AN ALL-ENCLOSED SUPER-HETERODYNE

By

G. P. KENDALL, B. Sc.
Prevent microphonic valve noises by using Burnddept Anti-Phonic Valve Holders

SOMEONE slams a door—a heavy lorry passing by makes the house shake—somebody races upstairs, stamping his feet—the children jump about in their playroom—when you are using dull-emitter valves such actions as these may cause ear-splitting microphonic noises and render tuning almost nerve-racking. The best way to eliminate microphonic noises is by means of Burnddept Anti-Phonic Valve Holders. When they are fitted no vibration of any kind will make your dull-emitter valves "howl." Moreover, Anti-Phonic Valve Holders will prolong the life of your valves. The valve sockets are countersunk and thus the risk of short circuits is eliminated.

If you are building a portable set, you should certainly fit Anti-Phonic Valve Holders. Whatever type of valves you use in the instrument will then be safely protected against damage in transit.

Go to the local Burnddept Agent and ask him to show you the Anti-Phonic Valve Holder. He has other Burnddept Components which will interest you, too.

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promise! The latest addition to the famous "ATLAS" Range is the new SQUARE LAW LOW LOSS VARIABLE CONDENSER, and once again promise is even excelled by actual performance. A few of its outstanding features are:

The fixed vanes are insulated from the moving vanes by means of ebonite tubes outside the electrostatic field, and losses are still further reduced by the end plates, which, instead of being "full," are cut away.

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"Clarke's" ATLAS SQUARE LAW LOW LOSS CONDENSER

The performance of R.C.C. Units, at all frequencies audible to the human ear, has already been described (April, May and June issues of "Modern Wireless").

It has been shown that the degree of response given by the Units is so nearly the same at all frequencies that amplification of speech and music can be carried out with very little distortion indeed.

If you are interested in the technique of Broadcast amplification you may have seen the earlier notes to which we refer, and you may have appreciated our arguments.

If you are not interested in this technique you are probably, at any rate, desirous of making your Loud Speaker sound as clear and realistic as possible.

It is surprising to find how frequently this or that device is advertised as giving "perfect results" or "complete freedom from distortion"—this is all nonsense, and merely induces a feeling of contempt for the advertiser on the part of discerning readers.

It is therefore not strictly possible to claim that any method of amplification is "free from distortion," but it can be claimed that when R.C.C. Units are properly used, the distortion in the amplifier is very very small—so small in fact, that it is quite negligible compared with that taking place in other parts of the installation (e.g., Valves, Telephones and Loud Speaker).

If you use R.C.C. Units in your amplifier you can have real confidence in that part of your equipment.

It is a good insurance for the future to use R.C.C. Units, because, in the event of better valves, telephones or a more aperiodic Loud Speaker being brought into use, the distortion in your amplifier will not even then be apparent, and hence it will not be necessary to face the expense of a new amplifier.

It is feasible to obtain bad service even from a Rolls-Royce, if it is badly driven—therefore, when using R.C.C. Units do not employ unsuitable circuits or valves.

A circuit diagram is enclosed in the carton of each R.C.C. Unit.

R.C.C. Units are inexpensive—they cost less even than poor transformers.

The Polar R.C.C. Unit consists of wire-wound anode resistance, grid leak and specially built Dubilier condenser. It is perfectly self-contained, with four clearly marked terminals correctly positioned for easy wiring.

Illustration is five-sixths actual size.

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NOW that so many good and dependable types of general purpose, and really low consumption valves are available, the super-heterodyne receiver of seven or eight valves becomes extremely attractive from the point of view of the would-be designer of a portable set capable of a really good performance upon a frame aerial of the integral type.

To what extent real portability can be achieved in a super-heterodyne receiver is something of a debatable point, since it must be remembered that something like seven or eight valves seem desirable to ensure really satisfactory results upon a small portable frame aerial, and so large a number of valves involves considerable weight. The weight of eight anti-vibratory valve sockets alone is no small matter, and to this we must add the weight of four or five high frequency inter-valve coupling units, at least two variable condensers, one or more low-frequency inter-valve coupling units, the necessary potentiometers and rheostats, to mention only the more important components, and the total weight must in the nature of the case be somewhat considerable.

Practical Limits
Again, the high-tension battery must be of fairly robust capabilities, and the filament battery also must be able to give at least half an ampere and preferably rather more, so that small dry cells are ruled out. Using components of the readily obtainable standard type, it therefore seems to me that it is scarcely practicable to reduce a super-heterodyne to such limits of portability as will render it a most valuable adjunct when motoring, on the river, or on holidays. Provided that the idea of portability is not carried too far in the design of the set, it is quite possible to produce an instrument which possesses the attractions we have just been considering, and which can in addition be regarded as an all-enclosed instrument for general reception, giving entirely satisfying results, and with the additional advantage of no external accessories in the way of batteries, or aerial and earth leads, so that it can readily be taken from room to room as may be desired.

A Useful Combination
The receiver to be described in this article represents an attempt to comply with the requirements which we have just been considering, in combining a satisfactorily portable instrument with one for general reception, so designed as to be capable of being carried about with the minimum of trouble, since everything is enclosed in the cabinet, with the exception of the loudspeaker. This latter has been omitted for the reason that if it were built in, serious increase in the weight of the instrument would result, and, furthermore, it is not desirable to limit the choice of batteries.
of the user to any one make of loud speaker.

**Aims**

At the outset, it was decided that it would not be possible to achieve dependable loud speaker results under the worst of daylight conditions from all stations, regardless of the locality in which the set was used, bearing in mind that a frame aerial of quite small size was to be employed. The minimum standard of performance therefore decided upon was that of dependable loud speaker results under the worst of daylight conditions, from one main station, in practically any locality in which the set might be used, and good headphone signals from the remaining stations. These results, furthermore, were to be obtained with a frame aerial with a maximum "size" of 26 inches square, this being arbitrarily fixed by the fact that I happened to possess a folding frame of this size, which struck me as being a very reasonable one for portable purposes.

The testing has all been done in London, the stations adopted as the standard being Birmingham and Bournemouth, adequate and reliable daylight reception of these two on the loud speaker being aimed at, since they represent something like the maximum distance at which one is likely to be situated from one's nearest station in most parts of Britain. As a matter of fact, a set which will render these two stations upon the loud speaker with reasonable dependability in daylight in the summer under the unfavourable local conditions in which I work, is one which will also give loud-speaker results from all the B.B.C. stations at night time under any moderately good conditions.

Eight valves were finally decided upon, the first being the high-frequency amplifier on the short wavelengths (a separate oscillator being used), three intermediate amplifiers, and one note magnifier. It is probable that I have erred somewhat on the side of over-generosity in the provision of valves in order to cope with possible unfavourable conditions; An inspection of Fig. 1 will show how the eight valves are arranged in circuit before we proceed to consider the actual construction of the set. In this diagram \( V_1 \) is the separate oscillator valve, \( V_2 \) is the high-frequency amplifying valve for the short-wave signals, \( V_3 \) is the first detector, \( V_4 \) \( V_5 \) and \( V_6 \) are the long wave or "intermediate frequency" amplifiers, \( V_7 \) is the second detector, and \( V_8 \) the note magnifier.

**The Circuit**

Immediately above the oscillator valve \( V_1 \) will be seen three coils whose ends are indicated by numbers from one to six, and it should be explained that these three

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*To operate the set it is only necessary to open the end door.*
windings are all contained in a single unit, called the oscillator coupler, the one which I have employed being of Bowyer-Lowe make. As indicated by the dotted line round these coils, they constitute one boxed-in component. One of these windings is tuned by the condenser C., which is of .005 µF capacity and its associated vernier, the only other tuning control being the condenser C., which is provided for the purpose of tuning the frame aerial, which is connected to the two terminals indicated.

H. F. Coupling

Immediately above, the high-frequency amplifying valve V. will be seen a component with four connections, which is marked T.. This is an aperiodic high-frequency intervalve coupling unit, produced by Messrs. Peter Curtis, Ltd., under the name of the "Constant-Tuned" unit. This couples the high-frequency valve to the first detector, interposed between them being the "pick-up" winding 5 to 6 of the oscillator coupler. The usual grid condenser and leak is provided for the first detector, the remainder of the intervalve coupling units being marked T.. T. is what is known as the input filter, and this together with T., T. and T. are all of Bowyer-Lowe make, each coupling unit being one complete component, which is boxed in and fitted with terminals. These coupling units operate upon a fixed wavelength, no tuning arrangement being necessary. Across the primary of the input filter will be found a fixed condenser C. and it must carefully be noted that this is the condenser supplied by the makers of the units, which must on no account be replaced by any other condenser which the constructor may chance to have.

Stability Control

T. is the low-frequency intervalve transformer, and it will be observed that a fixed condenser of .001 µF is connected across the primary winding of this, which I have found a very desirable aid to stability upon the long wave side. It will be observed that a potentiometer is provided which controls the grid potentials of the three long wave amplifying valves, and in practice this provides a control of the amount of natural reaction in the intermediate frequency amplifier. A fixed condenser of .005 µF is shunted across the slider of the potentiometer and the negative end of the filament circuit.

The Cabinet

The receiver is built into a light wooden cabinet of the shape of a suitcase, and a few notes upon the desirable features of this box may perhaps be useful. Its internal dimensions are 5 in. by 15 in. by 21 in. The large door is 15 in. by 15 in. wide, and if these sizes are given to a cabinet maker no doubt a satisfactory case will be obtained, provided that the cabinet maker is warned to reduce weight as much as possible, and to adopt some finish which will stand a good deal of knocking about without being spoiled, such as a dull oil-finish.

The cabinet is provided with two doors, one in the side which gives access to the interior of the set, the battery compartment and certain of the controls, the other opening in the end, and disclosing a narrow vertical ebonite panel upon which are mounted the two tuning condensers, the potentiometer which controls the long wave side, and a small vernier condenser, which is placed in parallel with the oscillator tuning condenser C..
These views of the upper and under sides of the shelf will serve as a key to the wiring diagram.

and all the components except those which have been mentioned as being mounted upon the ebonite panel.

Rheostat Panel

To the underside of the wooden shelf is attached a second small ebonite panel by means of two brass brackets; and this second panel carries the three filament rheostats, the two terminals for the frame aerial, the two for the loud-speaker and the various high-tension positive terminals. These terminals, reading from left to right as one looks into the cabinet from the side, are the frame aerial pair, H.T. + 1, which supplies the oscillator valve, H.T. + 2, which is the terminal for the two detector valves, H.T. + 3, which supplies all the high-frequency amplifying valves, and H.T. + 4, which supplies the note magnifier. The latter terminal is also a common terminal for the loud-speaker. Thus, it is both the high-tension positive terminal for the note magnifying valve, and the lower terminal of the pair to which the loud-speaker is attached. The batteries are arranged at the bottom of the box, and it will be found that there is exactly space for a "Siemens" 108 volt high-tension battery, which is a convenient size when its weight is permissible.

If, however, the set is to be much used for carrying about a 72 volt unit will suffice, and for this there is ample room. (More on this subject at a later point in this article.) A small grid bias battery may be placed on the right of the high-tension battery, and at this point can also be inserted the filament battery. This, in my opinion, should be a small 4-volt accumulator rather than a dry battery, since the latter must become exceedingly bulky and heavy to feed so many valves. One of the almost miniature 4-volt accumulators sold for running model electric launches will be found very suitable, especially if it is of the unspillable variety. One of five ampere hours actual capacity output will just suffice if .06 valves are used, one of ten ampere hours being a convenient and desirable size.

Battery Leads

No other terminals for batteries than those mentioned are provided, a pair of leads soldered directly on to suitable points on the wiring being arranged for the low-tension supply, the negative socket of the high-tension battery being connected directly to the positive terminal of the accumulator, no special terminal on the set being provided for this; while the positive socket of the grid bias battery is connected directly to low-tension negative. From the appropriate secondary terminal of the low-frequency transformer a short flexible lead is taken, bearing
upon its end the usual battery plug, and this is inserted into a suitable negative socket of the grid bias battery. The various battery connections are thus completed with a minimum number of terminals.

The actual components used in the original set are given in the following list, and with this aid the constructor will be able to collect the necessary materials.

1 cabinet (Burne-Jones & Co., Ltd.).
1 ebonite panel, 5 in. by 15 in. by 2 in. (Burne-Jones & Co., Ltd.).
8 shock-absorbing valve holders (Burne-Jones & Co., Ltd.).
1 ordinary base-board mounting valve socket (Burne-Jones & Co., Ltd.).
2 fixed condensers .0003 μF capacity (Dubilier Condenser Co., Ltd.).
2 grid leaks of 2 megohms (Dubilier Condenser Co., Ltd.).
1 fixed condenser .005 μF capacity (Dubilier Condenser Co., Ltd.).
1 fixed condenser .001 μF (M. Michael clip-in type).
1 low-frequency transformer (L. Michael, Ltd.).
1 potentiometer (Sterling).
2 variable square law condensers of .0005 μF capacity (Collinson's Precision Screw Co., Ltd.).
3 dual rheostats (Burne-Jones & Co., Ltd.).
1 "Constant-Tuned" interstage coupling unit (Peter Curtis, Ltd.).
1 oscillator coupler (Bowyer-Lowe Co., Ltd.).
1 input filter with condenser (Bowyer-Lowe Co., Ltd.).
3 intermediate frequency transformers (Bowyer-Lowe Co., Ltd.).
7 terminals.
1 piece of ebonite 4 in. by 8½ in. by 1½ in., with one corner removed by a slanting cut.
Radio Press panel transfers.
1 vernier condenser (Burne-Jones, Ltd., enclosed type)

Construction

Little need be said of the actual attachment and assembly of the parts, since I think this is quite clearly shown by the diagrams and photographs, and such constructional work as is involved is of a very simple nature. Care should be taken in working to the dimensions and arrangement given, since the whole set has been packed into as small a space as seems desirable, and the exact spacing to within quite small limits is somewhat important, as I found to my cost in the preliminary experimental work.
In this view of the set removed from its cabinet, the position of the rheostat panel may be clearly seen.

Therefore endeavour to copy the layout very accurately, and take careful note of the fact that the valves are arranged in two rows, running along one row in one direction and then back along the other in the opposite direction, so that the last valve, viz., the low-frequency amplifying valve, is that which is side by side with the first detector.

Wiring

The wiring probably represents the most difficult part of the construction of this set, since there is not very much space available in which to carry it out, and a good deal of it runs from components on the lower side of the shelf to others upon the upper side of it. This involves drilling holes in quite large numbers in the shelf. The wiring was actually carried out partly with the ordinary square tinned wire, and partly with Glazite, which proved extremely convenient for the purpose. The wiring diagram is marked to indicate which type of wire is used for certain connections, and it will be observed that most of the wiring which runs through the shelf, or which unites components separated by some considerable distance, is done with Glazite, the shorter wiring which does not run through the shelf being done with the square wire.

Points for Care

Points to which particular care should be directed in the wiring operation, are the connections from the "Constant-Tuned" coupling unit, and more particularly those to the oscillator coupler. These must be carried out with due care to see that the right connection is taken to the proper numbered terminal, since a mistake may result in failure to oscillate on the part of this valve, and, of course, the breakdown of the whole set.

Presuming that the wiring of the set is now finished, we come to the testing and operation of the instrument, and after the completed panel and shelf have been slipped into the box, the first question which confronts us is that of the type and arrangement of the valves to be used. In a set employing so many valves, and in which it is desired to use quite a small filament battery, we are limited almost definitely to the type of dull emitter taking .05 amp. for the filament, with possibly one or slightly larger consumption for the last (note-magnifying) valve. The
Detector, first high-frequency amplifier, three intermediate frequency amplifiers, and second detector, it is necessary to use valves requiring the same filament voltage, since these are all controlled from the one filament rheostat. A good combination, for example, is to use Mullards Radio Valve valves for the first H.F. and the combination, since these are all controlled from requiring the same filament voltage.

Suitable Valves

Alternatively, of course, five valves of the same type can be used, such as the D.E.3, B.5. D.06 general type, to mention the three examples of this type made by Messrs. Marconi-Osram Valve Co., Ltd., the B.T.H. Co., Ltd., and Mullards Radio Valve Co., Ltd. Practically any type of general purpose low-consumption valve can be used here, and I have obtained quite good results from imported Continental valves of the 06 type.

H.T. Values

The high-tension supply may be a 108 volt battery, and the plugs should be inserted so that terminal number 1 receives 102 volts, terminal number 2, 30 volts, terminal number 3, 54 volts, and terminal number 4 the whole 108 volts. When only a 72 volt battery is used terminal number 1 is brought down to 66 volts, and terminal number 4 to 72 volts, the others remaining at the same values as those just given.

Assuming that all the batteries have now been connected up properly and the valves turned on to an approximately correct degree of brilliance, we must deal with the question of the operation of the set. First connect a pair of telephones to the loud-speaker terminals, and a frame aerial to the frame terminals. Now experiment with the potentiometer, and discover at what point upon its range the long-wave side breaks into self-oscillation. When the valve filaments have been correctly adjusted, this should take place when the slider of the potentiometer is approximately one-third away from the negative end and one-third away from the positive end. This is merely a very rough rule to give a general idea as to whether the set is working correctly. Remember that in general if the set oscillates too freely it can be stabilised by brightening the valve filaments, but this must not be carried too far, or the valves themselves may be injured.

Testing the Oscillator

Set the potentiometer so that the long-wave side is just oscillating, but no more, and proceed to revolve the dial of each condenser C3. At several points upon the dial you should hear chirping noises like carrier waves, which should disappear when you turn the potentiometer towards the positive end so as to stop the long-wave side from oscillating. The presence of these chirps may be taken as an assurance that the oscillator valve is functioning more or less correctly, and one can then proceed to search for signals. Set the potentiometer so that the long-wave side is on the verge of self-oscillation, and proceed to search for signals by manipulation of the two tuning dials.

A Warning

Operating a superheterodyne for the first time is no very simple matter and you must not expect to obtain anything like the full results for a time. Next month the question of operation, types of valves to use, adjusting the set to obtain the best results, and so on, will be considered fully. Meanwhile space compels me to leave the constructor to acquire skill in manipulating the two dials and the potentiometer with a few final practical notes.

The First H.F.

It will have been noted that no potentiometer is provided to control the grid potential of the first high-frequency valve, and a few words of explanation are desirable as to the methods of controlling any natural tendency to self-oscillation on the part of this valve. The aperiodic intervalve coupling employed does not produce any strong tendency to oscillation, but it is possible, with a valve which oscillates readily, by turning down the filament current, to produce self-oscillation upon, a small frame aerial. No difficulty should be experienced with this, so long as the following points are borne in mind. If you find that signals are apparently poor and distorted, and if you hear noises like carrier waves upon, revolving the frame aerial condenser, it is probable that the first valve is oscillating, and the remedies to be adopted are an increase in filament brilliancy of the group of valves controlled by the middle filament rheostat, and possibly a slight decrease in the high-tension voltage applied to H.T. +3. If the difficulty is very pronounced, try a different valve in the first socket. If the only available valves are such as to produce self-oscillation here (an extremely unlikely state of affairs), a temporary remedy which may be adopted until a more suitable type of valve can be obtained, is to break the lead which connects one of the secondary terminals of the "Constant-Tuned" unit to filament positive, and take this lead to the slider of the potentiometer.

When the set is used for portable purposes, a folding frame aerial is extremely desirable, and unless the set is to be used in very close proximity to a broadcasting station, I would recommend that as large a frame as possible, should be employed. (The only objection to a large frame is that when used very close to a main station the interference problem is rendered somewhat more severe.) A separate frame aerial is most desirable, but for use upon comparatively local stations quite good results can be obtained upon a small frame wound upon the large door of the cabinet, and details will be given next month as to the construction of this frame.

Results

To give a preliminary idea (to be expanded in a later account) of the results to be expected from this set, I may mention that the following stations were received one afternoon in June at satisfactory loud-speaker strength:—Birmingham, Bournemouth, Hamburg, Toulouse, and Glasgow. Madrid was heard at good phone strength on the same occasion, all on the 26-in. frame, and in particular summery (and hence unfavourable!) conditions.

After dark I have had loud-speaker results from all the main B.B.C. stations (and two relays) except Cardiff, Manchester and Aberdeen (phones only), but of course results vary from night to night and in the different localities in which the set has been tested.

NEXT MONTH

The conclusion of this article will appear in our next issue, with full instructions for operating the set, notes on possible troubles, and details of the built-in frame aerial.
possibly you noticed, and possibly again you did not, that in a recent lecture upon the motion of electricity in metals, Dr. H. A. Lorentz referred to the fact that when conductors are cooled below a certain critical temperature their resistance is what the vulgar would call a washout. In polite words, it ceases to exist. Now, even if you had seen this statement, would it have suggested anything to you? I doubt it, reader. On the other hand, when I came across it a whole train of possibilities presented themselves to what I call my brain, though I must admit that others describe it in less flattering terms. Would it not be possible, for instance, to keep one's earth plate in a refrigerator and so obtain its capacity, and so obtain

Frigidity

Now this is the kind of temperature that takes a bit of getting down to. It is simply of no use at all to ask the ice-cream man to help you. It is sometimes approached at meetings in Scotland in the chilly silence which succeeds the chairman's announcement that a silver collection will be taken at the door as the audience leaves, but one could hardly incorporate chairman, ball and audience in the average receiving set. Again, I have known a frigidity not far above absolute zero occur in my own feet when called upon to perform some dangerous task. You see the obvious objection to this method of producing a low temperature. A prolonged coldness in the pedal extremities leads infallibly to chilblains, if not to frostbite. You can, of course, produce a remarkably chilly atmosphere by appearing at a dinner party without your collar, or even by wearing brown boots with your otherwise perfect evening garments. No one, however, wishes to go through life perpetually garbed in glad rags minus a collar and plus brown boots. Further, the requisite coldness cannot be produced unless there is a dinner party, and no one, I imagine, would care to give one of these every evening during broadcasting hours. If it were necessary to do this; the use of temperatures in the neighbourhood of absolute zero in the

Difficulties

make some people tear their hair.

by myself and by Professor Goop to whom I at once communicated the inspiration that had come to me. Our joint motto has always been Super aura ad astra, which may be freely translated: "The higher you go the fewer." Difficulties make some people tear their hair, or burst into tears, or pay their tailor's bills, or take some other desperate action. It is quite otherwise with the Professor and myself, who, when confronted with difficulties, are at our very happiest. I will just give you one example to show you what I mean. The other night, wishing to receive KDKA's short wave transmission, the Professor took down from a shelf the special open-work solenoid coil that he keeps for this purpose. You may gather something of his surprise when I tell you that he found that a lady mouse had made her little hive within it and that about a dozen healthy youngsters, snug in the warm nest, were asking loudly if it was not nearly breakfast time. Now here was a real difficulty. It has been amply proved that the presence of mice in the field of any coil enormously increases both its inductance and its self-capacity.

The Difficulty Solved

Professor Schnitzelwurst has in fact produced a formula which
wills be found most useful should this occur to you. In case you do not know it, it is \[ x = \sqrt{\frac{M}{2L} + \frac{2L}{2L}} \]

I.O.U.

where \( M \) is the number of immature mice, \( 2L \) may or may not be 305 metres, I.O.U. is a scrap of paper, and \( x \) is an unknown quantity. Even with the help of this formula the Professor found himself no nearer to receiving KDKA. Something had to be done. It was obviously impossible to remove the nest bodily from the coil, for that would have been the kind of rank cruelty that is foreign to any real Englishman. The only possible solution was to remove the coil from the nest, and this the Professor did, placing the little creatures and their home in Mrs. Goop’s Sunday hat.

You will see at once how great minds can rise to the occasion in times of stress. It was a real stroke of genius, and I can assure you that Mrs. Goop told the Professor about it for three whole days almost without stopping.

I Tell the Professor

Having once got this absolute zero idea, I went, as I said, to see the Professor about it without any delay. As I entered his study I found that the kindly man, in the absence of his wife, had the latest Gooplet upon his knee and was engaged in charging him to capacity with a feeding-bottle. Seeing me, he rose at once, depositing the infant in the coal scuttle, and advanced with outstretched hands. Having greeted him, I remarked that to judge from his howls, the child appeared to be in a state of violent oscillation that must be causing considerable interference in the neighborhood. "Child," said the Professor, "what child?" I indicated the Gooplet. "Ah, yes, of course," cried the Professor, picking up his now somewhat begrimed offspring and re-seating him on his knee. He then plugged in the transformer, which silenced the howls and produced smiles and gurgling noises.

The Thermoheostat

I outlined my idea, and as Mrs. Goop luckily appeared and removed the encumbrance, we were able to get on with it at once. Why should we not, I suggested, produce eventually a receiving set controlled by the varying resistance obtainable from the use of slight rises and falls in temperatures approaching absolute zero? We agreed at once that there was a great deal in this project, but resolved for the moment to confine ourselves to something straightforward and simple. What we decided to do was to produce a Thermorheostat, and this we have done. What is a rheostat? It is a device whose thingmejig comes loose whenever you turn the knob in the hope of lighting up your valve filament. It is a thing whose thingmejigs are always so placed that you have to stand on your head to solder wires to them. It is a thing whose spiral squishes when you hold it firmly in order to be able to drive home the fixing screws. It is a thing pierced with 5 B.A. holes, which you buy on Saturday night, when you have no 5 B.A. screws and have lost your No. 25 drill. There is obviously a vast demand for a super-rheostat which has none of these defects. That is why we have developed the Thermorheostat, which will meet the requirements of even the most exacting. The modus operandi of this wonderful new filament regulator will be gathered at once from the diagram which is given here-with. The components required are simply a helium liquefying apparatus, a blow-lamp, and a resistance coil with a value of 100 ohms. The helium thingmebob may be obtained very reasonably from dealers in disposals goods, rag and bone dealers or other merchant princes. Its cost as a rule will not exceed four or five thousand pounds, and it is therefore comfortably within the purchasing powers of any reader of MODERN WIRELESS. The blow-lamp may be borrowed from any painter (house, not picture), whilst the resistance wire can be bought for a few pence. Let us see exactly how the apparatus works.

How It Works

When we make a start the total resistance in circuit is 100 ohms. The valve therefore does not light up. We now blow the apparatus into action, squirting a spray on to the coils of wire. Before you can say "knife" or "Jack Robinson," or any of the other things that nobody ever wants to say, down goes the resistance to zero, and you have a pretty nippy up-dated valve in a blue flame. It is just this nippiness that is the crux of the whole question. It is essential that the blow-lamp should be brought into play just at the right moment in order that the desired amount of resistance may be obtained. When the Thermorheostat is first operated, it is as well to borrow half a dozen valves from friends for experimental purposes. They will quite understand when you return them with blow-lamps intact and explain that you were engaged in really important experiments. Once the requisite deftness with the blow-lamp has been acquired, perfect control of the filament is assured. Each sets it is perhaps best to provide one liquefier and one blow-lamp per valve, though this is not absolutely essential, since the former may be furnished with a hollow nozzle, whilst the latter is easily manipulated, after a little practice.

Test Report

A complete Thermorheostat was despatched for test to Mr. A. D. Scooper per goods train. His report, which is most encouraging, is as follows: A sample of the Goop-Wayfarer Thermorheostat has been submitted for test. This is a neat and compact little device which will appeal specially to those to whom space is a consideration. We had no difficulty in installing the apparatus in our own drawing-room after removing the furniture. On test it was found that the resistance obtainable varied between 100 ohms maximum and -000000162593 ohm minimum. Though the minimum is rather higher than we care about for serious experimental work, the Goop-Wayfarer resistance can be recommended to anyone who requires a reliable component with a fair degree of quantitative security. It will recommend itself especially to those who are constructing portable sets for summer use.
The Hamburg Broadcasting Station

By Capt. L. F. PLUGGE, B.Sc., F.R.Ae.S., F.R.Met.S.

An interesting account by our Continental Broadcasting Correspondent of his visit to the well-known German station now so familiar to listeners in this country.

The Hamburg Station is regarded as one of the most important in Germany. Hamburg is a great intellectual centre and has at all times formed a republic of its own. As a great port in the days before the war, vast wealth was accumulated with that consequent intellectual development.

As a typical example of the weight the Hamburg Station holds with regard to other German broadcasting stations, it might be mentioned that when the general broadcasting committee of Germany was formed a few months ago, with a representative for each broadcasting station in Germany, Herr Blonck, Chairman of the Hamburg Company, was unanimously elected Chairman for the General Committee.

The station is owned by the Nordische Rundfunk A.G., and is generally referred to as "The Norag," which it will be noted, is coined with the aid of the initials of the Company's name.

The transmitting station is housed in the Post Office building, above the Telephone Exchange. It is the law in Germany that the Post Office should hold 51 per cent of the shares of any broadcasting company. The aerial is of the usual type, erected on the roof of the building. It looks more like an oversized receiving aerial than a transmitting one, and consists of two single wires some 200 feet long, 10 feet apart, towering about 100 feet above the roof.

The masts attracted my attention. They appeared to be extremely slender, being formed of a thin steel tube about one foot in diameter and held rigid by a great number of stay wires radiating in all directions.

The studios—three in number—are on the ground floor. Only one, the large one, is regularly used for transmission, one of the others being used for experimental purposes, and the third is at present converted into an office, although its draperies have been allowed to remain.

The large studio is capable of accommodating an orchestra of 30 to 40 musicians. The "Norag" orchestra, which forms part of the permanent staff of the station, consists of some 20 musicians, conducted by Herr Kapellmeister Schink. The latter is a brilliant pianist and does not conduct his orchestra in the orthodox fashion, but occupies his position at the piano and beats time with his head in a manner which might be described as acrobatic.

Many of my readers who have tuned in this station have no doubt noticed the great number of complete plays and also operas which have been transmitted by...
Broadcasting an open-air play entitled "A May Night on the Alster."

some time before my visit, an open-air play was specially staged to be transmitted by this station; it was called "A May Night on the Alster," and is claimed to be the first radio play produced in the open for the special purpose of being broadcast. The Alster is a large lake situated in the midst of Hamburg, and is an excellent place for sailing, punting and canoeing.

The Microphone

The microphone which up till now has been in use at the Hamburg broadcasting station is of a type not far removed from the magnetophone used in this country. It is not suspended on sponge-rubber but rests on a pedestal and is enclosed in a wooden box. The mechanism consists of a thin strip of corrugated aluminium ribbon which is lightly stretched between the poles of an electromagnet. The ribbon is free to vibrate, and these small vibrations produce changes in a magnetic field. Currents generated by these changes are amplified and applied to the modulating valve in the usual manner. This microphone is what might be described as the old one, but is still used for ordinary transmissions. A new microphone called the "Reis" microphone is at present being experimented with. A great deal is being said in favour of it, and it can be seen in the accompanying photograph of the studio. The Reis microphone is very simple in appearance and is enclosed in a solid block of white marble, which, it is claimed, renders resonance impossible. The instrument is subject to patents, and I was not able to find out its exact mechanism, although the engineer in charge kindly offered to take the instrument to pieces for my benefit. A couple of the screws were sealed, so I did not feel justified in allowing him to do this.

The Gong

The Hamburg station is known as the station which rings the gong, and speculations have often been made among British listeners as to what was happening with reference to this "gong-like" sound which has also been described as produced by silver bells. Herr Blankenese, the station director, kindly initiated
me into the secrets of the profession, and showed me the champagne glass which produces this sound when rapped on the edge by the pencil of the announcer. I understand that a great number of glasses have been broken during this process since the opening day of the station.

A Unique Method
I think there is something in favour of the gong in the manner used at the Hamburg station. One rap means a minute interval; two raps, two minutes interval. These, however, are not in my mind the important gong signals. The

The author before the microphone on the occasion of his broadcasting from the Hamburg studio.

one of which I am in favour is the one gong which is struck immediately before the announcer speaks. This, I consider, draws the attention of the listener who has been waiting to the effect that something important is about to occur, like the heralding of kings of old. Without such a warning it often occurs, especially on long-distance reception, that the first word of the announcer is missed. The first word is often the most important, such as in "London calling", and I have often heard from listeners abroad and noticed myself how difficult it is to identify the London station over great distances for this reason.

Striking the Hour
The chimes giving the time signal from the Hamburg station are not produced with champagne glasses but by means of tubular bells. By the aid of these bells a quarter-hour chime is produced and the announcer also strikes the requisite number corresponding to the hour. It may be interesting to note that the hour is struck in a different manner in Germany from the way clocks strike the hour in this country. The hour is always repeated after each quarter chime, and four chimes are given before the hour to denote a full hour.

In the accompanying photograph a certain number of keys will be observed affixed to the announcer's desk. These keys form part of a very elaborate mechanism which has recently been evolved by one

of the Hamburg Post Office engineers. By means of this it is possible for the announcer to ring the chime desired. The whole mechanism is controlled electrically and acts on the instrument which has just been described. This new device is not yet in use, but will be operating within a few days.

The Control Room
The control room is adjacent to the studio. There the amplifiers can be seen for the station itself, the land-line running to the relay stations and also for simultaneous broadcast.

A noticeable feature might be mentioned with regard to the resistance utilised with the valves of all amplifiers in the station. This consists of what might be described as an auxiliary valve which contains a filament enclosed in hydrogen gas. The filament glows at a low red heat, and it is claimed that this maintains an absolutely constant current in the filament of the operating valve.

The Transmitter
The transmitting gear itself is housed on one of the top storeys of the building and employs one large Telefunken transmitting valve which is capable of handling approximately 1 kilowatt, but which is loaded to 1.5 kilowatts for the purpose of transmission. The filament takes 16 volts, and 1,500 volts are applied to the plate, which glows dull red when in operation. A small, modulating valve is situated in the same panel and this alone forms the transmitting equipment. It is very much in the experimental stage. It is not proposed to change it for the present, as a new station is now under construction by the Nordische Rundfunk A.G., which is hoped will be operating within the next three months. The same studio, will be used for this new station, but the transmitting gear will be installed some five miles outside the city, and 8 k.w. will be used.

The Generators
The generator room is on the second floor in the Post Office building. Current is obtained from a motor and two generators running on the same shaft. One of the generators produces 750 volts and the second 25 volts, the latter being used both for charging the accumulators and exciting the field of the high-tension generator. There are three such generator sets, two being in constant use and coupled in series in order to produce the 1,500 volts required for the plate current. The third group is spare. The low tension power to the valve filaments is supplied by a battery of large glass laboratory accumulators supplying twenty volts. There are two such batteries, one in use and one on charge.

Aerial Arrangements
The aerial is brought into the transmitting room by an ordinary ebonite leading-in tube, and the earth connection is made to the water mains. From the general aspect of the gear itself it can be described as exceedingly simple and unpretentious. It is obviously the original experimental gear which is still in use, and the results which will be obtained from the new high powered station will no doubt give a better idea of the Nordische Rundfunk Gesellschaft A.G. is capable of doing with the backing of the Hamburg citizens.
In the March issue of Modern Wireless I described the "Resistance Four," a four-valve receiver consisting of a detector and three stages of resistance-capacity coupled L.F. amplification. For the benefit of those who prefer transformer coupling I have decided to describe a receiver following a similar lay-out and capable of giving the same, or perhaps slightly less, volume and at the same time utilizing a method of switching one, two, or all the valves into operation without the necessity for any alteration in the adjustments of the set. The constructor will therefore find it an easy matter to tune in a station on the 'phones using the detector valve only, to increase the strength of signals if necessary by adding a stage of low-frequency amplification, or to use all three valves for working a loud-speaker. The receiver is simple to manipulate; and the beginner will have no difficulty in operating it in an efficient manner. The problem of the best type of switching to employ is not easy to solve; but everyone will agree, I think, that the actual act of switching should be as simple as possible and that the complication in wiring should be as small as possible. I have constructed a very large number of sets, and in doing so have tried practically every type of switching device, my conclusion being that the American plug and jack method is very difficult to improve upon for switching in low-frequency circuits. No readjustment of H.T. voltage is required, and it is so convenient to be able to add another stage or two of magnification by the insertion of a plug attached to the telephone or loud-speaker cords. Transformer coupling lends itself in particular to this method, for in the ease of resistance-capacity coupling efficient switching is not so easy to arrange for on account of the readjustment of H.T. voltage so often necessary. With jack switching one may, if one so desires, light the filament of the valve to be used at the instant of inserting the plug, but while this has many advantages, I did not consider that these were sufficient to warrant the inclusion of a refinement of this nature in the receiver I am describing in this article. After all, it is only the matter of a moment to turn the required valve on or off by the

Fig. 1.—The theoretical circuit. The value of the condenser $C_1$ is best found by experiment.
The grid battery is held between the small spring clip shown on the left of the above photograph, and the cabinet.

partial rotation of the filament rheostat knob, and at the same time any extra complexity in the wiring is avoided.

The Circuit

The circuit employed is straightforward in every respect, and it consists of a valve rectifier followed by two efficient stages of transformer coupled low-frequency amplification. The aerial circuit is tuned by a \( 0.005 \mu F \) square law type variable condenser, which may be placed either in series or in parallel with the aerial coil. Three positive tappings are taken from the H.T. battery in order that the correct voltage may be applied to the anode of the particular type of valve used, in accordance with the operating data which the makers in nearly every case supply with the valve. Reaction may be used when necessary. A clip-in condenser is connected across the two contacts of the jack in the plate circuit of the last valve, and is intended to be used as a loudspeaker tone control. The best value should be determined by experiment, and will probably be between \( 0.002 \mu F \) and \( 0.01 \mu F \). It is, of course, better to employ an entirely separate tone-control and filter-unit as part of the loudspeaker equipment. In the same way the condensers \( C_a \), \( C_c \), and \( C_f \), which are shown dotted in Fig. 1, should be considered essentially as part of the H.T. battery unit. They have not been included in the set itself.

Components

The components actually incorporated in the set are as follows, but these could, of course, be replaced by others of equal quality:

1. Mahogany cabinet with loose baseboard, size 18 in. by 7 in. by 6 in. inside—(Carrington Manufacturing Co.).
2. Black ebony panel, 18 in. by 7 in. by \( \frac{1}{2} \) in. (Radion).
3. \( 0.005 \mu F \) variable condenser, square law pattern (Collinson's Precision Screw Co., Ltd.).
4. Two-coil holder (Peto-Scott Co., Ltd.).
5. Dual filament resistances, or resistances suitable for the type of valve used (Burndept Wireless, Ltd.).
6. Black nickelled valve windows (Grafton Electric Co.).
7. \( 0.003 \mu F \) grid condenser (Dubilier Condenser Co., Ltd.).
8. 2 megohm grid leak (Dubilier Condenser Co., Ltd.).
9. \( 0.005 \mu F \) fixed condenser (Dubilier Condenser Co., Ltd.).
10. Clip-in condenser, complete with clips and base (L. McMichael, Ltd.).
11. Angle brackets for securing panel to baseboard (Henry Joseph and Co., Ltd.).

The complete receiver. Note the symmetrical lay-out.
The wiring is extremely simple and should present no difficulties.

9 Nickelled terminals, W.O. type (Burne-Jones and Co., Ltd.).
A quantity of square section tinned-copper wire, about 15 lengths (Sparks Radio Supplies).
A few 4 B.A. and 6 B.A. screws and nuts, and a short length of flex.
A set of Radio Press panel transfers.

**Construction**

The construction of the receiver is quite a simple matter, and the panel lay-out diagram, together with the wiring diagram, will enable the constructor to reproduce the actual receiver in the easiest possible manner. To carry out the construction efficiently the following tools will be required:

- A 1.2-inch steel rule.
- A scriber.
- A pair of dividers.
- A good quality soldering-iron, a quantity of soldering paste or resin and some blow-pipe solder.
- An American drill and a set of twist drills.
- A carpenter's brace, together with a 3/8 in. twist drill with a square shank, and a 1/8 in. drill for the valve windows. (A high-speed drill to take bits of this size would be very expensive, and is, in any case, not really necessary.)
- A rose bit for counter-sinking.
- A centre-punch and a small hammer or mallet.

A screwdriver.
A pair of side-cutting pliers and a pair of long-nose pliers suitable for wire bending.

These are the essential tools, but in addition a set of B.A. spanners, some files and a supply of emery cloth will be found useful.

**Marking Out**

First mark out the panel by means of the steel rule and scriber to the dimensions given in Fig. 2. The spacing for the terminals is set off with dividers. The top terminal is placed on the centre line through the valve windows, and the bottom one on the centre line through the jacks. The distance between these two centre lines is divided into five equal parts, thus giving the four equidistant points for the remaining terminals. The three terminals and the two 6 B.A. screws on the left of the panel are spaced out in a similar manner. The holes for the valve windows are 3/8 in. in diameter, and drilling should be carried out from both sides of the panel after first running a 3/32 in. pilot hole through the centres. The fixing screws are spaced equidistant round a 1 in. diameter circle; and it is a good plan to use the metal back-ring as a template. The filament resistances are supplied complete with drilling template, and are therefore easily mounted.

The 3/8 in. drill used for the spindle clearance hole will also serve quite well for mounting the jacks, although a slightly smaller drill would in some cases be an advantage. The terminal shanks, and a 4 B.A. clear-drill are therefore required. This same drill should also be used for the two holes which secure the angle bracket to the panel.

The two reaction leads are held by means of two 6 B.A. screws and nuts on the left of the panel above the aerial and earth terminals. Two flexible leads are soldered to these screws and taken through the cabinet to the moving socket of the coil holder, the other two flexible leads being taken from A1 and Earth to the two screws on the fixed socket. Sufficient slack should be allowed for the free movement of the moving socket through its arc.

**Mounting Components on the Baseboard**

The setting out of the components on the baseboard is quite straightforward, and the lay-out can be followed by reference to Fig. 3. It is as well to mention that the valves are not placed directly behind the valve windows, as this is not convenient in this case, and in practice it is just as easy to view the valves through the windows in the positions in which they are placed as it would be if they were allotted a position in a direct line behind them. The actual wiring of the receiver should be carefully followed from the diagram, especially the connections to the jacks.
Fig. 2.—The panel lay-out, blue print (full size) No. 121a, price 1s. 6d. post free, may be obtained from the Sales Dept.

It is as well to wire up the filament resistances first and then to place the transformers in position. A good hot, clean iron is essential, and a non-acid flux should be used. A 0.003 μF fixed condenser is connected across the two outside tongues of jack No. 1, and I consider this value to be sufficiently large for the purpose; in fact, it is often possible to use even a smaller size, such as 0.003 μF. In any case the smallest value consistent with adequate reaction control should be used.

Operating the Set

To operate the receiver, connect up the low-tension battery to the terminals marked L.T. + and L.T. - and a high-tension battery of 100–120 volts to the terminals marked H.T. + 1, 2, 3, and H.T. -. Do not insert the three positive plugs until the valves have first been inserted and the filaments lit. To do this, rotate the rheostat knobs clockwise. If bright emitter valves are preferred, I recommend that you use two of the general purpose type for the rectifier and first L.F. and a small power-valve, such as an M.O. D.E.5, D.E.4, B.T.H. B.4, Mullard D.E.A.0, or D.F.A.R. in the last stage. Some of these valves work from a 4-volt accumulator, and others are intended for one of 6 volts, but it is solely a matter for the constructor to decide, as all of them will give excellent results. The equivalents of these valves in the 2-volt or 0.6 type will be found equally satisfactory. Assuming two general purpose valves and one of the small power type to have been inserted in the valve holders, the following values of H.T. and grid bias should be taken as a rough guide: H.T. + about 60 volts, H.T. + 2, 8–120 volts, and 1.5–3 volts grid bias, and H.T. + 3, 120 volts and 6 volts grid bias. These values vary, of course, with the type of valve used, and the maker’s instructions should be adhered to. Place a No. 50 or 75 coil in the reaction coil socket of the two-coil holder, and a No. 35 or 50 in the fixed socket. Place
the aerial tuning condenser in parallel by connecting the aerial lead to \( A_1 \), joining \( A_2 \) and "Earth" together by means of a piece of wire, the earth lead being taken to the terminal marked "Earth."

Keep the reaction coil well away from the aerial coil and, assuming that the valves are lit to a suitable degree of brilliancy, rotate the aerial tuning condenser dial until signals are heard. Then bring the reaction coil nearer to the aerial coil and note whether signals increase in strength.

When the telephone or loud-speaker plug is inserted in jack 1, the French station at Toulouse comes in on the detector and one stage of low-frequency amplification only. In daylight, Birmingham can be received at fair strength, but Bournemouth, although audible, is somewhat weak. At night, when the conditions are favourable, it should be possible to receive several of the other B.B.C. stations, but these would not be called real loud-speaker strength. With the A.T.C. in series, a No. 50 coil will serve for the lower B.B.C. band of wavelengths with a No. 75 for those above 400 metres. A small reaction coil, such as a No. 25 or perhaps a No. 75 will be necessary, although this is, of course, an indication of a poor aerial system. Using Gambrell coils an "A" in the aerial and an "a" for reaction should suffice, but in certain cases an "A" or "B" will be required. If a large reaction coil must be used for good results, I would strongly advise the listener to improve his aerial and earth.

Test Report

The set was tested on my main aerial in Kent at a distance of about 15 miles from 2LO, and which consists of a single wire 100 feet in length and 35 feet (average) in height. Using a large G.A.V. loud-speaker the local station is uncomfortably loud and the receiver gives adequate volume with the reaction short circuited. The correct coils to use with the A.T.C. in parallel, i.e., with the aerial joined to \( A_1 \) and \( A_2 \) and "Earth" connected together, are a No. 35 in the aerial socket and a 35 or 50 for reaction. The efficiency of the aerial used largely decides the size of reaction-coil, and in some cases the receiver gives adequate volume with the reaction short circuited.

As the two stages of low-frequency amplification will only be necessary in most cases for loud-speaker work, provision is made for the tone condenser \( C_4 \) across the last jack only.

The correct coils to use with the A.T.C. in parallel, i.e., with the aerial joined to \( A_1 \) and \( A_2 \) and "Earth" connected together, are a No. 35 in the aerial socket and a 35 or 50 for reaction. The efficiency of the aerial used largely decides the size of reaction-coil, and in some cases the detector valve only is in operation. Upon inserting the plug in jack 2 a stage of low-frequency amplification is added, and the insertion of the plug into jack 3 brings all the three valves into use. As the two stages of low-frequency amplification will only be necessary in most cases for loud-speaker work, provision is made for the tone condenser \( C_4 \) across the last jack only.

No difficulty was experienced in tuning in several Continental stations on the loud-speaker after dark, using all three valves, and 35, should be used. I have, using a set of this type, found it possible to receive the American short wave station KDKA, employing as a secondary coil a Gambrell "a/4" in the aerial socket with 5 turns of No. 18 s.w.g. d.c.c. wire wound loosely round the outside to form the aperiodic aerial coil. An "a/2" or "a" will serve for reaction.

Tuning, of course, is very critical, and the results are not so good as would be obtained using a low-loss short wave receiver.
NOW that the wireless set has come to be regarded as an indispensable piece of furniture in many homes, there is a demand for a type of receiver which will give consistently good reception of the broadcast programmes. For the man whose main concern is experiment, and by whom broadcasting is regarded as only one type of available transmission among many, circuit arrangements employing one or two valves may suffice. But those who desire rather to reap the full benefits of the programmes provided by the broadcasting stations, not only in Great Britain, but all over Europe, need a type of circuit which can be reasonably certain to fulfil their requirements at any time. When listening to the programmes from their local broadcasting station, they dislike being permanently attached to the set by head-telephones, preferring the complete freedom afforded by the use of a loud-speaker. Some, too, wish to hear the foreign transmissions, selecting for preference those that can be reproduced at reasonable strength on a loud-speaker. Finally, many like to feel that their set is capable of bringing in the more distant stations, even though head-telephones are necessary for this purpose.

Many Circuits Available

The requirements outlined may be filled by a receiver containing four valves. Many combinations of this number of valves are possible, and it is proposed to indicate here a few practical circuits. Receivers constructed in accordance with the diagrams given will not be found unduly complicated to control, a point which will appeal to those who feel alarmed at the sight of a large number of dials and switches on the panel of a receiver. A few

![Diagram: A circuit suitable for loud-speaker reception from the local station. Good quality is assured by the use of resistance-capacity low-frequency amplification throughout.]

Fig. 1.
Volume and Range
Where, however, the nearest broadcasting station is at a greater distance than, say, 30 miles from the receiver, it becomes advisable to use one or more stages of high frequency amplification before the detector, in order that the variations of potential applied to the grid of the detector may be large enough to ensure its efficient working. In the circuit of Fig. 2, V functions as high frequency amplifier and V2 as detector, two stages of transformer coupled amplification being added to provide sufficient energy for a loud-speaker. As in the previous circuit, coil L1 may be a No. 35 or 50 for the broadcasting wavelengths; L2 may each be a No. 50 or 75, the smaller size being used as the reaction coil. Values of 0.003 μF and 0.005 μF will serve for the tuning condensers C1 and C2, respectively.

In this circuit the varying potentials applied to the grid of V2 by the incoming oscillations present in L1, C1 produce amplified oscillations in the anode circuit of V2, in which the circuit L2, C2 is also tuned to the desired frequency. The consequent varying potentials across L2, C2 are applied between the grid and filament of V2, which acts as a detector, the usual grid condenser C3 and leak R4 being provided. When the circuit L2, C2 is tuned to the same frequency as L1, Ci, self oscillation of V2 may occur, due to the inter-electrode capacities of the valve. To counteract this, a potentiometer, R6, of 400 ohms resistance, is connected across the filament.
Fig. 3.—The above circuit is very simple to handle, requiring only two adjustments—variation of C₁, and the coupling between L₁ and L₂. Similarity will be observed between this circuit and that of Fig. 2.

Simplicity of Operation

Simplicity of control is a feature which makes a wide appeal; the diagram of Fig. 3 shows a circuit which has only two main tuning controls, the tuning condenser C₁ in the aerial circuit L₁, C₁, and the reaction control provided by coupling the coil L₂ to L₁. Care is necessary in the handling of this form of reaction coupling; or the aerial will be energised to the annoyance of other listeners. The operation of this receiver is essentially similar to that of the circuit of Fig. 2 described above, with the exception that for the “tuned-anode” system employed in Fig. 2 there is substituted an anode resistance R₁, whose value may be

Fig. 4.—This circuit consists of a stage of high frequency amplification followed by a detector and two low-frequency amplifying valves. Good quality is obtained without great sacrifice in volume by the combination of transformers and resistance-capacity couplings.
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Price 18/6 from all Wireless Dealers.
Fig. 5.—Considerable range is possible with this circuit, two stages of high frequency amplification being employed, followed by a stage of low-frequency amplification for loud-speaker working.

80,000 ohms. The remainder of the circuit is similar to Fig. 2, and the values of components may be the same as those given for that circuit. This resistance-capacity method of high-frequency coupling will function over a wide band of frequencies, no tuning adjustment being required, but it is not efficient on wavelengths below about 1,000 metres. This circuit therefore is recommended for the reception of the long-wave broadcasting stations, such as Chelmsford and Radio-Paris. For this purpose L_1 may be a No. 150 coil, and L_2 a No. 200, C_1 having a value of 0.005 μF.

**Quality with Volume**

The circuit depicted in Fig. 4 is again essentially similar in operation to that shown in Fig. 2, with the exception that reaction is provided by coupling the coil L_3 in the anode circuit of the detector valve V_2, to the aerial coil L_1, instead of to the anode coil L_3 of the high frequency amplifying valve V_3; also resistance-capacity coupling is substituted for transformer coupling in the second stage of low frequency amplification. Resistance-capacity coupling is to be preferred for the second stage of L.F. amplification, when really good quality of reproduction is desired; the volume of sound obtainable in this manner is not so great as that given by transformer coupling, but comparative freedom from distortion is assured.

A suitable valve, designed specially for resistance-capacity coupling, should be used for V_3, in order to obtain the best results. As in Fig. 2, provision is made in this circuit for using 2, 3 or 4 valves as required, the telephones and loud-speaker being permanently connected to jacks which can be plugged in at the desired point.

**Greater Range**

Some people are unfortunate enough to be situated in districts which are somewhat remote from broadcasting stations, or which are “blind” from the point of view of reception. For them, and for those who wish to receive some of the Continental stations at moderate loud-speaker strength, the circuit of Fig. 5 will be found suitable. Two stages of H.F. amplification precede the detector, so that weak incoming oscillations are considerably amplified before rectification, enabling the detector to operate efficiently. A single stage of L.F. amplification provides sufficient energy to operate the loud-speaker.

The operation of the H.F. stages in this circuit is in principle similar to that of Fig. 2, except that no reaction is provided. The amplified oscillations in the tuned circuit L_2 C_2 L_1 being the primary winding of a high-frequency transformer, cause varying potentials to be set up across the secondary winding L_3, since this is in a position of fixed close coupling to L_4, these varying potentials being thus applied across the grid and filament of V_3. The operation of the second transformer L_4 L_5 is similar. As high frequency amplifying valves used in this manner are prone to self-oscillation, the grids of both V_1 and V_2 are connected to the slider of the potentialmeter R_4, the resistance of which may be 400 ohms; by suitable adjustment of the slider sufficient damping can be introduced into the grid circuits of V_1 and V_2 to stabilise their operation.

The coil used for L_1 in this circuit may be a No. 35 or 50 for British broadcasting; while the H.F. transformers should be suitable for the wavelength band to be covered.

For use in conjunction with those circuits in which plugs are incorporated for inserting the telephones or loud-speaker, a suitable arrangement of these components is shown in the small diagram. The telephones and loud-speaker are permanently attached to the plugs; the value of the condenser across the loud-speaker being best determined by trial. Care should be taken in connecting the leads to the plugs to see that the positive lead from the telephones or loud-speaker is connected to the H.T. lead when the plug is inserted; if all the jacks also are connected up the same way round, there will be no fear of injuring the permanent magnets in the earpieces.
A Filter and Tone-Control Unit

By

C. P. ALLINSON.

This unit will be found particularly valuable by those who desire to obtain the best results from their loud speaker.

A most desirable addition to any multi-valve receiver working a loud-speaker is a filter circuit which isolates the loud-speaker so that the steady current flowing in the plate circuit of the last valve does not pass through its windings. With the present small power valves so frequently used in L.F. amplifiers the actual steady plate current may have quite a large value, and by the use of a filter circuit all possible risk of injury to the delicate windings of the loud-speaker is eliminated.

Further, in order to get the greatest possible purity of reproduction, a very real consideration to all listeners with a critical ear, some form of tone and volume control is needed.

A Convenient Size

The unit here described combines the various requirements set out above, and also in order that telephones may be substituted for the loud-speaker with the least trouble, a jack is used.

The photograph shows the neat appearance of the unit, and its symmetrical lay-out will be readily appreciated. Contained in a mahogany or an oak cabinet, it can be made to match with the receiver in use, and the one shown will match very well with a receiver built into an "All Concert" cabinet.

Fig. 1.—The panel lay-out. The loud speaker is automatically cut out when the telephone plug is inserted in the jack.

Fig. 2 shows the theoretical circuit diagram. The choke coil \(L_1\) and the condenser \(C_1\), combine to form an efficient filter circuit, effectively isolating the windings of the telephones or loud-speaker...
LISSENUM

SILENCE—
for those distant stations!

Many listeners would like their local station to close down so that they might search for distant stations without interference.

That is, of course, quite out of the question—and certainly most unnecessary, too.

With LISSENAGON "X" COILS, distant stations can be tuned in without the slightest sign of interference, just as though the local station had actually closed down, in fact.

Readers of this magazine who wish to make their receivers highly selective should write for interesting leaflet describing the many uses of LISSENAGON "X" COILS. In many cases no alteration is necessary to a receiver, in others the alteration to wiring is a matter of a moment. Those interested in Neutrodyne and Reinartz circuits, wavetraps, etc., should also have a copy of these particulars of LISSENAGON "X" COILS.

LISSENAGON "X" COILS are particularly suitable for the H.F. stage of the "Neutral Grid" circuits designed by Mr. Cowper.

A TEXT BOOK OF LISSEN PARTS will also be sent free on request. It contains a fund of useful information which will be of interest to all readers of this magazine.

In all cases where Standard Coils are required, Experimenters who are only satisfied with the most efficient—

USE LISSENAGON COILS—the coils which intensify tuning.

LISSEN LIMITED
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Phone—Richmond 2285 (4 lines). 'Grams—"Lissenium, London."

LISSEN PARTS—WELL THOUGHT OUT, THEN WELL MADE,

In replying to advertisers, use Order Form enclosed.
To get the best out of your set, put the best into your set. Fit the right valve for your individual needs.

The most efficient electrode system for one type of valve is not necessarily the best for other types. The electrode system of each type of the "Valve in the Purple Box" is the result of scientific determination of the best design for the conditions under which it is to be used.

A noteworthy example is

**TYPE D. E. 3.**

a general purpose valve for use with dry batteries, or 4-volt accumulators.

**REDUCED PRICE 16/6**

Outstanding features:

**FILAMENT.**

Although current consumption is only .06 amp., electron emission equals that of bright emitter taking over twelve times the current. The filament does not depend for its emission on a substance coated on the outside which rapidly wears away in use. The active material permeates the whole of the filament.

**GRID.**

Special machinery provides for abnormally high exactness of manufacture. Spiral grid, each turn welded to grid support. Full control over electron emission ensured.

**PLATE.**

Most rigid construction employed (spot welding). Active portion of filament entirely enclosed.

_The most economical valve in the World!_
Fig. 2.—The theoretical scheme of connections.

from the steady plate current. This choke, however, offers a very high impedance to all fluctuating currents.

It is important, of course, that the choke should have a high impedance, or else a loss in signal strength may result.

By means of the switch S₁ it is possible to connect a variable resistance across the loud-speaker (a variable anode resistance is used), thus giving control over volume as well as helping to reduce any resonance effects that may be present in the loud-speaker windings.

The switch S₅ allows one of four condensers (C₅, C₆, C₇, or C₈) to be connected across the loud-speaker terminals, thus giving a very effective control of pitch. The values of these condensers are: C₂, .0075 F, C₃, .004 F, C₄, .006 F, C₅, .01 µF, and different values will be found best under different reception conditions. With very loud signals, the large size condenser may be used with advantage, especially with some loud-speakers. Different types of received signals will require different capacities according to their tone and strength.

Different Values Should be Tried

Speech, for instance, will be most clearly received with one value: an instrumental solo with another, and orchestral items with another; while the use of clip-in condensers allows further values than those given to be tried.

The loud-speaker being connected to the terminals marked L.S., telephones may quickly be substituted by plugging them into the jack shown in the circuit diagram, and on withdrawing the plug the loud-speaker is automatically placed in circuit.

The following components are required, and for the information of constructors who may wish to follow the design of the unit described in every detail the makers' names are given:

1 Single-circuit jack (Elwell Wireless, Ltd.).
2 Sets switch parts (Bowyer-Lowe Co., Ltd.).
3 Variable anode resistance (Bretwood, Ltd.).
4 Clip-in condensers and mounts. Values required are .002, .004, .006 and .01 µF (L. McMichael, Ltd.).
4 Large lacquered brass terminals (Burne-Jones and Co., Ltd.).

Fig. 3.—The wiring diagram. The values of the clip-in condensers should be experimented with until best results are obtained.
I set Radio Press panel transfers.
Square tinned wire for connections.

The construction of the unit is a simple matter. If guaranteed ebonite is used time and trouble will be saved that would otherwise have to be expended in removing the surface of the panel and its attendant risk of leakage. If the panel has to be rubbed down, use glass-paper (sometimes called sand-paper) in preference to emery. The latter has the tendency to work into the surface of any material to which it is applied.

The panel layout in Fig. 1 will show you where to drill the various holes, and the wiring diagram shows the layout of the base-board. Having mounted the two switches, jack, variable anode resistance, and terminals on the panel, fix this to the base-board and screw down to the latter the components which are to be carried thereon.

The connections to be made are clearly shown in Fig. 3, and should present no difficulty.

To connect up the unit, join the two terminals marked "To set" to the output or loud-speaker terminals of your receiver. The loud-speaker is then connected to the terminals so marked, and telephone tags are placed into the two screw-down connectors in the plug. When the 'phone plug is inserted in the jack the loud-speaker is automatically cut out of circuit and vice versa. A little experiment will soon show the best value of capacity across the loud-speaker for good reproduction.

The completed unit is a refinement that will enable one to obtain added pleasure from wireless reception.

The T.A.T. System

Sir,—As requested, I have much pleasure in sending results obtained from the T.A.T. system, using 2 H.F. and Det., reaction on tuned anode. My aerial is 20 ft. high at the house end, and 35 ft. the other, being practically unscreened. The earth is two copper plates sunk 4 ft. under the aerial. The valves are 2 B.T.H. B5, 06 amp., for the H.F. side, and A.R.D.E. for detecting.

These have to work four pairs of 'phones, situated in various parts of the house, and previously were used as I.V.F. In a few minutes I changed to the T.A.T. system, and was successful in tuning in most of the B.B.C. stations right away. The coils are homemade basket coils, and the chokes necessary are 250 for 5IT, and 400 or 500 for 5XX, both No. 30 D.S.C.

On finishing the set off properly, the results were excellent; 5IT and 5XX loud-speaker strength, 5WA, 22Y, 6BM, 5SC at strong 'phone, and 2BD, 2LO, 5NO at quiet strength. Many German stations come in at loud-speaker strength with one pair, whilst Radio Paris, Ecole Superieure and Eiffel Tower are at moderate loud-speaker strength.

So many stations come in that I can at present give no DX results until I have sorted them out, but I believe Komarow and Seville have been heard. Judging by the above, America should be quite readable, since I have picked it up on one valve on the only two occasions that I have tried, when I sighed for a stable H.F. circuit.

The circuit is a delight to handle and very stable. Components:—Fallon variable and Dubilier fixed condensers, Lissenstat minors, Sterling and Brunet 'phones, H.T.C. valve holders, and Calvern tuning condensers. The last two are excellent additions to any set.

Wishing your paper every success and thanking you for the many good circuits that appear. I may add that I have been a reader since No. 1. Yours truly,

JOHN A. BENJAMIN.

P.S.—5IT and 5XX come in very quietly on four pairs of 'phones with no aerial.

Brigenorth, Salop.
The Demons of Shock & Noise beaten at last!

At last appears the truly efficient Sterling "Non-Pong" Shock Absorbing Valve Holder to put the demons of shock and noise in their place, beaten and powerless. No more "pong" noise — no more shocks to break filaments that the ordinary rigid valve holder cannot prevent. For the "Non-Pong" absorbs shocks, prevents irritating microphonic noises, and very considerably lengthens the life of a valve.

Use "Non-Pong" Holders in the set you are building, or the Adapter type in sets already fitted with ordinary holders.

STERLING
NON-PONG
Shock Absorbing
VALVE HOLDERS

At your radio dealer's

Announcement of STERLING TELEPHONE & ELECTRIC CO., LTD., Manufacturers of Telephones & Radio Apparatus, etc.,
210-212, TOTTENHAM COURT ROAD, LONDON, W.1
Works: DAGENHAM, ESSEX
Watch our Smoke!

The North American Indian “broadcasted” news by means of smoke signals.

A code message was transmitted by alternately lifting and replacing a wet blanket over a fire.

Faulty or unsatisfactory reception is the smoke that spells out this message:

FOR PERFECT RECEPTION—USE ★★ COMPONENTS.

Fixed Condensers.

The new improved type ★★ fixed condenser is now available. All capacities are a standard size and instantly interchangeable. Both sides are faced with high-grade insulating material with the capacity engraved on one side.

Capacity is within 10 per cent. of its rated value, an important feature especially when condensers are used in critical circuits. They never change their value and will give you everlasting service.

PRICES.

As illustrated, any value.

- 0.0001 μF to 0.001 μF 1/9 each.
- 0.001 μF to 0.005 μF 2/3 each.

(Two clips are supplied with each Condenser.)

Grid Leaks and Anode Resistances.

If you would be sure of a Grid Leak or Anode Resistance that does not change its value with use and is always silent in action, be sure to get ★★ resistances. Can be obtained mounted (as illustrated) or unmounted (with two clips).

PRICES.

Grid Leak, all values, 2/- each.
Anode Resistance, all values, 2 1/2 each.
(Each supplied with two clips.)

Grid Leak and Condenser.

An extremely useful and efficient unit containing a 0.003 μF Condenser and a ★★ grid leak. PRICE (as illustrated) 4/- each.

You can’t go wrong if you specify ★★ Components.

Obtainable from all Dealers.
All Hours of Transmissions reduced to British Summer Time.

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<tr>
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<td>12.30</td>
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<td>Sweden</td>
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<td>12.30</td>
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<td>Weather Forecast in French and English</td>
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<td>Lausanne</td>
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<td>34</td>
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<td>35</td>
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<td>Komarow</td>
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<td>Westphalia</td>
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<td>10 mins.</td>
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<td>Eiffel Tower</td>
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<td>Exch. Quotations (Sat. excepted)</td>
<td>5 mins.</td>
<td>1 Kw.</td>
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<tr>
<td>250</td>
<td>4.0</td>
<td>Munich</td>
<td>485 m.</td>
<td>Bavaria</td>
<td>Concert</td>
<td>6.0 p.m.</td>
<td>1 Kw.</td>
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<td>159</td>
<td>4.10</td>
<td>Radio-Wien</td>
<td>532 m.</td>
<td>Vienna</td>
<td>News, followed by Concert</td>
<td>6 p.m.</td>
<td>1.5 Kw.</td>
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<td>239</td>
<td>4.25</td>
<td>Royal Dutch Meteorological Inst.</td>
<td>1100 m.</td>
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<td>Night Frost Reports</td>
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<td>4.30</td>
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<td>505 m.</td>
<td>Berlin</td>
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<td>700 Watts.</td>
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<tr>
<td>Ref. No.</td>
<td>B. S. T.</td>
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<tr>
<td>46</td>
<td>4.30</td>
<td>Leipzig</td>
<td>FL 454 m.</td>
<td>Germany</td>
<td>Concert</td>
<td>6 p.m.</td>
<td>700 Watts</td>
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<tr>
<td>52</td>
<td>4.30</td>
<td>Eiffel Tower</td>
<td>PCF 1950 m.</td>
<td>Paris</td>
<td>Exch. Closing Prices (except Sat.)</td>
<td>3 mins.</td>
<td>2 K.</td>
</tr>
<tr>
<td>249</td>
<td>4.30</td>
<td>Van Daz</td>
<td>East Prussia</td>
<td>Amsterdam</td>
<td>Time Signal, Stocks and Shares</td>
<td>6 p.m.</td>
<td>2 K.</td>
</tr>
<tr>
<td>5</td>
<td>5.0</td>
<td>Konigsberg</td>
<td></td>
<td>East Prussia</td>
<td>Light Orchestra (Wed and Sat., Mond. Hour)</td>
<td>6 p.m.</td>
<td>2 K.</td>
</tr>
<tr>
<td>159</td>
<td>5.0</td>
<td>Zurich</td>
<td></td>
<td>Switzerland</td>
<td>Concert by Hotel Baur-au Lac, relaxed</td>
<td>6 p.m.</td>
<td>500 Watts</td>
</tr>
<tr>
<td>160</td>
<td>5.0</td>
<td>Brema</td>
<td></td>
<td>Silesia</td>
<td>Light Orchestra</td>
<td>6 p.m.</td>
<td>1.5 K.</td>
</tr>
<tr>
<td>233</td>
<td>6.30</td>
<td>Stuttgart</td>
<td>SFR 1780 m.</td>
<td>Brussels</td>
<td>Concert, followed by News</td>
<td>7.15 p.m.</td>
<td>1 K.</td>
</tr>
<tr>
<td>224</td>
<td>7.15</td>
<td>Berlin</td>
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<td>1 K.</td>
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<td>186</td>
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<td>1 K.</td>
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<td>1 K.</td>
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<tr>
<td>162</td>
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<td>FL 2650 m.</td>
<td>Paris</td>
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<td>7.15 p.m.</td>
<td>1 K.</td>
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<td>168</td>
<td>6.30</td>
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<tr>
<td>244</td>
<td>7.30</td>
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<td></td>
<td>Munich</td>
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<td>1 K.</td>
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<tr>
<td>169</td>
<td>7.30</td>
<td>Hilversum</td>
<td></td>
<td>Paris</td>
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<td>11 p.m.</td>
<td>1 K.</td>
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<td>228</td>
<td>7.30</td>
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<td>63</td>
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<td>1 K.</td>
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<td>126</td>
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<td>234</td>
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<td>1 K.</td>
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<td>242</td>
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<td>Concert</td>
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<td>8 Kw.</td>
</tr>
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<td>56</td>
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<td>German</td>
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<td>8 Kw.</td>
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<tr>
<td>164</td>
<td>8.30</td>
<td>Royal Dutch</td>
<td></td>
<td>Utrecht</td>
<td>Night Frost Report</td>
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<tr>
<td>164</td>
<td>9.30</td>
<td>Meteorological</td>
<td></td>
<td></td>
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<td></td>
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<td>143</td>
<td>9.30</td>
<td>Italian</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>60</td>
<td>9.30</td>
<td>Radio-Wien</td>
<td></td>
<td>Vienna</td>
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<td>15 Kw.</td>
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<td>77</td>
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<td>33</td>
<td>9.0</td>
<td>Radio-Barcelona</td>
<td>EA1 3245 m.</td>
<td>France</td>
<td>Concert Tests</td>
<td>5 mins.</td>
<td>300 Watts</td>
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<tr>
<td>164</td>
<td>9.0</td>
<td>Radio-Paris</td>
<td></td>
<td>Paris</td>
<td>Concert, sometimes preceded by Lecture</td>
<td>11 p.m.</td>
<td>15 Kw.</td>
</tr>
<tr>
<td>84</td>
<td>11.30</td>
<td>Radio-Toulouse</td>
<td></td>
<td>Berlin</td>
<td>Time Signal in G.M.T. (Spark)</td>
<td>5 mins.</td>
<td>5 Kw.</td>
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<tr>
<td>42</td>
<td>12.30</td>
<td>Radiosonicia</td>
<td></td>
<td>Nauen</td>
<td>Time Signal in G.M.T. (Spark)</td>
<td>8 mins.</td>
<td>50 Kw</td>
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**SUNDAYS.**

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<tr>
<th>Ref. No.</th>
<th>B. S. T.</th>
<th>Name of Station</th>
<th>Call Sign and Wave-length</th>
<th>Situation</th>
<th>Nature of Transmission</th>
<th>Closing Time or Approx. Duration</th>
<th>Approx. Power used</th>
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</thead>
<tbody>
<tr>
<td>83</td>
<td>8.0</td>
<td>Frankfurt</td>
<td></td>
<td>Germany</td>
<td>Morning Prayer</td>
<td>1 hour</td>
<td>1 K.</td>
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<tr>
<td>85</td>
<td>8.30</td>
<td>Leipzig</td>
<td></td>
<td>Germany</td>
<td>Morning Prayer</td>
<td>10.45 a.m.</td>
<td>1 K.</td>
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<tr>
<td>153</td>
<td>9.0</td>
<td>Konigsberg</td>
<td></td>
<td>Germany</td>
<td>Morning Prayer</td>
<td>9.45 a.m.</td>
<td>1.5 K.</td>
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<tr>
<td>212</td>
<td>9.0</td>
<td>Voxhaus</td>
<td></td>
<td>Germany</td>
<td>Morning Prayer</td>
<td>10 a.m.</td>
<td>1.5 K.</td>
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<tr>
<td>255</td>
<td>9.0</td>
<td>Helsingfors</td>
<td></td>
<td>Finland</td>
<td>Divine Service</td>
<td>9.30 a.m.</td>
<td>1 K.</td>
</tr>
</tbody>
</table>
The difficulty of "overcrowding on the dial" is not always the fault of the condenser, especially if the latter be the new Igranic Square Law model. There are other factors which determine selectivity, as, for instance, the proximity to your receiver of a high-power station working on approximately the wavelength of the distant station required. Then there is also the method of coupling High Frequency Valves, upon which a lot depends. The surest way to selectivity lies in the adoption of the form of coupling made possible by the Igranic Unitune Aperiodic Fixed Coupler. This component combines many of the advantages of both direct and loosely coupled methods of tuning without their attendant disadvantages. It is therefore particularly efficient when receiving on short wavelengths.

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The difficulty of obtaining reaction is also overcome by using the Unitune Fixed Coupler. The Unitune Fixed Coupler may be used in any ordinary receiver employing standard coil holders.

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<table>
<thead>
<tr>
<th>Type</th>
<th>Fill Volts</th>
<th>Fill Amps</th>
<th>Plate Volts</th>
<th>Price</th>
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<tr>
<td>A.R.</td>
<td>4.0</td>
<td>0.75</td>
<td>30-80</td>
<td>8/-</td>
</tr>
<tr>
<td>R.</td>
<td>4.0</td>
<td>0.75</td>
<td>50-100</td>
<td>8/-</td>
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<tr>
<td>A.R. D.E.</td>
<td>1.8-2.0</td>
<td>0.3</td>
<td>20-100</td>
<td>14/-</td>
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<tr>
<td>A.R. 06</td>
<td>2.5-3.0</td>
<td>0.06</td>
<td>20-100</td>
<td>16/-</td>
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<tr>
<td>P.V.5 D.E.</td>
<td>5.0</td>
<td>0.25</td>
<td>50-150</td>
<td>22/-</td>
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<td>P.V.6 D.E.</td>
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<td>0.4</td>
<td>60-120</td>
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<td>P.V.8 D.E.</td>
<td></td>
<td>3.0</td>
<td>0.12</td>
<td>60-120</td>
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</tbody>
</table>

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Royal “Ediswan” Lamps, made with the same skill and care as Ediswan Valves, give unusual brilliance at extremely little current consumption. They are strong, too, and will last for years in ordinary use.

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## SUNDAYS (Contd.)

<table>
<thead>
<tr>
<th>Ref. No.</th>
<th>B.S.T.</th>
<th>Name of Station</th>
<th>Call Sign and Wave-length</th>
<th>Situation</th>
<th>Nature of Transmission</th>
<th>Closing Time or Approx. Duration</th>
<th>Approx. Power used</th>
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<tbody>
<tr>
<td>214</td>
<td>9.0</td>
<td>Munster</td>
<td>--- 410 m.</td>
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<td>Morning Prayer</td>
<td>10.0 a.m.</td>
<td>1.5 Kw.</td>
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<tr>
<td>213</td>
<td>9.40</td>
<td>Boemendaal</td>
<td>--- 350 m.</td>
<td></td>
<td></td>
<td>7 hour</td>
<td>1 Kw.</td>
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<td>256</td>
<td>10.0</td>
<td>Copenhagen</td>
<td>--- 775 m.</td>
<td>Westphalia</td>
<td>Divine Service</td>
<td>11.15 a.m.</td>
<td>1.5 Kw.</td>
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<tr>
<td>97</td>
<td>10.55</td>
<td>Eiffel Tower</td>
<td>FL 2650 m.</td>
<td>Holland</td>
<td>Sacred Concert</td>
<td>3 mins.</td>
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<td>59</td>
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<td>FL 2650 m.</td>
<td>Prague</td>
<td>Classical Music</td>
<td>4 mins.</td>
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<td>297</td>
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<td>Sacred Concert</td>
<td>5 mins.</td>
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<td>92</td>
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<td>Radio-Wien</td>
<td>--- 530 m.</td>
<td>Stuttgart</td>
<td>Classical Concert</td>
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<td>1 Kw.</td>
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<td>11.30</td>
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<td>--- 485 m.</td>
<td>Bavaria</td>
<td>Sacred Concert</td>
<td>1 hour</td>
<td>1 Kw.</td>
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<td>96</td>
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<td>Ko p i g wus-</td>
<td>LP 1300 m.</td>
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<td>1.10</td>
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<td>NSF 1050 m.</td>
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<td>Children's Stories, followed by concert</td>
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<tr>
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<td>--- 2400 m.</td>
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<tr>
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<td>--- 515 m.</td>
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<td>1 hour</td>
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<td>Spain</td>
<td>Concert</td>
<td>60.30 p.m.</td>
<td>650 Watts.</td>
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<tr>
<td>269</td>
<td>7.15</td>
<td>Oslo</td>
<td>--- 475 m.</td>
<td>Norway</td>
<td>Lecture and Concert</td>
<td>9.0 p.m.</td>
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<td>279</td>
<td>7.40</td>
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<td>NSF 1050 m.</td>
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<td>9.10 p.m.</td>
<td>5 Kw.</td>
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<tr>
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<td>1 Kw.</td>
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<td>Denmark</td>
<td>Concert, followed by News</td>
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<td>1.5 Kw.</td>
</tr>
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<td>114</td>
<td>8.0</td>
<td>Radio-Wien</td>
<td>--- 530 m.</td>
<td>Vienna</td>
<td>Concert</td>
<td>10.0 p.m.</td>
<td>1 Kw.</td>
</tr>
<tr>
<td>118</td>
<td>8.0</td>
<td>Konigsberg</td>
<td>--- 463 m.</td>
<td>E. Prussia</td>
<td>Concert</td>
<td>10.0 p.m.</td>
<td>1 Kw.</td>
</tr>
<tr>
<td>173</td>
<td>8.0</td>
<td>Frankfurt</td>
<td>--- 470 m.</td>
<td>Germany</td>
<td>Lecture, followed by evening programme</td>
<td>11.0 p.m.</td>
<td>1.5 Kw.</td>
</tr>
<tr>
<td>119</td>
<td>8.0</td>
<td>Hamburg</td>
<td>--- 395 m.</td>
<td>Germany</td>
<td>Concert, followed by News</td>
<td>11.0 p.m.</td>
<td>5 Kw.</td>
</tr>
<tr>
<td>220</td>
<td>8.30</td>
<td>Voxhaus</td>
<td>--- 505 m.</td>
<td>Berlin</td>
<td>Evening Programme</td>
<td>11.0 p.m.</td>
<td>5 Kw.</td>
</tr>
<tr>
<td>125</td>
<td>8.30</td>
<td>Stuttgart</td>
<td>FL 2650 m.</td>
<td>Paris</td>
<td>Concert or Lecture (May begin 15 mins. earlier or later)</td>
<td>10.30 p.m.</td>
<td>4 Kw.</td>
</tr>
<tr>
<td>174</td>
<td>8.0</td>
<td>Munich</td>
<td>--- 485 m.</td>
<td>Bavaria</td>
<td>Concert, followed by Dance Music</td>
<td>11.0 p.m.</td>
<td>8 Kw.</td>
</tr>
<tr>
<td>124</td>
<td>8.0</td>
<td>Breisau</td>
<td>--- 418 m.</td>
<td>Silesia</td>
<td>Light Orchestra, Dance Music at 11.0 p.m.</td>
<td>10.30 p.m.</td>
<td>1.5 Kw.</td>
</tr>
<tr>
<td>121</td>
<td>9.0</td>
<td>Lausanne</td>
<td>HBz 850 m.</td>
<td>Switzerland</td>
<td>Concert or Talk</td>
<td>9.30 p.m.</td>
<td>300 Watts.</td>
</tr>
<tr>
<td>128</td>
<td>9.15</td>
<td>Radio-Paris</td>
<td>SFR-1750 m.</td>
<td>Clincy</td>
<td>Detailed News Bulletin</td>
<td>9.0 p.m.</td>
<td>8 Kw.</td>
</tr>
<tr>
<td>122</td>
<td>9.15</td>
<td>Zurich</td>
<td>--- 515 m.</td>
<td>Switzerland</td>
<td>Concert</td>
<td>10.0 a.m.</td>
<td>300 Watts.</td>
</tr>
<tr>
<td>127</td>
<td>9.30</td>
<td>Leipzig</td>
<td>--- 454 m.</td>
<td>Brussels</td>
<td>Symphony Concert</td>
<td>10.0 p.m.</td>
<td>700 Watts.</td>
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<tr>
<td>116</td>
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<td>Radio-Belge</td>
<td>SBR 265 m.</td>
<td>Germany</td>
<td>Concert, followed by News</td>
<td>10.10 p.m.</td>
<td>2.5 Kw.</td>
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<td>Voxhaus</td>
<td>--- 410 m.</td>
<td>Westphalia</td>
<td>Classical Concert</td>
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<td>199</td>
<td>9.30</td>
<td>Ecole Superieure</td>
<td>FPTT 458 m.</td>
<td>Paris</td>
<td>Concert or Lecture</td>
<td>10.30 p.m.</td>
<td>5 Kw.</td>
</tr>
<tr>
<td>173</td>
<td>8.30</td>
<td>Radiotronica-</td>
<td>--- 425 m.</td>
<td>Rome</td>
<td>Concert, followed by Late News</td>
<td>11.0 p.m.</td>
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<tr>
<td>130</td>
<td>8.45</td>
<td>Radio-Paris</td>
<td>SFR 1750 m.</td>
<td>Clincy</td>
<td>Concert, followed by Dance Music</td>
<td>11.0 p.m.</td>
<td>8 Kw.</td>
</tr>
</tbody>
</table>
The Long-Range Neutrodyne Receiver

To the Editor of Modern Wireless.

Sir,—I am writing to tell you the results obtained with the Long-Range Neutrodyne Receiver described in the January issue of Modern Wireless, by John Underdown, which I have built.

The set is built into a two-door cupboard, all leads out at the back. The design of the panel is the same except that the top portion from just below the rheostats is bent back at right angles, consequently there are only 3 dials, 2 jacks and 1 push-pull switch on the vertical front.

My aerial is of T-type; the length between insulators 110 ft. and 50 ft. above the ground. The down lead, taken from the exact centre, is 45 ft., so that the effective length from either end is 100 ft. The earth lead is taken to the ground and a wire is buried one foot below the surface and directly beneath the aerial.

Results are as expected. All B.R.C. main stations except 2LO, which is very poor in this district, and Cardiff, which is variable, come in at loud-speaker strength. Leeds, Plymouth, and Edinburgh are quite loud enough for a good-sized room.

We have one great difficulty here at the mouth of the Mersey; hundreds of ships and "Seaforth the All Powerful." Anyone living inland cannot realise the perfect medley of morse all around the dial, and the difficulty of tuning in foreign stations. However, one gets used to it.

"Foreign language" stations come in very well, same at loud-speaker strength and one in particular as loud as the local station. The only foreigner I am able to recognise is Radio Iberica.

Selectivity is fair, but, having had experience with Super-Heterodynes and the Cockadood Circuit, it is not as I should like it.

However, the set is very simple to handle and most important point of all, it "gets there" every time.

Wishing the Radio Press every success.

Yours truly,

H. KINGHAM.

New Brighton, Cheshire.
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July, 1925

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- 24 x 12 x 1/2
- 24 x 10 x 1/2
- 18 x 9 x 1/2
- 18 x 10 x 1/2
- 14 x 7 x 1/2
- 14 x 12 x 1/2

" BECOL " panels are supplied cut to the following sizes:

- 24 x 12 x 1/2
- 24 x 10 x 1/2
- 18 x 9 x 1/2
- 18 x 10 x 1/2
- 14 x 7 x 1/2
- 14 x 12 x 1/2

" BECOL " Ebonite is guaranteed free from defects.

Type O (below panel).

Better parts mean better Results

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A radio receiver can only be as good as the quality of its components. Best possible results cannot be expected if you incorporate components of doubtful manufacture and efficiency.

It is wise to select radio components that have been proved by popular use to be of the highest radio efficiency. Such components are the H.T.C. products. Experienced experimenters and constructors have, by comparison with components of other makes, proved H.T.C. products to be all that we claim, and have thereby been eminently satisfied.

By incorporating H.T.C. components into your set wherever possible, you definitely ensure its maximum efficiency.

That the "Success" Superforma is tunable considerably increases the selectivity of the receiver, gives greater amplification and generally improves the efficiency of any Super Heterodyne Receiver. By turning the small knob, the tuning condenser may be locked in position.

THE Success Noloss Condenser provides a really high grade instrument for the use of serious experimenters and constructors. If you appreciate radio instruments of quality, we are satisfied that the Success Noloss Condenser will meet with your entire approval.

The Success Noloss Condenser is the first variable condenser of British manufacture rightly designated No Loss. Has a to 1 gear, while making a vernier unnecessary also removes all hand capacity effects, since the body has no electrical contact with the moving vanes. Many other superlatives are apparent.

Ragged Construction.
Skeleton Design.
Pigtailing Connections to moving vanes.
Copper Vanes.
Fixed Vanes secured to bottom end plate only.
No backlash.
No vernier employed.

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Quick or Vernier at will, Designers favorite with the "Success" Noloss Condenser. 30 x 1 Gear. Price 6.

The SUPERFORMA

The outstanding feature of the "Success" Superforma is the incorporation of a most Variable Condenser as an integral part of the unit.

The fact that it is tunable is a consideration which enables the experimenter to balance up the stages for himself, after the set is built, and to tune out interference.

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Amongst the special features which contribute to the remarkable efficiency of the new B.T.H. R Valve are the following:

HIGH VACUUM, ensuring silent working and long life.
LOW ANODE CURRENT, with consequent increase in life of H.T. battery.
EXCEPTIONALLY LOW GRID CURRENT, ensuring excellent quality and volume without distortion, even when the means of giving suitable grid bias are not available.
TIPLESS BULB, giving better appearance and reducing risk of accidental breakage.

Filament voltage \(= 4 \text{ volts}\)
Filament current \(= 0.7 \text{ amp.}\)
Maximum anode voltage \(= 100 \text{ volts}\)
Voltage amplification factor \(= 7.5\)
Anode resistance \(= 27,000 \text{ ohms}\).

B.T.H. R VALVE

Insist on B.T.H.-the Best of All.
A description of an interesting receiver employing auto-coupling both in the aerial and the anode circuits

February, 1925, issue of this journal. In the article referred to, circuits were described and illustrated in which a small separate coil was included in the anode circuit of the high-frequency valve, this coil being coupled to a larger coil tuned by a variable condenser to the wavelength of the incoming signals.

Further Details

If this small coil in the anode socket is wound upon the same form as the larger tuned coil, we may replace the two coils by a commercial form of plug-in coil known as the “Unitune” as made by the Igranic Electric Co., Ltd. The present circuit consists of tapping off a portion of the tuned circuit coil and connecting this

---

**Fig. 1.—The theoretical circuit of the receiver.** L₁ and L₂ are “X” coils
small portion in the anode circuit of the high-frequency valve, while the tuning condenser is placed across the whole of the coil in the usual manner. The remainder of the circuit is perfectly straightforward and needs no comment. Note magnifiers may, of course, be added if desired.

**Stabilisation**

Owing to the fact that the damping in the aerial circuit has been considerably reduced by the inclusion of auto-coupling, it is necessary that some form of stabilising shall be incorporated, and this is most simply accomplished by means of a potentiometer, which is joined across the accumulator, the slider being taken to the lower end of the aerial tuning circuit and to earth. A terminal, marked "A" in the circuit diagram, has been provided upon the receiver in order that the ordinary form of direct coupled aerial tuning with parallel condenser may be tried in conjunction with the tapped tuning in the anode circuit. The receiver illustrated in the photographs accompanying this article will be found exceedingly simple to construct.

**Components Required**

As is customary in a description of receivers in Radio Press journals, a list of components used in the construction of this receiver will be found below. The makers' names have in some cases been given in order that any reader so desiring may exactly duplicate the receiver, but of course, any equivalent make of components of good quality may be substituted without sacrificing anything in the nature of good results.

One insulating panel, 10 by 9 by 

Two filament rheostats ("Polar," Radio Communication Co., Ltd.).

Two sets of valve sockets, or alternatively two complete valve holders.

Eight terminals.

Two "Declo" Dial Indicators (A. F. Bulgin and Co.).

One set of Radio Press Panel Transfers.

One Dorwood condenser and grid leak mounting (Dorwood). This is a one-hole fixing component.

One Dubilier 2 megohms grid leak. (Dubilier Condenser Co.).

In addition to the above a set of Lissenagon "X" Coils will be required for the band of wavelengths it is desired to receive. If it is only desired to receive the short wave broadcasting, the three coils, 50, 60 and 75, will be found sufficient. If, however, it is desired to receive the Chelmsford station and Radio-Paris in addition to the former stations, it will be necessary to purchase two Lissenagon "X" coils of the 250 turn size.

**Notes on Components**

The majority of the aforementioned components are perfectly conventional and require no special comment, with the exception of the filament resistances. These, as has possibly been previously pointed out, in connection with Radio Press sets, are of a very useful design, it being possible by undoing a knurled nut to remove the resistance bobbin from the holder and replace it with another of a different
Selectivity and Control

The use of H.F. Transformers always results in greater range and increased selectivity. The design and construction of the high grade turned ebonite former ensures minimum losses, resulting in sharp, accurate tuning on all waves. It is the Transformer that made High Frequency Amplification Popular!

A further improvement is now obtainable by the use of the H.F. Reactor. Replacing the usually clumsy swinging reaction coil, this device is used in conjunction with the H.F. Transformer. The reactor barrel is inserted in the central hole of the Transformer, and approximately adjusted by sliding it up or down the guide pins. Final adjustment is by means of a fluted knob, giving true micrometer control. The full benefits of reaction are thus obtainable with a certainty and ease of action that are a revelation to expert and novice alike; while risk of interference with other listeners is largely eliminated.

Reactor barrel No. 30 covers all wavelengths between 250 and 1,500 metres; for use above and below these wavelengths the two other barrels supplied can be substituted by a few turns.

H.F. Transformers are supplied in six ranges of wavelengths covering from 80 to 7,000 metres. Price 10/- each. The complete set in handsome case, Nos. 00-1 55/-.

Your receiver will be unequalled for range, selectivity and ease of control if you fit H.F. Transformers together with the H.F. Reactor. Every other H.F. Transformer on the market is one reason more why you should use H.F. Transformers. Only in the Transformer will you find all the following points incorporated:

1. High Grade Ebonite former turned from solid.
2. Means of providing sure and delicate control of oscillation by the insertion of the H.F. Reactor and Damper.
3. Windings placed in alternates lots in former, giving highest possible insulation and the lowest capacity between them.
5. Greatest possible Selectivity.
7. Robust Construction.
8. Highest quality workmanship and finish.

Only the H.F. Transformer will enable you to increase the range of your set to its uttermost, enabling you to receive with ease stations never previously heard.

The H.F. Reactor comes to you in a handsome dust-proof case complete with eight guide pins and three interchangeable barrels. Price 15/-.

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Run a lead from your Set into the garden and enjoy your Brown Loud Speaker in the cool of the evening. Its mellow tone—free from the slightest trace of harshness or distortion—is a delight to everyone. Music and song are rendered in a manner which reflects even the personalities of the artists themselves.

No other Loud Speaker can approach the Brown for truthful reproduction because none other can utilize its famous tuned reed principles which are protected by patents throughout the world. Just as the famous Brown A-type Headphones are adjudged the standard by which all others are measured, so Brown Loud Speakers are chosen by critics as being the nearest approach to perfection that science and modern engineering practice have yet evolved.

The masterly combination of the tuned reed in conjunction with an aluminium diaphragm of exceptional thinness results in a sensitiveness and tonal purity which have definitely placed the Brown Loud Speaker in a class by itself.

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<th>Type</th>
<th>HI. 21 in. high</th>
<th>H2. 12 in. high</th>
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</thead>
<tbody>
<tr>
<td>120 ohms</td>
<td>£5.5.0</td>
<td>120 ohms £2.5.0</td>
</tr>
<tr>
<td>2000 ohms</td>
<td>£5.8.0</td>
<td>2000 ohms £2.8.0</td>
</tr>
<tr>
<td>4000 ohms</td>
<td>£5.6.0</td>
<td>4000 ohms £2.10.0</td>
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Care should be taken in wiring the grid condenser and leak.

resistance. It is obviously thus possible to obtain the holder for the bobbin and to mount this into position on the panel. Suitable bobbins may then be purchased for the particular type of valve to be used, and if at any time it is desired to change the type of valve, a fresh bobbin may be brought into use by a very simple operation.

The only other component which calls for comment is the Dorwood grid condenser and grid leak mounting. This is of an unconventional design and upon examination will be found to possess three soldering tags, arranged so as to be one above the other. In this particular case the top soldering tag is connected to the grid of the second valve, the middle to the positive low-tension wire, and the bottom connection is joined to the lower end of the anode tuning circuit, \( L_1 C_2 \).

**Constructional Details**

The layout of the components upon the panel has been designed for the utmost simplicity of construction, and it will be found possible by drawing five vertical lines and three horizontal ones in the positions indicated upon the panel layout drawings, to locate the centres of the majority of the components.

Provided that the components used are those given in the specification, or closely resemble those used in the actual receiver, the drawings and the layout may be followed exactly, but should the components used by the constructor vary markedly in any one respect from those used, it may be necessary to alter slightly the layout in order to accommodate the components. It will be noticed in the back-of-panel photographs that no nuts are used upon the shanks of terminals or valve legs. This is because these components are screwed into tapped holes in

---

Fig. 3.—It may be necessary in certain cases to use magnetic reaction. In this case a coil \( L_1 \) should be coupled by means of a two coil holder to \( L_1 \).
the panel, the writer favouring this method of mounting. If the constructor does not happen to have the necessary taps to hand, it is clear that a slightly larger hole may be drilled in order that the terminal or valve leg may pass easily through this hole and a securing nut may be used upon the under-side of the panel. Only one screw head is visible upon the surface of the panel, this being the securing screw for the one hole fixing grid-leak and condenser.

Wiring

Wiring is carried out using No. 16 tinned copper wire, of circular section, and will be found to be quite simple on reference to the wiring diagram Fig. 4, and the back-of-panel photographs will be of assistance to constructors in determining the relative heights of the connecting wires. Only one flexible lead is used in this receiver, this being the connection from the anode of the first valve through a hole in the panel situated below the anode coil socket and brought out to a spade tag which may be joined to either of the tappings upon the anode coil. The spacing of the filament resistances behind the valves and the low-tension terminals behind the resistances for simplicity of wiring will be appreciated by the shortness of the filament leads.

Operating the Receiver

It is advisable first of all to put in the valves and join up the accumulator. Turn on the filament resistances, and if the valves light correctly turn the resistances to the "off" position, and join up the high-tension battery, telephones and earth. The aerial lead may be joined to either of the tappings of the aerial coil, and in the same manner the anode tapping may be joined to either of the terminals on the side of the anode coil. It is recommended that a 50 or a 60 Lissie X coil be used in the aerial and a 60 or a 75 Lissie X coil in the anode circuit. With these connections made, turn on the filament current and vary the two condensers simultaneously. Provided that the local station is working, this should very soon be picked up, and careful adjustment of the tuning condensers will result in the signals being heard at their greatest strength. Provided that you are situated fairly close to the local station, no difficulty should be experienced in picking this up, but when signals are fairly weak, tuning must be carefully carried out, owing to the selective properties of this circuit. In general, it will be found that louder signals are obtained with the aerial lead joined to the tapping on the aerial coil representing the greater number of turns, and the same remark applies to the anode tap. Selectivity will, however, be greater when the aerial, at all events, is joined to the tap which puts the smaller number of turns into the aerial-earth circuit.

Reaction Control

It will in general, be found, that ample control of reaction is obtained by means of the potentiometer incorporated in the receiver. If the potentiometer is worked towards the negative end, the set

(Continued on page 683.)
PROTECT YOUR VALVES
with the
"DUBRESCON"

THE disconcerting flash that occurs when the filament terminals of a valve are accidentally touched across the anode and grid sockets of the valve-holder is one of the expensive kind—say 8/- or more. Every amateur probably flashes away quite a lot of money this way every year. There is also a similar effect when the H.T. leads are mistakenly connected to the L.T. terminals, and the valves switched on.

These mistakes are like all others—expensive.

Valve immunity, however, can now be purchased for SIX SHILLINGS. That is the price of the new Dubilier Dubrescon, which makes it impossible for valves to be burnt out by accidental short-circuiting or similar causes.

The Dubrescon must be inserted in series in one of the H.T. leads—quite a simple operation. The H.T. current can then never exceed the usual filament current, and your valves are secure for ever. The Dubrescon does not interfere with the passage of the H.F. currents.

It is advisable to buy one now, ready for next time. And in doing so, be sure that you

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Faults in Tuning Coils

G. P. KENDALL, B.Sc., Staff Editor

Faults are sometimes caused by handling coils too roughly.

It is a curious psychological fact that the detachable accessories to the wireless receiving set, such as plug-in transformers, plug-in coils, and even valves, are some of the last components to be suspected when the whole set goes wrong, and we realise that some fault has developed. Possibly one has a feeling that it is so easy to find out whether any of these units are defective by the simple process of substitution, that one simply does not take the trouble to do so. On the other hand, of course, to substitute a sound high-frequency transformer for a suspected one is not always possible to most of us, since it assumes that we possess an alternative one covering the same wavelength range.

Impaired Selectivity

Now, these detachable units are by no means so trouble-proof as we are apt to assume, and I have often had the experience of being called in to diagnose troubles in quite ambitious sets, which were ultimately traced to such apparently trifling causes as a break in the connections of a tuning coil. It is therefore hoped that it will be of some assistance to the general reader to devote some notes this month to the general question of the faults which are liable to develop in tuning coils, to those which may be found present in defective specimens which may sometimes be purchased, notwithstanding the strict testing carried out by the more reputable firms, and to those which may be found in homemade coils.

One of the variable factors in a coil is the degree of insulation between the turns in the windings, and since this insulation can be impaired to such a point that the result is a quite definite fault, we will consider this point first. The kind of thing that may happen is something like this. A set may be giving perfectly good results, eliminating the local station and giving the impression of a satisfactory degree of selectivity, and then possibly as winter approaches the degree of selectivity may be gradually impaired until the user realises that his sharpness of tuning has definitely suffered. The usual investigations as to the condition of the earth connections, joints in the aerial, and so on are all made, and possibly no clue to the trouble is found. In such a case, when attention has been given to the more usual points, suspicion should fall upon the tuning coil, especially if the set is being used in anything which can be regarded as a damp position.

The Effect of Moisture

Readers of Wireless Weekly will remember that I have recently carried out some simple tests upon the effect of moisture in coils, and the results showed fairly clearly that it can be, in certain types of windings, an extremely serious factor. For example, I have known the signal strength given by a certain coil to fall to a value of only one-third its correct figure after the coil had been exposed for a few days to the air.

Faults in Tuning Coils

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of a moderately damp room. Coils which are tightly wound and in which many turns cross one another, with considerable pressure at the crossings, are in general very susceptible to the effect of moisture.

Impregnated Coils

At this point I must give a word of warning as to impregnated coils, also based upon the results of experiments described in Wireless Weekly. It is not safe to assume that because a coil has been impregnated with some form of varnish that it is therefore proof against damp, and need not be suspected in connection with any mysterious flattening of tuning.

Baking Desirable

Bearing these points in mind, it would seem that a reasonable rule for the set user to adopt is one which dictates that wherever it is possible that trouble is due to dampness in coils, the offending component should be submitted to a prolonged baking at as high a temperature as its construction will permit. Experiment leads me to think that this is a very desirable practice to adopt in the winter months wherever it is not possible to keep tuning coils in a thoroughly sturdy windings.
The plug-in components are often
the last to be suspected when a
defect occurs in the set. In this
article the location of faults in
coils is dealt with in an extremely
simple manner.

Dry Position.

Certain types of
coils, it should, perhaps be stated,
are more or less immune to the
effects of damp, and these coils
are of the general type in which
the turns do not cross one another
with any degree of tightness,
or possibly do not cross one another
at all. Such types of these in-
ductances are single layer coils,
loosely wound, and the various
arrangements of spaced winding
upon some form of insulating
support. Coils wound with
enamelled wire, also, may generally
be taken as being to all intents
and purposes damp-proof. As an
example of the type of winding
in which damp has little harmful
effect, the reader is referred to
the type of "X" coil which is com-
eonally referred to by my name
and of which a specimen is
illustrated in Fig. 3 herewith.

Another possible source of trouble
in tuning coils which must be
classed as a fault, is the production
of a high resistance at some
point in the winding or its con-
nections, in any one of quite a
variety of ways. Such a fault
will probably again show up in
abnormally flat tuning, poor signals,
and considerable difficulty in mak-
ing the set oscillate. This latter
is quite a good guide, provided that
faults are taken to explore all the
other possible causes of difficulty
in producing self-oscillation. When
such symptoms are noticed, the
first thing to do is to give the
coil a thorough baking, and

if this does not remove them,
we turn to the
next possibility of the production
of some defect of the nature of a
high resistance in the winding, and
obviously the first
point to receive
attention should
be the connec-
tions between the
ends of the
winding and the
plug and socket
mount.

Defective Joints

In good makes of coils these
will be found to be soldered, and the
soldered joints should be carefully
exposed by partial dismantling
of the coil, and given a minute
examination. It must be borne in
mind that even the most careful
manufacturers are to some extent
at the mercy of the factory hands
who carry out the soldering opera-
tions, and it is by any chance an
unsuitable speed of flux should be
used, it is quite possible for cor-
rrosive actions to go on which will
in due course produce a partial
or complete break where the
soldered joint once existed. Upon
examination, this trouble will
generally present tell-tale signs of
a tarnished or corroded appear-
ance of the metal parts, and if
the wire is gently pulled it will
probably come away in the fingers.
The obvious remedy of course,
is to be found in careful cleaning
of the parts and re-soldering.

Bad Contact

In some makes of coils it may be
found that soldered connections are
not made, but merely that the ends
of the winding are bared and secured
under the heads of the screws which
fasten the band or other means
of attachment to the plug. In such
cases it is desirable to release the
ends of the wires and scrape them
bright once more, since it is quite
possible for tarnish to set in under
the screw head (especially if the
coil is kept in rather a damp place)
of sufficient extent to produce a bad
contact.

It is not in general necessary to
consider the possibility of an
actual break in the windings of
the coil, since no reputable manu-
facturer will permit joints, soldered
or otherwise, to exist in the windings
of his products, and it is highly
improbable that a break could be
produced by any other means
than the corroding away of a
soldered connection. Since the
probable points of location of the
trouble are to be found at the ends
of the windings, if a careful exami-
nation here fails to reveal the fault
and if it has been ascertained that
the plug and socket makes proper
contact with the corresponding
points upon the coil-holder, it
may generally be assumed that the
coil is free from the defect of a
high-resistance or partially broken
contact.

I have not made any mention
of the other possible fault, viz.: a
complete break, since this as a
rule is very easily identified. It
generally leads to a complete
absence of signals, and very often
a buzzing noise in the "phones.
It is, of course, very readily
decided as to general nature, by the
application of the dry cell and
telephones test to the plug and
socket of the coil mount, a very

Fig. 2—How to test a coil
for a break in the winding.
faint or non-existent click denoting a break.

Short circuit

The possibility of an actual short-circuit in a tuning coil may seem perhaps a rather far-fetched one to those who have never experienced such a fault, but it is actually one which is well within the bounds of everyday chances. The symptoms will be a complete noting the effect. If the trouble now disappears and if the suspected coil gives quite a strong click when tested through with the telephones and dry cell it is probable that a short circuit exists across the two ends of the windings. This is actually quite a possible trouble, even with a properly-made coil, and one of the ways in which it may happen concerns the arrangement of the two leads to the plug and socket of the mount. If the two wires come out underneath the mount and are taken to the soldering points on the plug and socket portions with a little slack wire to spare, it is quite possible that if too much of the wire has been bared for soldering purposes, when the coil is pressed down upon the top of the plug and secured, the two wires may cross and touch. Such a defect would, of course, be discovered if it developed in the original mounting of the coil, but it may actually develop in the course of use in a coil which responded perfectly to the makers' tests.

Obscure Cases

Partial dismantling of the coil and inspection will in most cases show that the trouble has taken place in the way which we have just considered, but where it is found that the short-circuit persists even when the coil is dismantled, our suspicions should turn to the plug upon which it is mounted. I have now come across no less than three specimens of plugs in which a definite short-circuit existed inside the moulding, resulting in one case from an actual chip of metal which had lodged between the two plug and socket portions, while in another from over-long screws being employed for securing the band which holds down the coil, and in the third from the presence of a mass of metal filings and soldering paste upon the top of the plug beneath the coil.

The simplest test to adopt in such cases is to take the coil off the plug altogether and test the latter separately with the ever-useful telephone and dry cell.

The only other fault which may occur in home-made or bought coils which I have found at all common is that which is produced by a plug of defective quality.

The symptoms again will be flat tuning and reluctant self-oscillation, with probably some loss in signal strength. To discriminate between this fault and that of dampness in the windings, the precaution should be taken of baking the coil, and noting whether the fault is removed. If it is not, and examination fails to reveal any signs of a poor or a partially broken contact, the plug should fall under suspicion, and the only effective way of testing this without any measuring instruments, is simply to remount the coil upon a sound plug, or better still, to attach to the two free ends separate pin and socket contacts, which can be pushed into the appropriate socket upon the coil-holder. In the case of a particularly bad and leaky plug it is often possible to obtain a quite clear and distinct click between the pin and socket with the telephones and dry cell method, and when this can be done no hesitation need be felt in deciding upon the plug as the cause of the trouble.
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(SENIOR MODEL)
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120 ohms.—W.291

Now Reduced to
£5 — 5 — 0

Junior Model, 2,000 ohms.—W.295
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£2 - 15 - 0.

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WITH FOUR CAPACITIES AND
LOWEST LOSSES IN WIRELESS

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Each condenser has four available capacities, three single and one double, any one of which can be used at the will of the experimenter.

Square law tuning gives selectivity throughout the scale. A micrometer attachment gives additional precision by moving the rotor without backlash through five degrees with a gear reduction of 33 to 1.

The Four-Square Condenser means precision tuning for every experimenter. Write for the brochure describing it.

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FOUR-SQUARE
SQUARE LAW CONDENSER

Use the coupon or send a postcard for fully explanatory brochure. Buy the condenser from good dealers everywhere.

BOWYER-LOWE CO., LTD.
LECHWORTH.

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Vital importance attaches, therefore, to the high-frequency resistance of every connection. The new skin of special nickel-silver alloy of high electrical conductivity ensures in CLIX a perfect fitting connection with a high-frequency resistance of practically zero. This fact, in conjunction with the large area of contact surface provided with the minimum of capacitive metal in both plug and socket portions, gives CLIX its supremacy over every other form of plug, switch or terminal.

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AUTOVEYORS, LTD.
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Adapting the "Simple Selective Set"

By A. D. COWPER, M.Sc., Staff Editor

A description of how to convert the receiver described by Mr. Cowper in the April issue to a Reinartz receiver with a very wide range of reception.

From correspondence it would appear as if the little set with Reinartz type reaction and "semi-aperiodic" aerial coupling by means of a tapped coil, described in Modern Wireless for April, 1925, by the writer, has proved quite as successful in other hands. Some correspondents appear to have met the difficulty foreshadowed by the author (p. 377, Vol. IV., No. 3), that certain types of valves will require a size larger reaction coil throughout. The smallest coil that will give certain oscillation on demand should be used; and the mistake should not be made of trying to get over the difficulty of a low-powered valve by using a larger reaction-condenser. A large part of the charm of the Reinartz arrangement, in its refined form, would then be lost, as with a 0.005 μF reaction-condenser the shift of wavelength with reaction-coupling becomes very marked. The same phenomenon will be noticeable if the radio-choke is inadequate (as in the early American versions of the circuit)—particularly on the long waves. Some correspondents appear to have failed to take to heart the suggestions as to elimination of oscillation overlap, by careful adjustment of H.T., filament-temperature, and gridleak value, for DX work, especially with soft valves, and altering two wires one obtains a straight Reinartz receiver with reaction and aperiodic aerial coil in one, which can be used with plug-in coils either of the purchased or home-made variety, to cover an enormous range of wavelengths in the simplest way possible. This does not interfere with the use of the original tapped coil, when desired.

The slight alteration is indicated in the figures. Taking the wiring diagram on p. 374 of the article in the April number of Modern Wireless, an extra terminal is put in between the coil holder plug L₃ and the existing (alternative) aerial terminal A₂. The wire connecting the coil holder L₃ and the original terminal A₂ is then cut, and connected to this new terminal, now called A₃. The old terminal is now connected by a short wire to the lead from the coil holder plug L₂ to the 0001 μF reaction-condenser, as shown (Fig. 3), and is called A₂.

Reinartz Reaction

Now by putting the aerial-lead on the terminal A₃ we get the reaction-coil (which is plugged into the holder L₂) in series between aerial and earth, i.e., it acts as an aperiodic aerial-coil; whilst at the same time it is connected to the reaction-condenser and performs as an ordinary Reinartz reaction-coil, as shown in the circuit diagram. By plugging suitable coils into holders L₁ (grid

Fig. 1.—The theoretical circuit of the receiver as modified. An extra radio-choke may be inserted at X if necessary.
coil and $L_2$ (aperiodic-aerial and reaction combined), we can obtain practically any range of wavelengths. The aerial-and-reaction-coil must (a) be sufficient to give oscillation with the valve in use, (b) if possible, not tune the aerial up to the wavelength in question; the aerial must have a natural frequency with this coil inserted in series with it, rather above the working frequency. Otherwise the set becomes dead, or unmanageable. On the longer waves the small radio-choke fitted may prove inadequate, and the obvious remedy is to insert a large choke-coil, e.g., a No. 400 or larger, in series with the existing choke and between it and the 'phones. Some queer phenomena may be observed with inadequate chokes.

**Coils**

The coils below about No. 35 should be made of stout wire (No. 14-20 d.c.c.) as a plain solenoid or "hank" coil, roughly wound on a 3-in. former, then removed and bunched up lightly and tied with tape. The No. 17 coil was actually of No. 20 d.c.c. on a 3-in. former, the others were as described. In the ultra-short-wave region, success will result only if a suitable valve (one which oscillates readily) be used, such as DE5B or DE3B; together with ample H.T. Some types of tuning-condenser—and some alleged "ebonite" coil-plugs—will prevent oscillation completely, and therefore any hope of sensitive reception on these wavelengths. The smallest coils were wound with No. 14 d.c.c. (or bare) copper wire, about 4-in. diameter and air-spaced about 4-in.

![Fig. 3.-The modified wiring diagram. Note that terminal A₂ in Fig. 2 now becomes A₃.](image)

The receiver was not, of course, designed for ultra-short wave work, and the minimum observed, with three and two turn coils in position, was about 19 metres (just under 16,000,000 cycles frequency) by careful comparison with heterodyne wave-meters which had been calibrated by the harmonic beat method, against longer-wave instruments. Oscillation was fairly precarious on this wavelength, but on 40 metres (7-turn grid coil, 4-in. diameter, of No. 14 d.c.c. spaced 1/4 in., reaction similar but of 4 turns) the set operated exceedingly, receiving loud amateur morse on a lead to the 3-wire counterpoise alone (connected to "earth" E); and would also operate as a "grid-leak-howl" super- regenerative receiver on this frequency, with a 2-megohm grid-leak and with a No. 11-turn coil with centre earth-tap, 51-turn grid and 51-turn reaction coils, giving loudspeaker results. The 20-metre point was announced incidentally, by a chorus of motor-ignition noises from passing traffic, especially heavy lorries and motor-omnibuses.

### COIL SIZES AND WAVELENGTHS.

*(With aerial both Maximum and Minimum will be raised somewhat)*

<table>
<thead>
<tr>
<th>L₁</th>
<th>L₁</th>
<th>Min.</th>
<th>Max.</th>
</tr>
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<tbody>
<tr>
<td>40</td>
<td>No. 17 (about made)</td>
<td>116</td>
<td>330</td>
</tr>
<tr>
<td>60</td>
<td>25-35</td>
<td>150</td>
<td>300</td>
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<tr>
<td>75</td>
<td>33</td>
<td>250</td>
<td>700</td>
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<tr>
<td>100</td>
<td>60-75</td>
<td>350</td>
<td>900</td>
</tr>
<tr>
<td>150</td>
<td>75</td>
<td>500</td>
<td>1300</td>
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<td>250</td>
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<td>800</td>
<td>2000</td>
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<tr>
<td>300</td>
<td>150</td>
<td>1050</td>
<td>2500</td>
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(Ignacine)

<table>
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<tr>
<th>L₁</th>
<th>L₁</th>
<th>Min.</th>
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<tbody>
<tr>
<td>106</td>
<td>330</td>
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<td>150</td>
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**Built-up Coils. DE5B Valve.**

<table>
<thead>
<tr>
<th>Turns</th>
<th>Min.</th>
<th>Max.</th>
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<tbody>
<tr>
<td>25</td>
<td>85</td>
<td>210</td>
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<tr>
<td>17</td>
<td>11</td>
<td>153</td>
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<tr>
<td>11</td>
<td>7</td>
<td>110</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>84</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>34</td>
</tr>
</tbody>
</table>

* Extra radio-choke required; No. 400 coil in series with 'phones with aerial reaches 2600 m.
A new departure in British Condenser design, giving the following advantages:

1. Practically negligible losses.
2. One-hole fixing — one \( \frac{1}{4} \) diam. hole is needed to fix this condenser to panel.
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Supplied in the following sizes —

<table>
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<tr>
<th>Size</th>
<th>Price with Vernier</th>
<th>Price without Vernier</th>
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<tr>
<td>00025</td>
<td>8/-</td>
<td>6/6</td>
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<tr>
<td>00003</td>
<td>9/-</td>
<td>7/-</td>
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<tr>
<td>0005</td>
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<tr>
<td>.001</td>
<td>10/-</td>
<td>9/-</td>
</tr>
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Price £5 the outfit, including one Interchangeable Oscillator (Broadcast range). Other wavelength ranges supplied at 15/- each.

Special Note.—As some apprehension may exist in the mind of the constructor as to the efficiency of "Super-Hets" we are prepared to supply the Magnaformer Outfit on 7 days' approval against cash.

Price £2.18s. gd. phone: Gerrard 2650.
Simpson & Blythe, 8-9, Sherwood St. Piccadilly, W.
Mr. Harris’ Investigations in the United States

Mr. Harris’ trip to America is proving extremely interesting, and in this article we give a description of some of his experiences, including his visit to WAHG, pending accounts from his own pen.

Radio Press offices in London and was reproduced in Wireless Weekly.

An Enthusiastic Welcome

Arriving on the Saturday, Mr. Harris appears to have spent most of Saturday afternoon and Sunday inspecting the windows of the larger radio stores of New York, gaining an impression of the more commonly used apparatus and components, and began his real investigations upon the following Monday. An enthusiastic welcome is being extended to him everywhere, according to the wont of the American wireless man, and during the early part of the week Mr. Harris met a number of the leading wireless editors in New York, with whom he spent a considerable time going over the salient features of American radio conditions, while later he was the guest at a dinner given in his honour by the leading technical writers and editors at the Harvard club, of which he has been given the temporary freedom.

A reproduction of a photograph taken at this dinner accompanies these notes, and upon the left of the photograph, reading from the head of the table towards the front of the picture, will be seen the following gentlemen;

Mr. Casem (New York Telegram.)
Mr. Paul McGinnis (New York Journal.)

The presentation of the “Radio Cake” to Mr. Harris by Mr. A. H. Grebe.

A NUMBER of reports have been received from Mr. Harris since his arrival in the United States, and pending the publication of accounts of his experiences from his own pen, the following much condensed version giving the outline of his investigations may perhaps be of interest.

Mr. Harris reached New York some eighteen hours late, as a result of a thick fog and bad conditions on the trip, but his voyage was otherwise uneventful, if we except the fact that he rigged up a short wave receiver on the way across, and found it possible to listen to British transmitters for the greater part of the voyage. He arrived in the middle of a very severe hot spell in New York, which he appears to have found exceedingly trying. Immediately the long-drawn-out formalities of the Customs, etc., were over he appears to have had the usual array of Press photographers to face, and their efforts produced a somewhat amusing result: the portrait which was distributed from one of the American photographic agencies bore upon its back an extraordinary "caption," in which Mr. Harris was described as being "known over the world as the best radio announcer!"

A print bearing this remarkable legend was actually sent in to the
Nearby every Mast brings
LETTERS OF APPRECIATION
and
REPEAT ORDERS
An indication of the best service one can offer to their customers.

YOUR CABINET
Hand made in selected well-seasoned wood in Polished Mahogany, Oak, or Wax wood by highly skilled craftsmen to your own particular design or requirements.

YOUR PANEL
Highest grade Ebonite by Messrs. Siemens and Radio Panels always in stock.

INSURE PERFECT CONNECTIONS
with
RADIO AGAR'S SOLDER
Resin Cored.
Sample 2-oz. Box, 1/3 post free.
CLEAN TO HANDLE: NON-CORROSIVE
UNIVERSALLY USED.

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Manufacturer of Telephone & Radio Apparatus
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Est. 1912.

ELECTRADIX RADIOS
"C" Valves, Air Force, low loss, 4/-, 6 for 24/- post free; Dual Emitter, D.E.C., 12/- (cost of buyer's risk). Wattmeters, 50/-; 6/-, 5/- and 6/- Morse Receivers, 20/-; Wheatstone, £3 Spark Sets, 15/-, R.A.F. Steel Masts, 2/9 per ft., 10/-, Receivers, 10/-; 5/- valve, 25/-; 5/- valve, £4; 7/- valve, £6; 12/- valve, £5 10/-; 15/- valve, £8; all prices less valves.

Junctions, £3 and £5 10/- Res. Boxes, multi-range standards, 1 to 2,000 ohms, 17/- to 50/-.

ALTERNATORS, 10/-, Valve Transmitters, £3.

WAVEMETERS, 50/-

RADIO RECORDER, £6 10/-

20/- and 25/- Marconi Rounds.

Valves, 5/-, 6/-; 20/- to £2.

Waxed Teak by highly skilled craftsmen, Hand made in selected well-seasoned wood in Polished Mahogany, Oak, or Wax wood.

An indication of the best service one can offer to their customers.

Mr. Roe (Radio News),
Mr. Arthur H. Lynch (Radio Broadcast),
Mr. W. C. Alley (Radio Retailer),
Mr. M. Clements (Radio Retailer),
Mr. A. B. DeLacy (Popular Radio),
Mr. L. M. Cockaday (Popular Radio),
Mr. H. C. Bodman (Radio Merchandising),
Mr. M. B. Sleeper (R. & M. Engineering),
Mr. Nixon (Radio Dealer),
Mr. Paul C. Oscanyon (Amateur Radio),
Mr. C. H. Albrect (New York Graphic),
Mr. B. Bragdon (New York Sun),
Mr. Sylvan Harris (Radio News).

Later in the week a visit was paid to the factory of Messrs. Attwater-Reed (one of the leading American manufacturers of sets and components) at Philadelphia, returning to New York the same night.

An Amusing Presentation
Much of the listening-in which Mr. Harris has been doing has been carried out upon Long Island, where he has been the guest of Messrs. A. H. Grebe, whose factory is situated in Richmond Hill, Long Island. Here he has had many opportunities of testing a variety of the sets produced by the Grebe works, and it was here that he spoke via the Grebe broadcasting station WAHG. His broadcast speech appears to have been an affair accompanied by a good deal of ceremony and an amusing presentation of an enormous "radio cake."

As is usual when someone of distinction speaks from such a station, preliminary notices were sent round to the Press, in which the subject of Mr. Harris' talk was announced to be "Radio from an English point of view," this informal talk taking place at 10 p.m. In these preliminary notices, an explanation was given of Mr. Harris' position as Editor of The Wireless Constructor and the designer of so many of the home-constructed British receiving sets, and references were made to

Interesting Disclosures
Mr. Harris is devoting much time to the investigation of actual practical receiving conditions, and he has been listening-in for long periods in positions ranging between nine or ten and about thirty miles out from New York, using a variety of different receivers, including super-heterodynes and the more elaborate neutron instruments. Remarks contained in his letters indicate that he is gaining some rather extraordinary impressions of the selectivity question, and also of the problem of self-oscillation; and some extremely interesting disclosures should be forthcoming from Mr. Harris direct at an early date.

A photograph taken on the occasion of the dinner given in Mr. Harris' honour at the Harvard Club. Mr. Harris may be seen at the head of the table.

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Manufacturer of Telephone & Radio Apparatus
9, Colonial Avenue, Minories, E.1
Est. 1912.
what were described as "the famous
Harris Hookups"?

Mr. Harris' actual address from
WAHG was a general account of
the British broadcasting system,
the arrangement of main and relay
stations with our system of
simultaneous broadcasting, our
licensing system, the position of
the B.B.C., our troubles with
oscillators, and so on; and when
he had finished the announcer
of the station proceeded to explain
to the listeners what was taking
place in the studio during the
presentation of the "radio cake." The
cake in question was described
as being as large as a tub, covered
with frosting representing the
British and American flags and
hearing an inscription: "To
Percy Harris, Leading Broadcast
Authority of the British Empire,
from WAHG." This cake was
presented to Mr. Harris in person
by Mr. A. H. Grebe, the president
of the firm and the whole episode
appears to have created much
amusement.

A Well-Equipped Station

Another broadcasting station
which Mr. Harris has visited as
part of his investigations is that
very old 'friend, WJZ, where he
was given the greatest of freedom
to go and see just what he pleased,
which he seems to have done
extremely fully. He gained the
impression that this was a remark-
ably well-equipped station, and
mentions as particularly note-
worthy the fact that modulation
is constantly checked by watching
the trace of an oscillograph.
It would seem that the authorities
of WJZ realize their responsibility
in the matter of their station
must have upon the pronunciation
of listeners, for all their announcers
are University men.

At the end of this, his first week,
a visit was paid to the experimental
station and laboratory at Garden
City, Long Island, of the well-
known American magazine Radio
Broadcast. The impressions gained
here should be particularly
interesting, since in this laboratory
are prepared some of the best of the
American designs for the home
constructor. Another visit to an
establishment of an American wire-
less magazine followed shortly
on this, when Mr. Harris was shown
over the new broadcasting station
just erected by the Radio News,
which is to operate with the call
sign WRNY. This station Mr.
Harris found fitted with standard
Western Electric equipment,
giving a choice of powers
between 300 and 1,000 watts, but
it has not, of course, yet been
officially opened.

This is as far as Mr. Harris' letters
carry us as regards the
progress of his investigations, but
cables which have been received
during the last few days before
MODERN WIRELESS goes to press
indicate that he has now visited
the Bureau of Standards, where he
met Dr. E. W. Austin and Dr. J.H.
Dellinger, but no details of this
visit are as yet forthcoming.

(Continued from page 70)

will oscillate fairly freely and it will
be, in most cases, necessary for
the potentiometer knob to be
turned somewhat towards the posi-
tive end. Cases may arise in
which difficulty may be experienced
in making the receiver 'oscillate
even with the potentiometer upon
the negative end when receiving
the high-power long-wave stations
such as 5XX and Radio-Paris.
In these cases it may be necessary
to slightly alter the receiver in
order that a reaction coil, which is
to be inserted between the anode
of the second valve and the tele-
phones, may be coupled to the
aerial coil. In this case, the aerial
coil socket will be replaced by a
conventional two-coil holder, the
aerial coil being placed in the fixed
socket and the reaction coil in the
moving socket. This is, however,
an extreme remedy which will only
be necessary in extreme cases, upon
very bad aerials. In such latter
cases, it may be necessary to
change the telephones with a small fixed
condenser, say 0.003 µF capacity.

Results

The receiver was initially tested
upon the writer's main aerial which
has an average height of roughly
40 ft. after the London station had
closed down. Upon careful tuning,
two French broadcasting stations
were heard at good strength, and
shortly afterwards three French
amateurs were heard giving their
locations and sending gramophone
records.

Subsequently, good signals
received from Bournemouth and
Birmingham with no interference
from London, whilst several German
stations came in, and Radio-Tou-
louse was excellent in the phones.
Radio-Paris was separable from
Chelmsford in south-east London,
and the concert from the former
station was enjoyable to a degree
seldom experienced.
Success of T.A.T. in Sweden

Sir.—I have studied MODERN WIRELESS for over a year and I have found this paper to be the most interesting of all on this subject. Mostly all of your different sets have been tried by me and I find your T.A.T. system (as described by Mr. John Scott-Taggart in the November 1924 issue) the most interesting and that it gives the best results, both as regards efficiency and stability.

My receiver consists of 2 H.F. - D. - 3 L.F., and is so arranged as to enable me to use any number of valves from 1 to 6. The L.F. valves can be used either with transformers or with resistances at will.

I receive all the Continental broadcasting stations at full loudspeaker strength, using the large transformers or with resistances at either with valves. I get far better results with your tapped transformers or with resistances at either with valves.

[We do not share this opinion generally speaking.—Editor.]

I am now going to try your T.A.T. circuits utilising the new "Trap" method of tuning (described by Mr. John Scott-Taggart, in the February issue of MODERN WIRELESS). As soon as I have done so I shall be pleased to let you know the results.

Bergvik is situated 230 kilometres north of Stockholm and about 1,650 kilometres from London. (10 kilometres equals 6 Eng. miles.)

I also enclose a summary of the Swedish Broadcasting Stations that you may rely upon being up to date.

Yours truly,

Pontus Heden.

Bergvik, Sweden.

From South Africa

Sir.—Being a reader of MODERN WIRELESS and Wireless Constructor since the inception of both books, I wish to congratulate you on the excellent diagrams and also radio notes.

I have made a 4-valve set, using the circuit given in the November MODERN WIRELESS, on page 690, and it works excellently, although I have put in a few extras such as switches and fixed condensers.

I am 30 miles from Cape Town and get our station excellently on the loud-speaker. I get the same results from Jo'burg and Durban.

I have had Bournemouth quite loud on the 'phones on this set, and I can recommend it to your readers. I use 4 Marconi "R" valves.

In your Christmas number you have a diagram of a Reinartz set by Percy W. Harris, which I have made and get excellent results on 2 valves, detector and low frequency from KDKA, Pittsburgh.

Our village is very screened by trees, and the distance from KDKA is about 8,000 miles.

Every morning this week I have picked up KDKA quite loud on the phones.

The coils I find the best are made from 14 S.W.G. wire (enamelled), having three turns for aerial and ten turns for the grid coil; the reaction coil has seven turns.

Wishing you every success and also congratulating you on your good book.

Yours truly,

J. F. Lategan.

Stellenbosch, S.A.

A WONDERFUL DIFFERENCE

GAMBRELL COILS.

<table>
<thead>
<tr>
<th>AERIAL CIRCUIT.</th>
<th>ANODE CIRCUIT.</th>
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</thead>
<tbody>
<tr>
<td>With 100 feet P.M.G. Aerial.</td>
<td>Condenser .0005 mfd. max.</td>
</tr>
<tr>
<td>Approx. Number of Turns on nearest Ordinary Coil.</td>
<td>Condenser .0005 mfd. max.</td>
</tr>
<tr>
<td>a/2</td>
<td>5 9/</td>
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<tr>
<td>25</td>
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<td>H 16/</td>
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<tr>
<td>1500</td>
<td>J 19/</td>
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</table>

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The Colvern Selector Low Loss Precision Condenser is an instrument which gives the precise adjustment so essential to obtain perfect reception, whether on loud signals, such as the local broadcast, or transmission from low-powered distant stations. The mechanical method employed ensures accuracy to 1,000th of a degree; and, a further consideration, the eye is not called upon to supplement imagination. The scale interval is readily readable to that small difference in capacity with the utmost accuracy available.

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685
A view of the complete instrument showing the disposition of the various components; note the type of inductance used.

For those who wish to receive broadcast programmes simply on the telephones and who are situated at not much greater distances than, say, ten miles from a main broadcasting station, a well-designed crystal receiver, used in conjunction with a good aerial and an efficient earth connection, has much to commend it. The mere fact of the excellent reproduction—a faithful counterpart of the original—which it is possible to obtain is in the opinion of many a sufficient justification for the use of a crystal receiver in preference to a valve set.

Obtaining Loud Signals

No one will deny that it is a simple matter to obtain quite good results in crystal reception even with the most rudimentary or even crude apparatus; but, seeing that in nearly all cases a crystal set is required for reception from one station only, which is generally a nearby broadcasting station (excluding, of course, the high-powered station at Chelmsford), it is as well to concentrate on the design of the receiver with a view to obtaining the maximum signal strength under these conditions.

The set illustrated in the accompanying photographs represents an attempt to produce a crystal receiver on these lines. On the author’s aerial and earth system at about nine miles from ZLO this set gives, as far as can be judged aurally, results louder than those given by most of the various types of crystal sets tried. This is confirmed by independent observers.

Comparisons

In one case actual comparison by means of a four-pole throw-over switch with a crystal receiver embodying an air-spaced single-layer coil wound with No. 18 gauge wire, adjusted to give the maximum signal strength, showed that there was no difference, judged aurally, in the loudness of signals.

Some recent work done by Mr. A. D. Cowper on this subject (refer Wireless Weekly, Vol. 6, Nos. 4 and 10) is of interest and indicates that, provided an efficient type of coil is wound on a low-loss former, there is little advantage to be gained by the use of very thick gauges of wire for a crystal tuning inductance when we have the full damping effect of the crystal-phone circuit across the whole of the inductance. As a result of much experimental work, Mr. Cowper selected No. 18 gauge wire wound as a single layer air-spaced inductance on a low-loss type of former, as the limit of thickness to which it was an advantage to go with a circuit embodying a variable crystal tap.

It must, of course, be appreciated that a crystal receiver which gives particularly good results on a certain aerial and earth system will not necessarily give the same performance upon another system, though with average broadcast receiving aerials of fair efficiency and if provision is made for varying the aerial inductance, the results should not be sensibly different assuming a good earth connection to be used in all cases, since dead-end losses with an air-spaced inductance of the type indicated above do not appear to be serious.

Gauge of Wire

Some readers may be surprised to learn that the wire used for the inductance in the crystal set to be described is of No. 24 gauge, enamel insulated. Since the effectiveness of a crystal set is, in the end, judged aurally, the author considers that the slight increase in signal strength, if any, which may be observed with a thicker gauge of wire in a coil of the type illustrated does not warrant its use under ordinary circumstances in view of
In this contribution the author describes a crystal receiver designed to meet the requirements of those who are willing to take a little more trouble in the construction of a set to obtain that extra volume which makes all the difference between average and good crystal reception.

The theoretical circuit of the set is shown in one of the accompanying diagrams. It will be seen that a coil of 60 turns tapped at every ten turns is used, and that both aerial and crystal taps are provided. The parallel tuning condenser C has a maximum capacity of \(0.0025 \, \mu F\). Allowance is made for a loading coil \(L_2\) for the reception of the Chelmsford station; a short-circuiting plug is inserted into the socket provided for this when using the set on the lower broadcast wavelengths. A by-pass condenser across the telephones is not used, since no difference could be detected aurally with or without this component.

**Baseboard Mounting**

The photographs should give a good idea of the arrangement of the set, which is mounted entirely on a baseboard. The tuning condenser and the crystal detector are both placed at the front of the board in accessible positions. The special coil is mounted at the back, while a strip of ebonite, supported away from the coil in the front, carries six Clix sockets from which short leads are taken to the tapping points of the coil. A single coil mount to take the loading coil for Chelmsford is affixed to the baseboard on the right-hand side of the coil. The 'phone terminals are mounted on the right-hand side at the back of the baseboard, while the aerial terminal is on the left of the low-loss coil former at the top, the earth terminal being in a corresponding position on the right.

For those who wish to make an exact duplicate of the set, the following list of the components actually used is given, but the discriminating constructor has ample choice of suitable material.

1. Baseboard, 9 in. by 6 in. by \(\frac{1}{4}\) in. thick (Camco).
2. \(0.0025 \, \mu F\) variable square-law condenser (Sterling Telephone and Electric Co., Ltd.).
3. Crystal detector (Type B.C. 38, General Electric Co., Ltd.).
4. Single coil mount (for baseboard mounting) and shorting plug (Burne-Jones and Co., Ltd.).
5. Terminals.
6. Clix sockets and 2 Clix plugs (Autoveyors, Ltd.).
7. Ebonite strips, 6 in. by \(\frac{1}{4}\) in. by \(\frac{3}{8}\) in. thick and two \(\frac{1}{2}\)-in. lengths of 3-in. diameter ebonite tubing (or the complete former may be obtained drilled and ready for assembly and winding of the coil from Burne-Jones and Co., Ltd.).
8. Ebonite strip, 3 in. by \(\frac{1}{4}\) in. by \(\frac{1}{4}\) in.
9. Some stiff copper wire for wiring and two short lengths of flex.
10. Two \(\frac{3}{4}\)-in. lengths and two \(\frac{3}{4}\)-in. lengths of screwed 4 B.A. rod, six \(\frac{1}{4}\)-in. 4 B.A. countersunk screws.
11. 2 dozen 4 B.A. nuts and some suitable brass wood screws.
12. No. 24 S.W.G. enamel-insulated copper wire. (Approximately two ounces will be required.)

The construction of the special air-spaced coil will first be dealt-
with. As will be seen from the photograph showing a view of the complete coil, the former consists of two ebonite rings to which are secured the six strips of ebonite, equally spaced round the circumference of the rings, thus providing a hexagonal-shaped former.

Spacing the Turns

The method adopted of spacing the wire is of interest, and was first described by the author in Wireless Weekly, Vol. 6, No. 4 (April 29th, 1925) in the article "A New Receiver for Modern Conditions." It consists essentially of winding the wire in the "grooved" surface formed by winding twine of suitable thickness round the ebonite strips of the former, and solves in a simple practical manner the difficulty of spacing the windings satisfactorily without the necessity of cutting a large number of slots in all of the strips.

If the ebonite for the former has not been purchased already cut to the correct size and drilled, it will be necessary to cut the various strips and rings to the sizes specified in the list of components. Then at \( \frac{1}{4} \) in. from each end of each strip a 4 B.A. clearance hole is drilled, and the holes in three of these strips are countersunk on one side to take 4 B.A. countersunk headed screws. In each of the ebonite rings six 4 B.A. clearance holes are drilled symmetrically and spaced equally round the circumference.

Then take one of the ebonite strips and, starting \( \frac{1}{2} \) in. from one end, wind on some good quality twine fairly loosely so as to cover the strip, except for \( \frac{1}{4} \) in. at each end. Secure the ends of the twine suitably with the aid of a little sealing-wax. This twine should be of such thickness that 66 turns can be wound on fairly loosely and evenly on the 5 in. of winding space. Thus the twine required will be approximately 1-12 in.

Assembling the Former

The former is then ready for assembly, and the method of doing this should be quite clear from the photographs and the accompanying diagrams. The two inch lengths of 4 B.A. screwed rod serve to hold the strip carrying the Clix sockets at a distance from the coil and also secure one of the strips of the actual former. Two terminals and back nuts fix the strip at the top of the former, while that at the bottom of the former is held in position by means of the two \( \frac{1}{2} \) in. lengths of screwed 4 B.A. rod and 4 B.A. nuts. The method of mounting the former on the baseboard consists in inserting the projecting lengths of 4 B.A. screwed rod into two holes drilled through the board at a distance of \( \frac{1}{2} \) in. apart. A nut and washer screwed down on each rod above the baseboard and a second nut countersunk into the wood at the back of the baseboard then adequately secure the former, which should not be mounted, however, until the coil has been wound and completed.

Winding the Coil

In winding the coil, first of all drill two small holes in each end ring, where indicated on the diagram showing the complete coil. Secure the beginning of the winding through a pair of these holes, allowing about six inches of wire for connection purposes, and then wind on 60 complete turns of the No. 24 gauge wire. The wire should be wound on tightly and pulled down between the appropriate turns of twine as it is passed over each strip of the former. If the twine has been wound on evenly and fairly loosely as previously indicated, there should be no difficulty in winding in this manner a robust and uniformly spaced coil. When the last turn has been completed, the end of the wire is firmly fixed by passing it twice through the small holes in the end ring and pulling tightly.

Mounting the Components

The completed coil should now be mounted on the baseboard, together with the variable condenser, the crystal detector and the single-coil mount, in the positions indicated in the wiring diagram. The variable condenser is secured to the baseboard by means of four 4 B.A. screws passing through holes drilled in the board and countersunk at the back of it. These four bolts screw into the tapped lugs provided on the end plates of the condenser. The two telephone terminals are mounted on the short strip of ebonite, and behind the fixing nut of each is secured a large soldering tag arranged to project from the side of the strip. The shanks of
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6 1 d.

4 h.

5 6

6/8,

5 At,

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4 h.

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4 h.

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6/8,

14/11

1011

1/5

3/3

6S9

5 d

6 1 d.

4 h.

5 6

6/8,
POVERTY once achieved often becomes a millstone. To be rude to one's enemies is a joy of life, but the tactful avoidance of one's friends is an awkward measure. An Englishman's home is his castle, but there are times when, satisfied with the friendship of good tools, he wishes it were surrounded by a moat.

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<tr>
<th>Size</th>
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the terminals are then cut off just above the fixing nuts; the strip is fixed to the baseboard by means of two wood screws passing through countersunk holes in the ends of the ebonite, spacing washers being placed on the screws between the strip and the board to lift the strip a suitable distance above the latter.

Wiring

The set is now ready for wiring; this is quite a simple matter and should be followed without difficulty from the diagram showing a plan view of the set. Note that the beginning of the coil on the right-hand side of the former is connected to one of the screw contacts of the loading-coil socket, while the other end is left free. The connection to the loading coil socket should be so arranged that when the loading coil is plugged in, its windings are in the same direction as those of the lower wavelength coil. Both ways should be tried and that which gives the lower condenser reading, say, the Chelmsford wavelength should be adopted.

There finally remain only the coil tappings to be made; at every tenth turn the enamelled wire should be carefully scraped with the blade of a penknife and short lengths of wire soldered to these points. The other ends of the wires are soldered to their respective Clix sockets. It will be found most convenient to use a thin gauge of bare wire for this purpose, for instance some of the No. 24 gauge.

Tuning for Loudest Signals

The operation of the set to get the best results is as follows:—Insert one Clix plug into the other, then plug the whole into the various tapping sockets in turn, at the same time varying the tuning condenser. Select that socket which gives the loudest results and leave the aerial tap plugged into it; then after careful adjustment of the crystal detector, try the effect of varying the crystal tapping, again retuning slightly if necessary.

With some aerials the effect of changing the crystal tapping may not give any increased signal strength, but in general on a good aerial this is a desirable refinement.

Some indication has already been given as to the results obtained in the author's case on the local station; in addition Chelmsford is received quite well, though the strength, as with all other crystal sets the author has tried on his present aerial, is not so good as that from London.

An auto-coupled circuit may also be tried by taking the aerial connection direct to a Clix plug and inserting this in the various tapping sockets. With regard to the tuning range with the coil as described and using the total number of turns in the aerial circuit, this proved to be from 330 metres to 520 metres with direct coupling on the author's aerial. Since provision is made for varying the amount of inductance in the aerial circuit there should be no difficulty on an average aerial of tuning to any particular wavelength in the broadcast band. For reception on a certain wavelength using a given aerial and earth system, it may be an advantage to experiment with the size of the coil with a view to obtaining the best inductance value under the particular conditions.
It may be safely assumed that the desire to hear really distant broadcast is prevalent amongst practically all possessors of wireless receiving sets. It is still often thought, however, that a set which will receive distant signals without forcing cannot be used successfully unless the operator possesses much skill in tuning. This is not the case. Wireless Weekly for May 27 contained a constructional article by C. P. Allinson entitled "Distance with Two Valves," whilst in the issue of the same periodical dated June 3 a description of a three-valve receiver specially designed for distant reception by Stanley G. Rattee, M.I.R.E., appeared. Both of these sets, whilst covering really long distances, possess no more than a little volume if purity can be obtained from this set.

Pure Reproduction

Most listeners are ready to forego a little volume if purity can be obtained. John W. Barber in the May 27 issue of Wireless Weekly gave full instructions for the building of a receiver for the local reception by Stanley G. Rattee, M.I.R.E., appeared. Both of these sets, whilst covering really long distances, possess no more than a little volume if purity can be obtained. It is still often thought, however, that a set which will receive distant signals without forcing cannot be used successfully unless the operator possesses much skill in tuning. This is not the case. Wireless Weekly for May 27 contained a constructional article by C. P. Allinson entitled "Distance with Two Valves," whilst in the issue of the same periodical dated June 3 a description of a three-valve receiver specially designed for distant reception by Stanley G. Rattee, M.I.R.E., appeared. Both of these sets, whilst covering really long distances, possess no more than a little volume if purity can be obtained.

Selectivity, also, in many localities is one of the very necessary qualities desired in a modern receiver. Without this, pleasing loud-speaker reception from a distant station is practically impossible, owing to the number of stations working on a limited band of waves. In the "Two-Valve Wavetrap Set," described in Wireless Weekly for June 10, Mr. D. J. S. Hartt has incorporated a selective arrangement in the aerial circuit which eliminates jamming to a remarkable degree, even when the troublesome station is nearby.

Distant Reception and Simplicity

In the various books mentioned above several articles appeared which are of extreme value to the serious experimenter, and some of them are given below.

A loud-speaker shunting unit enabling the tone of your speaker to be controlled was described by A. S. Clark in May 20 issue. In the same number some useful and reliable information regarding Lit zendrant coils as compared with other types is given by G. P. Kendall, B.Sc., who is well known as an authority on these subjects. Ultra-short-wave reception nowadays receiving the attention of many amateurs as well as professional workers, and both classes will welcome the article by A. D. Cowper, M.Sc., in Wireless Weekly for May 27, giving constructional details of a set for 20 metres and below, besides a description of the actual difficulties encountered in this sphere.

A Double-Purpose Receiver

In the July issue of the Wireless Constructor D. J. S. Hartt, B.Sc., has described a set which may be called unique. Two valves are used, and with only two alterations—moving a switch over and altering the position of a plug—this set may be used either as H.F. and detector for distance, or as detector and L.F. for local work.

Any doubt as to the correct method of connecting H.T. batteries in a multi-valve set is effectively eliminated by a short instructional article by Percy W. Harris, the Editor of the Wireless Constructor. The same writer also describes a receiving set in which, by the turn of a switch, either valve or crystal may be used as a detector.

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Trap Circuits

SIR.—As reports are asked for of the above described by Mr. Scott-Taggart in MODERN WIRELESS, February, 1925, I submit my personal experience of the Fig. 11 circuit.

Being situated within 4 mile of the Cardiff station, my need for selectivity is very great, and with the above circuit I can eliminate SWA entirely and receive Bournemouth and Birmingham at good 'phone strength without the faintest undercurrent from Cardiff.

My aerial is inside the house and consists of six 15 ft. wires, about 15 ft. from ground. I have not taken any special precautions to prevent losses on the H.F. side of set, and am using Igranic coils. It took me some time to ascertain the best combination of coils and the reaction coil L5.

In conclusion, may I thank you for producing an "all-station-at-any-time" circuit, and also hope that this report may be of interest?

Awaiting further developments from you on what I consider to be the finest piece of research work produced for some time.

Yours truly,
Cardiff.

G. J. BEST.

The "Long Range" Neutrodyne Receiver

SIR.—I am writing to let you know the results I have had with the four-valve Neutrodyne described by John Underdown in January MODERN WIRELESS. I had a little trouble at first, but it was my own fault for using ordinary valve-holders instead of the anti-capacity type. The first-mentioned completely spoiled H.F. amplification. I wonder if anyone else is having the same trouble. Another curious thing is that although I am not using Neutrodyne Units (I am using McMichael 300 to 600 transformers), I can still tune the set down to Edinburgh, 328 m., which I get at good 'phone strength on first three valves. On four valves I get nearly all the longer wave B.B.C. stations on the L.S. Glasgow is as loud as Birmingham. The station I do not seem to find is Aberdeen, 495 m. With an extra L.F. valve I think the set is ideal for long-distance loud-speaker work.

Will close down now for I expect you have hundreds of other letters to read.

Wishing MODERN WIRELESS every success.

Yours truly,
Cardiff.
T. R. CHENEY.
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July, 1925

The well known
"Popular Wireless"
Continental Set.
Some Suggestions for Obtaining Better Reception

By JOHN UNDERDOWN.

The subject of getting the best out of the set is one which is of pressing interest to the experimenter and broadcast listener alike, and a few suggestions with this end in view will be appreciated. Distant reception is becoming more and more difficult as the evenings get lighter, and those at some distance from a station are finding it increasingly necessary to take measures to combat a falling off in signal strength which is to be expected until the Autumn with its shorter and darker evenings is with us again.

Examine the Aerial

Attention should be directed first to the aerial and earth system. Insulators which have been up during the winter and have become coated with dirt should be taken down and cleaned, halyards should be examined and arrangements made for tightening up the aerial so that swinging in wind is avoided, since critical reaction control is difficult with a swaying aerial. If it is intended to go down to the shorter waves, which are rapidly becoming increasingly popular, it should be remembered that a number of thinner and longer insulators are to be preferred to the more usual large shell type, since these have an appreciable capacity which serves to pass a certain amount of signal energy to earth via the rope or flexible steel wire used to raise and to lower the aerial. An excellent arrangement to keep the aerial taut and at the same time avoid trouble due to stretched rope shrinking and breaking when subjected to wet weather, is the use of a weight on the end of a rope as shown in Fig. 1. A petrol or similar tin filled to an appropriate height with water or soil forms a ready means of obtaining a suitable balance weight to give the required degree of tautness. It is advisable that a further length of rope be taken from above the tin, as shown, to a cleat, so that should the weight become detached, the aerial does not drag the rope through the pulley.

Height is one of the main considerations with the aerial for distant reception, but against this it must be remembered that increased height generally means an increase in the ratio of atmospherics to signal strength, and is not necessarily advisable in all cases for summer reception.

The Importance of the Earth

The earth connection should also be examined carefully, as if this tends to develop a high resistance through joints becoming unscrewed, or corroded, the set will often become unstable or very insensitive, and capacity become pronounced, a large reaction coil necessary, and the delicate reaction control, so essential for long-range working, be lost. Where the soil is sandy and tends to become very dry, thus affording only a poor earth, a good method of obtaining an efficient system is to bury one or several parallel wires under the aerial and to the full length of this. These need not necessarily be placed more than a few inches deep, and ordinary aerial wire will be found perfectly satisfactory. A symmetrical arrangement is to be preferred if a number of parallel wires are used. Thus a good arrangement is to lay one wire directly underneath the aerial and a parallel wire on either side of this, distant three to six feet from the central wire. Alternatively, a counterpoise is an excellent substitute for the normal earth connection, and will often give sharper tuning with lessened reaction.

Selective reception is obtained, using coupled circuits, when coil-holders permitting weak coupling are used.
This circuit is primarily shown to indicate a number of methods of obtaining fine control.

This need not be complicated in nature; a single wire stretched directly under the aerial, preferably to the full length of the former, six feet or so up and well insulated, answers admirably. It should be brought into the house through the same type of lead-in tube as the aerial, and equally well insulated. Where the foliage of trees has grown so as to almost touch either the aerial or the counterpoise, this should be cut back well, as growing foliage often makes a marked difference in signal strength.

Keep the Earth Moist

Where a buried earth is used, the surrounding soil should be kept damp, it seemingly making little difference how deep the earth plate is buried, provided this is in damp subsoil. This seems to be confirmed by Mr. Kendall's experiments on "Earth Connections", given in Wireless Weekly for June 19, 1925.

Do not think that too much stress has been laid on the aerial and earth system and fall into the often accepted common belief of assuming that reaction can be applied to entirely wipe out the effects of losses in this system, since no amount of reaction can completely compensate for a small and poor aerial, as this is the essential collector of energy, and therefore should be as large and efficient as is reasonably possible. It should also be remembered that when the aerial is poor, delicate control of reaction becomes increasingly difficult to obtain. For long distance reception of weak telephony with sets employing reaction it is essential to be able to adjust them easily to just below the oscillating condition, in which state they are most sensitive. Those who have spent some time in carrying out attempts at distant reception of Continental and American stations will fully appreciate that it is necessary to have some much more delicate control of reaction than is afforded by the average type of coil-holder which opens book-wise. It is equally essential if ease and certainty of control is to be obtained that values of plate voltage and filament current be adjusted with some care to obviate trouble from "over-lap," which is evidenced in a set by the fact that the reaction coil has to be withdrawn considerably past the point where oscillation started before oscillation ceases. Many excellent schemes have been put forward for obtaining the requisite delicate control, and it is proposed to deal in this article with some of them.

The Reaction Condenser

Reference to Fig. 2, in which a good long-distance 2-valve circuit is given, consisting of a high frequency stage using tuned anode coupling followed by a valve detector with reaction coupled to the aerial coil, shows other methods of obtaining fine control of reaction. One consists of using a condenser \( C_3 \), in parallel with the reaction coil. The use of this condenser, without upsetting to an appreciable extent the other tuning adjustments of the circuit. This is an essential detail from the point of view of the user of the set, since with a number of circuits a change in reaction setting will effect a considerable change in wavelengths of the tuned circuits. That hand capacity should be at a minimum is also vitally necessary, since otherwise a station which is tuned in may easily be lost when the hand is withdrawn from the set.

The Use of Gearing in Coil-Holders

A large number of coil-holders now on the market are fitted with reduction gearing fixed on the adjusting handle which engages with the spindle carrying a coil. Both coarse and fine adjustment may be obtained with the one handle by means of ingenious mechanism. This method has, however, the disadvantage that slight movements between the coils in getting the necessary reaction adjustment also effect slight changes in the mutual inductance and capacity between the coils, which tends to upset, to a certain extent, the setting of a tuned circuit.

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The Use of a Variable Telephone

A method seldom seen but one which gives more delicate control than that obtained by the use of the reaction coil, and at the same time does not result in appreciable changes in wavelengths of the tuned circuits, is the use of a variable telephone condenser. In place of the ordinary condenser $C_b$, which is usually of $0.001$ to $0.002 \mu F$, $C_b$ may be made a fixed condenser of $0.0005$, whilst $C_a$ in parallel with it may be made variable and of $0.005 \mu F$ in value. In cases where a stage of low frequency amplification is used these condensers will, of course, be placed across the primary of the low frequency transformer. An extremely fine control of reaction may be obtained by varying the value of $C_b$, it being possible to hang on the edge so that a strong atmospheric will send the set in and out of oscillation.

The Potentiometer

A very delicate and most popular method of obtaining fine reaction control is the use of a potentiometer connected as in the diagram of Fig. 2. This is connected across the low tension battery, and the lower end of the aerial coil $L_1$ is taken to the slider of this instrument. The method gives remarkable freedom from hand capacity effects, and also changes in wavelength. A large condenser, $C_a$, of about $0.006 \mu F$ should be connected across the lower part of the potentiometer winding as shown. It is also an advantage to connect a further large fixed condenser across the remaining portion of the potentiometer windings, although this latter condenser is not vitally essential. When using this method the set is in its most sensitive condition with the potentiometer slider at, or near, the negative end of the winding, and generally the set is best worked in this position, it being preferable to use a smaller reaction coil $L_2$ and to work on the negative end of the winding rather than to use a large reaction coil and work towards the positive end of the winding.

The Potentiometer is used these condensers will, of course, be placed across the primary of the low frequency transformer. An extremely fine control of reaction may be obtained by varying the value of $C_b$, it being possible to hang on the edge so that a strong atmospheric will send the set in and out of oscillation.

Other Methods of Fine Control

Fine control may be applied to other parts of the circuit with advantage, and for distant reception the use of a variable grid leak may be provided, provided that discrimination is used in the type chosen; one which has no tendency towards thickness or towards packing, and in which the values are strictly reproducible should be used. Condensers with shunted or integral verniers or those fitted with some method of reduction gearing are extremely useful for tuning anode and secondary circuits, and also in the aerial, especially if the latter system is of low resistance. It is a much-discussed point as to whether the vernier should be incor-

Figure 3 shows a separate vernier condenser with a long insulated handle is advantageous for the Tropodynamic oscillator circuit.

Combined Series and Parallel Tuning

For the ordinary broadcast wavelength band and below, it is a generally accepted fact that series tuning sometimes tends to render the set more sensitive than parallel tuning, and this method should be adopted where the set will not readily oscillate and reaction demands tend to be excessive. The benefits of combined series and parallel tuning have so far been but little appreciated, but when its merits become better known it should come into well-deserved popularity. By using a series condenser, $C_2$, as well as the parallel condenser $C_3$ across the aerial coil, selectivity may improve, since the damping of the aerial circuit is lessened and the arrangement is most satisfactory. The range of a given coil is also considerably increased and -finer tuning made possible by the manipulation of the two condensers. In practice I would recommend that $C_2$ be made $0.003$ or $0.001 \mu F$, whilst $C_3$ may be of $0.005 \mu F$ capacity.
By the use of suitable gearing fine adjustment of capacity is obtained.

of this condenser are at a high frequency potential to earth. The oscillator and first detector part of the Tropadynearrangement. is shown in Fig. 3, and the vernier condenser previously referred to is shown as C4. My experience with this type of circuit has been that for C, the condenser tuning the frame aerial, no vernier is needed, since the tuning of this part of the circuit is not particularly critical.

A number of geared condensers are now on the market, and these are eminently suited for use in sharply tuned circuits, such as the oscillator circuits of certain Supersonic Heterodyne receivers. Alternatively ordinary types of low-loss condensers may be used with a separate vernier, connected in parallel or alternatively a number of small NeutralDyne condensers now on the market may well be used. Extension handles of various types give improved control and greaters freedom from hand capacity effect.

Coil-Holders for Selective Reception

Now that the ordinary broadcast wavelengths of 300 to 500 metres are so rapidly becoming crowded with foreign as well as British stations, the question of selectivity is becoming a vital one. The most selective type of set to use is, of course, a Supersonic Heterodyne receiver, but sets of this type require a large number of valves and are out of the reach of a very great number of listeners. In such cases the use of a loose-coupled circuit is suggested, and here the choice of a suitable coil-holder is one of great importance. With most

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ordinary types of coil-holders which open bookwise it is impossible to
get minimum coupling, around which region most selective results are obtained. Minimum coupling is only approached when it is possible to arrange that the plane of one coil lies on the centre axis of the other. Minimum coupling is not necessarily obtained when the secondary coil is exactly
at right angles to the centre axis of the aerial coil, but it is somewhere in
this region that minimum coupling effects are obtained. A number of
coil-holders in which the movement is such that one coil may be
arranged so as to allow weak coupling to be obtained, are now
on the market, and these types are to be advised for use in coupl-d
circuits.

Neutrodyne stabilisation
A loose-coupled circuit is shown in Fig. 4, in which the Neutrodyne
method of stabilisation is introduced. No direct magnetic re-
action is shown in this circuit, but reaction effects may be obtained by
slightly upsetting the adjustment of the Neutrodyne condenser shown
as N.C. in the diagram. With circuits of this type it will often
be found advantageous to earth the lower end of the secondary
coil as indicated: This arrangement will be found to be extraordinarily sensitive, provided suitable com-
ponents are used, and selectivity is extremely high if L₁ and L₂ are
used in the type of coil-holder previously indicated, and worked
with the loosest possible coupling, which in practice may be practically
with these two coils at right angles.
A New Trade Journal
An Announcement.

In replying to advertisers, use Order Form enclosed.
Sir,—I have recently completed the "Resistance Four" described by Mr. A. Johnson-Randall in MODERN WIRELESS for March, and after lengthy try-outs which I have given it during the holidays, I feel that I ought to write and say that in my opinion it is surely the solution to perfectly faithful reproduction of any type of broadcast, whether it be the high notes of a talented soprano, the full efforts of a church organ or even massed choirs. I am, of course, referring to full loud-speaking volume.

Looking back, during the past three years, I have constructed possibly twenty different multi-valve sets, and towards the latter part of that period, like all experimenters, decided that best transformers, etc., paid in the end, and again, like all experimenters, felt proud of the performance of the "final" effort containing two transformers totalling £4, until such time as an item came across which proved that there are certain notes in certain items which get the finest transformers guessing.

In constructing the "Resistance Four" the writer departed from the article in the matter of resistance and detector-valve H.T. "Polar" units were used and detector voltage was cut down to a point which made oscillation just possible, and by careful comparison between this adjustment and the full 120 volts on all four valves, I may say that the former adjustment was a further step to super-natural reproduction.

This may be accounted for by the fact that D.E. 5B valves were used in L.F. stages only and that an R5V was used in detector stage.

The first reception, when wiring was completed, was a church service which we get from 5½ miles periodically, and, hardened as I consider I am (after three years) to the wonders of wireless, I was honestly amazed at the delivery from my oak Amplion Dragon of the most perfect congregational singing possible. Hundreds of voices and full organ without a trace of distortion.

The writer considered that this set will never be called upon to deal with anything more searching, and so it was boxed with all batteries enclosed, coils enclosed, tuning fixed, reaction coupling fixed, plugged and fixed to the wall at a convenient height, with a four-point switch enabling the smallest member of the family to turn "on" perfect reception at will.

There is another convenient space on the wall ready to accommodate the only wireless wonder that could equal the "Resistance Four," and that, I anticipate, will only be occupied in the days when we shall be worrying you about correct grid bias for bringing up "detail" in television.

Yours truly,
Newport, Mon. E. N.
Before the old "penny-farthing" ceased to be a familiar feature of the landscape, T.C.C. Condensers were being chosen by discriminating electrical equipment manufacturers. To-day still finds it favoured by Broadcast instrument manufacturer and amateur alike as the recognised Mansbridge Condenser. Throughout the whole of its long history there has never been the slightest deviation from the high standards originally set for accuracy, permanence and dependability.

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Important Announcement.
Owing to reported applications from our Colonial friends, we have decided to postpone the closing date of our crossword prize puzzle scheme till September 1st, 1925. Write for particulars to—

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GLAZITE™ NOW PACKED IN A FEET LENGTHS (1/16 S.W.G.) for the convenience of amateurs constructing one or two valve sets, four lengths in an envelope (one length of each red, blue, yellow and black). Price 1/- per packet.

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Telegrams: Electric, London. Telephones: Clerkenwell, 1557, 1558, 1559, 1560
“Darco” Grid-Leak
A sample of the new “Darco” fixed grid-leak has been submitted by Messrs. Darco, Ltd. This is of ordinary dimensions and general appearance, but has in place of the customary conical contact-caps, which necessitate a special clip-fitting for mounting the leak, flat-topped caps fitted with small screws and nuts for making connections, soldering trugs being placed here for direct mounting, if desired, on the grid-socket of the valve. It is evident that this may lead to some simplification of wiring of a receiver. The grid leaks are, we understand, guaranteed to be within 15 per cent. of the nominal value of 2 megohms. On test, this proved to be the case, the value coming out at slightly under 2 megohms. We gather that these leaks are made within values ranging from 3 to 1/4 megohm, the last value being particularly suitable for variable-capacity coupled amplifiers.

Plug and Socket Connectors
We have received from Messrs. Lisenin Wireless Co., samples of a new type of “Positive Grip” plug and socket, for making connections to radio receivers and which can be easily removed and altered. Small sockets (which are, incidentally, of the correct size to act as valvesockets when required) are fitted into the panel with a back-nut; into these a conical plug on the end of the other fitting is inserted, giving a secure hold and good electrical contact. The flex, or other wire, is gripped between conical surfaces; in the other end of the plug, the ends being turned back over the inner cone, and held in a vice-like grip by screwing up the coloured insulating sleeve outside. The insulated portion of the wire passes some distance into the fitting, giving a neat and unusually strong finish here. The sleeves are supplied in two colours, black and red. The appearance of the device is decidedly pleasing, and the price asked is moderate, in view of the high finish. We can certainly recommend these connectors, both for permanent use on a receiver and for temporary experimental hook-ups.

“ApeX” Anti-Capacity Valve Holder
A behind-the-panel valve-holder for the American type of receiver with vertical panel and totally enclosed valves which is rapidly growing popular has been submitted by Messrs. Apex Electrical Supply Co. This is a moulded composition holder with a large side flange, provided with holes for affixing to the back of the panel by two small screws, carrying the valve-leg sockets embedded as usual in the insulation-resistance was unexceptionable, and free oscillation was obtained with a valve when using this socket.

A “Precision Variable” Condenser
An interesting type of geared low-loss variable condenser has been submitted by Messrs. Precision Screw Co., Ltd. In this, an extremely fine and exact adjustment is made possible by the use of a tangent worm-gear, giving a 20 to 1 ratio, the brass worm being actuated by a taper-steel handle, provided with a 360 deg. bevel dial, and the ebonite worm-wheel being mounted on the spindle of the condenser itself. This is thus arranged at right angles to the controlling spindle, and is actually mounted on an angle-bracket behind the panel. Each complete turn of the controlling spindle moves a counter-dial through one division, in a manner similar to that of a cyclo-meter. A scale of complete turns, reading from 0 to 10, is visible through a small hole, just above the zero mark of the bevel scale and shows in what part of the capacity range one is working, thus 20 divisions on the bevel scale are equivalent to one degree on an ordinary tuning-scale, whilst the position for any one station can be read off with a corresponding degree of accuracy. All back-lash is avoided by a slotted plate and bolt adjustment for the worm engagement, and by a strong spring which takes up end-play in the worm bearings. On trial the movement was found to be very smooth and quite free from play. The bracket, with worm, bearings, counter-mechanism, etc., is fixed by the usual one-hole-mounting device, a second small hole being needed for the indicator sight-hole. The bracket fits the standard type of variable condenser manufactured by the firm, being affixed to it by two small bolts through the holes normally used for mounting the
putting up temporary flex connections, both on the electric supply side and for loud-speaker extensions into another room or into the garden. The joints were readily made secure, and well insulated. The larger size proved to be admirably adapted for making connections in lightly insulated steel stranded aerial wire, always a troublesome job. These connectors can be recommended for general use in practical radio work.

**Ediswan Variable Condensers**
We have received from Messrs. Edison Swan Electric Co., Ltd., samples of their variable condensers of the "square-law" type, with cam-shaped plates of hard brass. These are extremely substantially built, heavy instruments, evidently intended for satisfactory service over long periods of hard wear. A sturdy frame of insulating composition is arranged for use either horizontally on a base-board, or mounted behind the panel, in the ordinary way, tapped screw-holes being provided for both modes of mounting. A fairly large clearing hole (½ in.) is required through the panel around the spindle in the latter case, as well as two screw-holes. Ample metal bushed bearings are included in the design, and strong spring washers which ensure good contact and eliminate any play in the spindle. A large central soldering tag, and an extra small nut on one column are provided for external connections, whilst positive stops limit the range of movement of the rotor plates. We should like to have seen a more lasting and mechanical device for locking the bevel scale and knob on the spindle than that actually incorporated.

On test, the -001 nominal size had a minimum capacity of about 13 µµF and a maximum of -00107 µµF.
July, 1925

The instrument submitted was of small size and lightly constructed; possibly on account of previous rough handling, or in transit, it was broken when it reached us, so that it required much reconstruction in order to make a fair test of its performance. On trial with an efficient low-loss crystal receiver on the local transmission, the mean of six fairly uniform settings gave 16 microampere signal strength as against 34 for a standard good galena handset, or 67 per cent. Taking into consideration the stability and permanence of the one setting for this combination, this would represent a good high-fidelity, when incorporated in an ordinary broadcast receiving set. With a more substantial construction this device should give every satisfaction wherever a fool-proof and trouble-free receiver is required, rather than the last fraction of signal strength.

"A C." Valve Sockets

A type of low-capacity valve socket which gives, on measurement, an extraordinarily low casual capacity, between the parts when mounted in the panel, is brought to our attention by Messrs. Sparks Radio Supplies. These sockets are put up in packets containing each a set of sockets alone, the former with a drilling-jig, or these together with a suitable No. 16 drill, at a very moderate price. The first hole is to be drilled; the drilling-jig is then bolted in place by a screw and nut, then the second hole is then drilled, and after fastening the jig by a second screw and nut the other two holes are finished giving perfect spacing. Then one socket is screwed in position, without previous tapping of the hole (though this can be done) if desired, with a taper No. 2 B.A. tap applied lightly; and the others can be guided by threading them on the legs of a spare valve placed in position when the first socket has been fixed.

On trial, these instructions were found quite easy to follow. Whilst admittedly rather more trouble to fit than standard solid types of sockets, these low-capacity sockets can be strongly recommended for critical work.

The "Therla" mica condenser

The "Therla" mica condenser is of open construction, with a metal cover, and are provided with a triple connecting-tag at each end, as well as holes spaced at 9 in. for panel mounting by the customary small screws. For grid-condensers, these can readily be supported by the connecting wires alone. On measurement of the capacities, these came out sufficiently near the nominal for prac-

tical use as grid and blocking condensers respectively, viz., 0.0026, 0.0027, and 0.0012 μF. In actual reception each sample gave satisfactory service, and the smallest size worked well as a grid-condenser on ultra-short waves. While the connecting tags are a little flimsy for experimental work where connections are frequently made and broken again, for permanent incorporation in a radio receiver these fixed condensers will evidently prove completely adequate.

"Hovimo" Crystal Valve

A two-crystal combination which is known to give great stability combined with a good degree of sensitivity is utilised in the "Hovimo" Crystal Valve device, a sample of which has been submitted to us for practical trial by H. Molchak. Tellurium-zincite combinations have been commented favourably on by experimenters for some years. With the transparent yellow-crystalline modification used here, which shows similar properties to good zincite but actually is superior to the latter in use, it is possible to provide but simple means of adjustment for the crystal contact and still to maintain a good efficiency of rectification under ordinary reception conditions. In the Hovimo device the two crystals rest loosely in a short vertical glass tube in a small mounted stand, provided with terminals on the base. Contact plugs and the necessary connections, whilst some degree of adjustment is possible with a screw plunger at the top, giving close control of the pressure applied.
The Valve is the heart of your set. HOW MUCH DO YOU KNOW ABOUT IT?

COMPLETE satisfaction from any radio receiver is, as a rule, based upon the operator's knowledge of its fundamentals. In just the same way as a motorist keen upon maximum efficiency needs to be conversant with his machine, so must the radio enthusiast know and understand the component parts of his receiver if best possible results are his ideal.

There is the valve, for example. The whole working efficiency of a valve receiver centres around the valve more than any other component. It is in fact almost what the heart is to the human body, a life giver. It would be impossible to detect or to amplify weak long distance radio signals except for the valve. Yet how many radio experimenters and constructors know more than the very barest of facts about the valve? It is patent, however, that a good working knowledge of this vital component should be acquired by every radio man intent upon maximum efficiency. Indeed, it is essential to the experimenter and constructor!

Such a knowledge of the valve as meets the needs of the present day radio enthusiast is contained in "Elementary Text Book on Wireless Vacuum Tubes" by John Scott-Taggart, F.Inst.P., A.M.I.E.E. This book, which is one of the foremost treatises on the radio valve, is in its fourth edition, which testifies to the success it has already met with in the radio world. It is written in Mr. Scott-Taggart's usual lucid manner, thus making highly technical matters clear to the man who knows little of the subject.

The fundamental principles of the radio valve and its practical uses are dealt with fully and the text is profusely illustrated with graphs and circuit diagrams, which makes the subject a pleasant and a simple study. No serious experimenter or constructor can afford to do without the book.

Well bound and printed on good paper, it is eminently suitable to stand on the experimenter's shelf, and to be constantly thumbed over for reference.

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Here is a brief description of the book's contents: Opening with instructions for making a very effective yet inexpensive little appliance which is used in conjunction with a pair of telephones for testing the set and its components, the author proceeds to deal with the testing of every radio part likely to cause faults, and gives complete series of tests for all types of receivers from crystal to multi-valve sets. Special attention is given to the testing of reflex circuits.

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Radio in America

In addition to the splendid radio articles which are a regular feature of Wireless Weekly, it will shortly publish a series of articles of special interest. Mr. Percy W. Harris, well known as Asst. Editor of Wireless Weekly and Editor of The Wireless Constructor, will describe the tour of America that he is making for the purpose of studying the conditions of radio and broadcasting. Mr. Harris has so far visited New York and suburbs, Long Island and Philadelphia. He has listened to the American broadcasting stations and has made exhaustive investigations into the question of relative selectivity of British and American sets, interference by oscillation, the merits of Super-Set circuits, and the amount of interference between the numerous broadcasting stations operating in the city areas. He has also studied the American home constructor in regard to his tastes and abilities, and the components he uses. Mr. Harris will have some very interesting things to say about all these topics and no British radio enthusiast should miss them. Buy your copy of Wireless Weekly regularly and so do not miss any of these special articles on Radio in America.

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