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A NEW SERVICE TO OUR READERS.

MANY of our readers, at some time or other, must have come face to face with the fact that a set which they have built for their use either from their own design or from designs given in *The Wireless World* is legally an unsaleable article, the reason being that the majority of receivers to-day make use of patents, and unless the builder of a set is licensed under those patents he is not legally permitted to offer the set for sale. A set once built must, therefore, be scrapped, and only the components can be disposed of, but not the set as a whole.

The only alternative to dismantling is the illegal one of selling the set privately to a friend who can be trusted not to give away the circumstances under which the set was purchased. Apart from being illegal, this method of disposing of a set is unsatisfactory, as it is necessary for the would-be seller to find a buyer privately, for he cannot advertise the set for sale without the risk of being discovered by those whose patents would be infringed.

In view of these circumstances, we feel sure that our readers will be pleased to know that *The Wireless World* has been able to make arrangements whereby the sale of unlicensed home-built apparatus can be legalised, provided that the sale is effected through the columns of *The Wireless World*. The arrangement is this: That any reader who desires to dispose of a set he has constructed can advertise the set in the small advertisement columns of *The Wireless World*, the advertisement appearing under a box number. The arrangements will be precisely the same as those already in force under the deposit system which is a feature of the advertisement organisation of *The Wireless World* and details of which are given at the heading of the small advertisement columns.

The Wireless World will undertake to deduct from the amount realised on the sale, which will be deposited with *The Wireless World*, the proportion which is due as a royalty payment in cases where it is customary amongst manufacturers to pay royalties, and the balance will be passed to the seller after the sale has been effected.

Should no sale be effected, no royalty charge will, of course, be made. In the event of a sale being realised, *The Wireless World* will issue to the purchaser a certificate indicating that royalty has been paid on that particular receiver, and thereafter the set becomes a saleable article and may change hands freely.

We believe that in introducing this scheme for legalising the sale of home-constructed apparatus we are providing a means for clearing up a position which has been unsatisfactory to everyone concerned and has virtually existed from the time that the home construction of experimental receivers first became popular. It will assist the constructor to get back some of his expenditure on apparatus and so enable him to purchase new components and construct new apparatus which he might have hesitated to build unless a means had been provided for him to recover some of the expenditure on other apparatus.

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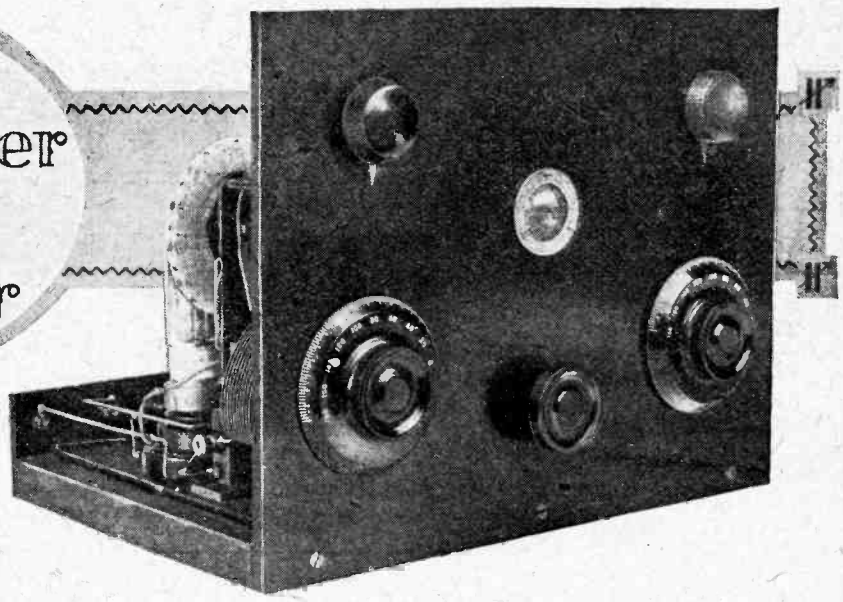
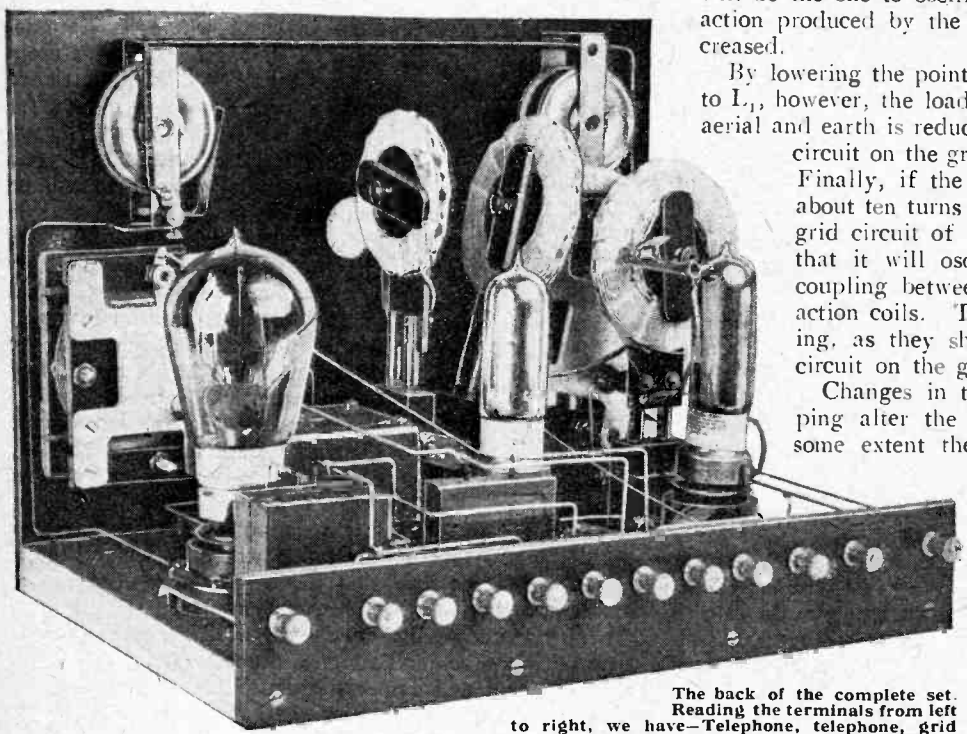
Auto-Transformer Coupled Receiver



A Three-Valve Receiver with Selective Tuning Arrangements.

By W. JAMES.

IN the ordinary receiver which has a plain tuned anode or tuned transformer coupling between the high-frequency amplifier and the detector, it is a fairly difficult matter to get selective reception with stability. The selectivity can be improved, and the load on the grid circuit of the first valve altered by connecting the aerial to a tap on the tuned grid coil L_1, Fig. 1. If we consider for a moment that a tuned anode circuit is connected in the output of the first valve, V_1, as it would be if the plate of V_1 were joined to the junction of coil L_2 with condenser C_4, we can see what effect the position of the aerial tap has on the behaviour of the receiver.



The back of the complete set. Reading the terminals from left to right, we have—Telephone, telephone, grid battery — and +, H.T.+ 3, 2 and 1, H.T.—, L.T.— and +, earth and aerial

Effect of the Aerial.

With the reaction coil L_3 coupled to L_2 to give positive reaction, and the aerial and anode circuits tuned to a signal, energy is transferred from the plate to the grid circuit by capacitative coupling, the capacity being that between the grid and plate circuits. If the aerial is connected to the top of L_1, probably the anode circuit will be the one to oscillate first as the amount of reaction produced by the reaction coil L_3 on L_2 is increased.

By lowering the point where the aerial is connected to L_1, however, the load put on the grid circuit by the aerial and earth is reduced, and the effect of the plate circuit on the grid circuit is more pronounced. Finally, if the aerial is connected to include about ten turns of a seventy-five-turn coil, the grid circuit of V_1 will be so lightly damped that it will oscillate with a much looser coupling between the tuned anode and reaction coils. These experiments are interesting, as they show the effect of the anode circuit on the grid circuit.

Changes in the position of the aerial tapping alter the selectivity, stability, and to some extent the signal strength, and for a given aerial and earth there is one point for connecting the aerial which will give best results.

Effect of the Anode Coil.

Turning now to the tuned anode circuit, remove the connection between the plate of the H.F. amplifying valve V. and the junction of

Auto-Transformer Coupled Receiver.—

L_2 with C_4, and connect it to a point on L_2, as in Fig. 1. It will be noticed that as the number of turns between the tapping and the fixed potential end (H.T.) of L_2 is reduced, the sharpness of tuning increases, and less reaction is required to cause the circuit to oscillate. We have, in fact, an auto-transformer, the portion of L_2 between the tapping and +H.T. terminal being the primary, and L_2 C_3 the secondary, circuit. As the H.T. end of L_2 C_3 is connected by a condenser C_2 to the filament, L_2 C_3 is virtually joined between the grid and filament of the detector V_2; C_4 and R_1 being, of course, the grid condenser and leak.

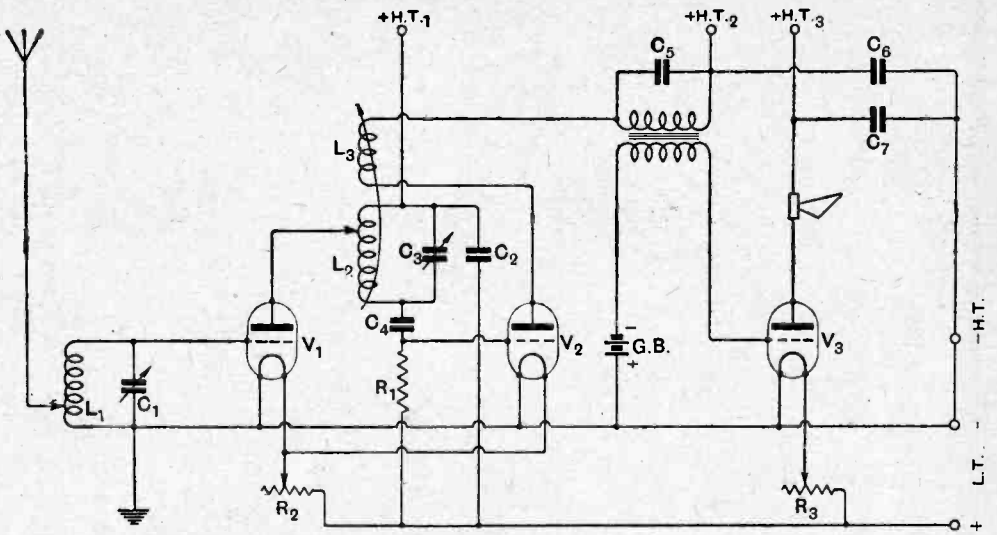


Fig. 1.—Theoretical connections. C_1 = 0·0005 mfd.; C_3 = 0·0003 mfd.; C_4 = 0·0002 mfd.; C_2 = C_5 = C_7 = 0·125 mfd.; C_6 = 0·001 mfd; R_1 = 2 megohms.

By altering the tapping points of the aerial and plate coupling has a good deal of effect on the behaviour of the circuit as a whole.

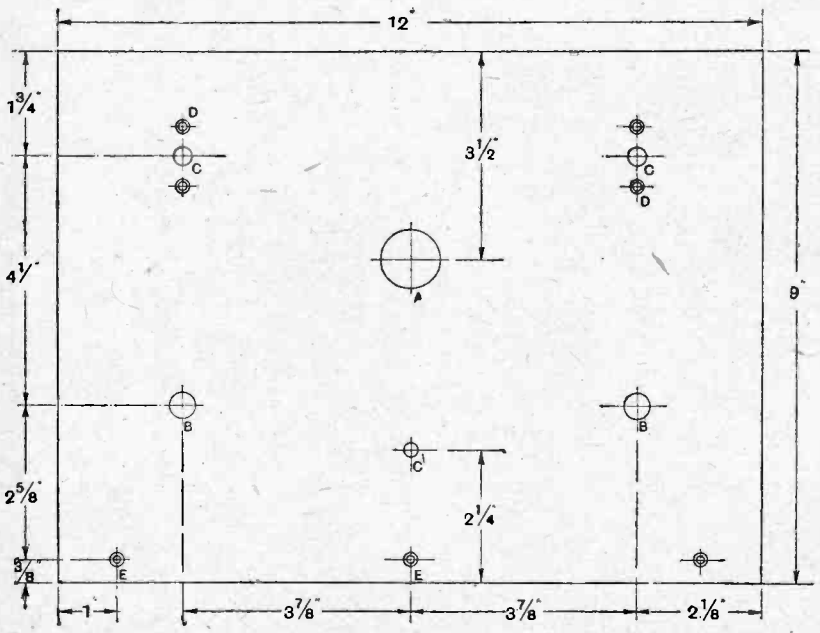


Fig. 2.—Scale drawing of ebonite front panel. A = 1in. dia.; B = 7/16in. dia., C = 5/16in. dia.; D = 4 B.A. clearance holes, and countersunk; E = 1/8in. dia., for No. 4 wood screws.

on coils L_1 and L_2 respectively, we can produce a number of interesting effects, and adjustments can be made to give a degree of selectivity and signal strength not possible with the usual direct-coupled aerial and anode circuits. Even when magnetic coupling is negligible, anode and grid circuits are coupled by the capacity of the electrodes of the valve, the capacity formed by the sockets of the valve holder, and by circuit wiring, and this capacity

Importance of Ample Grid Bias and Plate Voltage.

The remaining portion of the receiver consists of an intervalve transformer, grid battery, and the output valve V_3. A grid battery of ample voltage is, of course, essential; one of 4½ volts will probably be suitable for use in a receiver of this type. The value of plate voltage applied to V_3 should be carefully chosen to suit the grid bias, and will depend on the type of valve. If the valve is of the D.E.5 type, a plate voltage of 120 will be necessary. A convenient arrangement would be to use 60-milliampere type valves in V_1 and V_2, and a power valve, such as the D.E.4, in V_3.

How to Build the Set.

The receiver is built in a simple but effective manner. On the ebonite front panel (Fig. 2), which measures 12in. × 9in. × ¼in., are mounted the two tuning condensers C_1 and C_3 (0.0005 and 0.0003 mfds respectively), and the two filament resistances. Of these, R_2 controls two valves, V_1 and V_2, and may have a resistance of 30 ohms if 60 *m*A. valves are to be used, or 4 ohms with valves such as the D.E.R. or D.E.5; R_3 controls the

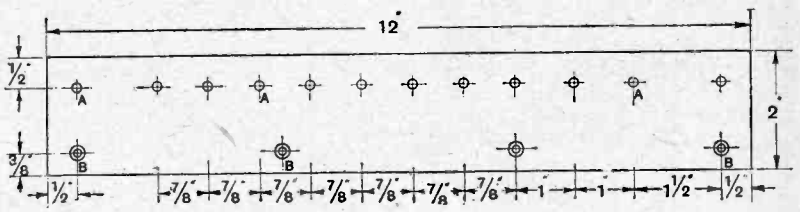


Fig. 3.—The terminal strip A = 4 B.A. clearance holes; B = 1/8in. dia

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power valve V_3, and its resistance should be chosen to suit this valve.

Mounted on the baseboard, Fig. 4, are the three valve holders, a single coil holder for L_1, a two-coil holder for L_2 and L_3, the grid condenser and leak C_4 R_1, the intervalve transformer with its bye-pass condenser C_5, the three large condensers C_2, C_6, and C_7, and the terminal strip. The terminal strip measures 12in. × 2in. × ¼in., and carries 12 No. 4 B.A. terminals, as indicated in Fig. 3. It will be observed that the two-coil holder is mounted at an angle with the baseboard; this is to allow a larger movement of the reaction coil, and is effected in this receiver by bending the brass feet used as supports to a suitable angle. The aerial coil is fixed at right angles to the anode and reaction coils to prevent magnetic coupling.

The mounting and fixing of the parts should present no difficulty, but it is as well to assemble the panel and baseboard to be sure the parts clear, and that the condensers have free movement. Basket coils are employed as tuning inductances, and these can be purchased or made to fit in the space available.

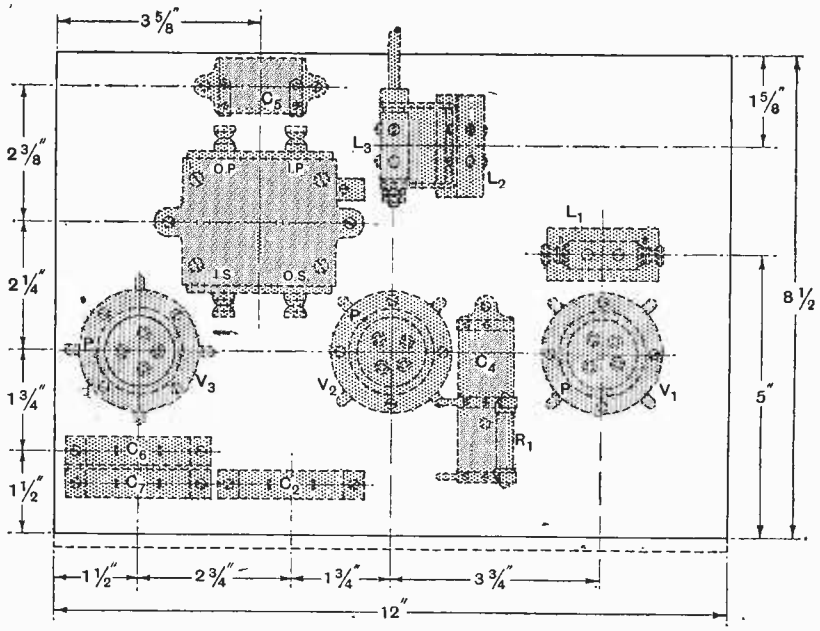


Fig. 4.—Arrangements of parts on the base.

Wiring the Receiver.

Wiring is best commenced with the panel removed from the baseboard. It is convenient to use No. 16 tinned copper wire, which should be well stretched before being cut into suitable lengths. Run the grid and plate wires in as clear and short a path as possible; then put on the longer wires connecting the terminals on the connection strip to the set. Some of these should be covered with

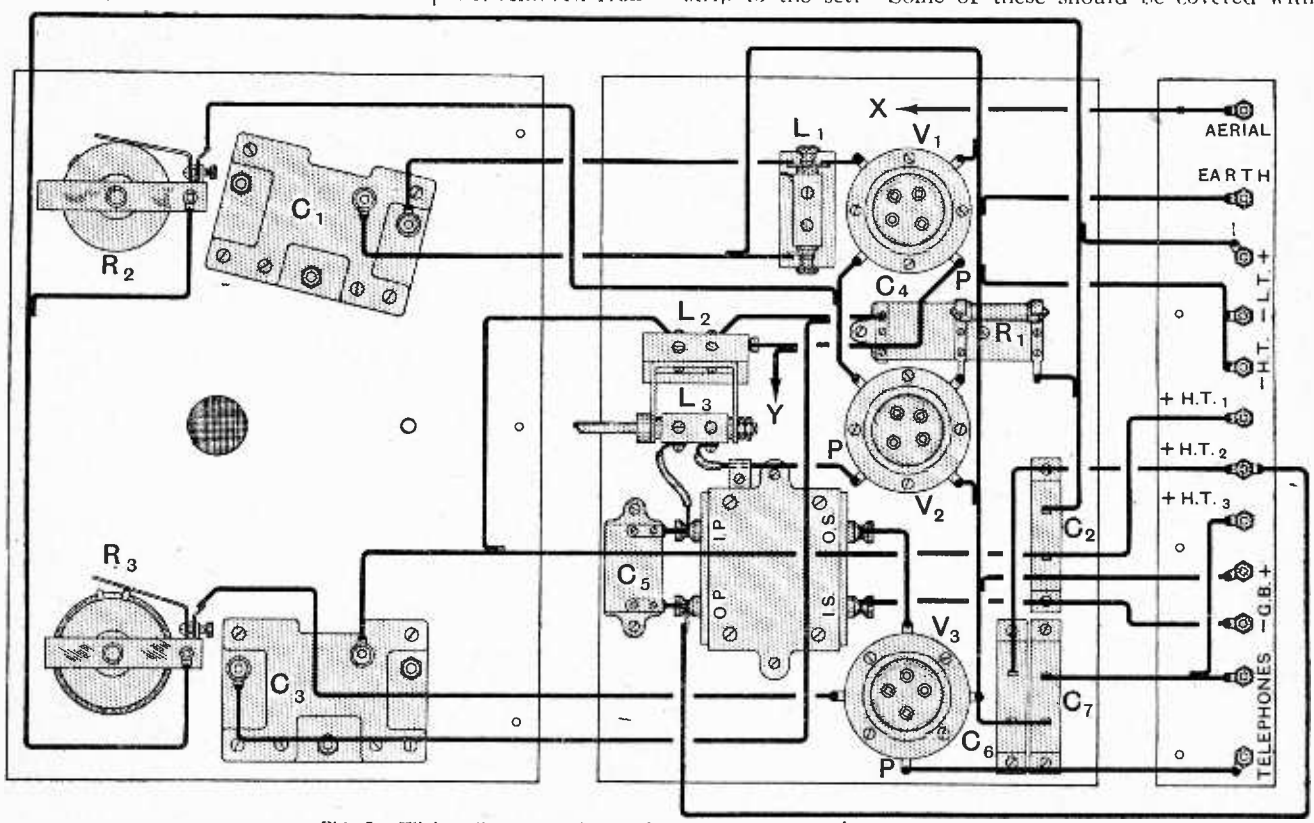


Fig. 5.—Wiring diagram. Connection X taps on coil L_1, and Y on coil L_2.

COMPONENTS REQUIRED.

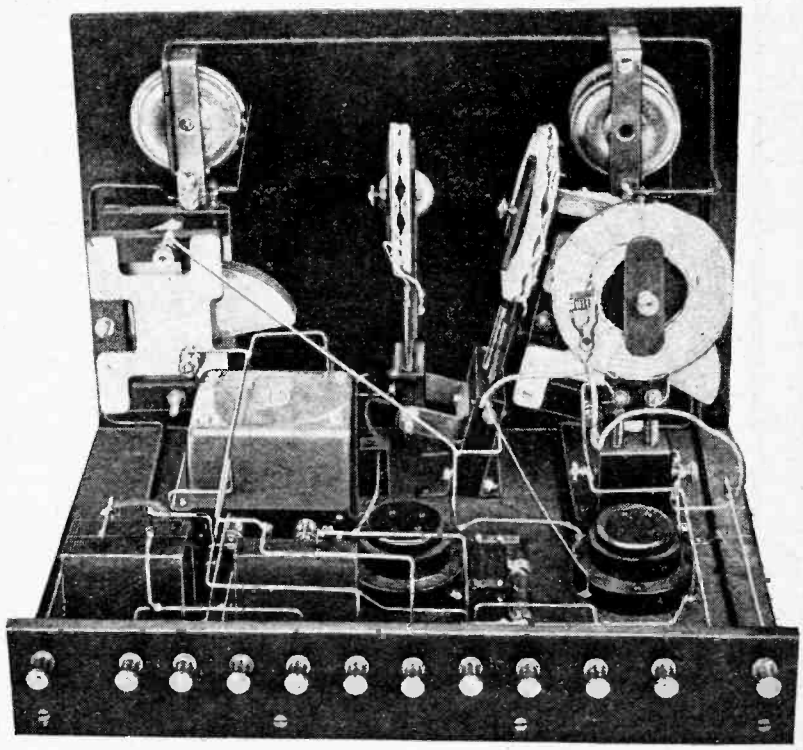
1 0·0005 mfd. square law tuning condenser (Ormond).
1 0·0003 mfd. square law tuning condenser (Ormond).
1 4 ohms filament resistance (Igranic).
1 30 ohms filament resistance (Igranic).
1 2 coil holder (Peto Scott).
1 Single coil holder.
1 First stage (low ratio) transformer (Gambrell).
3 Anti phonic valve holders (Burndept Wireless).
3 0·125 mfd. Mansbridge condensers (T.C.C.).
1 0·0002 mfd. fixed grid condenser (Dubilier).
1 0·001 mfd. fixed condenser (Dubilier).
1 2 megohms grid leak with mounting base (Dubilier).
1 Valve window.
1 Ebonite panel, 12in. × 9in. × ¼in.
1 Ebonite terminal strip, 12in. × 2in. × ¼in.
1 Baseboard 12in. × 8½in. × ¾in.
12 No. 4 B.A. terminals.
2 Sets of Reactone basket coils.
3 Basket coil holders.

systoflex sleeving. The wire which is used for connecting the aerial terminal to the tap on coil L_1 marked X in Fig. 5 should be a stiff wire for part of its length, and may be held with an ebonite cleat. To the free end of this stiff wire join a short length of insulated flexible wire and a clip for experimental purposes. In the case of the plate wire from V_1, which connects to a point on coil L_2, it is convenient to run a stiff wire from the plate to a tag held by a screw put into the side of the fixed coil holder L_2, and to solder a flexible wire to the tag.

Finish off the wiring with the panel and baseboard assembled, taking care to run the wire in such a manner that the condensers and reaction coil do not foul any of them

Two sets of Reactone basket coils were obtained, and two 75-turn coils chosen for L_1 and L_2. These were tapped at the fourth, fifth, sixth, seventh, and eighth layers by soldering short lengths of bare wire. A 50-turn coil was used for reaction.

A D.06 L.F. valve was used in the H.F. stage, and another one of this type in the detector, with a D.E.4 in the L.F. stage. Suitable voltages are 4 for the filament, 50 for the H.F. and detector valves, 120 for the L.F. valve, and 4½ volts grid bias. When the set is adjusted, it will be found possible to tune in a number of stations at good strength, and the set is one to be recommended to those who like to make a few adjustments which will enable them to get the degree of selectivity combined with good signal strength which they find desirable in their own particular circumstances.



Most of the wiring can be seen in this view. The two flexible wires have a clip soldered to their free end.

GERMAN WIRELESS DEVELOPMENTS.

WHILE since 1918 England has made little progress with Empire and long-distance wireless, Germany has put in operation a complete system of world wireless communications. Her network is now complete and ready to be used for distributing news and propaganda, and for commercial purposes.

Germany organised her new means of communication on scientific lines, conquering one country after another. A service began with America in 1919. By the autumn of 1920 it had developed considerably, and a large volume of daily messages was sent from the German high power stations at Nauen, near Hanover, and from Eilvese, near Berlin, to Marion and Rocky Point, near New York. Messages were relayed from these stations to Central and South America and beyond. The rates are less than the cable tolls. Wireless letters are sent at a third less than the ordinary rates, and half rates are charged for deferred messages.

The methods of transmission and reception in Germany have been carried to a high state of perfection, and it is expected before long that there will be uninterrupted day and night services. So satisfactory has been the German experience of wireless during the last few years that wireless is regarded not only as supplementing cables but as a substitute for cables.—*Sir Robert Donald, in "The Daily Telegraph."*

DISTORTION IN AMPLIFIERS.

Some Measurements on L.F. Valve-Couplings for Broadcast Receivers.

By G. W. SUTTON, B.Sc.

IT may safely be stated at the present day that the satisfactory reproduction of speech and music through a broadcast receiver and loud-speaker is almost entirely a question of design and adjustment of the amplifier. The quality of the transmission, at least from the English stations, leaves little to be desired, though observers situated in the Midlands, where several stations may be compared under fairly uniform conditions, may appreciate some difference between them at times. Rectification, either by a crystal detector or on the lower bend of the anode current characteristic of a valve, calls for little adjustment and introduces unnoticeable distortion. [The "cumulative grid" method, while being more efficient than the latter on small voltages, begins to distort appreciably when larger voltages are applied, as one would expect from the shape of its rectification characteristic.] Some loud-speakers, too, in the writer's opinion, are far from being the "weakest link in the chain," despite their recognised inefficiency at the lowest frequencies.

Distortion Due to Valve Couplings.

We are left, then, with the amplifier, valves and couplings, and this, we feel sure, is the most frequent source of distortion. It is perhaps natural to blame the loud speaker for objectionable reception as it is the source of the sound, and it has frequently surprised the writer to compare the performances of the same instrument on well and badly adjusted amplifiers. Too much stress cannot be laid on the necessity for the correct adjustments of the anode voltage and mean grid potential of the amplifying valves. Unless these are such that the portion of the valve characteristic employed is reasonably straight and that no appreciable grid-current flows during even a fraction of the grid potential excursion corresponding to the loudest received note, noticeable distortion is bound to be introduced. In practice neglect of these precautions leads either to "woolliness" or "rattle," and as these effects make themselves apparent at the loud-speaker, this unfortunate component is frequently blamed.

The principle underlying the operation of all forms of coupling is, first, the provision of a large impedance in the anode circuit of a valve to convert fluctuations of anode current into corresponding changes of potential, and, secondly, some device to transfer these changes to the grid of the next valve without allowing the D.C. anode voltage of the first valve to influence the mean grid potential of the second. If the impedance takes the form of a resistance then the only available method of sorting out and handing on the A.C. voltage is by means of a condenser and grid-leak. The resistance itself has already been briefly discussed in a previous article, and the advantages and drawbacks of the method are fairly well appreciated.

The point about which there seems to be most uncertainty is the magnitude of the condenser and leak. This has been discussed theoretically by Mr. Colebrook,[1] and he suggests 0.05 mfd. and 0.25 megohm respectively, and incidentally points out the necessity for very high insulation resistance in the condenser. It is therefore desirable to use a good mica condenser for the purpose. Various values of capacity are used by different writers, varying from 2 mfd. on the one hand to 0.005 mfd. on the other. If we grant the necessity for a mica dielectric, the question is one of balancing first cost against the lower frequency it is necessary to by-pass without undesirable diminution of amplitude. In this connection it must not be overlooked that the efficiency of reproduction of even the best modern loud-speaker falls off rapidly in the neighbourhood of $100f$-$50f$, and that, despite this, the bass notes of instruments, particularly the piano, can be made to "come through" in a by no means unsatisfactory manner.

It would appear, therefore, to be unnecessary to strain after perfection in the amplifier at the lowest frequencies, and that we may rely on the accommodating latitude of the human ear to an appreciable extent. The difference in cost of mica condenser of 0.01 and of 0.1 mfd. or more is worth considering, and the following tests indicate that the smaller value, used in conjunction with a 1 megohm leak, is inappreciably inferior to a 0.1 mfd.

Choke and Transformer Couplings.

If a choke of suitable inductance is used in place of the resistance there are two alternative methods of coupling available, namely, the before-mentioned condenser and leak, and an inductively coupled secondary winding. In the latter case the choke becomes a transformer, and the possibility of winding more turns on the secondary than the primary and so obtaining a step-up of voltage at once suggests itself. Although this possibility is a valuable one it can be overdone, and there are other methods of attaining high amplification which are in some ways preferable. It would appear that much of the trouble with poor intervalve transformers is due to the manufacturers using too high a ratio of turns That this does not necessarily mean a corresponding voltage ratio the following tests show very clearly.

In order to obtain a high ratio with economy of material the temptation to reduce the number of primary turns below that which will ensure a suitable value of primary inductance is very strong. With large ratios, too, there is increased possibility of the grid-filament impedance of the ensuing valve, which is, of course, negative under certain operating conditions, affecting the overall amplification. This in practice introduces a "rattling" quality into louder notes and may even set up persistent oscillation. It may be counteracted by placing a resistance of 0.5 to 2 megohms across the

[1] *Experimental Wireless*, Vol. I., No. 12. Sept., 1924.

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transformer secondary, or by winding a few short-circuited turns somewhere on the iron core, but by so doing the voltage ratio is materially reduced and so the object of the high turns ratio defeated.

It is suggested that we regard the intervalve transformer as an inductively coupled choke with the definite purpose of reminding us that it performs two separate functions (*a*) of extracting a voltage from the anode circuit of one valve, and (*b*) of stepping this up and handing it on to the next. Unless the primary inductance is sufficient (at least 20 henries for most valves), it will not

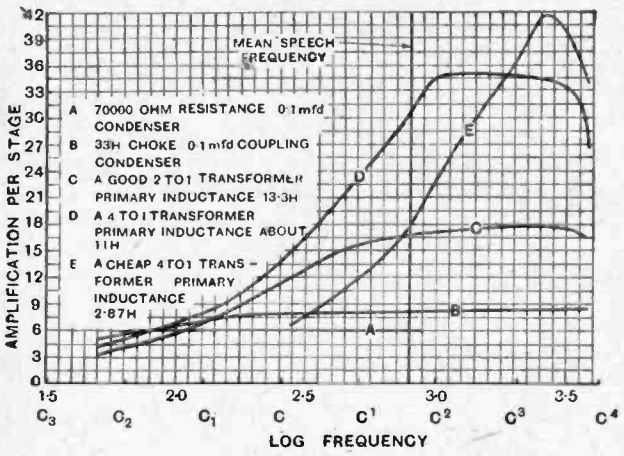

Fig. 1.—Comparison of several transformers with a 33 henry choke and 70,000 ohms resistance. Note: C represents the middle C of the pianoforte keyboard, C^1 C^2, etc., the octaves above, and C_1, C_2 the octaves below.

satisfactorily perform the first function, in which case distortion must result.

By "satisfactorily performing" this function, we mean that the ratio of the voltage actually extracted from the anode circuit in which it is placed to that which is theoretically possible (the symbol "μ" is generally used for this) should not vary greatly over the more important part of the audible frequency range.

Several factors influence the variation of effective step-up ratio with frequency, and it is not sufficient that a transformer should possess high primary inductance

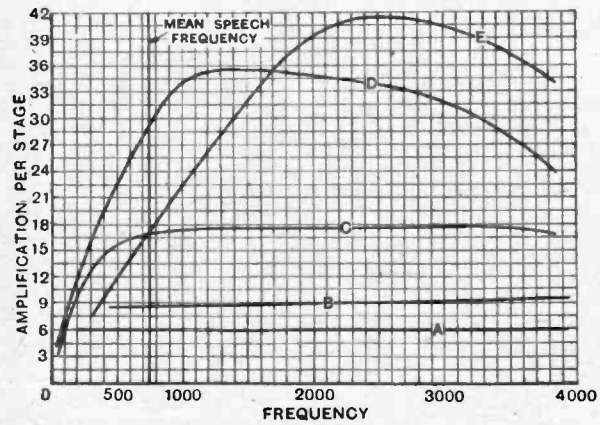

Fig. 2.—Curves of Fig. 1 reproduced to the more usual frequency base.

alone. It is but comparatively recently that these points have been sufficiently considered in design, and that really satisfactory intervalve transformers have been produced.

The deficiencies of the earlier transformers led those who sought after high-quality reproduction to investigate the alternatives, resistance, and choke coupling. The valve manufacturer meanwhile produced special valves of high amplification factor to counteract the lower overall amplification per stage obtainable by these methods, and we now have several alternatives, equally satisfactory from the point of view of quality, to choose from.

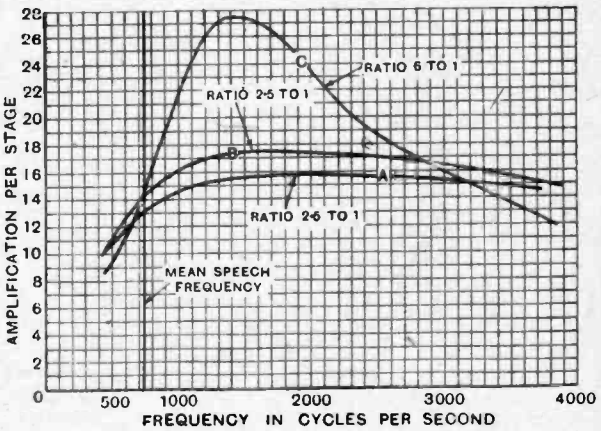

Fig. 3.—Amplification-frequency curves for experimental transformer of varying turns ratio. The turns ratio is not the only criterion of the amplification obtainable.

The following practical tests were originally carried out to check conclusions arrived at in a previous article. These were subsequently extended to provide data for those wishing to choose or design components for their own amplifiers.

The results of a few tests are given in Figs. 1—7. Some of these are plotted to a base of "log. f" for reasons given in the previous article. The octaves in the musical scale are marked off on the horizontal axis, so as to enable the relative importance of different frequencies to be more readily appreciated.

A few tests were first carried out to compare a choke,

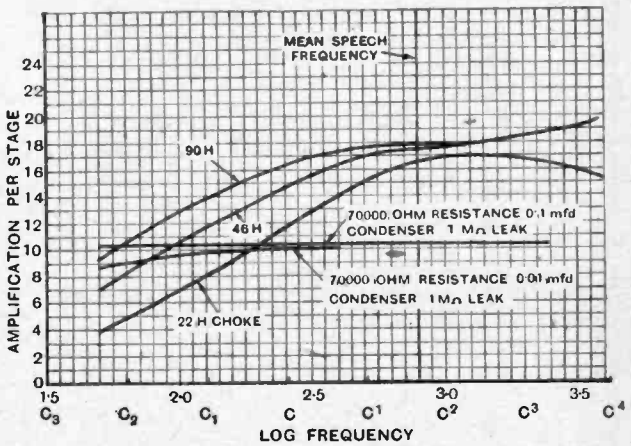

Fig. 4.—Amplification-frequency curves for three chokes and a wire wound 70,000 ohms resistance with a D.E.5b valve.

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of approximately 33 henries inductance, with a 70,000 ohms wire-wound resistance when used with a general purpose dull-emitter valve of amplification factor 10 and impedance 30,000 ohms. It may be safely deduced from these results (Figs. 1 and 2) that a choke of this magnitude should be equally as satisfactory, on this type of valve, as a resistance, from the point of view of faithfulness of reproduction, taking the previously mentioned points into consideration.

The characteristics of the most recent pattern of a well-known 4/1 transformer, and of a frequently used cheap transformer, in conjunction with the same valve, are also plotted for comparison. The weakness of the more expensive transformer is its low primary inductance of only 11 henries.

Some tests on a transformer having the following constants are illustrated in Fig. 3. The core consisted of stampings of dubious quality, comparatively few in number, and butting badly at the joints. This, together with the disposition of the windings, probably introduced

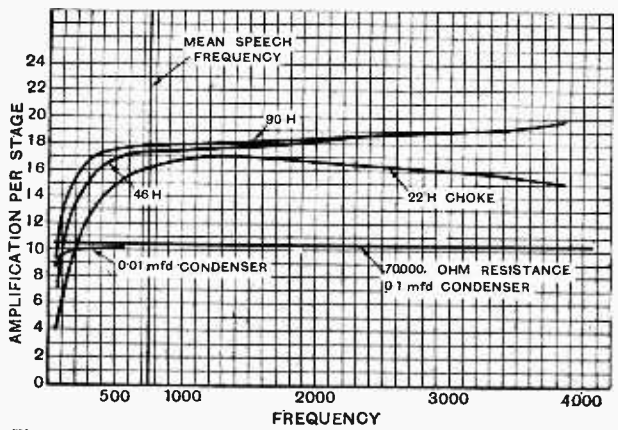


Fig. 5.—Curves of Fig. 4 plotted to the more usual frequency base.

considerable magnetic leakage between primary and secondary. The winding was in four layers, the inner three having 2,000 turns each, and the outer one 8,000. In curve (B) the second and third layers formed the primary, and the first and fourth the secondary. Thus the turns ratio was 2.5/1. The primary inductance was 10 henries. In curve (A), Fig. 3, the first and third layers formed the primary, and the second and fourth the secondary. The turns ratio, therefore, remained unchanged, but the capacity and leakage were altered. This was sufficient to affect the maximum amplification by more than 10 per cent. In curve (C) the third layer was used as primary, with an inductance of only 2.7 henries, while the first, second, and fourth formed the secondary. It will be seen that nothing approaching a 6/1 step-up of voltage was obtained even at the maximum.

The object of this test was to stress the fact that the design of intervalve transformers of even moderate ratio is a complicated matter, and does not merely involve winding turns on a few stampings in a given numerical ratio. The amateur who wishes to make coupling components for himself would be well advised to employ chokes. But even when it is appreciated that magnetic leakage and capacities of and between windings as well as primary inductance can so profoundly modify the performance of a transformer, it still remains to construct the instrument so that it shall have suitable values of these quantities, which is by no means easy.

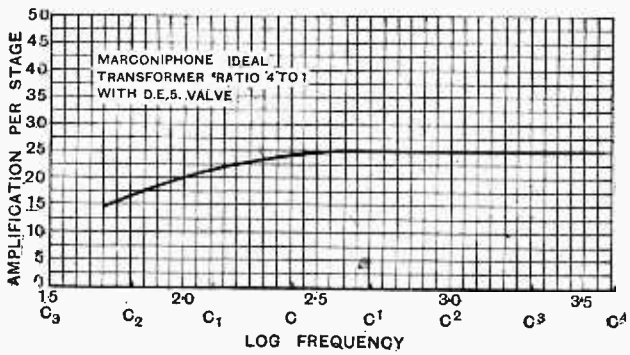


Fig. 6.—Amplification log-frequency curve for a Marconi "Ideal" transformer, ratio 4 to 1 with a D.E.5 valve (amplification factor 6, impedance 8,000 ohms).

In Fig. 4 the result of employing a valve of high amplification factor with resistances and chokes is shown. The relative merits of 0.1 and 0.01 mfd. coupling condensers are also illustrated. This was tried out on the resistance so as to show the effect more clearly. It appears safe to conclude that the 0.1 mfd. condenser is unnecessarily large. In Fig. 5 the same results are plotted, as is more usual, to a frequency base. This practice seems, to the writer, to give a somewhat distorted impression of the performance of a component. Telephone engineers, being chiefly concerned with intelligibility, which is largely a question of the lower harmonics rather of the fundamentals of notes, have selected 750-800 as "mean speech frequency," and even this, instead of being somewhere near the centre of the normal audible range of, say, 100 to 4,000 cycles, falls well to the left when using the ordinary frequency base. In music, and when we are interested in the *quality* of the

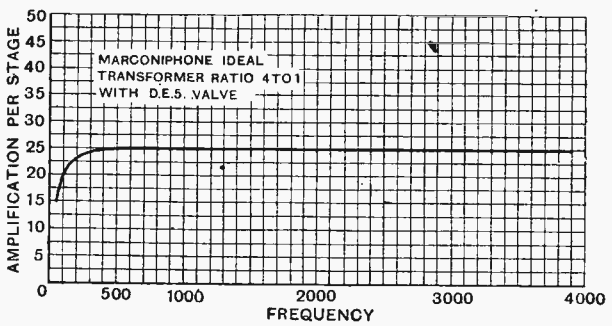


Fig. 7.—The curve of Fig. 6 plotted to the usual frequency base.

reproduction of spoken words, it would seem that we should give principal attention to at least two octaves below this, and perhaps one above. Rapid changes of amplification within this range would almost certainly entail appreciable distortion.

In Figs. 6 and 7 characteristic curves for a Marconi "Ideal" transformer used with a D.E.5 valve are shown. The remarkable uniformity of amplification with fre-

Distortion in Amplifiers.—

quency of a good modern transformer when used with a suitable valve is thus apparent.

A brief note on the method of measurements employed may be of interest. The circuit of the apparatus is given in Fig. 8. An approximately sinusoidal A.C. voltage of frequencies between 50 and 400 cycles per second was obtained from a small motor-generator set. Frequencies between 400 and 4,000 were obtained from a carefully adjusted valve generator, the actual voltage employed being controlled by placing a large coil in a suitable position in the magnetic field of the oscillator.

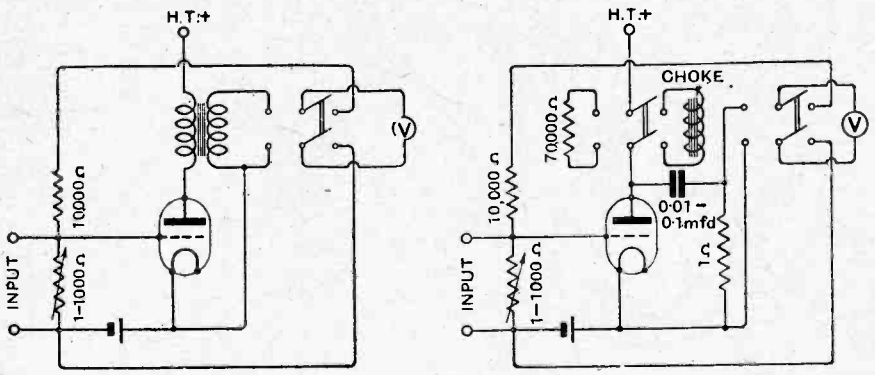


Fig. 8.—Method of testing the intervalve couplings.

The valve voltmeter was of the anode rectification type, and the resistances had values of 10,000 ohms and 1,000 ohms, the latter being adjustable to 0.1 ohm. By means of the switch the A.C. potential drop across the resistances in series was rapidly compared with that on the secondary of the transformer or with that on the grid leak. By adjustment of the resistance these two readings were made alike in each test, thus eliminating the necessity for calibrating the voltmeter. The amplification was thus directly measured in terms of the resistances. It was found that the readings could be repeated with agreement to a few parts in one thousand throughout. The sensitivity and stability were, therefore, more than sufficient for the purpose of the tests.

In conclusion, it seems a remarkable fact that so few manufacturers publish the data of their loudspeakers, phones, chokes, and transformers. Definite information as to the values of anode and grid resistances, the constants of valves, and so forth, is available, but the only figures supplied with most phones and transformers are their D.C. resistances and ratio of turns. Both of these figures are the merest indication of the useful constants of these instruments. As for chokes, not even this seems to be available as a rule! In connection with the D.C. resistance of phones, one calls to mind the case of a certain manufacturer, of pre-war days, who wound his headphones with resistance wire to ensure the 4,000 ohms, which was demanded of him, with the minimum of material.

THE TRIENNIAL CONFERENCE OF THE INTERNATIONAL ASTRONOMICAL UNION.

THE work of the Conference is divided up into thirty-one "Commissions," each dealing with distinct subjects of astronomical investigation and each having its own members and President.

That dealing with all questions of time, including, of course, wireless time signals, is *No.* 31, *la Commission de l'heure*, and includes distinguished astronomers from all parts of the world, presided over by the Astronomer Royal for Scotland, Professor R. A. Sampson, F.R.S.

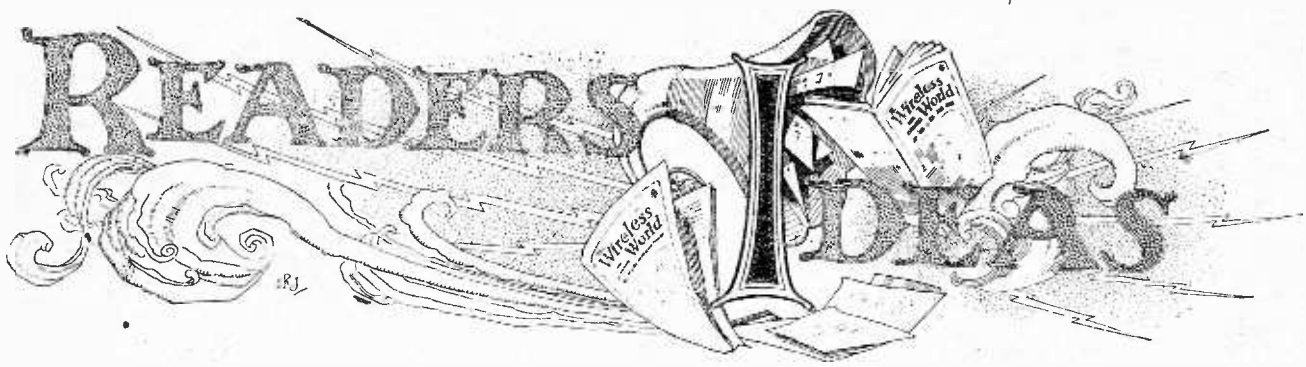
The Commission held its first meetings on Friday, the 17th July, in the Arts School at Cambridge. The proceedings were conducted in French. The morning sitting was devoted mainly to formal business and to an account by M. Baillaud of the method of time determination adopted in the Paris Observatory and its transmission from FL and LY wireless stations. In the afternoon the Commission settled down to a critical discussion of the relative merits of the various codes and the times at which they should be transmitted, particularly in Western Europe, and whilst no formal resolutions were passed—the Commission being adjourned to formulate and record them before the close of the Conference—the conclusions arrived at were substantially as follow:—

The semi-automatic code in which the time signal consists of a single dot at the end of each of three consecutive minutes (known as the old Paris code) is recommended to be dropped altogether. This involves the cancellation of 9.0 a.m. YN, 10.45 a.m. FL, and 10.45 p.m. FL as superfluous. The 8.20 a.m. YN rhythmics are also to be cancelled.

The ONOGO automatic code, in which every tenth second is indicated by a dot, each of its three minutes ending in three dashes (known as the International Code), is to be altered in the manner recommended by the British Horological Institute, *i.e.*, by the substitution of six-dot seconds for the final dashes and to be transmitted at morning and at night, preferably with an interval of twelve hours between them, but whether at 8 or 9 a.m. and 8 or 9 p.m. is left to the discretion of the *Bureau de l'heure*.

The above morning and evening transmissions to be followed, after an interval of one minute, by rhythmic signals commencing at the precise instant of G.M.T., consisting of 306 beats in five minutes, the beat beginning each minute, *i.e.*, the 1st, 62nd, 123rd, 184th, and 245th to be of half-second duration, with a correction to be published promptly by the issuing observatory.

The above decisions should be a source of considerable satisfaction to the British Horological Institute and to its Chairman, Mr. Hope-Jones, who originated the Greenwich six-dot seconds transmitted from the B.B.C. stations.

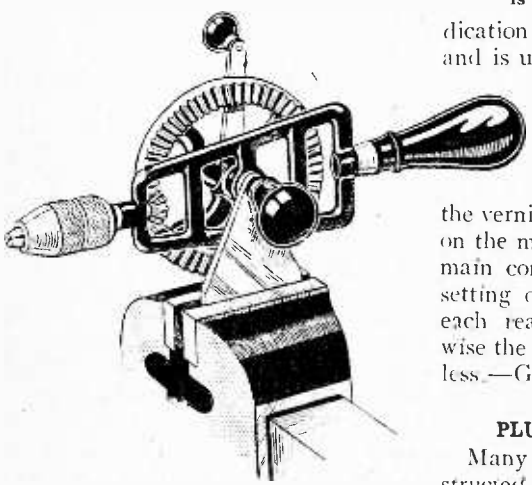


A Section Devoted to Novelties and Practical Ideas.

HAND DRILL ATTACHMENT.

A hand drill makes an excellent winding machine for telephone magnet coils, etc. The drill is held in a vice, and the spindle carrying the coil former is inserted in the drill chuck.

Some difficulty is generally experienced in holding the drill, as the frame is made of cast iron. The sides of the frame taper slightly, and it would be impossible to hold it firmly in the vice without damaging the casting. It is better to hold the knob at the side of the drill; but when this is done the knob tends to unscrew, due to the lateral pull of the wire as it is fed on to the coil former.

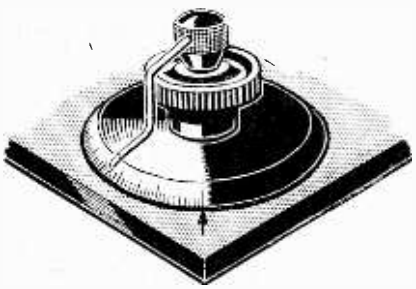


Method of mounting a hand brace for carrying out small winding jobs.

By far the best way of mounting the drill is to unscrew the side knob and to fit a strip of iron or brass, not less than $\frac{1}{8}$in. in thickness, in the manner shown in the diagram. If the knob is screwed up tightly, the drill will be held quite firmly in the vice and may even be used for polishing terminals for lacquering and filing up small brass parts.—W. R. S.

VERNIER POINTER.

The position of the vernier plate in a variable condenser is generally indicated by a white spot or small arrow on the vernier knob. The indication thus given is only arbitrary, and is useless if an accurate log is to be kept of stations received.



A useful addition to a variable condenser is an indicator for the vernier.

By fixing a long, thin pointer to the vernier spindle, the position of the vernier condenser can be indicated on the main condenser scale. As the main condenser dial is variable, the setting of this dial must accompany each reading on the vernier, otherwise the vernier reading will be valueless.—G. A. W.

oooo

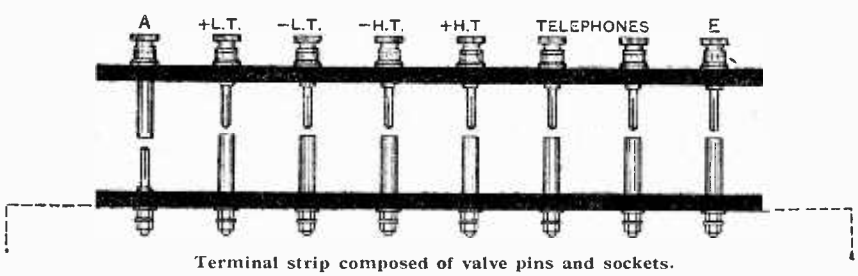
PLUG-IN TERMINAL STRIP.

Many receivers are now being constructed with the battery supply terminals mounted on an ebonite strip at the back of the cabinet. If, instead of terminals, valve sockets are fitted for the battery supply, it is quite an easy matter to disconnect all batteries when switching off the receiver. An ebonite strip of similar dimensions to the terminal strip is fitted with valve pins spaced to correspond with the sockets on the receiver and the leads from the batteries, aerial, earth, etc., and soldered to the pins. By withdrawing the pins, the receiver will be entirely isolated from the batteries. In order to make the terminals non-reversible, a special spacing of the pins may be adopted, or the positions of the pins and sockets may in some cases be reversed. R. E. W.

oooo

CLEANING EBONITE.

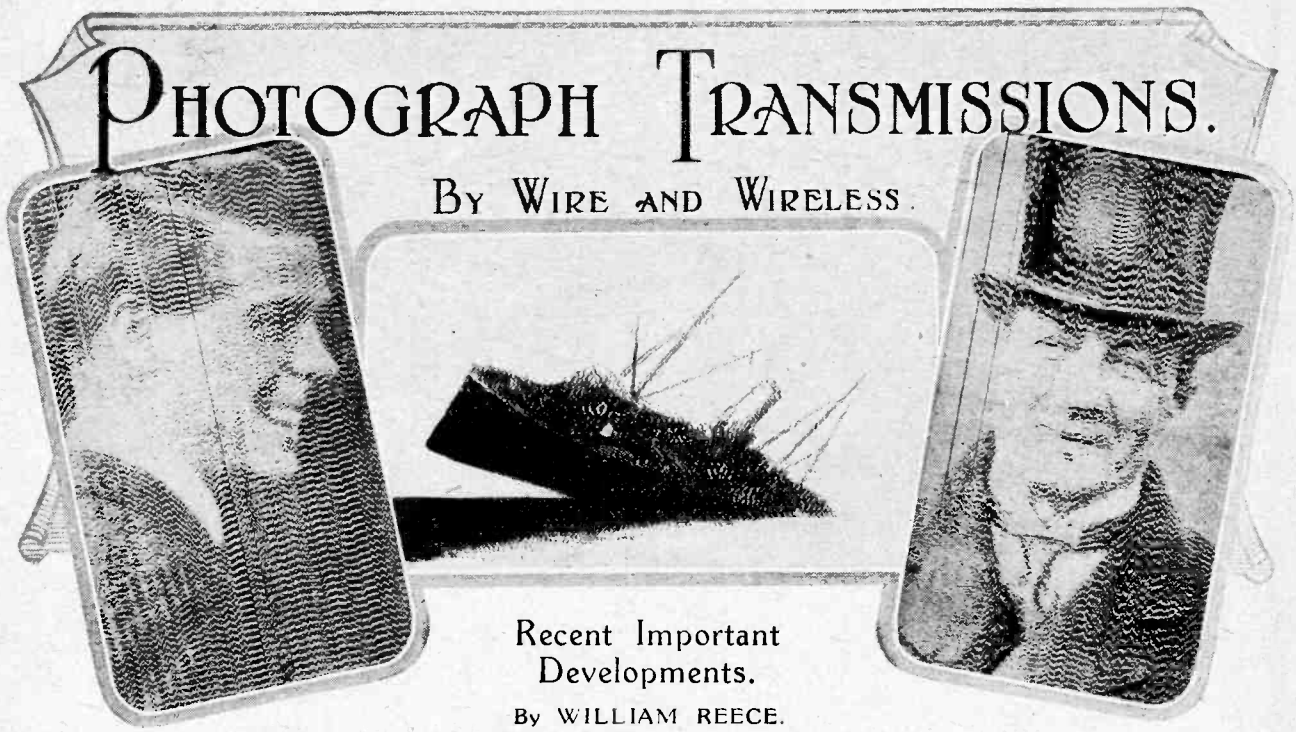
However much care may be taken in wiring a receiver, it generally happens that a certain amount of flux evaporates and adheres to the back of the ebonite panel. It is not generally realised that carbon tetrachloride is an excellent medium for removing grease and flux, both of which are instantly soluble in this liquid. The chemical should be obtained in the pure form and applied with a camel hair brush or a small wad of cotton wool. Carbon tetrachloride is not inflammable, and evaporates rapidly.—T. E. J.



Terminal strip composed of valve pins and sockets.

PHOTOGRAPH TRANSMISSIONS.

By Wire and Wireless.



Recent Important Developments.

By WILLIAM REECE.

THE first attempts to send pictures by telegraph are said to have been made by Alexander Bain, an Edinburgh clockmaker, in 1843, and F. C. Bakewell, about 1850.

Since that time many systems have been tried, and workers on the problem are to be found in all the principal countries of the world. There is M. Belin in France, Herr Korn in Germany, T. Thorne Baker, J. L. Baird, Mr. Bartholomew, and Capt. McFarlane of *The Daily Mirror*, and others in England, and Francis Jenkins and R. H. Ranger in the United States.

In connection with the United States Army manœuvres at Honolulu, photographs were transmitted by wire and wireless over a distance of 5,136 miles from Honolulu to New York. Each picture took twenty minutes to transmit, and the signals which made up the picture existed twice in the form of light, three times in the form of electrical currents passing through wires, and twice as wireless waves. The route traversed by each signal was as follows:—Twenty-nine miles from a picture transmitter at Honolulu to the broadcasting station at Kahuku; 2,372 miles by wireless from Kahuku to Marshall, California; nineteen miles by wire from Marshall to the broadcasting station at Bolinas, California; 2,640 miles by wireless from Bolinas to Riverhead, Long Island; and 76 miles by wire from Riverhead station to the Broad Street Office of the Radio Corporation of America. The portraits were recognisable, and some of the pictures came through with distinct detail.

During this year's manœuvres of the United States Army at Honolulu, photographs of the day's happenings and of the naval and military leaders engaged, were transmitted by wire and wireless over a distance of 5,136 miles from Honolulu to New York. The apparatus used has reached a stage of perfection when it can no longer be regarded as experimental, and its adoption commercially is now under consideration. A valuable feature of the system is that it ensures secrecy.

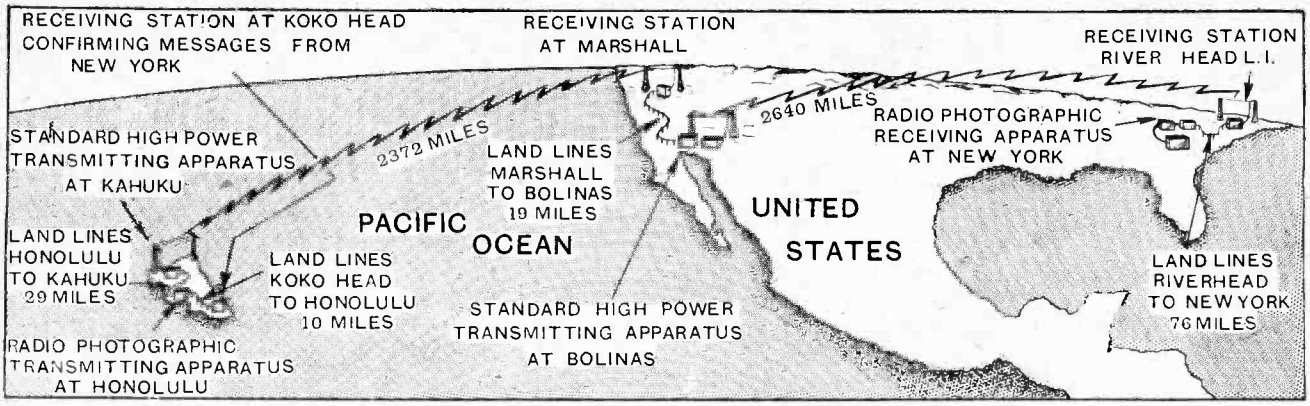
Interception Unlikely.

The method used was that which has been developed by Mr. Ranger for the Radio Corporation of America, and the experiment was conducted at the request of the United States War Department, who regard the wire and wireless transmission of pictures as a forthcoming military factor of the first order. It is looked upon as a means of secretly transmitting orders and maps, because, by a slight manipulation of the position of the carriage, a transmitted picture could be so twisted and distorted that the signals would be received by intercepting stations not acquainted with the adjustment as an unintelligible mass of dots and dashes, or as a distorted map bearing no relation to any geographical formation.

It is claimed that the Ranger system has several distinct advantages over other systems, as, for instance, dual reception by photography and by a pen and ink drawing which forms itself under the observation of the attendant as transmission is taking place, thus enabling a check to be kept on the quality of the result; and the peculiar wavy lines of which the photograph is made up, which makes it particularly suitable for newspaper reproduction.

Synchronising System.

The apparatus is compact, and can be used on any line, telegraph, or wireless circuit. An essential requirement of the system, as of all picture transmission



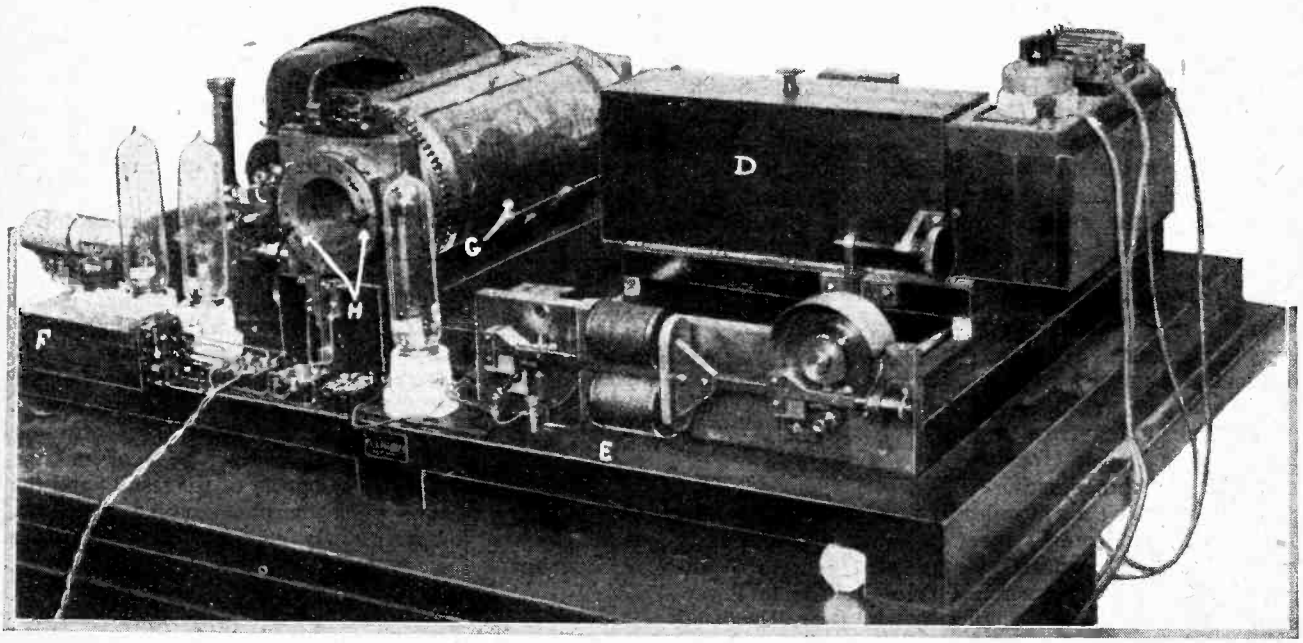
Stages in transmitting a picture from Honolulu to New York, consisting of links by land wire and wireless.

systems, is absolute synchronism of the sending and receiving apparatus. If the receiver should lag behind the transmitter, the picture will be blurred and unrecognisable. The synchronising apparatus is, therefore, of the greatest importance. In the Ranger system this consists of special driving motors, one geared to the transmitting cylinder and one to the receiving cylinder, synchronism being maintained by a tuning fork. This tuning fork keeps the motor correctly geared to time, in spite of the load of electric current variations. The photographic film, which is fixed in place on the glass cylinder, may be either positive or negative, but a positive is generally used because it enables the operator to form a better judgment of the values of light and shade in the picture. A contrast of pure white and solid black gives the best results in the present stage of experiments, but a fair amount of shade and detail is procurable.

Inside the glass cylinder there is a small but powerful electric light which is focussed through lenses and sends a beam through the film in a tiny point of light. The drum only describes a half circle, and rotates backwards and forwards through this arc at a fairly high speed, moving a fraction of an inch horizontally at the end of each rotation. Thus the beam of light, which is stationary, passes through every part of the picture during the process of transmission. The beam is directed into a light-proof box, inside which is a photo-electric cell, the electrical resistance of which changes in accordance with the amount of light which falls upon it, and in this way reflects the light and shade of the picture.

New Type of Photo-electric Cell.

The particular type of photo-electric cell used has been developed by the General Electric Company of America. It consists, essentially, of a pear-shaped bulb 2½in. in diameter. The positive electrode enters through the neck of the bulb, but makes no contact with the



APPARATUS FOR THE TRANSMISSION OF PICTURES. The sensitive photo-electric cell is contained in the cabinet (D). A positive film is held under the glass cover (G) and the direction of rotation of the cylinder is controlled by the stops (H). The electromagnets (E) advance the position of the carriage.

Photograph Transmissions.—

interior surface. The negative electrode enters through the wall of the bulb, and makes contact with the metal-coated inner surface, with the exception of a small clear space 1½in. in diameter opposite the negative lead. This space serves as a window for admitting the light waves. The whole of the inner surface of the bulb is coated with a thin, highly reflecting coat of metal which, besides rendering the bulb opaque to light, except at the window, ensures good conductivity for the electric current. The cell is filled with argon, and potassium compound is deposited on the inner surface. This produces a current depending upon the amount of light received. The more brilliantly illuminated it is the greater the current that is allowed to pass. The current enters the photo-electric cell through the negative electrode, and passes through the argon filled space to the anode. The light sensitive bulb coating gives off electrons depending in quantity upon the amount of light passing through the window. Changes in the amount of light reaching the cell have their counterpart in the output of current. In this way the variations of light and shade are recorded as the film sweeps past the beam of light.

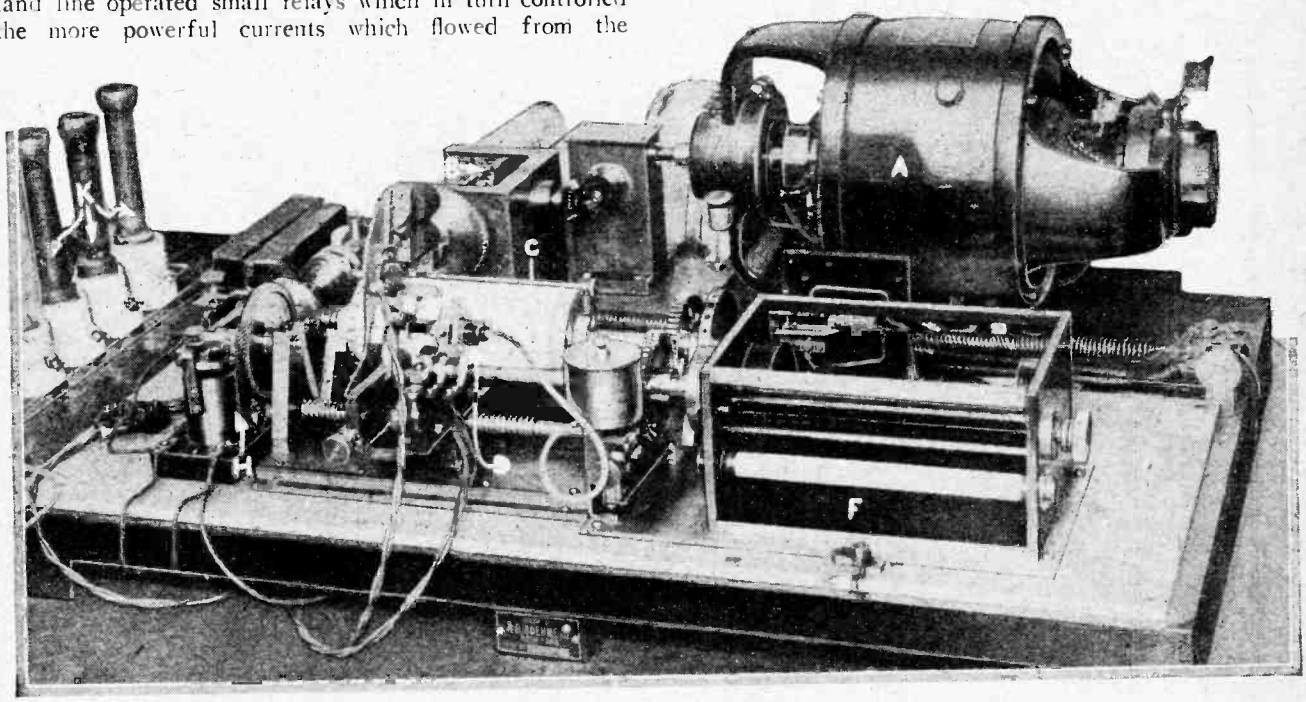
Transmission of the Picture After Analysis.

Current impulses from the photo-electric cell pass through a series of vacuum amplifiers, and are fed into a modulating device preparatory to transmission over the ordinary wireless signal circuit. The electrical equivalents of the picture are then transmitted over land lines to the wireless station—in the case of the English demonstration given some time ago, from London to Carnarvon. At the wireless station the impulses from the land line operated small relays which in turn controlled the more powerful currents which flowed from the 200-Kw. generator to the antennæ system. The signals were then radiated from the antennæ in interrupted impulses similar to the dots and dashes of the Morse code. These signals were received at Riverhead, Long Island, New York, in the same way and on the same apparatus as the commercial Morse signals, though, instead of dots and dashes, they were an unintelligible series of electrical impulses. They were passed through valve amplifiers and then over land lines to the office of the Radio Corporation in New York.

Apparatus for Recomposition of the Picture.

Here the unintelligible code carrying the photograph was passed through a translating device, in which each electrical pulse of energy had its own definite task to perform in reassembling the picture which came out of the machine as a stippled engraving in the shade values of the original picture.

The picture is reproduced in duplicate, one copy being a photographic film and the other a pen and ink drawing on a strip of paper. The drawing is made by a specially constructed fountain pen which bears against the paper wrapped round a rotating cylinder. The pen is attached to an electrically controlled lever in such a way that every pulse of electric current which passes through the coils of the relay draws the pen into contact with the surface of the paper and makes a fine ink mark. A changing current fed through the magnet coils causes the pen to wriggle in step with the current impulses. This produces curious irregularities, and gives a stippling effect, which is very pleasing as compared with the rigid straightness of the lines produced by other methods. The marks do not appear in exactly the same place in



THE RECEIVING APPARATUS. The motor (A) drives the cylinder (C) on which the picture is recorded through the train of wheels (B), the speed synchronising with that at the transmitter. The pen (D), fed from the ink reservoir (E), draws the "pen picture," and a duplicate may be recorded photographically within the camera box (F).

Photograph Transmissions.—

any two transmissions, so that each transmission has an individual character of its own. In watching the pen in operation, it is difficult to believe that it is not guided by a human hand, so deliberate and reasoned do its movements appear. When 128 lines are laid side by side in each inch, the dot and dash effect disappears, and wavy, horizontal lines appear in a kind of herring-bone pattern. This waviness is due to the capacity introduced into the actuating circuits mainly to minimise the effects of atmospherics producing a delay which results in the dot and dash appearing in slightly different positions in each line. This effect also gives the individual character to each drawing to which reference has been made.

This wavy effect was not sought by the inventor, but it has proved to have a certain value. If there is any slight difficulty at the receiving end the picture is likely to be systematically streaked, and it has been found that the wavy pattern disguises the streaks. At first the pen was used as a check to the camera, but it was afterwards found that it produced pictures which had some advantage over those made by the camera, so that now the pen pictures are used as often as the photographic ones.

From the illustrations accompanying this article, it will be seen that while much has yet to be done in order to ensure reception of perfectly satisfactory pictures by wireless, the Ranger system has every appearance of being a commercial reality. It is understood that experiments have been taking place for some months past between England and America on this system, and that a possibility of introducing it commercially is under consideration.

Calls Heard.

Extracts from Readers' Logs.

Whittington,

(July 2nd to 7th.)

Great Britain :—2CC, 2KF, 2MC, 2NM, 2OD, 2LZ, 2XY, 5AAR, 5IG, 5LF, 5SI, 5SZ, 6GH, 6TM. *France* :—8CT, 8CO, 8DT, 8DP, 8FQ, 8FW, 8WA, 8BON, 8GVR, 8WAG, 8HGV, 8RDI, 8VAA. (Heard on 30 to 50 metres).

(0-v-1) R. POLLOCK.

Smethwick, Staffs.

British :—2CC, 2OX, 2OW, 2KW, 2LZ, 2NB, 2WY, 2YX, 5BA, 5MZ, 5QX, 5SZ, 5VQ, 6QB, 6OT, 6UX, 6US, 6AL, 6FG, 6RM, 6TD, 5RZ, 6YR, 6NS, 6RM, 6TD, 5RZ, 6YR, 6NS, 6RM, 5SL, 5HA, 6BT. *French* :—8FQ, 8OW, 8AR, 8KZ, 8HM, 8QZ, 8WU, 8RLH, 8FU, 8RLS, 8WAL, 8SSC, 8PL, 8HID, 8DO, 8MN, 8LL, 8PLM, 8OO, 8FI, 8R1C, 8TM, 8RV, 8TVI. *Belgian* :—R2, R7. *Finnish* :—1NA, 2ND. *German* :—X2. *Dutch* :—OPM. *Italian* :—1RT, 1MT, SOK, Sokolinki (station). *American* (20-40 metres) :—1AAC, 1ASF, 1BOQ, 1CCX, 1CKP, 1CMP, 1CMX, 1ER, 1OW, 2DK, 9CCX, 9EFZ. *Canadian* :—1EB.

RALPH H. PARKER. G2KK.

West Norwood, London.

2AOX, 2BLB, 2BM, 2HD, 2NB, 2PY, 2VX, 2XV, 5FT, 5JH, 5HX, 5OC, 5TV, 5VA, 5XY, 5ZA, 5ZH, 6BD, 6DO, 6TX, 6UH, 6YR, I1AE, I1BP, I1FP, B2SSK, BF2, BP7, BZ2, BD7, BZ1, BQ2, BR2, BR7, BK7, BH6, NOPM, NOMR, NOFP, NOFO, NPB8, SMNG, SMVH, SMVU, SMZS, YZ, KY4, KL4, PCUU, OCDB, NRL, WIZ, PE, X3AD, S2NC, 3AKK (?). L. H. THOMAS (G6QB).

Braintree.

Australia :—3EF, 3BD, 2YI, 2CM (on 33-35 metres), 3BQ. *New Zealand* :—2AE. *Brazil* :—1AB (on 35 metres). *Argentina* :—CB8 (on 35 metres).

D. WOODS (2AXZ).

New Haven, Conn., U.S.A.

English :—2KF, 2XY, 5DH. *French* :—8QQ, 8SM, 8ALG, 8YOR. *Italian* :—1ER. *Argentine* :—2AF. *New Zealand* :—2AE, 4AA, 4AR. *Australian* :—2BK, 2DS.

(All on about 40 metres.)

C. B. WEED (U1BHM).

Sheffield.

British :—2DX, 2FT, 2HQ, 2KF, 2LZ, 2NB, 2NX, 2NM, 2OD, 2VX, 2XY, 5EA, 5KY, 5LF, 5MA, 5NW, 5SI, 5TA, 6AV, 6RM, 6VM, 6VP. *French* : 4SR, 8AG, 8AQ, 8CC, 8CK, 8EU, 8FT, 8FW, 8NA, 8NX, 8RA, 8TK, 8UT, 8VU, 8WA, 8WOG, 8WOZ, YZ. *Dutch* :—OGN, OGO, OPM, 2PZ, PCMM. *Czecho-Slovakian* :—OKG. *German* :—4EA, XOX. *Belgian* :—Q2 G6. *Danish* :—7ZM. *Swedish* :—5MYZ. *Unknown* :—CBY, 4UI, 5Y5, 3CA.

E. W. CROSS.

Cromer.

American :—4ET, 5AA, 5NR, 5UI, 5XI, 5WI, 8SO, 8TID, 8TK. *Mexican* :—BX. *South American* :—UR. *Italian* :—1CO. *Belgian* :—O2, 12, X2. *French* :—YZ. *Mosul* :—GHH. *Unknown* :—STT.

(0-v-0.)

A. A. BARRETT (2AJP).

Madeira.

(During the Month of June, 1925.)

British :—2KF, 5DH, 2DX. *French* :—8ALG (Algerie), 8MAR, 8CT, 8SM, 8QQ, 8EU. *Dutch* :—PCUU. *American* :—9GL, 2AHK, 9CJ, 1ANQ, 8NB, 9KH, 2HA, 1AMS, 1BQI, 8DON, 2EM, 2AJK, 1ABS, 1ADU, 9FK, 2CKP, 1PL *Swedish* : SMYV. *Unknown* :—OCKJ, YZ1.

Reinartz, 0-v-1.

A. C. DE OLIVEIRA (P3CO).

Burnley, Lancs.

July 1st—July 19th. Below 120 m. *America* : 1ABP, 1AR, 1ARH, 1BDN, 1BES, 1BHM, 1CCX, 1CME, 1CMP, 1CMX, 1CMY, 1JN, 1JW, 1KKX, 1UJ, 1UST, 1UW, 1XF, 1ZA, 2AFN, 2BIA, 2CTH, 2DGI, 2GK, 2GY, 2MW, 2ULC, 2XI, 2XU, 3KK, 3JW, 8BON, 8DON, 9GZJ, WIR, W1Z, WSC. *Cuba* :—2BY. *Canada* :—1AM, 1AR, 1BG. *Brazil* :—1AB, 2SP. *Argentine* :—A8, CB8. *India* :—7XX. *Scandinavia* :—2NM, 7EC, 7ZM, SMYZ, SMYY, SMVU. *Italy* :—1AS, 1CM. *Belgium* :—G6, E2, X2, R2, B9, P7, K2, E7. *France* :—8ALG, 8AZ, 8BN, 8EU, 8FN, 8GNA, 8JAB, 8RA, 8RI, 8RIF, 8RCR, 8TOK, 8OT, 8VAA, 8WA, 8PRI. *Holland* :—PCMM, 0OO, 0RW, 0BA. *Britain* :—2BDQ, 2CC, 2DX, 2KF, 2LZ, 2MK, 2NB, 2NM, 2OD, 2QM, 2SW, 2SZ, 2VR, 2VO, 2XV, 5DH, 5SI, 5QV, 5UW, 6RH, 6RM, 6JV. *Miscellaneous* :—M1DH, II9WWZ, H1CK, EAC9, EA4T, 8BP, 9B, 2FE, 1PL, 9XR, MI7, KXH, BSM, KX8, PAR, CBY, GTRS.

J. MUSCUTT.

East Molesey.

(From July 1st to July 13th.)

British :—2AH (telephony). 2DF, 2HP, 2HY, 2KV, 2MA, 2NB, 2NG, 2UN, 2ZG, 5AI, 5DK, 5KY, 5MA, 5MS, 5OG, 5QX, 5SV, 6AL, 6DO, 6JV, 6MP, 6SU, 6TD, 6VP, 6YQ, 6YA. *French* :—8AQ, 8CAX, 8CC, 8CV, 8DI, 8GVR, 8IPK, 8JO, 8KIR, 8KK, 8KR, 8MJU, 8NA, 8NO, 8NOK, 8NOO, 8NTA, 8NY, 8PKX, 8RCR, 8TK, 8VV, 8WO, 8WOZ, 8YB, 8ZN, 8Z3. *Dutch* :—0PM, 0MS, 0RM, 0RO, OWW, 0ZN, PB8. *Belgian* :—2I, 2Q, 2R, 4RE, 4UC. *Swedish* :—SMHI, SMRA, SMRG, SMYZ. *Miscellaneous* :—7WOZ, 9AOB, 7G, U5RZ, KXH.

G. M. THOMAS.

Addresses of Stations Wanted.

We have received enquiries from various correspondents regarding the QRA's of the following stations, and shall be glad if any of our readers can give the required information :—

3CA (no nationality letter given; heard calling 2MA and 9WWZ, using ACCW).

LOAA (presumed Norwegian).

RCRL (working with RER), all heard on July 7th, on about 50 metres.

Also :—BZ, 1AP, 1AB, 1AF, and 2SP. C1AR, EAC9, G2YT. KXH, M1AF, M4HS, SMVL, STT, U8JMA, Z2AX.

OPENING OF THE DAVENTRY STATION.

Complete Technical Description of the Equipment.

The temporary high power broadcasting station of the B.B.C. at Chelmsford, which has been in operation for over a year for research and development purposes, was replaced on Monday, 27th July, when the new Daventry station was opened by Sir William Mitchell-Thomson, K.B.E., M.P.

THE Prime Minister, in writing to the Managing Director of the British Broadcasting Company on the occasion of the opening of the Daventry station, very aptly refers to the event as "another milestone on the road to the social betterment of our people." The significance of this announcement may not be particularly apparent to-day, but those who may look back a year or two hence and recall these words will undoubtedly regard them as prophetic.

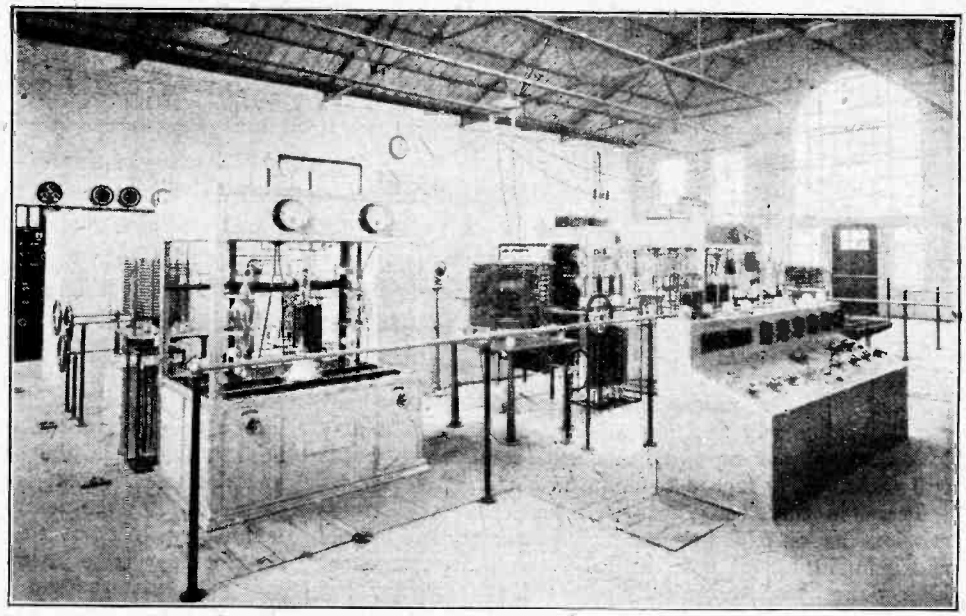
It was in July, 1924, that 5XX first commenced transmissions as an experimental high power station located at Chelmsford, and now, in July, 1925, the permanent high power station centrally situated at Daventry has come into existence. The station was officially opened on July 27th by His Majesty's Postmaster-General, Sir William Mitchell-Thomson, K.B.E., M.P., who, together with the Chairman, the Managing Director, the Chief Engineer and other officials of the British Broadcasting Company, journeyed to Daventry from London with a large number of guests of the company who had received invitations to be present on this important occasion. The opening ceremony took place before the microphone in the small studio which has been provided in the station building. Daventry, it must be remembered, is not located in an easily accessible spot, for the nearest town of importance is Northampton, a distance of 12 miles by road. On this account there is no intention of conducting elaborate programmes from the station studio, as the London studio will be used and connection be made through to Daventry by Post Office land lines. The large number of reports which have been received by the B.B.C. all indicate that

H.M. Postmaster-General, Sir Wm. Mitchell-Thomson, Bt., K.B.E., M.P., standing before the microphone in the studio at Daventry. With him are: The Mayor of Daventry, Councillor J. H. Johnson (in robes); Mr. J. C. W. Reith (Managing Director); Lord Gainford (Chairman); Sir Wm. Bull at the right of the microphone and Mr. Litt, Engineer-in-Charge, on the extreme right.

Opening of the Daventry Station.—

reception is satisfactory almost all over the country, and this speaks well for the efficiency of the station.

The opening of the station was the occasion for appreciation to be expressed by Lord Gainford, the chairman of the B.B.C., of the excellent relations which had always existed between the company and the Post Office ever since the inception of broadcasting, whilst Capt. P. P. Eckersley, the chief engineer, took the opportunity of acknowledging the work of the members of the technical staff of the B.B.C. and the various contracting firms who had been entrusted with the erection of the station. The actual wireless equipment was supplied and installed by Marconi's Wireless Telegraph Company, whilst the contract for the masts and aerial equipment was given to the Radio Communication Co., who, in turn, engaged the services of Mr. C. F. Elwell for the design and construction of the masts. Mr. Elwell has been responsible for mast erection work at a large number of modern high power stations. The Western Electric Co. designed the special line amplifier, and co-operated with the B.B.C. and the Post Office in making possible the transmission of programmes from the London studio to the Daventry station.



A view of the interior of the station. The control table can be seen on the right.

The Postmaster-General, in his address, commented on the question of the utilisation of broadcasting for the transmission of political speeches, and expressed the hope that, as far as possible, broadcasting might be kept clear of party politics and operate solely as a national service. For the B.B.C. to associate itself with political matters would, he thought, make the position in the future more difficult and hamper the policy of those responsible for guiding the destinies of the B.B.C. in a way which he considered would be regrettable.

Below we are able to publish various technical details of the equipment of the station which were not available until the date of the opening, together with some additional photographs.

The building is a brick and steel girder construction of dimensions 116ft. by 64ft., and 16ft. high to the roof eaves. The interior is divided into two main portions, one for housing the rotary electrical machinery, having a floor space of about 1,500 sq. ft., and the other, in which the wireless transmitting apparatus is installed, occupying a space of about 3,300 sq. ft. The building also provides room for a studio, a workshop, and a store room, besides various smaller compartments to be used as offices, etc.

The masts are two in number, with a height of 500ft., and are placed 800ft. apart. They are of the stayed type, or iron lattice-work construction, and of triangular section.

Aerial System.

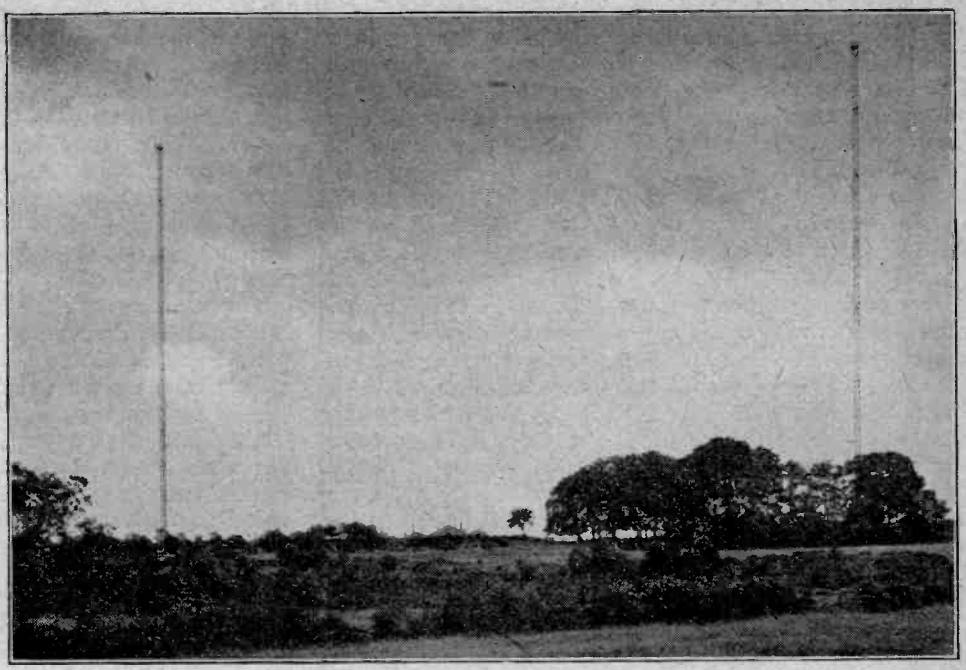
The "T" shaped aerial is composed of a ten-wire cage along the horizontal portion, which has a length of 600ft., with a down lead consisting of a six-wire cage brought to an insulator and lead-in trunk placed on one of the roof ridges.

The earthing arrangements comprise a number of metal plates sunk in the ground and forming a ring round the building. A wire from each earth plate is led up to an insulator on a 15ft. mast, of which there are thirty-eight disposed in a circle of 100ft. radius from the aerial trunk, and then above the roof to a ring fastened round the trunk. From this ring a couple of copper strips are taken down inside the trunk to the earth terminals of the transmitter. Such a system of earthing forms an electrostatic screen over the roof, and probably serves to reduce aerial losses to some extent.

The electrical power is supplied by the Northampton Electricity Supply Co. in the form of three-phase alternating current at 11,000 volts 50 cycles. This is transformed down to 375 volts at a substation on the site. It was thought undesirable to rectify the three-phase supply direct for supplying the valve transmitter, as any slight out-of-balance load on one of the incoming phases might cause difficulty in maintaining the requisite degree of smoothing, so rotary machinery is installed to provide a local single-phase supply. Although the present rating of the station is fixed at 25 Kw., by which is to be understood the mean power input to the plates of the magnifier valves, provision has been made for a rating up to 60 Kw. on the same basis as regards the machinery to meet possible future requirements. All transformers, chokes, cables, and high-frequency apparatus used in the station have been designed with sufficient capacity for dealing with this higher power when required.

Opening of the Daventry Station.—

The power plant consists of three 70-Kw. 1,000-volt 300-cycle motor alternators, two 25-Kw. 1,000-volt 300-cycle motor alternators, and three 10-Kw. motor generators delivering direct current at 20/30 volts. There are also a few smaller machines, such as motor pumps, etc.

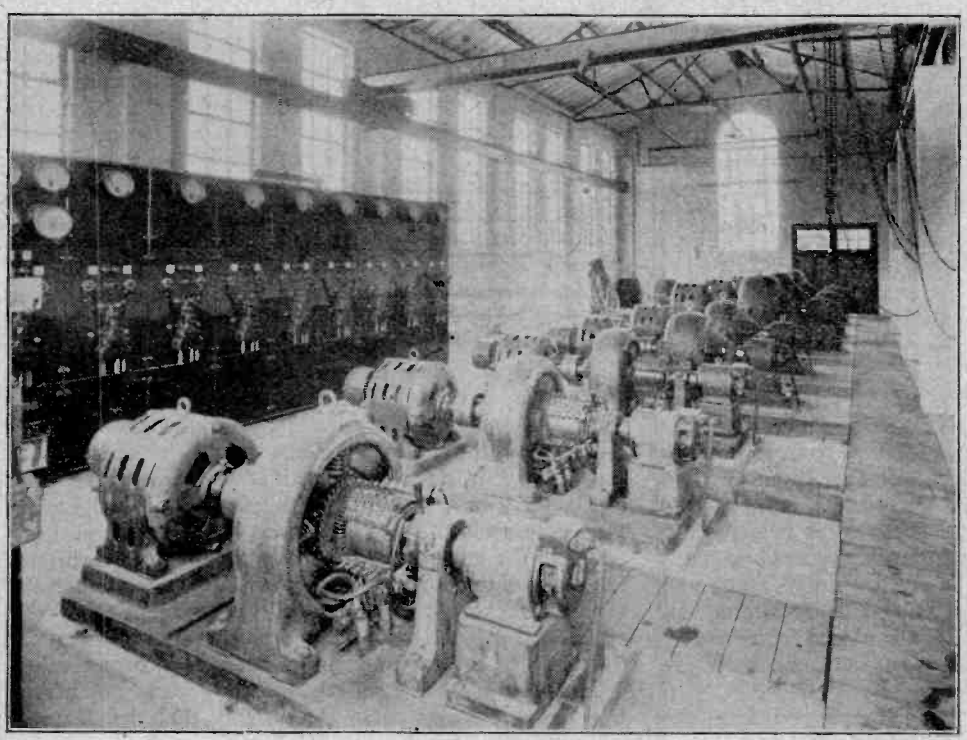


A new photograph of the two masts and the station buildings.

Power Supply.

Two of the 70-Kw. machines are in use at one time, the third machine being a spare, one machine supplying power for the modulator valves, and the other for the magnifiers. One 25-Kw. alternator is run for supplying power to the drive oscillator, and also for lighting the filaments of all the rectifying valves. The direct current motor generators are used for lighting the filaments of the drive, sub-modulator, modulator, and magnifier valves, two of these being required, leaving one available as a reserve. All these machines are fitted with individual self-exciters.

The design of the wireless apparatus has been based upon the experience obtained at Chelmsford with the experimental high power broadcast station 5XX, in fact, both stations are similar as regards the theoretical circuits. In the new station more attention has been paid to the appearance of the various units, and the control switching has been elaborated, with a view to securing greater convenience of operation and quicker repair in the event of a breakdown. The wireless transmitting gear may be conveniently described under the following heads.



The machine room and control panels.

The independent drive comprises two air-cooled rectifying valves, type MR9, and one water-cooled oscillator, type CAT1. The rectifiers are arranged for full wave rectification, and simply direct current at ten thousand volts through the usual smoothing circuit to the oscillator anode. The drive oscillatory circuit is constructed of a pair of copper strip inductances astatically connected to reduce the external field, and an air dielectric condenser shielded by a metal case. The plate input to the drive oscillator is about eight kilowatts, which is an un-

Opening of the Daventry Station.—

usually high ratio of the power supplied to the magnifier, but this permits of securing the necessary magnifier grid excitation with a very loose coupling, resulting in negligible reaction back on the drive and consequent freedom from frequency variation with variation of magnifier input.

The magnifier unit is formed of four water-cooled rectifier valves, type CAR2, and three water-cooled oscillatory valves of the same type as the drive, namely, CAT1. The oscillator valves are capable of dealing with an input of thirty kilowatts at ten thousand volts, and in this station are normally operated at 10,000 volts with a plate current of 2.5 amperes. The filament input is the same for all the water-cooled valves used, namely, 1 Kw. each at 20 volts 50 amperes. The oscillatory circuit of the magnifier consists of an inductance of stranded cable and a shielded air condenser. The grids of the magnifier are excited inductively from the drive circuit, the direct grid current required being about 300 milliamperes for the three valves. The grid circuit includes an anti-reaction coil which is inductively coupled to the plate inductance in such a manner that the internal valve capacity coupling is neutralised, so that it is not possible for the valves to operate as a self-oscillator if the drive excitation is removed. This adjustment is an important factor in securing stability of working and constancy of wavelength. The closed oscillatory circuit of the magnifier is inductively coupled to the aerial tuning inductance which is of the same stranded cable as the closed circuit coil.

Modulating Equipment.

The modulator consists of four water-cooled rectifiers, type CAR2, and six water-cooled modulators, type CAM1. The modulating valves are similar in size and appearance to the oscillators, but have a much more open grid mesh with a low amplification factor. The modulator is worked with plate voltage and current equal to that of the magnifier, the current been adjusted by the setting of the grid negative voltage. For normal working this setting is between 1,200 and 1,300 volts negative, thus a large grid sweep is possible during modulation without running into grid current. The grid negative voltage is obtained from a dry cell battery, and as no current is taken from the battery this source is quite satisfactory, as has been proved by twelve months testing at the Chelmsford station.

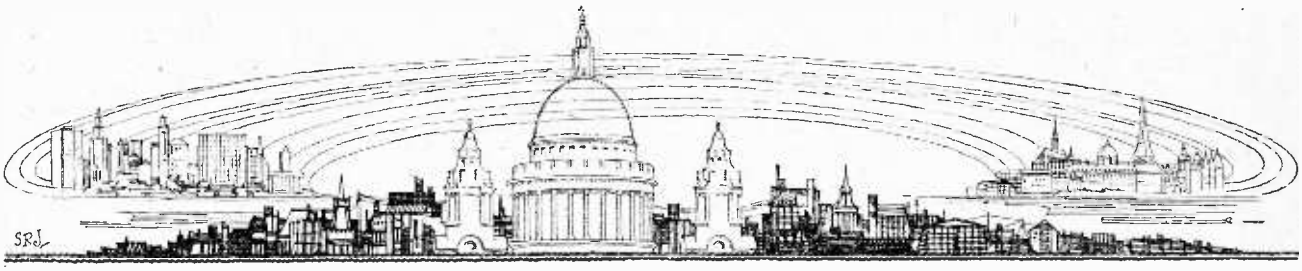
The smoothing circuits for a set of this size present something of a problem, as the permissible ripple is very small for high quality broadcast telephony, and the smoothing units are necessarily somewhat bulky and costly. The condensers for the smoothing system consist of zinc plates with glass dielectric, oil immersed in porcelain containers. The total capacity used on each half of the circuit is approximately 3.5 microfarads and the inductance about 16 henries. The smoothing inductances are closed iron core chokes placed in oil tanks. Each choke contains about 5 cwt. of iron, and there are eight of these in all.

One air-cooled valve, type MT7B, operated from the same high tension source as the main modulator, and coupled by resistance and capacity to the grids of the modulator valves, functions as the sub-modulator. The grid of the sub-modulator is in turn coupled also by resistance and capacity to the sub-sub-modulator which is a block of four LS5A valves supplied by a 400 volt accumulator battery and with accumulator heated filaments. The usual land line amplifiers are situated in a separate room removed as far as possible from the high-frequency apparatus, and are adaptable for amplifying either the audio-frequency currents coming over the land lines or those from the microphone in the local studio.

The arrangements made for water cooling the valve anodes deserve attention. As the anodes are at high potential it is necessary to insulate the valve water jackets from the main supply of water. This is accomplished by running the water both in and out of the jackets through spraying nozzles. The water spray forms an almost perfect insulator, and, therefore, no loss is sustained by leakage. The cooling water is stored in a concrete lined pond holding about 5,000 gallons, and is pumped from there up to a tank in the roof, falling by gravity through the valve jackets back to the pond. The rate of flow is adjusted to allow about one gallon per minute through each valve jacket, and under these conditions the water leaving the valves is only increased in temperature a few degrees. As it is important to use cooling water free from lime or other ingredients capable of forming a deposit on the anodes, rain water is utilised, and arrangements are made to drain water from the roof into the storage pond, a rainfall of one inch giving about 1,000 gallons to the pond.

The apparatus for controlling the power input to the various sections of the transmitter is mounted on one control table placed in such a position in the apparatus room that the shift engineer at the control table has a clear view of the valve panels and the various indicating instruments mounted thereon. On the control table are mounted the exciter field rheostats of all the alternators and dynamos, so that the machines can be brought up to the required voltage from there. Magnetic trip switches enable any particular machine to be cut out at quick notice if necessary, and a master switch is available which, when opened, stops all the machines generating, except the filament lighting dynamos. The whole of the high tension wireless apparatus is enclosed by a metal railing, the gate of which has a safety switch to cut off power when opened. The system of relays and wiring adopted renders it necessary to start up in a certain prescribed order of operations. The high tension voltage cannot be applied to the drive oscillator unless the safety gate is closed and the valve filaments alight, neither can the power be thrown on the magnifier and modulator valves until the gate is closed, all filaments fully alight, and the drive oscillating at approximately its correct input. Also, if for any reason the drive should cease oscillating the set is automatically shut down. A wavemeter with visual indicator on the control table keeps the shift engineer informed as to the wavelength constancy, and can show half a metre variation from the correct value.

Even in such a rapidly expanding art as wireless telephony it seems more than likely that the Daventry station will serve as a model of what is desirable in a super broadcast station for several years to come.



CURRENT TOPICS

Events of the Week in Brief Review.

NEW BROADCASTING STATION FOR BRUSSELS ?

A proposal is under discussion for the provision of a second broadcasting station at Brussels, according to our contemporary *La T.S.F. Moderne*. Such a station would probably be controlled by the *Soir* newspaper.

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INTERNATIONAL CODE FOR PARIS TIME SIGNALS.

The abolition of the old Paris code by means of which the Eiffel Tower still transmits time signals at 10.45 a.m. and p.m., was, we understand, recommended by the *Commission de l'Heure*, of the International Astronomical Union at its recent meeting at Cambridge. The Commission recommended the adoption of the International Code with this difference, that in place of the last three dashes each of the three minutes shall end with the six dot seconds as transmitted by 2LO.

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EXPERIMENTS ON THE RIVER.

The problem of keeping cool on a hot day, even during the excitement of outdoor transmission and reception, was effectively solved by the Hounslow and District Wireless Society on a recent Sunday, when a highly successful "River Day" was held. A photograph taken on this occasion forms our cover illustration this week.

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AMATEUR WIRELESS IN EARTHQUAKE.

The recent disastrous earthquake at Santa Barbara, California, called forth the pertinacity and resource of two wireless amateurs, Messrs. Brandon Wentworth and Graham George, by whose united efforts the stricken city was first put in touch with the outside world.

Although both their stations were smashed in the general upheaval, Wentworth and George were undeterred. Without delay they made for the local wireless store, and within an hour of the first shock they had assembled a three-inch spark coil, a rotary gap, a twelve-volt battery, and a transmitting key. An undamaged superheterodyne receiver from the store stock was commandeered, and the pair then sent out the S.O.S. In a few minutes replies were received from two ships, which were able to summon naval aid.

JAZZ MUSIC FROM CHINA.

A new manifestation of the "yellow peril" is observable in the recently published programme of the Shanghai broadcasting station, which includes two hours of jazz band music each day. The station transmits daily, except Sunday, on a wavelength of 356 metres, opening at 9.45 a.m. (local time), and closing at 11 p.m.

At Tientsin the Japanese firm of Giussho and Co. transmit daily gramophone selections on 350 metres between 7 and 9 p.m. It may be pointed out that time on the East Coast of China is 8 hours fast of Greenwich.

OPENING OF DAVENTRY. The Postmaster-General, Sir William Mitchell-Thomson, Bart, K.B.E., M.P., "snapped" in company with Lord Gainsford, P.C., at the base of one of the 500-ft. masts.

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AUSTRALIAN SHEEP FARMERS AND WIRELESS.

A unique wireless service to be established shortly for the benefit of Australian farmers has been described by Mr. E. T. Fisk, Chairman of the Amalgamated Wireless (Australasia), Ltd., in an interview with *The Morning Post*. The projected service will establish wireless communication between the remotest sheep-stations and the nearest telegraph stations. These will be linked to the Central Wireless Station, which will be in direct touch with the outside world.

Mr. Fisk, in company with Mr. G. Mason Allard, Chairman of the Amalgamated Wireless (Australasia), Ltd., is at present on a visit to this country for the purpose of completing arrangements for "beam" wireless communication between England and Australia.

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AMERICAN RADIO DEFICIT.

The first deficit in its history has been reported by the Radio Corporation of America, the last quarter's earnings showing a net loss of $391,000, compared with a net profit of almost $2,000,000 in the March quarter.

The chief cause of the decline is stated to be the price cutting of rival companies, the Radio Corporation having refused to lower its prices. Seasonal conditions are also regarded as partly responsible for the unfavourable results.

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WEATHER BROADCASTS FOR SHIPS.

At the expense of fitting a small broadcast receiver any vessel in the vicinity of the British Isles may now obtain weather forecasts for the succeeding 12 hours as a result of a new arrangement made by the Board of Trade. Provision has been made for broadcasting certain portions of the weather Shipping Bulletin by coastal stations and by the B.B.C. The Daventry station broadcasts the Meteorological Office forecasts at 9.30 a.m. (G.M.T.), and the stations at Liverpool, Bournemouth, and Newcastle transmit local forecasts between 9.20 and 9.35 p.m.

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MILL HILL WORKS WITH MACMILLAN EXPEDITION.

Mr. G. W. Goyder (G2HM), of Mill Hill School, one of the first British amateurs to communicate with New Zealand, has gained further distinction by securing two-way communication between this country and the MacMillan Arctic Expedition ship "Bowdoin." Communication was first established on Saturday, July

18th, and subsequent signals have been exchanged with the "Bowdoin," since she crossed the Arctic Circle, between the hours of midnight and 6 a.m.

Mr. Goyder's apparatus is of unusually simple construction. He works with a Mullard 250-watt valve on a wavelength of 40 metres, and employs a single-wire aerial. The receiver makes use of the Reinartz circuit, an interesting point in view of the fact that Mr. J. L. Reinartz, its inventor, is the operator of the equipment on the "Bowdoin."

Immediately Mr. Goyder picked up his first signal from the Arctic regions he set about to transmit, and received an acknowledgment at once, together with a request from the explorers to forward messages on their behalf to friends in the United States.

The Science Master at Mill Hill School will be glad to hear from any who receive signals from the "Bowdoin."

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FRENCH AMATEUR SEEKS TESTS.

F8UOU, an amateur residing near Paris, wishes to arrange tests with British amateurs on wavelengths between 20 and 40 metres. He transmits, principally on 36 metres, and with a power of 45 watts, every Tuesday and Friday evening. Communications may be addressed to F8UOU, c/o Mr. E. J. Erith, Winchfield, Albion Road, Sutton, Surrey.

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HIRE-PURCHASE ACCUMULATOR SERVICE.

A useful "Accumulator Service" is being conducted by Messrs. James and Williams, of 31, Queen's Road, Battersea, S.W.8. In addition to the usual charging arrangement, whereby an accumulator is collected, charged, and delivered for a small fee, an inclusive fee has been arranged for the provision of this service over a period of three months. The firm has also instituted a hire-purchase scheme, whereby customers may pay an inclusive quarterly fee for the service, the accumulator becoming the property of the customer after four quarterly payments. The firm maintains a 24-hour delivery service.

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ARCTIC SIGNALS HEARD IN NEW ZEALAND.

Mr. I. H. O'Meahe (New Zealand 2AC), of Gisborne, is reported to have picked up short-wave signals from the MacMillan Arctic Expedition.

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NRRL STILL BUSY.

NRRL, the experimental short-wave station with the U.S. Pacific Fleet, is maintaining its activity under the control of Lieut. F. H. Schnell, of the American Radio Relay League. Although the fleet is steadily steaming south-west and rapidly increasing the distance from the United States, consistent reports are still being received at League Headquarters of the reception of NRRL by American amateurs. One of the most interesting reports is that of W. K. Francis (U8PL), of Shawnee, Okla., who has reported good reception when the fleet was 6,000 miles south of Honolulu.

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BRITISH ENGINEERING STANDARDS ASSOCIATION.

In accordance with a scheme to widen the scope and influence of the work of the British Engineering Standards Association, the Main Committee of the organisation has decided to enlarge the membership so as to enlist the active support of all the great industries of the country.

The new membership is to include professional engineers, industrial firms, and business men, who are invited to become members of the B.E.S.A. at a minimum annual subscription of two guineas. The Prime Minister has addressed a letter to the Chairman, Sir Archibald Denny, Bart., expressing the hope that the Association will be successful in this effort, which he feels sure will contribute materially to maintaining and improving the efficiency of our national industries.

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VACANCIES FOR R.A.F. CADETS.

The next examination of candidates for entry as flight cadets to the Royal Air Force Cadet College, Cranwell, in January, 1926, will begin on November 17th. On this occasion not less than 35 cadetships will be offered. Forms of entry, which can be obtained from the Secretary, Civil Service Commission, Burlington Gardens, W.1, will not be accepted, in any circumstances, later than September 17th. The work offers great scope both in its military and in its technical aspects to young men of ability, and facilities are given to officers to specialise in aeronautical engineering, wireless telegraphy, aerial gunnery, and other subjects.

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INSTITUTION OF ELECTRICAL ENGINEERS.

The Committee of the wireless section of the Institution of Electrical Engineers elected for the session 1925-1926, comprises Major Basil Binyon (Chairman), and Messrs. R. C. Clinker, P. R. Coursey, C. F. Elwell, Prof. C. L. Fortescue, Prof. G. W. O. Howe, Capt. N. Lea, C. F. Phillips, Capt. H. J. Round, E. H. Shaughnessey, Commr. J. A. Slee, C. F. Trippe, L. B. Turner, Commr. G. C. Cardy, Major H. C. B. Wemyss, Major H. P. T. Lefroy, and Major A. G. Lee, members of the Council, the last four being nominated by the Admiralty, War Office, Air Ministry, and Post Office respectively.

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THE PRIME MINISTER AND DAVENTRY.

The following is the text of a letter from the Prime Minister to the Managing Director of the B.B.C., written on the occasion of the opening of the Daventry Station:—

10, Downing Street,
Whitehall, S.W.1.
July 21st, 1925.

DEAR MR. REITH,

I confess to a feeling of keen disappointment at my inability to attend the opening of the new Wireless Broadcasting Station at Daventry.

It is not too much to say that broadcasting is already contributing appreciably to the happiness and knowledge of the present generation. The opening of the Wireless Broadcasting Station at Daventry—the highest powered station at present in the world—will give no fewer than twenty million people the opportunity to receive both education and entertainment by means of cheap and simple apparatus; and I look upon Daventry as another milestone on the road to the social betterment of our people.

STANLEY BALDWIN.

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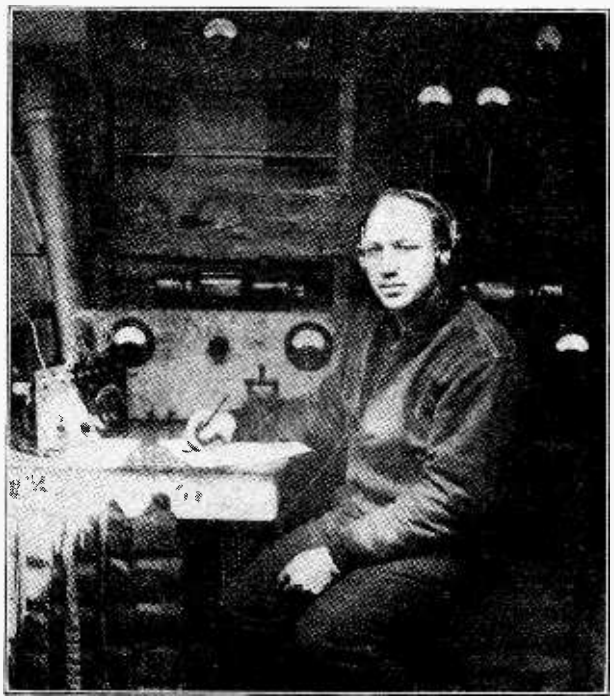


OPERATOR ON THE "BOWDOIN." Mr. John L. Reinartz, the well-known American amateur, who is in charge of the wireless apparatus on the MacMillan Expedition. The photograph shows the Zenith-Reinartz short-wave transmitter with which the "Bowdoin" is equipped.

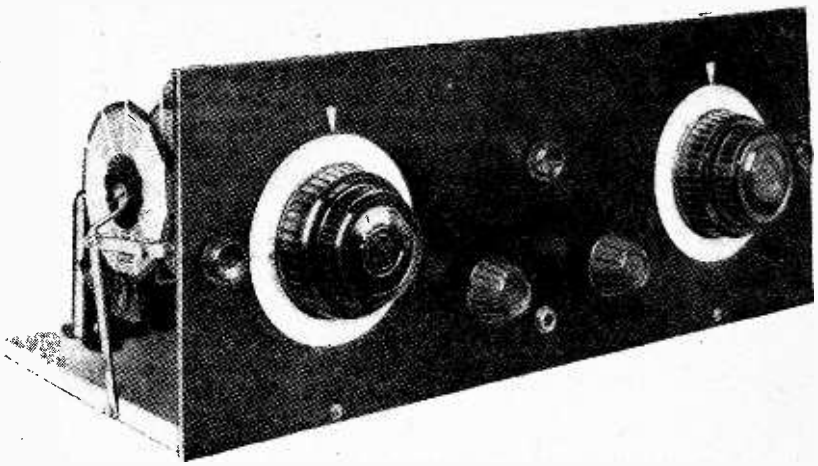
CATALOGUES RECEIVED.

Sterling Telephone and Electric Co., Ltd. (210-212, Tottenham Court Road, W.1). Publication No. 414. Sterling reaction units and adapters, with diagrams of circuits incorporating their use.

E. Vincent and Co. (Coimbatore, South India). "The Wireless Amateur's Handbook." A comprehensive catalogue of wireless sets and accessories by various well-known makers, with useful notes, glossary of technical terms, and list of broadcasting stations.

The Marconiphone Co., Ltd. (Marconi House, Strand, W.C.2). Brochure, "Splendour in Sound," describing the well-known Marconiphone loud-speakers and amplifiers and the various uses to which they have been put.

Further Notes on the ROBERTS REFLEX NEUTRODYNE RECEIVER.



By H. A. HARTLEY.

PROBABLY the greatest difficulty in setting up the Roberts reflex neutrodyne receiver [1] is in properly neutralising the capacity of the amplifying valve. It should be emphasised that if the neutralising process is not carried out properly, considerable interference may be caused to other listeners. A further result of such a condition is that the efficiency of the receiver may be lowered by as much as 50 per cent., and it behoves the operator, therefore, to be quite sure that the neutralising condenser is adjusted correctly.

Setting the Balancing Condenser.

Since the receiver will radiate if not neutralised, an obvious method of carrying out the process is to make adjustments until no radiation from the aerial takes place. Connect a pair of headphones and a crystal detector in series across the aerial and earth terminals, and tune the receiver to a nearby broadcasting station. Increase reaction to such an extent that the detector valve oscillates and an audible beat note is formed with the carrier wave of the station. If the amplifying valve is not properly neutralised, this beat note will be heard in the headphones connected with the crystal detector across the aerial and earth. Adjust the neutralising condenser until the beat note is no longer audible, ascertaining at the same time that the detector valve is still oscillating. This is a very simple but perfectly reliable method.

The system devised by the inventor of the circuit is as follows:—Closely couple the reaction coil to the radio-frequency transformer, and tune in the carrier wave of a station so that the beat note is heard as above, using only the second condenser. The pitch of the note is immaterial, provided that the setting of this condenser is not altered during the subsequent adjustments. If the first condenser is now slowly rotated, the intensity, but not the pitch, of the beat note will be found to vary on each side of a silent point. If it is found that the intensity *gradually* increases, *quickly* decreases, and *quickly* increases and decreases again, the dial being turned in the same direction all the time, the proper balance has not been obtained, and the neutralising condenser must be adjusted until the periods of gradual increase and decrease on either side of the silent point are of the same extent. This may, perhaps, be made clearer by means of Fig. 1.

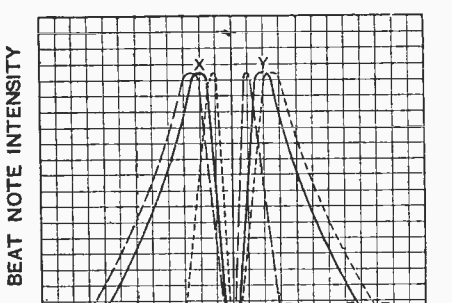


Fig. 1.—Illustrating the relationship of dial setting to intensity of beat note for different settings of the balancing condenser.

The curves AOD and COF show the unbalanced intensity of the beat note caused by too small or too great a capacity in the neutralising condenser. When this latter is at its correct value, the intensity is denoted by the curve BXOYE. Then a gradual increase from B to X, followed by a rapid decrease to the silent point O, is balanced by a rapid increase to Y, and a gradual decrease from Y to E, the curve being perfectly symmetrical about the point O.

Testing the Components.

Those who have constructed the receiver and cannot get it to work properly may be glad of the following hints.

Before assembly, all the components to be used should be tested for faults. A pair of headphones and a pocket lamp battery are all that are required to test the coils for continuity, or the condensers for short circuits. It is important to test the coil P when wound, to make sure that there is no short circuit between the two windings. Coils A and S_1 must be mounted at right angles to, and as far away as possible from, coils P, S_2, and R, and the variable condensers should be more than two inches apart.

The writer again wishes to emphasise that all coils must be wound in the same direction. In this connection it may be suggested that, if the coils are already mounted, reversing the connections to coils S_1 or S_2 may put matters right, although if the instructions in the constructional article are carefully followed, no difficulty should be experienced.

If regeneration cannot be obtained, the plate voltage on the detector valve is too low, or the connections to the reaction coil are reversed. If, on the other hand, regeneration is too fierce, the detector plate voltage is too high.

[1] Described in *The Wireless World*, July 1st, page 2.

Further Notes on the Roberts Reflex Neutrodyne.—

Should it be found that after several efforts the trouble cannot be traced, the whole receiver should be tested circuit by circuit. Insert the plug in the jack, connect the headphones in series with the detector high tension, and remove the amplifying valve from its holder. Connect the aerial to the plate socket of the first valve holder, the earth to the amplifier H.T. terminal, and short the primary of the audio-frequency transformer The receiver is now, in effect, an ordinary three-circuit regenerative receiver, and should be handled as such. Revolve the second condenser, and, with reaction well advanced, endeavour to tune in some station. If no carrier wave can be heard, the coils P, S_2, and R should be examined for reversal of connections or windings. Possibly the grid leak or condenser is at fault. If everything appears all right here, the aerial, earth, and amplifier tap of the H.T. battery should be connected to their proper terminals, the amplifying valve reinserted in its holder, and signals again tuned in. No results means that either the connections or direction of winding of coil S_1 with respect to A are reversed, or that the inside terminals of the coil P have been connected together instead of one inside to one outside. If satisfactory signals are still obtained, the trouble lies in the audio-frequency amplifier, and this should be tested as follows. Remove the short across the primary of the transformer, and connect the headpones and batteries in the normal position. Then connect the aerial to the fixed plates of the variable condenser across S_2 and the earth to the moving plates. The receiver is now functioning as a detector and one stage of audio-frequency amplification. Unsatisfactory reproduction may be due to unsuitable connections to the transformer, and these should be changed round and the effect noted.

By following the above method, each of the three portions of the circuit—the radio-frequency amplifier, the regenerative detector, and the audio-frequency amplifier—is tested in turn, and faults may be traced much more quickly than by testing isolated portions of the circuit without method.

It is important to try different positions for each valve, as some valves, although apparently identical with others, often perform much better as amplifiers than detectors, and vice versa. Valves of the B.4 or D.E.5 types are recommended for use in this receiver.

The correct voltage for the grid battery depends on the valves used and also the plate voltage. Various values should be tried, 3 or 4½ volts usually being found most suitable.

A correspondent raises the question of wavelength range of the receiver, and desires to know if it is practicable to use plug-in transformers to receive long-wave stations. The receiver has been designed for efficient reception between 250 and 500 metres, and it is difficult to make any receiver truly efficient for both long and short waves. The reflex neutrodyne could be adapted to receive such stations as Daventry or Radio Paris, but the loss in sensitivity would far outweigh anything gained by adding the few long-wave stations to its "repertoire."

T. and R. Bulletin.—A New Journal.

A journal devoted to the interests of the transmitting amateur has made its appearance during the week, and is conducted by the Transmitter and Relay Section of the Radio Society of Great Britain for private circulation among its members. There is no clearer field at the present time for the introduction of yet another journal devoted to wireless interests, and one which caters expressly for the transmitting amateur, and this new journal, in addition to containing articles and information of special appeal to the transmitter, should go a long way to increasing the membership and activities of the T. and R. Section.

The policy of the new journal is clearly defined in an editorial in which it is to be learned that the journal is to be conducted by a voluntary staff, working under the guidance of an editorial committee. It is the aim to include in the pages articles of a technical, though not unduly mathematical, nature, on transmission, and in particular relating to short-wave work, hints and tips of a practical nature in addition to a "Calls Heard" section and information relating to transmission tests. A query section is also to be included in which readers are invited to furnish replies.

An appeal is made for articles, and it is to be hoped that transmitting amateurs will come forward and render assistance in making the editorial pages a success, for on the merits of the submitted articles the success of the journal depends. Judging from the first issue, however, there is no doubt this new journal will go ahead, for although limited in its appeal it will certainly fulfil an urgent need.

The address of the editorial office is 1, Montreal Road, Ilford, Essex, and copies of the journal are obtainable by taking up membership of the Transmitter and Relay Section. Application should be made to the Hon. Secretary, T. and R. Section, Radio Society of Great Britain, 53, Victoria Street, London, S.W.1.

NEWS FROM THE CLUBS.

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Lewisham and Bellingham Radio Society.

On July 21st an interesting evening was spent in discussing "Gadgets and Tips." Among the subjects dealt with was a useful multiple switch designed to overcome "dead end" effects in tuning inductances. The instrument proved highly efficient on test. Mr. E. R. J. Lampard described a method of soldering aluminium in which the solder used consisted of 8 parts of tin and 2 parts of zinc. As a suitable flux he recommended 8 parts of steric acid, 1 part of tin chloride, and 1 part of zinc chloride. Mr. Lampard uttered a special warning against overheating the aluminium and advised the use of a nickel soldering bit to avoid discolourisation of the parts to be soldered.

Particulars of membership of the Society may be obtained from the Hon. Secretary; Mr. C. E. Tynan, 62, Ringstead Road, Catford, S.E.6.

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Worthing Wireless Society.

Evidence that this new Society is progressing by leaps and bounds was provided at the last monthly meeting, held on Tuesday, July 14th, when a large number of members and friends assembled to hear a lecture on the elementary theory of wireless, delivered by the Hon. Secretary, Mr. H. N. R. Moore, B.A., B.Sc.

The lecturer dealt first with the nature of the waves in air and ether, proceeding to an explanation of the theory of the atom and the electron. He concluded what he termed "a hasty sketch" with a description of conductors and insulators and an explanation of lines of force.

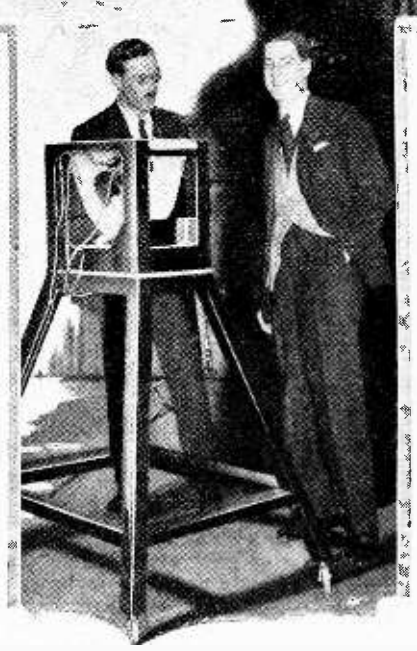
Mr. Moore intends to deal more fully with each branch of the subject in future lectures. The Society has inaugurated an instrument fund by means of which it is hoped that the members will soon have an adequate collection of components for experimental purposes.

It is understood that Captain P. P. Eckersley, chief engineer of the British Broadcasting Company has signified his willingness to lecture at the opening meeting of the winter session in September.

Hon. Secretary; Mr. H. N. R. Moore, 18, Courtis Avenue, Broadwater.

BROADCAST BREVITIES.

NEWS FROM THE STATIONS.



Daventry "on the Air."

Amid the almost universal approbation that has greeted the opening of the new 5XX, one or two dissentient voices have been heard. The ground of complaint is the quality of programmes, a subject which invariably lends itself to treatment by those who make almost a speciality of criticism, whether it be just or undeserved. It was said that if the B.B.C. had the programmes to arrange for any theatre, music hall, or picture house, they would empty it in a fortnight.

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Comparisons.

The difference between the task of the theatre or music hall syndicate and that of the B.B.C. is obvious to the most ordinary intelligence. No broadcast programme could be repeated on successive nights, nor even in successive weeks. Indeed, on a recent occasion it was proposed to broadcast from 2LO a programme which had been given from the station three weeks earlier; and although the first broadcast was, by the concensus of listeners' opinions, shown to be extremely successful, the programme officials decided that the interval was not long enough. The second performance, therefore, did not take place from 2LO, but from another station.

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To Avoid Monotony.

New talent is called for with increasing insistence as one means of avoiding monotony; because in all probability, even with first-class artists, it would in a very short time be discovered that broadcast listeners could have too much of a good thing. Variety is the spice of broadcasting, and however good any particular item may be, a reasonable amount of time must elapse before it is given again to listeners.

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At the Theatre.

In the case of a theatre, those members of the audience who have not appreciated the items offered do not dream of going to hear them again. Broadcast listeners, however, expect something different—which may or may not appeal to them—to be provided on each successive night.

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Problems.

The B.B.C. is confronted with the problem not only of improving the quality of its music: of omitting this or that talk at the instance of some few listeners; or of introducing more dance music at the request of others; but of covering as many interests as possible each evening with something that will appeal to the greatest number of people, hoping fervently the while that few will sit for a solid five hours of the evening with headphones on, or loud-speaker going at full blast, in the expectation that the whole evening's programme will keep them enthralled from beginning to end; and that if it does not keep them so enthralled, that they will have any grievance against the officials who are striving to please all tastes.

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Licences Abroad.

In a Swedish town where the Chief of Police is on the Radio Committee, it was believed that only a small proportion of the listeners actually held licences, and one morning practically the entire police force of the town was detailed by the Police Chief to make house-to-house enquiries. Many offenders were caught, prosecuted, and fined. Within a week the number of licensees had doubled. When the Government's attention was called to the action taken by the Chief of Police they approved it, and ordered other towns to adopt the same methods. When the information reached a certain small town that this was to be done a long queue quickly formed up outside the Post Office, and, shrinking modestly in an effort to efface himself in the queue, stood the Mayor of the town.

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School Transmissions.

The satisfactory results attending the school transmissions during the term recently ended encourages the belief that the arrangements for the next school term will undergo considerable expansion. Education authorities in various parts of the country are coming more and more to realise that in certain phases of school instruction, tuition will be undertaken by the one or two persons in all the world most qualified to give it.

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Lecturers.

It is an anomaly that the geography lesson, for example, should be under the direction of a person who perhaps has never been beyond the shores of England. Far better results could be achieved if the lesson were given by a person actually acquainted with the section of the globe with which the lesson dealt, or, as a compromise, if the lesson were divided so that the first part were handled by such an authority, and the second part were taken over by the local teacher, who could control the process of digesting the instruction which had been given.

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History Lessons.

History lectures could also be given by broadcast by men and women who had devoted their lives to an intimate study

FUTURE FEATURES.

Sunday, August 9th.

LONDON.—3.30 p.m., Mendelssohn Favourites. 9 p.m., Light Symphony Concert.

Monday, August 10th.

LONDON.—9 p.m., "Beating the Retreat," relayed from Dover.
BIRMINGHAM.—8 p.m., "An Hour in Devon."
CARDIFF.—8 p.m., Women's Night.

Tuesday, August 11th.

LONDON.—8.15 p.m., A Revusical Extravaganza, "Winners" (2nd Edition). S.B. to all Stations.

Wednesday, August 12th.

LONDON.—10.15 p.m., Pianoforte Recital by Sapellnikoff.
GLASGOW.—8 p.m., Musical Comedy (with Joan Hay) and Light Opera.

Thursday, August 13th.

5XX.—9 p.m., An hour from Wellington Pier, Great Yarmouth.
LONDON.—9 p.m., "Radio Radiance" (1st Edition).
ABERDEEN.—8 p.m., Scandinavian Night.

Friday, August 14th.

LONDON.—10.45 p.m., Excerpt from "By the Way," relayed from the Apollo Theatre.
CARDIFF.—9 p.m., Scenes from "The Merchant of Venice."

Saturday, August 15th.

LONDON.—9 p.m., "Radio Radiance" (2nd Edition).
BOURNEMOUTH.—8 p.m., "Navy and Army."

of particular periods in the story of the world. This is suggesting no more than is done at present as regards medicine and surgery. The appointment of specialists is just as important for education purposes. Broadcasting would thus become the handmaiden of the teacher.

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Interchange of Programmes.

It was recently announced that the Radio Corporation of America had completed arrangements with Germany for the interchange of programmes, and Major-General J. G. Harbord, of the Radio Corporation of America, concluded, during his recent visit to Germany, an agreement for a regular exchange. He predicted that within a year Americans will be receiving concerts from Germany on their own receiving sets.

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B.B.C. Plans.

The arrangement with the B.B.C. is on a different footing, and is much more complete. The B.B.C. approached the question in a systematic way by taking the leading part in the formation of the International Broadcasting Union, the idea being first of all to find a definite solution of the problem of wavelengths so as to check interference, which, otherwise, would be a continual obstacle to broadcasting progress. The wavelength question is a prelude to the successful interchange of programmes, first with the Continent, and then across the Atlantic, and it has already been shown that a determined attempt is to be made in a month's time to clear up the position as regards jamming.

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Via Daventry.

With that problem settled, the B.B.C. is in a fair way to its second objective. Daventry will then be the pivot upon which the success not only of the B.B.C. scheme for supplying an international service to British listeners will turn, but for ensuring the success of the American-German proposed interchange of concerts.

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B.B.C. Clearing House.

The Germans do not possess the necessary funds to enable them to erect apparatus capable of sending their programmes to the States, and the B.B.C., through its new high power station, will act as a sort of clearing house for receiving and relaying the programmes between Europe and the west.

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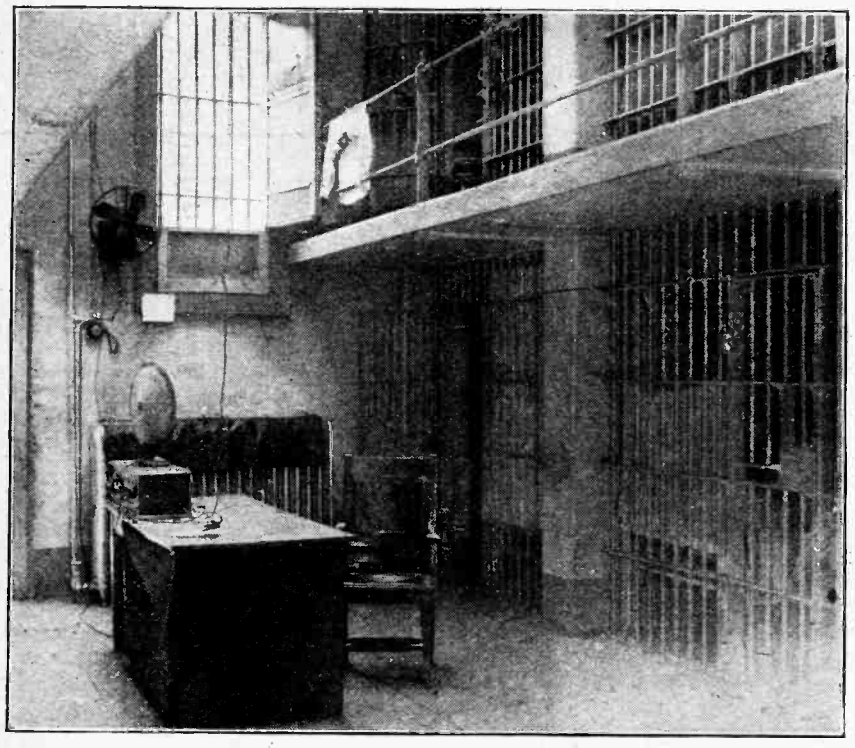
"Good-night, World."

We referred in these notes a week or two ago to the recent innovation at 2LO of ending the Sunday transmissions on a note in keeping with the solemnity of the Sabbath, and of getting away from the stereotyped "Good-night, everybody," which has come to be regarded as too casual and not sufficiently intimate to establish the spirit of true comradeship between listeners and that comparatively small band who are administering to their broadcasting wants.



BROADCAST RECEPTION IN PRISON. American convicts enjoy privileges that are denied their cousins in other lands. This photograph, taken at the Sing Sing Prison, New York, shows a broadcast receiver used to entertain the inmates.

Remembering Everybody.

A mass of correspondence has been received at Savoy Hill in appreciation of a development of the idea which was tried on Sunday, July 19th, when the announcer made a point of mentioning fifty localities or more by name, and bidding them a grand "Good-night" in appropriate phrase. The holiday-makers by Dee and in Devon, the stout toilers in the Midlands, the dwellers by lake and fell, and by the banks and braes of bonnie Scotland; the citizens of all the big cities and the islands round the coasts, and even our visitors and guests from overseas were not forgotten.

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Map Searching.

In the broadcasting of the B.B.C.'s "Pax vobiscum," the announcer had scoured the map of the British Isles pretty thoroughly, but correspondence showed that even so he had but half-fulfilled his object, for from peaceful hamlets and the wooded dales came mild protests at their non-inclusion. This was not an oversight, but, as the announcer explains, had he mentioned all the places worthy of inclusion the names would have filled a fairly bulky volume. In the next grand "Good-night" amends will be made.

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A Morning Transmission.

A morning transmission will take place from Bournemouth station on August 18th, from 11.30 to 12 o'clock. This will consist of an organ recital by Mr. Arthur Marston, relayed from the Royal Arcade, Boscombe. It is hoped that this new departure of morning transmissions three days a week will prove popular.

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Massed Bands Broadcast.

Bournemouth will relay the Naval and Military Tattoo from Portsmouth on August 15th, from 7 to 9.45 p.m. Massed bands will consist of 240 performers, with a male voice choir of 500.

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An American Play.

On August 19th the Manchester programme will include a performance by the 2ZY Mermaid Club of a short one-act American play, "Mrs. Pat and the Law," by Mrs. Arthur Aldis. This play is of the type that is very popular in the little theatres of America, and if successful will be the first of a series.

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Outside Broadcasts.

It has been suggested that the possibilities which outside broadcasts offer have been practically exhausted, and that the seaside, the Zoo, the Cathedral, the submarine, the nightingale, and similar broadcasts have already furnished all the novelty to be extracted from that class of transmission. This, however, is a despondent view of the opportunities which the microphone affords for introducing the unusual into the drabness of our normal life. We have had broadcasts from under water, from the coal mine, and from the air; but a really first-class concert from the saloon of an air liner has yet to be given to listeners.

ACOUSTIC PROPERTIES OF ROOMS.

Interesting Facts on the Effects of Echo, Reverberation and Resonance.

By HARRY A. GAYDON, A.M.I.A.E., A.I.P.I.

IN studying the science of sound, no aspect is perhaps more fascinating or interesting than the acoustic properties of rooms. Very small rooms naturally do not lend themselves so readily for experiments in this science, as a variation in the behaviour of sound in any two rooms of about the same size would be in most cases so minute that they would not serve for practical purposes. With rooms of fairly large dimensions, however, it is quite a different matter, and often a very little difference in the construction, size, shape, or material will make a considerable difference in the acoustic properties. For the better consideration of this subject, it will be as well first of all to get our minds clear on the questions of echo, reverberation, and resonance. Let us, therefore, imagine that we are in the exact centre of a perfectly spherical room, occupying a point of space only, the surrounding wall completely enclosing us. Fig. 1 may help to give the idea.

Our hypothetical room would have to be constructed of a perfectly smooth, non-resilient material, capable of reflecting every scrap of sound without loss. The wall at any point would, of course, be exactly the same distance from the centre. Now, if a non-directional sound be produced at the centre, it would travel away in all directions and reach every part of the wall simultaneously. As it would strike the surface at every point exactly at right angles it would be reflected back along the same path by which it came, and would be returned without loss or modification to the centre from whence it originated, all at precisely the same moment. Incidentally, it will be seen that the greatest concentration of sound will be at the centre, and anyone listening here would get the impression of greatest volume. As the sound waves radiate from the centre, so will the power or amplitude of the waves diminish, and if listened to at various points between the centre and the wall, it would be found that the least concentration, or power, or amplitude, or volume, whichever way you prefer to think about it, will be at the surface of the wall.

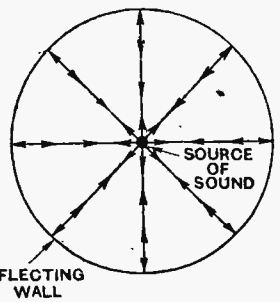


Fig. 1.—Representing a spherical room.

Echo.

Sound travels, as is well known, at approximately 1,100ft. per second in still air at a temperature of, say, 0 deg. Centigrade, or 32 deg. Fahrenheit. Also it is computed that sound persists on the ear for one-tenth of a second after the actual sound vibration has stopped. This would be represented by a distance of one-tenth of 1,100ft., which equals 110ft. Therefore, to obtain a true echo, that is to hear the reflected sound in its entirety after the originating sound is finished, we shall require a space of a certain size. The size will be governed by the length of time occupied to complete the original sound. As an instance, let us take a sound of one second's duration. A single note of a whistle, two or three spoken words, or whatever you wish, then the wall or reflecting surface must be sufficiently far away to take the sound at least half a second, plus one-twentieth of a second, to reach it, when it will take the same time to return, making one second, and a tenth of a second together. The tenth of a second, of course, is to allow for ear persistence. The reflected sound would then be heard at the centre of the room after the originating sound was completed, and a true echo thus produced. The room then would have to have a minimum diameter of 1,210ft., that is 1,100ft. plus 110ft. If a little larger there would be a lapse of time between the completion of the originating sound and the reception of the reflected sound, the length of which would be in proportion to the extra size.

Supposing now a sound of one second's duration is produced in a room 550ft. across, the wall would be in this case 275ft. away. The reflected sound will commence to arrive back in half a second; in fact, before the originating sound of one second is finished. The result of this would be that the reflected sound would, at it were, mix with the originating sound for part of the time and the effect of a true echo not be produced. For the sake of simplicity we will, for the time being, ignore the question of ear persistence. Anyone listening in the centre of the sphere, taking a simple sound, as, for example, a single note of a whistle, would at first hear the originating sound at its natural volume for half a second. The returning sound will now commence to arrive and add its volume to the original for another half a second and the intensity of the sound will be doubled. The originating sound now ceases, but the reflected sound will continue for another half a second at the original intensity. The observer will thus hear half a second of natural intensity, half a second of double intensity, and another half a second natural intensity again. The effect produced during the second half a second is known as reverberation. Due to this phenomenon the true sound is often greatly modified, its length of time extended, and the volume varied.

Reverberation.

Now if the sound is prolonged, it will be seen how, under certain conditions, it can be greatly amplified without undue modification. This may be looked upon as a form of resonance, although resonators as employed in some musical instruments are quite small affairs, and their length has a direct relationship to the wavelength

Acoustic Properties of Rooms.—

of the particular note that is being reinforced. This, however, is another matter. With a simple sound, as before mentioned, this may or may not, according to circumstances, be an advantage, but when we come to complex sounds, such as the spoken word, it will be realised that the modification will have the effect rather of mixing up the words and making them unintelligible. Let us take two simple words—NOW and THEN—and let us suppose that each takes half a second to pronounce. We first utter the word NOW. This travels towards the wall and returns just in time to mix itself up with the word THEN. We are looking at the problem in its simplest possible aspect. We are imagining, in fact, that the sound travels once only straight to the walls and back to the centre and then stops entirely, but were it possible to conduct the experiment above propounded, it would probably be found that the sound would continue for an indefinite period of time, thus adding further confusion. From the foregoing we shall now see that it is reverberation that we have principally to deal with when considering this question of room acoustics, for true direct echoes of the sound of one second's duration or over could only occur in buildings of very large dimensions, and then only under very special circumstances.

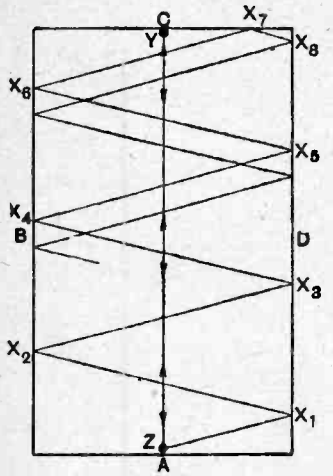


Fig. 2.—A rectangular room with smooth walls, A, B, C and D, and source of sound, Z.

If the originating sound was less than one second's duration, then the building could be proportionately less in size, but owing to ear persistence this cannot be reduced beyond certain limits.

Under certain circumstances indirect echoes might be obtained in a much smaller chamber than that required for a direct echo and yet produce a similar effect, for instance, by the sound being reflected back and forth from wall to wall and eventually returning to the observer by divers routes, but it will be found on examination that the length of path travelled will equal that of a direct echo.

Now up to this point we are taking only the simple aspect in order to get a clearer understanding, and have not, therefore, limited ourselves entirely to practical considerations. In practice, however, rooms exist having an almost infinite variety of shapes and sizes quite apart from the material of which they are built, and it will be seen that the reflection of sound causing reverberation begins to become very complex.

Example of Room with Smooth Walls.

Fig. 2 is a representation of a large rectangular room bounded by smooth walls—A, B, C and D—there being no obstructions whatever. Let a source of sound be at Z. This will then travel towards walls B, C and D, the sound being close to A cannot travel in this direction. Immediately in front of Z the sound will strike wall C at point Y and be returned along the same path, thus obeying the law known as "Angle of Incidence," which simply is that at whatever angle sound strikes a flat surface, so it will leave but in the opposite direction. For the benefit of those who are not familiar with this law, Fig. 3 will make matters clear. A is a flat surface. If a sound is projected towards A from point D, which is exactly at right-angles to surface A, then it will strike the surface and be reflected back along the same path. If at B_1 it will strike surface A at a certain angle and be reflected to B_2, at exactly the same angle in relation to the surface. The same will happen with C_1.

Owing to the nature of sound vibrations, sound tends to disperse in all directions, although its greatest intensity will travel, for a considerable distance at any rate, in the direction of its propagation. In the case of a speaker, either of the human or mechanical variety, standing at Z and directly facing Y, the greatest intensity would, of course, reach Y and be reflected back, as before explained, but all the sound does not reach this point. Some of it will strike wall D at a lesser intensity at, say, point X_1, and will be reflected to X_2, and so on to X_8, and continue until it dies away, or is, in other words, absorbed or destroyed. Also it will strike wall B at this and other angles and in addition above and below the level of the speaker, and a little thought will soon convince what an infinite number of paths the originating sound will travel in a room of this shape. It will be seen now that this study is beginning to become complicated, and when one takes into further consideration the floor, the roof, and the fact that sound will travel backwards and forwards in some cases many times before finally dying away, the matter becomes still more involved. Added to this, many rooms, and especially halls, have supporting pillars, recesses, projections, and so on, all of which have their influence. It is not at all an easy matter, as will be seen, to design a room and know definitely before it is built what its acoustic properties will be when completed, but all the same some conclusion can be arrived at by very careful study.

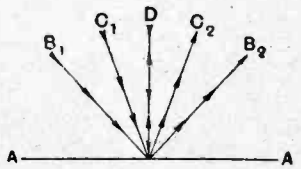


Fig. 2.—Explaining the "Angle of Incidence" law.

Best Position for Speaker.

Take, again, Fig. 2. It will now be obvious that the position of the speaker will also have its influence, and in many places will make a very great difference in the resulting effect, for to vary this position means creating new conditions.

Whilst on this point, it may be well to mention that there is a best position for a loud-speaker, gramophone, or come to that, a singer or instrumentalist, in every room, and often a little experimenting in this direction will repay the time and trouble expended.

In an oval building, such as, for example, the Royal Albert Hall, London, in which the writer has conducted many experiments—and most interesting and instructive

Acoustic Properties of Rooms.—

they were—the results obtained could well be accounted for by the above explanation.

On the behaviour of curved surfaces, one way to study these is to consider it as being composed of an infinite number of flat surfaces. The angle of reflection can then be worked out quite easily.

It is generally acknowledged that a certain amount of reverberation improves the tone of some instruments, or combination of instruments, such as a piano, organ, orchestra, etc., but the conditions that would suit these would not necessarily improve speech; in fact, in most instances it would prove detrimental. Most are familiar with the excellent tone of a good piano in a fairly large empty room, and how this tone becomes deadened on the introduction of furniture, carpets, curtains, etc., or in the case of halls, how different one's voice sounds before to what it does after the arrival of the audience. All of these have the property of absorbing sound, and thus reducing or entirely preventing reverberation, and it follows that a few heavy curtains placed correctly in some rooms or halls that are so bad for speech that words cannot be distinguished will often effectively remedy matters.

Under certain conditions, too complicated to be gone into here, sound can be made to destroy itself, and it is not impossible to design a room having properties of this nature and so prevent undue reverberation. As in the case of light, a perfectly smooth reflecting surface will not scatter the sound waves, but an uneven surface will do so. With light everyone knows that a perfect surface will reflect the rays without distortion; thus we have a mirror where it is possible to reflect an object almost to perfection. This is because the lines of light are not deflected. Take, now, the same mirror and cause its surface to be frosted, or in other words roughened, no image will be visible. The surface now possesses a very large number of different angles, and the light is thereby scattered. Light waves are exceedingly minute, so much so in fact, that they are affected in this way, even by the very slight roughness caused by the processes of frosting, but in the case of sound a frosted surface would not perceptibly affect it. This is owing to the comparatively exceedingly long waves that comprise sound, and to scatter it in a similar way the surface would have to be very rough indeed. Nevertheless, it is a condition that is sometimes met with, and in the writer's opinion does not always receive the amount of consideration it should do. Temperature and air currents also have their influence, as well as the material of which it is built. Some materials absorb or destroy sound more readily than others; thus it comes about that the results in two rooms of identically the same size and shape will produce widely different results.

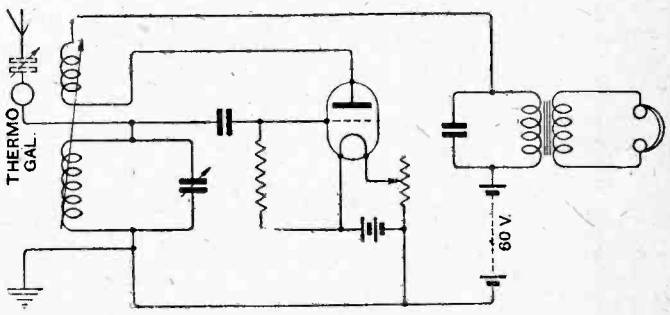
REACTION AND INTERFERENCE.

Tests on Oscillating Receivers.

TESTS have been made at the Post Office Research Station at Dollis Hill with a single-valve reacting receiver connected as in the accompanying diagram. Of special interest are the measurements taken when a D.E.3 valve (3 volts 0.06 ampere filament) was used. The oscillating current produced in the receiving aerial was measured with a vacuo-thermo junction and mirror galvanometer, and tests were made at a number of wavelengths. The results are given in the table:—

	Wave-length.	Aerial Coil.	Reaction Coil.	Aerial Current. Milliamperes.
Using series aerial condenser	400	100 μH.	250 μH.	1.1 —3.3
	400	100 μH.	500 μH.	2.15—5.0
Using parallel aerial condenser	600	250 μH.	500 μH.	0.95—3.3
	600	250 μH.	1,000 μH.	0.95—4.1
	1,000	250 μH.	500 μH.	0.7
	1,000	250 μH.	1,000 μH.	0.7 —1.6

The report[1] does not state whether the apparatus was set up and adjusted to give smooth reaction such as would be done by the average broadcast listener; rather would it appear that a very large reaction coil was used to generate more or less strong oscillations. It is interesting to learn, however, the magnitude of the comparatively large oscillating currents which can be set up in a receiving aerial merely by using a large reaction coil suitably coupled to the aerial coil.



Connections of the test apparatus.

It is stated that in some transmission experiments carried out at Devizes on a 250 feet high aerial, with an aerial current of 10 milliamperes on 1,800 metres, good C.W. signals were generally received at Dollis Hill, about 75 miles distant. It will therefore be appreciated that very considerable interference can be caused by an oscillating broadcast receiver

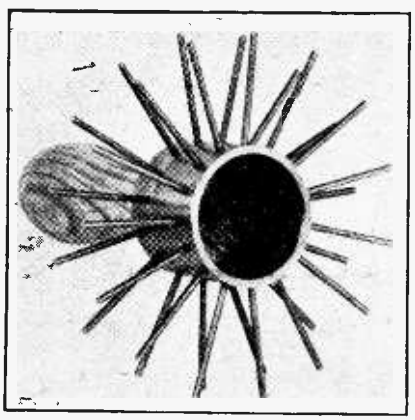
[1] The Post Office Electrical Engineers' Journal, Vol. 18, Part 2, page 174.

New Apparatus

A Review of the Latest Products of the Manufacturers.

WINDER FOR HONEYCOMB COILS.

There are many amateurs who prefer to construct the components used in the building of their receiving equipments, and a coil winder is a very necessary tool which should be kept to hand for making coils to given inductance values. It is not always an easy matter to construct a former for the purpose, particularly as the cylinder must be accurately divided, whilst all of the pegs are inserted into threaded holes carefully drilled and



The new Anvil coil winder is fitted with a handle which renders rotation of the drum a simple operation.

tapped so that they point exactly to the centre.

The Anvil Coil Former, made by Messrs. Burwood Electrical Supplies (1914), 41, Gt. Queen Street, Kingsway, London, W.C.2, consists of a cylinder with spokes according to the usual design, but possesses the great advantage that it is fitted with a conveniently shaped handle which makes coil winding a much easier process than when endeavouring to rotate a former by gripping the spokes. This useful winder is well made and inexpensive. It is supplied with data for winding coils to tune to various wavelengths and stations, and information is given as to the tuning range obtained with series and parallel condensers of various capacities.

B 28

RADIO "CONDIT."

Tinned copper tube is now available from Autoveyors Limited, 82-84, Victoria Street, Westminster, London, S.W.1, for the purpose of making instrument connections and a variety of other uses readily apparent to the amateur. In diameter it corresponds with No. 16 gauge wire and is obtainable in packets of six 24in. lengths.

Readers will appreciate the advantages to be gained by using this tubular conductor.

c c c c

THE DUBILIER MANSBRIDGE VARIOMETER.

With a view to providing a compact tuning instrument the Dubilier Condenser Company are now producing a variometer constructed on somewhat unique lines.

Four D-shaped inductances are arranged in a flat moulded case so that two of them may be rotated over the other pair, which are held stationary. The actual windings are of the basket type, and links are provided so that the coils may be connected either in series or parallel. The particular form of construction adopted produces a wider inductance range than is usually obtained. When bridged with a condenser having a capacity of 0.002 mfd., a wavelength of approximately 270-600 metres is produced, whilst for tuning to a wavelength of 1,600 metres the variometer may be bridged with a fixed condenser having a capacity of 0.002 mfd.

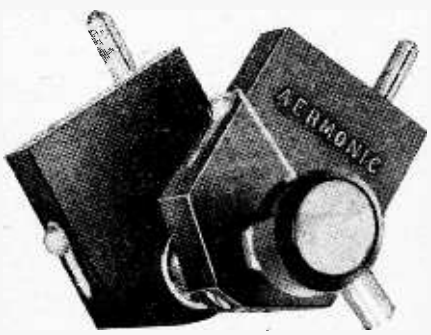
The instrument is well constructed, and a coiled bronzed spring is used for picking up contact with one end of the moving windings. The metal parts are nickel plated, and a good quality 0 to 180° dial is provided with a grub screw fixing.

The compact variometer recently produced by the Dubilier Condenser Company.

c c c c

AERMONIC COIL HOLDER.

When designing receiving sets one often finds the need for a two-coil holder suitable for mounting behind the instrument panel. Messrs. V. R. Pleasance, 56, Fargate, Sheffield, have recently added to



The Aermonic two-coil holder for mounting behind the instrument panel. A pointer and scale indicates the position of the moving holder, and is a relief from the customary engraved scale.

their range of components a coil holder to meet this requirement.

One holder is held firmly in position by means of the lock-nuts, which provide the one-hole fixing, and a long split bearing carries the spindle which rotates the other holder. The coil holder is well finished, the metal plates being nickel-plated and should prove quite durable in service.

Instead of the customary bevelled dial with engraved scale, a handle and pointer are provided, the latter being constructed in white material, which, in contrast to the black ebonite terminating piece to the spindle, gives an attractive appearance on the instrument panel.

VALVES WE HAVE TESTED.

M.O. D.E.5A and Ediswan A.R. 0·06.

A REVIEW of the desirable features of valves to be used in wireless receivers shows that for effectiveness it is necessary to use special valves in the different parts of the set. For instance, care must be taken in the choice of the last valve in the receiver, which works into the loud-speaker, for this valve is required to convert the signal voltages applied to the grid into current for operating this instrument.

For ordinary purposes it is desirable that the necessary anode supply be at a pressure of about 120 volts, and that with this anode voltage the characteristics of the valve be such that a considerable grid voltage can be applied without running off the straight portion of the grid volts-plate current curve or producing grid current. Such a valve is the M.O. D.E.5A, a modification of the well-known D.E.5. Designed for the final stage of a low-frequency amplifier, it is capable of delivering considerable power to the loud-speaker.

With the exception of the grid, the electrode arrangements are similar to those of the D.E.5, but the present design gives a very long, straight characteristic at a really moderate plate voltage.

The filament is rated at 0.25 ampere at 5 to 6 volts; plate potential, 60 to 120; and the test results obtained are given in the following table:—

D.E.5A.

(M.O. Valve Co., Ltd.)

Filament volts, 5.5. Filament current, 0.23.
Emission (total), 35 milliamperes. Filament efficiency, 28 milliamperes per watt.

Plate Volts.	Plate Current (Milliamps.) at Zero Grid.	Grid Bias. Volts.	Plate Current.[1] Milliamps.	Magnification Factor.	Plate Impedance. Ohms.
40	4.4	− 2	2.8	3.6	5,000
60	9.0	− 4	5.5	3.5	4,600
80	14.5	− 7	7.8	3.4	4,250
100	20.8	−10	10.0	3.4	4,000
120	27.5	−14	11.8	3.4	4,000

[1] Plate current when grid is biased to value of Col. III.

From the above table it will be seen that valves of this kind necessarily cause a heavy demand on the H.T. battery, and, therefore, a really good class unit should be installed.

The figures further show the very large input which can be applied to the grid at the highest plate voltage; a grid swing of at least 26 volts can be applied without distortion in the output.

We have used the valve with marked success as the last stage of a L.F. amplifier in connection with tests performed on a number of loud-speakers, and the output from the valve has been sufficient to operate some of the largest types on the market. Indeed, in some cases it has been an easy matter to overload the loud-speaker, which shows that the valve can supply all the energy required without being worked to its full capacity.

The D.E.5A is, of course, a special valve designed for a specific purpose, and for such it can be recommended.

IN a recent issue of this journal we commented on the fact that the Ediswan Company have replaced the A.R.D.E., which came in the general purpose class, by two separate types, A.R.D.E. H.F. and A.R.D.E. L.F. The first is intended for H.F. and detector work, and is designed to have a moderately high amplification factor, whereas the second, having a lower "m" value, is particularly suitable for use in L.F. amplifiers. Test results on these types were given.

In pursuance of this policy, the A.R. 0.06 has now been superseded by two types, samples of which have been sent to us for test purposes.

As both the H.F. and L.F. types have the same outward appearance, the Ediswan Co. have placed a distinguishing line on the bulb, the H.F. valves bearing a red line, and the L.F. valves a green one. The A.R. 0.06 H.F. and L.F. are similarly rated by the makers, this being: Filament volts, 2.5 − 3.0; filament current, 0.06 ampere, maximum plate voltage 100. The H.F. valve showed an amplification factor of 10 with an impedance falling to 32,300 ohms at the maximum rated plate voltage. Circuit tests on this type were entirely satisfactory, neither filament nor plate adjustments being at all critical.

For the L.F. type the amplification factor worked out between 6 and 7, the plate impedance being 19,000 ohms at the maximum plate voltage, and the grid biased to −6. At this setting the valve will handle quite a large input, yet the plate current is only a little over 2 milliamperes.

Both the types under review are good examples of their class, and to the user who requires 60-milliampere valves they can be confidently recommended.

Tabulated test results follow, which show in a small compass the performance of these valves:

A.R. 0.06 H.F.

(Edison & Swan Electric Co., Ltd.)

Filament volts, 3.0. Filament current, 0.07 amp.
Emission (total), 9 milliamperes. Filament efficiency, 42.8 milliamperes per watt.

Plate Volts.	Plate Current. Milliamps.	Grid Bias. Volts.	Plate Current.[1] Milliamps.	Amplification Factor.	Plate Impedance. Ohms.
40	0.6	−1.0	0.33	9.9	50,000
60	1.05	−1.5	0.7	10.0	44,500
80	1.65	−2.5	0.94	10.0	36,500
100	2.27	−3.5	1.25	10.0	32,300

[1] Plate current when grid is biased to the value of Col. III.

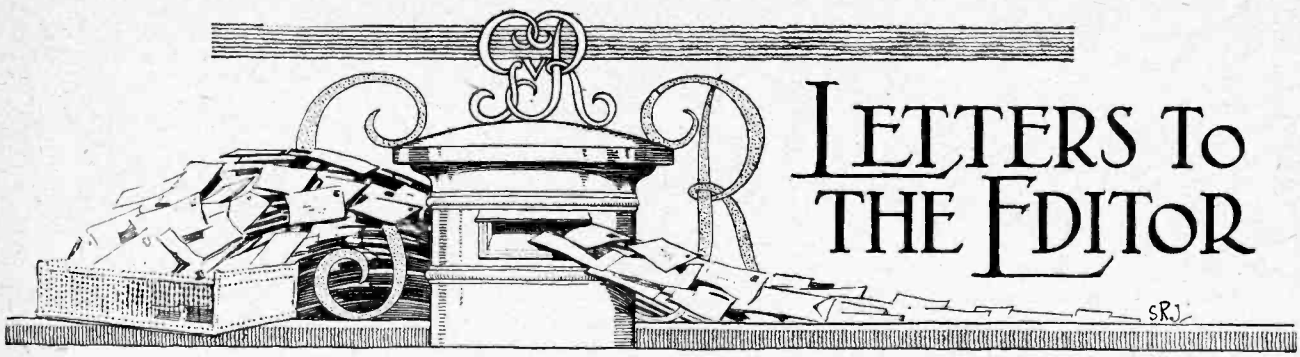
A.R. 0.06 L.F.

(Edison & Swan Electric Co., Ltd.)

Filament volts, 3.0. Filament current, 0.069 amp.
Emission (total), 6.8 milliamperes. Filament efficiency, 32.8 milliamperes per watt.

Plate Volts.	Plate Current. Milliamps.	Grid Bias. Volts.	Plate Current.[1] Milliamps.	Amplification Factor.	Plate Impedance. Ohms.
40	1.25	−1.5	0.875	6.8	26,700
60	2.2	−3.0	1.25	6.4	22,500
80	3.4	−4.5	1.73	6.2	20,000
100	4.6	−6.0	2.33	6.2	19,000

[1] Plate current when grid is biased to the value of Col. III.



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

Correspondence should be addressed to the Editor, "The Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

WIRELESS AND VEGETATION.

Sir,—Mr. White's letter in your issue of July 15th raises what is to me a very interesting point. I do not think that it is generally realized how effective aerials are in screening the ground underneath and near by from the effects of the earth's field. On a normal fine day the earth's surface is negatively charged, the corresponding positive charge being situated as a kind of space charge in the atmosphere. The tubes of force between these positive and negative charges produce an electric field of the order of 100 volts per metre at the earth's surface. On a thundery day this field may be 200 times the normal value and may be of opposite sign so that the earth's surface may have a strong positive charge instead of the weaker negative charge associated with fine weather. Whether or not trees and plants are affected to a marked extent by these electric fields I leave to the botanists to decide, but it is quite certain that an earthed aerial would shield very effectively the ground underneath it. It will be noticed that I have said that the aerial should be earthed, for it is only when it is earthed that we get the maximum shielding action. In this case the charge which normally would have existed on many square yards of ground is concentrated on the aerial wire itself.

So far as I am aware, most botanists think that the normal electrical gradient of the atmosphere is insufficient to affect the growth of plants, but, as Mr. White points out, the particular case of thundery weather seems worth investigating.

Potters Bar. E. V. APPLETON.

CAPACITY IN L.F. TRANSFORMERS.

Sir,—It is common for makers of L.F. transformers to-day to lay much stress on the extremely low secondary self-capacity of their instruments, and their statements as to the amount of this capacity are doubtless perfectly correct.

In this regard there are two questions which seem to me of interest. Firstly, are the winding methods used to attain this end such as not to increase the mutual capacity, which is not mentioned? I am not sure that the mutual capacity in some of these transformers does not exceed the secondary capacity, and attention is called to this because Mr. Dye, of the N.P.L., in his recent exhaustive investigations into the L.F. transformer, the results of which were published in *Experimental Wireless*, came to the conclusion that mutual capacity and secondary self-capacity have, broadly speaking, the same effect on the performance of the transformer.

Secondly, are the efforts at extremely small self-capacity rightly directed? Mr. Dye seems to be forced to the conclusion that they are not, and, in fact, from his figures, a transformer of 4 to 1 ratio gives all the better results for having a secondary self-capacity around 64 mmf.

A cheap and simple method used by myself for making rough measurements of the s.c. of transformer windings is as follows, and I invite comment:—Briefly, a station not too distant is tuned in on an ordinary set, the transformer winding under trial being connected *as a series condenser in the aerial circuit.* The aerial tuning inductance or parallel condenser must, of course, be increased greatly to compensate for the small series condenser formed by the winding.

The station being tuned in at maximum strength, the transformer is removed and a variable condenser of small capacity connected in its stead, and, of course, adjusted for maximum strength. The readings of this must be an indication of the s.c. of the windings.

With a transformer thus used, correctly advertised as being of very low s.c., the transmission from a station 50 miles away came in quite intelligible on a loud-speaker, with a two-valve dual set. A. O. GRIFFITHS.

Caergwrle.
Nr. Wrexham.

ITALY WORKS WITH NEW ZEALAND.

Sir,—Readers may be interested to know that on the morning of July 22nd, at 7 o'clock (G.M.T.), I worked on 40 metres with Z2AC, who reported my signals at good strength. I was using two Marconi M.T.4 valves with 6,000 volts, 42 cycle, on the plates.

On the morning of July 24th I worked another New Zealander, Z2AE, who reported my signals as "very strong."

I received fairly strong signals from NRRL on the mornings of July 19th, 20th, and 21st.

Venice. GIULIO SALOM (Italian 1MT).

WAVE TRAPS FOR SELECTIVITY.

Sir,—There seems to be a certain demand for a silent night for London, and perhaps some of the other B.B.C. stations, so that owners of multivalve sets may have a chance of picking up other stations, but do you not think that a better way of getting over this difficulty would be by the greater use of wave traps.

Too great selectivity is bad for good reproduction, and as a rule a three-valve set with one stage of H.F. will separate most distant stations, and it is only the local station that gives much interference. ROLAND C. WILD.

New Eltham, S.E.9.

PROPOSED BRITISH I.R.E.

The following official communication has been received by *The Wireless World* from the Institution of Electrical Engineers regarding a meeting which took place recently between the Committee of the Wireless Section of the Institution and Mr. James Nelson, M.I.E.E., who has recently proposed the formation of a new society for professional radio engineers:—

At the invitation of the Committee of the Wireless Section of the Institution of Electrical Engineers, Mr. James Nelson was present at a meeting of the Committee held on July 25th, when the question of a suggested new Wireless Society was discussed with him.

A statement on the subject will shortly be published, but it may be stated now that the definite conclusion has been arrived at that there is no need for a new body.

July 28th, 1925.

READERS PROBLEMS

Readers Desiring to Consult "The Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

Using Slow Motion Dials for Fine Tuning.

A READER asks whether it is preferable to use tuning condensers which have a single-plate vernier built in them, or to use a condenser without a vernier but with a slow motion geared dial operating the main shaft.

Taking all things into consideration, it is undoubtedly better to abandon the single-plate vernier in favour of a condenser in which a vernier motion can be imparted to the main body of moving plates, since with the former it is practically impossible to calibrate the receiver for the simple reason that a movement of the vernier plate may make a difference of two or three degrees in the setting of the main dial, and there is usually no method provided for indicating the setting of the vernier plate. Apart from this disadvantage, however, it will be found that considerably finer tuning will be obtained by using slow motion dials than by any other method. Unfortunately, however, some of these dials possess many disadvantages, chiefly owing to the large mass of metal in them. This is an advantage when the condenser is used in parallel with the aerial tuning coil, since the moving plates of the condenser and the metal dial can be earthed, thus forming an excellent screen, and all hand capacity effects are avoided. In those portions of a circuit, however, where neither set of plates is at earth potential with respect to H.F. currents, hand capacity effects are usually troublesome, and the only safe procedure to adopt is to purchase a dial which is entirely constructed of a non-metallic substance, or better still to obtain one of those condensers in which *both* sets of plates are entirely insulated from the framework of the condenser. It is then possible to earth the framework of the condenser, including the metal dial, and so remove all vestiges of hand capacity effect.

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A Stable Dual Receiver with Valve Detection.

MANY readers have written requesting us to publish a circuit in which the crystal detector used in the one-valve reflex receiver described in this journal for April 22nd, 1925, is substituted by a valve.

We give a suitable circuit in Fig. 1. It will be seen that no great alterations are necessary, and at the same time the elimination of the vagaries of the crystal is an undoubted advantage. The valve will in no way upset the stability of this receiver and the range will be somewhat increased, although not greatly so. The only point which requires consideration is the L.F. transformer. In the case of the crystal detector it was quite feasible to employ a transformer having a ratio of six or eight to one, in view of the low impedance of the crystal, but with the substitution of a valve detector, it is necessary that a considerably lower ratio be used in order to preserve the quality of reproduction. It is advised that careful experiments be made regarding the best method of connection of the primary winding of the transformer, whilst at the same time it is advisable to experiment with a lower value of fixed condenser shunting the transformer secondary than the maximum value which is given, since it is sometimes possible to increase the range of the instrument by reducing this value.

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Metres or Kilocycles?

A READER who has frequently read in technical publications that it is possible to operate a far larger number of stations without mutual interference within the fifty-metre band comprised between, say, 50 metres and 100 metres than in the band between, say, 1,950 and 2,000 metres, seeks to know the reason why there is apparently so much more room on the lower than on the higher wavelengths, since in both cases the band of wavelengths is of the same extent—namely, fifty metres.

In order to clearly understand this it is necessary to remember that in designating the differences in tuning of wireless transmitters or receivers in terms of wavelengths, we are considering an effect instead of getting to grips with the cause. The frequency in cycles per second corresponding to any wavelength can readily be ascertained from the formula $f = \frac{300,000,000}{\lambda}$, where f = frequency in cycles and λ = wavelength in metres.

Thus from this formula we find that a wavelength of 50 metres corresponds to a frequency of 6,000,000 cycles and a wavelength of 100 metres a frequency of 3,000,000 cycles. Similarly we find that a 1,950 wavelength corresponds to a frequency of 153,850 cycles approximately, and a 2,000 metre wavelength corresponds to a wavelength of 150,000 cycles.

Thus we see that although in both cases a band of 50 metres is available, yet in one case we have a band of frequencies extending over 3,000,000 cycles, in the other case we have but

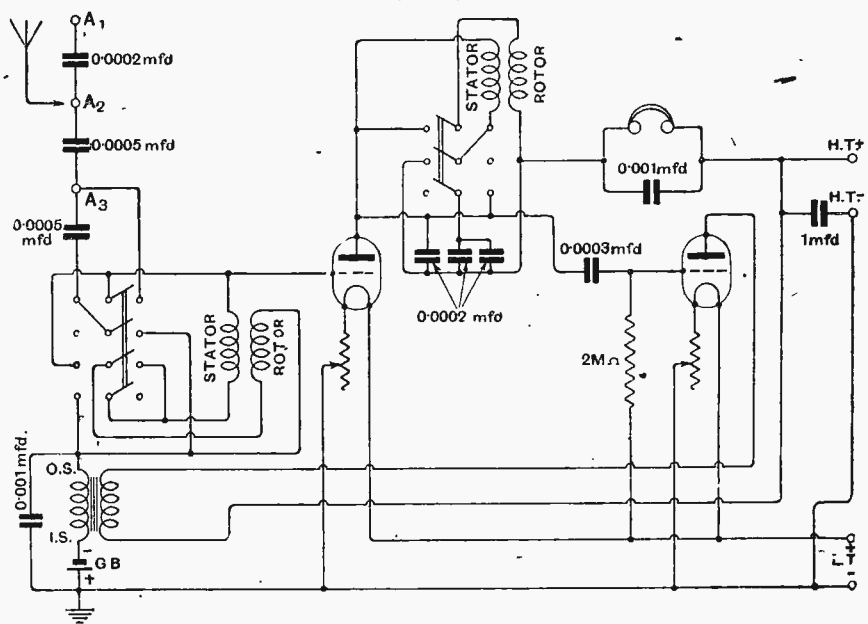

Fig. 1.—A variometer tuned broadcast receiver with one reflex stage and valve detector.

B 31

3,800 odd cycles available. Theoretically it would be possible to crowd about two hundred broadcast stations between 50 and 100 metres. A correct understanding of this will at once render apparent the reason of the sharpness of tuning on short wavelengths in comparison with long wavelengths, since on 2,000 metres a variation of three metres will only mean a variation of 112 cycles approximately, whereas on 50 metres three metres variation in wavelength is equal to a frequency variation of 60,000.

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A Single Valve Receiver with Fine Reaction Control.

A READER wishes to construct a single-valve regenerative receiver in which a finer control can be had over reaction than is usually obtainable by the customary method of varying the position of the reaction coil with respect to the aerial coil. In order to accomplish this, our reader desires to make use of the parallel reaction feed system, in which the H.T. supply to the anode of the valve is fed through a high-frequency choke coil instead of directly through the reaction coil.

We illustrate in Fig. 2 a suitable circuit embodying this principle. As is well known, when the receiver is approaching the oscillation point, tuning becomes very critical, and a slight movement of the reaction coil makes a very considerable difference to the tuning of the aerial coil. This feature is especially pronounced on short wavelengths, and is

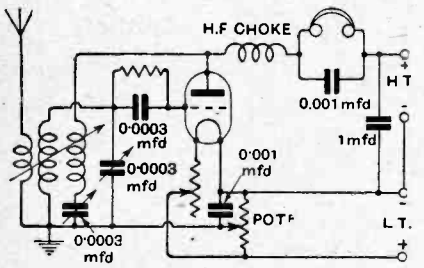

Fig. 2.—Critical reaction can be applied by this method.

a source of trouble even on the lower broadcasting wavelengths. If, however, the circuit shown in Fig. 2 is adopted, the reaction coil can be mounted near the aerial coil and regeneration controlled by means of the reaction condenser. It will be found that this circuit gives an exceptionally smooth control over reaction, the receiver gliding almost imperceptibly in and out of oscillation, and, moreover, if care is taken in construction, it will be found that oscillation commences and ceases at a definite point on the dial of the reaction condenser, in marked contrast to the erratic behaviour of many receivers, in which the slightest movement of the reaction coil causes the receiver to go into oscillation very abruptly. With regard to the number of turns on the reaction coil, this varies, of course, on different bands of wavelengths, although one coil should

cover the B.B.C. band, but it is important, in order to obtain the best results, to use the smallest coil with which it is possible to produce oscillation. It is, perhaps, an advantage to mount the reaction and aerial coils on a two-way coil holder in the usual manner, so that coarse adjustment can be made by the moving coil, and thus a wider band of wavelengths covered with one coil, although this is not absolutely necessary. The aerial coil is shown coupled to the secondary by two or three turns of wire, and can be made either variable or fixed in its position with respect to the grid coil. On the B.B.C. wavelengths, of course, the aerial can be connected to the top of the grid coil in the usual manner.

Perhaps the most important point to note in this circuit is the connections of the reaction tuning condenser. The moving plates of this variable condenser and also any metal vernier dial that may be used should be connected to the earth terminal, and in this manner all vestiges of hand capacity are removed when making reaction adjustment, since the moving plates are definitely at earth potential, and the hand nowhere comes into the vicinity of portions of the circuit not at earth potential.

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Adding a Stage of High Frequency Amplification.

A READER who possesses a receiver which incorporates one stage of high frequency amplification and is specially designed for operating in conjunction with a frame aerial wishes to add an extra stage of H.F. to this receiver, but he desired that this H.F. stage be made up as a separate unit in order that no alterations need be made to the existing receiver.

Since this H.F. amplifier is to be added to a receiver in which one H.F. is already incorporated, it will clearly be necessary to take special precautions to reduce the tendency to self-oscillation in this amplifier. The method of utilising a potentiometer in order to permit a certain amount of grid current to flow is unsatisfactory for many reasons, since it not only seriously affects selectivity, but the actual H.F. amplification obtained is reduced to such an extent that little benefit is obtained from the additional valve. It is greatly preferable that the neutrodyne method be used, whereby the stray capacities in the valve and its associated wiring are balanced.

A suitable circuit is given in Fig. 3, wherein this method is incorporated. The connections are so arranged that the frame aerial can still be used and no alterations are necessary to the receiver. The secondary of the neutrodyne transformer can consist of 60 turns of No. 22 D.S.C. on an ebonite former 4in. long × 3½in. in external diameter. The primary, which can consist of about 20 turns of

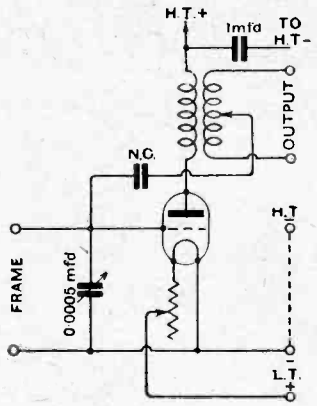

Fig. 3.—A stage of tuned high-frequency amplification.

the same gauge wire, should be wound on a former 2in. long, but of slightly smaller diameter, so that it will just fit inside the secondary tube. The "neutralising" tap is best found by experiment, the usual point being generally between the 15th and 20th turn from that end of the secondary which is connected to the normal "earth" terminal of the receiver.

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Choke Coils for Eliminating "Mains" Hum.

A READER wishes to construct choke coils for the purpose of eliminating commutator ripple when using the mains for the provision of H.T. to any type of receiver, and seeks our advice concerning the necessary number of turns, etc.

The choke coils in question may consist of approximately twenty thousand turns of No. 38 D.S.C. wound on an iron core. The dimensions of this core may be about one square inch in cross-sectional area and four inches in length. It may be built up from No. 22 gauge iron wire. The core should be well covered with one or two layers of Empire cloth before the windings are put on, and the choke when finished should be protected on the outside by a few layers of the same substance.

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THE B.B.C. AND MONOPOLY.

THE question of whether the monopoly of broadcasting should be placed in the hands of one organisation was a very vexed problem at the time that the British Broadcasting Company was formed.

For some considerable while since little attention seems to have been paid to this matter and interest in it has subsided to a great extent. It is almost certain, however, that in the near future the subject will be re-opened when the Government Committee is appointed to consider broadcasting "in all its aspects."

Since the time that broadcasting, under the direction of the B.B.C., first started in this country there has not existed any broadcasting organisation competing in opposition to the activities of the B.B.C., and on this account it has been frequently stated that the B.B.C. has been operating under a complete monopoly without any fear of competition. But an investigation of the true circumstances points very clearly to the contrary being the case, for although the B.B.C. has not had to compete with other programmes and other broadcasting interests, there has yet been a very genuine reason for the B.B.C. to strain every effort towards good programmes and a satisfactory organisation. The reason for this is that the permanency of the present constitution of the company is not to be regarded as guaranteed, for the present agreement under which the B.B.C. operates is for a limited period only without commitment on the part of the Government to renew it. The attitude of the Government is that this term, during which the B.B.C. has operated under a licence from the Post Office, is a period of probation to see whether this experimental method of conducting national broadcasting is capable of operating on a satisfactory basis. Naturally, if the B.B.C. have failed to satisfy the general public and have not carried out the work entrusted to the company in a creditable manner, then it will be most unlikely for the present agreement to be renewed and some new organisation may be expected to take its place.

In view of these circumstances it would be ridiculous to suggest that the B.B.C. has been without any competitive stimulation. It must be quite obvious to those who have watched events that the British Broadcasting Company has done its utmost to justify its continued existence substantially in its present form. The network of stations and relay stations has been made as complete as possible to leave little room for any additional stations to be put up. The high-power station at Daventry has been completed, and rumours are current of the intention of erecting a second station for the London area. All this is being done before the Government enquiry starts, and it is undoubtedly the policy of the B.B.C. to complete all this work so that no criticism can be levelled at the organisation that it has been inactive or unprogressive when the time for investigation arrives.

The responsibilities which will rest with the Government Broadcasting Committee of Enquiry to be set up at the end of this year are very great. It is not possible to foresee the influence which broadcasting may eventually

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have upon this country, but it is a weapon which must be placed only in responsible hands.

The value of broadcasting will depend to a great extent upon the energy and progressive spirit of those responsible for maintaining the service. In order to have some guarantee of energetic effort to ensure the best possible programmes and efficiency, it seems evident that only two courses of action are open to the Government Committee. These are, either to establish broadcasting on a competitive basis or to continue the policy of one organisation but safeguarding the service from stagnation by leasing broadcasting rights only for a limited period. Without intending to reflect in any way upon the present B.B.C. or those responsible for controlling it, we believe that it would be disastrous to establish the B.B.C. on a permanent basis so that it became virtually a Government department. There seems, on the other hand, to be no sound objection to the continuance of one organisation to conduct the service so long as some such provision as a short period lease of broadcasting rights is instituted, with the very definite understanding that the renewal of the lease will only be granted so long as a satisfactory service is provided.

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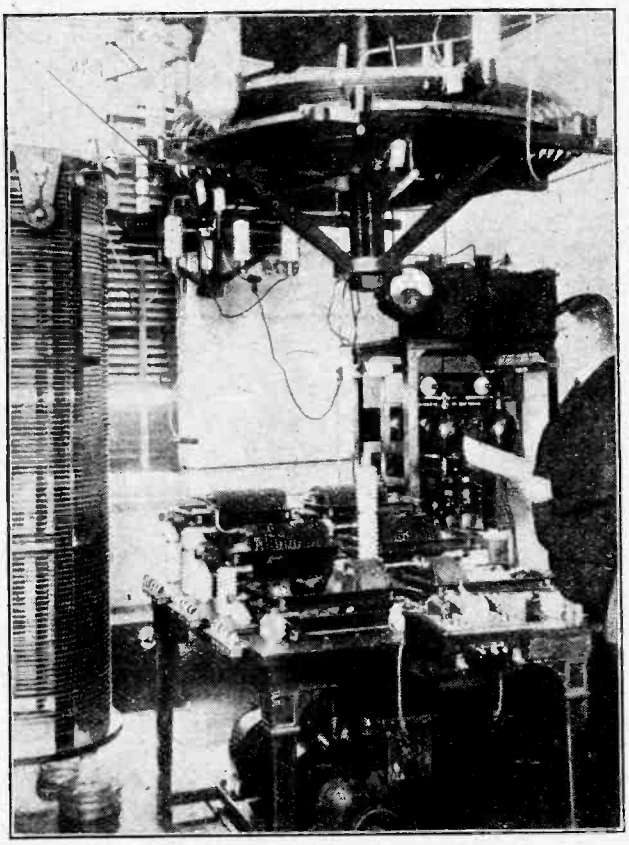
BRITISH INSTITUTE OF RADIO ENGINEERS.

IN the last issue of *The Wireless World* there was published under Correspondence a communication received from the Institution of Electrical Engineers relating to a meeting which took place between the wireless section of that body and Mr. James Nelson, the promoter of a new professional Radio Society, which has been the subject of comment in this journal. A further statement on the subject has since been prepared by the Institution of Electrical Engineers, and this is published under Correspondence in the present issue. There is also a letter from the temporary secretary of the proposed British I.R.E., which should be read in conjunction with the statement published last week.

Judging from a perusal of the statement of policy which is now made by the Institution of Electrical Engineers, it would appear that their attitude has changed very little, in spite of the meeting which was arranged at their invitation with Mr. James Nelson. The Institution of Electrical Engineers has not accepted the principle that the qualifications of a radio engineer are distinct from those of the general electrical engineer, for we find that all the privileges of membership of the wireless section are still to be freely extended to members, irrespective of whether they have wireless qualifications or not. We think that the case would be more satisfactorily met if actual membership of the wireless section were reserved to persons with wireless qualifications, and we doubt if it will be possible to prevent the formation of an independent professional radio society unless this point involving a principle is accepted by the Council of the I.E.E.

We shall, no doubt, hear a good deal more on this subject, which has aroused so much interest and has been discussed in the wireless and electrical papers at length.

AUSTRALIA'S GIANT STATION.



A view in the transmitting room of the high-power station at Pennant Hills, Sydney. Many improvements have been introduced, and the station will form one of the links in the Empire Wireless Chain.

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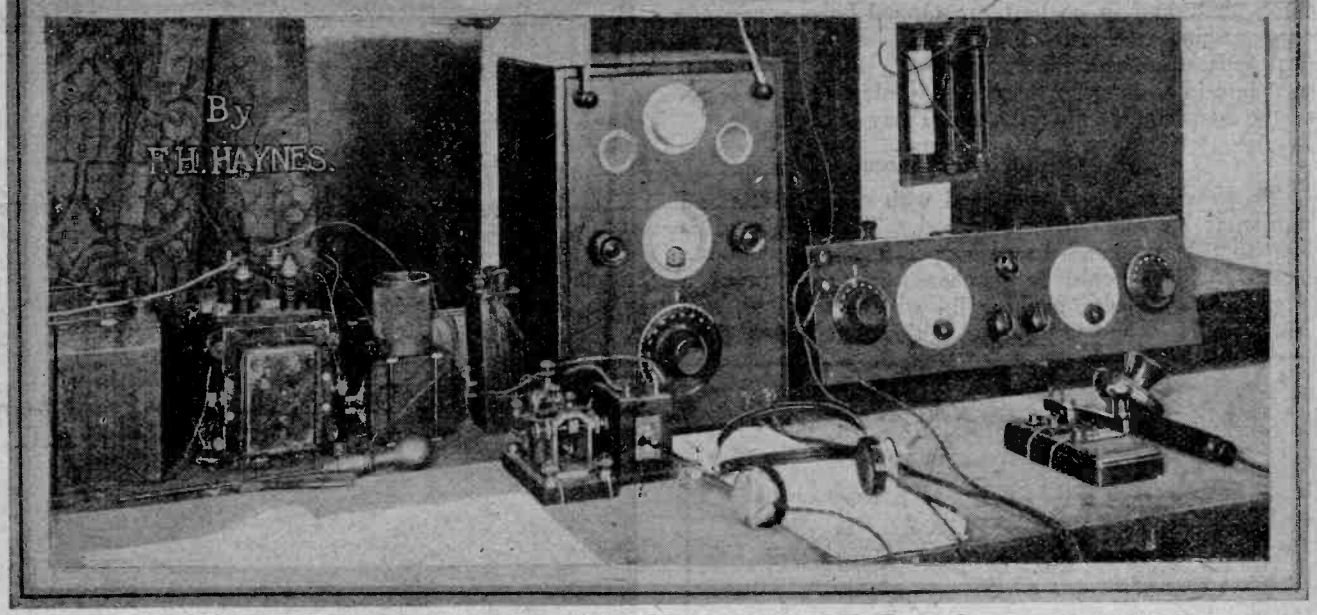
PROGRESS IN PICTURE TRANSMISSION.

WHEN we review the progress which has been made in line telephony, wireless telephony, and other branches of electrical communication, it may seem that transmission of pictures by electrical methods has made comparatively slow progress in the past. Recent developments of remarkable importance have, however, been achieved in America, and, in addition to the description of one system given in our issue of last week, we are able to give publication in the present issue to a number of photographs sent over line telephone circuits for distances approaching 1,000 miles. It is difficult to do justice to the originals of these pictures in printed reproduction, and this point should be borne in mind when the reproductions are examined.

The transmission of satisfactory pictures from point to point for newspaper reproduction purposes where speed is of vital importance would alone more than justify the enterprise necessary to develop a dependable system, but there are, in addition, many other applications of importance. For the verification of signatures in commercial transactions the possibilities are obvious. Then, again, there is reproduced an X-ray photograph which immediately suggests the importance of the transmission of such photographs where prompt expert medical opinion is required.

Telephony and C.W. 100 METRE TRANSMITTER



Complete Constructional Details of a 10 watt Transmitter.

THE success attendant upon the use of transmitting apparatus depends largely on the station layout and the perfection of design and construction of the equipment with a view to providing easy maintenance and operation. A given performance cannot be repeated with apparatus installed in a temporary or experimental manner, and it is only by persistent working with a set which will consistently hold its calibration and adjustment that long range communication tests can be attempted.

Designed for 100 Metres.

Interest centres on the use of short wavelengths, and a mean wavelength of 100 metres has been adopted in the design, for both telephony and C.W. working are easily arranged, the normal size aerial may be employed and long range telegraphy is obtainable. The instrument is compact yet not overcrowded, and the interior accommodation amply allows for the latitude in the space taken by components of varying design.

Layout of the Components.

A front ebonite panel, $\frac{5}{16}$in. in thickness, and shown in an accompanying illustration drawn to scale, carries the feed and aerial ammeters, filament controls, and the tuning condenser in the grid circuit. Other tuning adjustments are made by means of clips on to the loose coupled tuning inductances, and are accessible either by withdrawing the instrument or removing the back of the cabinet. A baseboard, $\frac{3}{4}$in. in thickness, supports the telephone transformer, modulating choke, grid condenser, wire-bound leak and grid cells for the modulating valve. A $\frac{1}{2}$in. mahogany platform is supported at a distance of 5in. from the baseboard by means of screws in the front panel and threaded 2BA rods at the rear passing through two $\frac{5}{8}$in. lengths of $\frac{1}{2}$in. ebonite tube with $\frac{1}{4}$in. hole. This platform carries the valve holders and tuning inductances. A bracket $7\frac{1}{2}$in. × 3in. is

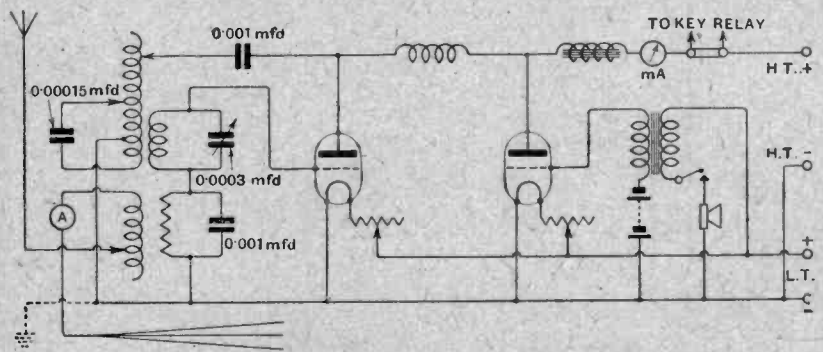


Fig. 1.—CHOKE MODULATED TELEPHONY TRANSMITTING CIRCUIT, with loose coupled aerial, suitable for 100 metre working.

Telephony and C.W. 100 Metre Transmitter.—

attached to the top of the panel by means of two No. 6 by 1½in. brass screws, giving support to the fixed capacity closed circuit condenser and the vertical ebonite rod carrying the grid coil. The high-frequency choke coil is attached to the back of the panel between the valves, being held in position by means of a wooden plug with a 4BA screw and nut through its centre.

A simple form of construction has been adopted throughout, and in no part are tapped holes employed. In describing the construction it is advisable, perhaps, to deal separately with each component, drawing attention to points in the design, so that advantage can be taken of the adaption of apparatus which may be to hand.

The Tuning Inductances.

Air spaced coils are employed with clip contacts and supported by four strips of wood. The wire used is No. 10 S.W.G. hand-drawn copper (on no account use bronze), which should be purchased in the form of a large diameter hank, about 2½lb. will be required, and free from kinks and in bright condition. It is shaped by

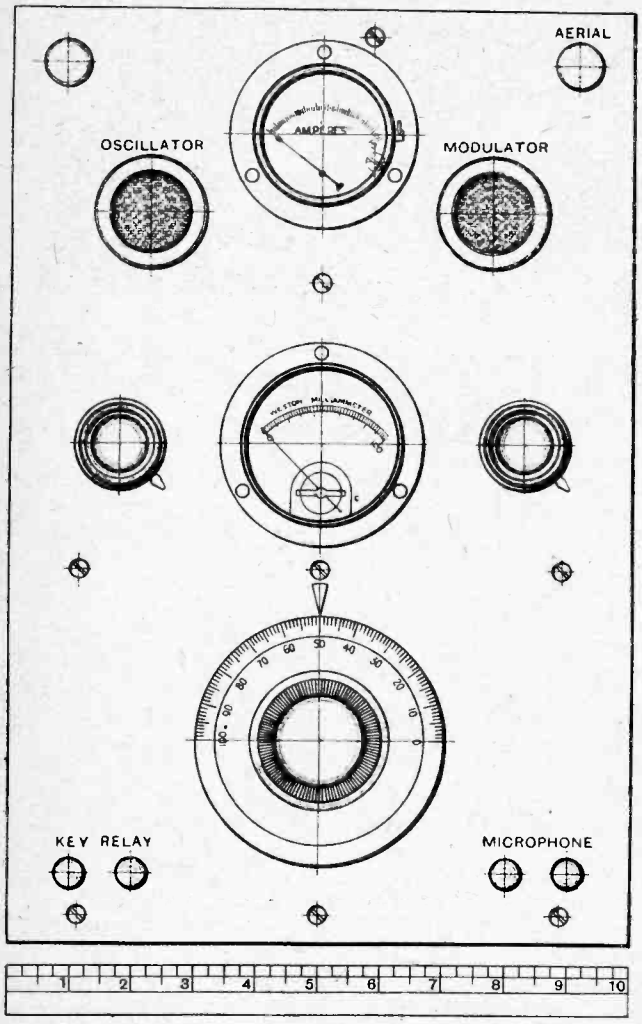
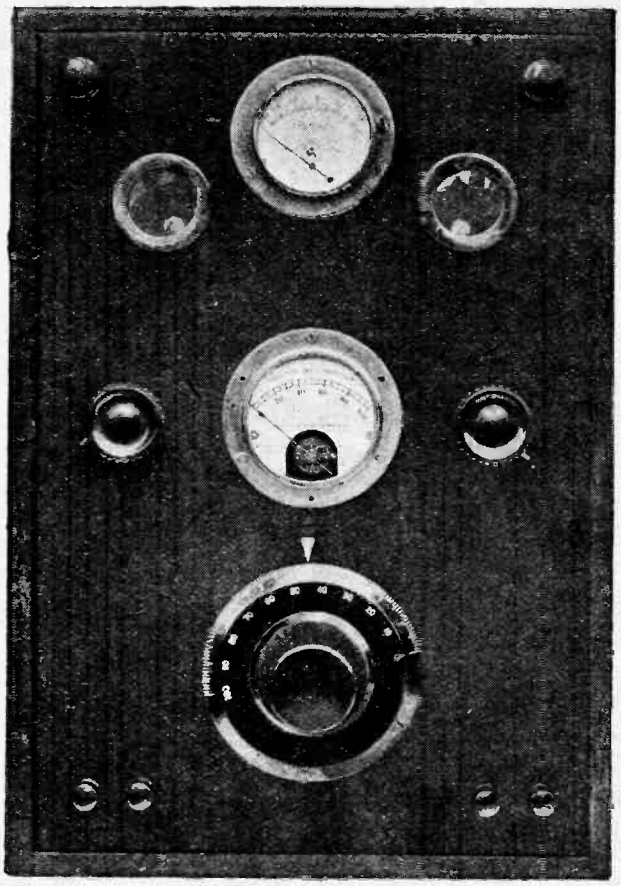


Fig. 2.—Scale drawing of the front panel, showing positions for the meters, and the screws for holding base board and apparatus platforms.



FRONT VIEW. The single dial of the grid circuit appearing on the front of the instrument suffices for occasional critical tuning. Large pattern valve windows are fitted (Aermonic). The aerial ammeter 0–1·5 is a cheap ex-Government instrument.

tightly winding on a 3¾in. to 4in. former about 5in. in length, tightly winding with turns touching. The required length, about 13 yards in all, should be paid out and wound on to the wooden former, keeping good tension all the time, obtaining a good grip on the wire with a heavy pair of pliers. The use of a back geared lathe makes the job one of a few minutes, though it can be quite well accomplished by hand with assistance. The supporting strips should be made from wood which has no tendency to split, and measure ⅝in. wide by ⅜in. thick and 10in. in length until finally adjusted. Holes 1/16in. are made at intervals of 7 millimetres, and are finally enlarged to 5-32in., clamping the strip in the vice to prevent splitting. One hole out of place will make the subsequent threading on of the turns difficult, and care must be taken to ensure that the brace is held perfectly vertical while drilling. It will be seen in the illustrations that the coil consists of two sections, one of 11 turns and the other 19 turns, and the required number is cut off before threading on to the strips. When completed, the diameter should be expanded to 4¾in.

The inductance of the larger coil forming the closed circuit is obtained by substituting in the formula

$$L = \pi^2 d^2 n^2 / K,$$

where L is the inductance in centimetres, $\pi^2 = 9.87$, d diameter in cms., n number of turns to the cm.,

Telephony and C.W. 100 Metre Transmitter.—

l length in cms., and K, a factor obtainable from tables representing the ratio of length to diameter. The value is given in microhenries by dividing by 1,000.

$d = 12$ cms. $n = 10$ turns to 7 cms. or $1\frac{9}{7}$

$l = 13$ cms. $K = 0.7$

$$L\,(mh) = \frac{9.87 \times 144 \times 10^2 \times 13 \times 0.7}{1{,}000 \times 7^2} = 26 \text{ microhenries}$$

The inductance of the aerial coil is about 12 microhenries, which, when connected up to any aerial of 0.0003 mfd. capacity, gives a maximum wavelength of 110 metres.

The coil is supported by means of three screws passing through the lower wooden strip into the platform, and a spacing piece of ebonite tube $2\frac{1}{4}$in. in length held in position with $3\frac{3}{4}$in. of 2BA threaded brass rod and nuts.

Grid Coil.

A former of ebonite tube $2\frac{1}{2}$in. in diameter and $1\frac{1}{8}$in. in length supports eight turns, four on each side of the centre, of No. 22 D.S.C. wire. The winding has an inductance of about 10 microhenries, so that when tuned with a condenser having a maximum value of 0.0003 mfd. (Igranic), a maximum wavelength of 110 metres is obtainable.

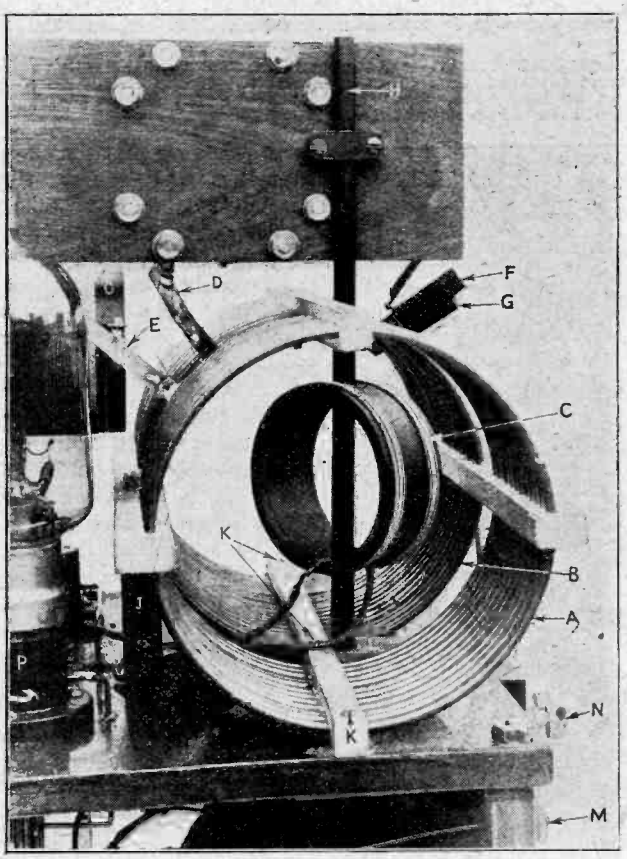


Fig. 3.—THE TUNING INDUCTANCES. (A) Aerial coil; (B) Closed circuit; (C) Grid coil; (D) Strip copper lead to closed circuit condenser; (E) Lead to counterpoise terminal; (F) Closed circuit tap; (G) Anode tap; (H) 5/16in. ebonite rod on which grid coil former is a tight fit; (J) Coil support; (K) Three holding down screws; (L) Piece of wood to form pivot for grid coil spindle; (M) Grid battery wander plug; (N) Terminals; (O) H.F. choke; (P) Modulator valve holder.

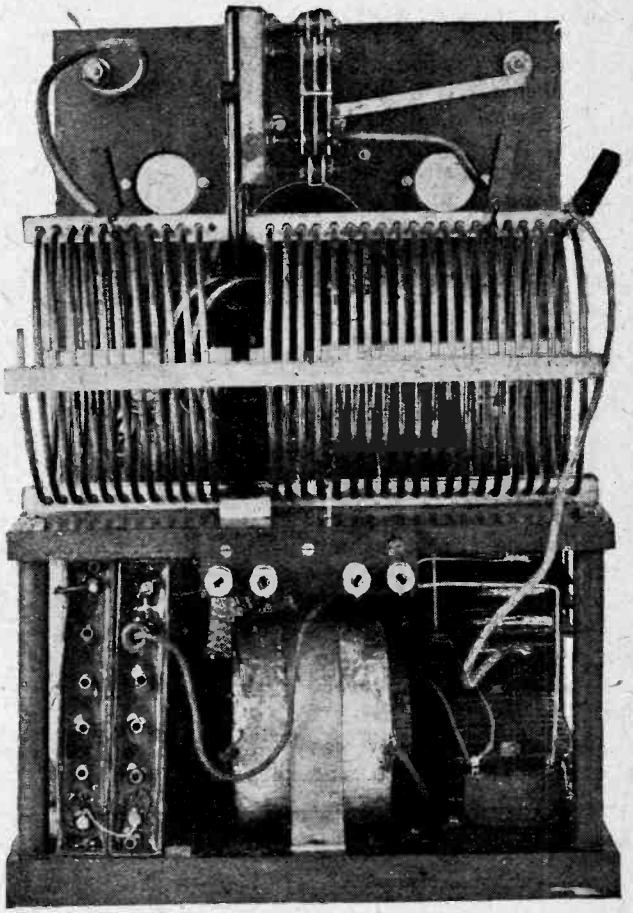


Fig. 4.—REAR VIEW, showing clearly the layout of the components, all of which can be seen, with the exception of the microphone transformer, which is behind the grid cells with its core at right angles to that of the modulating choke.

The coil is supported by making a tight fit on to a $\frac{5}{16}$in. ebonite rod, the latter being held in position by means of a small block of wood on the platform and a wooden or ebonite cleat on the bracket which carries the closed circuit condenser. Connection is made by means of flexible leads.

Closed Circuit Condenser.

A fixed capacity air condenser with liberal dielectric thickness is connected across a portion of the larger inductance to form a closed circuit and hold the wavelength constant. It is made in No. 20 or 22 S.W.G. hard brass sheet, and consists of five plates each 2in. × 3in. Threaded 2BA brass rod is used for assembling and 2BA brass nuts form spacers. The plates, sawn nearly to size, are clamped together and filed up to be quite true, and $\frac{3}{16}$in. holes drilled at $\frac{1}{4}$in. from each corner. In assembly, a spacing of $\frac{1}{24}$in. between the surfaces of the plates is arranged, minor adjustments being made with thin washers. Short pieces of No. 16 wire are soldered to the edges of the plates to provide good electrical bonding. The threaded spindles, which are 2in. in length, pass through holes in the wooden bracket, and

Telephony and C.W. 100 Metre Transmitter.—

the relative position of the sets of plates is adjusted.

The use of wood for supporting this condenser and also as spacing strips for the coils may call for criticism, though, at high radio frequency, the behaviour of wood as regards dielectric loss is superior to ebonite, provided its insulation is maintained by being in dry condition and excessive potential is not applied across it.

To arrive at the capacity, the area of overlap is multiplied by the number of dielectric spaces times 225 and divided by the dielectric thickness multiplied by 10^9. Thus capacity in mfds.

$$= \frac{225 \times 4 \times 4 \times 24}{10^9} = 0.000086$$

On test the capacity was found to be almost 0.0001 mfd., showing that the stray capacities offered by the spacing nuts must be taken into account. In conjunction with the tuning inductance, the maximum wavelength of just over 100 metres is obtainable.

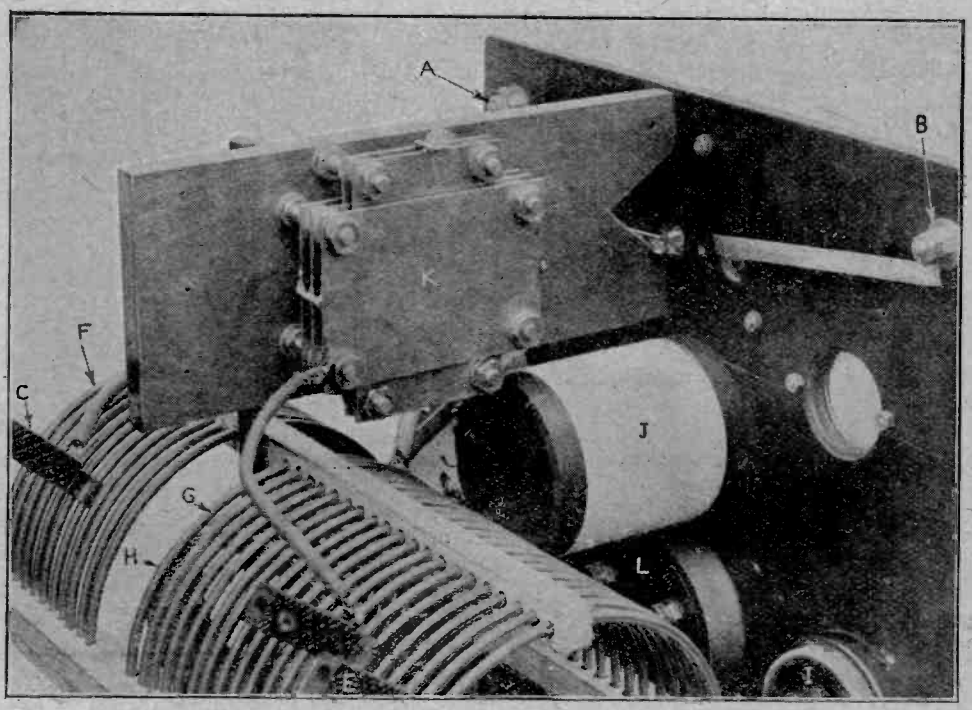


Fig. 5.—THE RADIO FREQUENCY EQUIPMENT. (A) Aerial terminal; (B) Counterpoise terminal; (C) Aerial clip; (D) Closed circuit clip; (E) Anode tap; (F) Aerial coil; (G) Closed circuit coil; (H) Grid coil; (I) Oscillating valve filament resistance; (J) H.F. choke; (K) Closed circuit condenser; (L) Milliammeter, 0–100 mA. (Weston or Sifam).

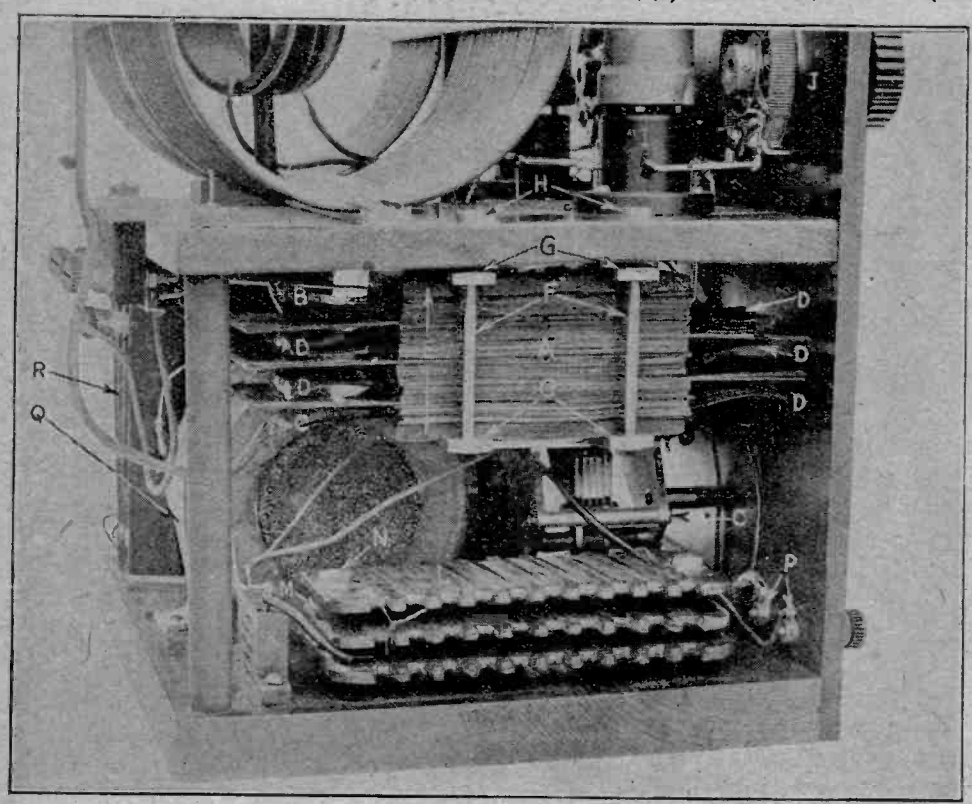


Fig. 6.—DETAILS OF ASSEMBLY. (A) Anode condenser; (B) and (C) Terminals of condenser; (D) Junctions between sections; (E) 1/4in. ebonite end plates; (G) and (F) Brass clamping brackets and rods; (H) Nuts on ends of rods for attaching condenser; (I) Oscillator valve holder; (J) Oscillator valve filament resistance; (K) Grid condenser; (L) Wire wound grid leak; (M) Ebonite spacers; (N) Holding down nut; (O) Grid circuit tuning condenser; (P) Keying terminals, bridged for telephony; (Q) Modulating choke, held down by strap; (R) Grid cells.

The Anode Tap Condenser.

This condenser, which is subjected to high voltages, has a capacity of about 0.001 mfd. It is inadvisable to adopt larger values, for it will be seen from the diagram that it forms an audio-frequency shunt across the modulating choke *via* the tuning inductance and the high-tension terminals. Several small mica condensers may be assembled in series to give the required value, as, for instance, four small receiving circuit condensers, each 0.004 mfd. In the illustrations it is seen that a number of sections are clamped together and also connected across at the ends.

Using mica $\frac{2}{1000}$in. in thickness, the reader can

Telephony and C.W. 100 Metre Transmitter.—

readily calculate the number of pieces of mica required, which is given by the formula :—

$$\frac{0.002 \times 0.004 \times 10^9}{225 \times 5.5 \times a}$$

where 0.002 is the thickness of the mica, 0.004 the capacity in mfds. required, 5.5 the dielectric constant of mica, and a the area in square inches of the overlap.

The Modulating Choke.

It is advisable for this coil to possess a reactance equal to four times the impedance of the modulating valve. Taking a mean valve impedance of about 10,000 ohms, a reactance of 40,000 ohms is needed at low speech frequency, say, at 200 cycles. The inductance required is

$$\frac{\text{Reactance}}{2\pi \times \text{Frequency}} = \frac{40{,}000}{2 \times 3.14 \times 200} = 30 \text{ henries approximately.}$$

Such a coil may be built on an iron wire core 3½in. in length with 50 layers of No. 34 S.S.C. each of 300 turns, producing 15,000 turns, which with thin paper between each layer gives a maximum diameter of approximately 3in.

As a considerable voltage is developed across the ends of this choke, a high degree of insulation must be maintained. The reader may be saved a great deal of trouble by making use of the secondary of a spark coil or transformer. One of the windings of a ½ Kw., 350 cycles, ex-Government transformer was found to consist of 24,000 turns, with a total diameter of 3½in. and a length of 2¾in., being built in sections, separated by layers of insulation.

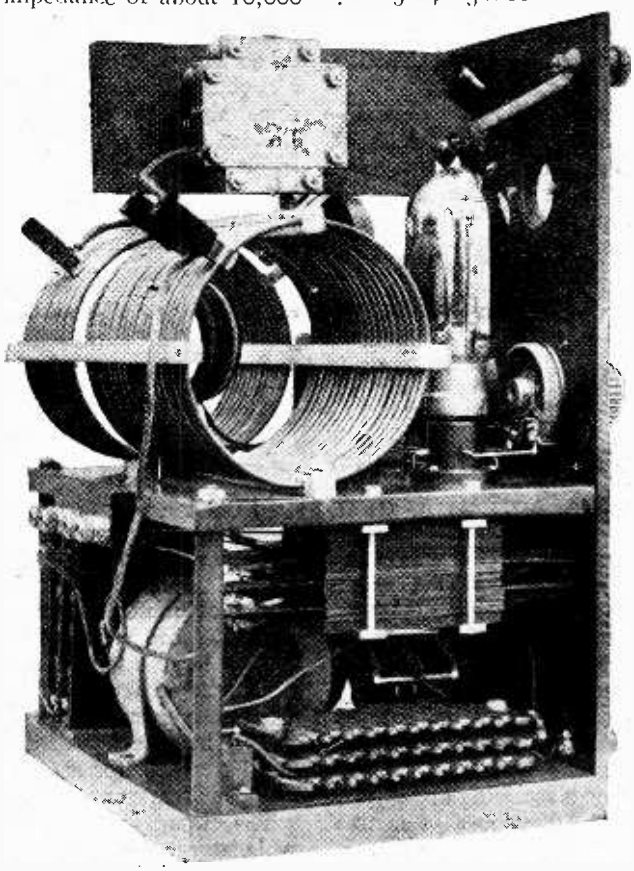


Fig. 7.—ANOTHER VIEW OF THE TRANSMITTER, removed from the containing cabinet. The valves are Type AT40X, requiring higher anode potentials than the Type DET1, to which reference is made.

Grid Condenser and Leak.

The grid condenser and leak are used to bias the grid of the oscillator valve and have normal values of 0.001 mfd. and 10,000 ohms. The condenser is an ordinary mica receiving condenser, while the leak is wound with No. 38 single silk " Eureka " wire, having a resistance of roughly 70,000 ohms to the pound. The wire is wound upon three thick pieces of shellaced cardboard measuring 5in. × 2½in. Ten slots are made in each card, carrying in all about 1 oz. of wire, which may be wound inductively. Between 3 and 4 oz. of wire should be procured. Two pieces of 2BA brass rod, 2¼in. in length, are used for attaching the cards to the baseboard, and ¼in. pieces of ½in. ebonite tube serve as spacers.

Radio Frequency Choke.

The high frequency choke coil connected between the oscillating and modulating circuits should have a reactance of about 40,000 ohms. This is produced at a wavelength of 100 metres, which is a frequency of 3,000,000, by an inductance in microhenries of

$$\frac{40{,}000 \times 10^6}{2 \times 3.14 \times 3 \times 10^6} = \text{approximately } 2{,}100 \text{ microhenries.}$$

From the inductance formula given earlier it will be found that a winding of No. 32 D.S.C. 6.5 centimetres in diameter and 6 centimetres in length will produce the required value. Thus, a 2½in. diameter ebonite tube may be employed, 3in. in length and carrying a winding for a distance of 2⅝in.

Telephone Transformer.

The core measures 3in. in length and is ⅝in. in diameter. The primary winding depends on the type of microphone employed and the potential of the battery. If it is the intention to operate the microphone from the filament battery, which may be of the order of 10 volts, one of the high resistance solid back type should be employed. The primary may then consist of five layers of No. 26 D.C.C. Several layers of Empire cloth should be used as insulation between primary and secondary. The latter is wound with No. 34 S.S.C. layer by layer, and impregnated with wax. There should be 25 layers, with thin paper insulation between each layer.

Filament Rheostats.

The type of resistances connected in the filament leads will depend upon the valves used. The transmitter is designed to accommodate the dull emitter transmitting valves M.O. type D.E.T.1, which can be operated over a wide range of voltages, between 150 and 600. The filament current is about 2 amperes, and a rheostat which is normally used to control three bright emitter receiving valves is satisfactory.

Operation.

The wiring up, which is simple, is left without mention, excepting that it is advisable to use strip conductor

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for the aerial and closed circuit connections. Part of the wiring is carried out with the platform attached to the front panel, which is brought into position over the baseboard when the baseboard components are connected up. Some of the leads will need to be left long and finally adjusted.

The use of a counterpoise instead of an earth is recommended, though the effect of tying down the filament battery to earth potential with a short lead may be tried. Otherwise the filament battery should be insulated from earth and connected with short leads. It is advisable to provide a large-capacity mica condenser immediately behind the instrument across the H.T. terminals, the connection to the H.T. supply or filter circuit being made through two high-frequency chokes similar in construction to that used in the set.

In brief, with the aerial disconnected and the modulator rheostat in the "off" position, tuning adjustments of closed circuit and grid coil should be made to give minimum feed current. The aerial tap is then adjusted to increase the feed to a maximum, and this will be found to coincide with the maximum current indication on the aerial ammeter. On bringing the modulator valve into action, adjustment of the grid biasing battery will be found necessary.

Keying is accomplished by means of a relay key connected across the keying terminals. A good relay can be made by extending the armature of a recording sounder and providing a wire to dip into a small cup of mercury covered with paraffin to prevent sparking. In addition, the recording contacts can be arranged to break the connection from grid leak to filament negative.

On preliminary test, using D.E.T.1 type valves as modulator and oscillator, and an H.T. supply of 400 volts showing a feed current of 22 milliamperes to the oscillator, an aerial reading of 1.2 amperes was obtained on 90 metres, the aerial being 55ft. in length and having a capacity of 0.00022 mfd. Brief telephony transmissions were at once accomplished with several local London stations, and by post the following morning a report arrived showing that the transmissions had been intercepted by an amateur at Scone, Perthshire, using a two-valve receiver.

A SHORT WAVE VARIOMETER.

An Efficient Tuner for 20-100 Metres.

By B. G. R. HOLLOWAY.

GREAT interest has been aroused by the announcement of the proposed allocation of the 20-40 metres waveband for the use of English amateur transmitters. The report of the success of 1XAM's transmissions on 23 metres and the reception of a New Zealand amateur on 20 metres in broad daylight makes this announcement doubly interesting. This will be sure to add to transmitting activity during the usually quiet summer months.

Critical eyes will be turned towards receiving apparatus, and the set which has served faithfully above 50 metres

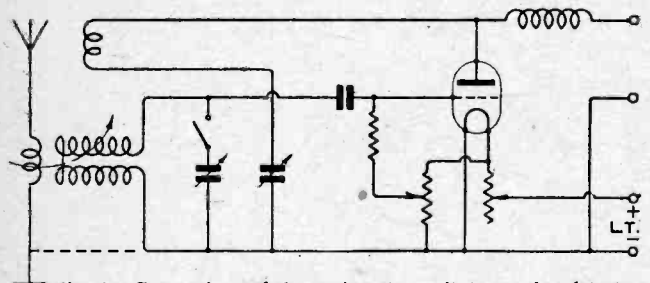


Fig. 1.—Connections of the variometer unit to a valve detector

will be seen to contain faults which are fatal for receiving on 20 metres. Undoubtedly, the Reinartz Circuit with one stage of note magnification comprises one of the most popular short wave sets among British amateurs.

When constructing this type of set for ultra short wave reception, the most important point to observe is the reduction of capacity across the secondary of the tuning system. This involves the use of low loss condensers and valves of the "test tube" type. But with the most expensive condenser, the minimum capacity is usually unduly large for very short wave work. With this in mind, the writer tried out variometer tuning with considerable success. The idea is not new in transmitting circles, but the use of a variometer with "fixed-tune" aerial coupling for short wave reception appears to be a tuning system not yet fully investigated.

The circuit involved is shown in Fig. 1, and is self-explanatory. The addition of the variable condenser with a cut-out switch is a refinement which greatly extends the range of the receiver. This was primarily added for the reception of KDKA on 68 metres. Even when receiving British broadcast, the variometer need not be idle, for, used in series with the secondary of a Reinartz tuning coil, it makes the most efficient vernier the writer has ever used.

The essentials of a variometer of this type are practically the same as those of the air-spaced coil, *i.e.*, the use of a minimum of solid dielectric, and the reduction of high-frequency resistance by the use of a suitable gauge of wire. The instrument differs from those used in transmitting, inasmuch that the rotor and stator are spherical, with a resulting greater efficiency and extended tuning range.

An advantage of the form of construction adopted is that the materials necessary for the construction of the

A Short Wave Variometer.—

variometer are neither extensive nor expensive, and the majority can be found amongst the inevitable scrap resulting from much experimenting.

Constructing the Ebonite Formers.

Two pieces of $\frac{1}{4}$in. thick ebonite are squared and trued to 3in. wide × 6in. long, and marked out to the dimensions given in Fig. 2. A hole about $\frac{3}{16}$in. diameter is drilled in the exact centre; through this hole a piece of 2 B.A. rod about 2in. long is bolted. The rod is placed in a lathe, and a disc $2\frac{15}{16}$in. diameter is turned from each piece. A parting off tool making a $\frac{1}{16}$in. cut should be used.

In the case where the constructor has no access to a lathe, the discs can be cut with a narrow-bladed saw and then trued by filing. The ordinary hacksaw can be used, but the width of the blade makes the operation difficult.

The discs and the four remaining ends are for the rotor and stator respectively.

The discs are slotted along a radius, as indicated in Fig. 2 in order to make a halve joint. This should be a driving fit; then no fastening device is needed.

In one of the discs two other slots are cut $\frac{1}{2}$in. wide

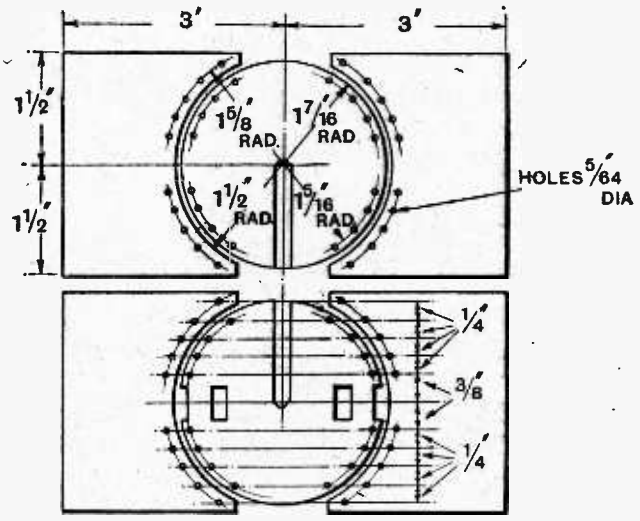


Fig. 2.—Details of the formers for the stator and rotor.

and $\frac{1}{4}$in. deep. At a distance of $\frac{3}{8}$in. below these slots two rectangular holes $\frac{1}{2}$in. × $\frac{1}{4}$in. are made by first drilling two $\frac{1}{4}$in. holes, then squaring with a warding file. The portions of the ebonite between the rectangular holes and the shallow slots are drilled $\frac{3}{16}$in. transversely. This operation needs care, since the thickness of ebonite on each side of the hole is only $\frac{1}{32}$in.

The sixteen $\frac{5}{64}$in. holes for threading the coil are drilled on a concentric circle of $1\frac{5}{16}$in. radius.

After the $\frac{5}{64}$in. holes are drilled in the stator formers the sharp ends arising from the turning must be cut down to about $\frac{1}{4}$in. from the first holes.

Winding the Rotor.

The wire, which is No. 16 gauge copper, is shaped by winding two coils of seven turns on a $1\frac{1}{4}$in. diameter cylindrical former. Commencing at the outside, one-half of the rotor is wound, and about 2in. of wire is left free at the beginning for making the necessary connection. The remaining half is now wound, starting as before at the outside, but turning in the opposite direction. The winding should be commenced in the same portion of the former at which the opposite half finishes. Thus the two inside ends finish in the same place and are, after cleaning, soldered together to make an overlap of about an inch in length.

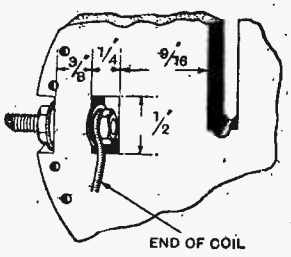


Fig. 3.—Method of fixing the spindles of the rotor.

Two 3in. lengths of 2 B.A. rod are now required. Each is fastened in a transverse hole by two nuts, one in the slot and the other fastening an end of the coil to the portion of the rod projecting into the rectangular hole. Two washers are used to prevent crushing the ebonite, as indicated in Fig. 3.

The Base.

Before the stator can be wound, the four pieces composing the former must be mounted on a suitable base. This consists of $\frac{1}{2}$in. thick hardwood, preferably oak or mahogany, squared to 6in. long × 5in. wide. It is necessary that the base should be made of thick hardwood, since any tendency towards warping would throw the rotor out of centre, making accurate calibration impossible. The base is shown in the sketch of the completed instrument (Fig. 7). Three pieces of the stator former are fixed first, and, before the fourth piece is screwed on, the rotor must be placed in position with the spindles pointing lengthways.

The stator coil can now be wound. Twelve turns of the wire are shaped on a cylindrical former $1\frac{1}{2}$in. diameter. The winding is commenced at the top, and is wound on in one piece. Care must be taken that the $\frac{3}{4}$in. gap is not bridged in a space containing a spindle, or fouling will occur.

Two pieces of ebonite 1in. wide, one $3\frac{1}{2}$in., the other $4\frac{1}{2}$in. long, are necessary to support the rotor. Both have a $\frac{3}{16}$in. hole drilled 2in. from one end, and an $\frac{1}{8}$in. hole $\frac{1}{2}$in. from the opposite end, as indicated in Fig. 4. These two pieces are screwed one at each end of the base to take the rotor spindles through the $\frac{3}{16}$in. holes. The position of the rotor is adjusted by means of locknuts and spring washers, shown in detail in Fig. 5. The spring washers are on the inside, and make contact with two $\frac{3}{8}$in. wide strips of brass. One strip connects with a terminal in the top hole of the longer support, and the other connects with a 4 B.A. bolt to which is attached the top end of the stator coil. The remaining end of the stator is attached

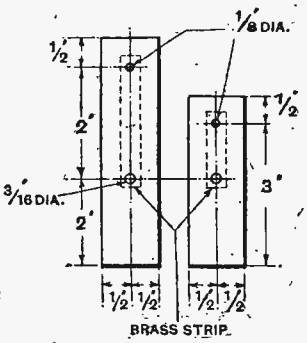


Fig. 4.—Ebonite supporting pieces and connection strips for the rotor.

A Short Wave Variometer.—

with a soldering tag to a terminal screwed in one of the formers adjacent to the longer support.

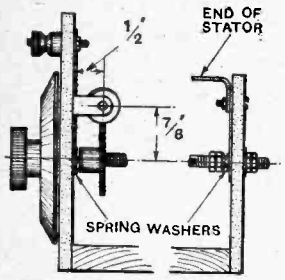


Fig. 5.—Arrangement of the slow motion device which turns the rotor.

The Gearing.

Those who prefer can use one of the geared dials which are now on the market, as the use of some fine turning device is essential. The gearing arrangement adopted for the variometer under description gives a ratio of 50-1, and has been found to be very satisfactory. It is sketched in Fig. 5.

The gears used are those made by Meccano, Ltd., and consist of the large gear wheel and worm drive. The centre must first be carefully drilled out to $\frac{3}{16}$in. in order to take tht 2 B.A. rod. This gear wheel is attached to the rotor spindle passing through the longer support by means of the set screw provided for the purpose. A bearing for the worm drive is made from No. 20 brass strip $\frac{3}{8}$in. wide. It is in the form of a "U" $\frac{7}{8}$in. wide, the centres of the $\frac{3}{16}$in. holes being $\frac{1}{2}$in. from the base of the "U."

The position of the bearing on the longer support must be adjusted until the gears mesh evenly without binding or play. Two 6 B.A. bolts are used to make the connection.

The "Fixed-tune" Aerial Coil.

The construction of the three-turn aerial coupling coil should be clear from the sketch in Fig. 6, as it consists merely of an ebonite support pivoted on one of the formers of the stator. The pivot for the coil is a 1in. length of 4 B.A. rod tapped into one of the stator formers remote from the dial. The coil is lifted free from the variometer by a spring washer, and is held in position by locknuts.

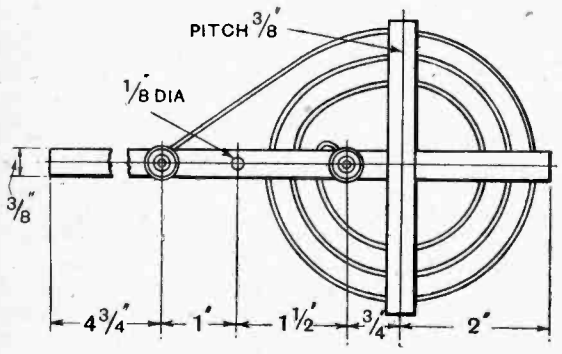


Fig. 6.—The "fixed-tune" aerial coil.

The Reaction Coil.

As with the usual Reinartz Circuit, the coupling between the reaction coil and the grid coil (in this case a variometer) remains constant. This constitutes one of the great advantages of the Reinartz Circuit, as any slight alteration of the coupling greatly affects the wavelength of the tuner.

The reaction coil itself consists of five to ten turns of 26 gauge D.C.C. copper wire wound without any attempt at spacing round the bottoms of the four stator formers.

The exact number of turns must be found by experiment. It should be the smallest number of turns which induces oscillation when the inductance of the variometer is at a minimum and the capacity of the reaction condenser is at a maximum. A large coil will cause uncontrollable oscillation on the higher wavelengths and increase the self capacity of the tuner to the detriment of efficiency on the lower wavelengths.

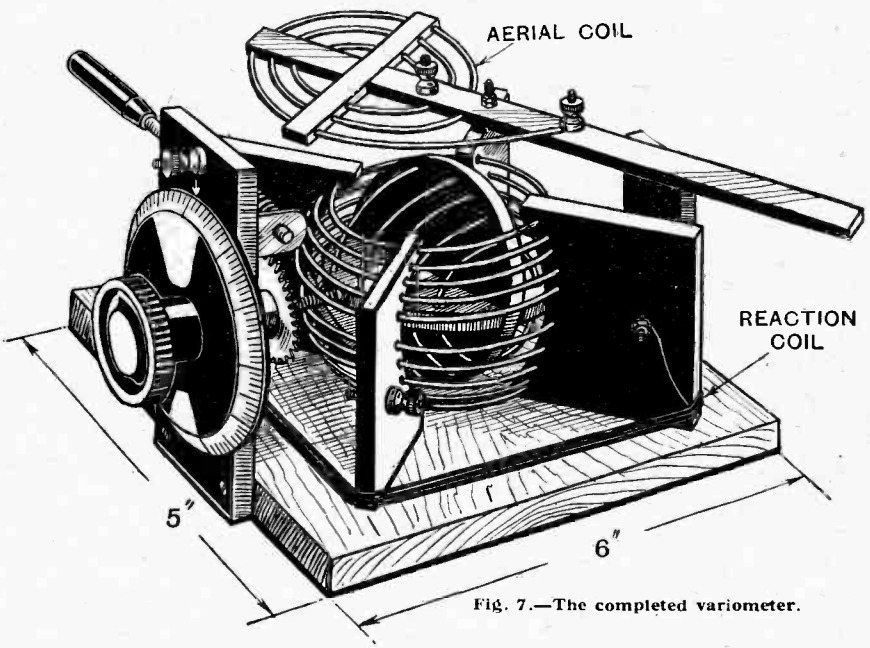


Fig. 7.—The completed variometer.

The ends of the coil are attached to two terminals, one in each of the stator formers, remote from the dial.

Calibration.

The only wavemeter available was not calibrated below 60 metres, therefore the variometer was placed in series with a coil of known inductance. By subtraction the minimum wavelength was found to be 18.6 metres, and the maximum 54 metres. A 0.0003 mfd. condenser in parallel further increased the range to 170 metres. When the variable condenser is in parallel, the variometer should not be quite at its maximum inductance, for a gap is caused between the two wavelength ranges by the minimum capacity of the condenser.

A small air dielectric condenser should be used in series with a standard P.M.G. aerial, but in general it will be found that for 20 metres reception, two 12ft. lengths of flex for aerial and counterpoise will give better results than the more normal aerial and earth.

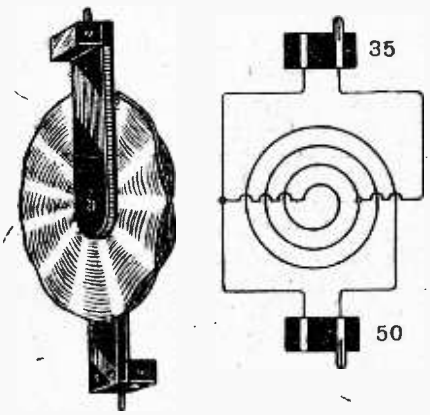
READERS' NOVELTIES

A Section Devoted to New Ideas and Practical Devices.

PLUG-IN COILS WITH TWO RANGES.

To cover a given wavelength range, fewer plug-in coils will be required if each coil is provided with a single tapping point connected to an additional plug on the coil.

In the diagram it will be seen that the coil is mounted between two basket coil holders with the plugs facing in opposite directions. The whole of the coil is connected across



Tapped plug-in coil with double mounting.

one plug, and the turns between the centre and the tapping point are connected to the other. Thus if a coil of fifty turns is tapped at the thirty-fifth turn, we have virtually a No. 50 and a No. 35 coil, depending upon the plug which is inserted in the coil holder.—V. S. B.

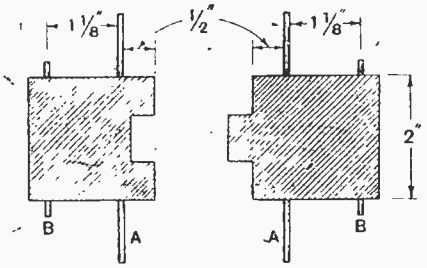
oooo

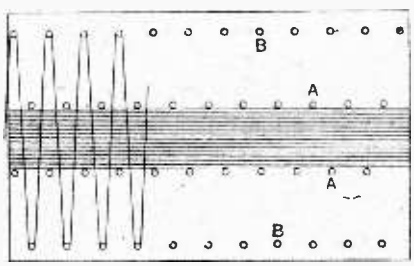
WINDING MULTILAYER COILS.

By means of the former here described it is possible to wind efficient multilayer coils which are self-supporting and which can be removed from the former without withdrawing the pins.

The wooden centre of the former is made in two halves which fit together, each half being provided with two rows of pins. An odd number of pins is used in each row, and these are arranged alternately in the manner indicated in the extended plan of the former.

The form of winding adopted is that in which a zig-zag layer alternates with a plain single layer of turns. In this instance, however, the solenoid layer is wound between the pegs A, while the zig-zag turns cross between the pegs B. After a solenoid layer has been wound over a zig-zag layer the loops are lifted off the pegs B and bent back over the coil. Another solenoid layer is then wound so that one zig-zag layer suffices for two solenoid layers. The



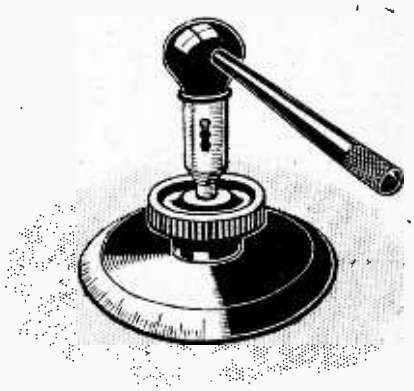


Section of former for winding multilayer coils and extended plan, showing arrangement of pegs and method of winding.

coil is continued in this way until the desired number of turns is reached, when it may be removed from the former merely by pulling apart the two halves. A coil constructed in this way is self-supporting, and does not require to be treated with wax or shellac.—F. N.

RATCHET CONDENSER ADJUSTMENT.

When several condenser dials in close proximity on a receiver panel are fitted with extension handles, there is always congestion when one or more of the dials have to be moved through wide angles.



Ratchet screw-driver adjustment for condensers in close proximity.

A convenient but rather expensive solution of the difficulty is obtained if "Yankee" ratchet screw-drivers are fitted to each dial. The blade of the screw-driver is cut off to within ½in. of the handle and forced into a hole drilled vertically in the top of the condenser knob. The extension handle is then fitted into the side of the wooden handle at right angles.

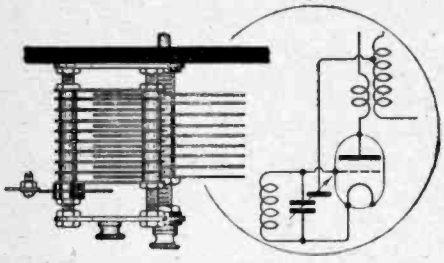
A small catch on the side of the screw-driver gives three movements; a ratchet movement in either direction and a locked position giving a direct drive. Thus the condenser dial can be moved throughout the whole of its range in either direction by a series of small movements of the extension handle.—J. W.

oooo

NEUTRALISING CONDENSER.

In the neutrodyne circuit a small balancing capacity is connected between a point on the H.F. transformer secondary winding and the grid of the preceding valve. The

value of this capacity has to be found by trial for a given set of valves and receiving conditions, but, once found, it may be fixed until some factor such as the insertion of a new valve makes its readjustment necessary.



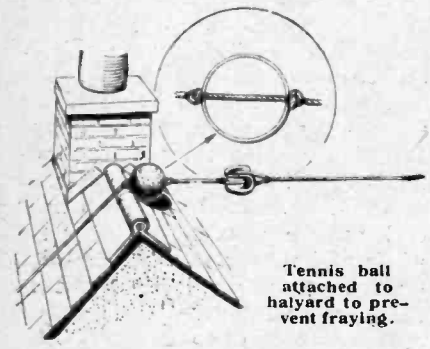
Neutralising vane fitted to tuning condenser.

The grids of the valves are connected usually to the fixed vanes of the condensers tuning the transformer secondary windings. The balancing condenser vane may therefore be mounted in the manner indicated in the diagram on one of the bolts passing through the fixed vanes. An ebonite bush and collar are made to fit the hole in the neutralising vane. The auxiliary vane can then be clamped in position with the lock nut originally fitted to secure the fixed vanes on the main condenser. The method is not only mechanically sound, but also effects a simplification in the wiring of the receiver.—E. H

oooo

FRAYING OF AERIAL ROPES.

When an aerial halyard passes over the roof of a house, the rope is apt to fray as a result of movements of the aerial in the wind. If an old tennis ball is perforated and held in position on the rope by knots tied on each



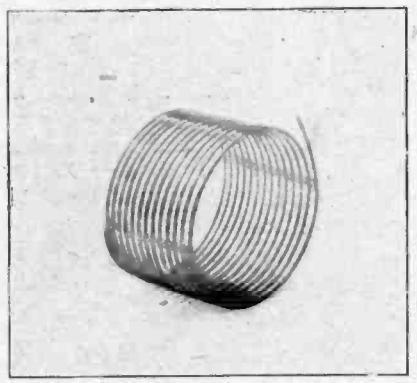
Tennis ball attached to halyard to prevent fraying.

side of the ball, the additional friction will prevent the halyard from slipping along the ridge tile. In addition, the pressure on the tile will be more evenly distributed.—J. H. G.

AIR-SPACED COILS.

While celluloid is, perhaps, not the best of dielectrics, the following method of mounting air-spaced coils can be recommended from the point of view of convenience.

The spacing strips are cut from corrugated celluloid sheet, which is sold for the purpose of spacing accumulator plates. The width of the strips, which are cut at right-angles to the corrugations, will depend on the diameter of the coil, but $\frac{3}{16}$in. may be taken as a good average. The strips are used in pairs, one on either side of the coil, and are sewn together between the turns with thread. For coils wound with thin wire requiring a narrow spacing, the strip may be cut from flat sheet



Corrugated celluloid supporting strips for air-spaced coils.

and specially corrugated by passing it between loosely meshed cog wheels.

If only three or four strips are used to support the coil, the dielectric losses may be neglected for practical purposes as far as reception is concerned.—W. L. S.

oooo

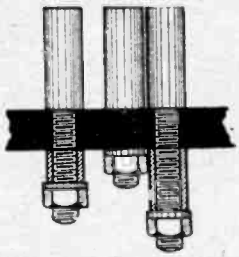
SECURING TERMINALS.

When fitting terminals to the ebonite panel of a receiver, it is an advantage first to make several radial cuts with a cold chisel on the under surface of the terminal before screwing down. The burrs will sink into the ebonite panel and prevent the terminal from rotating.—J. G.

oooo

VALVE SOCKET CONNECTIONS.

The drawing shows how the capacity and surface leakage of a valve holder may be reduced by fitting metal or ebonite sleeves to the grid and plate sockets. The filament sockets may be fitted without sleeves, but it is desirable that the securing nuts and washers should be of small diameter. If the socket threads are 4BA, it is convenient to re-tap 6BA nuts and to drill out small 6BA washers to a suitable size



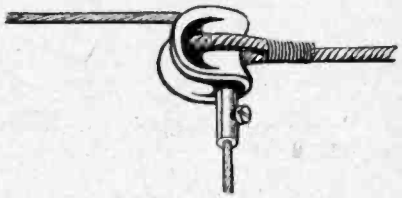
Method of fixing sleeves to grid and plate sockets of a valve holder.

In preparing the spacing sleeves it is important that the ends should be accurately squared; if possible, they should be faced in a lathe.—W. F.

oooo

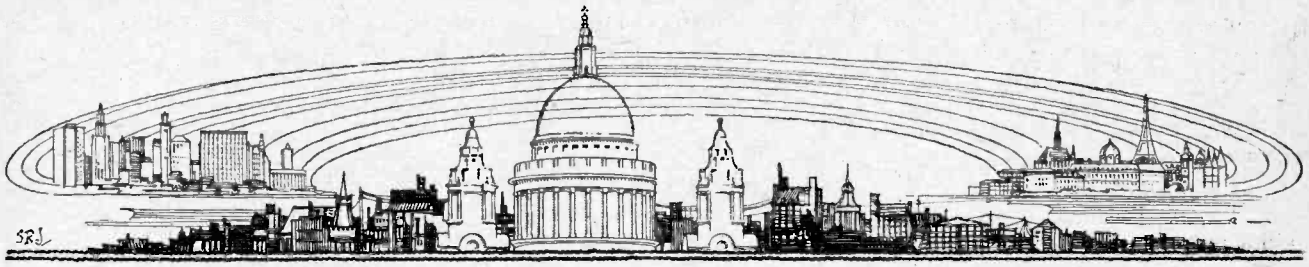
AERIAL JOINTS.

It is customary to twist or splice the aerial wire round the insulator at the lead-in end of the aerial, since soldered joints are undesirable. If for any reason the length of the aerial or lead-in has to be altered, it is necessary to untwist and remake this joint in a new place, with the result that unsightly kinks are left in the wire; and if phosphor-bronze wire is used, there is always the possibility of a breakage. An excellent adjustable stop for the aerial insulator is



Adjustable lead-in joint.

provided by an ordinary telephone connector terminal, which should be slipped over the lead-in end of the aerial wire and clamped to the wire with the set screws just below the insulator. Connectors of this type are made in several sizes, and there should be no difficulty in finding one with a suitable internal diameter for the aerial wire. If the connector passes through the hole in the insulator, the set screws may be exchanged for longer ones.—H. R.



CURRENT TOPICS

Events of the Week in Brief Review.

DX BETWEEN ITALY AND NEW ZEALAND.

Two-way communication has been established between Italy and New Zealand by Engineer Santangeli Marion (1ER), of Milan, and E. A. Shrimpton, of Wellington. The signals were exchanged on a wavelength of 40 metres.

oooo

HIGH-POWER BROADCASTING IN GERMANY.

Germany now being well equipped with broadcasting stations, attention is being given to the question of power. At least two prominent stations, viz., Munich and Hamburg, have increased their power already, Munich using as much as ten kilowatts. A high aerial tower is under construction for the Hamburg station and is expected to be ready in time for the September Radio Exhibition.

oooo

A TALK WITH YUGO-SLAVIA.

Mr. J. A. Partridge (G2KF), of Merton Park, reports that he exchanged signals with a Yugo-Slavian amateur, giving the call sign 7XX, on Sunday evening, July 26th, at 6.18 (GMT). Transmission from both stations was on a wavelength of 45 metres, and 7XX stated that this was his first wireless contact with Great Britain.

oooo

WEATHER REPORTS FOR THE WORLD.

What is stated to be the world's largest observatory is under construction on Mount Salève, which overlooks Geneva at a height of 4,500 feet. The observatory, which will cost £1,250,000, is being erected and presented to the French nation by Mr. Assan Dina, a Hindu millionaire. A powerful wireless station is to be installed to transmit weather reports all over the world.

oooo

FIRE AT MARCONI RESEARCH STATION.

A hut forming part of the Marconi research station on the outskirts of Chelmsford was destroyed by fire on Friday, July 31st, together with a quantity of experimental apparatus. According to early messages, important documents relating to the "beam" system were involved in the fire, but subsequent reports contradicted the rumour. The hut was situated nearly a mile distant from the Marconi Company's main works in Chelmsford.

KOENIGSWUSTERHAUSEN TESTING.

The new 1,300 metre broadcasting station at Koenigswusterhausen is still in the testing stage, according to *La T.S.F. Moderne*. The station is to be heard almost every evening, however, and the strength at which it is picked up in Paris is comparable to that of 5XX.

oooo

NORWEGIAN EXHIBITION.

A wireless exhibition is to be held at Oslo, Norway, during September. Negotiations have for some time been going on between the Norwegian Association of Radio Dealers and the Norwegian Radio Association regarding an exhibition of Norwegian and foreign radio equipment, together with apparatus assembled by amateurs. It was originally planned to hold this exhibition during May of this year, but, due to the lack of available space, postponement was necessary.

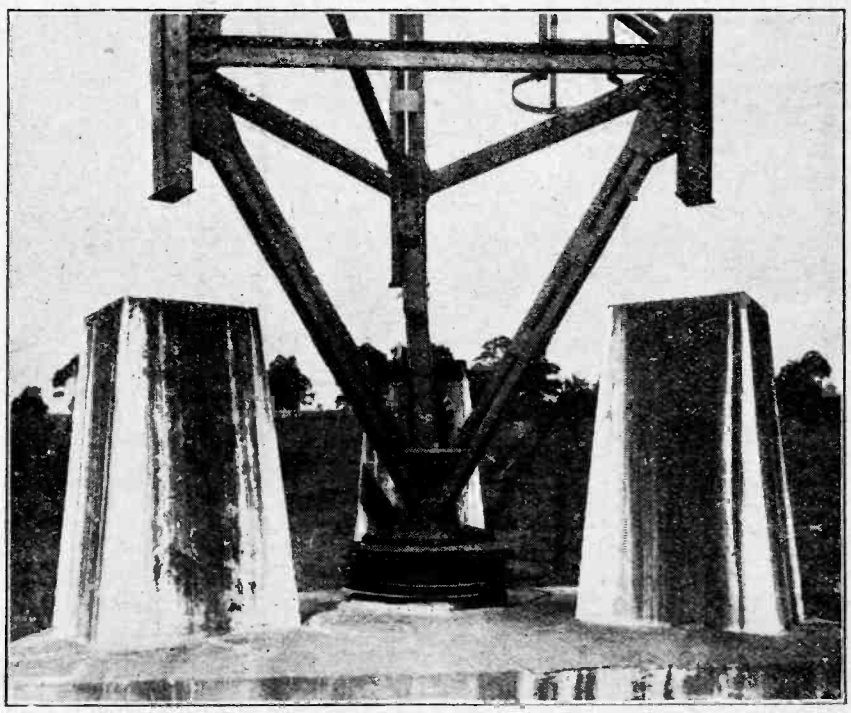
oooo

CHILIAN AMATEURS ACTIVE.

A statement that he was using a power of only five watts was elicited from Mr. Casilla (Chilian 2LD) of Santiago, by Mr. W. A. S. Butement (G6TM) of West Hampstead, when the two stations exchanged signals on Sunday, August 2nd. Communication was maintained from 6.30 to 8 a.m. (B.S.T.) 2LD reporting Mr. Butement's signals as R5. The British station worked on 45 metres and the Chilian on 35.

On the same morning Mr. J. Rogers (G6JO), of Falmouth, and Mr. A. McFarlane, of Croydon, heard signals from Chilian 1EG.

A letter from Mrs. J. A. Partridge



MOUNTED ON GLASS. The base of one of the 400-ft masts at the Pennant Hills high-power station, near Sydney, Australia. The mast rests on a number of glass plates. When replacements are necessary the mast is supported by jacks on the three concrete pillars.

(2KF) describing two-way working between his station and that of a Chilian amateur appears in our correspondence pages.

oooo

ITALIAN AMATEUR BUSY.

Signor Pozzi Silvio, Corso Torino 1, Novaro, Italy, is at present transmitting nearly every evening on 25 and 40 metres. He would be glad to receive reports from British amateurs who hear him.

oooo

BELGIAN WIRELESS CONFERENCE.

The rights of amateur transmitters, regulations relating to wavelengths, and the validity of a tax on aerials, are among the subjects coming under discussion at the general meeting of the Fédération Belge des Sociétés d'Etudes Radioelectriques, to be held at Malines on September 20th next. The delegates will be received in the town hall.

The same day will witness the opening of a wireless exhibition organised by the Malines Radio Club under the direction of Dr. Bredo.

oooo

20-METRE RECEPTION IN PALESTINE.

An interesting report of the reception in Palestine of American and New Zealand amateurs has been forwarded by a reader at Amman, Transjordan. On the night of July 18th-19th, between 11 p.m. and 4.45 a.m. (GMT) our correspondent picked up test signals from the following,—U2SZ, U2BEE, U4SA, U2XAF, U1CCX, U1AHG, U2BP, U2BUY, U8BGN, U1CKF, Z2AC and Z2AE. A three-valve set (0-v-2) was employed and strong signals were received in practically every case, even two hours after sunrise. Atmospheric disturbance was very noticeable during the hours of darkness.

oooo

BROADCAST PROGRAMMES FROM THE ARCTIC.

Owners of short wave receivers will be interested to learn that a series of official broadcast programmes will be transmitted on 40 metres by the MacMillan Arctic Expedition from the exploration vessel *Bowdoin* (WNP). The first of these programmes was broadcast at 4 a.m. (B.S.T.) on Sunday, August 2nd, when Eskimos contributed a native chant and Captain MacMillan described the latest adventures of the expedition. A wireless message sent from the *Bowdoin* on July 29th reported that the vessel was wedged in the Melville Bay pack-ice.

Mr. F. Walker, of Wallingford, who picked up signals from the expedition on July 19th, states that WNP's note is "mushy" but very strong.

oooo

GOVERNMENT CONTROL IN DENMARK.

Government control of all broadcasting activities in Denmark has been put into effect for a period of one year. A special board of 27 members, including Government officials, representatives of the various wireless organisations, the Press, and prominent professional singers has been appointed to take charge of the preparation of all wireless programmes.

Another feature of the new Government control is the enforced payment of licence fees by all holders of wireless apparatus

A PAGE FROM AN AMATEUR'S SKETCH BOOK.

Major Borrett (Canadian 1DD) sends "The Wireless World" some free-hand impressions of personalities at the Paris Amateur Conference.

in Denmark. Such licences cost 10 kroner for owners of crystal sets, 15 kroner for valve sets, and 200 kroner for receiving sets equipped with loud-speakers for use in public places. Failure to license wireless apparatus will make the offender subject to fine and his apparatus to confiscation.

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EXIT CLIFDEN.

Pathetic interest attaches to an illustrated circular which has been issued by Messrs. Thos. W. Ward, of Sheffield, giving details of material for sale in connection with the dismantling of the Marconi Wireless Station at Clifden, Ireland.

The Clifden station, which took two years to build, was opened for public service on October 17th, 1907, and for many years occupied a proud position among the foremost high-power stations of the world, maintaining regular communication with America.

A heterogeneous collection of material is now available for sale, including amplifiers, dynamos, cottages, a petrol locomotive, wavemeters, furniture, note magnifiers, and voltmeters. Under "Miscellaneous Lots" a variety of articles appear ranging from one testing board to one blow-lamp and one solder pot.

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AMERICAN AMATEURS ASSIST ARMY.

The work of members of the American Radio Relay League in assisting the military authorities with reports during the recent defence day tests has elicited a letter of commendation to Mr. Hiram Percy Maxim, the president of the League, from Colonel George McD. Weeks, Acting Chief of Staff of the Third Corps area. The Colonel wrote :—

"There were approximately one hundred and fifty amateurs who volunteered their services for handling messages relative to defence test activities. The results obtained impressed this headquarters with the effectiveness of this organisation as a means of rapid and efficient transmission of messages and a realisation of the valuable assistance that could be rendered in case of national emergency."

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ERRATUM.

We have been asked to draw attention to a small typographical error which we regret crept into the description of Fig. 3, on page 516 of our issue of May 27th. This photograph, which appeared in the article "Broadcast Organisation in Germany," depicted the choke invented by Drs. Pangs and Gerth, not *Gerch*.

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CHANGE OF ADDRESS.

Messrs. The Goswell Engineering Co., Ltd., manufacturers of "Quality" radio components, inform us that they have moved to larger and more commodious premises at 95-98, White Lion St., London, N.1.

SELECTIVITY.

A Review of Some of the Problems Involved.

By CAPT. H. J. ROUND, M.C.

IN modern high-class broadcast receivers there is a demand for selectivity and sensitiveness combined with good quality, which practically no single receiver on the market at present fulfils.

Types of Selective Receiver.

Two well-known receivers chiefly developed in America —*i.e.*, the supersonic receiver and the neutrodyne partly meet the conditions.

The supersonic receiver, as developed, is extremely selective in a way, but a serious defect in this selectivity will be shown later.

The neutrodynes, as developed, are excellent as far as they go, but have evidently been designed with the aim of reducing the number of controls to a minimum—probably in competition with the supersonic receiver—which is a mistake if one takes account of the fact that, as the controls are condenser handles moving almost exactly together, another handle or so would make little difference provided the result obtained was a considerable improvement, and with one or two more tunings the neutrodyne would be all that is wanted.

For sensitiveness, if we consider that the neutrodyne can be used on a decent aerial, and that it is bad practice to use the super on an aerial, owing to possible radiation trouble, there is not much to choose between the two sets of receivers. Of course, the use of a frame with a supersonic is of some advantage in preventing jamming, and under these conditions the neutrodyne will suffer considerably in comparison of sensitiveness.

Reasons for Selectivity.

It is proposed to consider here rather generally the methods by which selectivity is obtained on these receivers, giving indications how possible improvements can be obtained.

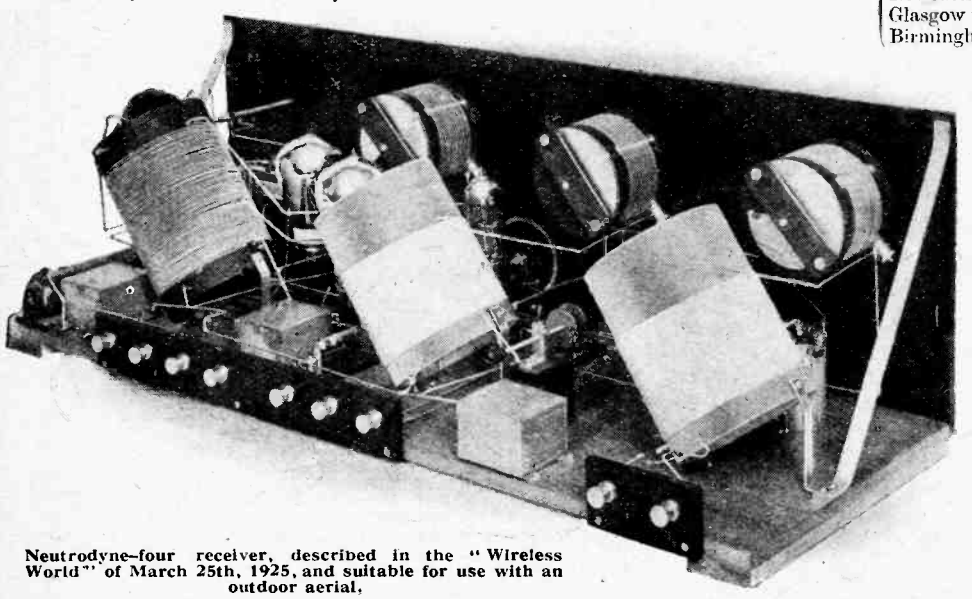
Let us first of all examine what our problem is: A wireless telephone transmitter radiates a band of, say, ±6,000 cycles round a central wave commonly called the carrier wave. We desire to receive this with as much uniformity as possible over the range of ±6,000 cycles round the carrier frequency. Experience dictates in general that the frequencies ±4,000 should not drop to more than half of the carrier wave for good quality. Now if we assume that our wireless telephone signals die away inversely as the distance, we can say that to receive a distant station, 200 miles away, to a strength equal to our local station, 2 miles away, we must be able by tuning to reduce the local station to 1/100th to bring it equal, and to 1/1,000th to bring it to a negligible value. This value of 1/1,000th is not sufficient reduction when distant signals are being received in daylight, or in weak spots at night, but, after building up receivers calculated round this basis, a few experiments will enable one to judge how much further one will want to go. We have now two *criteria* for our receiver:

(1) Over a band of ±4,000 cycles the efficiency of reception must not drop to more than half.

(2) At x cycles different from the carrier wave our signals should drop to 1/1,000th of those in tune.

It will be better if we find out what is feasible before we actually lay down a value for x. Naturally, we should like this to be about 7,000 cycles, but this will be hardly realisable in practice.

Approximately	Cardiff is	857,000 cycles
	London is	826,000 ,,
	Manchester is	800,000 ,,
	Bournemouth is	780,000 ,,
	Newcastle is	744,000 ,,
	Glasgow is	710,000 ,,
	Birmingham is	624,000 ,,



Neutrodyne-four receiver, described in the "Wireless World" of March 25th, 1925, and suitable for use with an outdoor aerial.

so that between London and Manchester we have about 26,000 cycles to play with, which is ample if we are at some distance from both, but troublesome if we are situated within two or three miles of either station.

Theory of Selectivity.

The basis of all selectivity is a tuned circuit consisting of inductance, capacity, and resistance. When an alternating voltage is applied to such a circuit, the current induced into it is a maximum at the point of tune, at which point its value is controlled entirely by

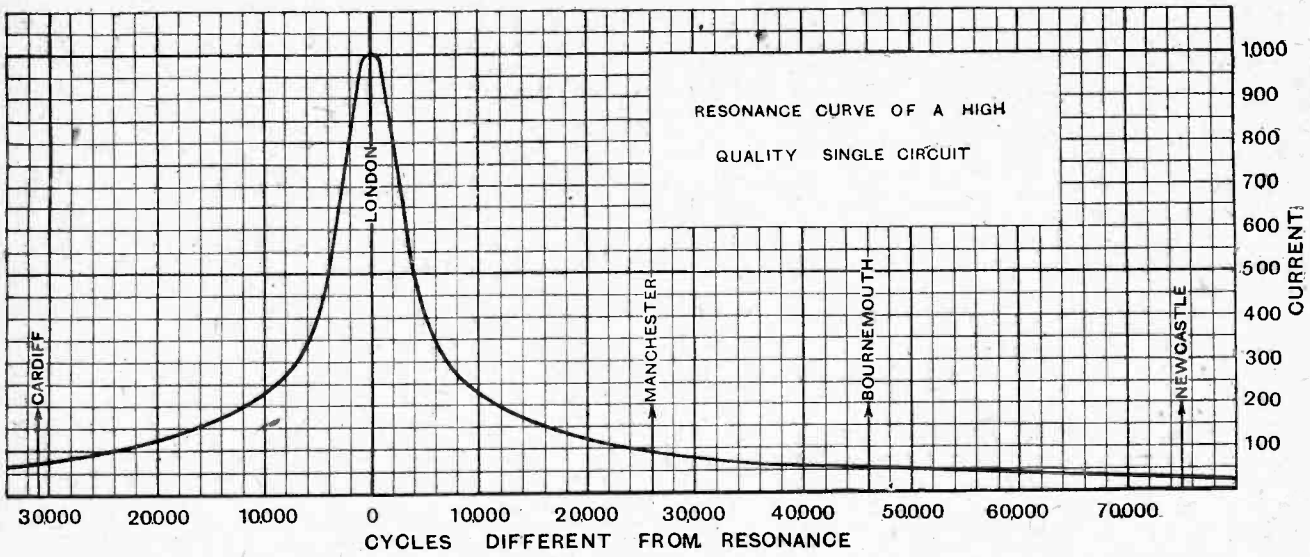


Fig. 1.—Resonance curve of circuit giving good quality of reception, in which the current value falls, at 4,000 cycles from tune, to half its value at resonance.

the resistance. This current falls off if the frequency of alternation is altered on either side of tune, because the impedance introduced by the capacity and inductance no longer balances.

Fig. 1 shows the resonance curve of a circuit arranged so that the current drops to $\frac{1}{2}$ at 4,000 cycles' difference from resonance. The circuit has an inductance of 200 mhs, and 5.6 ohms dead resistance (the capacity and wavelength do not matter in this first consideration). In actual practice, where the resistance varies with the wavelength, and where the resistance is made up partly by the shunting of the valve, we shall have to take L and C into consideration.

TABLE I.

Cycles' difference from tune.	Amplitude of Current.
0	1,000
4,000	500
8,000	270
16,000	147
32,000	73
64,000	36
128,000	18

It will be seen that such a circuit as Fig. 1 will not give us anything like the tuning we require, and we must search for an additional means to improve the effect. Of course, if we entirely neglect quality, we can reduce the resistance R by reaction to such a value that at least fair selectivity can be obtained—but then we have not complied with the first condition, that at 4,000 cycles' difference the current shall only drop to half the resonance value.

If the resulting current in the tuned circuit is permitted to act on a similar circuit by induction—preferably very loosely coupled—instead of getting a curve such as Fig. 1, we arrive at a curve which is produced by squaring the ordinates of Curve 1.

It is quite easy to reason out without mathematics that such a squared curve falls away quicker than the simple curve.

Thus, if we now continue the process—with 3, 4, 5, 6, etc., circuits—we shall get a series of curves cutting off more and more rapidly. Fig. 2 shows such a series of circuits. We have, however, not kept to the rule that at 4,000 cycles' difference the current shall only be reduced to a half, so that to meet this condition we must raise the value of R in each circuit until over the whole system the current at 4,000 cycles' difference from tune is a half of that in tune, and then we must examine our curve at higher frequency differences from this.

In Fig. 3 and Table II. is given the overall curve of four circuits loosely coupled with one circuit as comparison. The full line curve is one circuit, the dotted line represents four circuits drawn to the same maximum amplitude.

TABLE II.

Cycles' difference from tune.	1 Circuit.	4 Circuits.
0	1,000	1,000
4,000	500	500
8,000	270	130
16,000	147	30
32,000	73	1.1

The resistance in each circuit is now about 15 ohms. We see that at 32,000 cycles' difference there is a reduction of signals to about $\frac{1}{1000}$, and in general this will be sufficient tuning for most practical purposes, such as when 2ZY is being received near London, providing 2ZY is

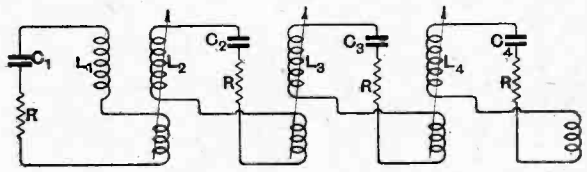


Fig. 2.—Four resonant circuits and compensating resistances coupled in cascade to give improved selectivity without detriment to quality.

giving us a signal of average strength. To get better results still, six or eight circuits may be used with higher values of resistance in each circuit. The amount of cutting off will then be sharper, or we can obtain better quality with the same tuning.

Selectivity.—

Here it is very evident that the four circuits are practically giving us such a reduction as we may want. Of course, compromise is now possible to the designer: he may limit the amount of tuning he wants to do, or he may say that he will forego quality to some extent and accept a reduction of a half at 3,000 cycles' difference, or similar variations depending upon his requirements.

Now, such a series of coupled circuits would not only be inefficient, but would necessitate an aperiodic amplifier of large amplification at the end of this series of circuits, and this would, unless very well shielded, pick up the local station on its own, thus defeating our object.

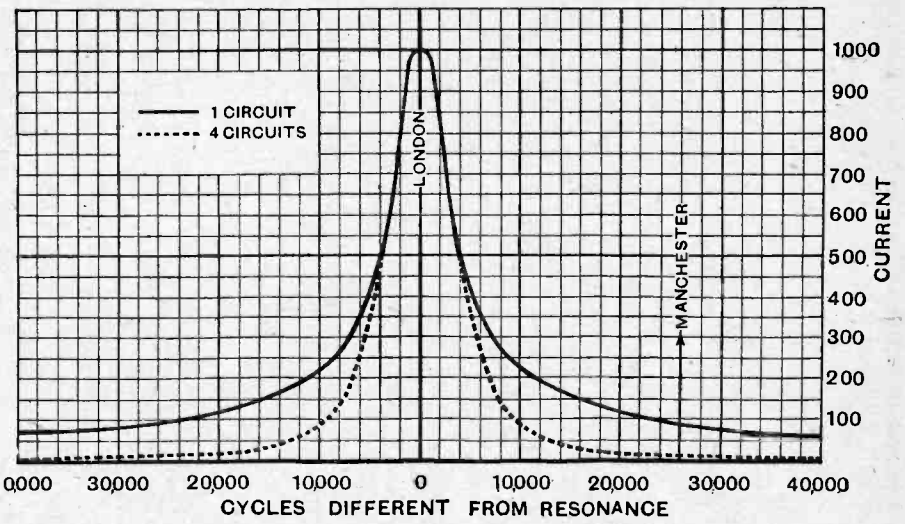


Fig. 3.—Resonance curve of single circuit compared with the curve of the series of circuits given in Fig. 2.

So we must couple our circuits together with valves and we must arrange our magnification per valve to be such that the overall magnification is what is required.

Fig. 4 shows four circuits coupled together with valves, where the incidental batteries have been left out for simplification. In all circuits but the aerial one the resistance is made up of dead loss *plus* valve damping.

It is not essential that all the circuits should have the same damping, providing we determine that our overall curve is what we want. A difficulty occurs here in that we shall run into oscillation trouble unless we prevent the magnified energy flowing back through the electrostatic capacity of the valves.

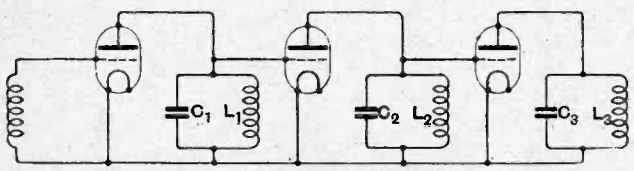


Fig. 4.—Schematic arrangement of four resonant circuits coupled in cascade by means of valves. In this case part of the damping is provided by the valves themselves.

It is possible to cascade four H.F. circuits by using V24 valves, but a more general solution is by means of the neutrodyne connections.

The term Neutrodyne, although actually a registered name applied to a particular circuit, has become rather generalised recently to mean any method of using a H.F. potential of instantaneous opposite sign to that on the grid or plate of a valve to balance out the capacity action of the valve in a manner which remains constant over the whole range of adjustment of the set. I shall use the term generally in that sense, but to go into details of the various methods which can be employed is not permitted here on account of lack of space. Fig 5 shows a generalised connection of this type.

It may be here mentioned that this valve circuit is not quite so simple as it seems, even neglecting reaction.

The R in our resonant circuit with valve coupling will be made up mainly of two components, one of the dead losses in the copper coil and the condenser and the other (in all cases except the aerial coil) due to the fact that the valve damps the circuit because it is across the circuit. (*Note.*—If P is the valve plate resistance, then it gives an effect equal to a resistance $R = \frac{L}{CP}$ in series with the circuit.) All H.F. tuning is done by varying either C or L or both. If we keep L constant, then as the wavelength of the circuit is lengthened by increasing the condenser—our resistance due to copper decreases and our additional equivalent resistance due to the valve also decreases. In consequence, we shall usually find our tuning sharpen up as we lengthen our wave. Undoubtedly the best method, from the theoretical point of view, would be to vary C and L together, then in that way the selectivity could be maintained roughly constant over our range. It is, however, a fine point, and may be met by not attempting to cover too great a range with each set of plug-in inductance coils.

The magnification given by such a cascade valve arrangement depends upon the ratio of the valve damping and the dead losses in the circuit attached to the valve, and these should in practice be roughly of the same order, with due regard to the resonance curve required.

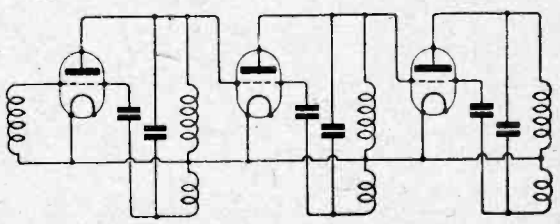


Fig. 5.—A method of coupling, in which the effects of valve capacity are neutralised. This set was described in the "Wireless World" for March 4th, 1925.

American practice seems to favour high magnification per stage and a small number of stages with large valves. I personally prefer small magnification per stage and a large number of stages with small valves. Undoubtedly

Selectivity.—
the tuning and stability and total magnification obtainable is greater, with no difference in ease of handling.

The Super-heterodyne.

If we take a short wave and receive it on a rectifier and then introduce a heterodyne, a beat tone will be formed, the same beat note being produced at two wavelengths on the heterodyne, or if the wavelength of the heterodyne is kept constant, then either one or two wavelengths will produce the same beat note.

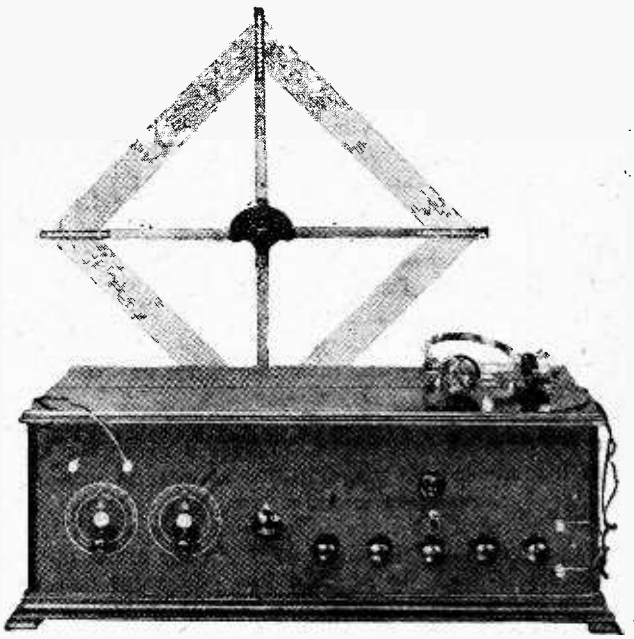
If instead of tuning in the high frequency circuit we apply the same cascade methods to the beat tone in circuits tuned to the beat tone, we can construct a valve filter circuit which can meet the same requirements as the H.F. cascade valve filter; in fact, we can aim at the same resonance curves, and they will be no better and no worse than the H.F. case, except that *two bands* of wavelength can enter through this beat tone filter.

The beat tone frequency of the usual supersonic receiver is about 50,000, and this is dictated by experience. At this frequency the centres of the two wavelength bands which will enter the filter, unless otherwise prevented, are 100,000 frequency apart. So to design the set that only one band can be received, we must precede the beat tone filter by a H.F. filter which will reduce a near-by wave with 100,000 cycles' difference to $\frac{1}{10\,00}$. This cannot be done by one H.F. circuit without sharpening the tuning too much, and two tuned H.F. circuits are therefore necessary, unless one is prepared to dodge from one position of the heterodyne to the other, hoping for luck. The filter band given by the H.F. circuits must be multiplied by the band given by the beat tone circuits in designing the set to get the overall curve.

The writer is aware that practically no set using the super method includes a double H.F. circuit, thus giving an apparent simplicity to operation, but the set is only partially doing what the neutrodyne can do completely.

On a particular super in use by the writer the beat tone wave is just the right length to give bad effects between Newcastle and London. For instance, if the frame is tuned to Newcastle, one side of the heterodyne gives London with a squeak due to Newcastle and London beat tones beating with one another. With that difference of tune the H.F. should completely eliminate London in the ideal set.

Owing to the lower copper losses in coils at low frequencies and to the valve capacities not being so important, it is possible to get more magnification per valve stably at long waves, and in consequence the overall magnification of a set using one or two H.F. stages, a rectifier and, say, two beat tone stages and a rectifier can be made a good deal greater than a straight neutrodyne, so that the system is eminently suited for frame working, but utterly unsuited to aerial working, as the presence of an oscillator in an aerial system is a danger to the neighbours, and no system of balancing out is safe.



An illustration of the first practical design for a supersonic heterodyne receiver published in this country. Owing to radiation from the local oscillator, this receiver is generally used in conjunction with a frame aerial.

Even the super on a frame is liable to cause trouble in congested districts to the man with a sensitive receiver. The super again is liable to receive long waves in tune with its filter band. These will not usually be audible until a carrier is received, when the beat tone produced by the carrier and the heterodyne will rebeat with the long wave and produce an audible note. However, the super has a distinct advantage in the fact that its resonance curve remains constant whatever the wavelength being received, and in general it will be more even in sensitiveness and tuning than the neutrodyne.

I think this point is outweighed by its faults, and there is a great future in straight tuned H.F. circuits and in methods of stringing them together in a stable and easily handled way.

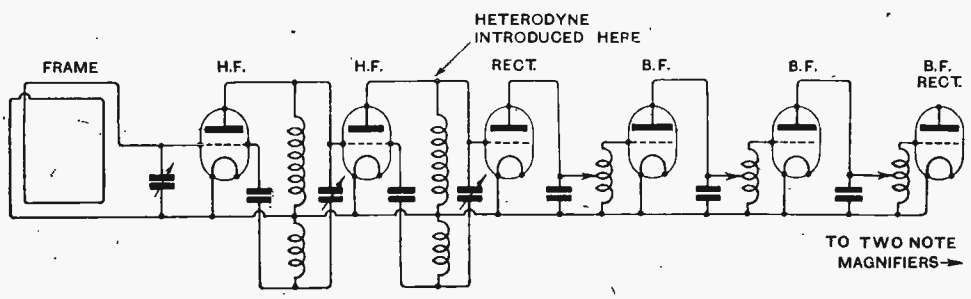
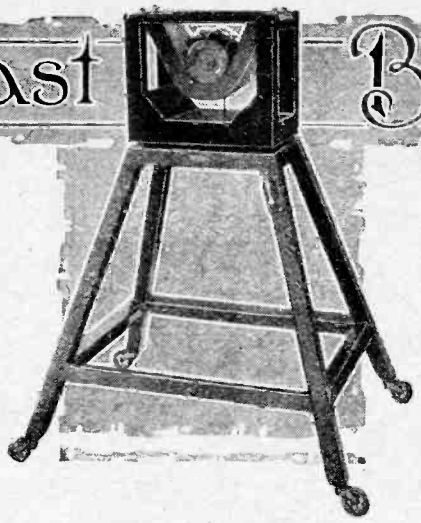


Fig. 6.—A circuit in which the super-heterodyne and neutrodyne principles are combined. For the sake of simplicity the batteries and local oscillator have been omitted.

Fig. 6 shows an ideal circuit combining the neutrodyne and supersonic receiver. The heterodyne is not shown, and all batteries, etc., are left out. Both for magnification and tuning, this is easily the best arrangement, but the number of valves and also number of controls will no doubt take away from its popularity.

Broadcast Brevities



SAVOY HILL

Divided Opinions on Daventry.

Although the B.B.C. is able to say that the majority of reports on the working of 5XX are good, it would be idle to contend that crystal-set users in all localities are as well-satisfied with Daventry as they were with Chelmsford. Numerous reports of non-reception have come from just those places in Kent, Essex, and parts of Suffolk which the engineers at Savoy Hill had marked out as probable bad spots even before Daventry came into being.

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Hints to the Disgruntled.

Among the letters received are many indications that listeners expected conditions to remain precisely the same for crystal reception from Daventry as from the old 5XX. But it is clear that a large number of correspondents in North Kent and South Essex should improve their aerials. People, too, who grew accustomed to listening with indoor aerials should remember that Chelmsford was naturally better placed than Daventry, so far as the localities mentioned are concerned, if an indoor aerial was used.

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That Second London Station.

Apart from all this, it is admitted that a large number of listeners have been "cut out" through the removal of the high-power station and have at present no alternative upon which to fall back. This is a state of affairs which cannot be allowed to persist. The army of listeners has come to be regarded as a force which must receive every consideration. The opinion of several listeners who have sent a joint complaint to Headquarters may be quoted, as follows:—

"The solution seems to be to give us a second station near London. It is hoped that the Government as well as the B.B.C. will keep in mind the great body of public opinion which has grown up around the broadcast service which cannot be ignored by those responsible, directly or indirectly, for supplying the service."

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Should Artists be "Introduced"?

Consideration is being given to the question whether broadcast programmes are suffering from the inclusion of introductory remarks respecting artists and speakers. Listeners have suggested that time is wasted in telling them of the feats that the artists have performed; the feeling being that persons who broadcast will stand or fall solely by their performances before the microphone.

FUTURE FEATURES.

Sunday, August 16th.

LONDON.—3.30 p.m.—Ballad Concert.

BIRMINGHAM.—3.30 p.m., Classical Programme.

MANCHESTER.—8.50 p.m., Chamber and Choral Music.

Monday, August 17th.

LONDON.—10.15 p.m., Violin Recital by Daisy Kennedy.

NEWCASTLE.—8 p.m., Popular Programme by the J. H. Squire Celeste Octet and John Henry.

Tuesday, August 18th.

ALL STATIONS (except 5XX).—8 p.m., The Opera "I Pagliacci" (Leoncavallo), conducted by Aylmer Buesst.

Wednesday, August 19th.

CARDIFF.—8 p.m., Melodies of Mendelssohn.

BELFAST.—7.30 p.m., Band of the Sherwood Foresters.

Thursday, August 20th.

5XX.—8 p.m., "Radio Radiance" Revue (5th Edition).

LONDON.—8 p.m., Chamber Music.

BIRMINGHAM.—8 p.m., An Hour with Gounod.

ABERDEEN. — 8 p.m., Musical Comedy and Opera.

Friday, August 21st.

LONDON.—8 p.m., The Kneller Hall Band—A Night with English Composers.

EDINBURGH.—8 p.m., "What is This?" A New Competition.

Saturday, August 22nd.

LONDON.—8 p.m., "Radio Radiance" Revue (5th Edition).

BOURNEMOUTH AND 5XX.—8 p.m., Comic Opera, "The Rose of Araby."

NEWCASTLE.—8 p.m., "An Hour in a Victorian Drawing-room."

TOPICALITIES.

A Desirable Feature.

By a singular coincidence, at the time when criticisms of this nature were being received by the B.B.C., a correspondent in the daily Press was putting up a case for the retention and extension of introductory remarks by the announcer. It is regarded officially as desirable that introductions should be broadcast, especially in the case of singers and artists whose reputations are Continental rather than British, and the broadcast gains in interest through references to an artist's past work, provided that such references are purely explanatory and not eulogistic.

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Daventry's Mishap.

The Daventry Station met with its first mishap during the August Bank Holiday period, when one of those already famous £80 valves burnt out and the station was put out of action for some five minutes.

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Expense of Valve Maintenance.

Valve maintenance is one of the most expensive items for wireless engineers. When the new 5XX was testing, a comparatively small mishap occurred; but the loss on valves ran up to £400 within a quarter of an hour. The most expensive misfortune of this sort occurred just after the war, when, at the one and only station which was then putting out a broadcast programme, an engineer inserted a switch the wrong way, and burnt out nearly £5,000 worth of valves. The occurrence was tragic enough; but when repairs had been effected, the engineer derived what consolation he could from the thought that during the burning-out he was spending more money per second than all the Allies combined were spending in the same period during the war.

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Statics and Power.

Are broadcasting stations using insufficent power to transmit programmes under all possible conditions of the atmosphere? When static interference is at its lowest the transmissions generally are good—that is, during the autumn and winter periods; but the question has arisen whether some elasticity in the power employed should be granted during the summer months.

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Nature's Own Broadcasts.

It has been suggested that if certain foreign stations were to increase their power beyond the usual limits the only way in which other stations could cope with the situation would be to increase their power likewise. This would be the

sort of competition which must be avoided in broadcasting; and let us hope that the time will never come when stations set out deliberately to jam each other. There is, nevertheless, a cogent argument for the increase of power to enable a station to compete with Nature's own broadcast efforts. The energy should not, perhaps, be limited to a uniform 3, 5, or 10 k.w., but should be worked out for all conditions of the atmosphere with a view to maintaining uniformity in the signals.

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Problem for Geneva.

Some experts are already turning their attention to the problem of power, against the time when it will be discussed by the International Broadcasting Bureau at Geneva, and the course which the inquiries are pursuing is to ascertain whether it would not be better to adapt power to atmospheric conditions rather than to fix the power from the point of view of general convenience without regard to static interference.

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Good and Bad Wavelengths.

Programmes from Schenectady (WGY) are now transmitted on four wavelengths, *i.e.*, 379, 38, 109 and 1,660 metres. This experiment marks an effort on the part of the engineers of the United States to discover some means of stabilising good wavelengths against bad. But the problem is not one for the engineer alone. If it were he could erect one station which, working with a power of 100 K.W. and on a 1,600 metres wavelength, could cover the whole country; listeners, however, would receive only one programme. Again, the engineer might favour two or three stations on high power and high wavelengths. Then two or three programmes only would be available; moreover, the theoretical separation of wavelengths would mean that a wide band would occupy a lot of ether which was needed for other services. That idea may, therefore, be abandoned. If the waveband were in the neighbourhood of 100 metres—a fairly reasonable wavelength—a large number of stations might be worked in to supply listeners with numerous programmes; but there are attendant disadvantages, such as night distortion.

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Britain's Compromise.

So far, then, as broadcasting in Great Britain is concerned, it seems clear that the curious accident of selecting a 300-500 metres waveband was a very good compromise. There is not much night distortion, and a satisfactory amount of programme matter can be squeezed in. The long wave has been chosen for only one station, to enable the B.B.C. to cover a wide area adequately and in a stable manner. If some method were required for linking up Europe by broadcast it might be sought in the region of short waves; but it would then become a question of framing a band that would keep in view the fact that the reception was intended for experts and not for the ordinary listener.

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Wired Wireless.

Much experiment is needed before the principle of short wavelengths can be accepted as adequate for broadcast or wireless linking. With a proper co-ordination of interest it should be possible to link up wire and wireless in order to provide a service far more efficient than wireless pure and simple. Indeed, the British engineer will tell you that whenever a telephone wire can be used as an adjunct to wireless it should be used, with efficient repeater stations. The results are much more satisfactory to listeners. For that reason the British system is built up on the system of telephone lines as links in the broadcast web, with the result that simultaneous broadcasting in Britain has reached a perfection that Continental countries are showing a disposition to emulate.

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Land Lines.

A scheme is projected by the engineers of the B.B.C. for the rearrangement of the trunk lines for simultaneous broadcast purposes. It is realised by all listeners that without physical telephone lines broadcasting would be impossible by the present methods. The quality of the transmission of the programmes from 5XX which have been relayed from 2LO has already shown that in this respect listeners are extremely well served. The new scheme provides that lines to various stations will concentrate on certain centres such as Leeds, Glasgow and Cardiff, and the direct lines to separate stations, therefore, will in some cases be eliminated. The Scottish stations are the only exception to the direct communication system at present, and they are linked up with London through Glasgow.

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Better Results Anticipated.

By the proposed rearrangement better results from the simultaneous broadcast point of view will be obtained, while the curtailing of the length of land lines will reduce the expense of hiring lines. In cases where a direct line from London is used to provide for several stations, the line will be tapped by those stations, and they would in effect help themselves to London programmes instead of being fed from London. The stations will control the necessary amplification in London merely by plugging in on their own switchboards.

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A Chance for the Critics.

"What's Wrong with This?" is the title of an unusual transmission from the Edinburgh station on August 21st. The broadcast will take the form of a short sketch with musical interludes, in which a number of errors, *i.e.*, anachronisms and mis-statements, will be made. A prize of three guineas is being offered to the listener who discovers the greatest number of mistakes, and one guinea to the runner-up.

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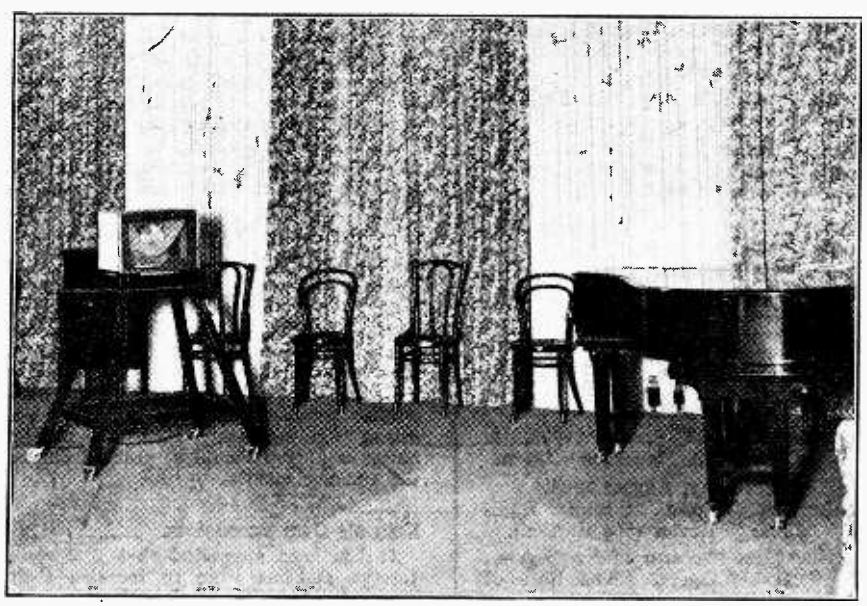
Sheffield Launches Out.

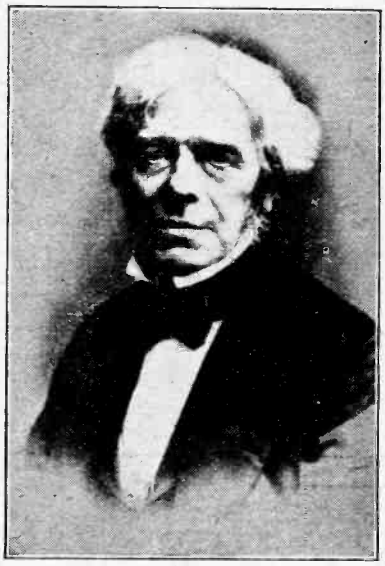
The Sheffield station is extending its outside broadcast arrangements, and has arranged to relay the Borough of Bridlington's Saloon Orchestra from the Royal Prince's Parade, Bridlington, from 4 to 5 p.m. each Wednesday until further notice, commencing on Wednesday next. Messrs. T. & J. Roberts' Café Orchestra will also be broadcast from the same station every Tuesday from 4 to 5 p.m., starting to-morrow.



IMPROVEMENTS AT EDINBURGH. A glimpse in the Edinburgh Broadcasting Station's new studio, which was opened on Friday, July 31st.

TELEGRAPHING PICTURES

American Developments in Telephotography



Michael Faraday: A picture transmitted over a 931 mile circuit.

IN a recent circular issued by the U.S. Bureau of Navigation at Washington, there appeared a brief announcement, which, small and apparently unimportant as it may have appeared at first sight, undoubtedly marks the beginning of a new era in the history of radiotelegraphy. The notice is to the effect that amateurs possessed of licences authorising them to transmit on certain wavelengths, may also make use of these wavelengths for the transmission of pictures.

Now, although an accomplished fact, radio-picture transmission is as yet very much in the experimental stage, and since it is, after all, but the natural development of ordinary telegraphic transmissions of pictures and photographs, it is necessary for us to have a clear understanding of the technical principles underlying such transmission before we can appreciate at a later date the trend of experimental work necessary to perfect radio transmission. It is therefore proposed in this article, by the courtesy of the International Western Telegraph Co., who kindly supplied the photographs reproduced, to deal briefly and concisely with line transmission of pictures and photographs as carried out by the American Telephone and Telegraph Co., leaving consideration of radio transmission to a later date.

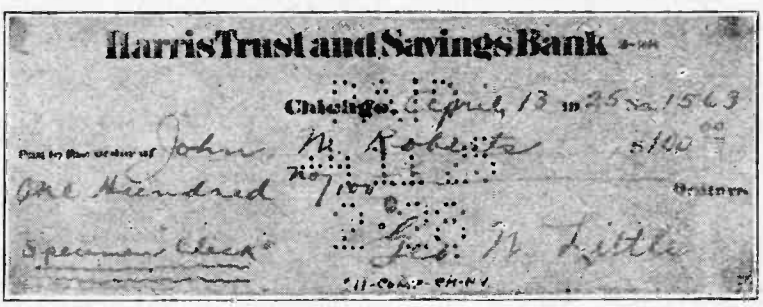
Photo-electric Cells.

Undoubtedly the heart and soul of this new invention and the thing which makes it possible is the modern photo-electric cell, which performs the same function as the old selenium cell. The properties of selenium have been known for more than half a century, and in the spacious days of Queen Victoria the transmission of speech along a beam of light over a distance of several hundred feet was a scientific accomplishment greatly used in scientific exhibitions for the amusement and edification of our grandfathers. Later, however, with the advent of other scientific novelties, the photo-electric telephone fell into disuse and was only revived a few years ago (in 1919), when it was hailed, as usual, by the lay Press as a new and startling invention. Briefly stated, selenium possesses the property of altering its electrical resistance in accordance with the intensity of light to which it is subjected, the fall in resistance being roughly proportional to the intensity of the beam of light focussed on it. It will readily be seen, therefore, that the current in any electrical circuit in which was included a selenium cell could be easily controlled by focussing a beam of light on the cell, the intensity of which beam was controllable by the operator. From simple data the principles underlying the old photo-electric telephone which so intrigued our grandparents are clearly apparent.

Disadvantages of Selenium.

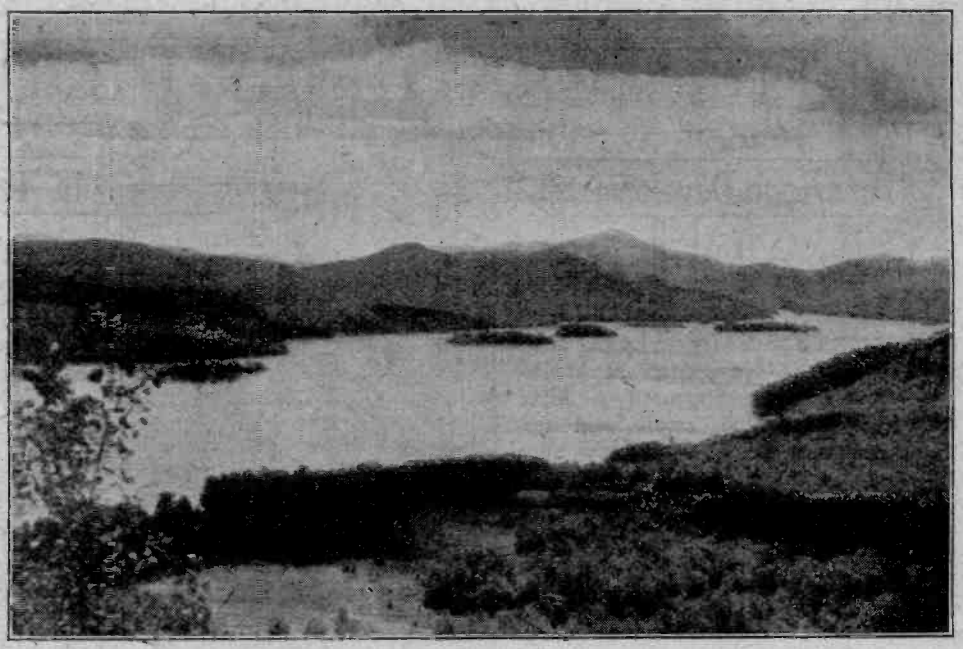
Unfortunately, however, selenium possesses the very serious disadvantage that a quite noticeable lag occurs between the change in light intensity and the change in ohmic resistance. This latter disadvantage completely inhibited its use for telegraphic transmission of pictures, and it was not until the modern photo-electric cell was developed, in which this disadvantage was eliminated, that progress in telegraphic picture transmission began to advance by leaps and bounds. This modern photo-electric instrument is a vacuum cell having an alkaline metal kathode such as potassium, and its response to minute variations in light intensity is practically instantaneous.

This crucial part of the circuit having been practically perfected, the actual realisation of successful picture transmission over an electric circuit became a comparatively simple matter. The *modus operandi* is really quite simple and straightforward in its fundamental state, and should be quite readily understandable from the ensuing description, based on information contained in the *Bell System Technical*



A specimen cheque transmitted by telephone wire.

Telegraphing Pictures.— *Journal* for April, 1925. The negative to be transmitted is first prepared as a positive celluloid film and rolled round a hollow glass cylinder, which is mounted on a carriage by means of gear wheels in such a manner that it is caused to move longitudinally with respect to its axis simultaneously with a rotary motion of that axis. A spot of light is thrown on to the film by means of a suitable optical system, and a moment's thought will enable us to realise that, owing to the dual motion of the cylinder just mentioned, this spot of light is caused to traverse the entire area of the film in a long spiral. Inside the cylinder is mounted a carefully adjusted photo-electric cell connected in an electric circuit, so that any variation in its resistance will cause a sympathetic variation in the current flowing in the electrical circuit which it controls. Now it is obvious that the beam of light passing into the interior of the cylinder is "filtered" by the light and dark portions of the enveloping film, and consequently the actual light impinging on the photo-electric cell fluctuates in accordance with the tone of the picture and the electric current is modulated accordingly. Now, at the distant receiving station is mounted a "light valve" consisting of an intense beam of light passing through a small aperture, which normally is completely covered by a thin metallic ribbon lying in a locally produced magnetic field. The incoming current is caused to traverse this "ribbon," and obviously the magnetic field set up around this ribbon by the incoming current will interact with the locally generated field, and so cause a movement of the ribbon which uncovers a portion of the aperture, thus permitting the passage of a certain "width" of light beam. Now obviously the current traversing the beam, since it is modulated in accordance with the tone of the picture at the transmitting end, will cause a movement of the ribbon which will be in sympathy with the "light and shade" of the distant picture, and if we arrange a cylinder having a blank film on it in such a position that the light beam can strike it when the aperture is opened, and provided that we do not forget also to cause the cylinder to move *in exact synchrony* with the distant "transmitting" cylinder, it is obvious that the fluctuation of the width of the light beam permitted to strike the blank film will be absolutely controlled by the varying tone of the film at the transmitting station. Therefore, we shall obtain on our blank film an exact negative reproduction of the

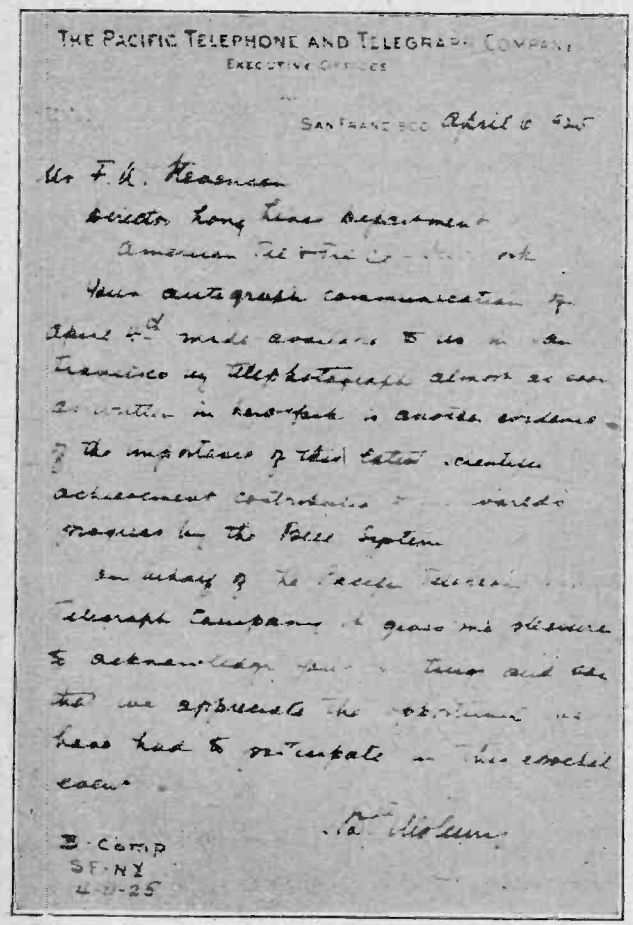


View of Indian Lake, Adirondacks sent over 220 miles of telephone circuit.

Interior view: 931 mile circuit.

Telegraphing Pictures.—

original photograph at the other end, the average time of transmission being about 7½ minutes. This method is perfectly satisfactory for circuits of moderate length, and thus it will be seen that the fundamental principles are perfectly simple and straightforward, as in the case of all truly great inventions. When, however, it comes to a question of transmission over long distances, we come up against the same difficulty which confronted the early pioneers in transcontinental telephony: namely, that long-distance telephone lines are not ordinarily suitable for the transmission of weak D.C. or A.C. at the customary frequencies of 50 to 100 cycles per second. It is at this juncture, therefore, that the thermionic valve comes once more into its own, both as an amplifier and as a generator of alternating current, the word alternating being in this case more applicable than the word oscillatory, since general usage has arbitrarily conferred on the latter term a periodic frequency of not less than ten thousand cycles per second instead of the hundreds per second which we made use of in the transmission of photographs over an electric circuit. The principles adopted are analogous to the principles of radio-telephony, since in the former case we radiate a continuous carrier wave and superimpose on it speech frequencies through the intermediary of a modulator valve, whereas in the present case we make use of a valve generated carrier *current* which consists of an alternating current having a frequency of approximately 1,300 cycles per second, and superimpose on it a modulating current, the modulation frequencies being controlled by the light and shade of the picture as previously described.



Photograph of a letter.

An X-ray photograph: 931 mile circuit.

It is obvious that the ribbon of the light valve is deflected twice during every cycle, and consequently the aperture is opened and closed with every pulse of the alternating current; the envelope of the pulses follows the light and shade of the photograph at the distant transmitter, but with time the actual course of the illumination shows a fine structure of the same periodicity as the carrier current.

If the negative at the receiving end is examined carefully through a lens, it will be found that variations in the thickness of the line traced by the point of light take place in small steps. These are particularly noticeable where the line width changes rapidly, and are caused by the pulses of the carrier wave and superimposed on the larger variations of width, which are, of course, proportional to the light and shade of the picture.

Now it is quite obvious that for success in this method it is of paramount importance that the moving cylinder at the receiving station be absolutely synchronised with the transmitting cylinder, and this is accomplished with

Telegraphing Pictures.—

the aid of phonic wheels controlled by electrically operated tuning forks. Impulses which are controlled by the tuning fork at the transmitting end are sent to the distant receiver over the same circuit as the photograph being transmitted, the latter being superimposed on a 1,300 cycle carrier current, as previously mentioned, whilst the synchronising pulses are superimposed on a carrier current having a frequency of 400 cycles per second, the two carrier frequencies being obtained from two valve oscillators and kept distinct by means of suitable filter circuits at each end of the system.

The method of reception which we have been considering, namely, that in which the picture at the receiving end is made up of varying width but constant density, is one of two methods which are in use, the second method being to use an aperture of fixed dimensions, light being allowed to fall on the film in a diffused manner, so that juxtaposed lines of constant width but of varying density are produced. The merit of the former method is that when the picture is received in negative form it may be printed directly on zinc for making a typographic printing plate if the structure is of suitable size, namely, about 60 to 65 lines to the inch, but unfortunately with this method the picture does not readily lend itself to retouching or to enlarging or reducing in size. The second method has the advantage that if the structure chosen is fine enough, namely, about 100 lines to the inch, it may be reproduced by the ordinary half-tone cross-line screen.

Reproduction of a finger-print transmitted by the system described.

Unfortunately, considerations of time and space do not permit us to go into the particular circuits used in the amplifier and modulator systems, although, of course, these follow the same general principles as those used in radiotelephony.

It cannot be doubted that the transmission of pictures, photographs, and drawings, etc., has an immense future before it, both from the scientific and the commercial points of view. One has but to glance at the reproductions of the cheque and finger-print to realise, however dimly, the tremendously important weapon that is placed in the hands of the representatives of law and order in their ceaseless warfare against the more disorderly members of the community, whilst the advantages that will accrue to the daily Press are scarcely less than that afforded by the introduction of the electric telegraph less than a century ago.

Although it must be admitted that pictures transmitted by wireless have not yet attained the same perfection as that shown in line transmission, it is but a matter of time before *radio* picture transmission takes its place in the service of man along with its sister radiotelephony, and becomes equally as commonplace, its present position of being a nine-days' wonder being usurped by television.

South Tottenham.

Below 100 metres.

British:—2OQ, 2NU, 2OS, 2MX, 2NR, 2QK, 2BQ, 2NB, 2JJ, 2JB, 5MS, SRL, 5SR, 5AA, 5SZ, 5CT, 6ZE, 6JV, 6MZ, 6DO, 6YQ, 6YG, 6UV. *French*:—8SSU, 8MJM, 8ZVR, 8CC, 8KX, 8UT, 8JD, 8MP. *American*:—1AA, 1ST, 1AM, 1WA, 1MT, 9GG, 9RO, 9KVN, 9MS, U2UN, N8VN, KDKA. *Various*:—4ZS, 4EA, 4RS, i2, Z2, O2 7PM, PCUU, H9WWZ, CBJ, RCRL.

100-200 metres. *British* (all telephony): 2XR, 2JB, 2OS, 2PX, 2XO, 2KT, 2AU, 5MA, 2KV, 2ARS, 2DY, 5OX, 5TR, 5UV, 5XN, 5CT, 5DY, 6BT, 6UT, 6YG, 6LB, 6TX 6IM, 6HC, 6DV, 6PD, 6BJ. W. P. Dolphin.

Change of Call-Sign.

Mr. F. W. Wilson, 115, Richmond Road, Montpelier, Bristol, has been allotted the call-sign 2VR in place of 2AMG, and would welcome reports.

Aberdeen.

(On July 19th, 40 metres unless otherwise stated.)

American:—1ACD, 1ACP, 1AF, 1AIR, 1ALR, 1ANG, 1ARE, 1ARH, 1AXA, 1BAI, 1BG, 1BHM, 1BQ, 1BYX, 1CAK, 1CCX, 1CK, 1CKP, 1CMF, 1CMX, 1EG, 1MY, 1NV, 1PL, 1PY, 1QM, 1RR, 1SW, 1TS, 1UW, 2AES, 2AFN, 2AGB, 2API, 2BBX, 2BC, 2BEE, 2BUY, 2BVA, 2CTH, 2CTS, 2GX, 2HA, 2LV, 2MV, 2SP, 2WC, 2AXF, 3BWJ, 3XVA, 4KC, 4KT, 4RR, 4SJ, 8AVL, 8CAU, 8SF, 9FF, 9XN, WIZ, WGY, KDKA (68 metres). *French*:—8IIP. *Dutch*:—0BA. *Cuban?*:—Q2BY. *British*:—2SZ. (0-v-1)

A. D. and D. J. Simpson (2BBT).

Calls Heard.

Extracts from Readers' Logs.

Amateurs Wishing to Arrange Tests.

Mr. F. M. Cooper (G6PF), 22, Guest Road, Endcliffe, Sheffield, wishes to get into touch with a transmitter in the Manchester area on 90 and 45 metres.

Mr. E. N. Adcock (G2BFL) will be working from end of August on 40-180 metres, and would be pleased to hear from any British or foreign amateur willing to collaborate in tests.

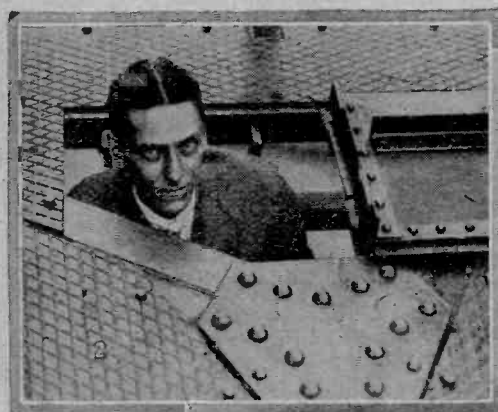
The Hon. Secretary of the Manchester Wireless Society states that the call-sign of the Society is G6MX and that the permits covered by 2FZ, 5MT, and 5MS have been returned to the G.P.O and re-issued. All communications referring to tests of G6MX should be addressed to the Hon. Secretary, 66, Oxford Road, Manchester.

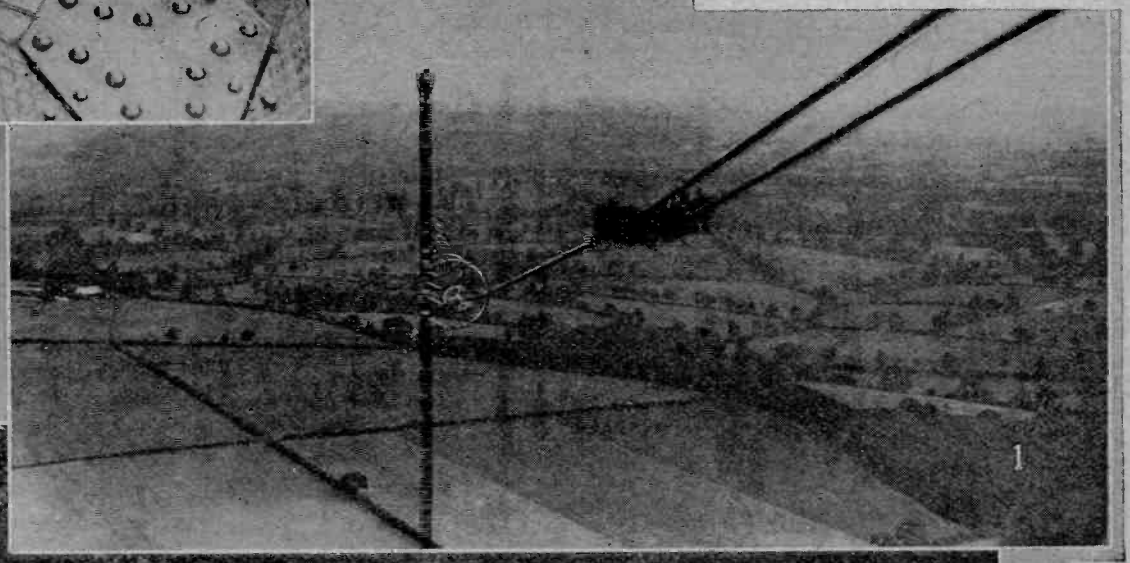
Station G5MB is worked by the Hon. Treasurer of the Society from 808, Stockport Road, Longsight, Manchester.

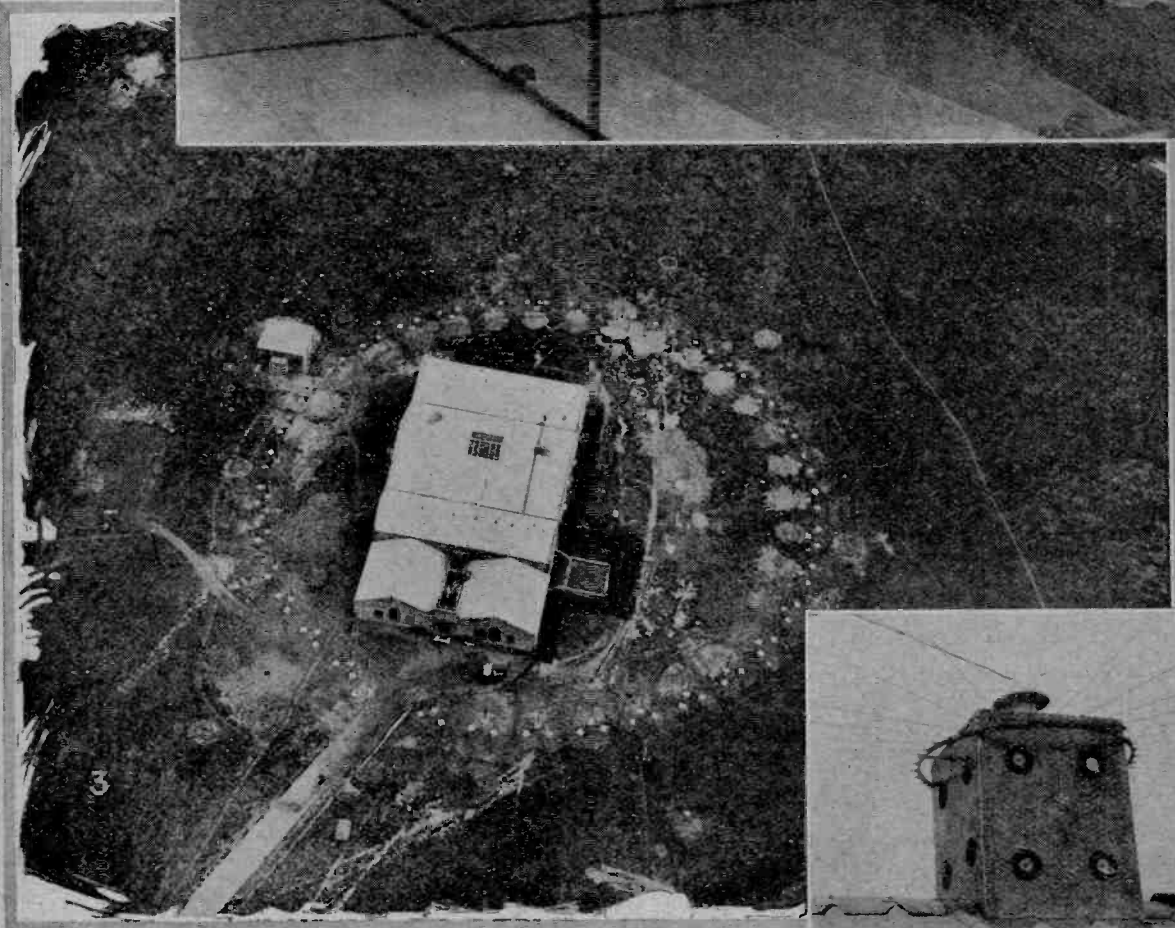
We believe that 2FZ is now the call-sign of the Radio Experimental Society of Manchester, and that 5MS is owned by Mr. H. M. Swann, of Lytham, Lancs, but we have not at present the name of the new owner of 5MT and will be glad if he will communicate with us.

DAVENTRY.

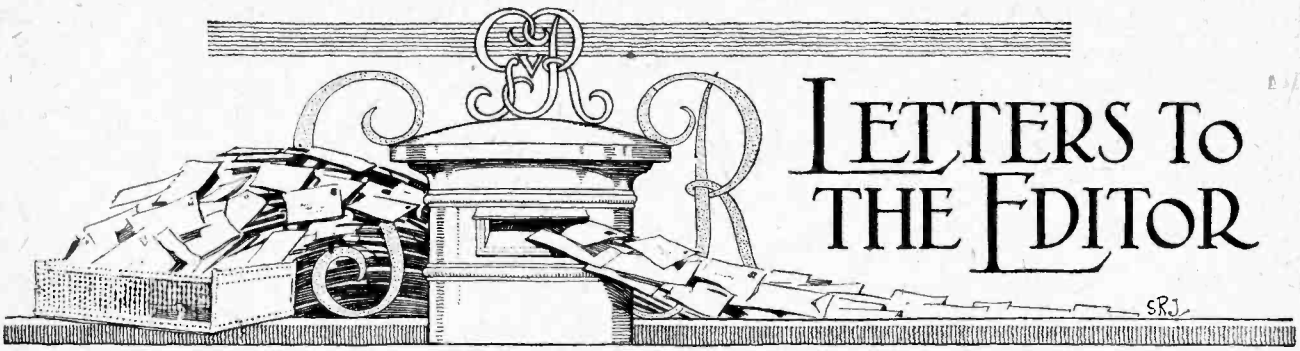
Some Unusual Viewpoints.







(1) Showing Mast No. 2 and the suspended aerial. (2, inset) The trap door at the top of the 500ft. mast. (3) A bird's-eye view of the power house, showing the "earth" ring. (4, inset) The aerial lead-in trunk. Note the radiating earth wires.



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

Correspondence should be addressed to the Editor, "The Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

PROPOSED BRITISH I.R.E.

Sir,—I think it has been quite clear in all the correspondence that the above society was proposed because there did not appear to be any body in existence in this country which catered sufficiently for the growing number of wireless engineers.

I am very pleased to say that by invitation of the committee of the wireless section of the Institution of Electrical Engineers I was present at a meeting of the committee which took place on Friday, July 24th. Matters were discussed very fully, and I must thank the committee for the businesslike manner in which they dealt with the subject. For the present it is sufficient for me to state that I am satisfied that entrance into the I.E.E. by those professionally engaged in wireless matters is not as difficult as I had imagined, and that it is realised by the Institution that radio matters are of great and growing importance.

I would like all those who have written supporting the proposed society to feel that they have done a great deal of good in demonstrating the need of more activity in wireless matters.

Further criticisms on the position after perusing any statement the council of the I.E.E. may make in the technical press can be sent to Mr. Y. W. P. Evans, 66, Oxford Road, Manchester. All our friends may rest assured that their interests will be well looked after. J. NELSON.

Prescot,
July 27th, 1925.

Sir,—You will probably have read an announcement in the electrical journals to the effect that the question of a new wireless society was discussed at a recent committee meeting of the I.E.E., at which Mr. Nelson was present by invitation. The statement goes on to say that "the definite conclusion has been arrived at that there is no need for a new body." As hon. secretary of the proposed association, I have been asked to state that the definite conclusion arrived at is only definite in so far that it should be augmented by the words "should it be proved conclusively that the radio engineering section of this country is fully catered for by the wireless section of the I.E.E."

I am to add that before this can be proved the statement which is shortly being issued by the committee of the I.E.E. will have to be studied and commented upon by those engaged in the radio profession. Y. W. P. EVANS,

Hon. Secretary, proposed Radio Institute.

Manchester.
July 24th.

The following official statement has been issued by the Institution of Electrical Engineers:—

Recent correspondence in the press indicates that there is some misconception as to the eligibility of wireless engineers for membership of the institution, and it is therefore necessary to state that it is possible for an engineer to become a member of the institution with qualifications of a purely wireless nature.

For the admission of wireless engineers to the class of associate member (A.M.I.E.E.) it is necessary, in addition to the possession of adequate professional experience for a period of at least two years, in the case of those who do not possess an exempting examination qualification, or do not submit a satisfactory thesis, to pass the A.M.I.E.E. examination in the following subjects:—

(1) English essay *or* translation from a foreign language.
(2) Applied mechanics.
(3) Heat, light and sound, *or* inorganic chemistry.
(4) Electricity and magnetism.
(5) Wireless and high-frequency engineering.

The committee of the wireless section of the institution have recently considered the above syllabus, and they are of opinion that it represents the minimum amount of professional knowledge which a qualified wireless engineer should possess. No conditions are laid down by the institution as to how or where an applicant may have obtained his training.

For others who are unable to pass the examination, there is provided the class of graduates, but it must be pointed out that admission to this class does not confer any professional standing, the requirements being a good education and employment in an engineering or scientific capacity in the applications of electricity.

In order to become a member of the wireless section of the institution it is necessary that the member of the institution shall be actively engaged in the study, design, manufacture, or operation of wireless or high-frequency engineering apparatus. The meetings of the wireless section are not, however, confined to members of the section, but are open to all members of the institution.

It has also been stated that the committee of the wireless section consists nearly always of the same body of men. This is not the case, as the rules of the section provide for the retirement of one-third of the ordinary members of the committee each year.

Some valuable suggestions have emerged from the recent correspondence and will receive the careful consideration of the wireless section committee, more particularly as regards the type and number of papers read and as to increasing the activities of the wireless section outside London.

As regards the suggested formation of a new society, the wireless section committee consider there is no need for it, because, as indicated above, wireless engineers can obtain membership of the institution and amateurs are already catered for by the Radio Society of Great Britain.

July 31st, 1925.

BROADCASTING FROM UKRAINIA.

Sir,—The Kievana Societo dil Amiki di Radio desires us to convey to English listeners an appeal for reception reports on the transmissions from their new broadcasting station at Kiev, Ukrainia, which is now working regularly from 3.30-4.30 and from 6-8 p.m. G.M.T. on a wavelength of 850 metres and using over 2 kw.

Letters to the Editor.—

The Russian language is not used, however, all announcements being made in the well-known international language ("Ido") and reports should be made and will be acknowledged in this language.

Reception postcards specially drawn up in this language are available free to any of your readers who care to send us a stamped addressed envelope, and are very readily comprehended.

These reports should be sent direct to the Secretario, Sro. M. Shaparenko, ulica Lvovskaya 46, ch. 3, Kiev, SSR. Ukrainia.

Alternatively, we will translate and forward any reports if they are sent to us in English.

INTERNACIONA IDO-RADIO-KLUBO,
E. H. TURLE, M.I.R.E., Hon. Sec., British Section.

THE REACTION CLICK.

Sir,—I was interested to read in your issue of July 22nd Mr. Baty's letter about the reaction click. He seems to me to be confusing two distinct phenomena, namely, the ordinary or self-oscillation of a valve, which is absolutely inevitable if the reaction is pushed too far, and the phenomenon known as "back lash," which means that the set will not stop oscillating at the same setting of the reaction coil at which it starts. It is this latter which causes the click, and is responsible for the limitation of signal strength. I think it is generally agreed that it is caused as follows:—The effect of reaction is to decrease the effective resistance of the grid circuit. Therefore, if the signal voltage in the aerial is constant, the current in the grid circuit increases as the reaction is increased. As the mean grid potential varies with the H.F. current in the grid circuit, and as the amplification depends to some extent on this grid potential, therefore the effective resistance depends on the H.F. current, and under certain conditions of grid and anode voltages it may decrease as the current increases. In this case, if the current increases beyond a certain amount, either by a further increase in reaction coupling, or, more annoying still, by some slight disturbance such as an atmospheric, the effective resistance will become reduced to zero, and the current will increase suddenly, with a click, to a large value, limited by the H.T. voltage. As the current is now very great, the reaction will have to be considerably reduced before the resistance again becomes positive. The best cure for this trouble is:—(1) Work with as small an H.T. voltage as possible; (2) adjust the grid potential carefully either with a potentiometer or with a variable grid leak.

Sherborne. A. R. MARCOM.

TWO-WAY WORKING WITH CHILE.

Sir,—On the morning of August 1st, whilst in communication with New Zealand stations 4AR and 2AC, I was informed by the latter that my station was being called by a Chilian station, CH1EG, and after exchanging tests with the New Zealand stations I effected communication with the Chilian, who gave his location as Latitude 38-40 S. Longitude 72-20 W., and his town as Vilcum, Chile.

A message was received addressed to Prof. Midgeley—Bradford Technical College, Bradford, England, in which the sender stated that he wished the students to be informed that he was using the wavelength of 39 metres.

I am not sure if this is the first two-way working with Chile, but I believe so, although stations from and around that part have been logged in England before.

The signals were still readable as late as 8.30 a.m. B.S.T., and an arrangement was made to continue the tests to-morrow (Sunday) morning early. The correct QRA of the station worked is:—

CH1EG,
Edmundo Guevara,
Vilcum, Chile.

It would seem that the owner of the station is an ex-student of the Bradford College who has returned to his native land and erected a station, with successful results.

The strength of signals was very good and quite steady until fading set in when daylight across the Atlantic put an end to the working.

J. A. PARTRIDGE (2KF).

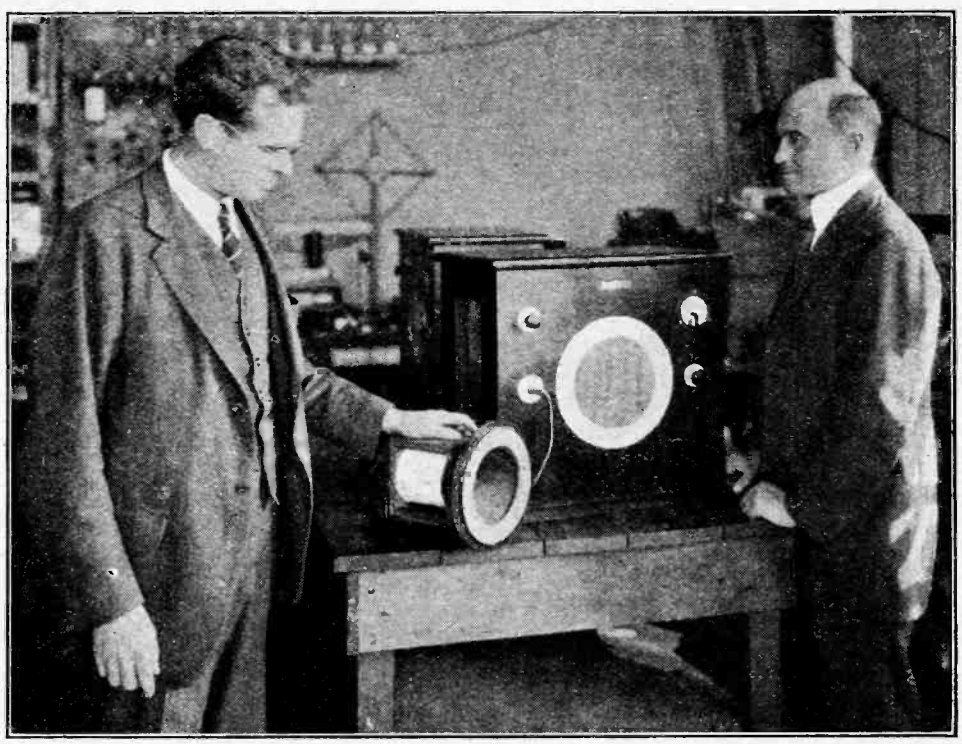
Collier's Wood, S.W.19.

AN AMERICAN HORNLESS LOUD-SPEAKER.

FOR the new hornless loud-speaker shown in the accompanying photograph, it is claimed that it will give faithful reproduction of the deepest organ notes and the highest violin harmonics without distortion.

The instrument has been developed by Messrs. Chester W. Rice and Edward W. Kellogg, of the research laboratory of the General Electric Company, for the Radio Corporation of America, and was demonstrated at the Spring Convention of the American Institute of Electrical Engineers at St. Louis.

The moving coil type of drive is employed, consisting of a coil suspended between the poles of a magnet, and the diaphragm consists of a paper cone about six inches in diameter. A baffle prevents air from circulating between the front and back of the diaphragm, thus allowing a horn to be dispensed with whilst permitting the radiation of the deepest tones. The edge of the paper cone or diaphragm is attached to the baffle by means of very thin rubber.



Readers' Problems

Readers Desiring to Consult "The Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

Methods of Rectification in Reflex Circuits.

A READER wishes to know if it is possible to devise a single valve reflex circuit in which the valve not only undertakes the amplification of incoming signals at a dual frequency, but also takes upon itself the duties of rectification, thus eliminating the crystal.

A moment's consideration will reveal to us that this is quite impossible under ordinary conditions, since the portions of the valve characteristic curve which we make use of for the two separate functions of amplification and rectification are quite different. In causing a valve to amplify at any frequency it is necessary to adjust the normal operating point of the valve to a position where no grid current flows, and the grid volts anode current curve is the principal characteristic which claims our attention. In rectifying by the leaky condenser method it is, of course, the grid volts-grid current curve which must be considered, and grid current must, of necessity, be permitted in order to bring about rectification, whilst in anode rectification the operating point must be adjusted to the "lower bend" of the grid volts-anode current curve, and thus it will be seen that the conditions necessary for either form of rectification are completely at variance with those necessary for amplification. Attempts have been made to design a valve suitable for the purpose mentioned by our reader by inserting a second grid auxiliary to the normal grid, and a certain measure of success has been obtained, but the system has not come into general use among amateurs.

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Advantages of a Carborundum Detector.

IT was pointed out in this section of the journal some little time back that greater H.F. efficiency was obtainable from a crystal receiver preceded by a stage of high frequency than was obtainable when this valve made use of dual amplification principles, and a circuit was given consisting of a crystal detector preceded by an H.F. amplifier, and followed by a stage of L.F. A reader has reported excellent results with this receiver at moderate distance, reception from a small loud-speaker being all that could be desired.

He lays particular stress on the high quality of reproduction due to the crystal rectifier, but wishes to incorporate a more permanent type of mineral detector, since this feature is the sole drawback to the instrument. It is, of course, possible to substitute the ordinary galena crystal by one of the perikon type, since this will be found to

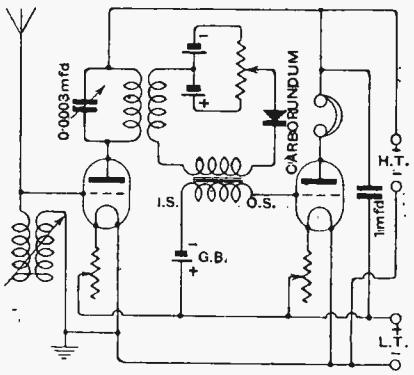

Fig. 1.—Connections of a carborundum-steel detector in a circuit including one stage of H.F. and one of L.F. amplification.

retain its setting considerably longer than the wire contact type, but even this leaves much to be desired. It is unfortunate that, since the advent of broadcasting, the carborundum crystal, with its remarkable stability and ease of adjustment, has fallen into disuse. This crystal, unlike the galena type, requires a very firm pressure, which is usually effected by a steel plate or a steel point such as a gramophone needle pressing firmly against it, and from the point of view of retaining its setting over a prolonged period will give points to many of the so-called permanent detectors upon the market. It functions best when a small initial potential is applied to it, and this can be effected by means of two dry cells and a potentiometer, as shown in Fig. 1. By making the connection *between* the two cells, up to 1½ volts negative or positive may be applied to the crystal, the central point of the potentiometer winding being zero. Provided that a high resistance potentiometer (30,000 ohms) is used, no fears need be entertained regarding the life of the dry cells, the current being only about 1-600th part of that taken by an 0.06 dull emitter, but a switch may be provided if desired in order to break the poteutiometer circuit when the receiver is not in use. It is necessary to use a lower ratio of transformer than the six or eight to one ratio permissible with the galena crystal, owing to the much greater impedance of carborundum.

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Home-constructed Transformers and Chokes.

A READER is desirous of constructing an intervalve transformer for use after a general-purpose valve in the least expensive manner, and wishes to know if this can be done without purchasing stampings.

This is, of course, quite feasible, and our reader is first advised to obtain a quantity of No. 22 gauge soft iron wire in 14in. lengths. With these a core should be built up to a diameter of ¾in. Cheeks 2½in. in diameter and about $\frac{3}{16}$in. thick should be mounted on the core at a distance of about 3½in., a few layers of empire cloth being wrapped round that portion of the core lying between these cheeks. Over this should be wound 9,000 turns of No. 42 S.S.C., this winding being covered with a few layers of empire cloth, and a secondary winding of 27,000 turns of No. 45 S.S.C. wound over this. One or two protective layers of empire cloth must now be wound over this secondary winding, and then the ends of the iron wire should be bent back and bound down, thus completing the magnetic circuit. The ends of the wires in the core must be tied down to prevent movement under the influence of the magnetic field and consequent distortion.

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THE BROADCAST COMMITTEE.

SOMEWHAT sooner than was anticipated, perhaps, the Postmaster-General has announced the full *personnel* of the Broadcast Committee of Enquiry appointed to consider the future of broadcasting and under what circumstances the service is to be carried on at the completion of the present period of licence enjoyed by the B.B.C., which expires at the end of next year.

Included in the terms of reference to the Committee are instructions "to advise as to the proper scope of the broadcasting service and as to the management, control, and finance thereof after the expiry of the existing licence on December 31st, 1926." It was announced by the Postmaster-General that any question of a reduction in listeners' licence fees would be considered under the heading of "finance," and the Committee was further asked to make recommendations with regard to any alterations in the existing law which might be necessary in order that their general recommendations could be put into operation.

The terms of reference to the Committee are certainly broad in character, but at the same time it would have been impossible for this to have been otherwise, because the problem which the Committee has to consider is very involved, and to have restricted the scope of the Committee would have resulted in a very unreasonable handicap in the effort to find a solution for the future.

The names of the ten members appointed to the Committee are such as to inspire confidence; it would seem that every member, apart from his recognised ability, has the additional qualification that he has an unbiased interest in putting broadcasting on a satisfactory basis. We have in the composition of the Committee no associations with the commercial side of broadcasting or the wireless industry, nor has party politics entered into the question of the selection of the Committee.

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CONTENTS.

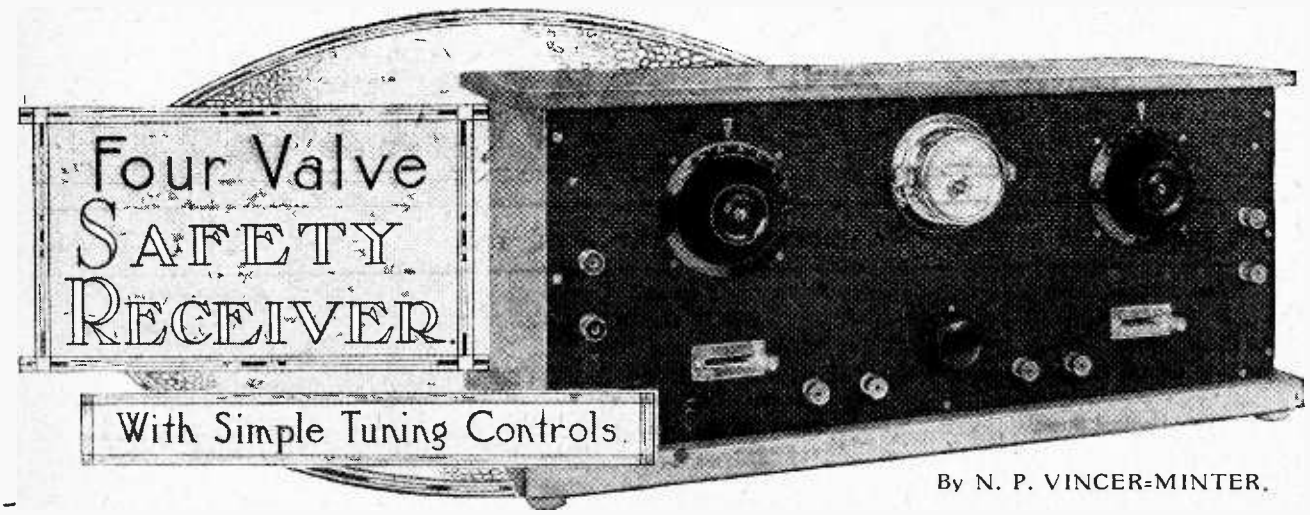
A NEW VALVE.

WE have recently been shown a most interesting valve of which the characteristics are such that it will give to its associated receiving circuit as near zero decrement as may be desired, without the use of any form of reaction.

This new valve is the invention of Mr. R. E. H. Carpenter, whose contact relay is already well known in commercial line and radio-telegraph practice.

The Carpenter valve is a three electrode employing normal voltages and a simple circuit. During the demonstration at which we were present, results given were equal to, if not better than, those commonly obtained with a high-frequency amplifier and valve detector; the control of the valve as regards its closeness to oscillation seemed quite simple. The quality of reproduction was good, due, perhaps, in part to the absence of the usual grid condenser and leak.

We are not at liberty at present to publish technical details of the device, but we hope to be in a position to do so at a later date. It should be explained that this valve is not yet available to the public.



By N. P. VINCER-MINTER.

Long Range Loud-speaker Reception without Reaction.

THERE is undoubtedly a very large class of people living in remote country districts far from any theatre or other place of amusement to whom the possession of a really simply managed wireless set capable of operating headphones and loud-speaker would be an inestimable boon. During the summer months this need is not so apparent, but in the dark winter evenings, which are now rapidly approaching once more, only those who have actually experienced the so-called delights of dwelling in the country can appreciate to the full the terrible boredom and ennui of existing throughout the long winter evenings in a remote locality where a village concert once a month is considered to be the height of dissipation bordering on the morally dangerous. Possibly those who grumble at the seven o'clock repetition of the contents of the London evening papers would cease to do so were they compelled to dwell for a period in a district where "late extras" are conspicuous only by their absence. Now there are a large number of sets described in various technical journals each week which are eminently suitable for the people thus dwelling outside the pale of civilisation, provided that such people are prepared to acquire a little technical knowledge and patience, and do not require an instrument which is as easily controlled as a gramophone, but as by far the greater number of people look upon the broadcasting service purely as a provider of entertainment, the typical set, requiring fairly critical adjustment of reaction, different H.T. values for each valve, juggling with plug-in coils, and other technical gymnastics which rejoice the heart of the average amateur, is definitely ruled out.

Undoubtedly, the average man with no taste for mechanics or "D.X. chasing," requires a neat, efficient set so simply controlled that even the female members of the family can with safety be permitted to operate the receiver without wrecking the home, and one, moreover, from which even ham-handed Henry could not extract a solitary howl; and, lastly, the set must be economical in its current consumption, since no device has yet appeared upon the market for charging accumulators from the source of illumination favoured by country dwellers. As for grid leaks, blocking condensers, regenerative reactances and anode rectification, the average man, like Gallio of old, "cares for none of these things" any more than he cares whether his

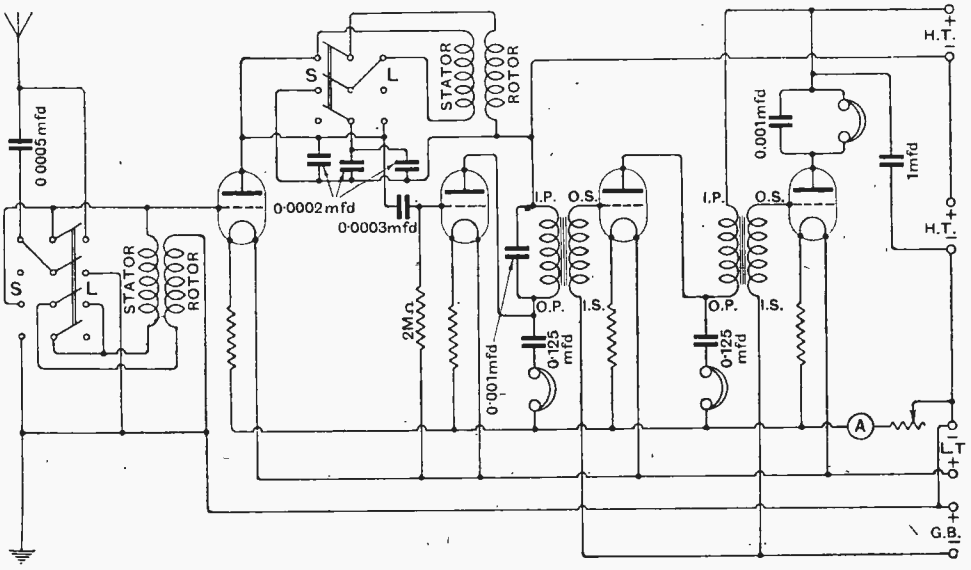


Fig. 1.—The theoretical circuit, showing alternative positions for the telephones or loud-speaker.

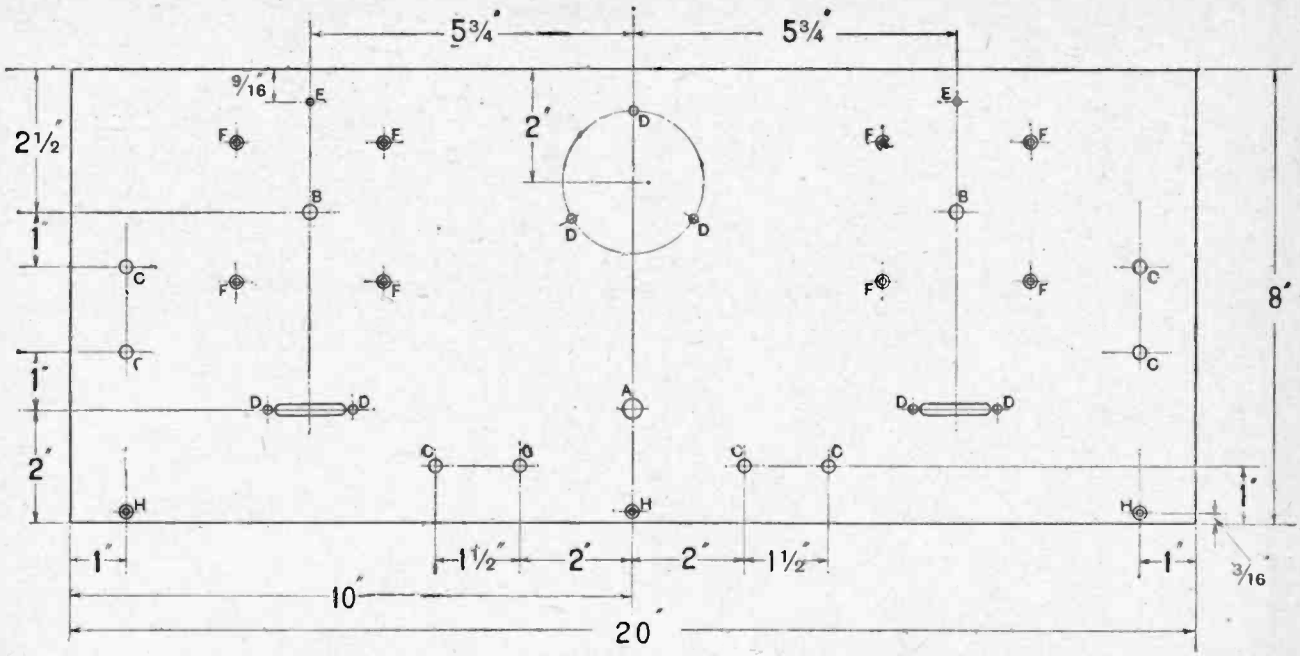


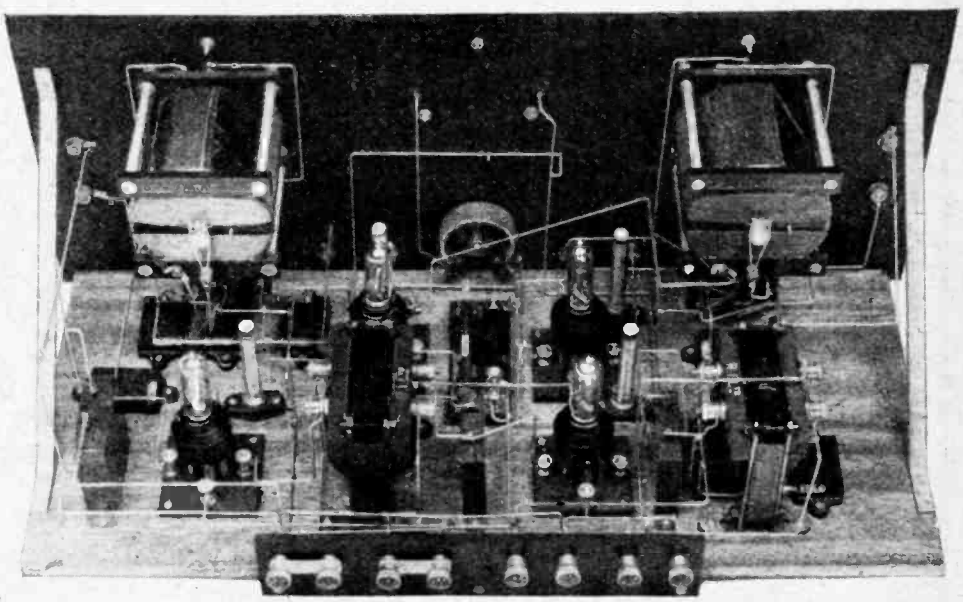
Fig. 2.—Dimensional details of the front panel. Drilling sizes are as follow: A, 5/16in. dia.; B, 1/4in. dia.; C, 7/32in. dia.; D, 5/32in dia.; E, 1/8in. dia.; F, 1/8in. dia. and countersunk for No. 6 B.A. screws; H, 1/8in. dia. and countersunk for No. 4 wood screws.

gramophone possesses a double spring or otherwise provided that it "delivers the goods."

Bearing all these things in mind, therefore, the writer determined to design a set which, for want of a better term, may be summed up by the word "foolproof." Unfortunately, this word is apt to convey the impression that the set is only suitable for loud-speaker reception of a local station within a score of miles of the receiving set. This is entirely erroneous, since on test this set brings in several main stations on the loud-speaker with the utmost ease, and ample volume for a large-size living-room, whilst a 150-mile *full* loud-speaker range for Daventry is a *very* conservative estimate, although the writer has had no opportunity of testing at a greater distance than 120 miles from Daventry; but at that distance the loud-speaker volume was considerable without calling upon the services of the fourth valve. Quite a number of Continental stations, more especially Madrid, came in repeatedly on headphones in a very pleasant manner.

Now, as will be seen from the theoretical diagram in Fig. 1, the receiver employs no deliberate reaction whatever except the modicum of regenerative effect which is inherent in the wiring, and consequently all stations within range can be definitely charted on the two variometer dials, and can always be brought in again at the same settings, which is a very great advantage. By putting the two range switches, seen under the variometer dials, to the left, the wavelength range is approximately from 250 to 700 metres, and with the switches to the right the range is from 1,000 to 2,750 metres on an average aerial, and so all B.B.C. stations, including Daventry, can be received, whilst Radio Paris and the Eiffel Tower come in equally well.

With regard to these wavelength ranges, let it be said right now that these are obtainable with the actual make



Complete view of wiring. Note the wide spacing of components, especially of the variometers, which is essential for obtaining the best results.

Four Valve Safety Receiver.—

of variometers used in the set in conjunction with the switching arrangements and fixed condenser values given, and prospective constructors are strongly advised to keep to the actual instruments used; but if other variometers are made use of, the necessary switching arrangements and condenser values should be obtained from the makers rather than from a dealer who is anxious to dispose of variometers which he may have in stock. The writer's advice is, however, to adhere strictly to the design of the set in this very important point. The method of connecting the telephones for reception of signals after the detector valve or after the first L.F. valve may strike many as unusual, and the reason for the non-inclusion of switches for the elimination of the third and fourth valves when desired may be sought by many. The reason is that the writer's experience shows that when a set is acquired by a person whose main desire is consistent musical entertainment, it is frequently desired that the loud-speaker be in operation whilst at the same time some enjoyable headphone reception is being adopted by some other member of the family, who, for one reason or another, does not care to listen to the loud-speaker; more often than not it is desirable for the loud-speaker to be in operation in one room whilst an invalid member of the family is enjoying headphone reception in another room of the house. Now, in general, it may be said that both L.F. stages will be in use on the loud-speaker, and if telephones were in series or parallel with the loud-speaker, headphone reception would be deafening and unpleasant, and consequently arrangements are made for

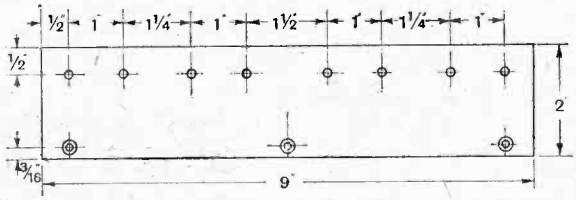


Fig. 3.—Details of terminal strip. Drilling sizes are 5/32in. dia. for terminals and 1/8in. dia. and countersunk for No. 4 wood screws.

obtaining headphone reception after the second or third valve whilst the loud-speaker is operating after the fourth valve, without appreciably diminishing the loud-speaker volume. Looking at the photograph of the receiver shown in the title-block, the two left-hand terminals are for aerial and earth. The two bottom pairs are for headphones, the right-hand pair providing stronger signals than the left-hand pair, whilst the loud-speaker terminals are on the right. Of course, if the volume is too great, the loud-speaker can be connected to the right-hand headphone terminals, and the filament of the fourth valve extinguished by giving the fixed resistor associated with it a quarter of a turn in an anti-clockwise direction. Several pairs of headphones may be connected to either pair of telephone terminals, according to the strength required, or, of course, several pairs of headphones may be joined respectively to both pairs of terminals if different strengths of signals are required on different headphones.

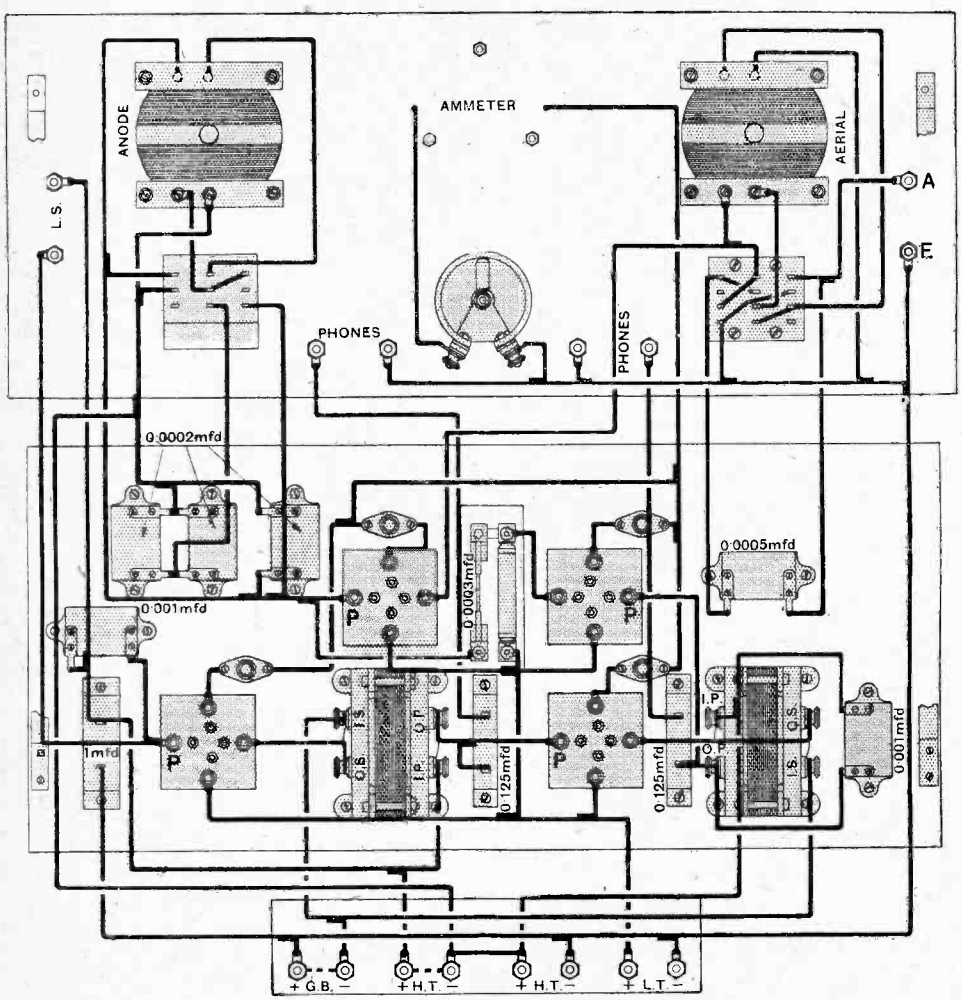


Fig. 4.—Practical wiring diagram. It is advisable to adhere as closely as possible to this layout.

Constructional Detail.

We can now proceed to the actual constructional details. In the first place, let it be said that the man who merely devises a wireless set as a musical reproducer will probably shirk the constructional work and leave it in the hands of a local craftsman, although in this case there is not the slightest reason for such a procedure, since the constructional work,

Four Valve Safety Receiver.—

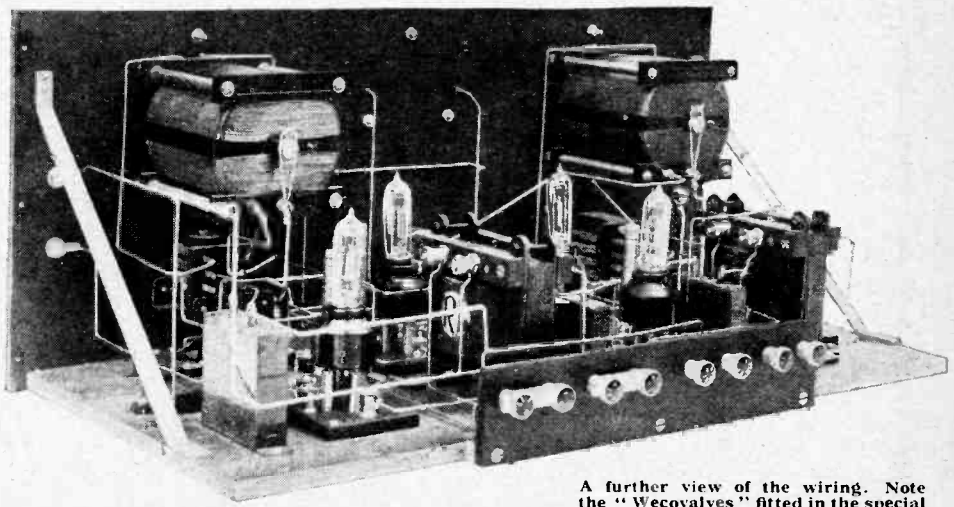
including the cabinet, is perfectly straightforward and simple, and, provided that the instructions given are followed out implicitly, success is certain, since every connection is straightforward, and there is no experimenting with the correct connections of the reaction coil, correct values of H.T., etc. All components used are readily obtainable, no home-made components being used, but, at the same time, if no previous experience has been had with a soldering iron, it is best to place the constructional work into professional hands.

All components, including panel and baseboard, which are of standard size, should first be obtained, ready "dressed" for use. Stress has already been laid on the advisability of using the same variometers as used by the writer, and it may be mentioned here that the values of fixed condensers given by the writer must on no account be departed from, nor must they be omitted, or failure will be certain. It is most important also that no attempt be made to use a smaller panel or to mount the variometers any closer together, or Bedlam will be let loose when the receiver is put into action. The necessity of obtaining an ammeter not having a greater scale than that given will be explained later.

A good type of general-purpose transformer (4 or 5 to 1 ratio in both stages) is also desirable. Before attaching the baseboard to the panel, all components should be mounted on the baseboard and panel, and the wiring of switches and variometers completely finished, and as much of the wiring of the baseboard components should be completed before attaching the panel to the baseboard. The wiring of the switches is the most difficult operation, and this should be done very carefully.

It will be necessary also after mounting the variometers to loosen the securing screws and withdraw these components slightly from the panel in order to facilitate wiring of them. Having completed the wiring, all connections should be checked very carefully.

The question of choice of valves and general operating data can now be entered into. A fixed resistor fitted into a screwed socket base is used in series with each valve filament, and these are rapidly interchangeable and can be obtained in all values according to the type of valves used and according to the source of filament supply used.



A further view of the wiring. Note the "Wecovalves" fitted in the special adaptors. The terminals shown short-circuited are for the provision of grid bias and extra H.T to the L.F. valves when desired.

Thus all types of valves, as, for example, 0.06 amp. dull emitters and "bright" valves, can be indiscriminately mixed in the receiver, and a 6-volt accumulator used without the slightest fear of ruining any valve, since under these conditions the variable rheostat merely acts as an "on and off" switch disconnecting *all* batteries.

If the utmost quality consistent with the utmost economy is desired, it is recommended that a 60-volt H.T. battery be connected across each pair of H.T. terminals, and a 4½-volt flash lamp battery connected across the G.B. terminals (there is no need to experiment with wander plugs), two 0.06 amp. valves being used in the H.F. and detector sockets, and two D.E.5 type valves being used in the L.F. stages. A 6-volt accumulator should be used, and a 48-ohm resistor placed in the resistor sockets associated with the H.F. and detector valves, short-circuiting plugs being placed in each L.F. resistor socket. Even a small 6-volt 30-A.H. accumulator will give four or five hours' service every evening for ten days, since the total current consumption of the four valves is only as much as *one* bright emitter.

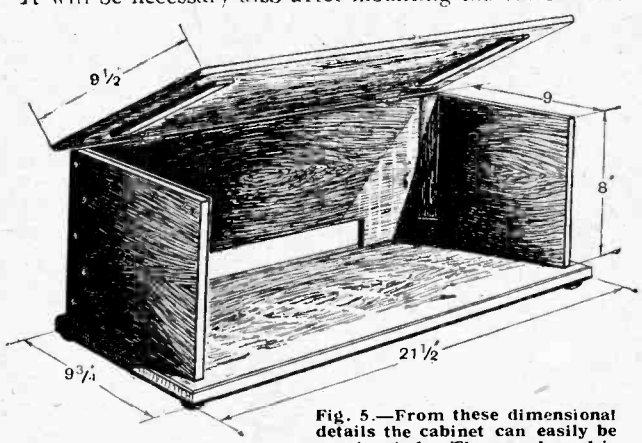


Fig. 5.—From these dimensional details the cabinet can easily be constructed. The wood used is 3/8in. oak. Four rubber "stops" are fitted under the base to obviate "microphonic noises" in the receiver.

L.T. Supply from Léclanché Cells.

If, however, the greatest economy and simplicity is desired for the non-technical person, four 0.06 amp. valves may be used with two *large* type sac Léclanché cells, a short-circuiting plug being used in each resistor socket. The writer has had a set of this type in operation each evening for the past eight months, using four 0.06-amp. valves in conjunction with two *large* type "lighting" cells supplied by the makers of the ammeter used in this

LIST OF COMPONENTS REQUIRED.

1 Ebonite panel, 20in. × 8in. × ¼in.
1 Ebonite terminal strip, 9in. × 2in. × ¼in.
1 Baseboard, 19½in. × 8½in. × ¾in.
2 Large type Sterling variometers.
1 Four pole double throw switch ("Utility" nickel plated).
1 Three pole double throw switch ("Utility" nickel plated).
1 Seven ohm variable rheostat (Lamplugh).
4 Base mounting valve holders (Scientific Supply Stores).
1 Ammeter with scale 0-2 amps. (Economic Electric Co.).
2 Nickel "Decko" Dial Indicators (Bulgin).
2 General Purpose L.F. Transformers (R.I. Ltd.).
1 1 mfd. fixed condenser (T.C.C.).
2 0·125 mfd. fixed condensers (T.C.C.).
2 0·001 mfd. fixed condensers (Dubilier).
1 0·0005 mfd. fixed condenser (Dubilier).
3 0·0002 mfd. fixed condensers (Dubilier).
1 Combined grid condenser and leak (McMichael).
8 Indicating terminals, H.T. +, H.T. +, H.T. −, H.T. −, L.T. +, L.T. −, G.B. +, G.B. − (Belling Lee).
8 Large size nickel terminals (Belling Lee).
4 Resistor sockets (Burndept).
4 Fixed resistors (Burndept).
4 Resistor "shorting" plugs (Burndept).
Material for cabinet.

set. These cells have been stowed away in a cupboard without the slightest attention being given to them; they have been in use five hours nightly since last Christmas. At the moment the cells show no need of attention, although it is anticipated that 5s. will have to be expended in renewing zincs and solution before the close of the year. No acid is used, the solution being sal ammoniac. The cost of *both* of these cells is less than that of *one* average 2-volt accumulator. Under these conditions, the G.B. terminals and the adjacent H.T. terminals may be short-circuited as seen in the photographs illustrating the wiring, and a single 60-volt H.T. battery connected to the remaining H.T. terminals. This H.T. battery will usually last several months if the cheap foreign ones costing about 6s. are avoided. Under these conditions the sacrifice of volume and quality is not nearly so great as might be supposed, and actually the volume and quality obtainable from this set operating under these conditions leaves very little to be desired; but on no account must cheap transformers of inferior grade be used.

Advantages of a Filament Ammeter.

In the photograph of the set, four "Wecovalves" are shown mounted in adaptors, thus enabling them to be inserted into ordinary valve sockets. These valves need 5-ohm resistors and a 2-volt accumulator, and possess the double advantage of being entirely non-microphonic and of it being impossible for the layman to burn out filaments when inserting a new valve, since a special bayonet cap fitting is used, which obviates this. A 2-volt 80-A.H. accumulator, which, being a 2-volt, and not a 6-volt unit, is quite light, will operate these four valves four or five hours nightly for about three weeks on one charge. The filaments of these valves are remarkably robust. The ammeter, which costs but a few pence more than a "bright" valve (9s.), and is quite reasonably accurate, is a very useful addition to the receiver, since it enables the novice to tell immediately when the accumulator needs recharging. For instance, using four "Wecovalves," the writer finds that the ammeter needle stands at slightly over 1 ampere. If, therefore, signals suddenly commence to weaken in the course of a concert, the user should at once glance at the ammeter, and if the needle has fallen below 1 ampere, the accumulator needs recharging. Provided, however, that the needle still indicates slightly over 1 ampere, the trouble must be sought elsewhere. In the case of four 0.06-amp. valves, the reading would be 0.25 amps., and thus the necessity of using a small-scale ammeter is readily seen. Having inserted valves and made all necessary connections to aerial, earth, and batteries, the two range switches should be placed to the right, the anode variometer set to 80, and the aerial variometer slowly rotated until 5XX is heard, and then the dial settings should be noted. In the case of 2LO, the switches are put to the left, and the anode variometer set to 20. All stations heard should be identified, and the two dial settings carefully noted, and then it will be found that any station will always come in again at exactly the same dial settings.

If made carefully in accordance with directions given, it will be found that this set will give constant and reliable service year in and year out, with absolute freedom from any mechanical or electrical troubles, since the instrument is the outcome of much experimental work conducted with a view to producing a receiver with as near an approach to the simplicity of a gramophone as possible, and it can be confidently recommended to any amateur who is desirous of building a set for the use of any relative or friend living in town or country who does not know and, moreover, does not *want* to know the difference between a grid leak and a supersonic-heterodyne receiver.

AMATEUR TRANSMISSIONS IN THE IRISH FREE STATE.

A SHORT while ago, according to the *Irish Radio Journal*, quite a number of letters appeared in the Press deploring the fact that amateurs could not obtain permission to carry out experimental transmissions in the Free State. Now that transmitting licences are being issued to *genuine experimenters*, no one appears to have had the pleasure of listening to an amateur transmission originated in the Free State. Surely the attitude of the Irish amateurs is not synonymous with that of the "dog in the manger"? Yet why the apathy?

"Let us hope," states the same journal, "that it is only due to the delightful weather we have been experiencing, and that the ardent experimenter is looking forward to the shorter days and longer evenings when the weather is less congenial.

"We sincerely hope that the Irish Radio Societies will install transmitters in the autumn, in order to set the lead and get into line with their *confrères* in neighbouring countries.

"The best means of qualifying for a transmitting licence is to join the local radio society and study, not neglecting Morse practice."

New Facts About OSCILLATING CRYSTALS.

The Results of Recent Experiments.

By Capt. H. J. ROUND and N. M. RUST.

Great interest has been centred around the subject of oscillating crystals since the first publication in this country of an account of the work of O. Lossev was given in "The Wireless World" for June 11th, 1924. The present article disclosing new information of a practical character will certainly be welcomed by the amateur.

EARLY in February, 1924, the writers decided to repeat Dr. Eccles's oscillating galena experiments, of which he published the details as far back as 1910.[1] Not only were these repeated, but a good many other crystals were found to have a similar property. Oxidised metallic surfaces were the first substances investigated. Then many of the well-known crystals, of which the most favourable material at first found was silicon and a peculiar white mineral, the derivation of which was difficult to find, called "arzenite" by the dealers from whom it was bought.

Zincite and Arzenite.

The investigation was partly completed, when O. Lossev's earlier work in Russia was communicated to us. That publication, of course, at once reduced the investigation from one of major importance from the commercial point of view, to one of interest only; but it was decided to continue the work for some time until it could be decided whether a really practical instrument could be turned out.

On account of Lossev's use of zincite, we tried this material, and after some experimenting succeeded in getting it to work, but not nearly so reliably as the "arzenite."

An amusing point about the "arzenite" was that the name suggested a poisonous material, and as we were continually fusing it we took great precautions not to inhale the vapour.

Afterwards an analysis by a chemist of this "mineral" indicated pure zinc oxide—in fact, a colourless pure crystalline zincite—unknown to any mineralogist we consulted. The suggestion is, of course, that it is a by-product from a furnace in some metallurgical process, but the dealers will not give the source away. As zinc oxide has not previously been produced in its crystalline state artificially—at least, in anything like large crystalline masses—it is of great interest from a chemical as well as an electrical point of view.

The writers were far more interested in getting reaction effects—that is, obtaining some element of magnification rather than oscillation. The earlier tests were done with long waves, and it is certainly easier to work with long waves, but we were very soon able to come down to the broadcast range.

The following may give some indication of the methods of getting reliable results, but we must warn those trying to repeat them that this is for the patient experimenter, and not for the broadcaster.

The Circuit Used.

The basic circuit used for all these crystal experiments is that shown in Fig. 1. The aerial is supplied with series and shunt low-loss condensers (7 and 8), the object being to adjust the damping of the aerial circuit to a value which can be handled by the crystal the power of which is not always sufficient to bring a highly damped aerial up to the oscillating point (small series condenser and large shunt condenser give low damping). The crystal rectifier 9 is preferably a good carborundum crystal used in conjunction with a potentiometer 10 and telephones 11.

We used carborundum through all the experiments, as it is very essential to have great stability in this circuit. If the crystal varies the damping applied to the aerial, then this will make the action of the crystal 3, 4 uncertain. We should advise that some considerable care is taken in obtaining a good stable carborundum crystal.[1]

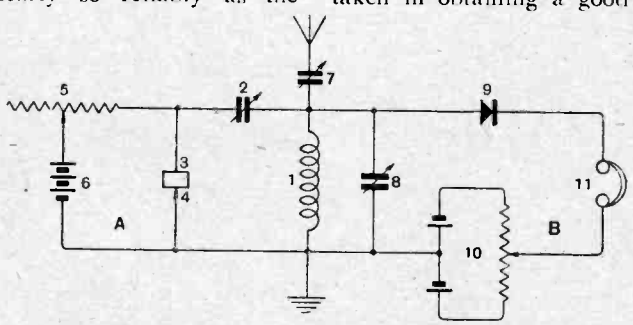


Fig. 1.—Arrangement of apparatus for decreasing the damping of the aerial circuit of a crystal set. The amplifying crystal circuit is A, and the crystal set B.

The condenser 2 is a very small one. An air condenser of 0.0002 mfds. is sufficient, and it will seldom have to be used at its maximum capacity.

The wire-wound resistance 5 should be variable in small steps up to 12,000 ohms, and the battery 6 from 30-40 volts. Those who wish to keep this battery down to 8 or 10 volts will have to put a choke coil in series with 5, as 5, being then used at a small value, will act as a H.F. by-pass, but for 30- to 40-volt working no choke is necessary.

The crystal 3, 4, to be tried should be firmly gripped in any of the well-known crystal holders, and then a short catwhisker tried over its surface.

Preparing the Crystal.

A good way to go about it is to get some very weak

[1] See *The Electrician*, December 16th, 1910.

[1] We believe the Carborundum Company are shortly issuing a fixed adjustment capsule, one or two specimens of which have recently been tested and found very good.

New Facts about Oscillating Crystals.—

signals on the rectifier and then, setting 2 at a very small value, make contact at 3, 4, and try the effect of varying 5, while steadily increasing 2. If nothing happens, then try a new contact, and so on.

The most important part of the apparatus is the crystal 3, 4, and our method of preparing "arzenite" for this is somewhat as follows:—

A 110-volt D.C. source has a 10-20-ohm stabilising resistance put in circuit with it. First a small piece of crystal is inserted in a vice—one side of the D.C. is connected to the vice, and the other to a piece of No. 22 copper wire.

A light touch will fuse the copper solidly on to the crystal. This forms the one end of the crystal, and this copper tail can be used afterwards for making good contact to the crystal.

Preparation of the Active Surface.

Again, with the crystal in the vice the other way round—and a small, solid arc carbon attached to the other side of the D.C.—quickly form an arc to the crystal and pull the arc out. The arc current used is about 5 to 10 amperes. With a little practice, a smooth, hollowed-out, fused surface looking rather like a hollow tooth will be formed. This is the active surface.

Our experience is that, for the first day after this fusing, this surface is very active for producing negative resistance effects, but a deterioration takes place, although many weeks afterwards we have found crystals with several active spots.

There seems some slight difference between the crystal surface if made positive or negative in the operating circuit, but it is not well defined.

Many points will be found on the crystal 3, 4 where oscillations can be produced which will beat with a carrier wave, some with a rough note, and some with a note as good as that given by a valve; and it is these smoothly oscillating points that will be found most effective in strengthening incoming signals.

Practical Value.

Inaudible signals can be brought up quite loud, and fair signals can with luck be brought to weak loud-speaker strength, but this latter feat is not often performed. We think it is preferable to start work on a frame, as its resistance is rather low, and it is easier to find an active point. Once a point is found, take care not to break the circuit anywhere, as the resulting kick will usually put the crystal out of adjustment.

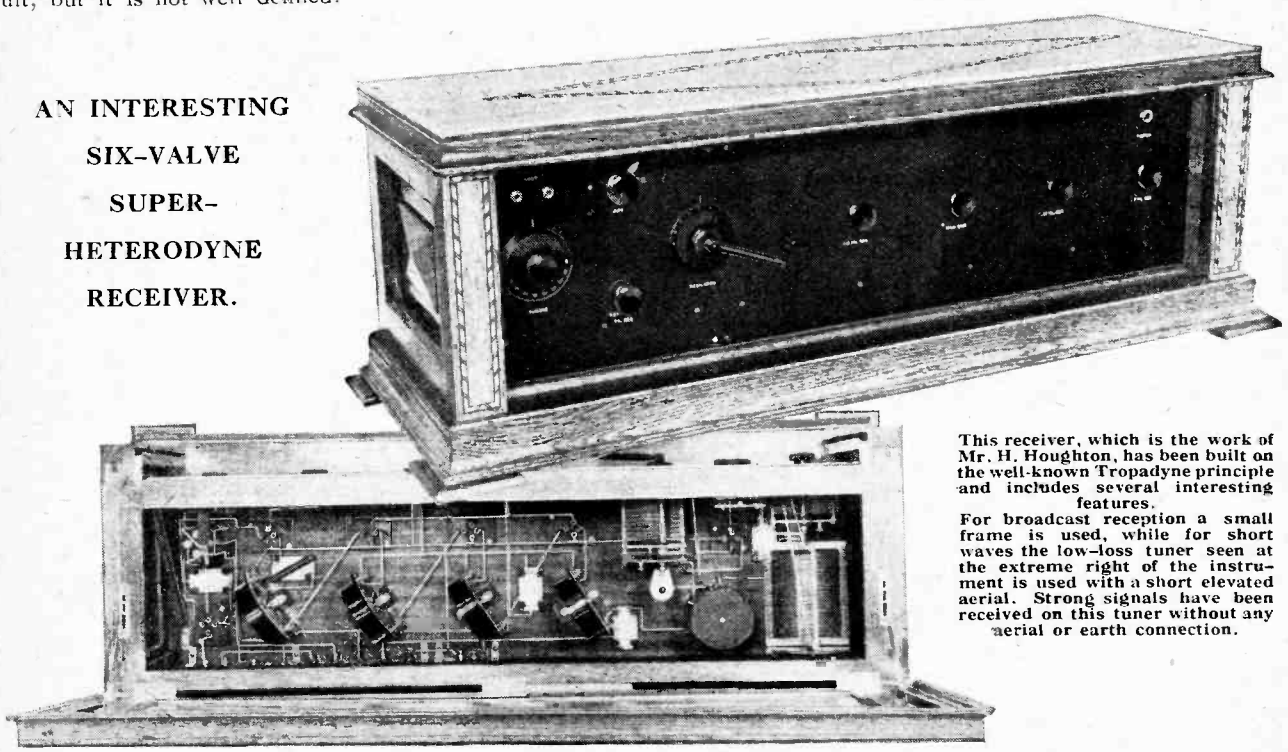
The resistance 5 should not go down to less than 1,000 ohms if a 40-volt battery is being used, as one is continually heating up the catwhisker and spoiling its active end.

If "arzenite" cannot be obtained, "zincite" can be treated in the same way.

The result of these researches was disappointing, because it was finally realised that, although for a demonstration the arrangement might be satisfactory, yet for practical broadcast an enormous improvement would have to be made. The difficulty of finding a sensitive place even on the best crystals is considerably greater than obtaining a sensitive point on a galena crystal when used as an ordinary rectifier.

The wavelengths normally used for all the later tests were 300-500 metres, but oscillations could be produced down to 100 metres quite easily.

AN INTERESTING SIX-VALVE SUPER-HETERODYNE RECEIVER.



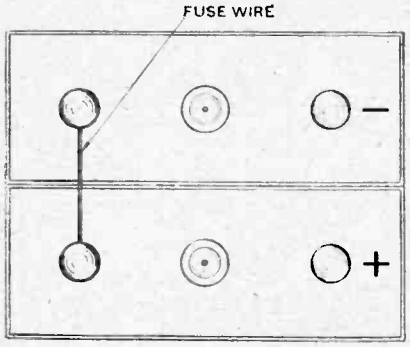
This receiver, which is the work of Mr. H. Houghton, has been built on the well-known Tropadyne principle and includes several interesting features.
For broadcast reception a small frame is used, while for short waves the low-loss tuner seen at the extreme right of the instrument is used with a short elevated aerial. Strong signals have been received on this tuner without any aerial or earth connection.

A Section Devoted to Novelties and Practical Ideas.

L.T. CIRCUIT FUSE.

A very convenient position for the fuse which is frequently inserted in the L.T. circuit is between the cells of the accumulator itself, if this happens to contain two or more cells. Most accumulators are now fitted with separate terminals for each cell in place of the permanent burnt lead connections which were at one time common, and it is therefore quite a simple matter to replace one of the connecting strips by a short piece of fuse wire.

The thickness of the wire will depend upon the object with which the



Filament circuit fuse inserted between the cells of the L.T. accumulator.

fuse has been inserted. If for the protection of the accumulator plates from direct short-circuiting, ordinary 5-amp. fuse wire will suffice; but for the protection of the valve filaments a thinner gauge depending on the type of valves must be employed.—T. W.

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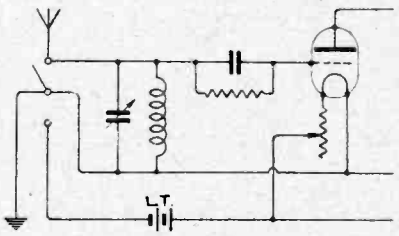
COMBINED L.T. AND EARTHING SWITCH.

A single-pole double-throw switch is frequently employed to connect the aerial through to earth when the receiver is not in use. There is no reason why this switch should not control also the L.T. current, when it will be seen that the earthing of the aerial will be coincident with the switching off of the valves.



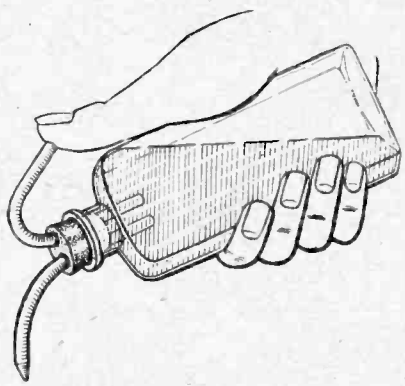
Connections of a S.P.D.T. switch arranged to earth the aerial when switching off the L.T. current.

The earth wire and the common connection to the negative ends of the valve filaments are connected to the blade of the switch, while the aerial and grid connections go to the upper contact. The connection from the negative side of the L.T. battery goes to the lower contact, as shown in the diagram.—E. C. D.

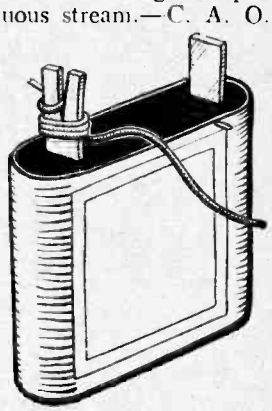
oooo

FILLING ACCUMULATOR CELLS.

It is necessary from time to time to add distilled water to accumulator cells to compensate for evaporation. Many accumulators are fitted with very small vents, and some special means has to be used to introduce the water. A glass funnel with a narrow neck may be employed, but a better method is to feed in the water from a bottle fitted with glass tubes similar to a chemical wash bottle. In this case, however, both tubes may be short, as it is intended that the water should flow into the cell by gravity. By placing a finger over the air inlet tube, the flow of water can be regulated to flow in single drops or in a continuous stream.—C. A. O.



A supply bottle for adding distilled water to accumulator cells.



Sound electrical connection between flash lamp batteries can be obtained without soldering by slitting the contact strip.

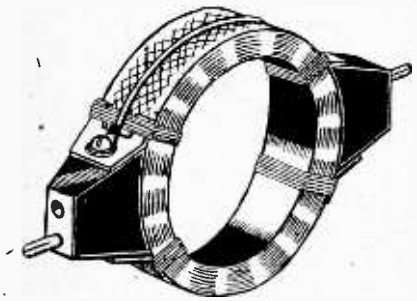
FLASH LAMP BATTERY CONNECTIONS.

As an alternative to soldering the connections between the units in a H.T. battery built up from flash lamp batteries, the contact strips may be split centrally with shears, and the connections made with tinned copper wire pressed into the slit and twisted round the contact strip. A perfectly noiseless connection results, and the possibility of damage to the internal connections of the battery attendant on soldering is eliminated.—H. C.

REACTION COIL CONNECTIONS.

The use of a special reversing switch for the reaction coil introduces an unnecessary complication into the wiring of a receiver. By fitting two plugs to the reaction coil itself with suitable connectors the direction of reaction can be made to depend upon the position of the coil in the holder.

The new coil plug is secured to the coil with string binding, with the plug connection corresponding to the position of the socket in the original coil



Reaction coil fitted with an extra plug to reverse connections.

plug. The connections will then run directly over the surface of the coil winding to reverse the direction of reaction, as indicated in the diagram. —G. P.

AERIAL CIRCUIT CONNECTIONS.

Viewed from the electrical standpoint, the use of terminals and short-circuiting links for charging H.F. circuits is much to be preferred even when special anti-capacity switches are considered as an alternative. The terminals can be spaced well apart, and when the connecting links are removed the capacity between adjacent terminals is negligible.

All the circuits in general use for aerial tuning can be obtained with a system of six terminals. The A.T.C. is connected across the first and second terminals at the top, and the A.T.I. between the third terminal and the sixth at the bottom. The secondary circuit, consisting of the closed circuit inductance and condenser permanently connected in parallel, is joined across the fourth and fifth terminals, counting from the top. The diagram shows five different circuits obtained by bridging different terminals and varying the points of connection of the aerial and earth leads.—E. R.

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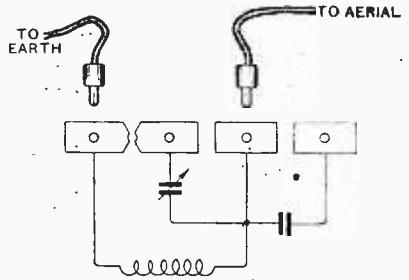
SERIES-PARALLEL SWITCHING.

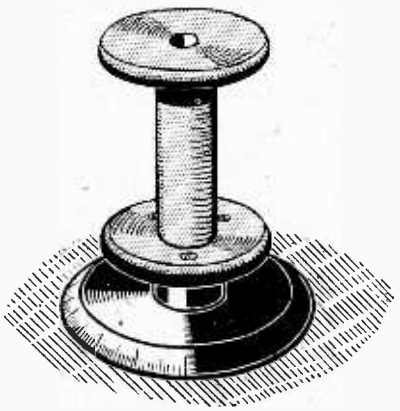
The diagram shows a convenient method of changing the connections of the fixed and variable condensers associated with the aerial tuning circuit. The switching is carried out with plugs and contact blocks similar to those used on Post Office resistance boxes. It is advisable first to drill a strip of brass at appropriate intervals



Plug and socket switching for aerial condenser connections.

and before cutting up into sections to mark the positions of the screw holes on the ebonite panel. If split plugs are used for the aerial and earth connections the holes need not be tapered and may be drilled with an ordinary twist drill of suitable size.

Depending upon the positions of the aerial and earth plugs, the variable condenser may be joined in series or in parallel with the A.T.I., and by inserting the aerial plug in the extreme right-hand socket, a small fixed condenser may be connected in series with the aerial when the variable condenser is in parallel.—A. L. B.

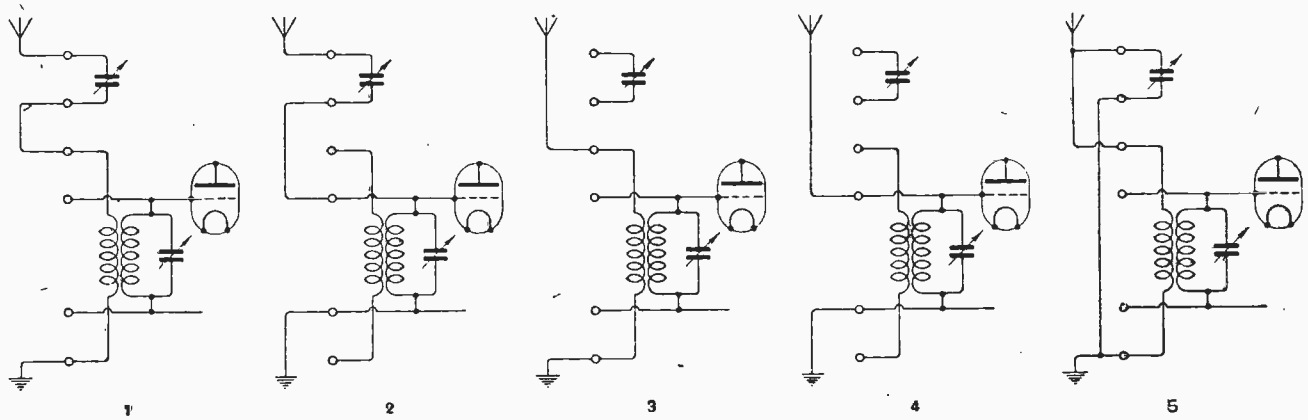


Empty wire reel as condenser extension handle.

AN INEXPENSIVE EXTENSION HANDLE.

An empty wooden wire spool screwed to the knob of a condenser dial makes an excellent extension handle which minimises if it does not entirely eliminate hand capacity effects.

A pleasing black "ebonised" finish may be given to the wood by painting first with a solution of logwood in water and then with a solution of ferrous sulphate.—D. G. B.



The following circuits are provided by the six terminals in the tuner circuit: (1) Loose coupling, A.T.C., in series; (2) Direct coupling, series and parallel tuning condensers; (3) Aperiodic aerial coupling; (4) Direct coupling, tuning condenser in parallel; (5) Loose coupling, A.T.C. in parallel.

Events of the Week in Brief Review.

S.B. IN FRANCE.

Simultaneous broadcasting, which has long been neglected in France, is at last coming into favour. *Radio-Toulouse* makes a regular practice of broadcasting certain parts of the *Petit Parisien* programme. Incidentally the Toulouse station is reported at remarkable strength in the French capital.

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SHORT WAVES FROM WBZ.

A series of transmissions on 49 metres has been commenced by the Westinghouse Company's broadcasting station, WBZ, at Springfield, Mass. The programmes, which are intended for the Canadian Government ship "Arctic," now in Polar regions, are sent out regularly every Thursday morning from 3.30 to 4.0 (G.M.T.).

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SWEDISH CABLES NEGLECTED.

The use of wireless in Sweden for commercial purposes has developed to such an extent that, according to a Gothenburg report, about 95 per cent. of all telegrams from Sweden to the United States are sent through the Government wireless station at Grimeton. The cable companies are stated to have reduced their pre-war rates.

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A FINE SUMMER RECORD.

The strongest signal yet received from Australia, states Mr. J. A. Partridge (G2KF), is that of A3BD, who has been heard working with U.S. stations as late as 9 a.m. During the last few weeks G2KF has worked with the following amateurs in the Antipodes:—A2CM, Z2AC, Z2AE, Z4AG, Z4AL, Z4AR. Stations heard are A2YI, A3BD, A3BQ, A3JU, Z2XA, and Z4AK.

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A MIXED BLESSING.

Listeners in France have no difficulty in picking up the transmissions from Oslo on 382 metres, owing to the fact that they coincide exactly with one of the harmonics of the high-power station at St. Assise (UFP), which operates on 2,290 metres. Unfortunately, the Frenchman, having lighted on Oslo's wave, cannot enjoy the programme until UFP has closed down. UFP is therefore a mixed blessing.

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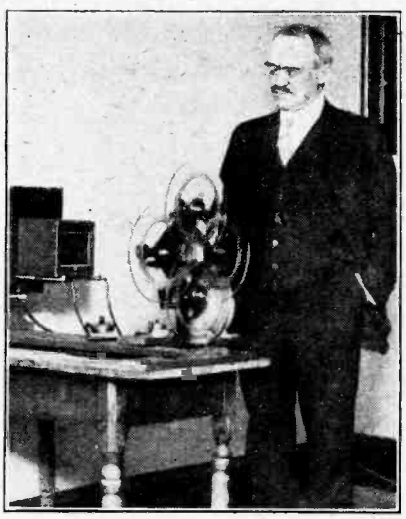
NEW ARGENTINE AMATEURS

Two more amateurs appear to have begun short-wave transmission in the Argentine, their call-signs being 3B8 and BA1. They were heard on a wavelength of 40 metres on Sunday, August 9th, by Mr. A. Studley, of Harrow.

LISTEN FOR THE CANADIANS.

Co-operation has been brought to a high pitch by Canadian amateurs, most of whom adhere to a definite schedule. At the present time they are transmitting on 120 metres every Thursday morning at 04.00 (G.M.T.). On nearly every other night they work on 40 metres from midnight onwards.

Major Wm. Borrett (C1DD), to whom we are indebted for the above information, states that he has worked with G2KF on several recent occasions, but adds: "Where are the rest of your gang?"



CINEMATOGRAPH PICTURES BY WIRELESS. Mr. C. Francis Jenkins, the American inventor, who has devoted considerable attention to the wireless transmission of photographs, has now turned his efforts towards cinematography by wireless. He is seen in the photograph beside his latest instrument.

23-METRE TRANSMISSION TESTS.

Amateur transmission tests on 23 and 45 metres will begin on October 1st between the stations of Mr. W. S. Crampton (2KV) of Weybridge and Captain Duncan Sinclair (2OC) of Shepperton. 2KV will operate on 45 metres, and 2OC on 23 metres. During the tests it is hoped to establish communication with various Dominion and foreign amateurs, and reports will therefore be welcome.

Transmissions will be made by 2OC from 7 p.m. to 7.15 p.m., and from 7.30 p.m. to 7.45 p.m. (G.M.T.) for one week commencing October 1st.

AMERICA'S "SUPER" BROADCASTING STATION.

With the declaration that it is "the first super-power broadcasting station," WGY, Schenectady, now transmits programmes with a power of 50 kilowatts, on 379 metres. It is interesting to note that at the Daventry high-power station, which at present operates with a power of 25 kilowatts, provision has been made for a rating up to 60 kilowatts. Should this full power be used, superlatives will apparently be lacking.

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WIRELESS SUCCOUR IN THE ALPS.

The lives of many Alpine climbers will doubtless be saved by the introduction of wireless aid posts, the first of which is to be installed shortly on Monte Rosa, in the Zermatt district. At present much valuable time is lost between the discovery of a victim of injury or exposure and the summoning of help from the foot of the mountains.

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PETIT PARISIEN CRITICISED.

Careful observations carried out by our contemporary, *La T.S.F. Moderne*, are stated to have shown that the wavelength of the *Petit Parisien* broadcasting station varies from the normal 345 metres at a frequency of 120 per minute. The changes are hardly noticeable in the Paris district, but in distant parts of the country they are said to interfere with reception in quite a marked manner.

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OPPORTUNITY FOR INVENTORS.

Sir Arthur Stanley, president of the Wireless League, has offered a gold medal for the best wireless invention produced during the next six months.

This award, which will be known as the Stanley Medal, will be open only to members of the Wireless League.

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THE PASSING OF 5UC.

The sympathies of all wireless amateurs will go out to the parents and friends of Mr. Jack Gardener (5UC), of Sutton, whose untimely death, under the tragic circumstances of a motor cycle accident, occurred at the beginning of August. The late Mr. Gardener, who held one of the first transmitting licences issued in his district, was a keen wireless experimenter prior to the days of broadcasting and one of the founder members of the Sutton and District Wireless Society, of which, for a time, he was chairman. In a letter of condolence to the bereaved parents, a friend described him as "a loyal and devoted colleague, and a real friend, of a sunny and cheerful nature."

RECORD SHORT WAVE RECEPTION?

In the short space of 1 hour and 40 minutes, i.e., between 05.10 and 06.50 (G.M.T.) on August 8th, Mr. Brigstock Trasler, of Northampton, picked up short wave signals from the following :—Z1AX, Z2AC, Z2AE, Z2XA, A2BC, A2YI, A3BD, A3EF, CH1EG, CH2LD, and NUMM, the last call sign belonging to a ship sailing between Australia and New Zealand. The receiving set comprised a Reinartz tuner and one L.F. stage.

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SHORT WAVE SIGNALS FROM JAPAN.

Mr. S. K. Lewer (G6LJ), of West Hampstead, London, has picked up signals from a Japanese amateur station which, judging from the call sign, is the first to be licensed in that country. This station, J1AA, of Tokio, was heard on weak C.W. at 11 p.m. (G.M.T.) on August 4th, transmitting on about 42 metres.

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BROADCASTING AND THE PEACE OF NATIONS.

The potentialities of the International Broadcasting Bureau as a means of instilling friendship among the nations was referred to by Mr. Hugh Redwood in a talk from the London Station on August 7th.

"When the Bureau is able to substitute a network of radio friendships for a tangle of heterodyned cross-talks," said Mr. Redwood, "then, and in a double sense, we shall realise the dream of statesmen and have a concert of Europe. The night will be filled with music and the jealousies, the hatreds and the ignorant hostilities, the cares that infest Europe to-day, shall fold their tents."

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THE GREAT UNEXPLORED.

When two-way communication has been established between this country and Japan, India, China, and South Africa, the DX enthusiast will sigh for fresh worlds to conquer. In the meantime these four countries still have to be linked up by amateur wireless, and an exciting contest is to be expected during the coming winter to decide which amateurs will gain first honours.

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BROADCAST RECEPTION "ON TAP."

The first block of residential flats to have wireless "laid on" in the same way as gas or electric light is situated at Fulham. A central receiving set has been installed in the War Seal Mansions, wall sockets for two pairs of telephones being provided in each of the 138 sitting rooms. The service is free.

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PROVISIONAL PATENTS.

"Many Inventions—Topical and Typical" is the title of an attractive little pamphlet issued by Messrs. Kings Patent Agency, of 146a, Queen Victoria Street, E.C.4. In it the reader is reminded that ideas are not safe until they are patented, but the inventor's guide and friend—the patent agent—is ready to help him in obtaining the provisional protection that is found invaluable in many cases.

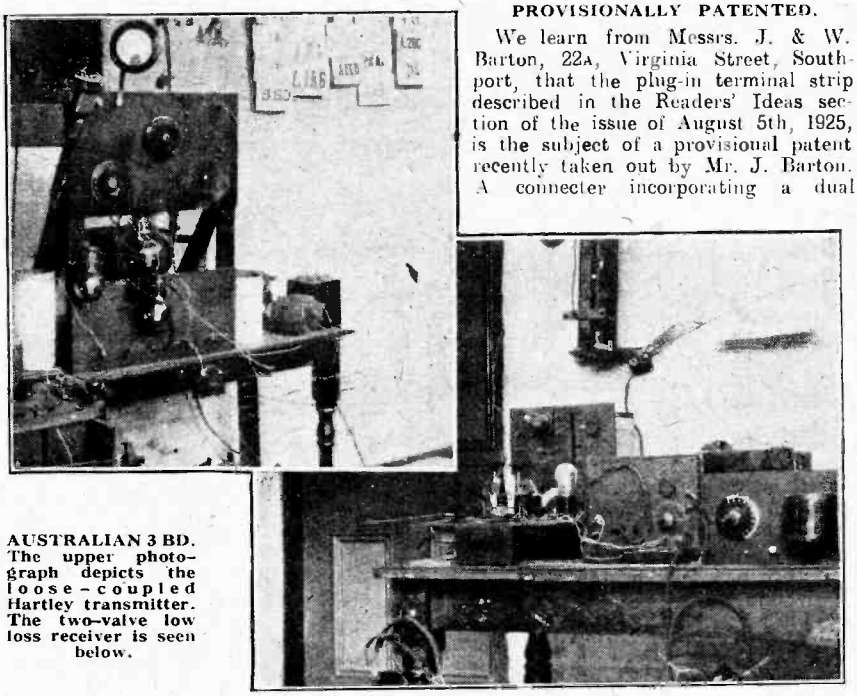
Messrs. Kings will forward their free "Patent" handbook to all applicants.

A FAMOUS AUSTRALIAN.

Mr. E. H. Cox, of Melbourne, the owner of A3BD, has forwarded photographs and some interesting details of his apparatus to Mr. C. L. Ward, of South Farnborough, Hants, who had reported the reception of his signals.

An ordinary two-valve low loss receiver is employed, whilst the transmitter comprises a loose-coupled Hartley circuit making use of two 30-watt Phillips transmitting valves. These can be seen in front of the panel in the accompanying photograph. In the course of his letter, Mr. Cox states that he can sometimes obtain an aerial current of two amperes with an input of 120 watts, and that he has been heard practically all over the world with an input power of 100 watts.

It is interesting to note that Mr. J. A Partridge (G2AF) has reported that the strongest signals recently received from Australia are those of 3BD.



AUSTRALIAN 3 BD. The upper photograph depicts the loose-coupled Hartley transmitter. The two-valve low loss receiver is seen below.

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A BURNDEPT DEVELOPMENT.

News of an interesting advance in the enterprise of Burndept Wireless, Ltd., is contained in the announcement of the formation, as and from July 30th, 1925, of the Burndept Wireless Corporation of America. The head office of the new corporation is at 52, Warren Street, New York City.

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INDIAN BEAM STATION.

Work has already started on the beam station in India for inter-communication with England. The transmitting station will be at Kirkee, a suburb of Poona, 116 miles from Bombay, the receiving station being at Dhond, about 48 miles distant. It is expected that traffic will begin about the middle of 1926.

RECORD LOW POWER TRANSMISSION?

While working with New Zealand 3AL recently, Mr. F. A. Mayer (G2CZ), of Wickford, Essex, was surprised to learn that the New Zealander's input power was only 14 watts—350 volts, 40 milliamps on the plate. Thereupon the power was gradually reduced until Z3AL reported that he was using only two and a half watts input, when signals were still readable. Below this power they were still audible but unreadable.

This would appear to be a low-power record for transmissions from the Antipodes.

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PROVISIONALLY PATENTED.

We learn from Messrs. J. & W. Barton, 22A, Virginia Street, Southport, that the plug-in terminal strip described in the Readers' Ideas section of the issue of August 5th, 1925, is the subject of a provisional patent recently taken out by Mr. J. Barton. A connecter incorporating a dual switch and designed on these lines is shortly to be placed on the market by this firm.

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AN ERROR.

The super-heterodyne receiver illustrated on page 200 of our last issue was described in *The Wireless World* for March 4th, 1925. A statement to this effect was erroneously inserted under Fig. 5 on page 199 of our last issue.

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CATALOGUES, ETC., RECEIVED.

R. A. Rothermel, Ltd. (24 and 26, Maddox Street, Regent Street, London, W.1). New radio catalogue of American wireless apparatus and components. Obtainable on application. 6d. in stamps should be enclosed to cover postage.

Hamley Bros., Ltd. (200-202, Regent Street, London, W.1). Abridged list of super heterodyne apparatus, supplementary to general radio catalogue.

Shenton and Co., Ltd. (68 and 69, Shoe Lane, London, E.C.4). Leaflet dealing with the "Supreme" condenser.

Dubilier Condenser Co. (1925), Ltd. (Ducon Works, Victoria Road, North Acton, London, W.3). Lists A.11 and A.15, dealing with the Dubilier-Mansbridge variometer.

Electrical Equipment and Carbon Co., Ltd. (109-111, New Oxford Street, London, W.C.1). Pamphlet dealing with the "Sonora" loud-speaker.

A. Rist, Ltd. (Waveney Works, Lowestoft). Set of humorous postcards illustrating wireless terms.

DIRECTIONAL RECEPTION.

PART II.

Frame Dimensions in Relation to Signal Strength.

By R. D. BANGAY.

IN a previous article[1] we examined the electrical effect produced in a loop aerial by an incoming wave. It may be helpful if we briefly summarise the results observed in the article referred to.

If the plane of the " loop " or " frame " is so placed as to lie at right angles to the direction along which the wave is travelling, as shown in Fig. 1, the magnetic lines of force constituting the wave will reach both the vertical conductors of the loop at the same instant. As a result both the vertical conductors will be cut by the same portion of the magnetic field at any given moment, and consequently the E.M.F.'s generated in the two conductors will at all times be exactly equal in magnitude. Moreover, the E.M.F.'s in the two conductors will be at any given moment acting in the same direction with relation to the earth's surface, *i.e.*, either both acting upwards or both downwards, as shown by the arrows in Fig. 1. It follows, therefore, that these E.M.F.'s are opposing and neutralising each other in relation to the electrical circuit formed by the loop. The E.M.F. generated in the conductor AB is at a given moment acting in a clockwise direction round the loop, as shown by the arrow, while at the same moment that generated in the conductor CD is acting in an anti-clockwise direction.

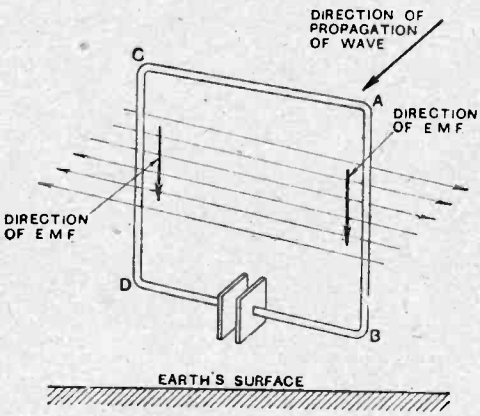

Fig. 1.—Diagram showing direction of E.M.F.'s in vertical conductors of a frame aerial placed with its plane at right angles to the direction of propagation.

Effect of Earthing the Loop.

From this it is clear that under these conditions the resulting current flowing round the loop will always be zero when the plane of the loop is at right angles to the direction from which the signal is coming. It is important to note here that if a path were provided from the loop as a whole to the earth, a current would flow upwards and downwards through that path because, as we observed above, the E.M.F.'s in the two conductors are acting in the same direction with relation to the earth's surface. Therefore, in order to make use of the non-receiving property of the loop aerial to signals emanating from a direction at right angles to its plane, we must so connect the detector to the loop circuit that no path is provided through it from the loop to the earth. This tendency for current to flow between the loop as a whole and the earth is known as the vertical component, and is an important factor to which we shall refer later.

Resultant E.M.F. in the Loop Circuit.

The other condition which we examined in the previous article was when the plane of the loop aerial is so placed as to lie edgewise to the direction along which the wave is travelling, as shown in Fig. 2. In this case it is clear that the incoming wave will reach one of the conductors slightly before the other. As a result the two conductors will always be cut by different portions of the magnetic field at any given instant. Therefore, although in this case also the E.M.F.'s in both conductors will pass through exactly similar cycles during the passage of a wave, the two E.M.F.'s will be out of phase with one another, and therefore the two E.M.F.'s will not always be exactly equal and opposite with relation to the loop circuit. From this we may conclude that when the plane of the loop lies along the direction of propagation, there is a resultant E.M.F. acting round the loop whose magnitude at any instant is the sum or difference of the E.M.F.'s in the two conductors, according to whether they are acting in the opposite or in the same direction round the loop at that instant.

The next point to consider is the relation of this resultant E.M.F. both as regards its magnitude and phase to the E.M.F.'s generated in the vertical conductors.

Now an electro wave consists of a system of magnetic lines advancing through space; the wave varies, as we explained in the previous article, in accordance with the sine law. That is to say, it starts at zero density at the front edge of the wave, increases to a maximum density in one sense in a quarter of its length, falls to zero density at half its length, reaches another point of maxi-

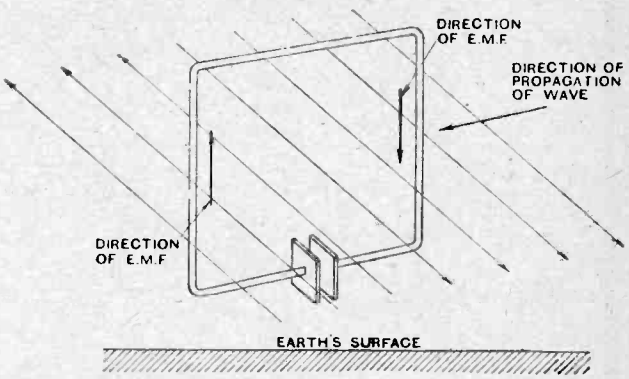

Fig. 2.—Direction of E.M.F.'s in a frame aerial placed with its plane in the direction of propagation.

[1] *Wireless World*, July 8th, 1925.

Directional Reception.—

mum density in the opposite sense at three-quarters of its length, and finally falls to zero density again.

We may, therefore, represent the density of the magnetic field by a simple sine curve, as shown in Fig. 3,

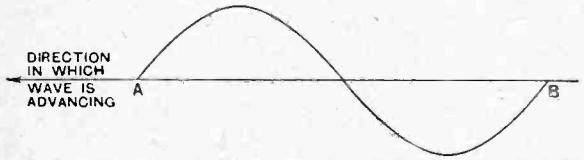

Fig. 3.—Sine curve showing how the density of the magnetic lines vary in a complete wave.

where A represents the front and B the back of the wave, while the distance A B represents the length of the wave.

Any ordinate of this curve, of course, represents the density of the magnetic field at that point on the wave. When this wave in its journey through space reaches a stationary conductor the lines of force are cut by that conductor as the wave passes across it. Since the magnitude of the E.M.F. generated in the conductor varies as the density of the field cutting it, it is obvious that the length of the ordinate at that part of the wave which at any moment has reached the conductor represents also the E.M.F. generated in the conductor at that moment.

The progress of a wave past a fixed conductor and the magnitude of the E.M.F. generated in that conductor are illustrated in Fig. 4, which shows nine successive

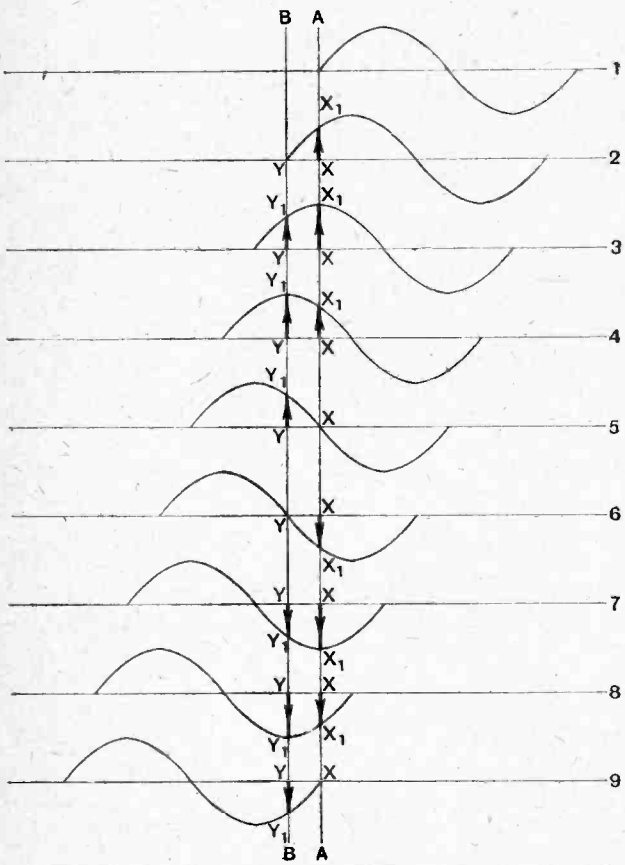

Fig. 4.—Diagram showing the relative magnitude of the E.M.F.'s in two vertical conductors AA and BB at nine successive moments during the passage of a complete wave.

moments at equal intervals during the transit of the wave across a conductor fixed in the position AA. In this diagram it is clear that the ordinate XX_1 in each case represents by its length the magnitude of the E.M.F. at that particular instant.

The reader should particularly note that this E.M.F. is exactly in phase with the incoming wave, that is to say, it reaches a maximum at the moment when the magnetic density of the wave is a maximum.

We can also make the same diagram show the instantaneous values of the E.M.F.'s generated in a second conductor by the same wave. Thus, if the second conductor is fixed in the position BB, the distance between A and B represents the distance between the two

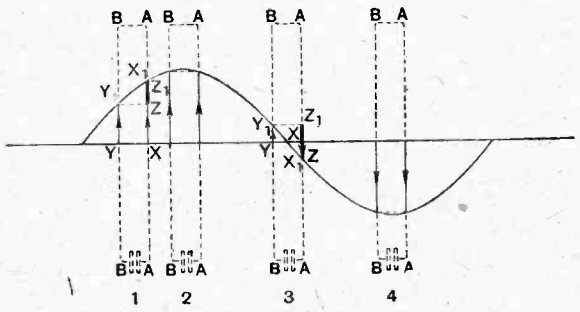

Fig. 5.—E.M.F.'s induced in the vertical sides of four frame aerials introduced at different points in a complete wave.

conductors measured to the same scale as the length of the wave. The magnitude of the E.M.F. generated in this second conductor is represented by the length of the ordinates YY_1 at each of the nine moments illustrated.

Graphical Representation of E.M.F.'s in the Vertical Sides of a Loop Aerial.

As in the case of the conductor AA the E.M.F. in this second conductor is also exactly in phase with the wave, and, moreover, the E.M.F. in this second conductor will reach exactly the same value as that generated in A But owing to the fact that the wave reaches B slightly later than A, the E.M.F.'s in the two conductors are not always equal at the same instant.

For example, at the moment indicated in position 2, the E.M.F. in the conductor A as represented by XX_1 is considerable, while that in the conductor B is zero. Again, at the moment 3 the E.M.F. in A has just reached its maximum, while that in B as represented by YY_1 is considerably less. It is easy to see that at a moment half-way between 3 and 4, and at another moment between 7 and 8, the two E.M.F.'s will be exactly equal and acting in the same direction with relation to the earth surface, as indicated by the arrow heads. Also, at a moment half-way between 5 and 6, the E.M.F.'s are again exactly equal, but this time in opposite directions with relation to the earth's surface.

It is not difficult to see how we can use this diagram to represent the conditions prevailing in a frame aerial, and from a study of it observe several important points which have a vital influence on the problem of directional reception.

Assuming for a moment that the frame aerial is placed edgewise to the direction in which the wave is travelling, then obviously A and B in Fig. 4 will represent the two

Directional Reception.—

vertical conductors forming the two sides of the frame aerial. As already explained, the E.M.F.'s generated directly by the incoming wave in each conductor are acting upwards and downwards between the aerial as a whole and the earth, and constitute the vertical component of the signal. Thus in Fig. 4 the E.M.F.'s represented by XX_1 and YY_1 do not represent the effective E.M.F. acting round the loop. The E.M.F. acting round the loop at any instant is, as we have seen, the difference or sum of the two E.M.F.'s at that instant according to whether they are acting in the same or in opposite directions. For example, at the moment 3 both E.M.F.'s are acting in the same direction, and, therefore, the effective E.M.F. round the loop is the difference between XX_1 and YY_1. At any moment between 5 and 6, on the other hand, the two E.M.F.'s are acting in opposite directions, and consequently the effective E.M.F. round the loop at that instant is the sum of XX_1 and YY_1.

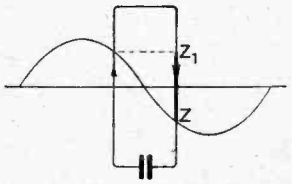

Fig. 6.—Resultant E.M.F. induced in a frame in which the vertical conductors are less than half a wavelength apart.

This point is illustrated rather more clearly in Fig. 5, where, instead of drawing a series of sine curves, as in Fig. 4, to illustrate the progress of the wave past the conductors, we have made a single sine curve answer the same purpose by showing the conductors of the frame aerial at different points along the curve. For obvious reasons this is a more convenient way of illustrating the same thing.

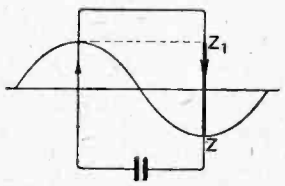

Fig. 7.—E.M.F. induced in a frame whose width is equal to half the wavelength of the incoming signals.

It will be observed in Fig. 5 that XX_1 and YY_1 again represent the vertical E.M.F.'s in the two conductors respectively. The effective E.M.F. round the loop is found by projecting a line YZ from one ordinate to the other, the length of the line ZZ_1 then represents the effective E.M.F. round the loop.

Now the important point to be observed from Fig. 5 is that the effective E.M.F. round the loop reaches a maximum when the node or zero point of the wave has reached the mid-point of the loop, and the vertical E.M.F.'s are at a minimum, as, for example, at 3 in Fig. 5. And *vice versa* when the densest part of the wave has reached the loop, and the vertical E.M.F.'s are at their maximum, the effective E.M.F. round the loop is zero, as at 2 and 4 in Fig. 5.

It is clear from this that, although the effective E.M.F. round the loop will alternate at the frequency of the incoming wave, it will always be exactly 90° out of phase with the wave, and, therefore, also 90° out of phase with the vertical E.M.F.

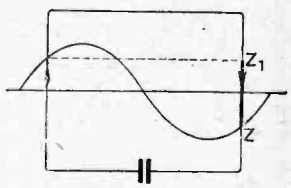

Fig. 8.—Diagram showing that the induced E.M.F. decreases when the width of the frame is made slightly greater than half a wavelength.

The next point to observe is that the relative magnitude of the effective E.M.F. round the loop to the vertical E.M.F. depends upon the distance separating the two vertical conductors, or in the case under consideration the size of the loop aerial. This is true only up to a certain point, *i.e.*, when the width of the loop is just half the length of the wave. If the loop is made larger than this, the effective E.M.F. becomes less. This point is illustrated diagrammatically in Figs. 6, 7, and 8. Fig. 6 shows the case of a frame aerial whose width is smaller than half a wavelength. Fig. 7 shows the case of a frame aerial exactly half a wavelength wide, and Fig. 8 the case of a frame whose width is rather more than half a wavelength.

In each case the length of the line ZZ_1, as before, represents the effective E.M.F. round the loop, and clearly this is greatest in Fig. 7 when the width of the frame is exactly half a wavelength.

NEWS FROM THE CLUBS.

Ipswich and District Radio Society.

Although officially the Ipswich and District Radio Society is closed for the summer, at infrequent intervals the members meet for excursions into outside territory.

On Sunday, July 26th, in response to a request from the hon. secretary (Mr. H. E. Barbrook), the Air Ministry very kindly permitted some thirty persons to make a thorough inspection of the airship sheds and the wireless station at the Pulham aerodrome. The party assembled outside the main gates punctually at half-past two. The first business was the inspection of the two great hangars, and the tour commenced with an examination of a large rigid airship in the process of demolition for scrap. The next vista created a murmur of surprise, for it revealed the R33—grim and silent after her recent struggle—in the process of reconstruction. After admiring the beauty of her lines, and the intricate mechanism of the interior, the R36 attracted attention, and being, as she is, of passenger type, she formed a striking contrast to the sister vessel next door. Finally there was a trip through the power station, and a hurried visit to the wireless cabin.

Hon. Secretary, Mr. H. E. Barbrook, 22, Vernon Street, Ipswich.

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Bolton and District Radio Society.

At a recent meeting Mr. J. S. McLeod gave an interesting lecture on "The Design and Construction of Wireless Receiving Sets." Naturally, with limited time at disposal, the various phases of so intricate a subject could only be dealt with briefly, but the lecturer so ably handled his points that one felt very little had been omitted. Enlightenment was forthcoming on "Straight," "Reflex," and "Super-het," together with remarks for and against the respective components, dealing in turn with valves, coils, condensers, etc.

Intending members are cordially invited. Communications should be addressed to J. Grimshaw, hon. sec., 70, Church Road, Bolton.

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Lewisham and Bellingham Radio Society.

"Coils, Coil-winding, and Variometer Construction," formed the subject of discussion at the Society's meeting on August 4th.

Mr. Lawrence dealt with the best method of obtaining low self-inductance, and outlined a system of variometer construction designed to secure a minimum of loss. Mr. E. J. Chapman described a special reaction coil for reception on wavelengths between 40 and 120 metres.

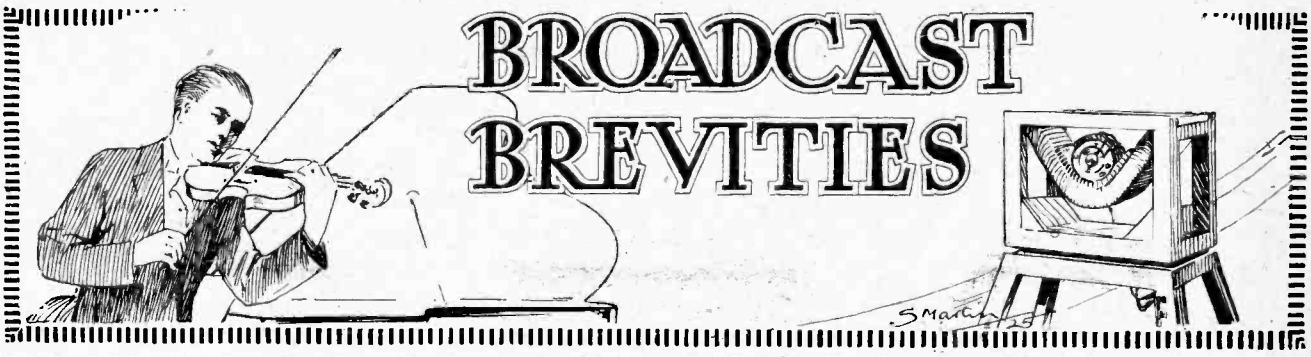
Hon. Secretary: Mr. C. E. Tynan, 62, Ringstead Road, Catford, S.E.26.

FUTURE OF BRITISH BROADCASTING.

The New Committee of Enquiry.

On this page we reproduce the portraits of the ten members of the Committee appointed to consider the future scope, management and finance of the broadcasting service in this country. These questions arise upon the expiry, at the end of 1926, of the licence at present held by the British Broadcasting Company.

(1) Lord Blanesburgh, representing the Law; (2) Lord Crawford (Chairman), the distinguished author and art amateur, and a former Cabinet Minister; (3) Sir Henry Hadow, Doctor of Music and Vice-Chancellor of Sheffield University; (4) Lord Rayleigh, the well-known scientist; (5) Mr. Rudyard Kipling, poet and man of letters; (6) Dame Meriel Talbot, former adviser to the Ministry of Agriculture and holder of official posts; (7) Sir Thomas Royden, Chairman of the Cunard Company; (8) Captain Ian Fraser, M.P., Member of Council of the Radio Society of Great Britain and Chairman of the Transmitter and Relay Section; (9) Mr. W. Graham, Financial Secretary to Treasury in Labour Ministry; (10) Mr. Ian Macpherson, M.P., former Cabinet Minister.



SAVOY HILL TOPICALITIES.

Birmingham's New Transmitter.

The engineers of the B.B.C. have been studying the question of the quality of transmissions from the Birmingham station, and the experiment is to be tried of introducing alterations in the transmitter. Birmingham listeners therefore may look forward to considerable improvements in reception at about the end of the present month.

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Government Help.

A good deal of interference takes place around this station, and the complaints indicate that the interference is due both to Morse and harmonics, but it may be said in defence of Government wireless services that everything possible is done to minimise interference with broadcast reception by the modification of circuits in use at Government stations.

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The New "Committee of Ten"—

The announcement of the names of the "Committee of Ten" appointed to inquire into the future of broadcasting brings to light a comparison interesting to listeners.

The Committee's terms of reference are: "To advise as to the proper scope of the Broadcast Service and as to the management, control, and finance thereof after the expiry of the existing licence on December 31st, 1926." The Committee will indicate what changes in the law, if any, are desirable in the interests of the broadcasting service when the two licences under which the B.B.C. operates expire.

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—And its Prototype.

It will be remembered that the Broadcasting Committee appointed in April, 1923, by Sir William Joynson-Hicks, then Postmaster-General, had as its terms of reference:—

(a) Broadcasting in all its aspects.
(b) The contracts and licences which have been or may be granted.
(c) The action which should be taken upon the determination of the existing licence of the Broadcasting Company.
(d) The uses to which broadcasting may be put.
(e) The restrictions which may need to be placed upon its user or development.

Vital Recommendations.

The recommendations of that Committee, which, like its successor, was a Committee of Ten, with Major-General Sir Frederick Sykes as Chairman, were first and foremost that the development of broadcasting must be encouraged and its use facilitated for a wide variety of service. It was also recommended that Broadcast service should not be operated by a Government department; but that those entrusted with the service should work under Government licence. The original broadcast band of wavelengths was also extended and it was the desire of the Committee that all possible steps should be taken to protect the band allocated to broadcasting from interference by other services. As regards programmes, the Sykes Committee decided that the B.B.C. had achieved a large measure of success in gauging the public taste and providing satisfactory programmes, and made the very useful suggestion that there should be a gradual extension of the broadcasting of news and that more latitude should be given for the broadcasting of special events without regard to the hour.

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News Service of the Future.

In the last named respect it may be noted that the B.B.C. has introduced a weather forecast at 10.30 a.m. at the request of the Government. As regards the extension of the broadcasting of news, reference to that matter in a recent article by a well-known writer raised an interesting point concerning the news service of the future. It is common knowledge that many persons object to the present day combination of "news and views" as circulated by the Press. Indeed, exception has been taken to the manner of presentation of the information contained in the news bulletins broadcast from Savoy Hill. Quite recently an evening newspaper castigated in its columns the B.B.C. for broadcasting certain material concerning a prominent politician.

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A Point for the Committee.

The writer overlooked the fact that the news bulletin in which the reference appeared, like all news bulletins, was broadcast by the B.B.C. in the identical terms in which it was supplied by the news agencies responsible for supplying the service. The ideal is to broadcast a news service free from anything in the nature of propaganda—"news" and not "views." It is likely that the Committee, over which the Earl of Crawford will preside, will go fully into this question when it begins its sittings in the autumn.

FUTURE FEATURES.

Sunday, August 23rd.

LONDON—3.30 p.m., Old Masters. 9 p.m., The Band of H.M. Royal Air Force.
BIRMINGHAM.—8.30 p.m., Saint-Saëns' Music.

Monday, August 24th.

LONDON.—8 p.m., An Hour of Variety.
MANCHESTER.—8 p.m., Chamber Music.
BELFAST.—8 p.m., Grand Opera and Light Opera.

Tuesday, August 25th.

5XX.—8 p.m., Chamber Music and Plays.
LONDON.—8.15 p.m., "Winners." S.B. to all Stations except 5XX.

Wednesday, August 26th.

LONDON.—10.15 p.m., Bransby Williams in Dickens Characters.
BIRMINGHAM.—8 p.m., Bach Programme.
GLASGOW.—8 p.m., Operatic Night.

Thursday, August 27th.

5XX.—8 p.m., International Programme.
LONDON.—9 p.m., Gems from Oratorio.
CARDIFF.—8 p.m., Band of H.M. Royal Air Force.
MANCHESTER.—8 p.m., Old Favourites.

Friday, August 28th.

LONDON.—8 p.m., An Hour of Song.
BOURNEMOUTH.—8 p.m. Adventure.

Saturday, August 29th.

LONDON.—9 p.m., "Radio Radiance."
BOURNEMOUTH.—8 p.m., The Barometer.
NEWCASTLE.—9 p.m., The Roosters.

Where the Microphone has Rested.

The disappointing results obtained by the engineers at one of the main stations in their recent attempt to broadcast the noise of the sea show how carefully the engineers must discriminate in trying to transmit natural noises. On the occasion referred to the microphone was placed on a sandy beach with the result that the sound of the breaking waves was broadcast as a very subdued murmur, and the listener who had not been told that the sound of the sea was being broadcast would have had great difficulty in guessing what the noises were supposed to represent. On a future occasion the engineers will be careful to place the microphone on a rocky shore or on shingle.

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A Noises "Query" Programme.

Apropos the broadcasting of natural noises, one ingenious suggestion is that a "What is it?" programme might be compiled, to consist of familiar sounds which listeners themselves would be left to identify. These noises might consist of street traffic or the equally familiar sounds in the listeners' own homes, but which, when broadcast, would be extremely difficult to identify; even the sound of the stropping of a razor could not easily be identified over the broadcast.

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Stars Precluded from Broadcasting.

We have frequently in these columns stated the position of the B.B.C. in respect of public entertainment broadcasts; but one aspect of the question which has not yet been touched upon is that of the employment of artists, who, by the terms of their contracts, are precluded from broadcasting during the months that they are free from theatrical engagements. One artist of considerable repute finds himself at the moment in just such a position. Although he has a contract which does not start for several months ahead, he is unable, by virtue of its terms, to fill in the interval with appearances before the microphone, as both he and the B.B.C. desire.

Amend the Contract.

In the case of an author who holds a commission to write for the periodical press, his contract sometimes binds him not to contribute simultaneously to papers within a definite area, nor simultaneously to papers of the same class as those covered by the contract; but an impossible situation would be created if he were precluded from writing at other times, even for papers in direct competition with those with which he may be likely to contract at some future time. Is it fair to an artist to debar him from working during what are known colloquially as "rest periods"? The anomaly is emphasised by the new conditions introduced by broadcasting, and the question will in all probability be thrashed out.

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What Station Is It?

Exception has been taken by listeners in several localities to the irregularity with which the name of the local station is announced, and the request has been made that listeners should be enabled to identify the particular station by a more frequent mention of its name or call-sign, namely, whenever announcements are made before the time. I understand that in future the name, but not the call-sign, of the local station is to be announced in this way, and thus the misconceptions which appear to have arisen will be avoided.

The World Requiem Broadcast.

The B.B.C. is discussing the possibility of broadcasting parts of the World Requiem on November 11th next. It will be remembered that last year a Service of Remembrance was broadcast from all stations on Armistice Day, and that during the two minutes' silence from 11 o'clock the transmitters themselves were switched off, in order to avoid anyone being troubled with oscillation. This year it is hoped to obtain an outside broadcast, possibly from the Cenotaph.

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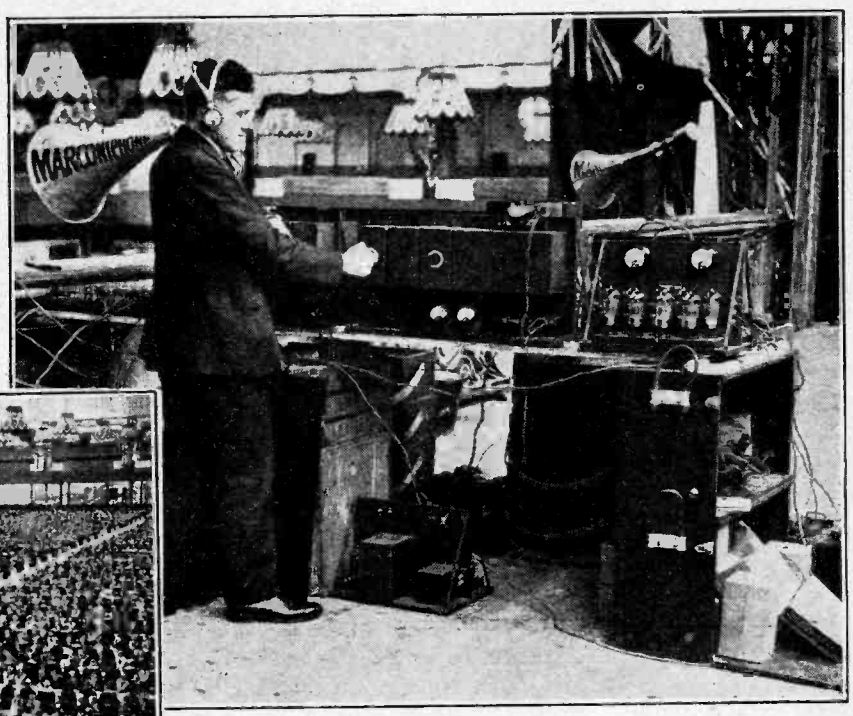
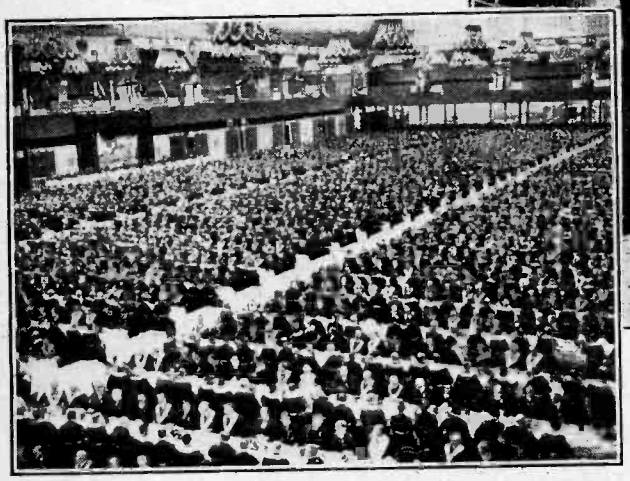
A Tragic Symphony.

The Symphony Concert at the Manchester Station on Thursday, September 3rd includes the famous "Pathetique" Symphony, by Tchaikovsky. This Symphony probably obtained tragic significance from the circumstances surrounding its production, as Tchaikovsky died three weeks after its first performance—he himself having conducted. His life was unhappy in many respects, and it is reasonable to admit the conjecture that his sorrows were mirrored in this work.

Among the soloists may be noted Miss Marjory Hayward, of the London Chamber Music Concerts, and Mr. Edward Leer, who recently took the tenor part at the Station in "Cavalleria Rusticana."





AMPLIFIERS AT A BANQUET. At the Masonic Million Memorial Banquet at Olympia on Saturday, August 8th, the post-prandial speeches were delivered by means of the Marconiphone amplifying system. The upper photograph shows the amplifiers in use whilst the lower photograph affords some idea of the immensity of the gathering. It is interesting to note that the loudspeakers were also used prior to the event to assist in the rehearsals of the catering staff.

BRITISH COAST STATIONS

The G.P.O. Spark Transmissions in Relation to Broadcasting.

By Lt.-Col. CHETWODE CRAWLEY, M.I.E.E.

THE Post Office has been intimately connected with wireless signalling since 1896, when Mr. Marconi, at its request, gave his first demonstration in this country. It was not until 1908, however, that the Department entered the lists commercially on its own account by opening a station at Bolt Head in Devon for communication with ships, and in the following year assumed a monopoly of this ship and shore communication by taking over from the Marconi Company and Lloyd's the other stations which were engaged on the work. This was, indeed, quite a logical development, as it was an extension, under one control, of the telegraph system of the country to ships at sea, a policy which has been followed by nearly every other country.

Interference with Listeners.

But something more was involved than merely commercial communication with ships, as obviously ship and shore signalling is intimately connected with the safety of life at sea, a matter of paramount importance to the greatest maritime country in the world. This fact accounts for the establishment of Post Office stations all round the coasts, some of them at places which, as can be seen by a glance at the map, would certainly not be chosen from a purely commercial standpoint.

Indeed, this matter of what might be called distress communication with ships is one which can never for one moment be absent from the thoughts of those who are responsible, a point which is not always appreciated by listeners who complain of interference from ship and shore communications. This trouble of interference has been eased up in many places by the use at the B.B.C. high-power station on a 1,600 metres wave, which is so far removed from the international ship wave of 600 metres as to be immune from interference from that source. In addition, the Post Office has arranged that, as far as possible, signalling near our coasts on the ships' waves of 300 and 450 metres is reduced to a minimum. All this has helped considerably to smooth out the troubles of listeners near the coast, but at places which are far from the high-power station and close to a commercial coast station, immunity from interference need not be expected unless elaborate, and therefore expensive, receiving apparatus is installed and intelligently operated.

The Post Office stations which are used for distress purposes, and conduct ordinary ship and shore commercial service, are situated at Wick, Cullercoats, Grimsby, North Foreland, Niton, Land's End, Fishguard, Seaforth, Port Patrick, Malin Head, and Valentia, the last two being worked by the Irish Free State Government on behalf of the British Post Office.

Spark sets are installed, and the power used varies from 1½ kw. at the smallest to 10 kw. at the largest station.

All these stations stand by to receive calls on a damped wave of 600 metres, as this is the distress wave agreed to internationally, and for the same reason all are always ready to transmit on that wave.

In addition, for the greater part of the day, Land's End stands by to receive and transmit on the 800 metres spark wave, as in the vicinity of Land's End there is so much signalling on the 600 metres wave that the use of the 800 metres wave, which is voluntarily fitted in many ships, is often of great assistance in disposing of traffic. For the same reason the Fishguard station is fitted for working on 800 as well as 600 metres, but it does not keep a separate watch on the 800 metres wave as is done at Land's End.

As might be expected from their positions, the North Foreland and Land's End stations are the busiest, but as North Foreland is not subject to quite so much interference as Land's End, a double watch is not required there.

The 300 Metre Wave.

Some of these coast stations have also to work occasionally on the 300 metres wave, as this is laid down internationally as a ship's wave; but, as already mentioned, working on this wave has now been curtailed as far as possible in the interests of the broadcasting service.

The only other spark stations for ship communication are the railway companies' small stations at Parkeston Quay, Folkestone, Newhaven, and Heysham, which are solely used for ships' service messages to the companies' boats. These stations used waves in the broadcasting band, but are now working, or arranging to work, on the 800 metres wave in the interest of coastal listeners.

The amount of traffic dealt with by Post Office stations to and from ships is increasing, and at present totals about three million paid words a year. But this

British Coast Stations.—

gives little idea of the total number of words actually sent and received, which for the eleven stations mentioned above is probably at least ten million words a year, and this represents not much more than half of the total ship and shore signalling near our coasts when the working of foreign coast stations is considered. As the greater part of this signalling takes place between noon and midnight, much of it with foreign ships not always accurately tuned, the coastal listener will readily understand that, unless he uses really selective apparatus, he cannot expect to listen always in splendid isolation to concerts transmitted from distant stations on small power.

Radiotelegrams.

A telegram for a ship may be handed in at any Post Office in the country, and if there is a doubt about which coast station would best deal with it the telegram is sent to the General Post Office in London, where it is routed to the appropriate station. In fact, the sender need only put the name of the ship on his telegram, and the Post Office will do the rest, though, to save time, it is always advisable for the sender to indicate the appropriate coast station if he knows it.

All ships on coming within range of a coast station are supposed by international regulations to report their position and next port of call, so that any traffic for them on hand, or coming to hand, can be forwarded at the first opportunity; but even when ships omit to do this a station with traffic on hand uses every means in its power, by calling the ship and by obtaining information from other stations if necessary, to dispose of its traffic without delay. Traffic received from ships is sent on at once over the land lines to the appropriate telegraph centre from which it is delivered direct to the addressee or telegraphed for delivery to the appropriate local office.

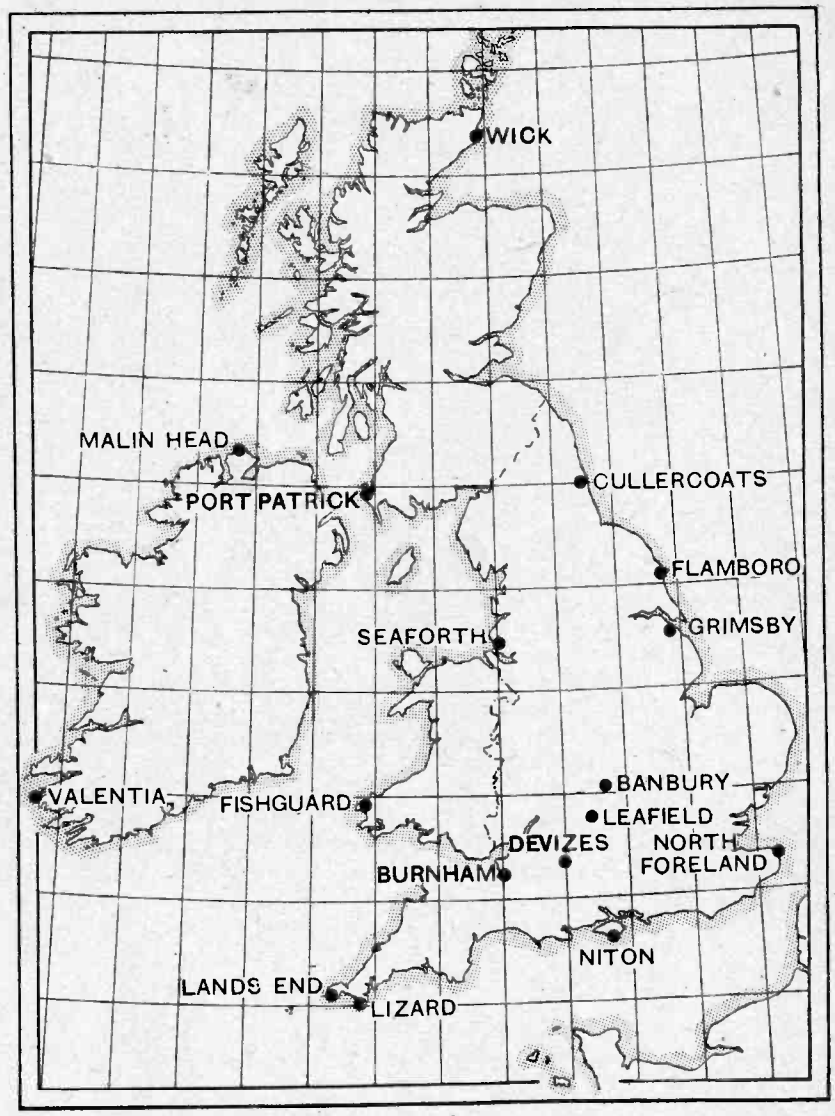
The normal charge for radiotelegrams is elevenpence a word, made up of sixpence for the coast station, fourpence for the ship, and a penny for the inland service, but smaller charges are made in the case of telegrams for certain short voyage vessels, such as cross-Channel boats.

Navigational and Weather Reports.

An important duty of most of these coast stations is to broadcast on the 600 metres wave navigational warnings containing information relating to derelicts, temporary extinction of lights or displacement of aids to navigation, drifting mines, and other important hydrographic matter.

These broadcast messages are transmitted immediately on receipt, and afterwards at definite periods of six hours until cancelled, the message being preceded by the danger call (TTT) sent ten times on full power and repeated after an interval of ten minutes. If a "watcher" is on duty in a ship, the ten minutes' interval allows time for an operator to be called to the instruments for reading the message, as a "watcher" is not required to read the Morse code, but must be able to recognise the TTT signal as well, of course, as the SOS.

Valentia and Malin Head stations are also used on the 600 metres wave for broadcasting weather messages at definite times, and all the stations are prepared at any time to furnish a ship with a local weather report at a charge of five shillings.



British coast and land stations engaged in communication with ships at sea.

SOS Service.

These navigational and weather broadcasts, though of great importance, are not so vitally important as the distress service which takes precedence over everything, nothing whatever being allowed to interfere with it.

British Coast Stations.—

As soon as an SOS signal is received, the station which is best placed for dealing with it takes control, and elaborate arrangements are made for reporting immediately from the controlling station to all concerned on shore and at sea the details signalled from ships in distress. Not one serious complaint has ever been received since this service was organised some fifteen years ago. In bad spells of weather, the number of cases of distress dealt with is considerable; for instance, in one period of three weeks this last winter twenty-seven cases were handled by our coast stations.

Staff.

The staff at a coast station consists of an officer in charge and eight or nine operators, so that two operators at least are always on duty, one on wireless watch and one on the land line, the latter being also available for the general running of the station's plant. At the Land's End station additional operators are employed for the watch on the 800 metres wave.

D.F. Service.

Directional receiving apparatus is installed at Niton and Cullercoats, as well as at the naval stations at the Lizard and Flamborough, for the purpose of giving ships their bearings from these stations, a charge of five shillings being made for each bearing given. Niton, Cullercoats and Flamborough work bearings on 600 metres, the Lizard on 800 metres.

Except in cases of fog, ships do not make much use of the directional facilities, but it must be remembered that many ships are now themselves fitted with directional receivers by which they can obtain a bearing from any transmitting station, though bearings obtained in this manner are not so reliable as those obtained from a direction-finding coast station.

The establishment of further D.F. coast stations is under consideration, and it has been decided to erect one shortly at the entrance to the Bristol Channel.

The installation of beacon stations at various points on our coasts is also being considered, and an experimental beacon using a 1,000 metres wave has been in operation for several months at Nash Point in the Bristol Channel.

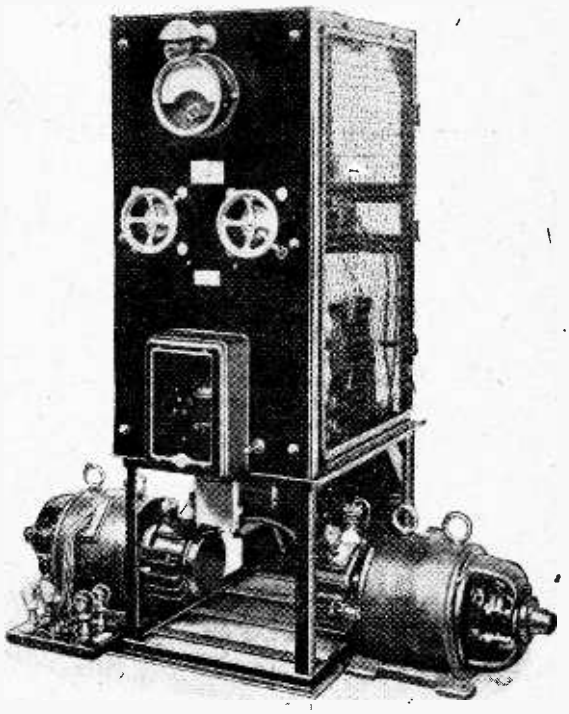
C.W. Stations.

Besides this system of spark stations which, as we have seen, has been set up primarily to assist in furthering the safety of life at sea, there is another Post Office ship and shore station at Devizes which has been established for commercial traffic to large ships.

This station is fitted with a 6 kw. valve transmitter, and works traffic at the same charges as are made for the spark service on a 2,100 metres wave up to a distance of about 1,500 miles with ships fitted with continuous wave apparatus.

As this C.W. traffic has increased rapidly during the last few years, arrangements have recently been made to increase the capacity of the station by operating it from a receiving station at Burnham, near Weston-super-Mare, by which means it is now capable of sending and receiving simultaneously.

Radiotelegrams for ships fitted with C.W. receivers out of range of Devizes can be broadcast from the Post Office 250 Kw arc station at Leafield at definite times at a charge of 1s. 6d. a word. These telegrams are broadcast at night only, and can be received up to about 3,000 miles.

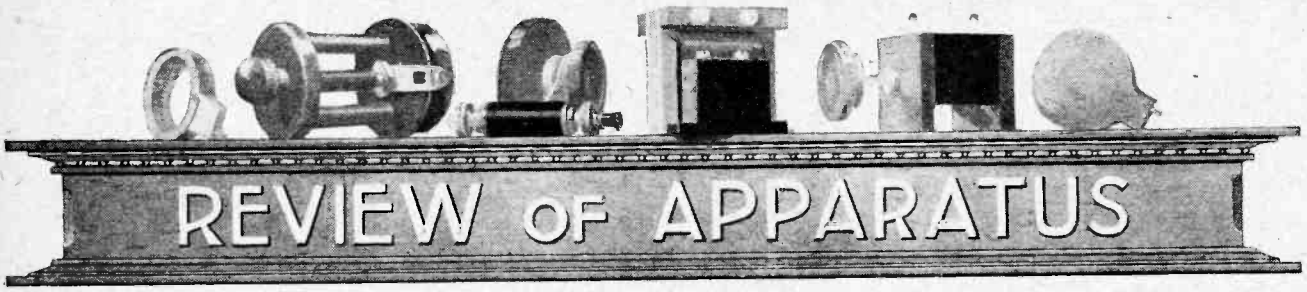


Spark transmitter used in British coast stations. The motor alternator and rotary spark gap are duplicated to minimise the possibility of a complete breakdown.

Press messages for ships are also broadcast nightly from the Leafield station, which is operated from the General Post Office in London.

WIRELESS IN HOSPITALS.

THE Advisory Council of the *Daily News* Wireless for Hospitals Fund has issued a general specification of the apparatus to be supplied for installation in hospitals to enable patients to listen on headphones. The specification has been drawn up by Capt. P. P. Eckersley, Dr. W. H. Eccles, and Mr. B. F. Crosfield, with the object of indicating the type of apparatus necessary to obtain good results without binding manufacturers to a rigid specification. The receiver may be of any standard type employing 1 H.F. magnification, detector and 1 L.F. valve. The Multiphone low-frequency amplifier, an attachment to the standard receiving set, is of special design to accommodate the large number of headphones which may be in use at the same time, the general principle being to parallel 100 pairs of 'phones to each separate output valve, the output of the transformers being designed to match the impedance of these 100 'phones. The use of loud-speakers in parallel, which tends to upset these conditions and reduce the efficiency of the headphones, is discouraged.



Latest Products of the Manufacturers.

LAMPLUGH'S NEW INSTRUMENT DIAL.

Messrs. S. A. Lamplugh, Ltd., King's Road, Tyseley, Birmingham, are rapidly extending their range of component parts, and a recent addition is an instrument dial of attractive appearance. It is a moulded dial of particularly clean finish with a large diameter milled edge which in operation facilitates obtaining a critical adjustment. The scale is divided into 180°, and the numbers appear on the flat face of the dial instead of the bevelled edge, giving an improved appearance. The centre hole is bushed, and two types of dials are obtainable, one of which is a 2 B.A. thread, and the other a plain hole for securing to a shaft by means of a grub screw. Looking into the threaded hole, the slotted head of a screw can be seen which, engaging in the thread, is used to alter the depth of the hole, and by this means a good tight fit can be obtained on the threaded spindle with the dial taken up sufficiently far to give the necessary clearance to the face of the instrument panel.

The new Lamplugh Instrument Dial. It is 3in. in diameter and available in two types for fitting to threaded or plain spindles.

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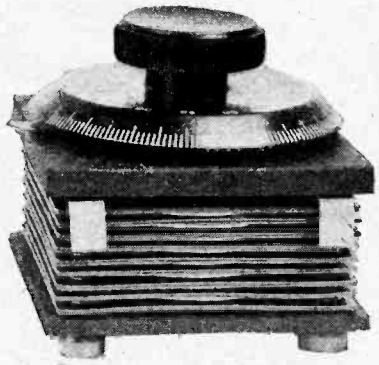
"ISLET" VARIABLE CONDENSER.

In this condenser, supplied by The Engineering Equipment Co., Sentinel House, Southampton Row, London, W.C.1, the fixed vanes are units consisting of a sheet of metal foil enclosed between two square sheets of insulating material. The sheets of insulation are held together at each corner by brass eyelets which act as spacing washers, and through which the securing bolts pass. The end plate, which carries a brass contact spring for the centre spindle, is held in position by knurled nuts so that it may be easily removed and the capacity of the condenser reduced by removing some of the fixed vane units. A register hole is cut in both the fixed and moving vanes, through which a rod may be passed when assembling the condenser.



"Islet" variable condenser with insulated vanes.

The condenser is certainly ingenious, and should be valuable in H.T. circuits where it is imperative that the vanes should not become short-circuited through dust or actual contact. Dielectric losses in the insulation protecting the fixed vanes, which might give trouble on very short wavelengths, are not likely to cause practical difficulties on the broadcast band of wavelengths.

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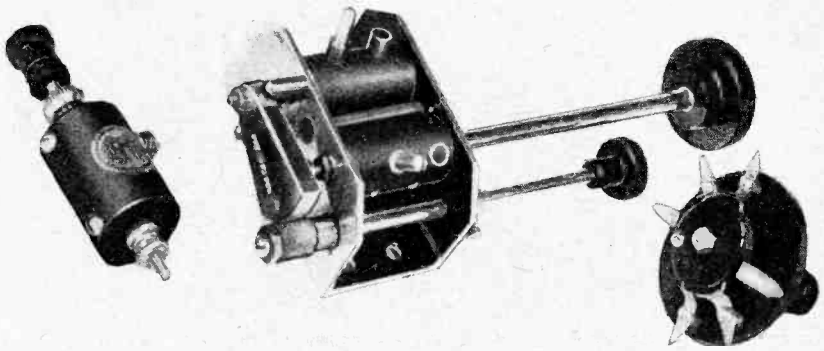
W.L. PRODUCTS.

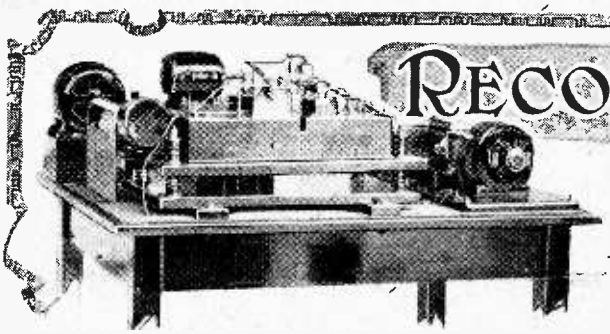
The coil holder manufactured by the Western Laboratories, Ltd., 11, Hanbury Road, Acton, London, W.3, is of very sound construction and includes an ingenious method of obtaining fine control over the coupling.

The body of the component consists of a rigid aluminium casting, machined and polished to give a pleasing appearance. Both coil holders are mounted in bearings in the end plates of the casting, and are capable of rotation. The spindle of one of the holders is extended and fitted with a large knob giving direct adjustment, by means of which the approximate coupling can be easily set. Final adjustment is obtained through a smaller control rod extending to the back of the casting and carrying at its extremity a rubber roller. This roller engages with an aluminium segment bolted to the spindle of the second coil holder, and gives a fine control over the movement of the second coil.

Other components manufactured by this firm include a rotary type change-over switch and a neutrodyne condenser of neat design. Both these components are fitted with "one-hole fixing" bushes.



Neutrodyne condenser, two-coil holder, and rotary switch, from the W.L.L. range of products.



RECORDING WIRELESS SIGNALS

PART II.

Operation of Typical Circuits.

By N. W. McLACHLAN, D.Sc., M.I.E.E., F.Inst.P.

(*Continued from page 145 of July 29th issue.*)

A VARIETY of recorders have been invented. The mode of operation is based on electro-magnetic, electrostatic, electro-pneumatic and electro-photographic principles. The only form which has proved of commercial value is the first named, *i.e.*, electromagnetic. There are a number of different forms of electromagnetic instruments, but the one which is most likely to come within the monetary purview of the amateur is that in which an iron armature is poised above a couple of iron cored solenoids and held in place on a pivoted arm by a spiral spring. This type, although stolid, is mechanically strong and can be put beyond the realms of scientific toys—an apt designation for some of the flimsy appliances sometimes seen for sale. The marking from this class of instrument is of a pure dot-and-dash nature. Although this marking is eminently satisfactory in the absence of interference and atmospherics, *i.e.*, when the signals are clean and clear cut, it is absolutely useless where these items abound. In general, we may say that they are in evidence in any commercial system of radio communication, and steps must therefore be taken to deal with them. Apart from the special design of receiving circuit necessitated in a commercial system, the marking on the paper slip must be a continuous line of rectangular profile. The reason for this is quite simple. From the tape of Fig. 7 E, page 393 of the issue of April 29th, it is clear that when an atmospheric impulses the aerial so that the current through the recorder is thereby sufficiently *decreased*, the writing arm or ink wheel falls back to the base line. With an instrument giving a continuous line, it is easily seen by inspection whether the vertical stroke is part of a Morse character or merely the superposition of an atmospheric. But with an inker, the wheel comes off the paper, and interrupts the record. In this way a dot may be missed or a dash split into dots, thus rendering the tape illegible.

Practical Points Concerning Inkers.

Where slow speed reception is concerned the adjustments of relay and inker are relatively simple and uncritical. As the speed increases so also does the difficulty, unless proper precautions are taken. Prior to conducting experiments, the inker ought to be thoroughly overhauled and cleaned to eliminate dirt from the bearings and toothed wheels, etc. The rubbing parts of the instrument can then be well oiled with clock oil. The inking wheel should be nicely cleaned and trued up in a lathe. Its rim has preferably a narrow slightly rounded edge to give fine clear marking. Thick marking can be secured by increasing the width of the edge. For high speed reception it is essential that the ratio of working force to equivalent mass of moving parts should be large.[1] Moreover, it may be possible to reduce the masses of the moving parts by paring down and using aluminium for the movable lever. Also a lighter iron armature may be advantageous, whilst a laminated one (the laminations being parallel with the lines of force and arranged to introduce no air gaps in the circuit) might assist in causing a rapid decay of the magnetisation when the current in the coils is interrupted. These, however, are points on which the reader can perform experiments for himself. In adjusting the inker, the movement of the armature should be small, and it ought to be a mil or so clear of the pole pieces when the lever rests on the spacing stop. In this position the armature should be symmetrically situated with respect to both north and south pole faces. The pull-off spring may require renewal if it is rusty. The tension should be adjusted to about half the magnetic pull between armature and pole pieces when the steady working current passes through the coils. It will usually be found that for high speeds the paper moves so slowly that the Morse characters are cramped. This condition can be alleviated to an extent by reducing the governor vanes or the gearing, but care must be exercised to avoid "hunting" due to improper governor control. As an alternative, a small motor with worm reducing gear and suitable paper pulleys can be used to pull the paper, but this method is cumbersome and adds to the already large expanse of gear. The pull-off spring will probably be unsuited for high speeds. It should be replaced by a shorter, stiffer spring of fairly high natural frequency, so that it does not interfere with the action of the armature.

When adjusting the gear, start with the recorder valve and set it with a grid bias so that the anode current is negligible. Adjust the relay to have a certain amount of bias, then take the 'phones and see that the signals are clear and regular at the detector.

Now adjust the relay on the usual series of dots, which precedes the insertion of tape to the Wheatstone transmitter at the distant station, until the sound is quite regular. The duration of contact on each stop will then be equal, giving equal marking and spacing. Switch the inker into circuit and adjust the stops and possibly the pull-off spring, until, with a small movement of the ink-

[1] Strictly speaking the ratio $\frac{\text{Working Torque}}{\text{Moment of Inertia}}$

Recording Wireless Signals.—

wheel, the marking is regular. In general, both relay and inker will require adjustment if the speed of sending is increased. For example, to cope with lag due to inductive effect in the inker, the relay bias may have to be towards the marking stop, and the inker pull-off spring may need slackening. This can be done most readily when dots are being sent from the transmitter. As the experimenter gradually gains experience with the apparatus, the adjustments become simple and are done instinctively. The inker and relay adjustments, even with high speed Morse, are often accomplished by the aid of one's aural propensities for rhythm. It will usually be found that adjustments for the highest speed of sending are satisfactory for lower speeds.

Recording Circuits.

In Fig. 1 on page 141 of the July 29th issue is indicated the layout of a simple recording circuit. The signals (of beat frequency 1,500 cycles or so) are applied to a power valve adjusted to its lower rectifying point on the anode current—grid voltage characteristic. The result is a pulse of current in the anode circuit each alternate half-cycle. Owing to the curvature of the valve characteristic, the wave form of the half-cycle of anode current differs from the voltage wave form applied to the grid of the valve. The difference is most marked when a large negative voltage

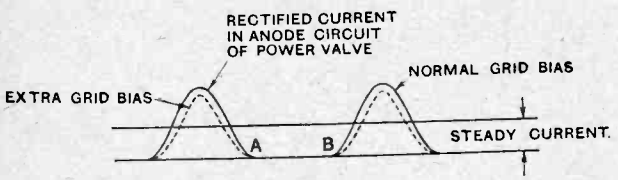


Fig. 6.—Diagram illustrating pulses of current in anode circuit of power valve. These pulses can be resolved into a steady current (through the relay) and a family of a.c. components. From A to B the a.c. components are vectorially equal and opposite to the steady currents.

bias is applied to the grid of the rectifier. This is depicted by the dotted curve of Fig. 6. Under normal conditions during a dash or a dot, we may assume for simplicity that a steady sine wave of beat frequency is applied to the grid of the rectifier or power valve. The anode current will then take a form of the nature illustrated in Fig. 6. This is a regular and recurrent series of impulses, and can be analysed by the aid of Fourier's Theorem into a steady current accompanied by a fundamental tone of beat frequency plus a string of integral harmonics of double, triple, quadruple frequency, etc.

The wave form of the anode current governs the relative amplitudes and initial phases of the harmonics. Now consider the impedance of the anode circuit of the power valve containing the relay alone. The latter has a large inductive impedance, which tends to suppress the alternating currents, especially the higher audio-frequencies. The net effect is to reduce the amplitudes of these alternating currents. From Fig. 6 we see that the vector sum of the steady and alternating currents from A to B, *i.e.*, every half-cycle, is zero. Thus if the a.c. components are reduced by the impedance of the relay, the steady current to balance this must also be reduced. Hence to augment the d.c. component, it is essential to reduce the impedance of the relay. The mode of achieving this condition has already been described, and consists in shunting the relay with a telegraph condenser of suitable capacity. Then the relay takes the d.c. and the condenser the a.c. component. The direct current is then limited by the combined resistance of the valve and the relay winding.

A.C.—D.C. Converter Circuits.

Without entering into details, it may be said that, wherever possible, the beat tone should be excluded from the relay. To accomplish this it is customary to use an alternating current—direct current converter unit, *i.e.*, a smoothing arrangement. Such a circuit is portrayed in Fig. 7. In addition to reducing a.c. through the relay, the magnification of the incoming signals is enhanced by the extra valve. The power valve is replaced by some suitable rectifying valve in whose anode circuit is situated a resistance of the order of 10^5 to 2.5×10^5 ohms, and for this purpose a grid leak will serve. Across this is shunted a condenser of from 0.01 to 0.03 mfd. which serves to smooth out the a.c. voltage component on the resistance. From the anode end of this resistance a battery is connected to the grid of the power valve to supply the requisite negative bias. The conditions to be fulfilled are (1) that during idle periods or spacing the anode current is adequate to hold the relay over on the spacing stop; (2) during signalling the anode current is reduced to zero, so that the relay falls back on the marking stop. Under these circumstances the relay connections must be reversed, since the circuit operates on a falling and not on a rising current. If the relay bias is altered by means of the adjusting screw, the connections need not be reversed, but it will be necessary to change over the marking and spacing connections to the inker. The question of grid bias is one which merits attention, since the voltage is of the same order as that of the H.T. Consider the rectifying valve V_2 of Fig. 7 during an idle period. Its impedance is extremely high, and many times that of the shunted resistance. Thus practically the whole of the H.T. voltage drop is across the valve, whilst there is little drop across the resistance. The drop across the latter is RI, and since I is almost zero, the drop is negligible in comparison with that across the valve. Hence the points A and B are almost at the same potential, *i.e.*, that of the positive end of the H.T. battery. This means that, in the absence of grid bias on the power valve, the grid potential is 120 volts positive with reference to the filament, 120 being the H.T. voltage. It will, therefore, be clear why the grid bias on the power valve is so large.

Another circuit which accomplishes the same result is sketched in Fig. 8. The only difference is the position of the resistance-condenser coupling between the last two valves. Here the resistance is inserted between the two filaments. The result is that the power valve is operated on a *rising* instead of a falling current, whilst the grid bias is very much smaller. Moreover, there is no anode feed to the power valve during idle periods. The only thing likely to be inconvenient is the provision of a separate filament battery for the valve V_2 owing to the potential separation occasioned by the coupling resistance. In

Recording Wireless Signals.—

general, it is advisable to work from common H.T. and filament batteries, and this can usually be accomplished provided there is an adequate supply of cells for grid bias.

Where the 110 or 220 volt mains are available, it is useful to employ this supply on the note magnifying and recording valves. The supply can also be used—after tapping and smoothing—on the H.F. amplifier. The appropriate circuits are given in a recent article on "Inter-

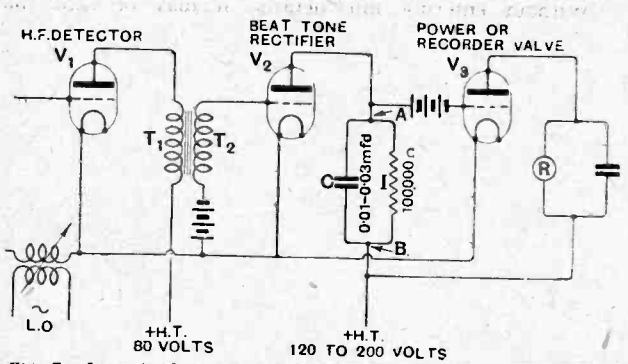


Fig. 7.—Layout of a.c.–d.c. Converter Circuit. A note amplifying valve may be inserted between the detector and the rectifier if required; or there may be a series of valve coupled note filters. During signalling the anode current of the power valve is suppressed. If another resistance coupled valve is interposed between V_2 and V_3, the anode current increases during signalling. This, however, involves a large grid bias battery.

ference."[1] Care must be taken that the smoothing system does not introduce oscillations or surges due to a large choke. In one case which came to my notice, it was necessary to cut out the choke and use a lamp of fairly high resistance to prevent surges of low frequency. These were very noticeable with a capacity-resistance amplifier used for broadcast reception. Incidentally, it may be mentioned that the note amplifiers do not need to be confined to transformer coupling, because resistance coupling will also serve, although more valves are needed. It has already been indicated that there should be an absence of grid current. Where the *power valve* is concerned, this is of little consequence, and with the strong signals needed for high-speed recording, grid current inevitably occurs.

Voltage of the H.T. Supply.

There are two points to which our attention may be directed, namely, the necessary high tension on the note magnifiers and recorder valve, and the signal strength or voltage change between the grid and filament of the latter. Quite a moderate H.T., say, 100 volts, will serve for clean, slow-speed signals, but where jamming and atmospherics are troublesome, this must be augmented to 150 or 200 volts, so that the grid bias can be increased to reduce grid current in the note magnifiers to a minimum. For speeds from 50 to 100 words per minute, the latter voltages are required to obtain a sufficient acceleration of the relay tongue, so that it travels quickly between the stops.

The necessary signal strength depends upon the speed of reception and upon the sensitivity of the relay. The condition to be secured is that the transit time or time taken for the tongue to travel from one stop to the other shall be small compared with the time the contacts are together. As an example, at 100 words per minute the duration of a dot or a space is about one-eightieth of a second. Thus the transit time should not be greater than one-third of this, *i.e.*, $\frac{1}{240}$ second. At 25 w.p.m. the respective quantities are one-twentieth and one-sixtieth of a second. Thus it will be clear why the signal strength must be augmented with the speed of reception. With regard to numerical values, the steady current through the relay should be about 2 m.a. for 25 w.p.m. (2,500 ohm model), and 8 m.a. for 100 w.p.m. Of course, with expert handling of the relay, smaller currents will serve. On the other hand, the larger currents will be found more satisfactory, since the settings are not so critical. These current values are to be measured by a d.c. meter in the anode circuit of the power valve on a long dash. During a succession of dots the values will be smaller—about half to two-thirds, according to the rectifier characteristic. Signal strength can also be considered by the voltage applied to the grid of the power valve. This can be tested approximately by setting the grid bias in the usual way for reception, and then finding the extra negative bias to prevent current flowing in the anode circuit of valve. On a long dash the product of current and resistance gives the mean value of the smoothed voltage applied to the power valve, provided there is no grid current. Knowing this voltage, which is fairly steady during the dash, it is only needed to shut off the H.F. and detector circuit, and shift the grid bias of the power valve forward (positively) by this amount to find the corresponding current through the relay. If the signals are strong enough to yield grid current the value of the resistance is not readily ascertained, owing to the variable leak between grid and filament. In practice, as stated above, this will often be found to occur at high speeds of reception.

There are recording circuits other than those previously mentioned, but we need not discuss them here. Circuits may be divided into two main classes: (1) Those in which

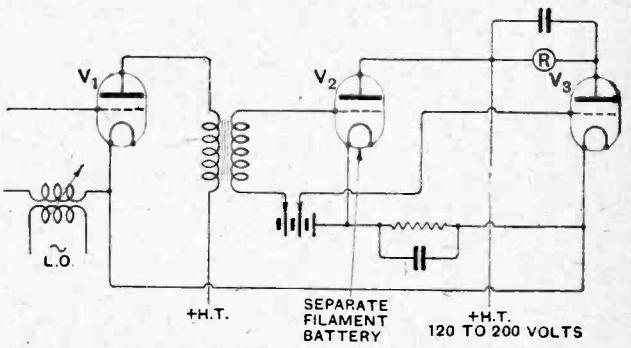


Fig. 8.—A.c.–d.c. Converter Unit, in which the anode current of V_3 increases during signalling. Valve V_2 requires a separate filament battery. A note filter or note magnifying valve and transformer may be inserted between V_1 and V_2 to secure extra amplification.

the current through the relay is obtained by some well-known straightforward method of amplification, (2) those in which the amplification is relatively small and the requisite current change is secured by an electrical trigger device. General experience points to class (1) being more reliable than class (2), since with a trigger circuit the

[1] *Wireless World*, February 25th, 1925, p. 80.

Recording Wireless Signals.—

setting of the circuits is rather critical and apt to be troublesome with variations in wavelength and signal strength. Then a trigger circuit has to be reset at the end of each Morse character, and this involves additional complications, although these are of minor consequence at low speeds of reception.

Atmospherics, Filter Circuits, and Rounded Signals.

For recording through atmospherics and jamming, the customary practice is to employ high- and low-frequency filter circuits. The influence of these is to alter the phases and attenuate the amplitudes of the audio modulation frequencies, so that the signal profile is no longer rectangular, but of a rounded nature. Moreover, the relay is rather tardy in operating, and in some cases will only reproduce clipped dashes, since the signal never reaches a sufficient amplitude to actuate the relay on dots. One might argue that an increase in signal strength would give the dots. This is so; but the relay would probably hold over on the marking stop if the dot were followed by a sequence of dashes. In order to get better recording conditions, it is essential to square up the signal profile. A simple way of accomplishing this is to increase the grid bias of the last rectifying valve in Figs. 7 and 8. The result is that the signals become much more recordable.

Recording Key Clicks.

On page 201 of the issue of this journal for March 18th we analysed the problem of key clicks and showed their origin. It may be of interest to some experimenters to make actual records of the clicks. Consider the circuit of Fig. 7 and assume that the local oscillator is extinguished. Each time the carrier wave of the transmitting station starts up at the initiation of a Morse character, the anode current of the rectifier V_1 will increase. The current will remain at its augmented value until the termination of the character. Now the sudden rise of current through the rectifier causes a voltage change on the primary of transformer T. This is accompanied by a change in voltage on the secondary, which is handed on in like manner to the grid of V_2. The result is a pulse of current through the relay. If the adjustment of relay and recorder are suitable, a short dot will be recorded on the paper slip, and this is actually the result of a key click. At the end of the Morse character the cessation of the anode current of V_1 sends a pulse through the system, but as the voltage on V_2 is now reversed, the result is a transient increase of (negative) grid bias, so that no current flows through the relay. Now if it should happen that the last statement is in conflict with practical results, the cause of a marking current is the outcome of the natural oscillation of the transformer, due to impulsing at the end of the character.

If the circuit is imbued with an adequate amount of electromagnetic inertia, the key clicks may not be so evident, and instead we may get full-blown Morse characters. I cannot vouch for this with certainty in a relay-inker system, but it is quite possible with the magnetic-drum circuits when slight alterations are made. The preceding argument leads to the interesting question, "Can Morse be Transformed?"

In order to assist in answering this question, the reader will be referred to page 202 of the March 18th issue of this journal. It was shown that a simple series of 50 dots per second was equivalent to modulation of the carrier wave by audio frequencies of 50, 150, 250, etc., cycles. It can also be shown that irregular transmission, *e.g.*, Morse, is equivalent to modulation by an infinite spectrum of frequencies, *i.e.*, from zero to infinity, whose numerical values are not correlated in the simple series 1, 3, 5, etc.

Recording Without a Local Oscillator.[1]

For simplicity let us confine our attention to the series of regular dots previously mentioned. Suppose we build a transformer to amplify audio frequencies substantially equally from 50 cycles upwards and use it instead of T_1, T_2, of Fig. 7 with the L.O. extinguished. This new transformer will then reproduce the audio frequencies 50, 150, etc., in their correct relative amplitudes, and should therefore reproduce the dots. In this reasoning one important link is missing, namely, the relative phases of the audio frequencies. The phases are altered by the transformer, and the effect is to cause distortion of the dots. The general result is that the dots are clipped. Coming now to the general problem of Morse, the phases are affected in such a manner as to clip both dots and dashes. In practice, however, by introducing a time lag electrically, it is possible virtually to transform the Morse signals, *i.e.*, to record by transformer coupling without the aid of a local oscillator. Also, if the H.F. rectifier is followed by a resistance-coupled amplifier (no condensers), recording can be done without a local oscillator. At the present time, however, this is of little interest in practical radio, because audibility of the signals is usually preferred.

[1] No note frequency is present, merely a series of radio-frequency currents. In the detector valve anode the result is a series of steady silent currents punctuated by spaces.

SCHOOLBOYS AND WIRELESS.

Liverpool Newspaper's Radio Competition.

[Photo: J. E. Marsh, Wallasey.

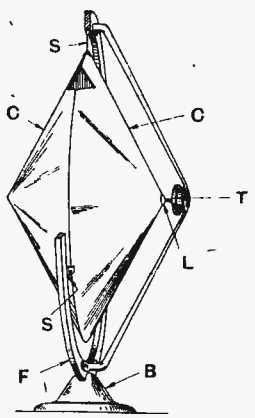
Prize winners in the recent Radio Competition organised by the "Liverpool Daily Post and Echo" photographed with their masters and classmates. The first and second prizes were respectively a pair of B.T.H. Headphones and a B.T.H. Crystal Receiver.

RECENT INVENTIONS

Brain Waves of the Wireless Engineer.

An Interesting Loud-speaker.
(No. 229,786.)

A rather interesting form of loud-speaker is described by the Western Electric Co., Ltd., in British Patent No. 229,786, which should provide some interesting subject matter for amateur experimental work. The accompanying illustration shows that the loud-speaker is of the hornless type, and the novelty of the invention lies essentially in the construction of a large conical diaphragm. The diaphragm is made in the form of a double cone C out of sheets of thin Bristol board. In order faithfully to reproduce the lower tones it is stated that the diameter of the cone should be from two to five or six times its height. A diameter of three feet and a height of ten inches is mentioned in the specification. Another feature of the invention lies in the manner of supporting the



The Western Electric double cone loud-speaker. (No. 229,786.)

diaphragm, which consists in supporting it preferably at three points by means of thin strips of light flexible material S, which are attached to a heavy circular frame F fixed to a base B in the usual manner. The diaphragm is energised by means of some form of telephone receiver T, which is connected to the apex of one of the cones by means of a link L. The specification also states that ordinary drawing paper may be used for the conical diaphragm.

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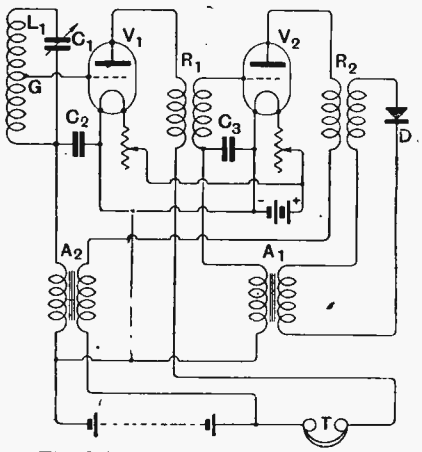
The Inverse Reflex Circuit.
(No. 225,579.)

A scheme generally known as the "Inverse Reflex System" is described by the Grimes Radio Company, Incorporated, and D. Grimes in British Patent No. 225,579. In the ordinary reflex circuit it is customary to employ a series of valves as high-frequency amplifiers, rectifying the output of the last valve by a crystal or valve detector, and to introduce the output of the rectifier to the



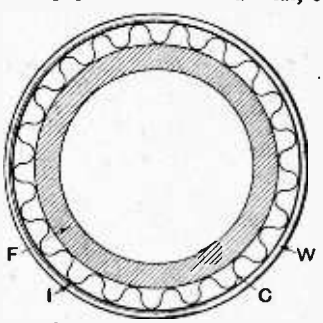
The Grimes "inverse reflex" circuit. (No. 225,579.)

grid circuit of the first valve. The low-frequency currents are then amplified by the series of valves in exactly the same order. In the arrangement shown in the accompanying diagram the last radio-frequency amplifier acts as the first audio-frequency amplifier. The advantages resulting from this arrangement, it is stated, lie in the equalisation of the load on each valve, and also a tendency for increased stability. Referring to the illustration it will be seen that a circuit L_1C_1 is tuned to the desired wavelength to be amplified. This circuit is connected across the input of the valve V_1. The grid connection is not taken across the whole of the coil, but at a point G. The object of this tapping is essentially to give a grid potential to the first valve which is consistent with stable operation. The valve V_1 is coupled to the valve V_2 by means of a radio-frequency transformer R_1, the secondary circuit of which is completed through a by-pass condenser C_3. A second radio-frequency transformer R_2 is included in the anode circuit of the second valve, and a crystal detector D is connected across the secondary winding. The crystal detector is connected across the primary winding of the first low-frequency transformer A_1. The secondary of this transformer is connected to the grid circuit of the second valve, *i.e.*, between the negative filament lead and the lower end of the secondary of the first radio-frequency transformer. It will be noticed that the anode circuit of the second valve also contains the primary of the second low-frequency transformer A_2. The secondary of this transformer is connected between the negative filament and the grid of the first valve by means of the H.F. input circuit. The telephones T, of course, are included in the anode circuit of the first valve, which in this case is the last audio-frequency amplifier. Readers who have not experimented with this type of reflex circuit will find that it is exceptionally easy to handle.

oooo

Spaced Coils.
(No. 232,704.)

A spaced coil is described in the above British Patent by J. Gray. Essentially the invention lies in spacing the layers of the coil by means of corrugated paper. Referring to the accompanying illustration, it will be seen that a cylindrical former F has placed round it a layer C of corrugated paper or similar material, over



Corrugated paper used to space the layers in a multi-layer coil. (No. 232,704.)

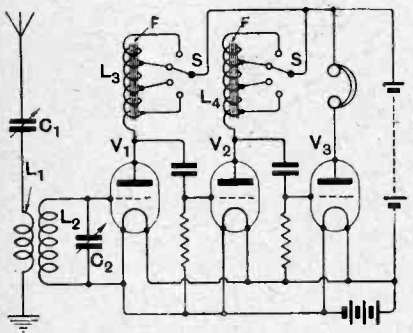
which is wrapped a layer of some insulating material I, which forms the surface on which the wire W is wound. The same procedure is carried out with successive layers. The object of the corrugations, of course, is to provide a large air space between the various layers of the coil. At the same time we should imagine that the somewhat larger amount of dielectric which is introduced into the field of the coil would give rise to considerable inefficiency, particularly on very short wavelengths. A fully air-spaced coil is preferable for short wavelengths, while a coil of the type described in this specification should prove quite efficient on longer waves, so far as self-capacity is concerned.

oooo

High Frequency Amplification.
(No. 210,440.)

British Patent No. 210,440, granted to L. Levy, gives details of a system of high

frequency amplification which should prove of interest to experimenters. The scheme is illustrated by the accompanying diagram, which shows an ordinary three-valve receiver employing two stages of high frequency amplification and one valve rectifier. The novelty of the invention lies in the manner in which the high frequency valves are coupled. It will be seen that an aerial circuit L_1, C_1, is coupled to a closed circuit L_2, C_2. The anode circuits of the valves V_1 and V_2 contain respectively two special chokes L_3 and L_4. The chokes are constructed by winding a number of turns of fine wire into grooves in a fibre or similar tube, tapping points being provided and taken to a selector switch S. A peculiar feature of the invention lies in providing these chokes with a movable iron core F, which is used for fine tuning purposes.



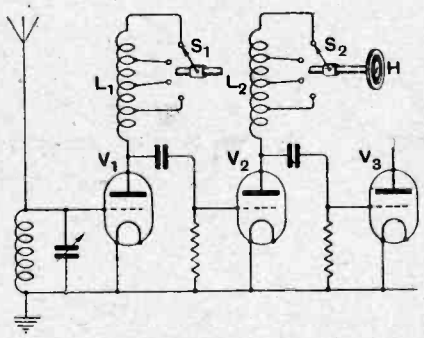
High-frequency amplification with variable iron cored chokes. (No. 210,449.)

The circuit appears to be particularly stable, which is a great advantage when using several stages of high frequency amplification.

oooo

A Single Control Tuning System. (No. 203,701.)

What we should have imagined was rather an obvious scheme is claimed in the above British Patent by The Dubilier Condenser Company (1921), Limited, and H. W. Houck. When it is desired to tune a number of high frequency circuits simultaneously it is customary to employ a multiple condenser, *i.e.*, one comprising a number of sets of movable plates mounted on the same shaft. A somewhat similar scheme is detailed in this specification, in which radio-frequency amplification is obtained by means of a number of tapped semi-aperiodic reactances connected in the anodes of the valves. Thus it will be seen that the valves V_1 and V_2 contain tapped inductances L_1 and L_2 provided with tappings connected to



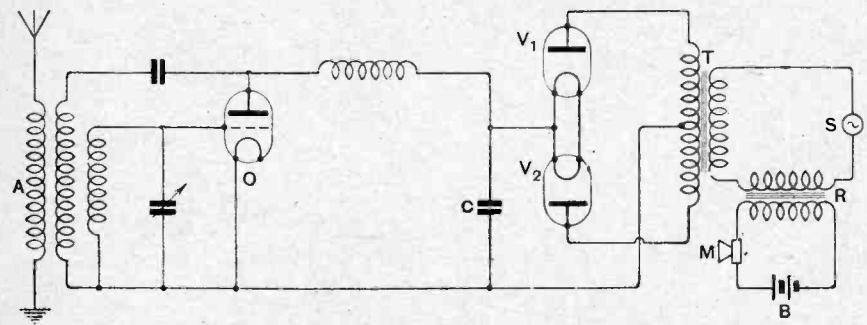
Multiple switch for H.F. anode-circuits. (No. 203,701.)

multiple switches S_1 and S_2. The switch arms are mounted on a common shaft provided with a handle H. It is interesting to note that some little difficulty is usually experienced in stabilising a circuit of this type unless the anode reactances are specially matched to suit the valves and other constants of the circuit.

oooo

A Modulation System. (No. 204,064.)

A rather interesting system of modulation is described in British Patent No. 204,064, by Dr. E. F. Huth and Dr. L. Kuhn. The invention really lies in modulating the anode supply of the main valve before the current is rectified. Referring to the illustration it will be seen that an ordinary valve oscillator O coupled to an aerial circuit A, is supplied with rectified current in the usual manner. The oscillator shown is an ordinary tuned grid circuit with shunt feed. The anode supply is obtained from a centre-tap step-up transformer T. The outers of the transformer go to the anodes of two rectifying valves, V_1 and V_2, the positive and negative poles of the supply being the filament of the two-electrode valves and the centre-tap of the transformer, which are shunted by a condenser C. This arrangement, of course, is quite normal. The transformer T, however, is supplied with alternating current from a source S which is of exceedingly high periodicity, at least of the order of 1,000 cycles, but preferably of 5,000 cycles. Owing to the very high frequency of this supply, and owing to the fact that the frequency of the ripple is, of course, doubled by the rectifier valves, the capacity of the condenser C need be but very small, as the ripple to be smoothed is comparatively of very high frequency, certainly well above any speech frequencies. Owing to this fact it is possible to modulate this supply in the primary circuit of the transformer T, and accordingly a microphone M and battery B are connected by a modulation transformer R in the primary circuit of the transformer T. Therefore, assuming that straight line rectification occurs, the direct current potential obtained from the rectifier will at any moment be proportional to the steady potential supply to the primary of the transformer T, plus or minus the instantaneous impressed speech voltage. Owing to the small size of the condenser C it will offer practically zero impedance to any voltage at speech frequency, and accordingly the speech voltages are impressed directly upon the anode of the oscillator valve, which modulates the output in a somewhat similar manner to the ordinary choke control system of modulation.

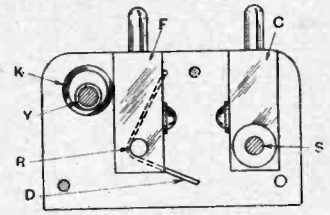


Telephone transmitter with modulated power input. (No. 204,064.)

oooo

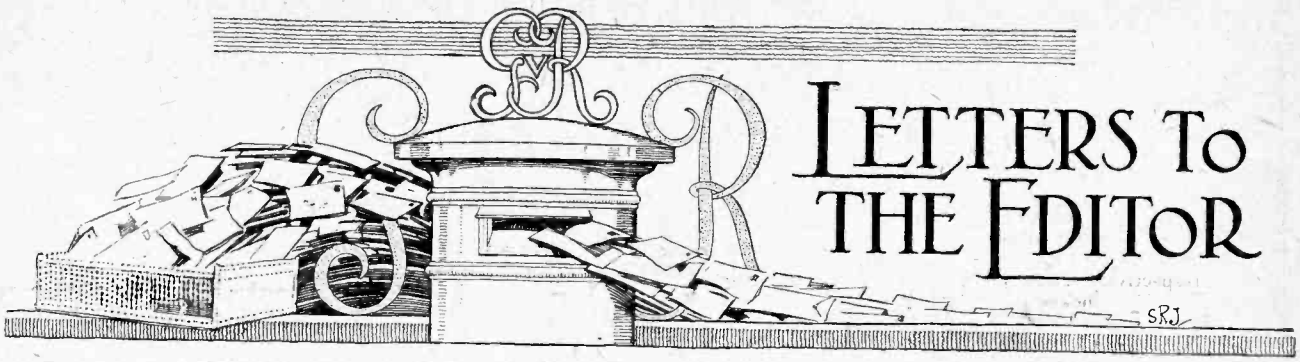
A Cam Controlled Coil Holder. (No. 231,251.)

A simple but efficient fine adjustment control for coil holders is described by A. P. Portway in British Patent No. 231,251. The arrangement, which is illustrated by the accompanying diagram,



Two-coil holder with cam adjustment. (No. 231,251.)

could no doubt be added to an existing type of coil holder without much trouble. It will be seen that both the coil plugs are capable of rotation. A coarse adjustment is obtained by the plug C, which is fixed to a shaft S provided with an extension handle and knob not shown. The other coil plug, F, is mounted on a rod R, and a spring D normally tends to keep the side of the plug against the cam K. The cam K is merely an eccentrically mounted cylinder on a rod Y, the rod being provided with a knob for the purpose of operation. Thus it will be seen that coarse adjustment can be obtained by a rapid movement of the coil plug C, while fine adjustment is obtained by moving the surface of the cam against the plug F. The spring D, of course, tends to prevent any undue movement. The specification describes other modifications on the same lines, including a worm gear.



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

Correspondence should be addressed to the Editor, "The Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

WIRELESS FOR HOSPITALS.

Sir,—As Chairman of the Advisory Council of this Fund, please allow me in your columns to give public thanks to the many radio manufacturers whose generous gifts are helping to equip the London hospitals.

Within three weeks of the appeal made by the *Daily News* gifts of over £8,000 in value had been made by the Industry, and this generous gift has enabled us to equip nearly half the number of beds in the voluntary hospitals.

We want to give every patient the companionable headphone to help lessen their sufferings and to give them a happy issue out of all their afflictions. KNUTSFORD.

19-22, Bouverie St., London, E.C.4.

AMATEUR SHORT WAVE TESTS.

Sir,—I am writing to tell you that, commencing October 1st at 7 p.m. Greenwich Mean Time, I am starting transmission C.W. on 23 metres with an input of 25 watts.

The call-sign used will be G2OC and the transmission will continue until 7.15 p.m. G.M.T. It will be resumed at 7.30 p.m. G.M.T., and will last until 7.45 p.m. G.M.T.

On the afternoon of October 3rd, tests will commence at 3 p.m. G.M.T. and will continue until 5 p.m.

As I am particularly anxious to carry out a series of tests with amateurs in other countries, might I ask that you would be good enough to give publicity to the above data and request that any stations wishing to reply should do so as near to 25 metres C.W. as possible at any time they like immediately after each transmission. Failing any ability to reply by wireless, I would welcome any reports which they might be pleased to send in. D. SINCLAIR.

Morven, Shepperton-on-Thames.

DANGERS OF CARBON TETRACHLORIDE.

Sir,—In the issue of your valuable journal for August 5th, under the heading of "Readers' Ideas," there appears a short note on the cleaning of ebonite, using carbon tetrachloride.

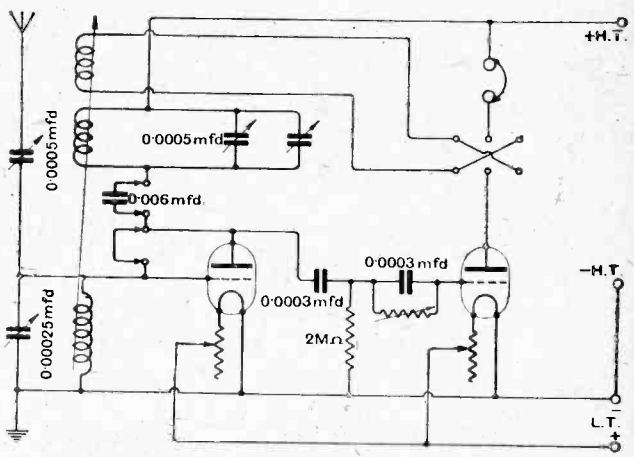
I think I ought to point out that, whilst the reagent is a very efficient one, the operation should be carried out in the open air, or at least in a very well ventilated room, and not in an enclosed space such as a small workshop. The reason is that the vapour of carbon tetrachloride is poisonous, and people with any heart afflictions are particularly susceptible to its action. You may remember that it was employed for a time in the substances used for "dry shampoos," but that several fatal accidents caused the use to be discontinued. The substance is well-known as a fire-extinguisher, but most makers issue warnings as to its use in confined spaces.

London, W.C.2 ERNEST W. YEOMAN, M.Sc., F.I.C.

AN INTERESTING CIRCUIT MODIFICATION.

Sir,—Referring to the letter from Mr. C. B. Grindrod, in your issue of July 22nd, I tried his circuit, and I agree with his claims, as the circuit is very stable, and, in my opinion, more selective than the ordinary "aerial reaction" circuit. In fact, this circuit appears to have all the advantages of a high-frequency valve plus detector, without the expense of using two valves.

My standard set is the tuned anode plus detector and usual L.F. valves. The plate of the first valve is disconnected from the anode coil and condenser, each of these connections being taken to two valve legs screwed into the panel. A plug is then made to fit the two valve legs to short them when it is desired to use the first valve. If only the detector is required, the plug is withdrawn and plugged from grid to plate in the first valve holder; for the sake of clearness in the diagram separate sockets are shown connected to the grid and plate sockets in the valve holder. The grid connection is thus connected *via* the plug from the aerial coil, through the grid condenser direct to the grid of the second valve, and if the aerial, reaction and anode coils are arranged in a 3-coil holder, one may use either H.F. or plain aerial reaction.



Two-valve receiver with tuned anode coupling modified to give the circuit suggested by Mr. Grindrod.

All, therefore, that is required to alter an ordinary set as above to Mr. Grindrod's circuit is to mount a 0.006 condenser on a two-pin plug to plug into the sockets between the plate and the anode coil, putting the other plug into the valve holder.

In experimenting, I found by using a 50 coil as A.T.I. and a 75 as coil B, that if one changed these coils about, the tuning condenser did not require altering for a given station. I use a 0.0005 mfd. condenser in series with the aerial, a 0.00025 mfd. across the A.T.I., and a 0.00025 mfd. across the anode coil, plus a two-plate vernier in parallel with the latter.

I have been able to tune in stations like Bournemouth, Sheffield, Liverpool, Hull, Glasgow, Petit Parisien in daylight much easier and with less interference than with any previous circuit, and from my little experience of about 10 days with this circuit I may say I am highly satisfied with it, with either one or more valves. ARNOLD JOWETT.

Halifax.

Readers Problems

Readers Desiring to Consult "The Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

A Peculiar Fault.

A READER recently constructed a superheterodyne receiver embodying six valves, and at first, when tested with ordinary bright valves it gave excellent results, but the size of accumulator necessary to operate the instrument for any length of time made the question of employing dull emitters very prominent. It was decided to use the D.E.R. type of valve, which, being rated at 1.8 volts 0.35 amp., is suitable for use with a two-volt accumulator. These valves were tried, but disappointing results were obtained, and our reader eventually communicated with us with regard to the matter, he expressing doubt whether this type of valve was altogether suitable for incorporation into a superheterodyne receiver, since when tested individually in a two-valve receiver using the same accumulator their performance was all that could be desired.

The reason for this trouble is not very far to seek. Whatever type of valve is employed in a receiver, it must always be borne in mind that the filament current should never under ordinary circumstances be allowed to drop below the makers' specifications, in this case 0.35 amp. per valve. If we employ one D.E.R. valve in a receiver in conjunction with a two-volt accumulator, a very simple calculation will show that the resistance in the external circuit must not exceed 0.5 ohm if we are to maintain a current of 0.35 amp. Similarly, if two valves are used in parallel the limit of external resistance to maintain the 0.7 amp. required by two such valves is 0.25 ohm. The maximum permissible external resistances for receivers employing more than two valves is as follows:—3 valves, 0.17 ohm; 4 valves, 0.12 ohm; 5 valves, 0.1 ohm; 6 valves, 0.08 ohm.

Thus it will be seen that in the case of a six-valve receiver the maximum external resistance must not exceed 0.08 ohm, and therefore if even one half-turn of a filament resistance is left in circuit it is fatal to good results. But apart from this it is necessary to take into consideration the external resistance of the usual flexible wire used for connection purposes, and in the case of a three- or four-valve set good results may be obtained by standing the accumulator quite close to the receiver and using the very thick "flex" such as is used for electric heaters, instead of the ordinary lighting "flex" usually employed, whilst any filament resistances that may be in the receiver should be either removed or short-circuited. In the case of six valves, however, a 4-volt accumulator should be resorted to, but even in this case the total external resistance must not exceed 1 ohm.

oooo

An Economical Loud-speaker Circuit for High-quality Reproduction.

A READER wishes for a circuit in which it is possible to receive one or two of the main broadcasting stations in addition to the high-power station at good volume on the loud-speaker, using three valves only, whilst at the same time high quality is desired.

We give in Fig. 1 a receiver suitable for this purpose. Sensitivity is provided for by making use of the conventional regenerative detector circuit, whilst a good step up in signal strength between the first and second valves is assured by the use of transformer coupling, and at the same time good quality of reproduction is assured by using a transformer having a large number of turns on the primary, which usually necessitates that this transformer be of low ratio.

The system of coupling between the second and third valves can be rapidly changed from choke to resistance by means of a simple single-pole switch, whilst the use of separate wander plugs will facilitate the increase of H.T. voltage necessary when changing from choke to resistance coupling. This receiver should be capable of bringing in quite a number of stations on the loud-speaker with most excellent quality, provided that a reasonably efficient aerial and earth system is used.

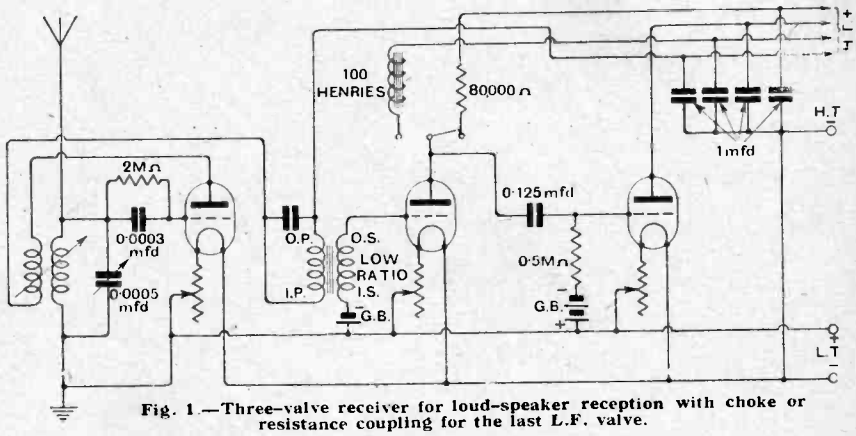


Fig. 1.—Three-valve receiver for loud-speaker reception with choke or resistance coupling for the last L.F. valve.

oooo

Methods of Using a Milliammeter.

A CORRESPONDENT who has recently become possessed of a milliammeter is uncertain of the precise manner in which this instrument should be used in determining whether the final valve of his receiver is operating on the correct portion of its characteristic curve.

Assuming that the valve is adjusted correctly, the milliammeter should give a steady reading indicative of the *mean* anode current flowing in the plate circuit of the valve, since although this value varies from normal in accordance with the superimposed modulation, its average value is constant. Should the valve be incorrectly adjusted or should it be overloaded, thus causing the operating point to be carried off the straight portion of curve, rectification of the L.F. impulses at once occur, and a change in the mean plate current will take place, this being indicated by "kicking" of the milliammeter needle. If, therefore, the needle "kicks," the grid battery should first be adjusted, and if this does not remedy matters the H.T. voltage should be increased and a fresh adjustment of the grid battery made. If this fails to steady the needle, and assuming that H.T. and G.B. batteries are not run down, and that the filament is heated at its rated value, the trouble will undoubtedly be due to overloading the valve, and the only remedy is either to use a valve capable of handling larger power, or to reduce the input to the amplifier.

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NEW B.B.C. WAVELENGTHS.

THE Conference of engineer representatives of European broadcasting organisations, which met recently in Geneva, is already producing results which will have a far-reaching effect upon the progress of broadcasting throughout Europe.

We mentioned at the time of the Conference that the most pressing work in hand for the Geneva Broadcasting Bureau was the allocation of wavelengths in Europe. Already it has been announced that the re-allocation of wavelengths will necessitate a change in the wavelengths of most of the British stations, and these changes will be tested out on the following nights, viz., August 31st, September 2nd, 4th, 7th, 9th, and 14th, and in each case between 11 p.m. and 1 a.m. (Greenwich Mean Time), the equivalent for this country being midnight to 2 a.m. (Summer Time). The list of new wavelengths is published elsewhere in this issue. In most cases the wavelength change is small, and many listeners will probably not notice that any change has taken place unless they are accustomed to checking the settings of their tuning dials very carefully.

The changes are, however, none the less significant, for a departure has been made from the consideration of the tuning of stations in terms of "wavelength" to "frequency," and as far as the broadcasting engineers are concerned wavelengths will become a thing of the past.

The shifting of wavelengths will apply to practically all European stations, and not only to those of this country. Definite bands of wavelengths were decided upon at the Geneva Conference for each country, for existing stations, and to accommodate future stations to be erected.

The National Physical Laboratory has undertaken the work of checking the changes in wavelength to ensure that each station is definitely on the allotted wavelength. It is extremely satisfactory to learn that this step is being taken, and it is to be hoped that from that date onwards there will no longer be any uncertainty as to the exact wavelengths of the stations in Europe. Unfortunately, it has not been possible hitherto to depend upon the published wavelengths of the B.B.C. stations. This deviation from the stated wavelength was often unavoidable on the part of the B.B.C., and was done in order to get away from interference from some station on the Continent transmitting too near the same wavelength. The effect of the Geneva Conference decisions should be to remedy this state of affairs permanently, since each broadcasting interest agreed to make no further alterations in wavelengths except in agreement with the Geneva Bureau.

We feel constrained to criticise the action of the B.B.C. in publishing these new values in "wavelength," because the occasion provides such an obvious opportunity for introducing the more satisfactory as well as more scientific measure of "frequency." It only requires that the B.B.C. should adopt the habit of speaking and writing of wavelengths in terms of frequency for the public to assimilate the new designation. It is not now too late for the B.B.C. to rise to the occasion.

CONTENTS.

How to Construct a Second Harmonic Set.

By H. F. SMITH.

MANY prospective constructors of the superheterodyne type of receiver are deterred by the large initial cost and considerable maintenance expenses of the usual seven-, eight-, or even nine-valve set. While it is not suggested that the receiver to be described is the equal of these more ambitious instruments, the writer can assert with every confidence that, judged on a combined basis of selectivity, range, and simplicity of operation, it gives better results than any of the more conventional arrangements of the same number of valves, and that the well-known advantages of the superheterodyne are obtained—some, perhaps, to a slightly less degree.

Second Harmonic Oscillator.

The circuit diagram is given in Fig. 1. The first valve functions as oscillator and detector combined, on the harmonic principle already described at some length in this journal.[1] Oscillations are set up in the circuit L_3 C_2, which is tuned to a wavelength either a little more or less than twice that of the signal to be received. The second harmonic, at half the fundamental wavelength of this circuit, combines with the incoming oscillations, and, providing the tuning is correct, a beat frequency corresponding to the frequency of the long-wave amplifier (in this case about 5,000 metres) is set up and amplified by the succeeding valves.

[1] W. James, *The Wireless World*, May 6th, 1925.

Arrangement of the Circuit

The aerial circuit is untuned, and fairly loosely coupled by L_1 to the grid circuit coil L_2, as it has been found in practice that low aerial damping is essential to the easy and stable operation of this type of set. Losses in the aerial and grid coils should be kept as low as possible, as there is no direct reaction on them to offset the bad effects. "Bottom bend" rectification is adopted in place of the more usual leaky grid condenser method, as it seems to make for quieter operation. The grid is biased to 1½ volts negative by a small single dry cell, GB_1.

The input to the intermediate frequency (or long-wave) amplifier is made by means of a tuned anode rejector circuit, L_5C_5, the differences of potential being applied to the grid of the second valve through a fixed condenser, C_3. With the small number of valves at our disposal, it is necessary to avoid waste of energy as far as possible, and, contrary to the usual superheterodyne practice, provision is made for the accurate tuning of the inter-valve coupling transformer L_7 L_8 by the variable condenser C_6.

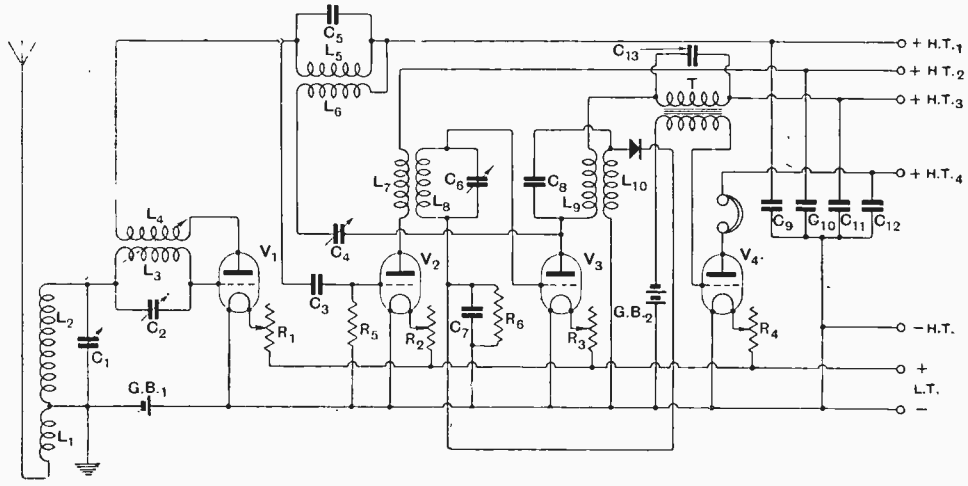


Fig. 1.—Theoretical connections of the receiver. The components have the following values: $C_1 = C_2 = 0.0003$ mfd., with vernier; $C_3 = 0.0003$ mfd.; $C_4 = 0.0002$ with vernier; $C_5 = C_7 = C_{13} = 0.001$ mfd.; $C_8 = 0.0003$ mfd.; $C_9 = C_{10} = C_{11} = C_{12} = 1$ mfd.; $R_5 = 1$ megohm; $R_6 = 0.25$ megohm; $GB_1 = 1\frac{1}{2}$ volts; $GB_2 = 4\frac{1}{2}$ volts.

A Reflex Stage.

The third valve functions in a dual capacity, amplifying the intermediate frequency and also the rectified pulses from the crystal

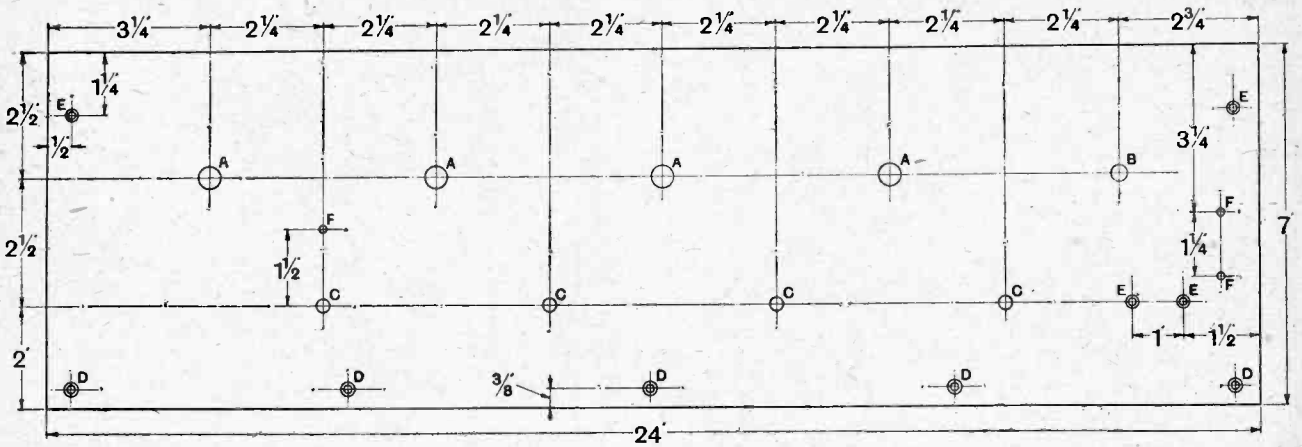


Fig. 2.—Details of the ebonite front panel. A = 7/16in. dia.; B = 5/16in. dia.; C = 1/4in. dia.; D = 11/64in. and countersunk; E = 5/32in. and countersunk; F = 5/32in. dia.

detector, which are fed back to it by a resistance coupling. The fixed condenser shunting this resistance should be of somewhat higher capacity than is usual in reflex circuits, to provide a fairly low-impedance path for the long wavelength currents being dealt with. The crystal is coupled to the anode circuit of the valve by the untuned transformer L_9L_{10} and fixed

accurately and easily controlled by varying the condenser, and the system has in this case certain advantages over the more usual method of applying direct magnetic regeneration. Incidentally, it may be remarked that when the intermediate frequency amplifier is just off the oscillation point, its tuning is sharpened up considerably, and a certain amount of distortion will be noticed, due prob-

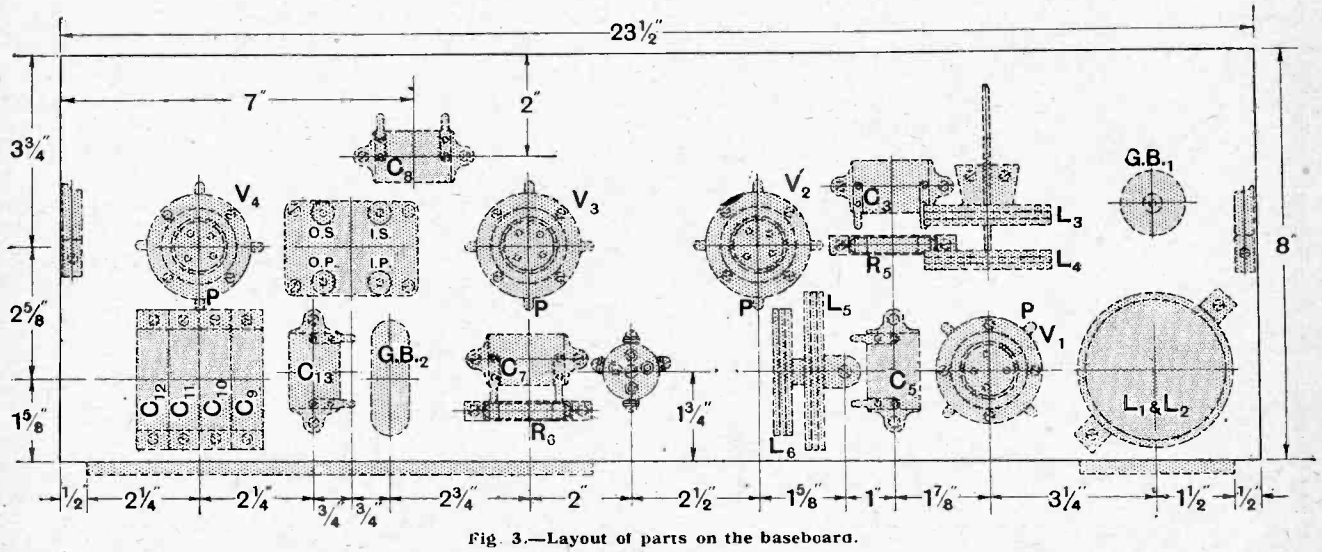


Fig. 3.—Layout of parts on the baseboard.

condenser C_8, the arrangement functioning probably as a choke-capacity coupling rather than as a transformer.

Reaction is introduced into the intermediate frequency amplifier by passing back some of the H.F. current in the anode circuit of the last valve through the variable condenser C_4 to the reaction coil L_6, which is tightly coupled to the input coil. The degree of reaction is

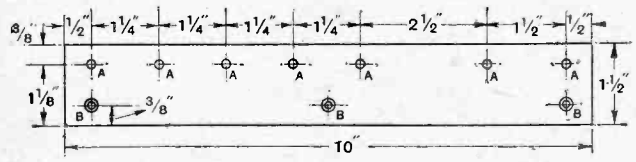


Fig. 4.—Drilling positions for the large terminal strip. A = 5/32in. dia. for No. 4 B.A. terminal, and B = 1/8in. dia.

ably to the cutting off of some of the modulation sidebands, which would otherwise be amplified and rectified. This is not in practice a very grave drawback, as it is seldom that the utmost degree of reaction need be used, and it may be said to represent part of the price one has to pay for economy in valves. The last and fourth valve operates purely as a low-frequency amplifier which is coupled to the plate of the third valve by transformer T.

Constructional Details.

Apart from the coils and H.F. transformers, all the components used are of standard pattern. The condensers C_1 and C_2 should

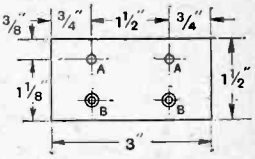
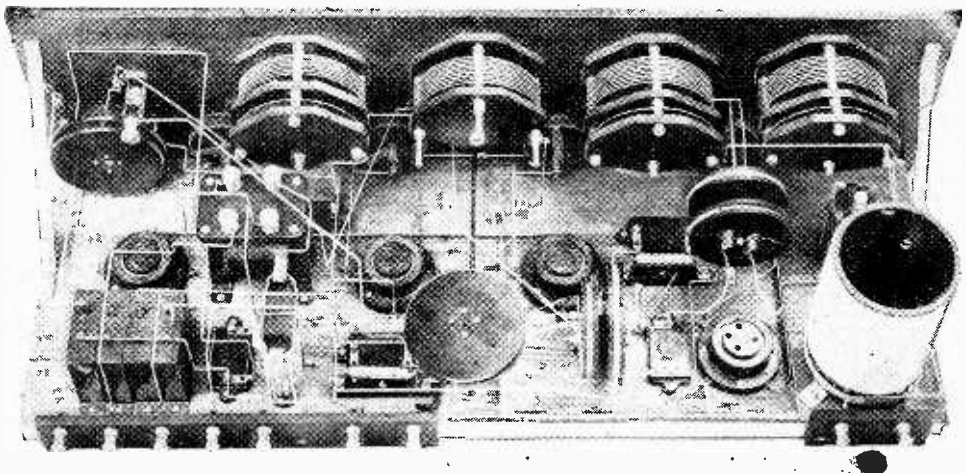


Fig. 5.—The small terminal strip. A = 5/32in. dia., and B = 1/8in. dia.

Four Valve Reflex Superheterodyne Receiver.—

be of good quality, particularly the oscillator condenser C_2, which *must* be provided with some form of fine control; a reduction gear is recommended, and the simple and inexpensive pattern in which a rubber ring engages with the edge of the dial is adequate. An extension handle is necessary on this control. The condensers C_1 and C_6 are on the long wave side, and so especially good instruments are not necessary. The reaction condenser C_4 should, however, have a low minimum, and there must be no risk of its plates short-circuiting.



A view of the receiver, which shows practically the whole of the set. The large coil on the right-hand side is the aerial-grid coil; next to it is the oscillator-reaction unit. The crystal detector can be seen on the extreme left-hand side just over the valve-crystal transformer.

The method of construction adopted will be readily understood by referring to the photographs, all the components being mounted either on the vertical ebonite

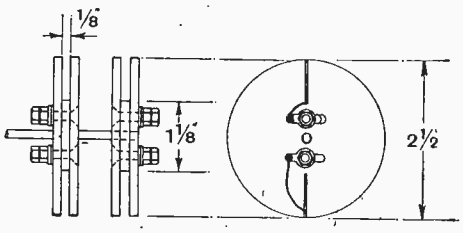


Fig. 6.—Details of the oscillator and reaction coils.

panel or the wooden baseboard, the whole being easily removable from the cabinet, which is preferably fitted with a lid. The output terminals are on the right-hand side of the panel, to facilitate the connection of a note-magnifying unit if required.

Winding the Coils.

The construction of the various coils is a somewhat tedious operation, but there is no real difficulty, particularly if the formers are bought ready made. Some form of mechanical winder is essential for the bobbin coils;

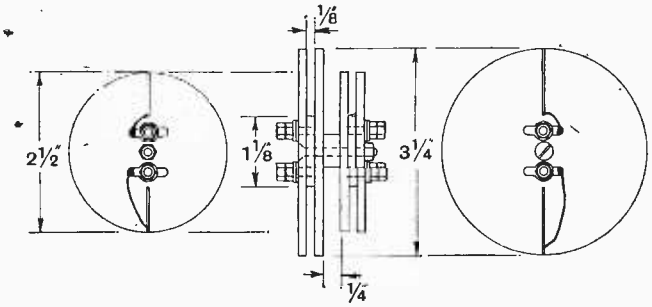


Fig. 7.—The input and reaction coils.

an ordinary geared drill with the usual ratio of about 5 : 1 will serve admirably. The drill should be held in the vice, and an old terminal fixed in the chuck. The shank of the terminal is passed through the centre hole of the former, which is then secured firmly with a nut. Note carefully the number of revolutions of the chuck corresponding to a single turn of the handle, and calculate from this the number of turns of the latter which will be necessary. The physical sizes of all coils, except L_1, L_2, have been reduced as much as possible to limit stray couplings between them. Care should be taken to give good spacing and to keep the axes of adjacent coils at right angles.

Details of the Coils.

All the coils except L_1 are wound on ebonite bobbins somewhat similar to those used for plug-in H.F. transformers. They may be turned up from the solid, or, much more easily, assembled from discs cut from ⅛in.

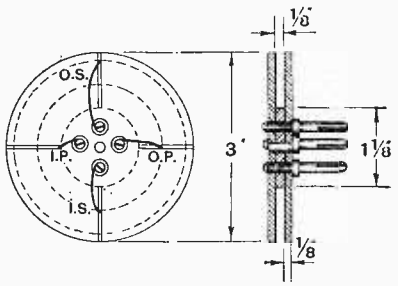


Fig. 8.—Arrangement of the coupling transformer.

ebonite sheet, held together by small 6 B.A. screws. The heads of the screws fixing the brass mounting brackets to the cheeks should be deeply countersunk, to avoid making contact with the windings.

The oscillator and reaction coils L_3 and L_4 consist of, respectively, 200 and 150 turns of No. 26 D.S.C. copper wire on formers dimensioned as in Fig. 6. Variable reaction is provided and is controlled by the metal rod shown, one end of which projects through the panel and is fitted with a knob. The other end is simply screwed into the centre hole of the reaction coil former. This simple and rather crude arrangement is perfectly adequate for its purpose, as the reaction setting is not critical.

Four Valve Reflex Superheterodyne Receiver.—

A small brass bracket is employed to hold the grid coil in position.

The input tuned anode coil L_5 has 575 turns of No. 30 D.S.C. wire on a $3\frac{1}{4}$in. former, the long-wave reaction coil L_6 being bolted to it, the necessary spacing being provided by an ebonite washer $\frac{1}{4}$in. thick. This reaction coil has 300 turns of the same wire, the complete assembly being shown in Fig. 7. The fixed condenser C_5, of 0.001 mfd., should be of a reliable make, with a guarantee of reasonably accurate capacity, as it determines the wavelength of the circuit. It may, of course, be necessary to reverse the external connections to the reaction coil.

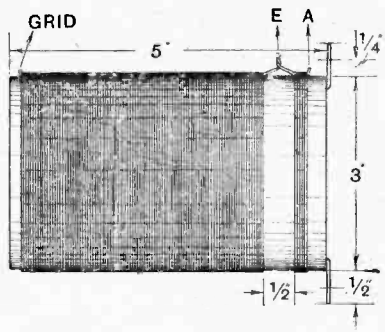


Fig. 9.—The aerial-grid coil.

The H.F. Transformer.

The H.F. transformer L_7 L_8 is of the conventional plug-in pattern, and a Sullivan No. 5*a* may be used. Instructions for winding are given, however, should the reader care to make his own. The construction of the former is shown in Fig. 8. Four slots are cut in the back disc for the leading-out wires, which are soldered to the shanks of the valve pins. These slots may be carried out through the edges of the disc if the constructor has no suitable tools to make them as shown. The connections given should be carefully followed. Commencing at the left-hand filament pin, looking at the back (or, rather, what would be the filament pin if a valve were in question), wind on 1,300 turns of No. 42 D.S.C. copper wire, bringing out the end to the right-hand filament pin. Insulate carefully with silk or a narrow strip of empire cloth, and, commencing at the plate pin, wind on the secondary in the same direction, with the same number of turns and wire, terminating at the grid pin.

The valve-to-crystal coupling L_9 L_{10} has three windings. These are put on one over the other, always winding in the same direction, and each consists of 1,300 turns

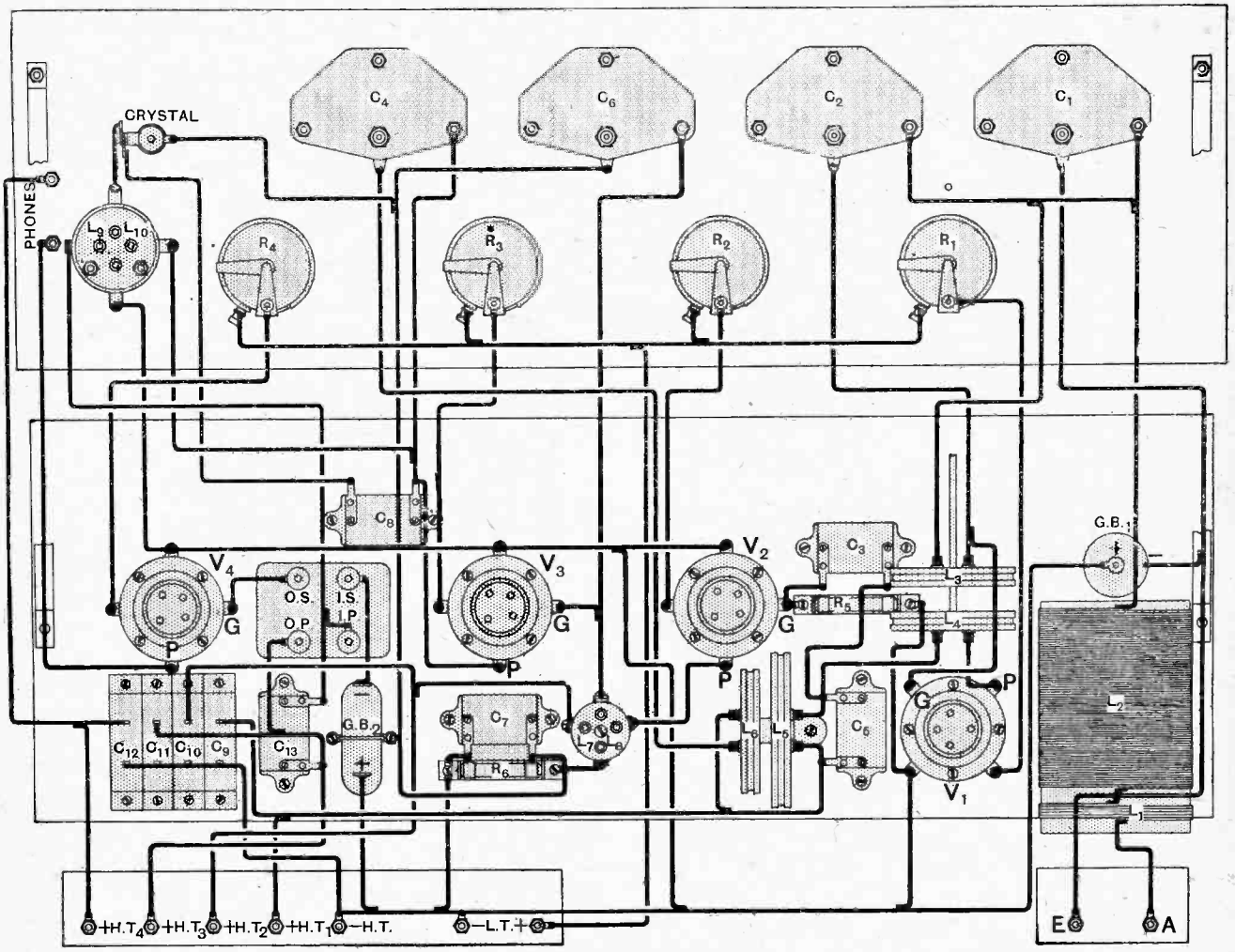


Fig. 10.—Complete wiring diagram.

MATERIALS REQUIRED.

2 0·0003 mfd. variable condensers with vernier, C_1, C_2 (Peto Scott).
1 0·0003 mfd. variable condenser, C_6 (Peto Scott).
1 0·0002 mfd. variable condenser with vernier, C_4 (Peto Scott).
4 0·001 mfd. fixed condensers, C_5, C_9, C_7, C_{13} (Edison Bell).
1 0·0003 mfd. fixed condenser, C_8 (Edison Bell).
4 1 mfd. condensers, C_9 C_{10}, C_{11}, C_{12} (T.C C.).
1 1 megohm grid leak R_5 (Dubillier).
1 0·25 megohm grid leak, R_6 (Dubillier).
4 Filament resistances (Lissen).
1 Crystal detector (Radio Instruments, Ltd.).
1 Ebonite panel, 24in. × 7in. × ¼in.
1 Baseboard, 23½in. × 8in. × ¾in.
1 1½ volt grid battery for GB_1 and one 4½ volt for GB_2.
4 Non-pong valve holders (Sterling).
1 Intervalve transformer, low ratio (Ferranti).
Ebonite for coil formers and terminal strips.
Wire for coils and connections.
2-valve holders for HF coils.

of No. 42 S.S.C. The first and third sections make up the primary, with the secondary between them. The former is identical with that used for the H.F. transformer, except that the winding slot is $\frac{3}{16}$in. wide instead of ⅛in. Commencing at the left-hand filament pin, put on the first section, covering with the usual layer of insulation and leaving an inch or so of end projecting out of the same slot for subsequent connection. Wind on the secondary, commencing at the grid and ending at the plate pin. Insulate as before, and then add the second section of primary, soldering the commencing end to the free projecting end of the first section. This soldered joint should be stuck down to the former with a touch of Chatterton's compound or similar adhesive. The end of this last section connects to the right-hand filament pin.

A 3in. ebonite tube former, 5in. long, is required for the aerial-grid coil. Commencing at one end, Fig. 9. wind on 75 turns of No. 20 D.C.C. wire. Leave a space of half an inch, and put on five more turns for the aerial coil. The junction between these coils is connected to earth and negative GB_1. Two small brass brackets should be fitted for mounting the coil to the baseboard.

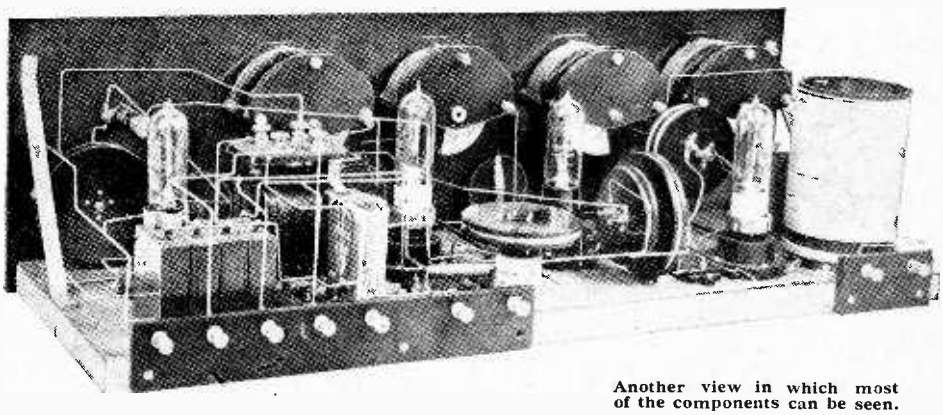
The drilling of the panel and assembly of the components is clearly shown in Figs. 2 and 3 and photographs. The lay-out given permits of easy and short wiring; the usual precautions, such as keeping grid and plate leads clear, should be taken, more particularly in the case of the first valve. If a ready-made H.F. transformer is used, the connections to it recommended by the maker should be followed, rather than those given here.

Operating the Set.

Practically any type of valve may be used, but for best results the combined oscillator-detector should have a fairly low impedance. The intermediate frequency amplifier is generally more stable if valves of moderately high impedance are used in it. The combinations of a D.E.6 with three D.E.R.'s, or a D.E.3 with two D.E.3*b*'s and a D.E.3 for the L.F., have both been found highly satisfactory. Separate H.T. tappings are provided for each valve. In general, it will be found best to apply a fairly low voltage to the first and second, and considerably more to the third and fourth. If, however, any very considerable voltage is used on the third valve, a grid bias battery of suitable value should be interposed in the lead connecting the bottom end of C_7 R_6 to L.T. negative.

It is recommended that the local station should be first tuned in, by simultaneous rotation of the tuner and oscillator condensers, with long-wave reaction set at zero, and oscillator reaction fairly tightly coupled. Reverse the leads to this coil if the valve fails to oscillate. Set the crystal and H.F. tuning condenser for best results, and then remove the aerial, as it is easier to make fine adjustments on a weaker signal. A main station should be audible at very considerable distances on the earth lead alone. Retune carefully, making several adjustments of both oscillator and H.F. condenser until confident that best results are obtained. The H.F. condenser may now be left permanently set. Try various H.T. and filament voltages, particularly on the first valve. The need for critical adjustment of brilliancy here is perhaps more apparent than real; as one is apt to be misled by the fact that alteration of the filament current generally makes quite an appreciable difference to the oscillator tuning, as does varying the reaction coupling. Always set the crystal with long-wave reaction at zero, or its damping effect may cause puzzling results. Incidentally, the amount of crystal damping is, to a great extent, determined by the capacity of the coupling condenser C_8. The value given is correct for most valves and crystals.

The aerial may now be reconnected, and other stations searched for by rotating the dials of the oscillator and tuner condensers, the other controls being left set. When a station is found and identified, make a note of the



Another view in which most of the components can be seen.

Four-valve Reflex Superheterodyne Receiver.

readings, in order that the same station, or another near to it in wavelength, may be easily found on subsequent occasions. It should be borne in mind that the tuning of the oscillator is extremely sharp, and that the condenser must be rotated slowly. It will be found that stations come in at two different settings of this dial, and Morse interference may often be eliminated by changing from one to the other.

Screening.

The selectivity of the receiver is absolute, as far as stations at any distance are concerned, and two transmitters not actually heterodyning each other can always be separated. It will sometimes be found that there is a certain amount of "spreading" in the case of a powerful near-by station. This can best be eliminated by screening, and the writer has found that the easiest method of doing this is to construct a tin box with a hinged copper gauze front, large enough to take the set. Extension handles (Igranic vernier pencils) are provided for the oscillator and tuner condensers, and project through holes in the gauze. Much can be done by merely enclosing the long-wave input and reaction coils in a metal box. These expedients do not seem really necessary under average conditions.

Oscillation.

It may be found that the first valve will not oscillate, or, at any rate, will not produce a sufficiently strong harmonic, even with the coils tightly coupled, or perhaps the results will be perfectly satisfactory on the shorter waves, but will fall off on the upper part of the tuning range. The remedy in either case is to add turns to the reaction coil.

When once the working of the set has been mastered, and preliminary adjustments made, it will be found delightfully easy and certain in operation, due largely to the fact that there are only two critical controls.

VALVES WE HAVE TESTED

THE MULLARD D.F.A.4.

THE resistance capacity method of inter-valve coupling for low-frequency work is a particularly interesting one, and has certain advantages, chief of which are (*a*) that the amplifier is easily set up, and (*b*) that the amplification, at any rate over the speech range, can be made independent of the frequency.

The main disadvantage is the comparatively low amplification per stage, for, as is well known to our readers, the full amplification of the valve can never be attained in practice. In a resistance-capacity coupled amplifier, the step-up must be performed by the valve itself, and this latter must, therefore, have a high amplification factor, together with as low a plate impedance as possible.

Certain of the leading manufacturers have produced a valve to meet these requirements, and the present notes deal with one such valve: the D.F.A.4, made by the Mullard Radio Valve Co.

Characteristics of the Valve.

The filament rating for this valve is 5-5.5 volts, with a consumption of 0.2 ampere; 75 to 125 volts H.T. being recommended. We have conducted extensive tests on a sample of this type, the results of which are given in the table.

As will be noted, 5 volts across the filament was sufficient for the specimen tested, at which value 12.62 milliamperes emission was obtained. Over the range tested the amplification factor remained very constant at about 20, with a plate impedance varying between 50,000 and 33,500 ohms, according to the plate voltage.

This impedance is somewhat higher than that quoted by the makers, the reason being that, whereas the maker usually determines the amplification factor and impedance at zero grid volts, we, in our tests, measure these values at a suitable operating point, that is, more nearer the conditions under which the valve will work. As an example, with 100 volts H.T. a grid bias of -2 will be found suitable, and at this setting the amplification factor and impedance are 20.5 and 33,500 ohms respectively. Apart from the special purpose for which it was designed, the D.F.A.4 will be found to give quite excellent service when operating as a detector or H.F. amplifier.

Results of Tests.

This class of valve, needless to say, should not be used with transformer-coupled L.F. amplifiers; its impedance is much too high. Neither should it be used as the last valve in the set, for in this position a valve capable of handling large grid voltages is required.

D.F.A.4.

(Mullard Radio Valve Co., Ltd.)

Filament Volts, 5.0. Filament Amp. 0.22.
Emission (total) milliamps 12.62. Efficiency 11.5 milliamps per watt.

Plate Volts.	Plate current at Zero Grid Volts.	Grid Bias. Volts.	Plate* Current. Milliamps.	Amplification Factor.	Plate Impedance. Ohms.
60	0.92	−0.5	0.7	19.9	50,000
80	1.52	−1.0	0.93	20.0	38,500
100	2.32	−1.5	1.19	20.5	34,000
120	3.18	−2.0	1.48	20.5	33,500

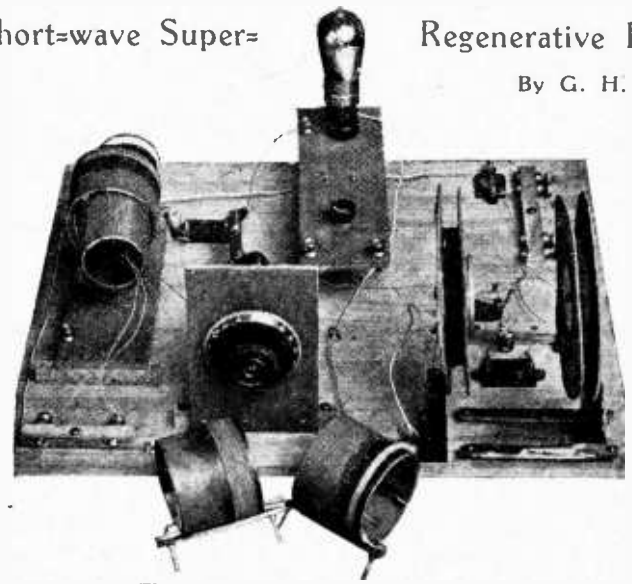
* Plate Current when Grid is biased to the value of Col. III.

LONG-RANGE SINGLE-VALVE SET.

Notes on a Short-wave Super-Regenerative Receiver.

By G. H. RAMSDEN (6BR).

DESIRING to carry out some experiments in duplex telegraphy and telephony working, the writer found himself in need of a receiver which would give reliable reception of European and the American short-wave transmitters without the use of an aerial-earth system. Multi-valve sets being expensive both in maintenance and installation, and awkward to tune for quick searching, a slightly modified single-valve Armstrong super-regenerative circuit was chosen.



The layout adopted by the author.

A theoretical circuit diagram is given in Fig. 1, and the photograph of the receiver will give an idea of the general lay-out. We will now discuss the set in detail.

Constructional Details.

The set is mounted on a wooden baseboard 19½in. long by 17in. wide by ½in. thick. Two transverse wood strips support the board 1in. above table level. American white wood is quite suitable for this component. All connections are made on the upper side of the base in order to facilitate experiments.

Three coils are employed at A to cover a range of wavelengths from 40 to 200 metres. They are made as follows: Three cardboard solenoid formers are prepared, 2½in. long and 3in. in diameter. The first coil (40-75 m.) will consist of six turns of No. 24 D.C.C., the second (68-130 m.), twelve turns, and the third (110-200 m.) twenty-one turns of the same gauge of wire. They are mounted in a manner designed to produce minimum capacity between the prongs. Cut two strips of thin ebonite or hard wood, slightly longer than the coil formers, and pass one piece through the coil and the other outside it. Now screw the two ends together with valve pins, and the coil will be held quite rigid. The ends of the winding are soldered to the valve pins. Care must be taken to make the distance between the pins the same in each coil. A few coats of shellac varnish will prevent the windings from slipping.

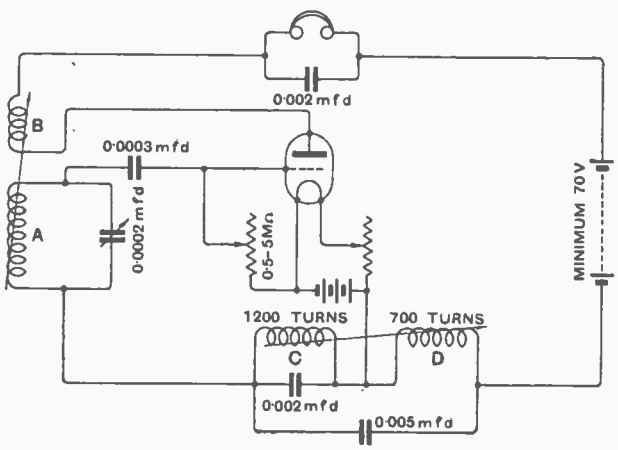


Fig. 1.—The circuit diagram.

Readers will do well to follow the specifications for the coils implicitly, as the reaction coil is designed to cover the complete range of wavelengths without dead spots, overlap, and other annoyances. It slides into the A.T.I. and consists of fourteen turns of No. 26 D.C.C. on a former 2in. in diameter by 6in. long. The winding will take up half an inch of the former. The remaining 5½in. act as a remote control handle. The reaction coil terminals are mounted on a strip of wood ½in. square by 2½in. long, which is screwed to the base so that the terminals lie parallel to it facing the A.T.I.

The coil holder consists of a piece of three-ply wood 9in. long by 3in. wide and supported about ¾in. above the surface of the baseboard by wood strips. Two valve legs are mounted in the centre, their distance apart being governed by the distance between the coil pins. An inch to the left of each valve leg are mounted an aerial terminal and an earth terminal, the latter really for the sake of symmetry, as it is never used.

The quenching coils C and D are wound in the slab form on circular wooden cores 1in. in diameter by ¼in. thick. Cardboard flanges 6in. in diameter are clamped to the centre-piece by a brass nut and bolt. The big coil consists of 1,200 turns of No. 34 D.C.C. copper wire, and the smaller of 700 turns, also of No. 34 D.C.C. They are mounted on ordinary basket coil holders, which may be purchased from any dealer. The coils plug into standard sockets, which are mounted in such a manner that the coupling may be altered at will. The capacity of the aerial tuning condenser should be kept as low as possible. A 0.0002 mfd. variable condenser is very satisfactory, giving the fine tuning so essential to short-wave reception. It is mounted at right angles to the base on a piece of three-ply wood 6in. long by 4in. wide.

The grid condenser is a Dubilier 0.0003 mfd. The value of the grid leak is rather critical, but a pencil

Long-range Single-valve Set.—

line on a strip of ebonite will be found quite effective and may be adjusted to the exact value required. It should be connected between the grid and negative filament lead.

The valve holder and filament resistance are mounted on a panel of three-ply wood 9in. long by 3in. wide, and supported 2in. above the board by a block 1½in. wide by 3in. long and 2in. high, the resistance being on one side of the block and the holder on the other. Separate terminals are provided for grid, plate, and filament connections. The leads from the filament terminals to the holder are passed through holes drilled in the supporting block.

Connections of Quenching Coils.

A 0.002 mfd. fixed condenser is connected across the big coil and a 0.005 mfd. across them both. The common centre tap may be taken to the filament positive or negative, whichever is found best by experiment. Three terminals are provided for the quenching coils. They are mounted in the usual manner, and may be seen in the photograph. The centre one is, of course, connected to the common tap and the two outer to the negative of the high tension and the A.T.C. respectively.

It is important that a 0.002 mfd. fixed condenser be connected across the telephones. The telephone and H.T. terminals are mounted as before, and can be seen in the photograph along the right-hand margin of the base, the pair with the condenser across being for the 'phones.

The high tension voltage should be kept above seventy volts. The "aerial" consists of 6ft. of lighting flex, supported a little above the level of the set. More than this produces instability, and, strangely enough, weaker signals.

Tuning Operations.

A certain amount of experimenting will probably be necessary before the best results are obtained for any given set. The circuit, however, is not so tricky as some writers would have us believe. To begin with, switch on the valve to full brilliancy, then plug in the high tension. A high-pitched whistle (the quenching note) should then be heard. If this is absent, examine all connections, reverse one of the quenching coils, or, if these alterations fail, break the H.T. circuit several times until the desired effect is produced. Having got the quenching coils oscillating, tighten the reaction coupling until self-oscillation is *just* set up. Now search round for signals, which should come in at great strength. Indeed, most European and East Coast American amateur C.W. transmitters paralyse the receiver altogether and must be read by the "key thump."

Stations Received.

All B.B.C. and several Continental stations are received at an excellent telephone strength on larger coils. Those up to 50 miles away will work a loud-speaker, as also will KDKA on 68 metres under favourable conditions.

European and American amateurs are, for the most part, too strong to be comfortable on the headphones. By removing the quenching coils and inserting shorting plugs in the sockets, the quenching oscillation is stopped, and the set thus converted into an ordinary valve detector. This, however, does not seem to limit range as much as one would expect, for the writer has regularly logged fourth district Americans a good R5 strength with the set working under these conditions.

THE NEW LYONS STATION.

French Broadcasting Service Established by Local Enthusiasts.

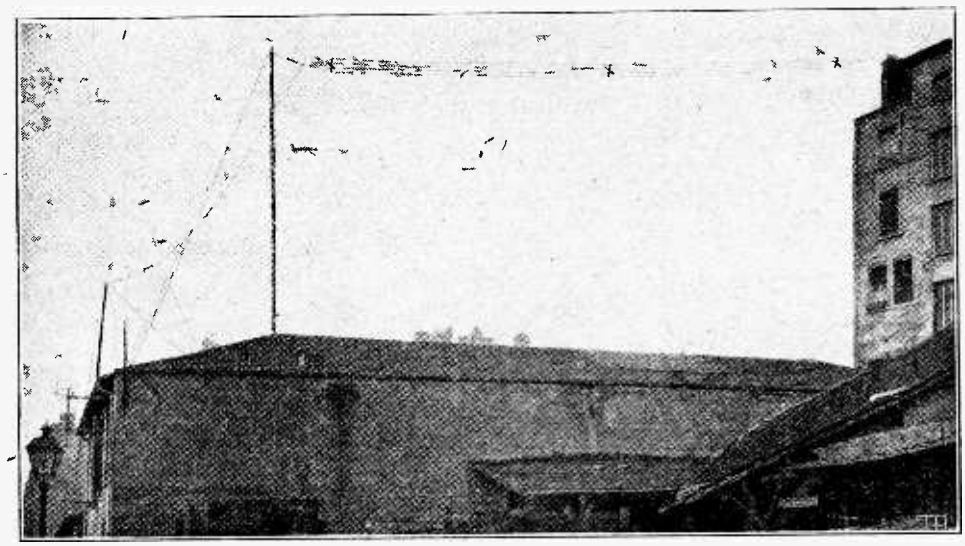


Fig. 1.—General view of the station building and the four-wire cage aerial.

THE first proposal for the establishment of a local radiotelephony station at Lyons was made by a syndicate of amateurs and professionals in the town. This group, after meeting with serious difficulties, eventually succeeded in installing the necessary transmitting apparatus and a studio. Eventually, in agreement with the "Syndicat de la Radiophonie Lyonnaise," the same society advanced the first sums of money to cover the licence fees and expenses of installation.

This station has been working since April 1st, transmitting at 12.30 p.m.

The New Lyons Station.—

news and concert until 1.45 p.m., and from 8.30 p.m. till 9 p.m. news and lectures, and from 9 p.m. to 10 p.m. radio concerts. There is a station orchestra and jazz band.

The Apparatus.

The apparatus used is entirely of French manufacture. The microphone is of the magnetic type and is supported by an elastic suspension. The low-frequency amplification comprises nine stages, resistance coupled, built into a metal case, which is supported on rubber to avoid the possibility of vibration. With the last six stages of the amplifier it is possible to introduce choke coupling instead of resistance coupling by means of switches. The three low-frequency stages shown on the left in Fig. 3 are used with a plate voltage of 80 volts, each valve being separately suspended in a sound-proof box to protect it from vibration. The remaining six stages, which are valves of R.27 type, take 4.5 volts for the filament and 160 for the anode, and the last two valves are the same type arranged in parallel with 200 volts on the plate. Negative potential to the grids is controlled by means of a potentiometer.

The transmitter is a 500-watt type, but can be converted into a 2-kw. equipment if necessary; 500-watt transmitting valves are used, taking 16 volts for filament heating, and a plate voltage of 8,000 volts. The anode current is 90 milliamperes.

The equipment comprises five modulating valves in parallel, and two oscillators in parallel. The various components of the equipment are separately housed in cabinets, as shown in Fig. 2. On the left the cabinet is divided into two compartments, the first of which contains the modulating valves, and the second the oscillators.

For the anode supply, three-phase alternating current from the mains is transformed by means of an alternator to two-phase current at 12,500 volts, 1,200 cycles, which is then rectified by means of two 500-watt valves and smoothed with filters.

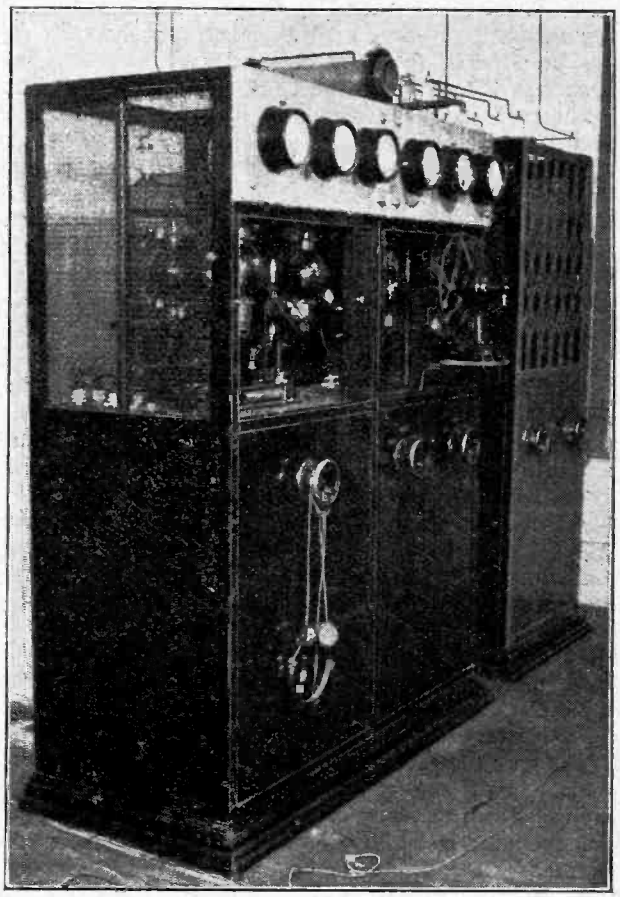


Fig. 2.—The main transmitting apparatus. In the first cabinet are mounted the modulating valves, while the second cabinet, which is fitted with a cooling fan, contains the two main oscillators.

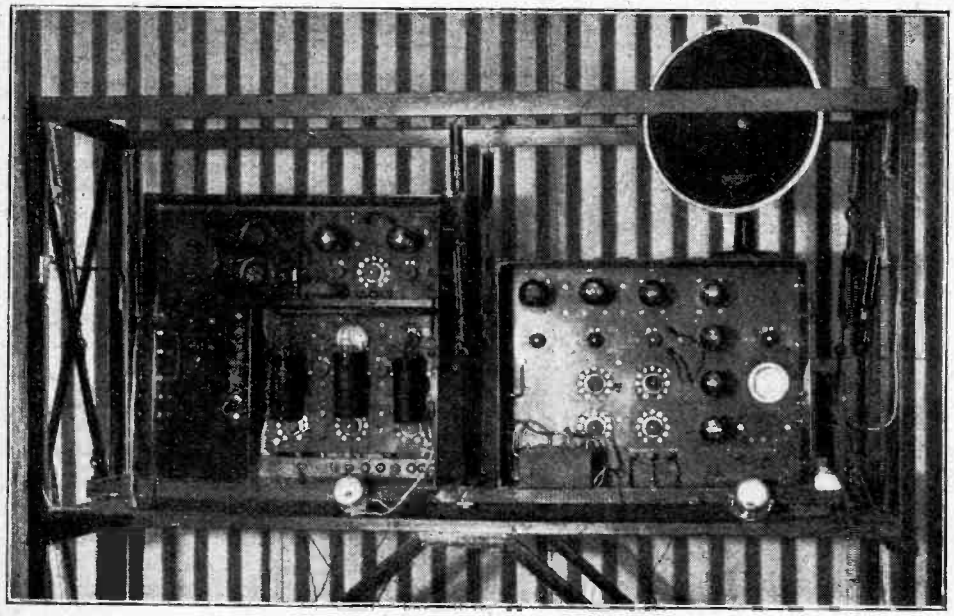


Fig. 3.—The microphone amplifier, comprising in all nine stages with resistance and choke coupling.

Wavelength and Location.

The wavelength used is 278 metres. The station is located in the centre of the town at Lyons, just behind the University, and a cage aerial of 4 wires is used, with a counterpoise of 14 wires, the total length of the aerial and counterpoise being 25 metres.

As soon as the necessary authority is obtained, it is likely that the station will be moved to high ground at some little distance from the town.

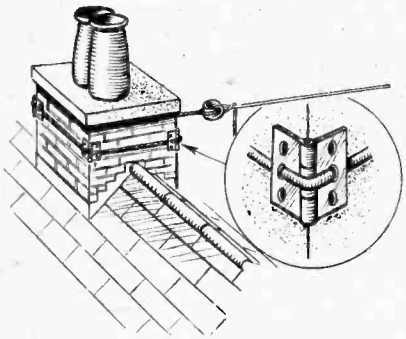
READERS' NOVELTIES

A Section Devoted to New Ideas and Practical Devices.

ATTACHING AERIAL TO CHIMNEY.

When fixing an aerial halyard or pulley to a chimney the brickwork is generally plugged and a staple driven into the wood, to which the aerial is subsequently attached.

The stack cannot be plugged in the top courses of bricks, and a foot or two has to be deducted from the height of the aerial on this account. Further, wooden plugs are apt to work loose under the influence of the weather and require constant attention.



Hinges used to protect brickwork when attaching aerial pulley to chimney.

It is much better to take a wire completely round the stack, but in this case care must be taken that it does not cut into the mortar at the corners. This can be avoided in a simple manner by fixing ordinary hinges at each corner in the manner indicated in the diagram.—R. A. H.

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GRID BIAS FROM THE H.T. BATTERY.

In experimental work, at least, where it is desirable to reduce wiring to a minimum, the system of connections shown in the diagram should be of great service. They enable grid and anode potentials to be obtained from the same battery provided that there are tappings at suitable intervals near the negative end.

In any receiving circuit the −L.T. connection is always negative with respect to the plate and positive with respect to the grids of the amplifying valves. Similarly, the intermediate tappings on an H.T. battery are each positive with respect to the negative end of the battery and negative with respect to the positive end. Therefore the −L.T. connection may be taken from any point on the H.T. battery; the tappings on the positive side are then used for the H.T. supply and those on the negative side to give the necessary grid bias.—A. S.

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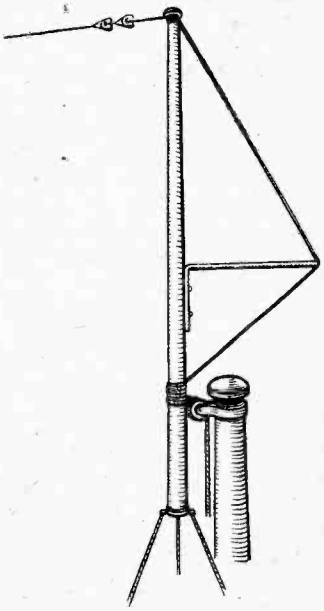
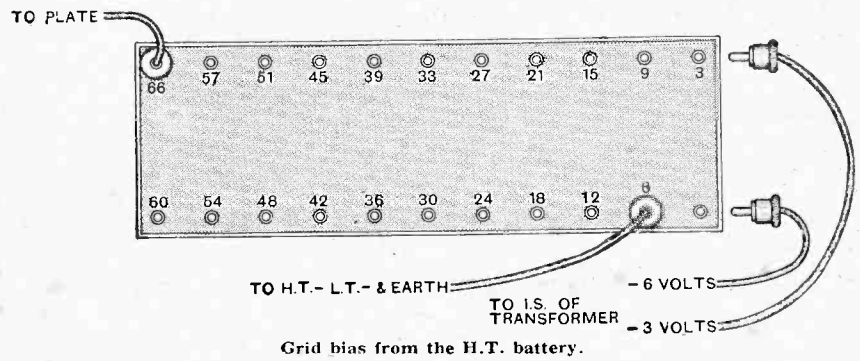
INCREASING MAST HEIGHT.

A temporary increase in the height of a mast may be effected by raising a piece of bamboo or light ash to the top pulley by means of the halyard. The extension should be braced if necessary, and the halyard attached at a distance from the bottom end about equal to one-quarter of the total length. Best results are obtained when the pulley is permanently attached to the mast, as indicated in the diagram, and if an ordinary pulley is used it should be fixed with wire in preference to rope. The extension is held vertically by three guy wires attached to the lower end and held by stakes driven into the ground at the three corners of a triangle.



Temporary mast extension raised by the aerial halyard.

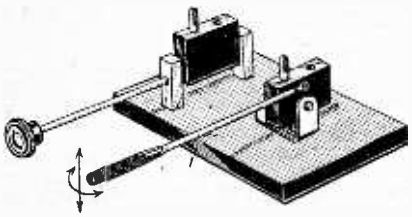
Provided that the original mast is stable there is no difficulty in increasing the aerial height by 8ft. or 10ft., and the improvement in signal strength is often well worth the trouble taken.—R. C. H.



Grid bias from the H.T. battery.

UNIVERSAL COIL MOUNTING.

The coupling between the coils in the two-coil holder shown in the diagram can be varied by three distinct movements. One coil holder is mounted on a spindle which is carried horizontally by two brass pillars screwed to the base. The other coil



A coil holder of simple construction, giving adjustment in three directions.

holder is carried by a stiff right-angle bracket, which is also screwed to the base. The screws passing through each arm of this bracket act also as pivots, and the coil can, therefore, be moved in two planes at right angles. In all there are three degrees of freedom between the two coils, which besides giving fine adjustment, enable the position of zero magnetic coupling to be found with ease.—C. A.

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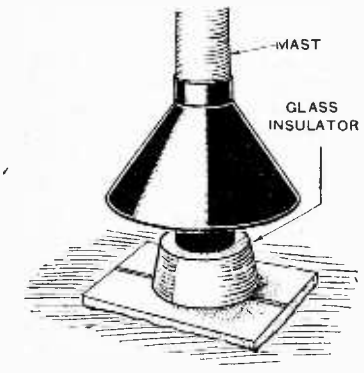
INSULATOR FOR STEEL MASTS.

On short wavelengths a steel mast may have a natural period which would seriously affect the efficiency of the aerial system, both for transmission and reception, unless the mast and, of course, the guy wires were totally insulated from the earth.

A glass cone, of the type generally placed under the castors of a piano, makes an excellent insulator for the base of the mast. The insulator should rest on a brick foundation, and may be prevented from moving laterally by filling the space under the concave lower surface with cement.



Piano castor used to insulate the base of a steel mast.

If the insulator is to be a success in wet weather, a cone must be fitted to deflect the water running down the mast. The cone must be large enough to prevent rain driving sideways on to the insulator, but must not be fitted too close to the ground if made of metal, as the capacity to earth would neutralise any benefits conferred by the use of the insulator.—A. M. H. F.

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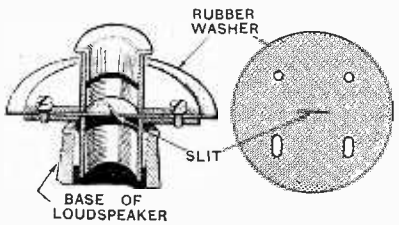
A LOUD-SPEAKER MODIFICATION.

Interesting acoustic effects are obtained by fitting an attachment with artificial vocal chords to a loud-speaker.

Two short pieces of brass tubing are obtained to fit the orifice in the loud-speaker base and the end of the horn. Flanges are then soldered to each tube to grip a rubber diaphragm



Fitting "vocal chords" to a loud-speaker.

provided with a short slit. The diaphragm is made larger than the flanges so that by releasing the clamping screws on one side the aperture of the slit may be increased by pulling the overlapping portion and again tightening the screws. It will be found that many loud-speakers are improved by this attachment.—P. J. P.

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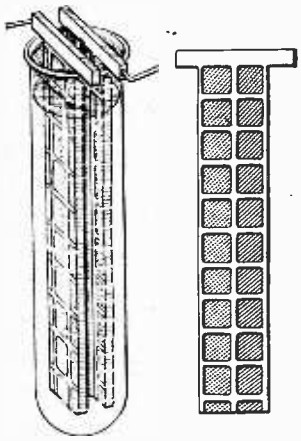
H.T. ACCUMULATORS.

A very successful accumulator H.T. battery can be built up out of old L.T. accumulators if a sufficient quantity of these is available. The plates should be removed from the cases and separated, when it will generally be found that the paste has fallen out in places, particularly in the positive plates. Strips should be cut from the sound portions of the plates, leaving two lugs projecting on either side at the top. Pairs of plates are lowered into test tubes with the lugs resting on the top of the tubes. Strips of corrugated celluloid are then inserted to prevent short circuiting. The cells are arranged in racks and soldered connections made between the lugs. If copper wire is used for the connections, it will be



High-tension battery elements cut from old accumulator plates.

advisable to treat the joints with anti-sulphuric paint to prevent corrosion.

The writer has been using a battery of this type for some considerable time with extremely satisfactory results. The battery is charged from D.C. mains through two lamps in series, the charging current being about 1-25th amp.—R. T.

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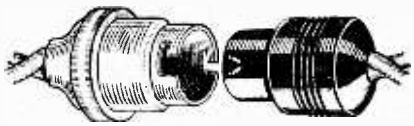
NON-REVERSIBLE PLUG ADAPTOR.

When deriving H.T. current from the mains, or when the mains are used for accumulator charging, it is important that the supply plug should always be inserted in the same way, so that the correct polarity is obtained. Power plugs are generally fitted with pins of different diameter to prevent reversal, but when the lighting mains are used and the supply is taken from an ordinary lamp



Non-reversible lamp-holder and plug adaptor.

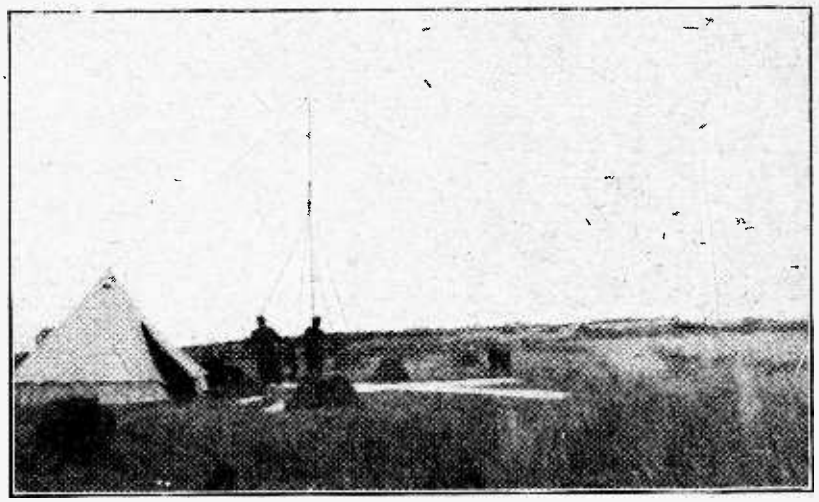
holder, both the plug and the holder must be marked to obtain always the same polarity.

To render the arrangement fool-proof it is a good plan to fit two brass pins to one side of the plug and to enlarge the width of the slot on the corresponding side of the lamp holder. It will then be impossible to reverse the connections.—S. M. C.

WIRELESS AT THE LIGHT AEROPLANE TRIALS.

A Description of the Portable Stations Used at Lympne.

AT the Light Aeroplane Trials held at Lympne on August 1st, 2nd, and 3rd, by the kind permission of the P.M.G. and at the request of the Royal Aero Club, three wireless stations were installed by members of the staff of Messrs. N. V. Webber and Co., Ltd., in order to maintain rapid communication between the aerodrome and the two turning points on the course—namely, Hastingley and Postling—these points being about four and five miles respectively from the Headquarters Station at the aerodrome.



General view of the aerial system employed at Hastingley.

The two auxiliary stations were similar in design, and consisted of a 2-valve receiver and a single-valve transmitter, equipped both for C.W. and telephony. Power was derived from large capacity dry-cell H.T. batteries, about 5 watts being drawn at 225 volts, giving an aerial current of 0.3 amp. between 150 and 200 metres. The complete circuit is shown in the diagram—both transmitter and receiver being combined in one instrument.

Wavelengths Employed.

A single-wire aerial 75ft. long was employed, supported by two bamboo poles 25ft. high; and a single-wire counterpoise immediately under the aerial and 3ft. from the ground was used instead of a direct earth connection. An earth pin about 6in. long was used for the receiver.

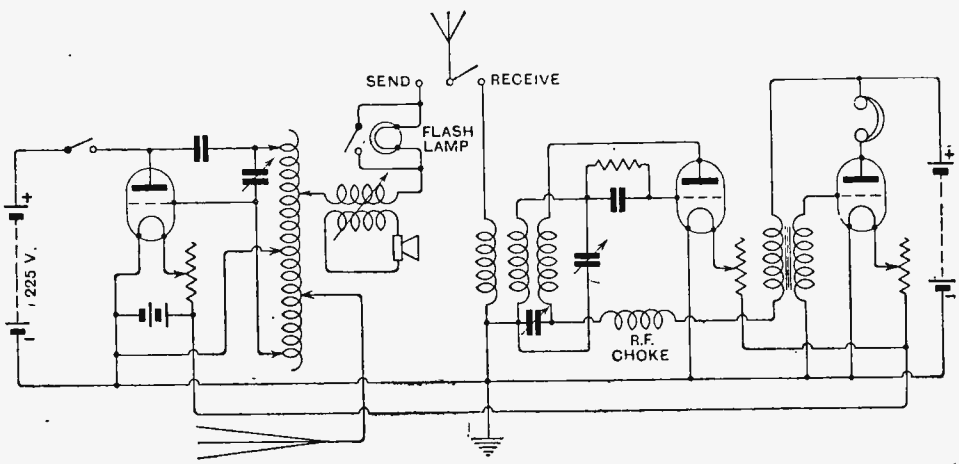
At the Headquarters Station two aerials at right angles were used—one for transmission and one for reception. Two receivers were connected in series—one tuned to the Hastingley station (6ZB) and other tuned to the Postling station (6ZC). Remarkably little interaction was experienced between these two receivers, even when tuned within a few metres of each other, although 6ZB was tuned to 200 metres and 6ZC to about 150 metres as a precaution; 6ZA—the H.Q. station—was tuned to about 175 metres. By these means reports were received without difficulty from both auxiliary stations simultaneously, and as both their receivers were tuned to Headquarters, orders could be transmitted to them as desired.

In spite of adverse conditions, such as rain, wind, and thunderstorms, everything went off as per schedule, telephone working being possible nearly all the time, with C.W. as a stand-by when static and oscillation from curious local sources made telephony unreliable.

Results of the Tests.

Great difficulty was experienced during the preliminary tests in keeping the wavelength constant, and two important conclusions were drawn from the subsequent experiments. Firstly, all field stations using portable aerials *must* have loose coupled aerial circuits—both on the transmitter and the receiver, and, secondly, aerial and counterpoise leads must be taken at the top and bottom of the tent respectively and should be firmly staked in order to prevent swaying.

In conclusion, it may be said that there was great satisfaction in knowing that reports could be given to the Royal Aero Club officials not only on the progress of the races, but on the safety of the pilots and passengers in the very frequent forced landings occurring during the meeting.



The circuit arrangement of the combined transmitting and receiving apparatus at the two auxiliary stations.

A GRID LEAK CONTROLLED BY LIGHT.

The Selenium Cell as a Variable Resistance Element.

By G. G. BLAKE, A.M.I.E.E., A.Inst.P.

THE following is a very successful and efficient method of grid control in which use is made of the electrical change of resistance in selenium, under the action of light, to control the voltage of the grid of a receiving valve so that it may be made to function on any desired part of its grid volts—grid current characteristic curve.

The wiring diagram in Fig. 1 is similar to that in general use where a grid condenser and leak are employed. It differs from the standard receiving circuit, in that the lower end of the grid leak is connected to a tapping on the H.T. battery instead of to the negative leg of the valve filament. The position of this tapping on the H.T. battery will vary according to the type of selenium cell used. In some cases, where a very high resistance cell is employed, it may be necessary to apply a higher voltage to the cell than to the plate of the valve.

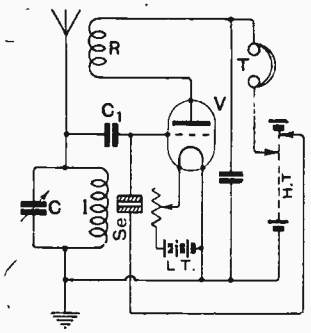


Fig. 1.—Selenium grid leak in a single valve receiving circuit. The condenser C_1 has a capacity of 0·00025 mfd.

The selenium cell may be placed in a box to exclude all unwanted light, and illuminated by a small 4-volt lamp, of the type used for pocket flash-lamps. By placing a suitable rheostat in series with the illuminating lamp, the resistance of the selenium cell can be very finely controlled. It is a good plan to connect two variable resistances in parallel for this purpose. Assuming that the lamp takes 0.25 amp. at 4 volts, a filament resistance of about 30 ohms may be used for the coarse adjustment and a 300 ohm potentiometer used as a rheostat connected in parallel with this to give fine adjustment.

Methods of Varying the Intensity of Light.

Another method is to run the illuminating lamp at a fixed degree of brightness and to interpose a shield of cardboard or other opaque material between the light and the cell. Fig. 2 illustrates the scheme. B is a division in the centre of the box M. The light from the illuminating lamp L passes through a round opening near its centre, and impinges upon a selenium cell Se.

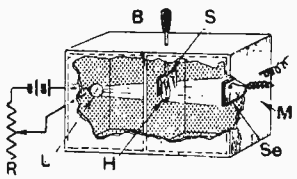


Fig. 2.—Method of illuminating the selenium cell. The intensity of light falling on the cell may be varied by the resistance R or the shutter S.

A cardboard shield S, shaped as indicated, with a number of pointed fingers or blades, can be pushed down over the opening H, so as to vary the amount of light which falls upon the cell.

The cell may, of course, be controlled from any available source of light. If the light is at some distance from the cell, a lens can be employed to bring it to a focus, and the resistance of the cell can then be varied by altering the position of the lens. This varies the size of the image of the source of light, and, therefore, the intensity of illumination per unit area of the cell.

The simplest arrangement when making up a set specially designed for light control is to use a bright emitter valve, and arrange that both the valve and the selenium cell are encased in a light-tight space behind the panel on which all the various controls are mounted. The light from the valve, if focussed by a small lens upon the cell, supplies sufficient illuminant, and a movable shutter can be employed to give the necessary control. With this arrangement it should be remembered, however, that any change in the filament current will be attended with a variation of the light intensity falling on the selenium cell. Any adjustment of the filament resistances must therefore be compensated by an adjustment of the light shutter if the grid leak resistance is to remain unchanged.

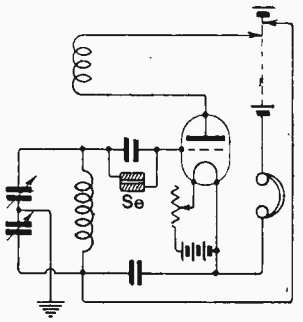


Fig. 4.—Connection of the modified Flewelling circuit. The double tuning condenser and the centre earth connection were described in "The Wireless World" of June 11th, 1924.

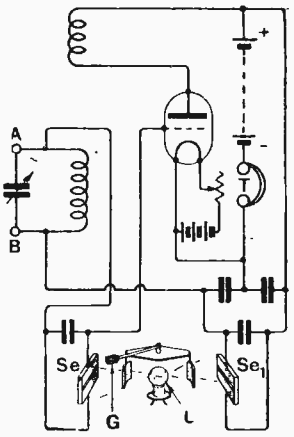


Fig. 3.—The Flewelling circuit, showing diagrammatically how the resistances of the selenium cells may be varied simultaneously.

Selenium Cells for the Control of the Flewelling Circuit.

Two selenium cells, suitably shielded from all extraneous light, might be employed in the Flewelling super-circuit, as indicated in Fig. 3, and illuminated from one source of light L.

The resistances of both Se and Se_1 could be varied simultaneously by means of a revolving shield placed over the lamp and actuated by the movement of a lever arm G. As in the previous case, it would be advisable to screen the lamp and cells in a light-tight box to prevent interference from extraneous light sources.

Fig. 4 shows the arrangement for selenium grid control applied to a simplified Flewelling circuit used without an aerial.[1]

[1] This arrangement of the two variable condensers in series with an earth connection between them was described by the author for use with the Flewelling circuit controlled by a flame grid leak in *The Wireless World* of June 11th, 1924.

Events of the Week in Brief Review.

NEARING A MILLION AND A HALF.

At the beginning of August the number of broadcasting licences taken out in Great Britain was approximately 1,400,000

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CHINA ABREAST OF THE TIMES.

According to *La T.S.F. Moderne*, a new broadcasting station has been erected at Pu Nan Fu, China. No details are at present available regarding wavelength, power and times of transmission.

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LOW POWER TALK WITH GERMANY.

Using the low power of 0.75 watts at 200 volts, Mr. G. A. Exeter (G6YK), of Kensington, has established two-way communication with the German amateur KY4, of Stuttgart.

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WIRELESS CONTROL OF SEARCHLIGHTS.

Not the least interesting feature of the Torchlight Tattoo which the Services are to give at the Wembley Stadium from August 24th to September 26th will be the wireless control of searchlights. This will be carried out by the 26th Anti-Aircraft Battalion.

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CZECHO-SLOVAKIA'S CENTRAL BROADCASTING STATION.

A broadcasting station to serve the entire Republic of Czecho-Slovakia is shortly to be erected at Prague, the Government having contracted with an American firm for the installation of a five-kilowatt station. Smaller stations are to be installed at Brno, Bratislava, and Kosice.

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BROADCASTING FOR BARBADOS.

Sooner or later every Government is finding itself called upon to frame laws and regulations regarding broadcasting. The Colonial Secretary of the Barbados has just announced that a Bill providing the necessary legislation will shortly be introduced into the House of Assembly. It is announced that these regulations will be similar to those in force in Britain.

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TELEPHONES ON GERMAN TRAINS.

All main line trains on the Hamburg-Berlin line are now equipped with wireless telephony installations. Passengers are thus enabled to call up telephone subscribers at any exchange and can themselves be called up.

It is understood that the system is to be introduced on all the main sections of the Government railways.

PROGRESS IN JAPAN.

The work of the Tokio broadcasting station, says a report from that city, is proving so successful that the Japanese Government is considering the feasibility of installing two new stations, at Osaka and Nogoya respectively. The Tokio station operates on 600 metres—hardly a convenient wavelength for the British listener.

A wireless exhibition is to be held in Tokio during the autumn.

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SERVICE FOR QUEENSLAND FARMERS.

A special service of market reports for the benefit of farmers will be a permanent item in the programmes of the Brisbane broadcasting station (4QG), which has now practically reached completion. Owned by the Queensland Government, 4QG will work on a wavelength of 385 metres, with a power of five kilowatts.

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THE NEW GENEVA STATION.

The new broadcasting station at Geneva opens it regular transmissions early in September. Frequent tests have already been carried out successfully, usually at 8.30 in the evening, and have consisted principally of instrumental and vocal items. The power of the station is 1½ kilowatts, whilst the wavelength is 1,100 metres.

Reports on reception are warmly welcomed by the directors, and should be addressed: "Radio-Genève, Hotel de la Métropole, Genève."

BUDAPEST TESTING.

Test transmissions on 565 metres are now being made by the Budapest broadcasting station, using a power of 1 kilowatt. The Hungarian postal authorities, who would be pleased to acknowledge reports of reception, request that communications should be addressed: "Ung. Postdirektion, Versuchabteilung, Budapest 1X, Gali ut 22."

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AMERICAN VIEWS ON BRITISH WIRELESS INDUSTRY.

An encouraging report from the point of view of the British wireless manufacturer has been issued by the American Government trade experts. This report, addressed to the American radio industry, declares that the development of the wireless industry in Great Britain has reached such a high state of efficiency that American manufacturers cannot hope to compete in the British market.

Next to the United States and Canada, the report adds, Great Britain has the most highly developed wireless market in the world.

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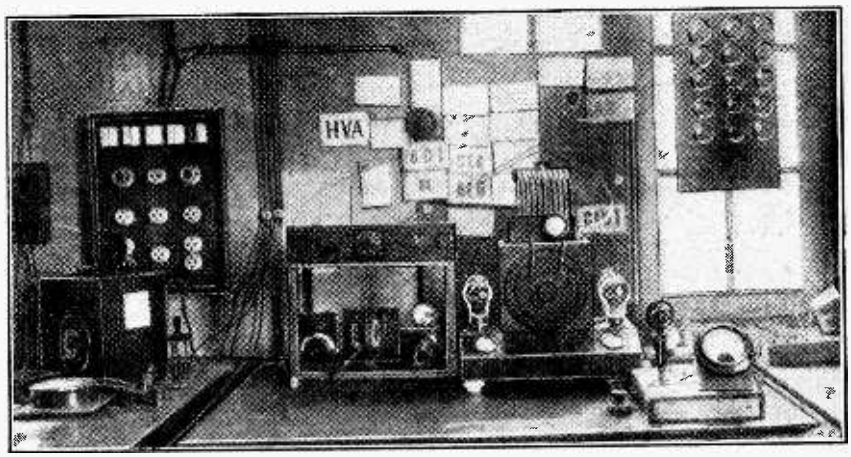
HIGH POWER FOR MILAN.

A further field for long-distance listeners will soon be available when the new broadcasting station at Milan is opened. This station is being erected by Marconi's Wireless Telegraph Co., Ltd., and is of the same type and power as the new 2LO station. The power used is 12 kw. Details of the call sign and wavelength are not yet available.



HVA, HANOI, INDO-CHINA. The transmitting equipment of one of the best known experimental stations in the Far East. Operated by Monsieur Mirville, HVA has been heard in Europe, America, and Australasia. Reports should be addressed to M. Mirville at the Radiotelegraphique Nord de P'Indo-Chine, Hanoi.

HOPEFUL GERMAN AMATEURS.

German amateurs are hoping that within the next few months the Government authorities will be prepared to extend the present facilities for experimental transmission.

According to a Baden correspondent, transmitting licences are at present issued mainly to clubs recognised by the German Post Office. Only in exceptional cases are transmitting licences issued to individuals.

The growth of public interest in the science may hasten the granting of facilities.

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"MARCONIPHONE" AND "STERLING" PRODUCTS.

Messrs The Marconiphone Co., Ltd., inform us that, as from August 1st, they have arranged with the Sterling Telephone and Electric Co., Ltd., to take over that company's selling organisation, both in the United Kindom and abroad. In future the Marconiphone Co. will act as sole agents for the whole of the lines marketed under the widely known "Sterling" trade marks.

The registered office of the Marconiphone Co., Ltd., will continue to be Marconi House, Strand, London, W.C.2, and the showrooms at Marconi House will also be retained, but the management, sales, distributive and clerical staffs will shortly be transferred to the Sterling Co.'s present head office, viz., 210-212, Tottenham Court Road, London, W.1.

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"UTILITY" WIRELESS PRODUCTS.

A company having recently been formed under the style of "The Utility Trading Co., Ltd.," we have been asked by Messrs. Wilkins & Wright, Ltd., to point out that they are not associated with this new company, but have, for a period of over 50 years been making and selling products under the description "Utility." "Utility" wireless products by Messrs. Wilkins & Wright are already well known to our readers.

DX WITH AMERICAN WARSHIPS.

Two readers report exchange of communications with American warships in New Zealand waters.

During the early hours of Monday, August 17th, Mr. A. McFarlane (G6RM), of Croydon, picked up signals on 42 metres from the U.S.S. "West Virginia" (NEDJ), lying in Auckland Harbour, and was able to establish contact, using a wavelength of 45 metres.

On the same morning Mr. F. A. Mayer (G2LZ), of Wickford, Essex, obtained two-way communication with the U.S.N. destroyer "Litchfield" (NUMM), in Christchurch Harbour. The operator of this vessel requested that QSL cards should be addresed: "Radio Room, U.S.N. Destroyer "Litchfield," c/o Postmaster, San Francisco, U.S.A."

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BRITISH AND FOREIGN VALVE AGREEMENT.

An interesting collaboration has been arranged between Messrs. The Mullard Radio Valve Co., Ltd., and Messrs. Philips' Glow Lamp Works, Ltd., of Holland, whereby the English firm is entitled to the use of all Messrs. Philips' patents, with all improvements, both present and future.

Not only will the Mullard Co. be permitted to use the designs of Messrs. Philips' exclusive machinery, but they will have the advantage of the advice and assistance of the Dutch company's technical experts. The resources of the combined laboratories of the two companies will thus be united for the benefit of valve users.

While the agreement is in force no further Philips' valves are to be imported into Great Britain, Ireland or the Irish Free State.

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ITALIAN AMATEUR'S EXPERIMENTS.

Signor Pozzi Silvio, Corso Torino 1, Novaro, Italy is at present transmitting nearly every evening on 25 and 40 metres, using the call sign 1AS. He would be glad to receive reports from British amateurs who hear him.

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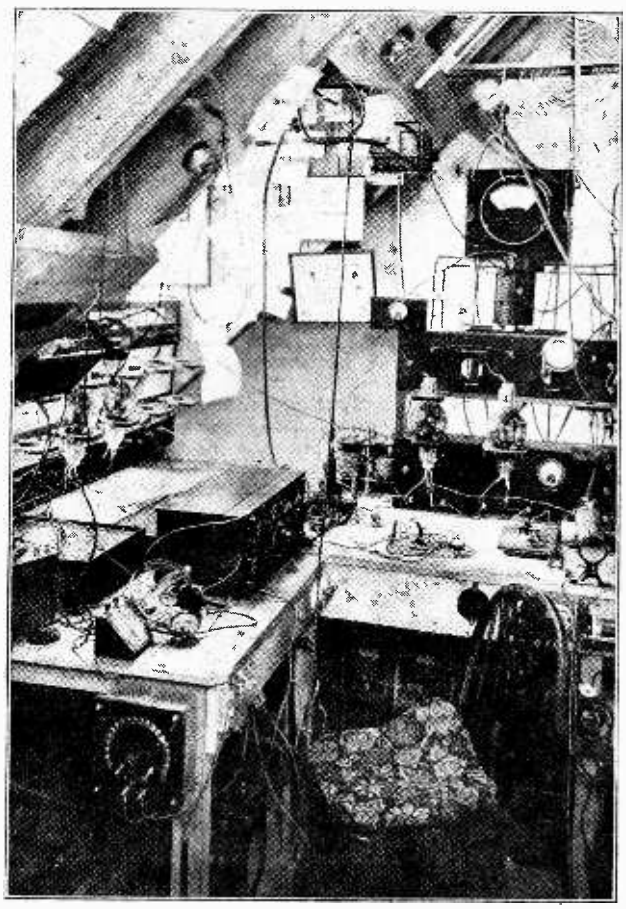
A WIRELESS INVENTOR.

Mr. Arthur Bower, who has been at Marconi House since 1911, is severing his connection with the company. He is abandoning the technical sphere of wireless for the purpose of devoting himself to the commercial side.

Mr. Bower is the inventor of a method for wireless reception without an aerial.



ANOTHER RECORD FOR 2NM. A new photograph of the transmitting and receiving equipment at the station of Mr. Gerald Marcuse, who has succeeded in communicating with Rome, Iraq, during daylight. Marconi T.250 valves were employed both for modulating and oscillating.

BIG GERMAN WIRELESS EXHIBITION.

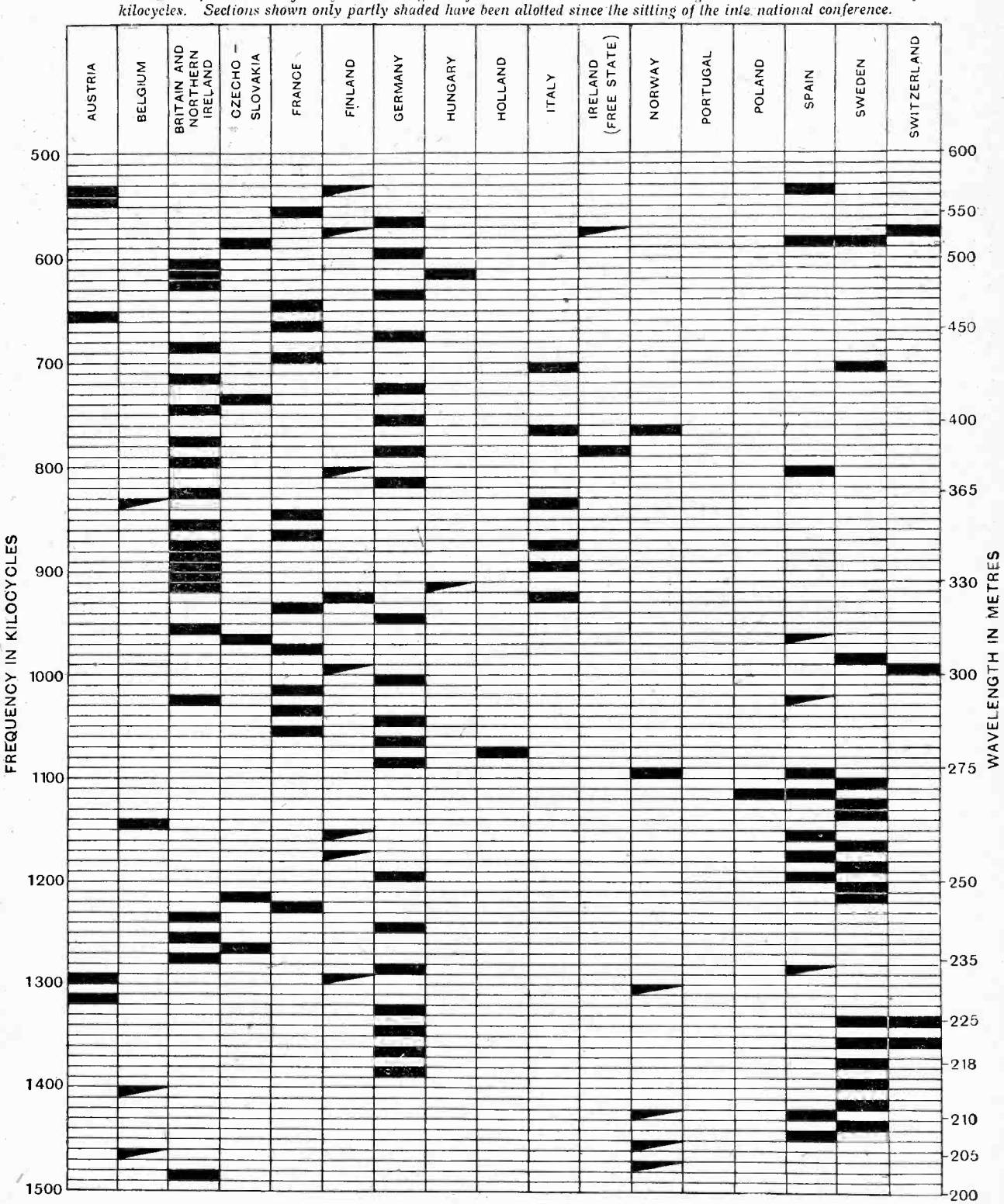
THE German wireless industry is undergoing rapid expansion in consequence of the Government decision, to take effect from September 1st, of raising the severe restrictions which have hitherto handicapped broadcasting in that country.

Added interest is therefore given to the great wireless exhibition to be held in Berlin from September 4th to 13th inclusive. The Kaiserdamm Hall, which will house the exhibition, has been specially built for the purpose; steel and iron and large masses of metal have been intentionally excluded in the construction of the building, which mainly consists of wood and concrete. Exhibitors will thus be able to operate their sets under highly favourable conditions. Standard indoor aerials will be used on every stand, so that the apparatus may be tested under fair and equal conditions, and each exhibitor will have the use of a sound-proof compartment for the purpose of auditions.

The management of the exhibition is in the hands of the Berliner Messe-ampt, Berlin, C.2, Breitestr. 35, and the interests of English-speaking visitors will be looked after by Mr. A. H. Farrell.

NEW WAVELENGTHS OF EUROPEAN BROADCASTING STATIONS.

A chart showing the allocation of wavebands to the various European countries, drawn up by the International Broadcasting Bureau at Geneva, with the object of minimising interference. The available wavelengths are divided into bands of 10 kilocycles. Sections shown only partly shaded have been allotted since the sitting of the international conference.



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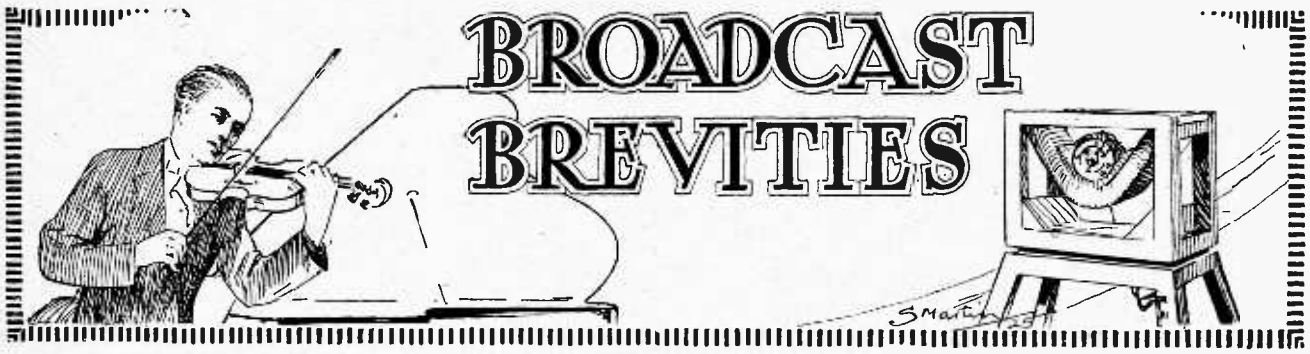

SAVOY HILL TOPICALITIES.

Trunk Lines.

The rearrangement of the trunk line system between the various stations first referred to in these columns in June last will come into force on September 14th, when a new sub-relay station at Leeds will be ready. At this sub-station the S.B. programmes to Leeds-Bradford, Hull, Manchester, Newcastle, and the Scottish stations will be amplified and purified before transmission to listeners. A similar scheme is in hand for the West and South-west of England, and a sub-relay station will later be brought into operation at Bristol. Reception in the districts named will not only be greatly improved, but the stations will be able to draw their programmes from these sub-stations instead of taking them direct from London.

oooo

Synchronised Broadcasting.

The bells of Buckfast Abbey, the most ancient of religious houses in Devonshire, were last Sunday relayed to Plymouth and broadcast from that and other stations of the B.B.C.; this was a fitting prelude to a religious service transmitted from Aberdeen and other stations. The experiment was of exceptional interest, as it foreshadowed the development of simultaneous and synchronised broadcasting schemes from different stations. There is no technical difficulty in the way of broadcasting a pianoforte accompaniment from Manchester to synchronise perfectly with a violin broadcast from London. The artists would be provided with headphones, and the effect would be identical with that obtained if the artists were present together in one studio. It would thus be possible for artists to fit in a broadcast performance with their other engagements in different towns, and so obviate the need of undertaking a train journey in order to appear before the microphone.

oooo

Experiments at 2LO.

Experiments have been proceeding during the past month with the transmitting apparatus at 2LO. Various changes have been made in the circuits of the sub-control and main controls in the actual transmitter. Not only is reception reported by listeners to be improved, but data have been obtained which will enable B.B.C. engineers to introduce changes at all the main stations, and any new set which may in future be installed at any station will be considerably altered in design.

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Stage Directions in the Studio.

During broadcasting "stage directions" are given to artists and orchestra by means of an indicator panel illuminated with red and white lights as required. The panels in the studios at present merely give two directions, "loud" and "slow." The B.B.C. are developing these indicators to cover orchestra, chorus, "effects," speakers and singers, and the list of directions on the panels high up on the wall facing the performers will be elaborated.

oooo

Concord in Calcutta.

Differences of musical taste recently threatened to produce an awkward situation in Calcutta's musical circles. A large number of wealthy Indians, belonging mostly to the Zamindar or land-holding class, have become interested in broadcasting, but their demand is for Indian music. The Europeans have a distinct preference for Western music. The Radio Club of Calcutta has solved the problem by broadcasting Indian and European music alternately.

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Redistribution of Wavelengths.

The Committee of Seven appointed by the International Broadcasting Conference at Geneva to redistribute wavelengths in Europe, have suggested the following revisions for B.B.C. stations:—

Station.	Old wavelength metres	New wavelength metres.
Aberdeen	495	496
Swansea	482	488
Birmingham	479	480
Belfast	439	438
Glasgow	422	420
Newcastle	403	403
Bournemouth	386	387
Manchester	378	377
London	365	363.5
Cardiff	351	351
Leeds	346	342.5
Plymouth	338	339
Hull	335	335
Dundee	331	331.5
Edinburgh	328	327.5
Liverpool	315	314
Nottingham	325	292.5

FUTURE FEATURES.

Sunday, August 30th.

LONDON.—3.30 p.m., Military Band Programme.
MANCHESTER.—3.30 p.m., Chamber Music.
GLASGOW.—9 p.m., Chamber Music.

Monday, August 31st.

BIRMINGHAM.—8 p.m., Grand Opera. 10.45 p.m., Late Transmission. Violin and Song Recital.
CARDIFF.—9 p.m., "L'Enfant Prodigue" (Debussy).
GLASGOW.—8 p.m., Traditional Music.

Tuesday, September 1st.

5XX.—8 p.m., Symphony Concert conducted by Percy Pitt, with Pouishnoff (Solo Pianoforte).
LONDON.—9 p.m., The Haslemere Festival of Chamber Music.

Wednesday, September 2nd.

LONDON.—8 p.m., "Old Masters."
CARDIFF.—8 p.m., "From Spain."
ABERDEEN.—8 p.m., Band of H.M. Royal Marines (Plymouth Division).
GLASGOW.—8 p.m., Light Classical Programme.
BELFAST.—7.30 p.m., Symphony Concert.

Thursday, September 3rd.

5XX.—9 p.m., The Haslemere Festival of Chamber Music.
LONDON.—8 p.m., Chamber Music.
MANCHESTER.—8 p.m., Symphony Concert.
GLASGOW.—8.45 p.m., The Old and the New in Song.

Friday, September 4th.

LONDON.—8 p.m., "Leaders of Men."
BOURNEMOUTH.—8 p.m., Scandinavian Programme.
NEWCASTLE.—9.15 p.m., Pianoforte Recital by Harold Samuel.

Saturday, September 5th.

LONDON.—8 p.m., "A Visit to the South Coast."
BIRMINGHAM.—8 p.m., A Musical Scena entitled "A Night in Italy."

Station.	Old wavelength metres	New wavelength metres
Bradford	310	245
Stoke	306	239
Sheffield	301	235.2

This is the first occasion on which any B.B.C. station will broadcast on a decimal of a metre. It will be noticed that four of the stations have been allocated wavelengths below three hundred metres, the minimum in the waveband fixed by the Postmaster General, whose sanction at the moment is awaited for the adoption of the new wavelengths before broadcasting tests can take place.

oooo

The Tests.

The tests will be held on the following nights, viz., August 31st, September 2nd, 4th, 7th, 9th and 14th, and in each case between 11 p.m. and 1 a.m. (G.M.T.), the equivalent for this country being midnight to 2 a.m. (B.S.T.).

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What the Stations Will Do.

The rules which Geneva regard as indispensable are as follow:—

(1) All stations without exception should take part in the trials whether their wavelengths are modified or not.

(2) During the whole course of each trial stations should use their full modulation.

(3) The call number of each station should be announced at intervals not exceeding one minute maximum, and the formula should be very definite. Instead of saying, for instance, "Constantinople calling," the announcer should say "Here Constantinople Station." The announcement should also be made in French.

(4) Music and speech should be transmitted alternatively.

(5) Listeners should communicate with the B.B.C. on the day following the test giving their observations on the transmission.

(6) Any discovery of interference will be at once wired to Geneva, which will reply instructing what steps should be taken to avoid a repetition of the interference at the following trial.

(7) The success of this general trial will depend particularly on the precision with which each station obeys instructions received from Geneva, even if such instructions appear contrary to local requirements. This should not prevent the various stations from informing Geneva as to points of divergence and these differences would be settled at Geneva at the Conference of September 21 and 22, when results of the tests will be compared.

oooo

Studio Audiences.

During recent weeks it has been found satisfactory to improvise an audience in the studio as an alternative to a broadcast from an outside theatre or hall, and the officials at Savoy Hill tend more and more to encourage the presence of artists and their friends during the broadcasting of items.

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The News Service.

A continental radio paper has stated that the B.B.C. is to conduct its own news service. There is, I understand, no such intention, but suggestions have been made that the news bulletins are badly in need of brightening up. They might be presented, say, in the form of "What has happened to-day." The range should be as wide as possible, and the matter presented in an interesting narrative form. A listener with a knowledge of "news values" objects to the presentation of the bulletins in the strictly newspaper form, where pressure on space renders condensation essential. "All broadcast," he says, "presents an excellent medium for the presentation of the day's happenings in a more exciting way."

oooo

New 2LO Studio.

In the arrangement of the new 2LO studio referred to in these pages a few weeks ago, as much scope as possible is being allowed for experiments as regards acoustics. Listeners of musical experience are probably sensitive to the faults of transmission due to the difficulties of resonance and time echo. The rearrangement of the draping material, which will be worked on pulleys, will, to a great extent, solve this problem, and attention will then be turned to the problem of replacing the reaction of an audience upon artists.

oooo

Daventry.

While Daventry is proving the means of serving the town and country listener, its further purpose of giving alternative programmes to main and relay stations throughout the country is being considered. If the B.B.C. is allowed to proceed further along the lines that it wishes to pursue, the power of some of its main stations will be raised as early as possible and plans for the provision of several alternative programmes will be developed.

oooo

What Will the "Policeman" Do?

These projects, however, as well as those of construction of another high power station and the duplication of the London Station, rest on the decision of the Government who, in the words of the Postmaster General at the opening of the Daventry station, have to police the ether and prevent it from becoming so overcrowded that the various services might interfere seriously with one another.

oooo

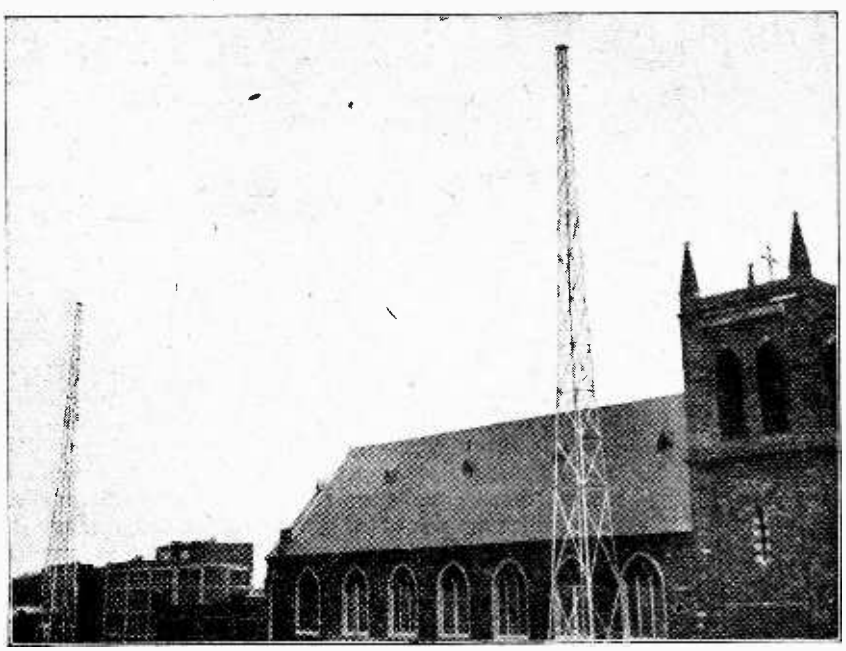
Improving Programmes.

In the meantime, the B.B.C. is taking seriously in hand the question of improving the Daventry programmes, and the policy to be pursued is, that if a programme is not good enough for 2LO, then it is not good enough for 5XX. Daventry, as the leading broadcasting station in the British Isles, should give listeners the best programmes available.

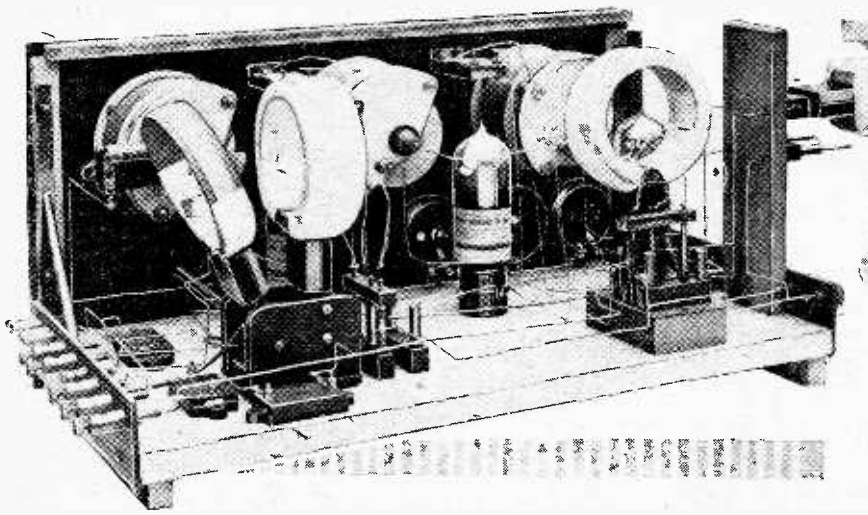
oooo

Interchange of Programmes.

The engineers of the B.B.C. are arranging a series of transmission tests during the coming winter as a prelude to the development of the interchange of programmes with the Dominions and foreign countries. Special experiments will be carried out on long wave transmission under certain conditions, and simultaneously it is hoped to transmit short wave signals, to ascertain how they will be picked up at considerable distances. The aim is to follow up the exchange of programmes between America, Canada and Europe with a similar exchange with South Africa and other of the overseas Dominions.



CHURCH AS A BROADCASTING STATION. The aerial system of the Paulist Fathers' Church in New York. A five-kilowatt telephony transmitter has been installed, with a wavelength range between 280 and 600 metres. The call sign is WPL.



H.F. AMPLIFIER DESIGN

The Importance of Stray Magnetic and Electrostatic Couplings.

By G. W. SUTTON, B.Sc.

IT is the purpose of the present article to discuss, in a brief and general manner, the principles underlying some present methods of constructing stable and selective H.F. amplifiers and to indicate suitable dimensions for a few components which the writer has found to be particularly satisfactory in their operation.

It must frequently happen that in building sets described in this journal some slight constructional modification is desirable to suit the particular requirements of the individual constructor. Unless the modification is made with an understanding of the consequent alteration of the circuit conditions, the result may well be to render the set most unstable or insensitive in operation.

Magnetic and Electrostatic Fields in Receivers.

It must be understood at the outset that inductance, which involves the presence of a magnetic field, is not confined to coils alone, neither is capacity, with its associated electrostatic field, confined to condensers. In general, we may say that, wherever current flows, the first type of field is set up, and wherever a voltage difference exists, there is a field of the second type. Consequently, even the shortest of leads between coils, condensers, valves, etc., has both its magnetic and electrostatic fields. Further, whenever either type of field embraces conductors other than those from which it arises (and this is always the case), "coupling" between those conductors results. By "coupling" is meant that a current in one conductor sets up a related current in the other. The design of a stable H.F. amplifier consists mainly in arranging for the proper control of all intentional or unavoidable couplings and in the elimination of all others.

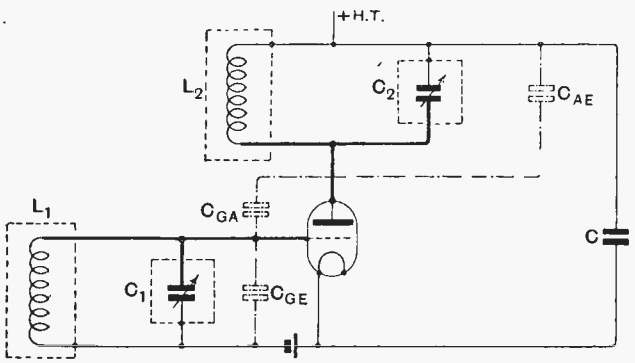


Fig. 1.—Stray capacities associated with a single valve H.F. amplifier. The wiring carrying H.F. currents at high potential is indicated by lines of double thickness.

Stray Couplings.

These stray couplings, both electrostatic and magnetic, between successive grid and anode circuits operate in one of two ways; either the sense will be such as to produce

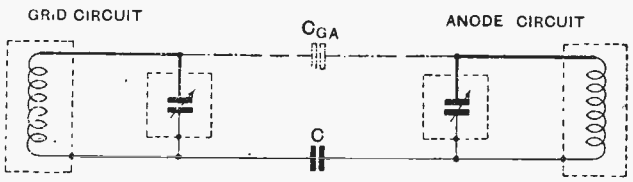


Fig. 2.—Schematic arrangement of the circuit in Fig. 1, showing capacities which are active in producing coupling between the grid and anode circuits.

positive reaction, and, therefore, a tendency to increased amplification, and finally to produce instability, or it will have the opposite effect of increasing the damping in the circuits involved. Under certain circumstances, of course, the stray capacity coupling may produce positive reaction, and the magnetic negative, or *vice versa*. This opens up the possibility of balancing out one stray coupling by another, of which more will be said later.

Of the two, stray magnetic coupling is more easily reduced to a minimum by careful shielding and spacing, though its potentialities appear to be frequently overlooked. Stray capacity couplings are much more difficult to handle. On wavelengths below about 1,000 metres, tuned circuits are found to be more efficient than those which are not tuned to the working frequency.[1] But the magnitude of stray capacity necessary to produce appreciable coupling between tuned circuits is very much less than that required when either is untuned. Conse-

[1] These are frequently but mistakenly referred to as "aperiodic" or "semi-aperiodic" couplings. From a scientific point of view the latter term is, of course, meaningless.

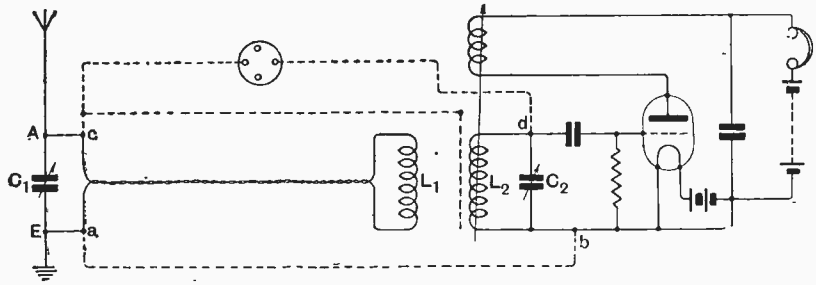


Fig. 3.—Circuit used to demonstrate the effects of small magnetic and capacitative couplings.

quently, as the efficiency is increased, the tendency to instability rapidly increases also.

The circuit diagram in Fig. 1 illustrates these points. The leads which are of principal importance as the seat of stray capacity couplings are those at high H.F. potential. The others may be either shielded or are at "earth" potential so far as H.F. is concerned, and the D.C. potential imposed by the anode battery is without effect so far as the points under consideration are concerned.

The stray capacities, then, may be considered as located in the imaginary condensers C_{GE}, C_{GA}, and C_{AE}. Of these, C_{AE} and C_{GE} are in parallel with the tuning condensers, and merely take part in the tuning instead of shunting useful current as they would with "untuned" inductance couplings.

By re-arranging the circuit as in Fig. 2, it is readily seen that C_{GA} forms a direct capacity coupling between the two circuits, and though it may be made no more than a few micro-microfarads, it is usually sufficient at the higher frequencies to set up oscillation.

An Illustrative Experiment.

Before discussing methods of dealing with these stray couplings, we shall describe a simple but illuminating experiment which most constructors will find it worth while to carry out before building a set.

The circuit L_1C_1 in Fig. 3 is connected to aerial and earth and tuned to the local broadcasting station. The leads from A and E to C_1 should be as short and direct as possible, while L_1 should be connected to it by twisted flexible leads about 2ft. long and mounted on a wooden or ebonite rod a foot or so long, so that it may be moved about without direct contact with the hand. The circuit L_2C_2 is connected to a detecting valve circuit—preferably with reaction—which is arranged as compactly as possible and carefully insulated. It should be placed on the side of the experimenter remote from the aerial and earth leads, so as to reduce direct coupling to the aerial system to a minimum.

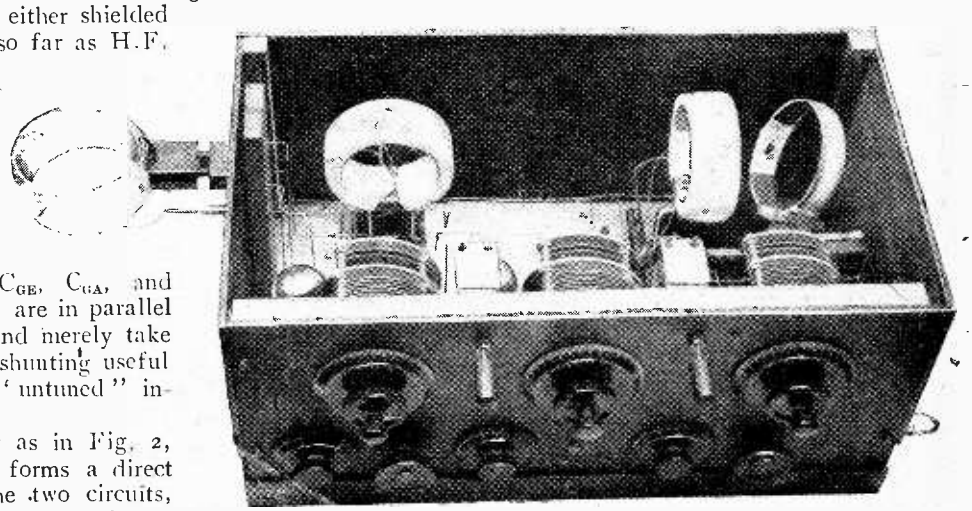


Fig. 5.—General view of the author's three-valve receiver, which includes two H.F. stages.

With L_1C_1 detuned, it will probably be found, unless the position is very close to the broadcasting station, that little or no reception is obtained on L_2C_2 direct. When L_1C_1 is tuned, however, reception is restored, its strength depending on the relative positions of L_1 and L_2.

With both circuits tuned, some interesting tests on the extent of stray magnetic couplings may be carried out. Firstly, L_1 should be held parallel to L_2 and on the same axis. It will then be found that quite audible signals are maintained up to distances apart of 18in. or 2ft. The coils should then be arranged with their centres the same height above the table, but with their planes at right angles. Under these circumstances they may be placed within an inch or two of one another without appreciable coupling, but very slight tilting in any direction is sufficient to restore reception.

Various other arrangements of the coils, such as the scheme of placing them on a level with their axes parallel and at an angle of about 60° with the horizontal may also be

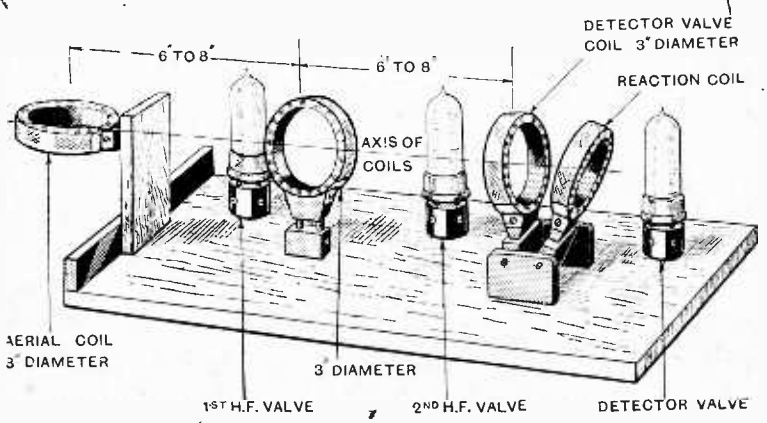


Fig. 4.—Distribution of coils adopted in the receiver in Fig. 5 to minimise stray magnetic coupling.

H.F. Amplifier Design.—

examined and an opinion formed of their efficiencies in reducing magnetic coupling to a minimum. The effect of screening may also be ascertained.

Electrostatic or Condenser Coupling.

In the above experiment electrostatic coupling between the two circuits was reduced to a minimum by keeping the circuits apart and as compact and well insulated as possible. A short experiment will now serve to illustrate the effect of very small stray capacities.

The coils should be placed perpendicular to one another, with their centres on a level and three or four inches apart. (This will doubtless have been found to be the disposition which enables them to be closest together with a minimum of magnetic coupling.) Upon connecting the points *a* and *b*, it will be found that considerable coupling has been thereby set up. This is due to the electrostatic field between the coils and leads, which was represented by C_{GA} in Fig. 2. The effect may be enhanced by connecting a piece of stiff wire at *c* and bending it near to the coil L_2; or the grid terminal of a valve holder may be connected to *c*, and the anode to *d*, with and without a valve in the holder.

By carrying out a few simple tests such as those just described, one is enabled to form a sound opinion of the importance of stray fields in the design and arrangement of H.F. amplifiers, and to estimate the best disposition of coils and leads on a panel.

Figs. 4 and 5 show a sketch and photograph respectively of an arrangement of coils for a two-stage amplifier which the writer has found to give very satisfactory results as regards minimising stray magnetic coupling.

Calls Heard.

Extracts from Readers' Logs.

Ashton-under-Lynn.

British:—2AYM, 2YO, 5MA, 5NW, 6JV, 6LC, 6MP, 6MX. *French*:—8NY, 8TK. *Dutch*:—OZA. *Spanish*:—EAR9. *Unknown*:—1NA, 3UI, 5TR, 3CA (calling 1AY).

(0-v-1) All on 60 to 100 metres.

K. Gooding (G2ARI).

Palestine.

American:—NKF, KCF, WIZ, WQN, WIR, WNP, WNG, 1AIR, 1WL, 1CKP, 1AXA, 1MCH, 1ARH, 1ARS, 1AAD, 1CCX, 1AHG, 2HA, 2BY, 2GBX, 2BEE, 2CTQ, 2AGB, 2GK, 2BP, 2XAF, 2BUY, 2KF, 3AFQ, 3BWJ, 3AHA, 4SA, 4OI, 4RM, 4CU, 8BGN, 9XN. *British*:—2AU, 2LZ, 2SZ, 2KF, 2UI, 2TF, 2HK, 2HG, 2NM, 2XY, 5DH, 5SZ, 5HZ, 5FT, 5LB, 6AH, 6GH, 6TN. *French*:—8AZ, 8BV, 8BY, 8DZ, 8CT, 8GZ, 8BN, 8SF, 8HO, 8ALG, 8TOK, 8QQ. *Swedish*:—SSMY, SMYY, SMLZ, SMXR. *Spanish*:—EARI, EAC9, EJX. *Italian*:—1DO, 1AS, 1AF, 1MT. *German*:—AGA, K6. *Iraq*:—1DH. *Yugo-Slavia*:—7XX. *Danish*:—7EC. *Finnish*:—2NM. *Dutch*:—OCDJ, OCTU, OCOB, PCUU, PCMM, OKI, OGN, OBA. *New Zealand*:—2AC, 2AE. *Unclassified*:—1AN, 1SY, 1ZF, 1LN, 1UF, 1UW, 2YT, 2TU, 3SH, 4US, 4ASK, 4AN, 4AF, 8WAS, 8PRI, LBM, CSF, AMO, POW, GSC.

(0-v-2) Cpl. B. Bond.

Leigh, Lancashire.

British:—2AOK, 2AOX, 2FC, 2II, 2KF, 2OO, 2QB, 2QV, 2SO, 2UA, 2VF, 2WY, 2ZK, 2ZU, 5CW, 5HG, 5HQ, 5HX, 5ID, 5OB, 5PO, 5QV, 5RZ, 5UA, 5UH, 5SQ, 6HS, 6IL, 6LF, 6LK, 6OK, 6OW, 6PW, 6SA, 6TW.

American:—1ACK, 2AGQ, 2AI, 2BCN, 2CWN, 2CJK, 2IU, 2CV, 3NMK, 8DBC. *French*:—8BN, 8CO, 8CZ, 8DFK, 8LM, 8OT, 8UD. *Belgian*:—4RS, E2. *Italian*:—1MT. *Holland*:—OBA. *Various*:—WIZ, WQN, 4CRS. (MB4, RS1AA)

(0-v-0) (35 to 500 metres.)

W. R. Stainton.

Glasgow, Scotland.

American:—3BWJ, 4OA, 5AI, 5NJ, 8AYY, 8BGN, 8BHT, 8BPL, 8BRD. 8BQ, 8BWB, 8CAU, 8CAZ, 8CJP, 8CLV, 8DAE, 8DO, 8DON, 8ES, 8LF, 9AUW, 9BBJ, 9BKR, 9BHT, 9CXX, 9FF, 9FK, 9XN, NRRL, WAP, WNP. *Canada*:—2BE, 2CG, 3AA, 9CH. *Cuba*:—2LR. *Argentina*:—CB8. *Brazil*:—2SP. *Chile*:—1EG, 2LD. *New Zealand*:—2AC, 2XA, 4AR.

(0-v-1 Reinartz) G. Rattray.

Brierfield, Lancs.

American:—WIZ, WGY, NKF, 4ASK, 4SA, 1ACI, 1AAO, 1CAK, 2 AGY, 1CUK, 2BGI.

(Heard July 28th, on 40 metres and below.) V. Sewell.

Alton, Hants.

July 30th to August 8th, 1925.

British:—2CA, 2DF, 2HP, 2KZ, 2MK, 2NM, 2NS, 2OD, 2OQ. 2OY, 2VR, 2XM, 2XX, 2XY, 2ZB, 2ZG, 5BY, 5IO, 5OK, 5YK, 6FQ, 6IV, 6SO. *French*:—8BP, 8CAX, 8CHR, 8CK, 8GRA, 8HSG, 8LMH, 8MA, 8NY, 8PRD, 8RW, 8TI, 8VTI, 8XF, 8XH, 8XI, 8YB, 8Z3. YZ. *Dutch*:—OCO, OKG, OMS, OPM, ORM, ORO, OXX. *Belgian*:—4RE, K3, K2, 4VA. *Sweden*:—SMLZ, SMAQ. *U.S.A.*:—1ACK, 1AMP, 1CCX. 1CMP, 1QD, 2AFN, 2BBJ, 4AIL, 5ADL, 5RTU, 8JK, 8JMA, 9CCX, 9QAK, 9XW. *Argentine*:—A8. *Others*:—WIR 7HJG, 1AU, 9DE, 99X.

O. W. Nicholson (G6MP).

Brockley, S.E.4.

Australian:—2CM. *Brazil*:—1AF, 2SP. *Canada*:—1AR. *Porto Rico*:—4OI, 4SA. *Macmillan Arctic Expedition*:—WAP. *American*:—1AAO, 1ACB, 1ACI, 1AHG, 1AIR, 1AMS, 1ANQ, 1ARH, 1BHM, 1BQ, 1CAK, 1CCX, 1CDA, 1CKK, 1CKP, 1PL, 1UU, 1UW, 1XU, 2AFN, 2AGQ, 2BEE, 2BQI, 2BR, 2BY, 2BYW, 2CTQ, 2GK, 2HA, 2MU, 2WC, 2XAF, 2XAP, 3HG, 3JW, 3WO, 4RR, 8CLC, 8DON, 8EB. 8SF, 9FF, WIR, WIZ. *Finland*:—1NA, 2NM. *Sweden*:—SMVL, SMXS, SMXU, SMYY, SMYZ. *Jugo-Slavia*:—7XX. *Italy*:—1AA, 1AF, 1AS, 1WB. *Spain*:—EAR6, EAR9, EAC9. *Chile*:—1EG. A. J. Perkins.

(0-v-1.)

Madeira.

American:—7MQ, 1BKK, 1BEE, 1AAO, 3CW, 4RR, 2CTH, 1ANE, WNP, 1XU, 1AILW, 1ADM, 4AF, 8JZ, 4ER, 1AC, 2CTK, 2LS, 6CTO, 3BG, 1RR, 1AE, 1ARE, 1CMO, 2BUY, 5AIL, 1ACI, 1AHG, 2HA, 2HZ, 1ZA, 1AHG, 1AR, 1PL. *Great Britain*:—5DH, 2SZ, 2LZ, 2CC, 2DX, 6TM, GCS. *French*:—Maroc, YZ, 8TOK. *Dutch*:—OCTU, PCMM, PCUU. *Brazilian*:—1AF, 2SP. *Unknown*:—SMYY, 2YT.

A. C. de Oliveira (P3CO).

Stations Unknown.

We print below a list of stations which some of our correspondents wish to identify and shall be glad if any of our readers can furnish us with the desired particulars.

AGA, POF, received on 20 metres, COR, ENS, KXH.

Stations Identified.

KY4, Rolf Fornis, Alexanderstrasse 21, Stuttgart. HDG, M. Martin, Route de Limoge, Montluçon, France.

Miscellaneous.

Mr. G. A. Jeapes, "Chandos," Station-Road, Great Shalford, Cambs., asks us to state that his call sign is G2XV. He has recently received cards intended for 2XY and 2VX.

Mr. T. Geeson (2SO), of Macclesfield, informs us that he heard G2VO, Mr. A. C. Holmes, of Keighley, calling M1DH, Mosul, and then picked up the reply from Mosul when using only one valve. Mosul came in quite steadily, on 37 metres, at about R3, while G2VO was transmitting on 44 metres on an input of 6 watts. This is thought to be a record for reception on one valve, taking into consideration the low power and distance.

KITE AERIALS.

Some Tests on Crystal Set Reception.

By E. A. Anson.

TAKING portable wireless sets on summer excursions has become very popular this year, and *The Wireless World* has published several articles on portable receivers for this purpose. Although the sets themselves are compact, the aerial usually has to rely upon a tree for support. There is generally a tree handy for this purpose, but those who take a set to the moors or sand dunes by the sea will find trees scarce and very unsuitable. Besides, it is hampering to be forced to restrict picnic sites to places near trees in a big area. Happily, this article will show that in just these districts the kite aerial is a very excellent substitute—in fact, an improvement on the normal home aerial.

The first consideration is the kite itself. To be suitable, it must be easily erected, strong, quite portable, and, above all, must fly steadily for long periods without attention. Roach's Brighton triangular tailless kites, No. 2, are very suitable; all the tests mentioned here were carried out with a kite of this type. It is roughly 2ft. 6in. by 3ft. 2in., and folds away into a bundle 3ft. 2in. by 1½in. Although this kite will fly without a tail, it was found that it flew much more steadily with a short tail about 8ft. long—in fact, this kite has flown for six hours on end with an aerial attached.

Arrangement of the Aerial.

The aerial consisted of 100ft. of No. 3/26 copper wire fastened to 150ft. of fishing line and then the kite. The line was attached to the aerial by a small home-made ebonite bobbin. This system of aerial and line permits considerable movement of the kite without much alteration of the position of the aerial, also the kite rises clear of local eddies. The aerial and line must be wound on a reel of some kind that can be revolved for winding purposes. A fair-sized fishing reel makes an excellent winder. It is absolutely essential that something of this type be used. The optimist who goes out with the line wound round a stick or in coils will find things resembling a cocoon rather than an aerial; wire and string once out of control assume quite the most depressing tangle ever seen.

The sketch in Fig. 1 shows the aerial kite system. The following tests were made at a house by the sea and almost on the dunes. In this case a water-pipe earth was used, but for reception on dry sand as found amongst the dunes a counterpoise was best. This consisted of 100ft. of twin lighting flex untwisted into two and laid out in a "V" under the kite aerial. At the time of these tests the wind was very strong and gusty from the west. The movement of the kite and aerial was not noticeable on headphones, but the microammeter needle moved up and down slowly about 3 microamps from a maximum of 20 microamps and a proportionate amount for other readings. The circuit used was a simple crystal circuit shown in Fig. 2.

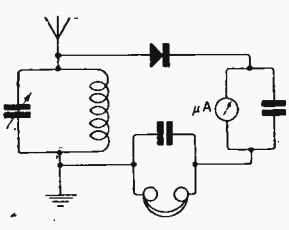


Fig. 2.—Connections of the crystal set.

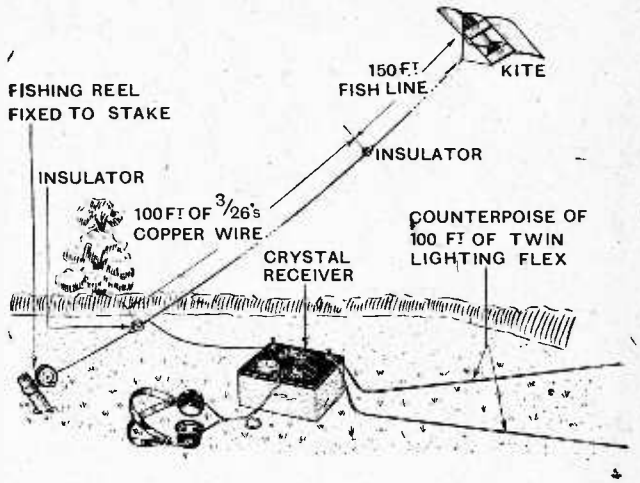


Fig. 1.—General arrangement of the apparatus for the tests.

The first test was on the afternoon transmission from 2EH. This station was ten miles away and is a relay station, not a powerful main station. Fig. 3 gives a reception curve for various lengths of aerial, and is derived from the table below :—

Length of Kite Aerial in Ft.	Rectified Current. Microamps, 2EH.	Aerial Capacity. Microfarad.
140	28	.00034
120	20	.00029
100	12	.00024
80	8	.00019
60	4	.00015
40	1	.00012
Home Aerial, 100ft. × 35ft.	6	.00027

A study of this result will show that a kite aerial 100ft. long gives twice as good results as the home aerial, and the kite aerial has a lower capacity by a small amount. The permanent home aerial is a very good aerial, and may be considered better than many aerials used for broadcast purposes. Another aerial, about 25ft. high, only gives 2 microamps of rectified current on the same

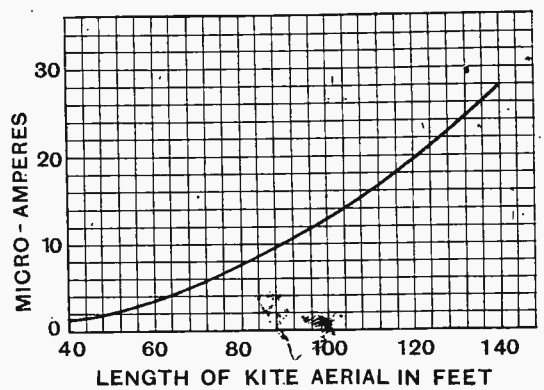


Fig. 3.—Curve showing the relationship of rectified current to the length of the aerial.

Kite Aerials.—

crystal and earth. A better adjustment of the crystal gave results as in the table below :—

Length of Kite Aerial in Ft.	Rectified Current. Microamps, 2EH.
140	35
120	22
100	14
80	8
Home Aerial.	7

With the same crystal setting, measurements were next made on 5SC, distant about fifty miles, and the following table compiled :—

Length of Kite Aerial in Ft.	Rectified Current. Microamps, 5SC.	Aerial Capacity. Microfarads.
140	2.0	.00031
120	1.4	.00027
100	0.7	.00024
Home Aerial.	0.3	.00027

Loud-speaker Results.

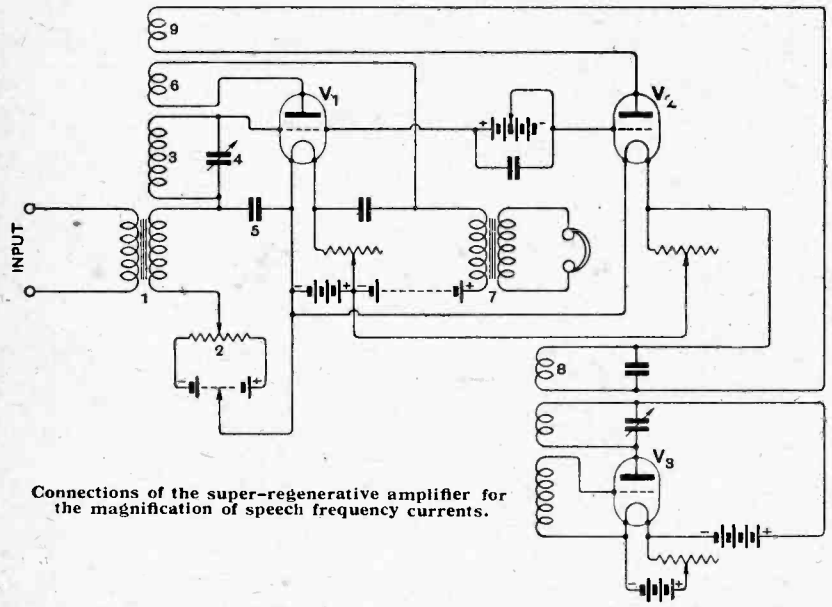
Speech from 5SC was just understandable on the home aerial, and with a rectified current of 35 microamps from 2EH speech was about R4. Rudiments of speech could be detected with a rectified current of 0.05 microamp and lower still. Good loud-speaker results were obtained on 1-V-1 with a station that gave 0.2 microamp on the crystal. Loud-speaker results were possible on weaker signals than this, but called for more reaction and critical adjustments, and the quality was spoiled by the magnification of parasitic noises.

These tests clearly indicate that the kite aerial can fill a gap in outdoor radio that cannot be filled in any other way. Such an aerial is not difficult to handle, but do not omit to make the reel fast to some secure support before flying the kite. Otherwise this is forgotten afterwards, and the sight of your portable wireless set emitting music as it slowly drifts above the heads of a thickly populated seaside beach might well cause consternation to the uninitiated.

A NEW SUPER-REGENERATIVE CIRCUIT.

Magnification of L.F. Currents.

THE principles of the super-regenerative receiver for the magnification of wireless signals are probably well known to readers of this paper, and the new circuit for the magnification of L.F. currents illustrated here appears to be based on similar principles. A valve with its plate and grid circuit retroactively coupled is furnished with a quenching arrangement so that it is in the super-regenerative state, while the L.F. currents to be amplified are applied to the grid circuit, which also includes an oscillatory circuit tuned to a high frequency. In practice this tuned circuit is given a frequency which is high compared with the quenching frequency, with the result that a degree of amplification is obtained which varies with the natural frequency of the tuned circuit and varies inversely with the quenching frequency.



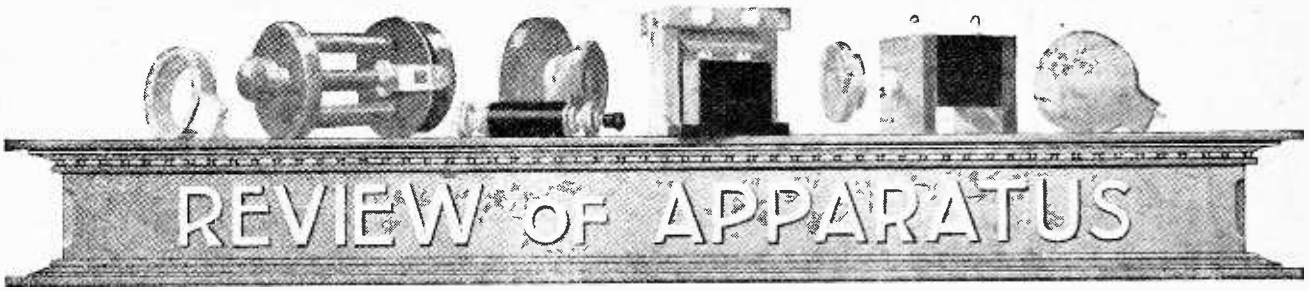
Connections of the super-regenerative amplifier for the magnification of speech frequency currents.

Referring to the illustration, which shows the connections of an amplifier suitable for magnifying speech currents,[1] the input to the grid of V_1 is by means of a transformer, 1, and the operating point of the valve can be fixed by means of the potentiometer 2. The grid circuit also contains a tuned circuit, 3, which can be adjusted by the condenser 4, the condenser 5 serving as a H.F. bye-pass.

In the anode circuit of V_1 is connected the reaction coil 6, telephone transformer 7, and the plate battery. The grid of valve V_2 is connected in shunt with that of V_1, the effective resistance of V_2 being varied at the quenching frequency by a valve, V_3. This valve has the usual circuits for generating oscillations, and the frequency is normally adjusted to a value just above the limit of audibility. For the magnification of telephone signals, for instance, the anode circuit of valve V_3 may be tuned to 20,000 cycles, and the natural frequency of circuit 3, 4 may be 10,000,000. Circuit 8 takes a supply of oscillating current which passes through the reverse reaction coil 9 for quenching.

Although for the amplification of speech many forms of quenching apparatus may be employed, that shown in the figure relies upon the quenching due to variation of the positive or negative resistance of the circuit of valve V_1 by the reversed reaction coupling. The arrangement also partly acts as a variable shunt to the grid circuit of the valve V_1 provided by the second valve V_2, the effective resistance of which is varied at the quenching frequency.

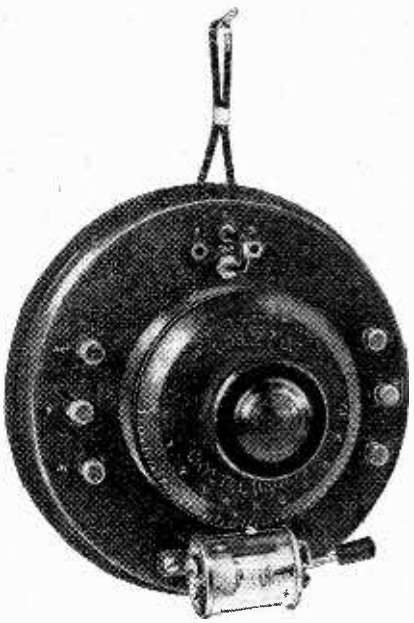
[1] British Patent No. 236,979, by J. B. Bolitho.



Latest Products of the Manufacturers.

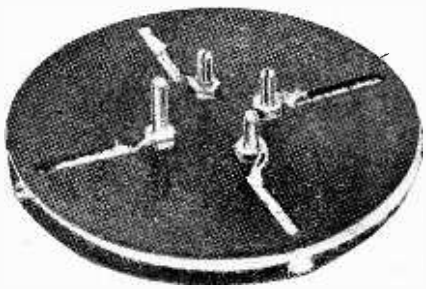
COSMOS CRYSTAL RECEIVER.

MESSRS. METRO-VICK SUPPLIES, LTD., 4, Central Buildings, Westminster, S.W.1, have placed on the market concurrently with the opening of the Daventry station a very compact crystal receiver of new design. The base of the receiver is



Cosmos crystal receiver.

circular and carries in the centre a tuning condenser. At one side of the base is mounted the crystal detector, and diametrically opposite to it a series of four plugs with a short-circuiting connection which enables the tuning condenser to be connected alternatively across one-third, two-thirds, or the whole of the tuning coil. In appearance this coil resembles an H.F. transformer, and is plugged into four sockets in the hollow base of the instrument. The spacing of the clips holding the crystal detector is such that the Cosmos "Permtector" may be substituted for the more usual galena and catwhisker detector. A loop is provided at one side of the base and it is intended that the set should be hung on the wall. The knob of the tuning condenser is shaped so that the telephones may be hung upon it when the set is not in use. The instrument is robustly constructed and well finished.



Tapped tuning coil and "Permtector," for use with the Cosmos crystal receiver.

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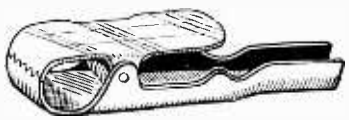
CLIP CONNECTIONS.

For experimental work a spring clip connection similar in construction to an ordinary tie-clip has innumerable applications. It is particularly useful in work with transmitting apparatus where adjustable tappings have to be taken from inductances wound with bare wire. The clip connections manufactured by Messrs. S. H. Collett, 52-54, Hampstead Road, London, N.W.1, are very strongly made,



Collet clip connector.

and are provided with a neck of large diameter capable of holding thick stranded cable as well as the ordinary gauges of connecting wire and flex.

°°°°

COLUMBIA RADIO BATTERIES.

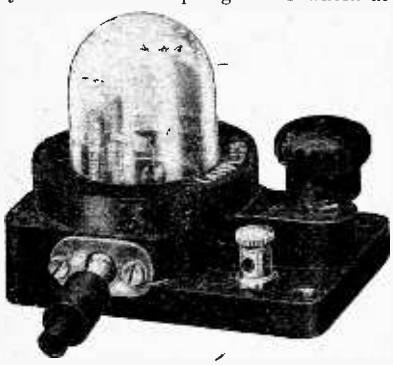
Dry cell batteries, whether for filament heating or for plate current, are apt to be troublesome components unless care is taken to choose batteries of suitable capacity for the demands made upon them. Years ago it was known that the dry cell battery was only suitable for supplying intermittent loads, and they were used in electric bell and telegraph and telephone installations. With the coming of broadcasting and the use of amplifying valves, dry cells which would supply a small continuous current for

New Columbia H.T. battery.

fairly long periods were developed, but of late it has been recognised that these small batteries are quite unsuitable for supplying economically the relatively large plate currents required by modern receivers. A set with four valves having a low impedance valve in the output stage may take a plate current as high as 20 milliamperes, and to deliver this load satisfactorily large and carefully constructed dry cells are required. While a battery of small cells will give this current for a time, a battery of twice the capacity will probably last three times as long. The battery illustrated here, known as the Columbia battery and manufactured by the National Carbon Company, is a heavy duty battery, designed for furnishing large currents for lengthy periods. The battery illustrated is of 45 volts with a tap of 22½ volts, and measures 8 3/16 in. × 7⅛ in. × 3½ in., and will economically deliver currents of 30 milliamperes. It is a well-made component, and of convenient size, and it is to be recommended. The distributing agents in this country are Messrs. J. R. Morris, 508-509, Imperial House, Kingsway, London, W.C.2.

A NEW CRYSTAL DETECTOR.

The Lamplugh micrometer crystal detector has many features which should appeal to the discriminating amateur. The crystal is held in spring claws which are



The Lamplugh micrometer crystal detector.

opened by pressing the plunger in the end of the adjusting arm. This arm is carried in a ball joint so that any point on the crystal may be brought into contact with the catwhisker which is normally stationary. For final adjustment, however, a micrometer movement is imparted to the catwhisker by the knurled knob on the front of the base. This knob moves the point, which is carried on a cross piece between vertical guides, through the medium of a lever in the base of the instrument.

The body of the detector is a massive ebonite moulding, as rigidity is essential if the micrometer adjustment is to be a success. The crystal and catwhisker are protected from dust by an easily removable glass dome, and a white background let into the base facilitates the preliminary adjustments.

The detector is manufactured by Messrs. S. A. Lamplugh, Ltd., Kings Road, Tyseley, Birmingham.

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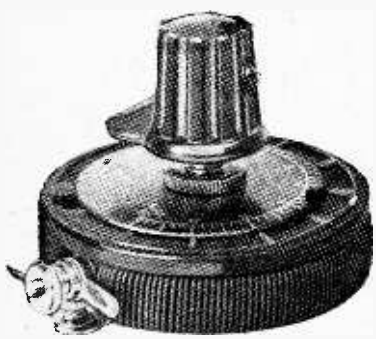
LISSEN WIRE RHEOSTAT.

The wire-wound filament rheostats and potentiometers manufactured by Messrs. Lissen, Ltd., Woodger Road, Goldhawk Road, London, W.12, follow standard practice in design and are very neat in finish and appearance. The resistance element which is wound on a strip of insulating material is well fitted to the moulding and does not move under the pressure of the contact arm.



Lissen wire-wound filament rheostat.

A "one-hole fixing" bush is incorporated in the moulding and an engraved circular dial for fitting to the front of the receiver panel is also provided.

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AMPLION IMPROVEMENTS.

Messrs. Alfred Graham & Co. have recently introduced some minor modification in the construction of their loud-speakers, of models A.R.114, A.R.19, and A.R.23.

The flare is now fitted with a threaded metal screw and is firmly held to the sound conduit by a heavy rubber bush, which, in providing a secure fixing, permits of the loud-speaker being readily dismantled. The oak and mahogany horns are constructed in an improved manner by the introduction of metal ribbing between the wooden sections and round the front edge of the flare. This latter modification renders the loud-speaker much more durable, producing a robust construction and adding very much to the appearance.

The Amplion loud-speaker requires no endorsement as to performance, and one of the standard "Dragon" A.R.19 models recently tested gave the excellent reproduction typical of this class of instrument.

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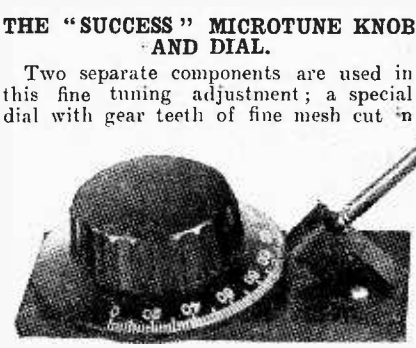
THE "SUCCESS" MICROTUNE KNOB AND DIAL.

Two separate components are used in this fine tuning adjustment; a special dial with gear teeth of fine mesh cut in



Geared dial and vernier adjustment by Messrs. Beard and Fitch, Ltd.

the periphery, and a bearing pillar carrying a pinion wheel and fine adjustment knob. The bearing pillar is of ebonite, and is at about 45° to the receiver panel, being held in a suitable position by two screws. The pillar is bushed to take the pinion shaft.

Normally the pinion is held away from the geared dial by a spiral return spring, so that excessive wear of the gears during rough adjustment is avoided. By depressing the fine tuning knob the gears are engaged and a 20 to 1 movement of the main dial is obtained. It is interesting to note that the spring adjustment on the pinion enables the gears to be properly meshed, and that there is consequently an entire absence of backlash.

The manufacturers are Messrs. Beard and Fitch, Ltd., 34, Aylesbury Street, London, E.C.1.

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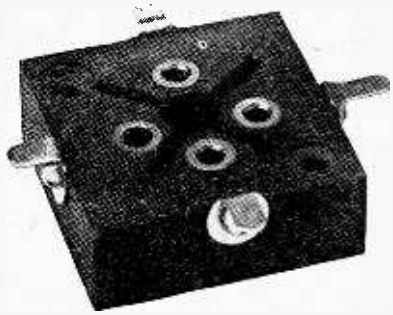
LOW-LOSS VALVE HOLDER.

The valve holder for short wave work made by Messrs. N. B. Webber and Co., Ltd., Vale Road, Oaklands Park, Wey-

bridge, is constructed from ⅛ in. sheet ebonite of best quality. The valve sockets are connected by means of lateral screws to soldering tags on the sides. In order to reduce capacity between the sockets and losses in the dielectric, slots



Low capacity valve holder for short wave work.

have been cut to remove as much of the ebonite between the sockets as is consistent with mechanical strength.

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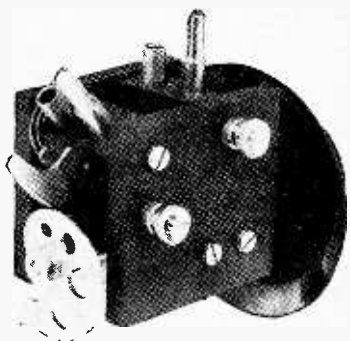
WOODHALL VERNIER COIL HOLDER.

The chief merit of this component is its compactness. It will be apparent from the photograph that the space occupied when the coil holder is mounted behind the panel is very small. A further advantage is that the movement of the coils is at right angles to that usually adopted, a feature which should prove useful when arranging the layout of components in portable sets where space is limited.

The moving coil holder is loosely mounted in holes in the ebonite side pieces, and its movement is controlled by two spiral return springs and a cam wheel actuated from the front of the panel. A 90° movement of the coil is thus obtained with a 360° movement of the tuning dial. The graduated dial itself is pressed from sheet material.

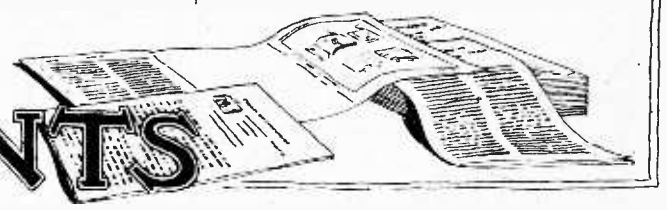
Terminals for each coil are fitted at the sides, and direct connection is made to the coil plugs and sockets in the case of the moving coil through the spiral springs.

The manufacturers are The Woodhall Wireless Manufacturing Co., Ltd., 21, Garrick Street, W.C.2.



Compact vernier coil holder for panel mounting.

The LAW of PATENTS



The Origin and Utility of "Letters Patent."

By OUR LEGAL CORRESPONDENT.

PRIOR to the year 1623 the Crown had found the granting of monopolies in all sorts of arts and manufactures a very lucrative business, and one which seemed capable of almost endless expansion. But this enterprising procedure, though a very good thing for the Monarch, was extremely bad for the industry of the country owing to the restricted trade and enhanced prices which resulted from it. Parliament, which in those days was just beginning to feel the fullness of its power, had struggled for long against this abuse of the Royal prerogative, and finally, towards the close of the reign of James I., put an end to it by the passing of the famous Statute of Monopolies. This statute declared that all future grants of monopolies should be void except "... any letters patent and grants of privileges for the term of fourteen years or under hereafter to be made for the sole working or making of any manner of new manufactures within this realm to the true and first inventor and inventors of such manufactures which others at the time of making such letters patent and grants shall not use, so as also they be not contrary to the law or mischievous to the State by raising the price of commodities at home or hurt of trade or generally inconvenient . . ." The whole of the present law of patents is based on this section of the Act of 1623, which, having been gradually elucidated and crystallised into concrete form by the decisions in numerous cases, is now embodied in the Patents and Designs Acts of 1907 and 1919, of which the former is the principal, and the rules made thereunder.

Correspondence indicates that many readers are unfamiliar with the law relating to the granting of patents. In this article our Legal Correspondent explains how a patent should be taken out, who may apply for a patent, and what constitutes a patentable invention.

A "Patent" is, or more correctly "Letters Patent" are, the open record of the Crown in Chancery of the fact that the patentee has been granted a monopoly in the use of a certain invention. It is incorrect, though quite usual, to call the invention itself or the monopoly a "patent."

Who May Take Out a Patent?

Referring to the above quoted section of the old Statute, we find the answer to this question in the words: "the true and first inventor and inventors of such manufacture." This seems plain enough, but it has been the centre of much litigation and calls for some consideration here.

In the first place a would-be patentee has to make a declaration that he is in possession of an invention of which he claims to be the true and first inventor. He must, therefore, be in a position to make a true declaration to this effect, and for that reason he must be the true and first inventor of every part of that which he claims to have invented.

The Patents and Designs Act of 1907, which contains most of the law on the subject at the present time, says that a patent may be applied for by "... any person ..., whether he is a British subject or not." "Any person" includes children and lunatics, and, though followed by the word "he," women and girls also. Decided cases, however, show that alien enemies and persons who have found things out through their employment as public officials cannot be granted patents.

Where there are a number of "true and first inventors," all must apply together for the patent, which will be granted to them jointly. But as long as the inventor, or all of them if more than one, is included, any number of outsiders may join in the application. Thus, where a member of a firm invents something the whole firm may apply for protection, provided the actual inventor applies with them.

It sometimes happens that two or more persons separately invent the same thing, but the only one who succeeds in patenting it is not the one who first thought it out. That is owing to the legal meaning of the words "first inventor." In this respect they do not necessarily mean the first man to think the thing out in his own mind, which would be a very difficult point to decide, but he who, having thought it out first, makes it public. The invention, however, must not be made public before it is patented, and therefore the meaning of the words really amounts to "the first successful applicant for the patent." If, therefore, you have invented something of value patent it at once or you may be forestalled.

What May be Patented?

To this question again we find an answer in the words of the old Statute which speaks of "grants of privileges for the sole working or making of any manner of new manufactures." The word "manufactures" is here the crucial word, and we find an admirable exposition of it in the following words of Lord Tenterden (then Chief Justice Abbot): "Now the word 'manufactures' has

The Law of Patents.—

been generally understood to denote either a thing made, which is useful for its own sake, and vendible as such, as a medicine, a stove, a telescope, and many others, or to mean an engine or instrument, or some part of an engine or instrument, to be employed either in the making of some previously known article, or in some other useful purpose, as a stocking frame or an engine for raising water from mines." Though this dictum is a hundred years old it is fully applicable to the Act of 1907 and the law of the present day.

But obviously not all manufactures are patentable, they must be "new manufactures." That is, they must be new within the realm, new to the British public. Therefore, a thing which is not new in a foreign country may still be patented here if not previously known in this country.

From this we see that the full answer to the question, "What can be patented?" is that it must be something which is new in this country, and something made which is useful and saleable for its own sake, or with which something useful can be done. Utility is, indeed, very forcible evidence of newness, for if the production of a thing is immediately met with a demand, which would not occur if it were not useful, it is fairly conclusive that there had previously existed an unsatisfied need.

The new discovery of a natural phenomenon cannot be the subject of patent rights, but the discovery of such a phenomenon together with a method of applying it to some useful purpose may be. And a new application of an old principle has been held to be a good subject equally with a new principle to be applied in the same manner as an old and known one. As was said by the Master of the Rolls in the case of Lyon v. Goddard, the question is: "Has there been an exercise of the inventive faculties? That depends upon a true view of all the circumstances, and it cannot be governed in any one case by the finding of fact on a totally different invention."

Application for Patents.

Grants of patents are made through the Patent Office, at 9, Southampton Buildings, Chancery Lane, W.C., from whence also the necessary forms may be obtained. The forms most usually required are the following, but there are in all thirty-nine forms for various purposes. The fees are paid by the means of stamps affixed on the forms.

No. of Form.	Subject.	Fee.
1	Application for Patent	£1
2	Provisional Specification	—
3	Complete Specification	£3
6	Application for extension of time for leaving Complete Specification (maximum extension one month)	£2

In an ordinary case there are two methods of applying for a patent. They are:—

(1) The submission of one copy of form No. 1 and two of No. 2 in the first instance, and a copy of No. 3 any time within nine months afterwards, or,

(2) The submission of one copy of form No. 1 and two of No. 3 together. One copy only of the last-mentioned form need be stamped, but in other respects they must be identical.

Typewriting or printing is recommended, but handwriting will be accepted if very clear and in permanent black ink. One side only of good quality white foolscap should be used and a quarter margin left blank.

Preparing Specifications.

The Provisional Specification must contain, besides the name and other particulars of each applicant, the title of the invention, and a fair and clear description of it. In this document the invention need not be described in detail, and drawings are not obligatory. The Provisional Specification must be dated at the foot and signed by each of the applicants, if more than one.

The Complete Specification is a document which requires the most careful preparation, and must be submitted within nine months (unless extension to ten months is obtained) of the date of the Provisional Specification, otherwise the application will be deemed to have been abandoned. This form also contains particulars of the applicants and the title of the invention, all of which must correspond exactly with those given on the previous form. This specification must contain such a full and complete description of the invention as would make it possible for a competent workman to carry it into effect without any further instructions. Drawings are generally necessary with the Complete Specification, which should be entirely independent of and complete without the Provisional Specification, but must be about the same invention.

This document concludes with a statement of claims showing what is claimed to have been invented. The form contains the proper preamble for this statement. It must be signed and dated as in the previous case.

Duration of Patents.

The normal term of an original patent is sixteen years, but its continuance beyond four years is subject to the payment of an annual renewal fee before the expiration of each current year.

Payment in this case also is made by the means of stamped forms, the appropriate form being No. 14. This form, stamped £5 and submitted before the end of the fourth year, entitles the patentee to the renewal of his patent up to the end of the fifth year. The fee for the sixth year (payable in the same manner before the end of the fifth year) is £6, and that for the seventh £7, and so on, increasing by £1 every year up to the end of the sixteenth year. All or any of these fees may be paid in advance. No days of grace are allowed, but extension of time for renewal may be granted on payment of a maximum fee of £20.

Any extension of the term of a patent beyond sixteen years can only be granted by an order of the Court.

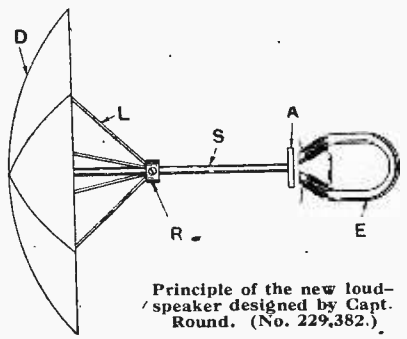
The various publications of the Patent Office, most of which are of considerable interest to inventors and others, may be consulted free of charge at the Patent Office Library and also at the public libraries in about twenty-six of the larger cities and towns in the country. They are also on sale at the Patent Office, from whence a complete list may be obtained gratis.

RECENT INVENTIONS

Brain Waves of the Wireless Engineer.

A New Loud-Speaker. (No. 229,382).

Captain H. J. Round, whose name is familiar to wireless amateurs, describes in British Patent No. 229,382 the construction of a loud-speaker. The loud-speaker, one modification of which is illustrated in the accompanying diagram, is of the horuless type, the diaphragm being of rather large size. The arrangement very much resembles an umbrella or parasol. In the illustration it will be seen that the umbrella-like structure is composed of a diaphragm D of paper, silk, or similar material stretched on a series of ribs, which are connected by links L to a ring R, which is pinned to a shaft or stick S. The end of the shaft carries an armature which is adjacent to the poles of the electro magnet E. Speech currents are passed through the coils of the electromagnet and attract the



Principle of the new loud-speaker designed by Capt. Round. (No. 229,382.)

armature, which in turn imparts motion to the diaphragm by means of the rod S and links. Several modifications of the scheme are described in the specification. For instance, it is found that with a diaphragm of large diameter the lower musical tones are emphasised to an extent which is detrimental to quality. It is therefore recommended that a smaller diaphragm should be used to enhance the higher harmonics.

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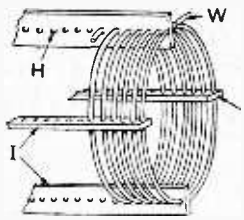
Short Wave Coils. (No. 231,978).

A now familiar and exceedingly efficient form of short wave inductance is described by F. H. Haynes in the above British Patent. The object of the invention is to produce a really low-loss inductance characterised by reducing the amount of dielectric in the field of the coil to a minimum. The coils are constructed by making a number of holes H in strips of insulating material I. The inductance is made from a rigid wire W, and is wound into helical formation. The inductance is then threaded through the



An efficient method of supporting air - spaced coils. (No. 231,978.)

holes in the strips, resulting in an exceedingly rigid structure—a point of prime importance when dealing with very short waves.

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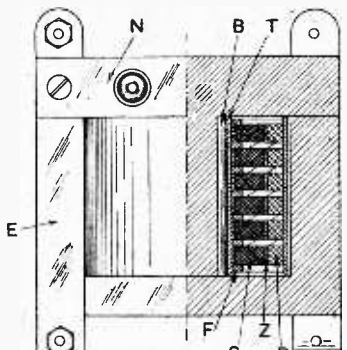
The R.I. Transformer. (No. 230,981).

The construction of the Radio Instruments transformer is described in the above British Patent by W. A. Appleton and J. Joseph. The accompanying illustration shows diagrammatically the internal construction of the transformer. The novelty of the construction of the transformer lies essentially in the method of winding the core. Both the primary and secondary coils are wound in annular sections, and the sections are spaced apart from each other. The transformer is shown in half-section in the illustration. In this particular transformer the secondary sections S are shown wound over a core before the primary P, the reverse arrangement being more usual. The sections are wound on a bobbin B com-



R.I. transformer, with sectionalised windings. (No. 230,981.)

posed of an insulating tube T provided with flanges F and are insulated between the windings with separators Z. The idea of the separators, of course, is to reduce the capacity between the primary and secondary windings, while the idea of sectional winding is to reduce the self-capacity of the windings as a whole. The transformer core is of the closed type, and is clamped between end brackets E, which carry two ebonite terminal plates N. The specification is exceedingly detailed, and describes the actual manufacture of the transformer very fully. The novelty of the invention, of course, lies in the particular sectionalising arrangement. Readers should remember, however, that transformers were sectionalised for purposes other than wireless many years before the scheme was applied to speech transformers.

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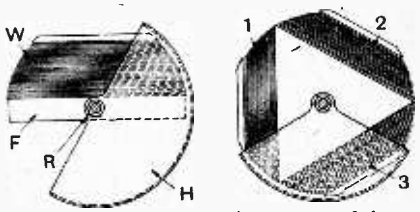
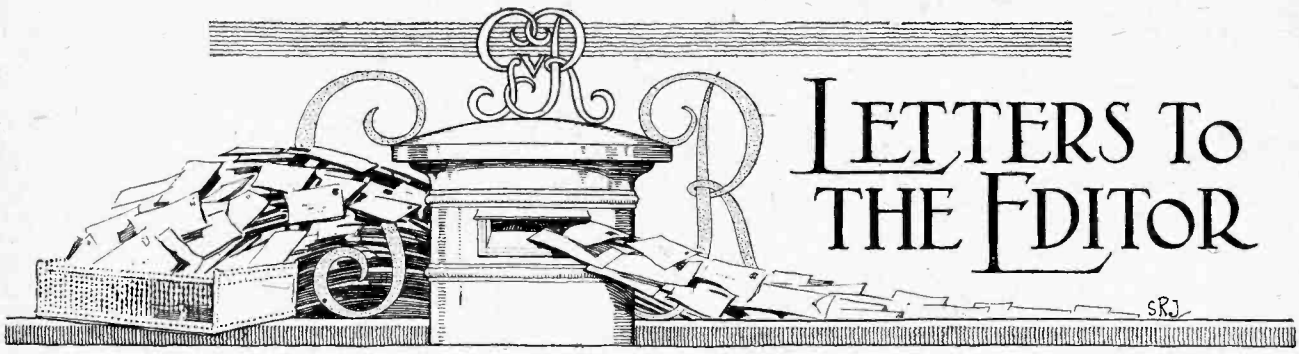
An Interesting Spade Tuner. (No. 231,952).

A rather interesting form of spade tuning is described in the above British Patent by N. H. Clough. It will be remembered that with the ordinary system



Spade tuner giving wide range of inductance. (No. 231,952.)

of spade tuning the inductance is wound in the form of a flat coil, and is in close proximity to a thick copper plate, which can be moved across its surface. According to the present invention the inductance, in one modification which is shown in the accompanying illustration, is wound upon a hemispherical former somewhat similar to the one half of the familiar variometer rotor. Thus in the diagram a single large coil is wound on a hemispherical former F as indicated, and a hemispherical metal plate H is provided with a knob for rotation. Thus it will be seen that on rotating the shaft the metallic hemisphere will move over the winding, and thereby vary the inductance value. Another modification is shown in the other half of the illustration, in which three coils, 1, 2, and 3 are provided, each having different inductance values, and a switch (not shown) is provided for putting each coil into circuit as desired. Thus a continuous inductance value can be obtained by 360 degrees rotation of the tuning device, which in this case is of somewhat different shape.



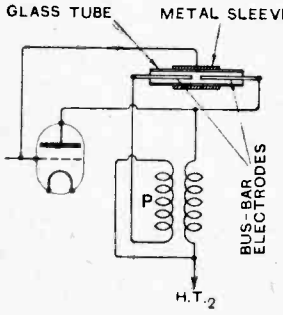
The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

STRAY CAPACITIES IN THE REFLEX NEUTRODYNE.

Sir,—Several correspondents have experienced difficulty in neutralising stray capacities in the reflex neutrodyne receiver described in the issue of July 1st. The trouble appears to be in not getting the "silent point," in the neutralising condenser, clearly defined.

It should be emphasised that if the components are arranged in such a manner that the interelectrode capacity of the first valve is more than neutralised, it is impossible to balance this capacity in the usual way



Alternative neutralising condenser for the reflex neutrodyne receiver described in the issue of July 1st.

Under such circumstances it is advisable to dispense with the neutralising condenser shown in the original receiver, and use one of the conventional type consisting of two pieces of "bus-bar" wire, a glass tube and a metal sleeve.

This should be connected as shown in the accompanying diagram.

The receiver should then be adjusted for neutralisation in the usual manner.

It might be pointed out that this adjustment is rendered difficult if the audio-frequency transformer is mounted too near the grid circuit of the detector valve. H. A. HARTLEY.

Westminster, S.W.1.

A TALK WITH YUGO-SLAVIA.

Sir,—With reference to the paragraph entitled "A Talk with Yugo-Slavia," on page 195 of your issue of August 12th, I am sorry to have to contradict Mr. Partridge. My station (G2UV) has, however, been in contact with Yugo-Slavia, 7XX on several occasions. My first communication with this station was carried out on June 11th of this year and was duly reported in *The Wireless World* of July 1st. At that time the input at my station was 9 watts (dry cells). 7XX reported that he was getting my signals at R6-R7.

Harlesden, N.W.10. W. E. F. CORSHAM (G2UV).

SWEDISH VESSEL'S SHORT-WAVE TESTS.

Sir,—As it might be of some interest to you and for the British transmitters, I write to give some information about a short-wave transmitter to be put on the Swedish motor-liner "San Francisco."

The ship is running between Stockholm and Buenos Aires, and will on these voyages carry a 100-watt short-wave set with a wavelength range of 25-50 metres. The set will work with a Telefunken 100-watt valve and on a straight, single-wire aerial 75ft. in height.

The "San Francisco," whose call-sign is SGC, is expected to leave Gothenburg on August 20th for Buenos Aires and will be glad to carry out tests with the amateurs in any part of the world. Operation hours will probably be 0060-0070 G.M.T. and 1800-1900 G.M.T., etc. The wavelengths will be one between 23 and 25 metres and at least one longer, between 35 and 45 metres.

The preliminary tests start immediately, and we hope to get in communication with many British transmitters during the voyage.

Wishing the best of success to your excellent magazine,

Stockholm. TORSTEN ELMGUIST (SMZS).

TRANSFORMER DESIGN.

Sir,—Through the columns of your paper I should like to be allowed to issue a warning to amateurs with regard to transformers marketed by makers of repute (?).

The first point, and the more common one, is that these manufacturers often make two types of transformers, marked 1st and 2nd stage, and in practically every case the 1st stage transformer is of high ratio and the 2nd stage of low ratio.

Now, as the 1st stage usually follows a detector valve of high impedance, a low ratio transformer is invariably required, and as that used in a second stage usually follows a valve of low impedance a high ratio transformer may be used. Therefore, not only is it misleading for the beginner, but detrimental to the makers themselves.

The second point is far more serious, and that is that in more cases than one the writer has found that the ratios of these transformers have been changed by decreasing the size of the secondaries, the primaries remaining the same.

The above remarks refer, not to cheap components, but to some of the most expensive. The writer has been "stung" himself, and on writing to one of the firms asking for an explanation for reducing the size of secondaries, he received a reply but no information. A. R. TURPIN.

London, W.C.1.

THE B.B.C. AND MONOPOLY.

Sir,—You state in your leader that "interest in it has subsided to a great extent." But I believe there is great interest taken in the above in one part of the country, simply because in most parts of North Wales they have no means of listening-in, except through the medium of expensive valve sets

The B.B.C. *has not* made a network as complete as possible, except where the large towns are concerned, as the nearest broadcasting station to North Wales is Manchester, with Liverpool as a relay station.

I believe if the B.B.C. would only consider the matter, they would see that a relay station in North Wales would be filling up a long-felt want, and naturally appreciated by thousands more that could afford a modest-priced set only.

AMATEUR.

READERS PROBLEMS

Readers Desiring to Consult "The Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

Incorrect Connections of an Amplifier.

A READER recently purchased an amplifier for addition to a single-valve receiver which he possesses, in order that a loud-speaker might be operated. He connected this instrument up in the usual manner with the input terminals of the amplifier attached to the telephone terminals of his receiver, and took the usual connections from his L.T. and H.T. batteries to the appropriate terminals on the amplifier. The valves, however, failed to light, and after a few moments smoke issuing from the amplifier caused our reader to disconnect all batteries and promptly investigate matters, with the result that he discovered that a considerable portion of the rubber sleeving on the wiring of the amplifier was charred. He has forwarded to us wiring diagrams of both receiver and amplifier, from which it can be plainly seen that the trouble was due to short-circuiting of the accumulator. This was brought about by the fact that in the amplifier the H.T.− was internally connected to L.T.+ instead of L.T.−, as in the case of the receiver. This, of course, resulted in short-circuiting of the L.T. battery when all connections were made.

The best thing to do under these circumstances is to alter the internal connections of the amplifier so that H.T.− connects to L.T.−, thus preserving the correctness of the terminal markings, although actually a remedy can be effected by merely reversing the connections of the L.T. battery to the amplifier. When purchasing an amplifier for use with any receiver, care should always be exercised to see that this connection in the amplifier corresponds to that in the receiver. It is unfortunate that valve apparatus is not standardised from the point of view of this connection, although it must be admitted that most of the leading manufacturers adopt the common minus connections. The effect of making the connection of H.T.− to L.T.− or to L.T.+ was discussed in the Readers' Problems section of this journal for April 22nd, 1925.

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Double Rectification Crystal Receivers.

A READER asks what is meant by a double rectification receiving circuit.

As is well known in the case of an ordinary crystal set, for instance, only one half of the oscillatory current set up in the aerial circuit by the incoming signals is rectified, the other half of the current representing, as it were, so much wastage. In a double rectification circuit, however, an attempt is made by means of using two crystals in conjunction with a telephone transformer having a double primary winding to rectify both halves of the wave, the combined output being applied to the telephones through a transformer of special design. In practice, however, very little additional signal strength is obtainable by this method. However, it is possible by using this method to construct a crystal set in which

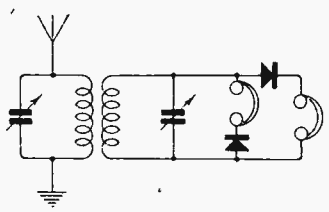

Fig. 1.—Connections of crystal receiver employing the double rectification principle.

no reduction is caused in signal strength by using two pairs of telephones over that obtainable when one pair only are used. As is well known, it frequently happens that owing to a crystal set being used on the outside fringe of the effective crystal range of a broadcasting station, reception is quite comfortable on one pair of telephones, but upon a second pair being added the strength is reduced, so that enjoyable reception on two pairs of headphones is not obtainable. The use of the circuit which we give in Fig. 1 does much to overcome this difficulty, each crystal rectifying different halves of the wave, and thus making use of more of the available energy in the aerial circuit.

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Obtaining Reaction in Neutrodyne Receivers.

IN the usual form of neutrodyne receiver which employs two or more stages of high frequency, it is not customary to make any provision for reaction, since it is usually found that the two H.F. stages provide sufficient sensitivity for all ordinary purposes. For reception of stations situated at extreme distances, however, some form of regeneration is certainly desirable, whilst in addition the use of a certain amount of this very useful property assists very considerably in promoting selectivity. There are three main methods of bringing about oscillations in a receiver of this type. In the first place a reaction coil may be added, reaction being carried from the plate circuit of the detector valve to the grid coil of the first H.F. valve. Secondly it will be found that by considerably increasing the value of H.T. supplied to the H.F. valves oscillation can be brought about, although it is advisable to include about 1½ volts grid bias on the H.F. valve in order to keep the plate current within economical limits. Probably, however, the most convenient method is to make the neutrodyne condenser associated with the first valve variable, and then in order to bring about regeneration, the first valve may to some extent be deneutralised by varying this condenser. The condenser associated with the first valve can be mounted so that its handle protrudes through the front panel in a convenient position, although the neutralising condensers associated with the other stage or stages of H.F. can be mounted on the base-board and permanently adjusted.

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Efficiency in Reflex Receivers.

A READER has written to ask whether "reflexing" can in any manner increase the range of a receiver, all other things being equal. In particular, he wishes to know whether, assuming that he built a very efficient 1-v-0 type of receiver and obtained a given range for it, he could expect an increase of *range* (as distinct from signal strength on stations already within range) by *efficiently* reflexing the H.F. valve, all other things being equal.

Let it be said in the first place that reflexing tends slightly to decrease the H.F. efficiency of the valve; and so we should normally expect a slight reduction in range. Yet on the other hand it is an undoubted fact that it is frequently possible to hear stations in a 1-v-0 receiver in which the H.F. valve has been converted to a dual amplifier which were not heard before these alterations were carried out. The reason for this is quite simple. The addition of the low frequency amplifier not only adds considerably to the strength of the signals which were previously audible, but also enables signals to be heard which previously were too weak to be heard although already present in the windings of the telephones, and thus stations previously inaudible are brought in. Obviously, then, the addition of L.F. amplification has increased the useful range of our receiver, although the actual H.F. energy impressed on the grid of the rectifying valve is no greater.

Using Transformers After Crystal Rectification.

A READER has raised the question of what is the best ratio of transformer to use after a crystal detector from the point of view of high quality of reproduction.

The form of this question is undoubtedly very misleading, since the main point to consider is what is the minimum impedance which should be possessed by the primary of the transformer associated with the crystal in order to eliminate all perceptible distortion. The actual ratio is really a secondary consideration which depends mainly on questions of design. Suppose, for instance, we decided (wrongly it is true) that the impedance of this primary needed to be very great, this would naturally postulate a very large number of turns on the primary, and it would therefore be impracticable from a constructional point of view to use a high ratio, since the large number of secondary turns required would not only necessitate an instrument of great bulk, but the self-capacity of the windings would be high, which is, of course, fatal to good results, and has the effect of lowering and muffling the general tone. Therefore a low ratio would be called for. However, the impedance of an ordinary "catwhisker" type of crystal is low, and does not therefore require an excessive number of turns on the primary of the transformer following it, and actually an 8 to 1 transformer of reputable make will be found to give the best results from the point of view of good volume, without sacrificing any of the good quality which we obtain from the use of a crystal as a rectifier. In the case of a Pericon detector, however, the impedance required is greater, and it will usually be found that a 6 to 1 ratio will give the best results. If, however, a carborundum crystal is used a lower ratio such as 4 to 1 is recommended.

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An Efficient Crystal Set for High or Low Wavelengths.

IN view of the opening of the new high-power station at Daventry, we have received a number of requests from readers for the circuit of an efficient crystal set which can be rendered suitable for the reception of the local station or the Daventry station by a simple switching arrangement without the intermediary of a loading coil.

It is, of course, not a matter of great difficulty to design a receiver of this kind, which can be quite simple and need not call upon the constructor to wind his own tapped coils, since standard parts can readily be used if the circuit given in Fig. 2 is adhered to. The components required will be a variometer of suitable size, a four-pole switch, and two fixed condensers of the capacities indicated in the diagram, and the usual accessories. In the diagram given in Fig. 2, when the switch is over to the left, the instrument will cover the lower broadcasting waveband, whilst placing the switch over to the right will not only adjust the receiver to the Daventry wavelength, but will also enable the time signals from the Eiffel Tower to be received. It will be seen that the instrument is, therefore, both simple and reliable, since all components such as variable condensers and loading coils are dispensed with. In the circuit the exact

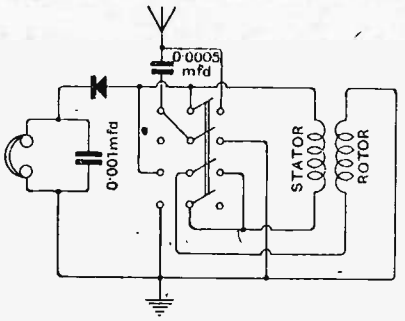

Fig. 2.—Crystal receiver for broadcast reception on long and short wavelengths.

value of the condenser shunting the telephones is unimportant, although the value given is advised, but the value of the remaining fixed condenser is, on the contrary, very important, since it enters into the question of wavelength adjustment. The value given is suitable for all large types of variometers, such as the Sterling and other makes, which have their stator and rotor windings brought out to separate terminals, but, should other types of variometer be used, it is important that the correct value of this condenser be ascertained from the makers.

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Reception of C.W. Stations with a Local Oscillator.

A READER who has successfully built a superheterodyne receiver has noticed that, contrary to his expectations, he is unable to receive C.W. signals on the waveband over which his receiver operates, in spite of the fact, as he mentions, that a local oscillator is employed.

In the case of the ordinary local oscillator which is used for reception of C.W. stations in conjunction with a non-regenerative receiver, the oscillator is adjusted so that in conjunction with the incoming signals an audible beat note is formed having a frequency of 1,000 cycles per second or so, and the actual frequency of the beat, and thereby the pitch of the received note, can be adjusted within the ordinary limits of audibility according to desire, by merely altering the tuning constants of the oscillator valve circuit. Thus the carrier wave from a telephony station will produce a continuous note, this note being broken up into dots and dashes in the case of a C.W. telegraph transmitter. In the case of a superheterodyne receiver, however, the local oscillator is adjusted so that in conjunction with the incoming signals it produces a beat note frequency far beyond the limits of audibility, usually about 60,000 per second (5,000 metres), hence the name *supersonic*, and if C.W. reception is desired it is necessary to provide another oscillator to "beat" in conjunction with the second detector valve and produce an audible signal. Alternatively, the second detector can be caused to heterodyne itself by causing it to oscillate and then slightly mistuning it, as in the case of the conventional single-valve receiver customarily employed by amateurs for the reception of C.W. stations.

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Low-loss Crystal Receivers.

A READER who has obtained remarkably improved results on his crystal set by substituting his ordinary aerial coil by one of the cylindrical low-loss type designed with air-spaced turns in order to minimise losses on the broadcasting band of wavelengths, wishes to construct a similar coil for improving reception from the high-power station.

It is obvious that a cylindrical type coil with air-spaced turns would be extremely bulky and unwieldy, since about 200 turns would be required. It is extremely doubtful also whether any material advantage would be obtained by employing a coil of this type on a wavelength of 1,600 metres. It must be remembered that a wavelength of 300 metres represents a frequency of 1,000,000 cycles per second, whereas in the case of a wavelength of 1,600 metres the frequency is only 187,500 cycles, and dielectric losses due to covering wires with insulating material, which may be serious on the lower broadcasting wavelength, can safely be ignored when dealing with high wavelengths. It would seem desirable, therefore, that our reader should construct a low-loss crystal set for the ordinary B.B.C. wavelengths, with an ordinary single coil holder connected in series with the coil and normally short-circuited so that a basket coil of suitable size can be inserted into this holder when desiring to receive the high-powered stations.