The Set Designed, Constructed and Described by the "P.W." Technical Staff.

NOW that 5 X X is transmitting a morning programme, it is a great advantage for those listeners who are situated within range of that station to be able to switch over to the long waves. At any point within 100 miles of the B.B.C.'s high-power station, quite good signals are receivable from Daventry upon 1,600 metres, provided, of course, that an ordinarily efficient outdoor aerial is employed.

Later in the day, when the local station is transmitting, in most districts these signals will be stronger than the Daventry ones. But, nevertheless, it is desirable to be able to change over to 1,600 metres, in order that the alternative programmes afforded by 5 X X are available, when the local station is closed down.

Few Parts Necessary.

For this reason there has recently been a great demand for an easily made, easily handled crystal receiver, which is capable of tuning both to the local station (low waves), and also up to 1,600 metres, for the reception of Daventry.

LIST OF COMPONENTS.

	s.	d.
1 Panel, 6×6×¼ in. with box	7	0
1 Lamplugh ·0005 variable condenser	17	6
1 "Gripheo" permanent crystal detector	2	6
2 Coil formers		6
¼ lb. 26 S.W.G. D.C.C. wire ..	1	3
1 Bretwood single coil holder ..	1	3
Screws, transfers, etc.	1	6

Most readers of this journal are already aware of the advantages of "Ultra" tuning. But, as a great many new readers have recently asked for another crystal set constructed upon these lines, the set shown in the photographs has been made. It is quite an easy little receiver to construct, employing home-made basket coils. The full list of the components necessary to build the set is given upon this page.

It will be seen that the parts utilised are few in number and not at all expensive. From the photographs given here it will be seen that the receiver is contained in a neat box with a flat ebonite panel. The aerial and earth terminals are to the left of the receiver, and opposite are placed the two terminals for the telephone connections.

The tuning condenser and loading coil sockets are placed centrally, the latter having a short plug-in position when receiving upon short waves. When receiving Daventry it is necessary to remove the shorting plug, and to plug in a 150-turn tuning coil.

The views of the underside of the panel show that there is nothing complicated about the set, the only point which might puzzle a novice being the fact that the aerial coil is separated into two half coils (the small basket coils seen on either side of the set). The connections are so made that these two small basket coils are united in effect into one aerial coil, working upon the Ultra principle.

In these days, when most listeners take an interest in the circuit which they use, it will be worth while to describe in a few words the underlying idea which has been so successful when embodied in the various "P.W." Ultra circuits. It is well known that in all crystal receivers there are two distinct circuits, the "detector circuits" and the "oscillatory circuit." The crystal and the telephone constitute the main part of the former, whilst the oscillatory circuit consists of the aerial itself, a tuning condenser and coil, and the earth lead.

The chief difference in crystal circuits lies in the method of coupling the oscillatory circuit to the detector. There are three main methods in which this can be affected, known respectively as "direct coupling," "inductive" (or "magnetic") "coupling," and "auto-coupling."

Direct and Loose Coupling.

The commonest method is by direct coupling. This consists of connecting the aerial and earth leads direct to a tuned circuit, across which the detecting apparatus ('phones and crystal) is placed. This method has several disadvantages, but it is extremely simple, which to a large degree explains its popularity.

Another plan which is often adopted is to lead the aerial and earth connections to one "primary" coil, which is entirely separated from the circuit to which the detector is connected. If the tuning coil in the latter ("secondary") is placed near the aerial coil, a certain amount of energy will be transferred magnetically across the space between them.

This method is therefore called magnetic or inductive coupling, but it has the disadvantage of requiring two tuned circuits, one attached to the detector, and the other attached to (and partly consisting of) aerial and earth. Two separate tuning controls are necessary, so in order to obviate this disadvantage, the method known as auto-coupling was evolved.

In auto-coupling there are still the two essential circuits, but part of the set is

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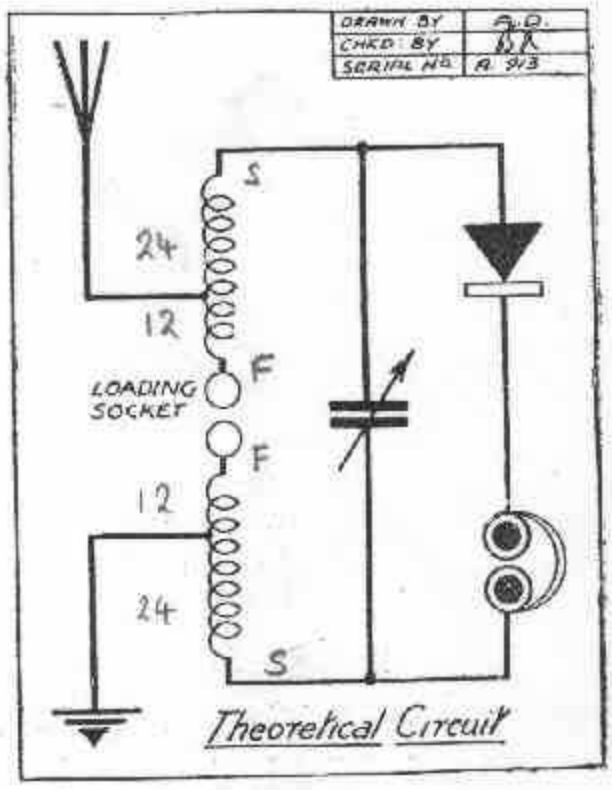
The "P.W." Ultra Crystal Set in its completed form but with loading coil removed.



A "P.W." ULTRA SET.

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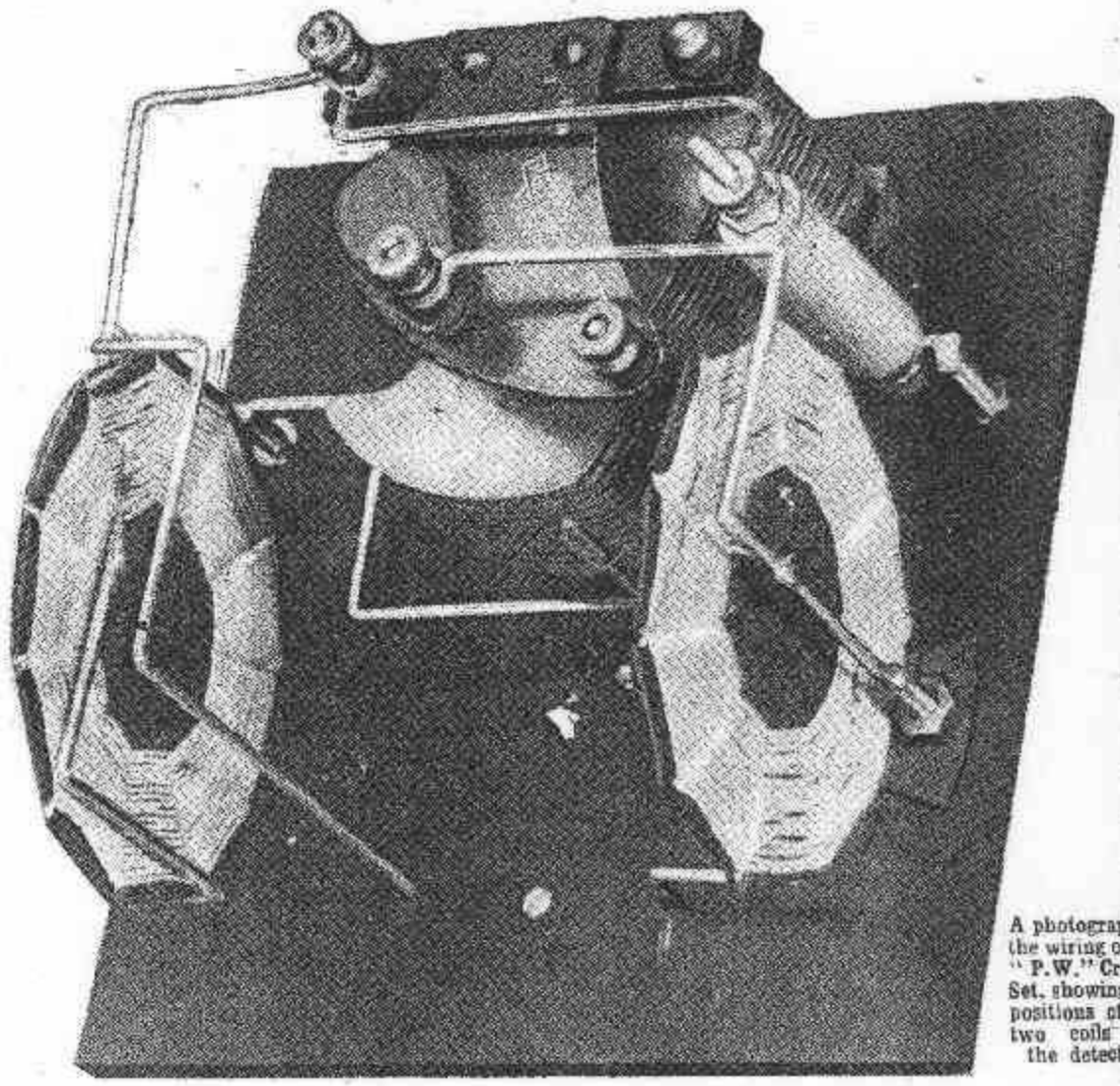
common to both of them. This will be seen from the diagram on the previous page. The aerial-earth circuit consists of the aerial lead, 24 turns of the Ultra coil, and the earth lead. (A shorting plug is inserted midway between the earth and aerial leads, and a loading coil is plugged in here when Daventry is being received.)

Across the two free ends of the coil is placed a tuning condenser, and in parallel with it are the crystal and telephones. When the local station is broadcasting part of the energy flows through the mid-portion of the Ultra coil, and if the main circuit is tuned to the incoming signals, strong impulses are set up in it, which are rectified by the crystal and heard in the 'phones.

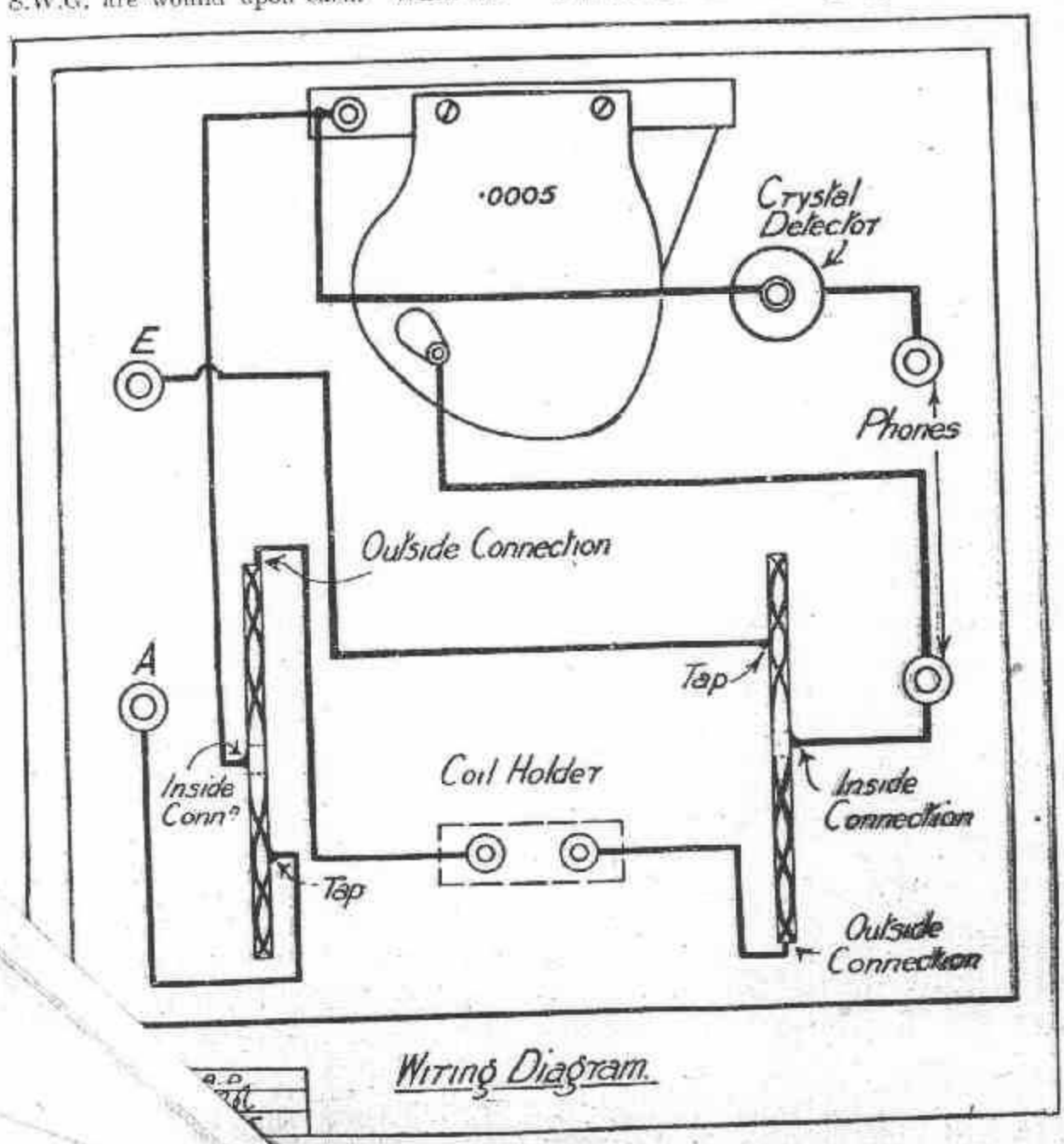
Winding the Coils.

These conditions would obtain if the aerial were placed at the *lower* end of the tuned circuit shown on the diagram, leaving the earth lead as at present connected. But the advantage of the Ultra system lies in the fact that the aerial and earth leads are connected at equal distances from the centre point of the coil, so that the auto-coupling is "balanced."

The first step is to wind the two small basket coils. The former upon which they are made has a diameter of $3\frac{3}{4}$ in. with a centre of $1\frac{1}{2}$ in. Thirty-six turns of No. 26 S.W.G. are wound upon each. When the 24th turn is reached in both cases, a loop is made and left for tapping.



A photograph of the wiring of the "P.W." Crystal Set, showing the positions of the two coils and the detector.



Wiring Diagram.

The 36 turns will leave a space of about $\frac{1}{2}$ in. on the outside of the former, so this should be trimmed off with a pair of scissors, except in the case of one section. This is left full length, a hole is made in the centre of it, and, when placed over the shank of the aerial or top 'phone terminal, and bent at right angles, this will hold the coil to the panel.

The drilling of the panel is quite an easy operation, and is carried out in accordance with the drilling diagram on the next page. It will be seen from the photographs that it is not necessary to mount the crystal detector separately, as the little component used in this instance can be fixed securely by its connection to the terminals and to the condenser.

Hints on Operation.

The wiring diagram on this page is self-explanatory, but do not forget when making the connections that the secret of success in the crystal set is good contact. Wherever possible the joints should be soldered, as if they are in any degree inefficient a loss of signal strength will result.

When the wiring has been completed it can be checked over from the list of point-to-point connections, which is given on next page. Great care must be taken to keep the panel clean and free from brass dust, flux, etc.

As the set is such a simple and straightforward one, it is hardly necessary to give further details of operation, etc., but for the sake of the novice the method of connecting up will be briefly outlined. Aerial and earth leads are connected to their respective terminals, and if the local station is to be tuned in a shorting plug should be placed in the coil holder.

Adjust the crystal and vary the tuning condenser until signal strength is obtained.

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To change over to the long waves all that is necessary is to remove the shorting plug from the coil holder and replace by a tuning coil having approximately 200 turns. Where a long aerial is employed 175 turns are sometimes better, but anything between

POINT-TO-POINT CONNECTIONS.

Aerial terminal to tap of left-hand coil. Earth terminal to tap of right-hand coil. Inside connection of left-hand coil to fixed plates of ·0005 variable condenser and to one side of crystal detector. Moving plates of variable condenser to inside connection of right-hand coil and one 'phone terminal. Other 'phone terminal to other side of crystal detector. The outside connections of the left and right-hand coils are taken respectively to the plug and socket of the coil holder.

150 and about 230 turns will generally do, the variation being automatically adjusted by altering the tuning condenser.

It may be as well to point out that any form of tuning coil will do for the loading coil, either basket coils or those of the duolateral type being the most popular.

The Loading Coil.

If desired, it may be a home-made basket coil, but this will be rather bulky. The best way to reduce its size as far as possible is to use "double winding." Instead of taking the wire in and out of *every* slot, it can be wound into *alternate* slots, the resultant coil being thicker, but less fragile, than when the normal slot-winding is employed.

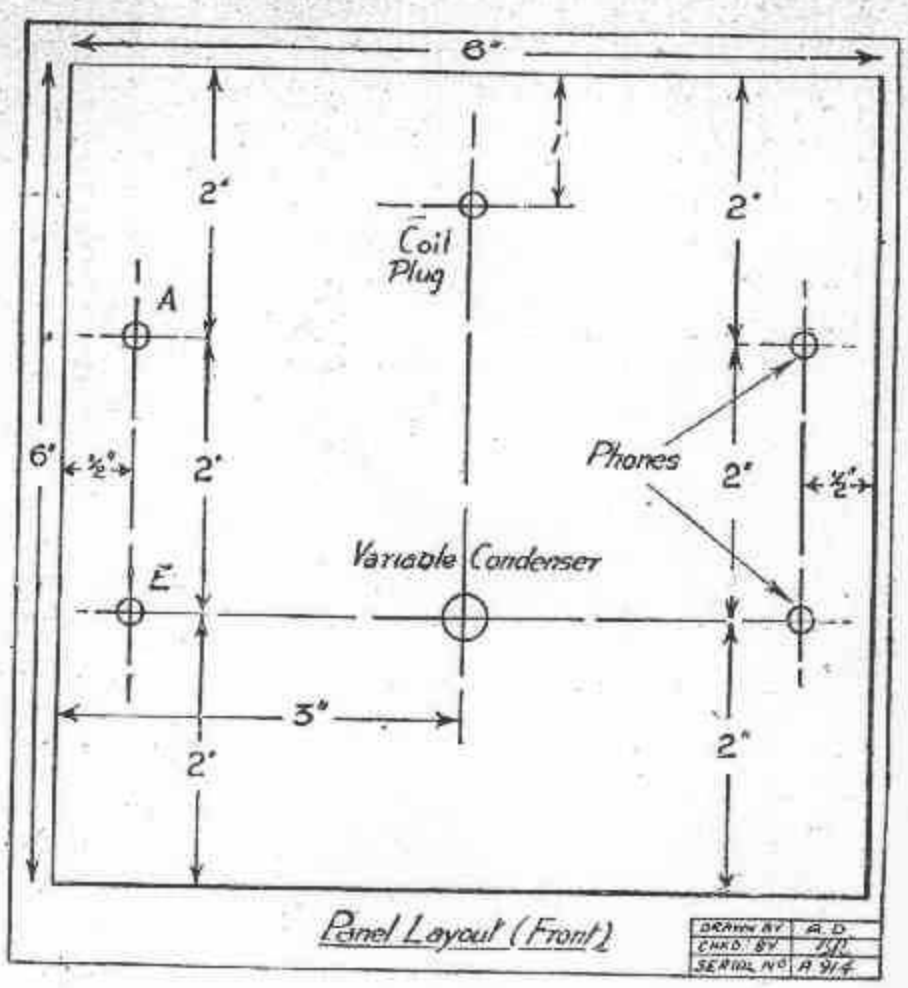
With the original set shown in the illustrations, good signals were obtained from Daventry's morning transmission, both in London itself and in the suburbs. Reception from 2 L O was clear and faultless, and any reader who gets similar results will be delighted with this simple but efficient receiver.

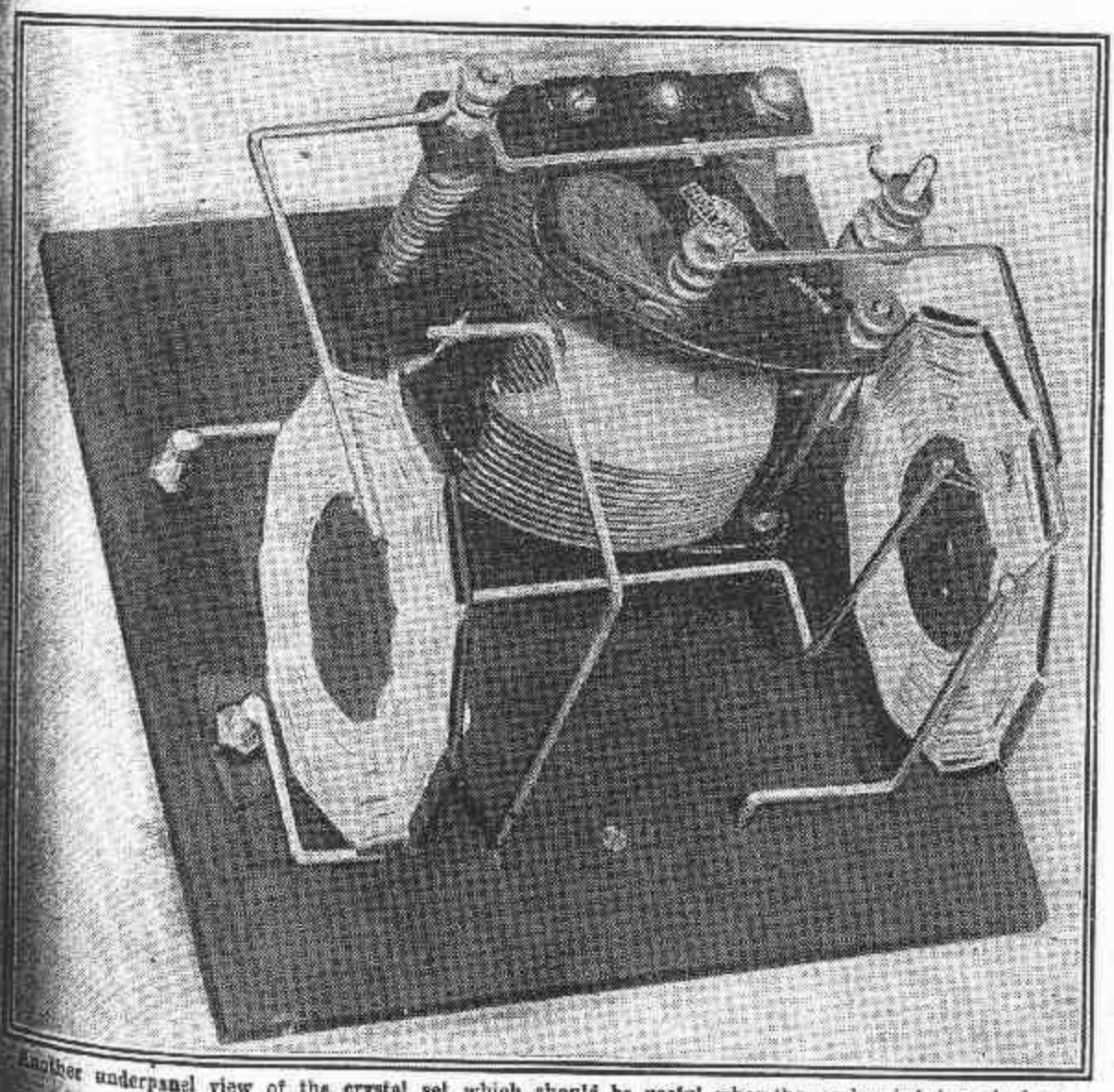
Amplification.

There is no reason, if signals are good, why an L.F. amplifier having either one or more valves should not be added to the "P.W." Ultra Crystal Set in order to enable it to operate a loud speaker.

Unless the signals are really strong—such as those obtainable when the set is within five miles of a broadcasting station—the one-valve amplifier will not be sufficient to operate a loud speaker properly. Two valves, however, should enable this to be carried out up to 15 miles or so from a local *main* station or 80 miles or so from 5 X X.

Such amplification will not necessarily increase the *range* of reception of the set, but can only be relied upon to increase the signal strength of broadcasting that is already audible.





Another underpanel view of the crystal set which should be useful when the receiver is being wired up.

FAULTY COMPONENTS.

TOO few wireless amateurs seem to realise that the whole success or failure of a wireless set depends upon its components, and if these are poor there is almost certainly bound to come a time when troubles will occur.

One of the main pieces of apparatus which can spoil the efficiency of the set is the fixed condenser. Recently the writer set himself the task of dissecting about two dozen fixed condensers of different makes, but according to the markings of the same capacity. Without going into details it is sufficient to say that out of the 24 only two were of the exact capacity stated. As a matter of fact, three of the cheap condensers were actually short-circuiting, which goes to prove how necessary it is to obtain apparatus of reliability.

Too great attention cannot be paid to such things as filament rheostats or resistances. Valves should never light up brightly as soon as the rheostats are the slightest bit "on," otherwise they are liable to burn out very quickly.

A rough-and-ready rule to discover the resistance required is to divide the valve makers figure for filament voltage by the figure for the filament current. Thus, if a valve takes 5 volt, and ·65 amp., such as the Marconi R.5V, a filament rheostat of approximately 8 ohms max. will be required.

What is more important, however, is the fact that the filament rheostat, as well as having a resistance of 8 ohms, must have wire sufficiently thick to carry ·65 amp., otherwise it will heat up and either offer a further slight resistance which, if receiving a distant station, might upset the working of the set or else fuse, scorch the panel, and possibly set something on fire.