

"WIRELESS World" Four, Foreign Listener's Four, or any other "Wireless World" circuit built to specification with listed components by experienced staff, work and results guaranteed.—Matlock Radio Manufacturers, Matlock House, Woodberry Grove, Finchley, N.12. 'Phone: Finchley 2837. [2358

IMPORTANT NOTICE.

Owing to the Christmas Holidays, the next issue of "THE WIRELESS WORLD" (dated December 24th) is closing for press earlier than usual.

In accordance with the Notice that appeared last week, the latest date upon which Miscellaneous Advertisements could be accepted for the above issue was FIRST POST WEDNESDAY, December 17th.

For the issue of December 31st, advertisements for these columns can be accepted not later than FIRST POST, MONDAY, DECEMBER 22nd.

Receivers for Sale.—Contd.

END of Year Clearing.—The following slightly used material is offered subject to sale; every item will be severely tested before despatch and guaranteed in workable condition; prices quoted for receivers include set of tested valves to suit; in the case of portable receivers batteries are included.

McMICHAEL Screened Dimic Three, 3 only at 10 guineas each; Bowyer-Lowe 2-valve S.W. receiver, with coils, 10 to 2,000 metres, det. and pentode, 150/-; G.E.C. 3-valve S.W. receiver, with coils, 10 to 600 metres, det. and 2 L.F., 125/-; G.E.C. World Wide Four, 2 S.G., det., power, with 2 frame aerials, 250-2,000 metres, 340/-; another, ditto, ditto, 250/-; another, ditto, ditto, 180/-; G.E.C. Screened Three, 163/-; another, ditto, 155/-; G.E.C. 8-valve superhet., frame aerial 250-2,000 metres, 250/-; another, ditto, ditto, 215/-; Truphonic 5-valve portable Melo-Set, 170/-; Selector 4-valve S.G. portable De Luxe, 290/-; Halcyon 4-valve S.G. portable De Luxe, 295/-; another, ditto, ditto, 265/-; Baird television kit, complete, 207/6; M.L. motor generator outfit, input 240 volts D.C., output 400 volts 100 m.a. and 6 volts 5 amps., complete with output smoothing equipment and cut-out, 345/-; another, ditto, ditto, 290/-.

APPLEBY, Chapel St., St. Marylebone, London. Tel.: Paddington 8828 (3 lines, private exchange). [0340

1930 Everyman Four to Specification, Ritherdon cabinet, valves, Mazda S.G.215, remainder 6-volt, complete with Blue Spot linen speaker, £14; also Ferranti B.E.M.1 eliminator, £12; all new this year.—Box 8364, c/o *The Wireless World*. [2486

MEGAVOX Receiver, S.G.-D.E.T.-P.E.N., finest components, new P.M.24A, milliammeter, tone control, pick-up switch, Exide 160 and 4-volt accumulators, working R.K. Senior speaker, perfect; £9.—Robertson, 6, Kingscote Rd., W.4. [2506

PHILIPS 3-valve A.C. Mains, cost £28; accept £20.—7, Prebend Mansions, Chiswick. [2517

EDDYSTONE and Marconi Short Wave Receivers; offers.—2a, Salisbury Rd., Seven Kings, Essex. [2510

McMICHAEL Super-screened Portable Four, 2S.G., cost £36/15, perfect condition; £18.—Haggie, Tornadee, Murtle, Aberdeenshire. [2514

SIMMONDS BROS. are Specialising on "Wireless World" Four and Other Modern Receivers; superb workmanship guaranteed; exchanges.—38, Rabone Lane, Smethwick. [2155

YOUR Old Receiver or Components Taken in Part Exchange for New; write to us before purchasing elsewhere and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St., Preston. [0226

5-VALVE Solodyne 1928 Receiver Mahogany Cabinet, Exide battery, 2-220 volts, A.C. eliminator, good order; £9.—3, Furze Lane, Purley. [2534

AMERICAN Lincoln, 2-v-2 Neutrodyne and valve, 250 to 2,000 metres, wonderfully selective; £3/5, parts worth more.—Petty, Clapham, Lancaster. [2561

STUPENDOUS Offer!!!—2-valve A.C. and D.C. receivers, new, complete!!! £4; marvellous performance!!! C.o.d.—96, Brockley Rise, S.E.23. [2539

PHILIPS 2514 3-valve Electric Receiver, 210v., not 3 weeks old, guaranteed perfect; owner making "Wireless World" Four; £16.—Manor House, Alphington, Exeter. [2544

5-VALVE Portable (National), new batteries, fully guaranteed, £8/10; 2-valve portable (Pentode) local stations—short wave—set, new batteries, £6; both equal new. Also large number "Wireless Worlds" and other radio publications, offers wanted; also quantity wire, various gauges and number of components, very cheap.—Write for particulars, Heywood, 98, Copeland Road, Ryo Lane, S.E.15. [2557

1930 5-valve Receiver, 5-watt output, 400v. eliminator, all in cabinet; cost about £80, accept £20.—Broadfoot, Roselea, Hoylake, Cheshire. [2556

ACCUMULATOR HIRE.

DON'T Buy Dry Batteries, join our service; we keep you continuously supplied with fully charged C.A.V. high tension accumulators, by regular exchanges, anywhere within 12 miles of Charing Cross, for less than the cost of unreliable dry batteries; nothing to buy—no deposit, payment on each delivery or by quarterly subscription; if your dry batteries have been in use for one month or more we definitely guarantee that accumulators will give better and more selective reception; we also give the same service with low tension accumulators or maintain your own at equally advantageous terms from the smallest portable size upwards; over 10,000 satisfied users.—Write or 'phone now to London's largest, most efficient and complete wireless accumulator service, for their interesting folder B2, post free.—Radio Service (London), Ltd., 105, Torriano Av., Camden Rd., N.W.5. 'Phone: North 0623 (3 lines). [1466

CHARGERS AND ELIMINATORS.

PHILIPSON'S Safety H.T. Supply Units are Famous for Reliability and Silent Working.

OUR New Prices Again Make Them Famous for Value; for D.C. mains model D.C.4 gives 120v. at 15 m.a., 27/6; D.C.5, 150v. at 25 m.a., 1 fixed, 2 var. tappings, 35/-; for A.C. mains model A.C.7, 120v. at 20 m.a., £3; A.C.5, 150v. at 30 m.a., 1 fixed, 2 var. tappings, £3/17/6; A.C.6, for 25 cycle mains, £5.

PHILIPSON'S Safety H.T. Supply Units are Guaranteed for 12 months; write for our booklet, "Radio Power."

PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. Phone: 2038. 'Grams: Safety, Bolton. Est. over 50 years. [0318

H.T. Eliminator Kit, incorporating Westinghouse H.T.5 rectifier, kits consist of transformer, choke, Westinghouse rectifier; required condensers, resistance, safety plugs and sockets, and baseboard; output 20 milliamps at 120 volts, 47/6, post free; metal case for same, 3/9 extra.

ELIMINATOR Kits, transformers, choke, condensers, valve, valve holder, resistance, terminals; 36/-; post free.—Fel-Ectric Radio, Garden St., Sheffield. [2049

VORTEXION Transformers and Chokes, wound to specification; best quality components only supplied.

VORTEXION No. 4 Bobbins, 1in.×1½in., 1/3, post 2d.; 1in.×1in., 1/-, post 2d.; cast aluminium end plates, 2/3 per pair, post 2d.; No. 4 laminations for 1½in. bobbins, 6/2, post 9d.; for 1in. bobbins, 4/2, post 6d.

VORTEXION, 72, Merton Rd., Wimbledon, S.W.19. Tel.: Wimbledon 2814. [0439

TANTALUM and Lionium for A.C. Rectifiers, blue prints for inexpensive H.T. and L.T. chargers.—Blackwells Metallurgical Works, Ltd., Garston, Liverpool. [1209

IGRANIC Model V208A, H.T. supply unit, 4v. charger, Universal H.T. mains, complete, accumulator and valves; cost £16, price £8.—Percy, 20, Bond St., Ealing. [2499

H.T. Eliminator Kits, 175v. 25 m.a., comprising Westinghouse H.T.6 rectifier, transformer, choke, 3 T.C.C. condensers, resistance, plug, baseboard; 41/-; lists free.—Edwards, 5, Bradford St., Chelmsford. [2500

REGENTONE W.2A. 100-120-volt mains, output 160 volts at 60 milliamps, nearly new, owner purchased all mains receiver, £4/15; Mullard H.T. unit, 100-105-volt mains, nearly new, £3; Valley L.T. and H.T. charger, 210-volt mains for 2-, 6-, and 12-volt accumulators charging up to 15 amps and H.T. accumulators at 0.1 amp, £3; all above guaranteed in perfect condition.—B. V., 10, Parsifal Rd., Hampstead, N.W.6. [2526

WESTINGHOUSE All-Metal Rectifier, 200v., 100 m.a., 9v. 2 a.m., 45 v.g.b. charge accumulators, cost over £30; offers, or exchange microscope.—W. H. Price, Reservoir House, Longsett, nr. Sheffield. [2508

ECKO All-power Unit, C.2A., 200-250-volt mains, 40-100 cycles, as new; £8/10.—Pinfold, 58, Camp Lane, Handsworth, Birmingham. [2519

SOUND SALES.—Genuine British Stalloy Stampings.

NO. 30 for "Wireless World" choke, 1½in. core, 4/6, post free; 1in. core, 3/6, post free.

NO. 4 Stalloy Stampings. 1½in. core, 6/-, post free; 1in. core, 4/2.

CLAMPS and Bolts for Above, 1/6 and 2/-.

WE Can Supply Any Wire, bobbin, terminal strips, etc., c.o.d.

"WIRELESS World" Constant Inductance Chokes; 15/-; repairs a speciality; see our speaker advertisement.

SPECIAL Filament Transformer, 200-240 volts, tapped primary, 4 volts, 4 amps., centre tapped output, metal shrouded, shockproof terminal; 15/-.

WE Guarantee All Transformers Undergo a 4-hour Test on Overload; for insulation, correct voltage and freedom from buzzing, the safety factor is ample for all requirements.

SOUND SALES, Tremlett Grove, Highgate. 'Phone: Archway 3871. [2492

BRYCE'S are Supplying Mains Transformers to Manufacturers and Constructors all over the Country.—Huge demand for AB.64, output 250-0-250v. 80 m.a., 2-0-2v. 1a., 2-0-2v. 3a., 3-0-3v. 1a.; price 24/6; post 1/-; guaranteed; order early; lists free.—Bryce's, 54, Dawson St., Bury, Lancs. [2548

Chargers and Eliminators.—Contd.

SAVAGE'S Specialise in Wireless Power from the Mains; reliable apparatus at reasonable prices.

SAVAGE'S Transformer Laminations and Bakelite Bobbins; intending home constructors should write for list.

SAVAGE'S Reliable Smoothing Condensers, 1,500 volts D.C. test, 1 mfd. 2/-, 2 mfd. 3/-, 4 mfd. 5/3; 500 volts D.C. test, 1 mfd. 1/6, 2 mfd. 2/3; 4 mfd. 3/9.

SAVAGE'S Power Chokes for the Power Pentode Two, smoothing L.C.36G, 18/-; output L.C.36P.G., 19/6; many other types available, write for list.

SAVAGE'S Mains Transformers for the New Westinghouse Units; please write for list.

SAVAGE'S New Foreign Listeners' Four Equipment.—Transformer; N.F.L.4, 33/-; smoothing choke, C32G, 20/-; output choke C32/0, 20/-.

SAVAGE'S "Wireless World" Four Equipment, mains transformer, W.W.4, 34/-; smoothing and bias chokes, type W.W.4C, 16/- each; centre tapped output choke, L.C.36P.G., 19/6.

SAVAGE'S Mains Transformer, B.T.4, 500-0-500 volts 120 m.amps., 7½ volts 3 amps., 6 volts 3 amps., 4 volts 2 amps., 4 volts 1 amp., 4 volts 1 amp., all centre tapped, specially developed to facilitate automatic bias in all stages; 57/6.

SAVAGE'S Mains Transformer, V.T.37, 250-0-250 volts 60 m.amps., 4 volts 1 amp., 4 volts 1 amp., 4 volts 1 amp., 4 volts 2 amps., all centre tapped, a useful instrument for modern receivers with automatic bias in every stage; 35/-.

SAVAGE'S Mains Transformers and Power Chokes are carefully constructed from first class materials with an exceptionally generous margin of safety; they are fully guaranteed and may be purchased with confidence.

SAVAGE'S Have Moved to Larger Premises; please note new address: 292, Bishopsgate, London, E.C.2. Telephone: Bishopsgate 4297. [1784

FERRANTI BEM1, £16/10; eliminator, £10; also other Ferranti components, cheap.—Cattanes, 97, Marylands Rd., London, W.9. [2513

MAINS Transformers, 240+240, 80 m.a., 4v. 2a., 4v. 5a., 25/-; 240v.+240v., 4v. 4a., 5v. 1.6a., 25/-; 135v., 50 m.a. 4v., 4a., 19/6; smoothing chokes, from 10/-; condensers and eliminator parts.—Challis, below.

SPECIAL Transformers Made to Specification.—Any above 7 days' approval or deposit.—Challis, 22, Park Rd., Rugby. [2531

CABINETS.

ARTCRAFT Cabinets, illustrated list free; radiograms, from 79/6; unbeatable value.—Artcraft Works, Grant Rd., Croydon. Established 1925. 'Phone: 1981. [1814

DIGBY'S Cabinets.—Table models in solid oak and mahogany; from 11/6 to 71/-.

DIGBY'S Cabinets, fitted with Radion or Resiston ebonite if required.

DIGBY'S Cabinets.—Pedestal model, with separate battery components; from 56/- to £12.

DIGBY'S Cabinets Made to Customer's Own Designs.

DIGBY'S Cabinets.—Write for new 16-page art catalogue.—F. Digby, 9, The Oval, Hackney Rd., E.2. 'Phone: Bishopsgate 6458. [0128

CABINETS for All Requirements.—F. W. Ramsey, 63, Shaftesbury St., London, N. Clerkenwell 7139. [1479

KAY'S Cabinets.—Exclusive practical models in radio and radiogram cabinets, 50% cheaper than elsewhere, used and recommended by the most distinguished and discriminating radio experts; a range of 60 designs to select from; illustrated price lists free.—H. Kay, Wireless Cabinet Manufacturer, Mount Pleasant Rd., London, N.17. 'Phone: Walthamstow 1626. [1789

CRAFTEASE Cabinets, for wireless sets and gramophones, ready to assemble or assembled; lists free.—Craftease Works, J. Mendip Industries, Winscombe. [2412

COILS, TRANSFORMERS, ETC.

TRANSFORMERS and Chokes for Battery Eliminators.—Chester Bros., 495, Cambridge Rd., London, E.2. [9706

APPLEBY Coils for "Wireless World" Four, with switches, 36/- set of four, post free; screen for above coils, 3/3 each, post free.

APPLEBY Screen Tubes for Screened Grid Valves, ventilated and insulated at cap aperture; 2/9 each, post free; suitable for "Wireless World" Four, and all modern circuits.

APPLEBY Midget Binocular, iron cored H.F. chokes suitable for "Wireless World" Four and all modern circuits; 3/9 each, post free.

APPLEBY Standard High Inductance H.F. Choke for All-purpose Use where high inductance and low self capacity are essential; 6/6 each, post free.

APPLEBY 600 and 1,000 ohms Midget Resistances for All Decoupling Purposes; 1/6 each, post free.

APPLEBY, Chapel St., St. Marylebone, London. Tel.: Paddington 8828 (3 lines, private exchange). [0343

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Coils, Transformers, Etc.—Contd.

BAND Pass Three Coils, 30/- set, "Wireless World" specification; slotted formers for winding, 8/6 set; grooved primary supports, 2/- set; all D.C. Three formers, 8/- set; decoupling resistances, 1/6 each; all post free.—Groves Brothers, Coil Manufacturers, St. Mary's Place, Shrewsbury. [2269

COILS.—Band Pass superheterodyne, complete set, 30/-; Band Pass Four, 25/-; Band Pass Three, 35/-; "Wireless World" Four, with screens, switches, 52/-; c.o.d.—Smith, 3, Park Parade, Harlesden, N.W.10 [2344

MAINS Transformers to Supply 3- or 4-valve Sets, 25/-; chokes, 15/-; these transformers give guaranteed outputs, 200v. 60 m.a. on load, quality second to none; traders and wholesalers, you need these.—Write Eric Cookson and Co., 14, Cambridge Rd., Blackpool. [2529

GRAMOPHONES, PICK-UPS, ETC.

HARLIE Pick-up, latest model, 37/- list, with volume control, unused; 25/-.—Adams, 3, Highlands Gardens, Ilford. [2511

B.T.H. Pick-up and Arm; 30/-.—89, Darfield Rd., Crofton Park, S.E.4. [2516

TRANSMITTERS.

M.16 Igranic Metal Rectifier, unused, output 7.5v. 3a., 20/-; set Colvern short wave coils, with mounts, 10/-; 20 Quartz lenses, oscillate without reaction, 3/- each, or 40/- lot.—Jeapes, 2, Salisbury Villas, Cambridge. [2536

VALVES.

AMPLIFIER Valve.—If you require power you cannot do better than one of these (or matched in pairs if required)

FILAMENT Volts 6, plate volts 400 (maximum), grid bias 84 volts (approx.), impedance 800 ohms, amplification factor 3.8, mutual conductance 4.35 m.a./volts; price now reduced to £5; see article "The Wireless World," 24th July, 1929, then send to North London Valve Co., Ltd., 22½, Cazenove Rd., Stoke Newington, London, N.16 [0341

THE Best of American Tubes, Diatron brand.—Sole agents, Perry Co., 32, Dawes Rd., Fulham. [2537

WIRE.

WIRE.—All gauges from 14 to 47, British manufacture, at less than wholesale prices; send for list.—Warbrook, Honley, Huddersfield. [2542

LOUD-SPEAKERS.

BAKER'S SELHURST RADIO 36-page Booklet, "Sound Advice is Yours for the Asking"; write now for new edition: see displayed advertisement on page 15. [0231

LATEST B.T.H. Moving Coil, 10in. cone, D.C., £5/10; Blue Spot, 66R, 26/6, as new.—Bowley, 16, Blenheim Crescent, Kensington, W.11. [2469

CELESTION Z.20, £7/15, as new, what offers?—Chapman, 93, Campden Crescent, Chadwell Heath. [2504

EPOCH Permanent Magnet Moving Coil Speaker, P.M.99; price 85/-.—Write Box 8416, c/o *The Wireless World*. [2521

MARCONIPHONE Moving Coil, 6-volt, in experimental cabinet, reproducing Tom Jones at this moment perfect; £4.—"Corone," St. Martin's, Oswestry. [2522

CELESTION Z.20 Speaker, in oak, as new, cost £8, bargain, £4/15; also 6-volt 80 actual accumulator, specially built for operating moving coil, £1/5.—Mebes, 144, Great Portland St., W.1. [2518

REALISTIC SPEAKERS, wood diaphragm, ingenious construction, unrivalled results, true to its name; chassis, 27/6, fit any unit; complete speakers, £3/10 to £25; write for particulars, demonstrations daily.—Realistic Speakers, 72, Penton St., London, N.1. [2308

SOUND SALES Specialise in Moving Coil Speaker Repairs.

SOUND SALES Supply Replacement Mains Transformers from 15/-

SOUND SALES Convert D.C. and Battery-excited Speakers to A.C.

SOUND SALES.—Amazing Christmas offer: Magnavox Little Giant moving coil speakers, complete, in oak, mahogany, or walnut finish cabinet, also special gold or fancy cabinet, guaranteed free from box resonance, 6-volt and 220v. D.C. models; £3/3; c.o.d. if required.

SOUND SALES, Tremlett Grove, Highgate. 'Phone: Archway 3871. [2365

£2.—Baker's moving coil speaker, 6v. pot, .6 amps., very sensitive.—Jamieson, Wem. [2543

BAKER'S Permanent Magnet Moving Coil Speaker, 1930 model, Camco oak cabinet, guaranteed perfect; £4/10.—"Anne Port," Hawes Lane, West Wickham. [2535

B.S.A. Kone, cost £7/7, perfect condition; £3/10.—Cannon, 20, Arbuthnot Rd., New Cross, S.E. [2533

Loud-Speakers.—Contd.

EPOCH Moving Coil Speakers.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—Have you heard the Domino model?

EPOCH.—The amazing model 101 (Domino).

EPOCH.—If you have not, take the first opportunity of doing so.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—No matter what loud-speaker you have heard, your decision will be firm.

EPOCH.—You will not hesitate, you will not ask your friend, you will not ask an expert.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—You will be glued to the spot. You will be hypnotised.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—And when you recover and find you have been awake, you will join in the Joyous Epoch Chorus, repeated frequently at each paragraph.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—The more you have studied loud-speakers the greater will be your surprise.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—A quick switch over against your favourite moving coil loud-speaker will be a revelation to you.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—You will find that the other moving coil speaker simply sounds ghastly, anæmic, weak, scratchy or wooily by comparison.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—The Domino destroys all previous standards of comparison.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—It is beyond the realm of ordinary comparison.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—The Domino is the speaker of the day.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—Has challenged the market in 3 successive seasons. The Domino is this season's challenge.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—Read what others say. The testimonials printed below are guaranteed absolutely unsolicited.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—"Gentlemen,

"YOUR 101 Domino Moving Coil Speaker Duly Received, and has now had 5 weeks' use, and my conclusion is that it is the only loud-speaker on the present market.

"THIS is My Fourth Moving Coil Speaker in 6 Months; I only wish I had seen your list before, I would then have been better off financially, as I sold a £7 popular make cabinet moving coil speaker for £2/10 to get the Domino, and I have not regretted it. Everything you claim under 'Epochisms up to date' I can substantiate. A friend of mine is ordering one of your Permanent Magnet C12 speakers today, after hearing mine. I had to wait 3 weeks for delivery of the speaker, and if I had to wait 6 months I would not have bought another, as there is nothing to approach yours.

"YOU May Use These Statements as You Wish."

EPOCH.—The amazing model 101 (Domino).

EPOCH.—"Gentlemen,

"LET me Congratulate You on the 101H in Cabinet. The speaker is streets ahead of anything we have yet handled. Its power is extraordinary, and I have never heard anything like it, and a 3-valve mains receiver is sufficient for almost any hall. On purity alone it would appeal to the music critic—in fact, it has been sold to one, a professional often appearing in public in London, and a conductor of more than local recognition.

"HOPE to be Able to Pass More Orders Through for This."

EPOCH.—The Domino is fitted with a 10in. climate proof diaphragm, weighs about 50lb., is marvellously made and finished, but costs only £6/15. Mains types are extra.

EPOCH.—Send for the new descriptive 30pp. booklet W.S.4a. It's free.

EPOCH.—Call for a comparative demonstration.

EPOCH RADIO MANUFACTURING Co., Ltd., Farringdon Av., E.C.4 (between Holborn and Ludgate Circus). 'Phone: Central 1971 (3 lines). [2472

COMPONENTS, ETC., FOR SALE.

BELLING-LEE Panel Fittings are designed to give an expert finish to any home-constructed set; catalogue post free.—Belling and Lee, Ltd., Queensway Works, Ponders End, Middlesex. [0018

COMPONENTS Lent on Hire.—Details from Alexander Black, Wireless Doctor, 55, Ebury St., S.W.1. Sloane 1655. [0329

AMMETERS.—Hot wire, 0-1, 4/-; new moving coil milliammeters, 0-5 upwards, 15/-; portable micro ammeters, 5in. scale, 0-200 upwards, 105/-; double range voltmeters, 3/6; instrument repairs and alterations of every description; send for list.—The Victa Electrical Co., 47, High St., Battersea, S.W.11. [1552

VALVE Screen, 3/-; coil screens, 2/9; choke screens, 2/6; as specified in "Wireless World" Radio Gramophone and other circuits.—The Loud Speaker Co., Ltd., 2, Palmer St., Westminster, S.W.1. [1801

CYLANITE Panel Covering, 30-1,000th in. thick, high insulation value, now obtainable in white, bronze, mahogany (large and small grain); 3/- per sq. ft.; send stamp for samples; trade enquiries invited.—Marsh and Wright, 5, Royal Arcade, Weymouth. [2387

PART Exchange.—See our advertisement under Receivers for Sale.—Scientific Development Co., 57, Guildhall St., Preston. [0228

H.T. Eliminators, 100v. A.C., output 250v., 70/-; Mullard Three, 50/-; Exide Accumulator, 6v. and 12v., good condition, 25/-; Amplion cabinet loudspeaker, new type, 30/-.—22, Porchester Sq., W.2. [2507

SALE, eliminator, 50 milliamperes and 4 volts, £4; Marconi choke, 7/6; G.E.C. pick-up, 12/6; L.F. transformers, 5/-; L.F. chokes, 4/-; 3 short wave coils, 4/-; L.T. charger, 25/-; Blue Spot speaker, mahogany, 32/6; Climax Chello speaker, 27/6.—Capper, 20, Parkers Rd., Sheffield. [2285

KILOMAG Four Type Metal Cabinet (Ritherdon), dark oak, once used, 3 dials for same (Colvern); 40/-.—Holloway, Hinton St. George, Somerset. [2505

INDUCTOR Speaker, £2/10; D.B.A. and D.B.G. Lewcos coils, £1, or nearest, as new.—Corden, Darley Abbey, near Derby. [2530

EXPERIMENTER'S Surplus, all nearly new: P.M.24B, 15/-; pair P625A, 13/-; P625, 6/6; P610, 6/-; L610, 4/6; 2 Ferranti, 25:1, 12/6 each; A.F.4, 9/-; Hypermu, 12/6; T.C.C. electrolytic 2,000 mfd., 8/-.—Renall, "Winton," Salisbury Rd., Leigh-on-Sea, Essex. [2528

A.C. Eliminator, 200/250 volts, 60 milliamps., full wave 70/-; Burndept pick-up, previous type, 10/-; Dix onemeter, with shunts, multipliers, 42/-; noiseless portable typewriter, £7.—10, Dryden Avenue, Southend-on-Sea. [2501

VALVES.—Philips 506K.F.W. rectifiers, Mullard 154 V.A.C., P.M.24A, 10/6; P.H.256, P265, 6/-; Vatea H.F.406, R.X.406, 3/-; unused Octron 210R.C., Cleartron 210R.C., 210H.F., 3/3; 215P, 3/9; all perfect, full emission.—Pepper.

TRANSFORMERS.—Brown A, 16/-; Burton, 6/-; Fotos, 3/-; Telsen Ace, 4/9; Ferranti, O.P.4C, 12/6.—Pepper.

LOUD-SPEAKERS.—Magnavox Senior Dynamik, D.C. mains, £4/10; Baby ditto, £2/10; Brown H4, 8/6.—Pepper.

SPEAKER Units.—P.R. cone, 4/6; Ediswan balanced armature, Amplion A.U.6, 12/6; Friho phones, 4/-.—Pepper.

COILS.—Lewcos D.B.G., 12/-; C.T.150, C.T.200, 2/-; A.M.S.4, 3/6; S.P.A., 2/6; S.P.T., 3/-; Wearite Titan, 6/9; Ferranti S.G.3, 12/6 per pair; set Igranic, 8/6; Lissenagon 25, 35, 50, 1/3; R.I. superhet. kit, 20/-.—Pepper.

CONDENSERS.—Marconi Triple Gang, 10/6; Ormond No. 3, 0.0005, 3/9; friction controls, 3/9; Brookmans 0.0005, 2/-; Lotus 0.00015, 2/-; Lissen, Keystone 0.0001 reaction, 2/6; 0.0002 S.L., 2/-; 0.0005 S.M., 2/6; Lamplugh 0.0005, 2/6; Jacksons 0.0003, Hammarlund 0.0003, 4/-; Utility 0.0002 S.M., 5/-.—Pepper.

CHOKES.—H.F. Lissen, Detex, Marconi, Binocular, 2/9; Climax, 3/9; Calton Stewart, 1/3; Marconi bypass units, 3/6,—Pepper.

PICK-UPS.—Vivavox, 12/6; Ediswan, 7/6; Revelophone (arm damaged), 10/6; Lotus remote-controls, 12/6; G.R.366 eliminator choke, £1/7/6; 25 henry ditto, 6/6; Exide accumulators, WPO3, 6/-; CZ4, 8/6, used few weeks; D.F.G., 3/6. Above perfect unless stated otherwise. Post free over 10/-. Send requirements.—Pepper, Wakegreen Rd., Birmingham. [2520

AMATEUR'S Surplus.—Large Blue Spot chassis, 3/-; Camco suitcase cabinet, 15/-; 2 Ferranti A.F.3, 15/- each; 1 Ferranti O.P.1, 12/6; 2 Formo 0.0005 condensers, 2/6 each; Ormond 0.0005 condenser, 3/-; Peto-Scot 0.0001 reaction condenser, 2/-; Peto-Scot neutralising condenser, 2/-; Tunewell panel mounting anode coil (unused), 7/-; 4 T.C.C. condensers, 2mfd., 2/- each; 5 ditto, 1 mfd., 1/6 each; 3 ditto, 0.01 mfd., 1/6 each; Wates 3 in 1 meter, 4/-; Dubilier, H.F. choke, 2/6; 4 10 ohm rheostats, 1/- each; 2 S.G. Patex valve holders, 1/- each; 8 Benjamin 3 W.B. valve holders, 9d. each; 100ft. aerial wire, 1/-; 400 ohm potentiometer, 1/-; unbored polished panel, 36×8, 2/-; 6 gridleak holders, 6d. each; 100,000w. Mullard resistance, 2/-; ¼ megohm Dubilier resistance, 2/-.—D. M. Drew, Doon Hill, Newton Stewart. [2540

Components, Etc., for Sale.—Contd.

66P, as new, perfect, 14/6, post free.—Lowson, Watling Rd., Bishop Auckland. [2560

SECOND-HAND Goods, all tested and guaranteed; any c.o.d. or "Wireless World" deposit system; callers any time; 'bus stop outside door, alight Fitzalan St.

6-VOLT Valves.—P.M.5x, 3/-; P.M.5b, 3/-; P.M.256, 4/-; L.S.5, 8/6; P.M.1 H.F., 3/9; Radion power, 2/6; S625 and holders, 5/6.

BLUE Spot Pick-up, type 88, 43/-; Marconi, 43/-; Harlie wave trap, 5/-; pair Wearite S.G. binocular coils, 15/-; Watmel cone unit, 8/9; Lissen coil holder, 3/-; pair Peto Scott H.F. coils, 9/6, for portables.

RETAILER'S Bankrupt Stock, only a few left.—Garrard D.S. motors complete, No. 10a; list 53/6, my price 33/6.

OSRAM L.S.5 Valves, 16/6; Mullard D.F.A7, 16/6; Philips 506 H.T. rectifier valves, 12/6, Osram U8, 15/-; all unused.

MULLARD Permacore Transformers, 10/6; Cossor 10/6; Ferranti A.F.3c, can be used as ordinary, 16/6; Ferranti O.P.M1, 16/6.

HYDRA Fixed Condensers, only a few left.—2 mfd., 650v. test, 2/2; 2 mfd., 500v. test, 1/10; 4 mfd., 500v. test, 3/6; 4 mfd., 375v. working, 4/6 (500v. A.C. test); 4 mfd. 500v. working, 6/-; 1 mfd., 700v. working, 3/-; Polymet 0.0003, 6d.; ditto, 0.01, 1/-; 0.001, 7d.

WATMEL H.F. Chokes, 1/6; Wearite 4-pole rotary switches, 2/9; large Precision valve holders, 7d.; gridleak holders, ebonite, 3d.; Lotus 0.00034 reaction condensers, 3/6; Cossor L.F. transformers, 8/6; Telson Ace, 3-1, 5/6; Ediswan ½ meg. leaks, 7d.

GRAHAM-FARISH Resistances, 2, 3, 4, 5,000 ohms and 100,000, 1/6 each; ditto, 250,000, 300,000 and 500,000 ohms, 1/- each; Ediswan valves, H.F.210, 5/6; R.C.C.210, 4/9; power 215, 7/-.

H.T. Eliminators, for A.C., 200 to 250v., gives 30 m.a., at 200v., metal rectifier, all insulated, 8 fixed tappings, full wave; £3/17/6, carriage free; impossible to touch a live part.—G. A. Ryall, 182, Kennington Road, London, S.E.11. [2546

WIRELESS Transmitting Sets for Morse or Distant Control of Models, complete and perfect, 12/6; high note buzzers, 3/6; heavy Morse tapping keys, with points, 4/-.—Below.

2-VALVE Transmitters for Speech or Music, new and complete, less valves, 15/-; potentiometers, 300 ohms, 3/6; L.F. transformers ratio 5:1, 2/6 each; large earphones, 1/3, 1in. spark coils, complete and working, 6/6; Ford ignition coils; 4/-; H.F. chokes, 1/-; Dewar switches, 1/-.—Below.

ELECTRIC Motors 1/16 to 1/8h.p., 110v. and 200v. D.C., silent running, carbon brushes, in perfect condition and working order, suitable for television, gramophones, or any small power purposes, 10/- each; a few with overheated windings, if rewound make good dynamos for H.T. accumulators, 5/- each.—Below.

D.C. Electric Motors, carbon brushes, ¼ to ½h.p., 110 volts, 25/-; ½h.p., 220v., 50/-; 6v. and 12v. car starter motors, 10/-; 110v. D.C. motor blower, 50/-; smaller ditto, 40/-.—Below.

CHARGING Dynamos, shunt wound, 50v. 4a., 35/-; 100v. 3a., 40/-; 20v., 6a., 35/-; water motor wheels, 8in. diameter, 4/6 each; hand telephones, 5/-.—Below.

MICROPHONES for Speech or Music, 2/6; microphone transformers, 2/6; button microphones in case, 1/6; new loud-speaker bobbins, 1,000 ohms each, 1/3 pair; P.O. hand generators, 80 volts 10 m.a., 6/6.—Below.

SHUNT Regulators to Carry 10 amps., 10/-; motor starters, make good shunt regulators or resistances for accumulator charging, to carry 3 amps, 6/-; to carry 6 amps., 8/-.—Below.

ALL Above Goods Guaranteed, cash with order or c.o.d., 3 days' approval from date of delivery; all letters answered and orders despatched per return; full descriptive list now ready.—Galpin, 1, Queen's Rd., Peckham, London, S.E.15. [2550

BANKRUPT Stock.—Two 9-valve gramophone amplifiers, by Dominion Gramophone Co. (foreign) suitable for demonstration work, using the following:—Three stages of push-pull, using Ferranti transformers, Pye chokes, B.T.H. pick-up arms, 2 Kolster-Brandes electric gramophone motors, Universal, Weston meters, M.L., H.T. and L.T. smoothing equipment, in metal cases, size 33in. high, 19in. wide, 36in. long, as new, in working order, suitable for A.C. or D.C. when worked by motor generator; can be heard working any evening, 4.30 to 6.30 p.m., or by appointment; £17/10 each.—Below.

DITTO, two 7-valve resistances and choke coupled in similar cases; £16/10 each.—Below.

ONE Samson 15-valve Amplifier, using 3 stages of push-pull, P.A.M. 16 type; £18.—Below.

TWO Control Panels, containing 3 Weston milliamp meters, model 506, 0-300, 0-100, 0-50, volume controls, switches, etc., 70/- each; two ditto, 0-300, 0-100, etc., 70/- each.—Below.

SIX Kolster-Brandes Electric Gramophone Motors, Universal voltage, including turntable; 32/6 each.—Below.

FOUR Control Panels, containing one Weston milliampmeter, model 506, 0-300 m.a., volume control, switches, etc.; 25/- each.—Below.

TO Callers.—A large quantity of various gear, dismantled from large amplifier, at bargain prices; 4.30-6.30, evenings.—'Phone: Royal 8546. Franks, 42, St. George's St., Cannon St. Rd., London, E.1. [2559

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Components, Etc., For Sale.—Contd.

FIVE T.C.C. Mica Condensers, 0.10 mfd., 4/- each; Ferranti A.F.5, 20/-.—Langford, Winsley Sanatorium, Bath. [2532

AMATEUR'S Surplus Components for Sale; list.—Box 8422, c/o *The Wireless World*. [2551

WESTINGHOUSE H.T.1, 47/-; Ferranti mains transformer, E.M.1, 17/-; Metvick filament transformer, 4v., 5 amps., 16/-; A.C. P, 9/6.—Gleed, Optician, Raynes Park. [2541

MARCONIPHONE Ideal 2.7 and Varley 6 Terminal Transformers, Brown Vee and Ormond cone units, half list prices; R.I. volume control. 3/-; Dubilier R.C.C. unit, 3/-.—43, Gibson Square, London, N.1. [2555

WESTON A.C. Ampmeter 0-1 amp., 6in. dial, 20/-; D.C. ampmeter, 0-10 amps, 3in. dial, 11/-.—Alex. V. Simpson, 28, Westgate, Burnley, Lancs. [2554

FERRANTI A.F.5, 17/-; Litz Everyman coils, 8/6 pair.—Carter, 3, Grange Rd., Kenton, Harrow. [2538

MISCELLANEOUS.

ALEXANDER BLACK.

THE Original Wireless Doctor, will call (London and Home Counties) and cure your set.

CONSULTATIONS by Appointment without Obligation; sets installed, maintained and brought up to date; components and McMichael portable sets on hire; purity reproduction specialists.

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EASY Payments.—We supply, by easy payments, components, accessories, and sets, any make; 10% down, balance spread over 11 months.—Send list of requirements to London Radio Supply Co., 11, Oat Lane, London, E.C.2. [0337

WIRELESS Notes.—A monthly service of information for all those who want the very best in wireless or gramophone reproduction; frank criticism of receivers and components; immediate postal help and advice in all difficulties; something new and unique; you must have it if you want to know the truth.—Full particulars free from Ernest H. Robinson, Langmead, Pirbright, Woking, Surrey. [1979

SCOTT SESSIONS and Co., Great Britain's Radio doctors, officially appointed as wireless repairers by Radio Society of Great Britain and Wireless League; old sets of every type repaired, rebuilt, modernised; send set for immediate quotation.

SCOTT SESSIONS and Co.—New sets constructed with your or our components, guaranteed finest workmanship; we specialise in "The Wireless World" circuits; remember we have satisfied customers throughout the British Isles and in three Continents; if you so desire, we will design and construct high grade apparatus to suit your especial circumstances for quality, range and selectivity.—Tel.: Tudor 5326. Muswell Hill, London, N.10. [0262

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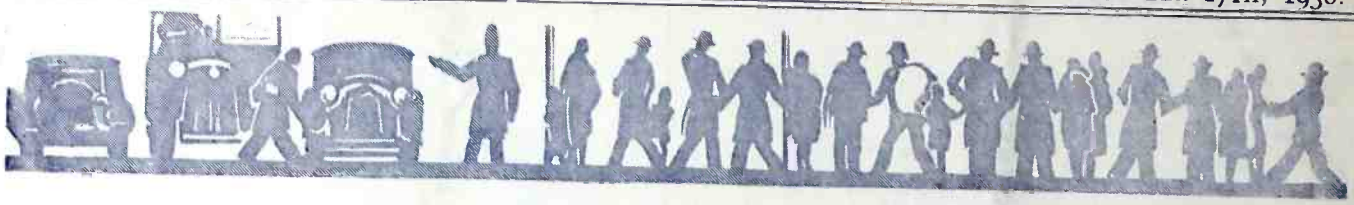

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Colonial and Foreign Agents:
UNITED STATES—The International News Co., 131, Varick Street, New York. FRANCE—W. H. Smith & Son, 248, Rue Rivoli, Paris; Hachette et Cie, Rue Réaumur, Paris.
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