CONFIDENTIAL.

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Portsmouth.

May, 1919.

HANDBOOK NO. H.91.

for

W/T RECEIVING SET MODEL MB.

This receiving set consists of a Box Amplifier Model MB or MBA with its accessories.

The instrument itself is a medium power amplifier of the high frequency transformer type.

Two designs of this instrument have been issued, one being a modification of the other, the later model being the MBA.

As these instruments differ in detail and appearance, two sets of instructions have been written dealing with each design separately.

"PART I" deals with the original design using two R4 valves, and termed Box Amplifier Model MB.

"PART II" deals with the modified design using R5 valves and having an additional space for a spare valve. This amplifier is termed Box Amplifier Model MBA.

"PART III" deals with the circuit required for charging the filament battery and also with the establishment of stores allowed to either model.

PART I.

BOX AMPLIFIER MODEL MB.

1. FUNCTIONS. This set is designed for use as an amplifier for either spark or continuous wave signals. It can also be used as a self heterodyne for the reception of continuous wave signals without the use of a separate heterodyne set. It is intended for use with the existing Model "C" receiving instruments and it can be connected up to them in such a way that the amplifier may or may not be in use as required.

2. CONNECTIONS. Figure 1 shows diagrammatically the method of connecting up the amplifier box to the Model "C" receiving instruments. Figure 2 is a diagram of connections of the amplifier box itself. Figures 3 and 4 are photographs of the set.

From these figures it will be noted that either one or both of the valves may be used as desired. The circuit of both valves is broken at the slider on the adjustable resistance. The circuit to the second valve only is broken by the switch on the lower right hand side of the box. The adjustable resistance has two windings arranged so that when the second valve is cut out of the circuit the voltage across the first valve does not greatly increase.

A single pole switch on the top of the box over the high frequency transformer is used for the purpose of cutting out certain sections of the transformer circuit to suit various ranges of LS value as follows:-

1st. stop

1st. stop of switch to be used for a range of waves from 210 to 450 metres (11 LS to 50 LS).

2nd. stop to be used from 450 to 1000 metres (50 LS to 256 LS).

3rd. stop to be used from 1000 to 2800 metres (256 LS to 2000 LS).

4th. stop to be used above 2800 metres (2000 LS).

3. THE ACTION OF THE CIRCUIT.

(i) For Spark Reception. Referring to Figure 2 it will be seen that when receiving spark signals each train of oscillations in the secondary of the induction tuner gives rise to a train of oscillatory voltages applied between the grid and the filament of the first valve. This high frequency variation of the grid-filament voltage leads to corresponding high frequency variations of the current flowing into the anode of the valve. This current is obtained from the condenser which is connected across the terminals of the 50-volt battery and passes through the primary of the inter-valve transformer on its way to the anode of the first valve. The changes of the anode current through the primary of this transformer give rise to induced E.M.F's in the secondary of the transformer, these E.M.F's being applied directly between the grid and filament of the second valve. The inter-valve transformer is a step-up transformer, that is to say the number of turns in the winding connected between the grid and filament of the second valve, is greater than the number of turns of the winding in series with the anode of the first valve. The reason for this is to secure the greatest possible changes of voltage between the grid and filament of the second valve. These changes are accompanied by the corresponding changes in the anode current of the second valve, this current also coming from the condenser connected across the 50-volt supply.

This amplifying action between the two valves is accompanied by a rectifying action at the anode of each of them, (see Wireless Telegraphy Manual for H.M.Fleet, Vol. 1 1917, Page 273). The rectified currents from both valves pass through the telephones. Consequently, every train of oscillations in the receiving circuit is accompanied by a rise and fall of the telephone current somewhat in the same way as when an ordinary crystal is being used, but with the advantage that owing to the amplifying action of the valves the changes of the telephone current are very much greater than when the crystal is in use.

A further amplifying effect is obtained by means of the re-action coupling between the anode circuit of the second valve and the secondary circuit of the induction tuner, The changes of the anode current of the second valve give rise to induced electro-motive forces in the secondary circuit of the induction tuner. These electro-motive forces may assist or oppose the current in the secondary circuit, depending upon the adjustment of the coupling coils. When the induced electro-motive forces are slightly assisting the secondary currents, the amplification obtainable is largely increased. The way in which this increase is obtained is most easily seen by taking a numerical case. Suppose that to begin with the re-action coupling is zero and suppose that one unit of power is being expended in maintaining the high frequency oscillations in the secondary circuit. This power will give rise to certain changes in current through the telephones. Now consider the conditions when the re-action coupling is brought into operation. For the same high frequency changes of the current in the second valve the same power will be required in the secondary circuit of the Model "C". But owing to the re-action a considerable proportion of this power is obtained from the second valve, for example: as much as 0.8 of the required power may be obtained in this way. Under these conditions the power required from the incoming signals is now only 0.2 units, instead of the whole 1 unit as in the case in which there is no re-action coupling, and consequently the set will be about five times as sensitive with the reaction coupling.

It would appear at first sight that the sensitivity could be indefinitely increased by careful adjustment of the re-action coupling. This, however, cannot in practice be realised owing to the fact that when the sensitive point is being reached any small shock, as for example a slight atmospheric will cause the amplifier to produce continuous oscillations. In practice therefore when receiving spark signals the re-action coupling is adjusted so as to be as near as possible to the point at which the oscillations set in.

(ii) For Reception of Continuous Waves. For the reception of continuous waves the re-action coupling is adjusted to a point just beyond the unstable position in which the amplifier sets up continuous oscillations in the secondary circuit of the induction tuner. The wave of these oscillations depends upon the L.S. value of the secondary circuit and to receive incoming continuous wave signals by the heterodyne method in the usual way it is necessary to adjust the L.S. value of the secondary circuit so that the frequency of the incoming signals is just slightly different to the frequency of the oscillations which are being generated. The detecting action at the anodes of the valves then takes place practically as when receiving a spark signal, the only difference being that the heteroydne beats constitute a rise and fall of the voltage supplied between the grid and filament of the first valve instead of intermittent trains of oscillations.

The most sensitive condition for receiving continuous wave signals is when the reaction coupling is only just sufficient to maintain the continuous oscillations. In practice, however, it is necessary to adjust the re-action coupling a little beyond this point in order to secure stability.

Under certain circumstances an increased sensitivity for the reception of spark signals is obtained when the valves are oscillating. But, as is always the case when receiving spark signals with a heterodyne oscillation, the note of the incoming signal is broken up and the gain of sensitivity is not infrequently more than compensated for by this loss.

The necessity for the fourway switch on the top of the box arises from the distribution of the stray capacity of the secondary winding. If the switch is not used it is found that the amplification on certain waves is greatly reduced, but by the proper use of the switch this difficulty is avoided. It is of use for the reception of both spark and continuous wave signals.

4. <u>GENERAL INSTRUCTIONS FOR WORKING.</u>

(i). Connect up as in the wiring diagram, taking care that the terminal marked A is really connected to the same terminal of the secondary of the induction tuner as is the crystal detector. Insert the valves and connect up the green and red leads to the grid and anode terminals.

(ii). Tune all circuits to the wave to be received in the usual way and adjust the re-action coupling coil to about its mid position.

(iii). Put transformer switch on the stop whose range includes the wavelength of the signals to be received.

(iv). Switch on the filaments of both valves and gradually increase the filament current until the maximum loudness of signals is obtained (the buzzer or wavetester used for these preliminary adjustments should preferably be placed at some distance from the receiving circuits).

(v). The re-action adjustments should be found which give the largest signals but which at the same time do not cause the valves to produce continuous oscillations.

(vi). If it is desired to receive continuous wave signals the adjustments of the re-action coil should be just beyond the point at which the oscillations set in.

(vii). When actually receiving signals a final retuning of all the circuits should be made in the usual manner and at the same time the filament current should be finally re-adjusted so as to give the best results.

> N.B. The filament currents should never be increased more than is necessary. The life of the valves decreases rapidly with increase of the filament current.

(viii). Provision is made for receiving spark signals with one valve only. This gives a sensitivity which is about the same as a really good crystal. It is preferable from the point of view of selectivity always to use one valve only so long as the signals are of sufficient strength. In this connection it should be remembered that the effects of interference are much more accentuated if both the signal to be received and the interference are strongly amplified. It is therefore useless to attempt to reduce the effects of interference with a signal of strength from R4 upwards by amplifying both the signal and the interference. On the other hand if the signal is very much weakened by using very loose couplings the amplifier can be used effectively.

(ix). The coupling of the induction tuner should generally be very much looser when the amplifier (either one or two valves) is in use than when using a crystal. It is desirable to loosen off this coupling as far as possible especially when receiving continuous wave signals.

(x). When the amplifier is in use the crystal should be disconnected either by means of the crystal switch or by taking out the plug from the crystal holder.

(xi). A voltmeter is provided on the top of the box with two ranges viz:- 0 - 8 and 0 - 80 volts. The former

range is

range is for reading the filament voltage and the latter the voltage of the anode high tension battery. A push switch is fitted on the right hand side of the box and by pressing the button the anode battery voltage may be read. Normally, when the valves are switched on, the voltmeter should read the volts across the filament. The voltmeter is intended to give the operator an idea as to the condition of the batteries as well as the best filament voltages to use with a particular pair of valves.

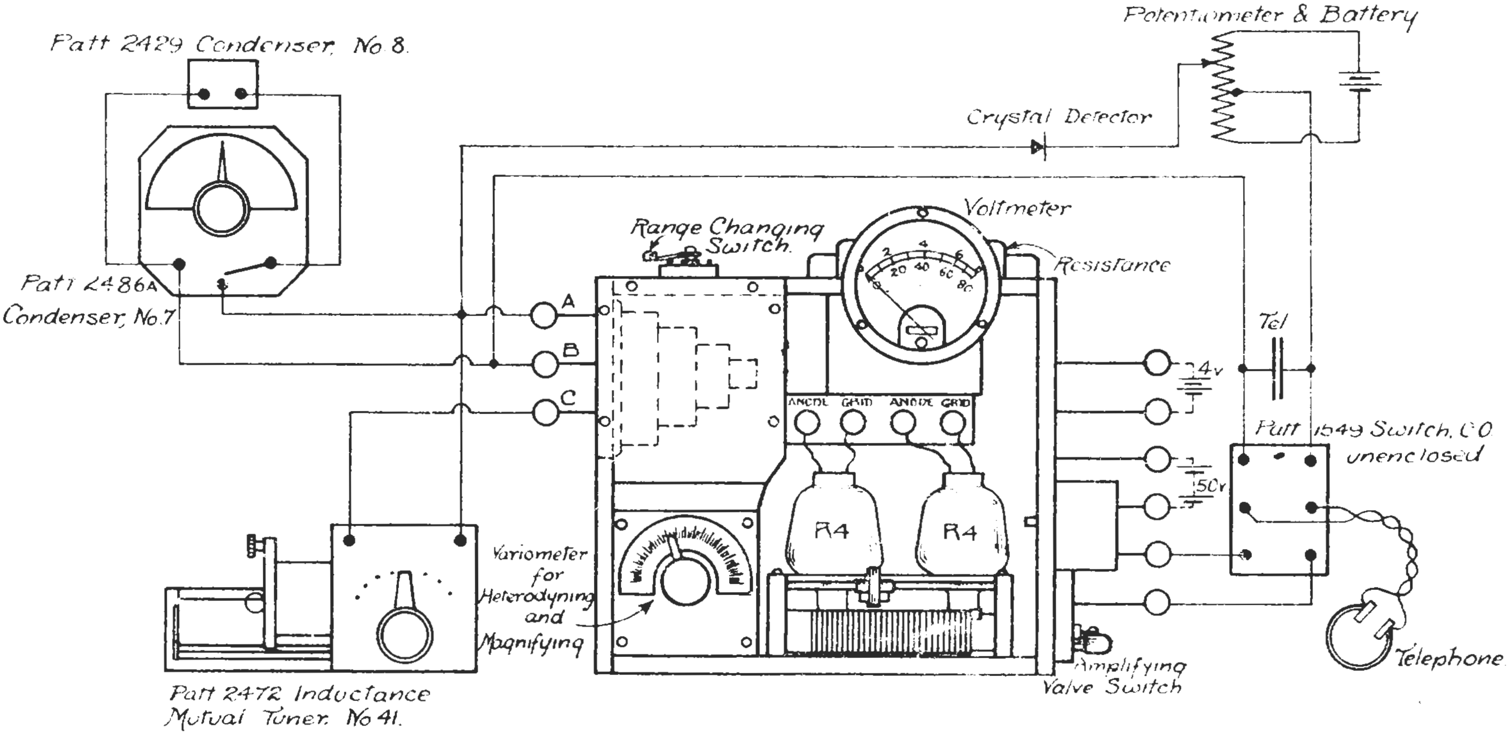
Potentiometer & Battery
Patt 2429 Condenser, No. 8.
Crystal Detector
Voltmeter
Range Changing Switch.
Resistance
Patt 2486A Condenser, No. 7
A
B
C
ANODE
GRID
ANODE
GRID
Tel
4v
50v
Patt 1549 Switch, C.O. unenclosed
R4
R4
Variometer for Heterodyning and Magnifying
Telephone
Amplifying Valve Switch
Patt 2472 Inductance Mutual Tuner. No 41.

FIG. 1.

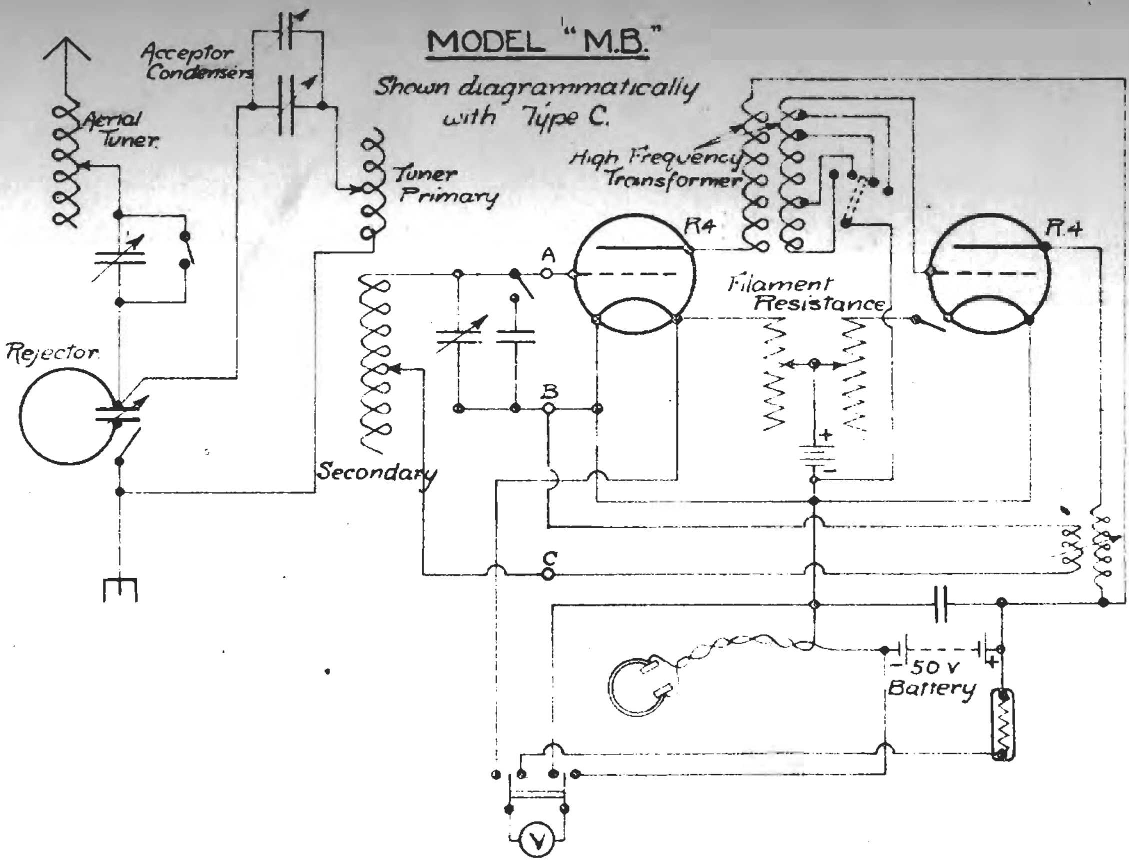
MODEL "M.B."
Shown diagrammatically
with Type C.
Acceptor
Condensers
Aerial
Tuner
Tuner
Primary
High Frequency
Transformer
R4
R.4
A
B
C
Filament
Resistance
Rejector
Secondary
+
–
– 50 V
+
Battery
V

FIG. 2.

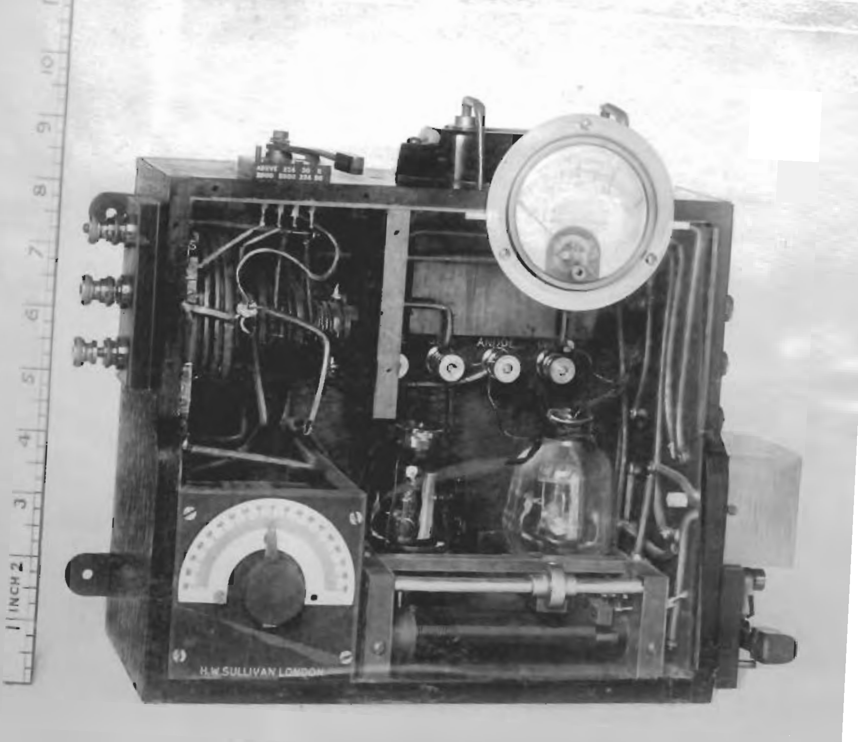

PHOTO. NO. 256.

Fig 4

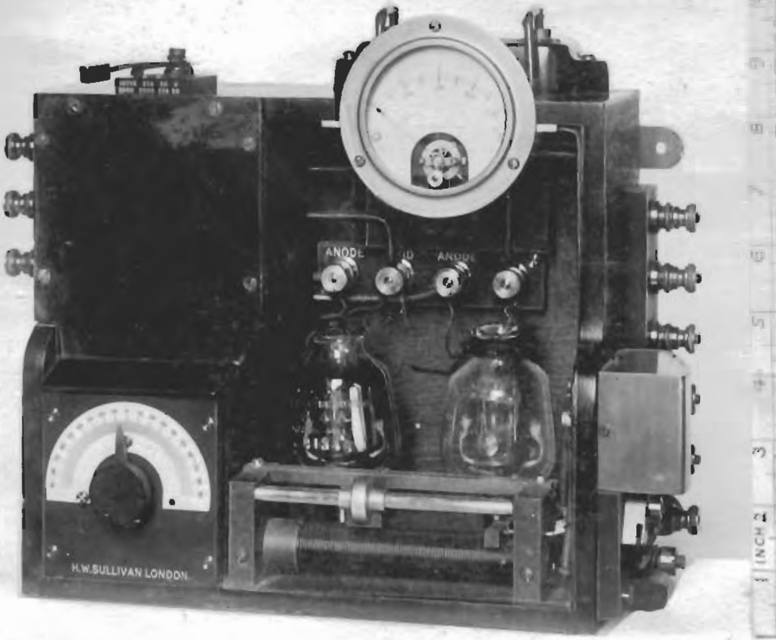

PHOTO. NO. 257.

Fig 3