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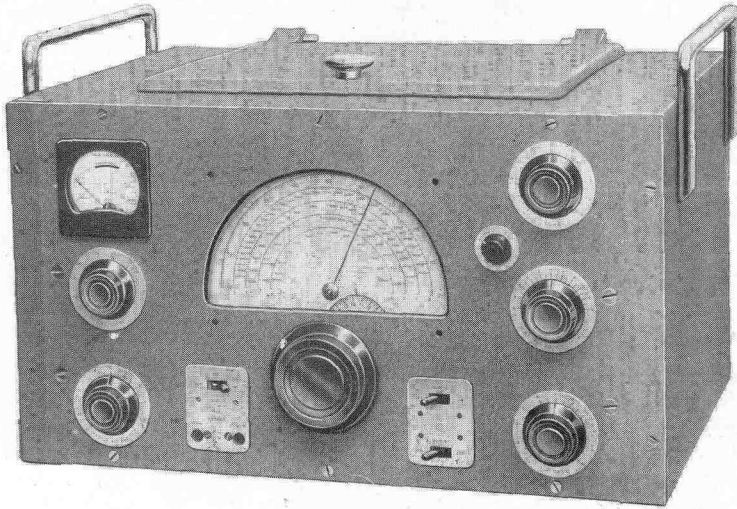
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**TYPE 358**  
**RECEIVER**

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## SPECIFICATION.



RECEIVER TYPE 358X.

### **GENERAL.**

This Receiver is of the superheterodyne type, specially designed for consistent and reliable reception of telegraphy and telephony signals even under bad conditions.

It has a tuning range of 31 Mc/s. to 40 Kc/s by the use of interchangeable plug-in coil units and the output is arranged for either high or low resistance telephones or loud speaker.

The Receiver operates from an input of 6 volts at 1.4 amps. and 175/180 volts 65 milliamperes high tension, which is supplied by a special power unit when operating from A.C. Mains.

For operation from a six volt accumulator a special Rotary Transformer Unit can be supplied to provide the necessary H.T. Voltage. This unit is free from interference and allows the same degree of performance to be obtained as when the Receiver is operated from the standard A.C. mains driven supply unit.

Controls have been kept to a minimum consistent with full operational manual adjustment, and have their function marked for ease of identification. The tuning dial is illuminated and has four ranges directly calibrated, other ranges being referred by graph to an outer scale. A spring loaded Tufnol geared condenser drive mechanism, having a ratio of 70-1 and fitted with a flywheel, permits smooth and rapid operation of the tuning control, free from backlash and noiseless mechanically and electrically.

The Receiver is now normally supplied with a band-pass crystal filter unit and known as type 358X. Triode output is available if desired, giving a reduced audio output, which, however, is more than adequate for all reception purposes.

## SPECIFICATION—continued.

## CIRCUIT ARRANGEMENT.

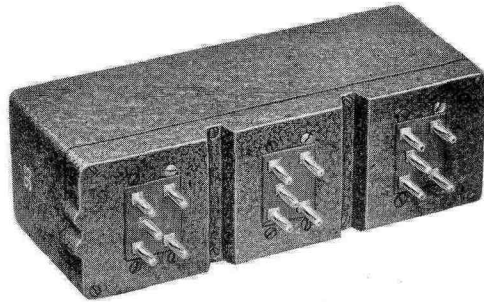
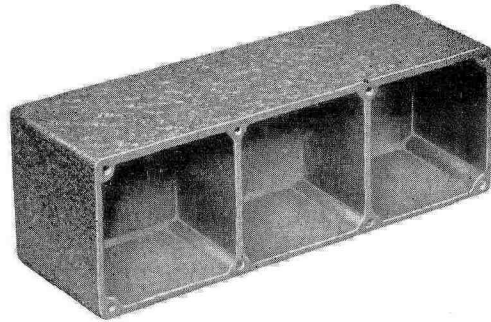
A variable Mu pentode H.F. amplifier stage followed by a triode-hexode frequency changer precedes two I.F. amplifier stages operating at 450 Kc/s, a double diode triode supplies delayed A.V.C., and operates as second detector and first L.F. amplifier. The second L.F. amplifier stage which forms the output is either a triode or pentode, depending on requirements. A fully screened and separate stage operates as beat frequency oscillator for the reception of telegraphy signals. The first I.F. stage in Receivers type 358X incorporates the band-pass filter unit which may be brought into operation by means of a control switch, mounted in the unit itself, but having the manual control knob located on the front panel of the Receiver.

## OPERATING RANGE.

The total range of the instrument is from 31 Mc/s to 40 Kc/s. This is covered by ten coil units, four of which are calibrated on the tuning dial, which also has an outer 0-100° arbitrary scale for use with the remaining six units.

The units are as follows :—

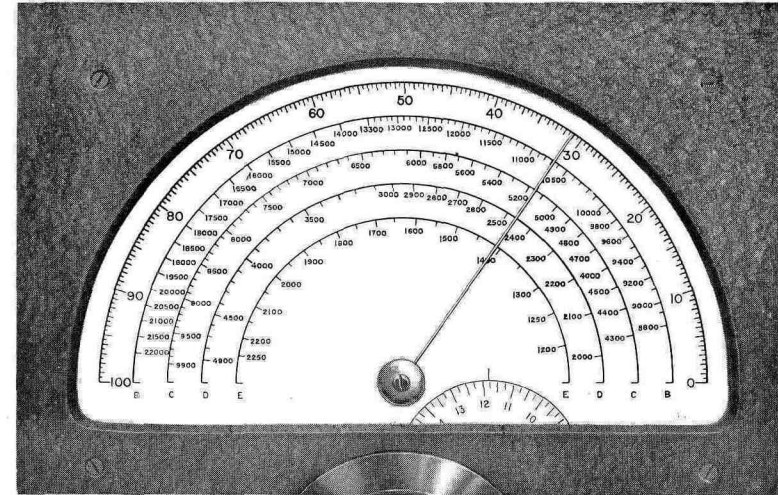
|            |          |        |   |        |       |
|------------|----------|--------|---|--------|-------|
| Calibrated | Range A. | 22,000 | — | 31,000 | Kc/s. |
|            | Range B. | 9,000  | — | 22,000 | Kc/s. |
|            | Range C. | 4,500  | — | 9,000  | Kc/s. |
|            | Range D. | 2,100  | — | 4,500  | Kc/s. |
|            | Range E. | 1,250  | — | 2,100  | Kc/s. |
|            | Range F. | 600    | — | 1,250  | Kc/s. |
|            | Range G. | 300    | — | 600    | Kc/s. |
|            | Range H. | 150    | — | 300    | Kc/s. |
|            | Range I. | 90     | — | 150    | Kc/s. |
|            | Range J. | 40     | — | 90     | Kc/s. |



COIL UNITS (Note internal screening).

## SPECIFICATION—continued.

Coil Units can be supplied in a special carrying box partitioned to take the ten units. This container is finished in the usual instrument case manner, and can be placed alongside the Receiver, allowing rapid change of units to be made, and at the same time affording the best protection for those units not in use.



## DIAL CALIBRATION.

The above photograph gives a clear idea of the manner in which the dial is marked. Four coils have direct calibration and the remainder are referred by graphs to the outer scale. These graphs will be found on pages 24 and 25 in the Operating Instructions.

The small Logging Scale is gear driven from the Drive Mechanism and, therefore, positive in action. By quick reference to the outer scale and the pointer reading thereon, and the reading of the logging scale, it is possible to return to any given point at any time quickly and accurately; further, any number of stations working on fixed wavelengths can be logged and returned to for operational purposes.

The use of the Drive Mechanism described elsewhere, and the dial detailed above, at once supersedes the old methods of bandspread and inaccurate calibration which automatically resulted. It being evident that at all times the main dial reading maintains accurate calibration in the system used.

The illuminated dial is particularly free from glare, and has been designed to eliminate as much as possible eye strain over long periods of operation.

## CONTROLS.

In addition to the main tuning control, there is H.F. Gain, L.F. Gain, Beat Frequency Pitch, Tone Control, A.V.C., B.F.O., and H.T. On-off switches, and Meter switch. In the case of the 358X there is a selectivity switch in addition. There are two jacks on the front panel giving high and low resistance output for telephones or loud speaker. Controls have their function clearly marked on the scales and in the case of those with rotary movement, have stops built in the actual knobs at the termination points to avoid strain on the shafts of the component.

## SPECIFICATION—continued.

## SELECTIVITY.

Adjacent channel : 2 Kc/s at 2.5 db down.  
 5 Kc/s at 35 db down.  
 With Crystal = 150 c.p.s. at 40 db.

## SENSITIVITY.

Approximately 3 microvolts above 1,500 Kc/s.  
 8 microvolts for lower frequencies.  
 30% modulation for 50 milliwatts output on all ranges.

## IMAGE RATIOS.

At 20 Megacycles, 33/1.  
 12 Megacycles, 100/1.  
 9 Megacycles, 210/1.  
 4.5 Megacycles, 400/1.  
 3 Megacycles, 500/1.

## INTERMEDIATE FREQUENCY.

450 Kc/s. The I.F. Transformers have received particular care in design and are highly efficient. They are free from drift due to climatic changes and maintain their set frequency.

## AUDIO OUTPUT.

1.5 watts Two output impedances are provided on the Receiver. Standard Pentode Telephones or loud speaker may be used in either jack provided their resistances are reasonably close to the values engraved on the plate.  
 Triode—100mw.

## SUPPLY.

Filament supply of 6 volts at 1.4 amperes. High tension supply of 175/180 volts at 65 milliamperes. For A.C. Mains a special Power Unit is supplied with effective smoothing to allow reception of weak signals on headphones without hum interference.

## DIMENSIONS.

Cabinet,  $20\frac{1}{2}'' \times 12'' \times 13\frac{1}{2}''$  deep.  
 Panel,  $19'' \times 10\frac{1}{2}'' \times \frac{1}{8}''$  steel. Standard rack mounting size.

WEIGHT. 50½ lbs.

## CABINET.

Steel, finished in an attractive durable grey crackle. Provided with spring loaded lid and substantial carrying handles. All brass fittings chromium plated.

## SPECIFICATION—continued.

## POWER UNIT. Type S.390.

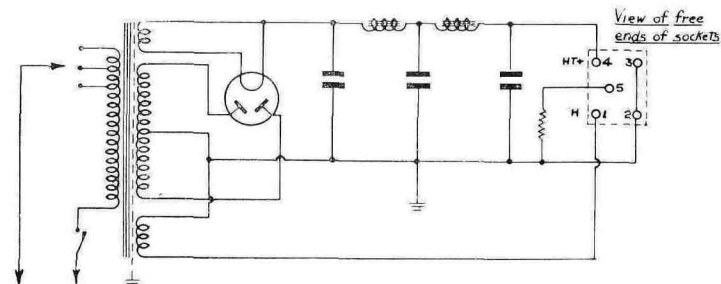
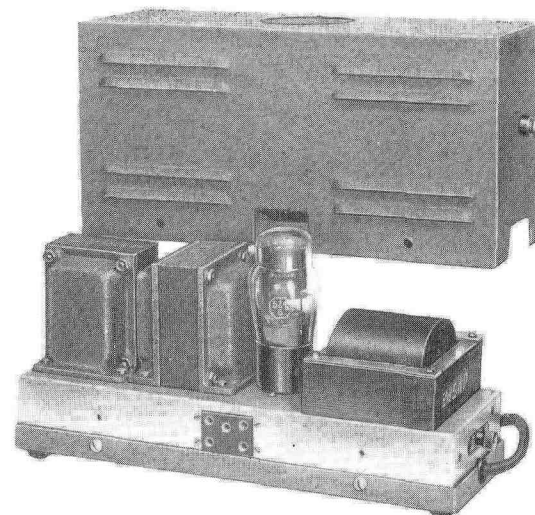


FIG. 1.

The Power Unit has been designed for A.C. Mains operation and for supplying the necessary current to the Standard 358 Receiver. It will be appreciated however, that it can be used to drive any radio or electrical apparatus, whose load is within the capabilities of the Unit.

## SPECIFICATION.

Input : Controlled by switch. 200-250 volts, 40-60 cycles.

Output : 6 volts 1.4 amperes A.C.  
 175/180 volts at 65 milliamperes.

Rectification : Indirectly heated full wave valve rectifier.

Rectifier Valve : 5Z4G or equivalent. Octal base. (international).

## SPECIFICATION—continued.

**Smoothing :** Condenser input circuit with two smoothing chokes reducing hum to an extremely low level, enabling headphone reception of weak signals.

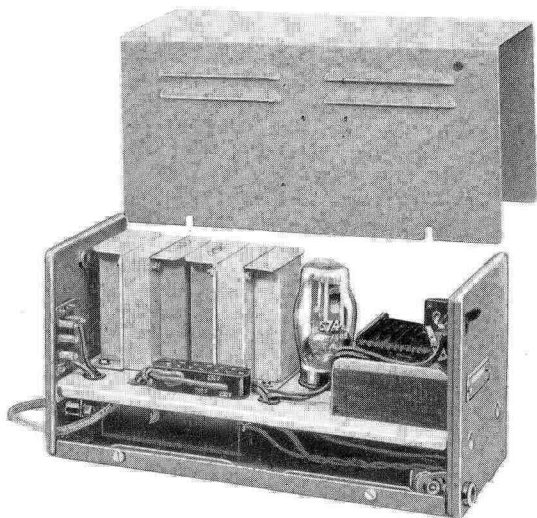
**Construction :** The unit is built on a plated steel chassis, fitted into a welded steel case, suitably ventilated and finished in grey crackle to match the Receiver.

**Dimensions :**  $6\frac{1}{2}'' \times 9'' \times 4\frac{3}{4}''$  deep.

**Weight :** 16 lbs.

The output of the unit is connected to a special five-way connector socket so that Receivers using Triode output and having a lower anode consumption, automatically connect a 7,500 ohm Bleeder Resistor across the rectified High Tension supply. The connection is made in the plug of the Receiver itself on Receivers using triode valves and omitted in those using pentodes. By this means the output voltage is maintained at a constant figure regardless of which type of Receiver the unit is supplying.

## POWER UNIT. TYPE S.390B.



This is a replacement type Unit giving the same electrical output and utilising exactly the same components as in our Power Unit type S.390, the only difference being the arrangement of the Components and the shape of the chassis and cover plus the use of a 6 volt bulb, mounted on the right hand side of the unit below the on-off switch and having a green indicator glass, the bulb being connected across the filament supply winding. This Unit is being supplied as a Standard Power Unit for other equipment as well as the 358 and 400 type Receivers.

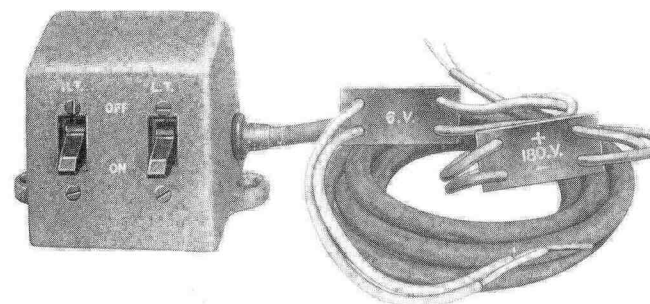
Dimensions :  $11\frac{1}{2}'' \times 5\frac{11}{16}'' \times 4\frac{3}{4}''$ .

Weight : 16 lbs.

## SPECIFICATION—continued.

## ALTERNATIVE MODELS.

## TYPE 358/I.



Control Unit for use with set when battery operated.

This Receiver is a modified version of the Standard 358 Receiver, and is intended primarily for headphone reception and battery operation if necessary. The normal output valve has been replaced by one drawing less anode current, and giving as a result a lower audio output. To accommodate the new type valve, the auto-bias resistor R.39 has been increased in value to 1,000 ohms. By means of the above modification the total anode consumption has been reduced to approximately 33 milliamperes at 180 volts.

To stabilise the voltage from the power unit at the new load, a bleeder resistance of 7,500 ohms 3 watt rating has been placed across the rectified output.

It will be noted that the "on-off" high tension switch referred to in the Operating Instructions has been replaced with a similar type switch controlling the dial illumination bulb circuit.

The power unit is provided with an "on-off" switch on the opposite side to the output socket, this switch being in the mains supply circuit. It is advisable to place this in the "off" position when changing coil units. In the case of battery operation the H.T. switch, located in the switchbox unit, should be put in a similar position, the L.T. switch being left "on" while the new coil is being inserted.

A special battery lead is supplied when the Receiver has to be operated from batteries. This lead incorporates a small switch box unit, illustrated above. A socket is fitted at the back of this unit, similar to that on the power unit, and the lead from the Receiver is inserted into same, thus bringing the two switches into circuit, and providing the necessary leads for connection to the batteries.

It is essential that both switches be placed in the "off" position when the Receiver is left inoperative, as should the H.T. switch be left "on" there will be a small drain, even though the filament supply has been switched off, due to the potential divider circuit incorporated in the Receiver itself.

For battery operation the following will be required :—

A 6 volt accumulator of sufficient capacity to give a reasonable number of operating hours, and a high tension supply which may consist of four 45 volt block units of the super capacity type, connected in series to give 180 volts.

## SPECIFICATION—continued.

## TYPE 400 and 400X.

These Receivers are based on the standard 358 design and apart from the dial calibration look the same. They have been produced for the reception of C.W. signals between 130 K cs. and 2,200 K cs. by means of four interchangeable coil units, and in view of the fact that only C.W. reception is the main consideration the A.V.C. circuit has been omitted.

The Intermediate Frequency is 110 k cs., and this, together with the design of the coil units, allows a very good open dial to be utilised giving direct calibration for the four coil units.

The output is a triode valve, giving ample signal output for all normal communication use.

The 400X incorporates the same type of crystal filter unit as the 358X but having a bandwidth in the normal position of 2 k/cs. and 250 c.p.s. in the selective position.

Circuit diagram is given on page 32 of this booklet, and further information may be obtained on request. The operating procedure is the same as for the 358 Receiver and the alignment procedure follows the methods indicated, but using the frequencies detailed for the coil units below.

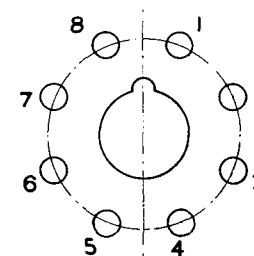
| Range. | Minimum.   | Alignment. | Tracking Point. |
|--------|------------|------------|-----------------|
| AA     | 2200 K/cs. | 1400 K/cs. | 1000 Kc/s.      |
| BB     | 1000 K/cs. | 700 K/cs.  | 500 Kc/s.       |
| CC     | 550 K/cs.  | 450 K/cs.  | 250 K/cs.       |
| DD     | 290 K/cs.  | 200 K/cs.  | 130 K/cs.       |

INSTALLATION.

These instructions are intended as a guide to the methods for obtaining the best results, and we recommend that the following procedure be adopted.

First ascertain that the mains adjustment screw at the end of the Power Unit is in the correct position having regard to the voltage of the A.C. supply on which the Receiver is to be used. Next, insert the five pin plug on the Receiver Power cable into the sockets on the side of the Power Unit.

## VALVE ELECTRODE CONNECTIONS.

OCTAL BASE  
(INTERNATIONAL)VIEW OF UNDERSIDE OF BASE

## SOCKETS.

| VALVE  | 1 | 2      | 3              | 4          | 5                      | 6             | 7      | 8       |
|--------|---|--------|----------------|------------|------------------------|---------------|--------|---------|
| EF.39  | M | Heater | Anode          | Screen     | Sup-<br>pressor<br>D.2 | —             | Heater | Cathode |
| EBC.33 | M | Heater | Anode          | D.1        | D.2                    | —             | Heater | Cathode |
| ECH.35 | M | Heater | Anode<br>Mixer | Screen     | Grid<br>Osc.           | Anode<br>Osc. | Heater | Cathode |
| L63    | M | Heater | Anode          | —          | Grid                   | —             | Heater | Cathode |
| 6C5    | M | Heater | Anode          | —          | Grid                   | —             | Heater | Cathode |
| 6J5G   | M | Heater | Anode          | —          | Grid                   | —             | Heater | Cathode |
| EL32   | M | Heater | Anode          | Screen     | —                      | —             | Heater | Cathode |
| 5Z4G   | — | Heater | —              | Anode<br>1 | —                      | Anode<br>2    | —      | Heater  |

Valves Type EF.39, EBC.33, ECH.35, and EL.32 have Top Cap Grid Connection.

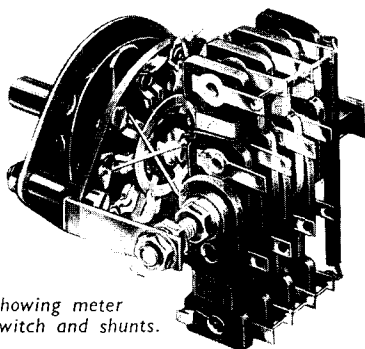
## INSTALLATION—continued.

## VALVES.

A set of valves is supplied and checked in the Receiver at the final bench test at the works, and it is essential that only the specified types should be used.

These are :—

| Maker's Type       | A.M. Type.     | Army.  | Admiralty Type. |
|--------------------|----------------|--------|-----------------|
| V1. Mullard EF.39  | VR.53          | ARP.34 | 10E.11399       |
| V2. Mullard ECH.35 | ECH.35         | ARTH.2 | ARTH.2          |
| V3. Mullard EF.39  | VR.53          | ARP.34 | 10E.11399       |
| V4. Mullard EF.39  | VR.53          | ARP.34 | 10E.11399       |
| V5. Mullard EBC.33 | VR.55          | AR.21  | AP.850          |
| V6. Mullard EL.32  | VT.52          |        | 10E.11398       |
| V7. Mullard EF.39  | VR.53          | ARP.34 | VR.53           |
|                    | TRIODE OUTPUT. |        |                 |
| V6. Marconi L.63   | 6C5            |        | 6J5G.W.1528A    |
|                    | POWER UNIT.    |        |                 |
| Rectifier 5Z4G     | VU.71A         |        | W.3792          |



Showing meter switch and shunts.

With the set in operation the valves should read within the normal limit line on the Test meter when each one is switched into the meter circuit. Any reading out of the limit line should be regarded with suspicion.

All valves must be inserted in their holders in the position shown on Fig. 4 before the set is put into operation ; further, at any time when changing valves always make sure that the Receiver is switched off. A flexible lead is fitted for the top connection to each valve excepting the output valve ; in some cases the spring clip is mounted inside a screening cowl ; this connection should be firmly pressed on the metal plug at the top of the appropriate valve. When inserting or removing valves always hold the base and not the glass body of the valve, as otherwise the glass is liable to become detached from the base.

## HEADPHONES OR LOUD SPEAKER.

Either should be provided with a jack plug. Insert the plug into the correct socket located on the front panel of the Receiver, depending on the resistance of the component being connected.

It should be noted that the output jacks of the Receiver are engraved 120 ohms and 2,000 ohms. These values actually refer to the D.C. resistance of the telephones likely to be used under the operating conditions. The actual impedance of these two output jacks are 600 ohms and 6,000 ohms for the 120 ohms and 2,000 ohms positions respectively. As a matter of interest the impedance of 120 ohms and 2,000 ohms telephones at 400 cycles approximates to 600 ohms and 6,000 ohms respectively.

## AERIAL AND EARTH.

The aerial input is arranged for a doublet or single wire aerial system. When a single wire aerial is used it should be connected to the "A1" terminal shown on Fig. 4 (page 19), whilst the shorting strip should be connected across terminals "A2" and "E" as shown.

If a doublet aerial is used, then the shorting strip should be removed from "A2" and the two leads from the doublet should be connected, one to each of the terminals "A1" and "A2." A direct earth wire, which should be well insulated, is then connected to the earth terminal.

## OPERATING THE RECEIVER.

Positions of the controls are indicated in the various photographs and their purposes will now be dealt with.

## H.T. ON-OFF SWITCH.

This is for bringing the Receiver into action. Always place in the "off" position when changing coil units.

## L.F. GAIN.

This is set from time to time at a position which allows reception at the desired strength. To decrease volume turn anti-clockwise.

## H.F. GAIN.

This controls the actual gain of the high frequency amplifier, and its regulation is connected with the type of signal being received and the use or not of the A.V.C. circuit. Rotation in a clockwise direction increases the gain of the Receiver. For more detailed application see notes under "Reception of C.W. and Telephony signals."

## B.F.O. ON-OFF SWITCH.

The beat frequency oscillator valve circuit is made to oscillate when this switch is in the "on" position, and is used when it is desired to receive a C.W. station. The B.F.O. may also be switched on when searching for a weak telephony station in order to locate the carrier wave.

## A.V.C. ON-OFF SWITCH.

This switch, as its name implies, is used to put the A.V.C. circuit in or out of operation. When searching for a very weak station, A.V.C. should be switched off and the H.F. Gain control fully advanced in a clockwise direction. A.V.C. should also be switched off when using the B.F.O., as otherwise the local oscillations will cause the Receiver to become insensitive. For all C.W. reception the A.V.C. should be switched off.

## SELECTIVITY SWITCH.

This switch controls the band-pass crystal filter circuit included in the first I.F. stage of Receiver type 358X ; thus providing the option of crystal selectivity by means of the two position movement.

When the switch is turned to the right the crystal is out of circuit and an I.F. bandwidth of 5 Kc s is produced, whilst the crystal filter is brought into use by turning the switch to the left, giving a bandwidth of 300 c s.

No other adjustment is necessary, as optimum conditions are obtained during final test at the factory.

The 300 c s bandwidth is intended for use when a high degree of selectivity is required when receiving C.W. transmissions. Any attempt to use it on Telephony will only result in unintelligible speech.

## BEAT FREQUENCY OSCILLATOR.

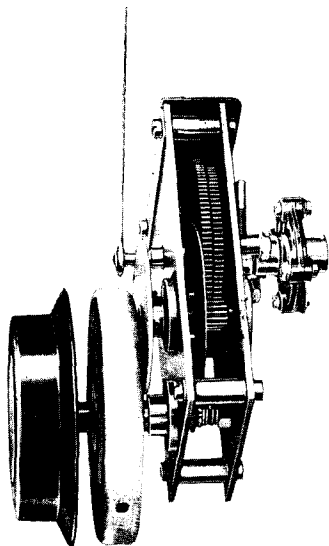
Only when the B.F.O. switch is on may this control be used, when the pitch of the note produced by the interaction with an incoming C.W. signal may be adjusted. Its application is fully covered in the notes on the reception of C.W. and Telephony Signals.

**OPERATING THE RECEIVER—continued.****TUNING CONTROL.**

The large centre knob is the tuning control. This operates the three gang condenser and also causes a hair line pointer to traverse the tuning dial, which has four directly calibrated scales for use with the coil units named on the dial. The outer scale is for use with additional coil units, with which graphs are supplied referring to this scale, and it also is used in connection with a vernier scale to give a form of fine tuning superseding the present methods of Bandspreading.

A specially designed drive mechanism incorporating flywheel control and spring loaded Tufnol gearing is fitted to the main tuning control. The gearing gives a ratio of 70-1 and makes possible minutely accurate logging. The progression of the pointer across the dial can be controlled to give hardly perceptible movement, and the action of the whole component is unbelievably smooth without backlash.

Bandspreading is superseded by a vernier logging scale, referred to above, gear driven from the main shaft. This system has all the advantages of band-spread whilst making a return to any given position simple, as the main dial remains accurately calibrated.



*Tuning Control Drive Mechanism.*

**TUNING CONTROL DRIVE MECHANISM.**

The tuning control system incorporated in this Receiver is worthy of description. It utilises a flywheel drive and spring loaded Tufnol gearing, giving a ratio of approximately 70-1. The gearing is driven through a friction disc and so arranged that when the pointer, which is attached to the shaft driving the gang condenser, is either at the zero or 100° terminating point of travel, the small stop-pin prevents further movement of this shaft and the friction drive acts as shock absorber, removing strain from the Tufnol gears themselves.

**OPERATING THE RECEIVER—continued.**

Mounted on the intermediate gear shaft, and flush with the main tuning dial is the vernier logging scale; this is marked in 25 divisions. One complete revolution of the logging scale causes the main pointer to move to 25° on the outer scale of the main tuning dial, and thus it may be seen that for each revolution of the logging scale, a movement of 25 degrees of the main pointer takes place. Very accurate calibration can be obtained using two check readings taken against the small dial and the outer scale on the main dial, this check being exceedingly useful when using the Receiver for spot frequency work, and at the same time this method will supersede the older method of bandspreading either electrically or mechanically, with their associated disadvantages.

**tone control.**

This is a control for attenuating the high note response of the output stage and can be used when receiving signals in a noisy locality to eliminate, to some extent, interference appearing with the signal. In connection with this the B.F.O. control will have to be set to give a suitably pitched note, according to the operator's individual requirements.

**CHECK METER.**

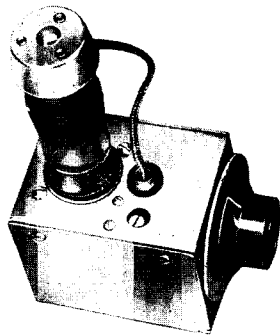
The original type meter supplied has been replaced on later models with a different type, and to accommodate this meter, a conversion plate is utilised for mounting. The shunts remain the same as the new meter has the same electrical characteristics.

When receiving telephony, with the A.V.C. in use, accurate tuning of the signal will be facilitated if the Anode Current Control Knob is set on the VI position. The meter will then operate as a tuning indicator of the resonant dip type.



OPERATING THE RECEIVER—continued.

## THE RECEPTION OF C.W. AND TELEPHONY SIGNALS.



Showing B.F.O. Untt.

### C.W.

Some care in the use of the controls for C.W. reception is necessary, especially if the signal being received is weak, and the B.F.O. control is not the least important.

When its dial is set to "0," the frequency generated by the B.F.O. is the same as the intermediate frequency of the receiver. Therefore, if the receiver is correctly tuned to the desired signal, the beat note produced will then be zero; further, by turning the control on either side of zero, the frequency of oscillations of the B.F.O. is increased or decreased, resulting in an increase of pitch of the audible beat note.

It will be seen that an audio difference frequency or "Beat note" can be produced by an incoming signal, if the B.F.O. is set at zero, which is the I.F. frequency (450 Kc/s). This is the result of detuning of the signal, and should not be resorted to, as sensitivity and selectivity are thus impaired—obtain zero beat with B.F.O. dial at "0" by tuning, and then adjust for pitch by means of the B.F.O. control.

By discriminate use of the B.F.O. control, the effect of an interfering signal may be reduced. Refer to figure 2 (a) and consider an unwanted signal producing an audible beat note of 5 Kc/s when the wanted signal is correctly tuned; then if the B.F.O. is adjusted nearer to the former to produce a 1,000 cycle note, the difference in the audio frequency between the two signals will be only 4,000 cycles. Now referring to figure 2 (b), with the same signal conditions, if the B.F.O. control is moved to the corresponding dial position beyond

OPERATING THE RECEIVER—continued.

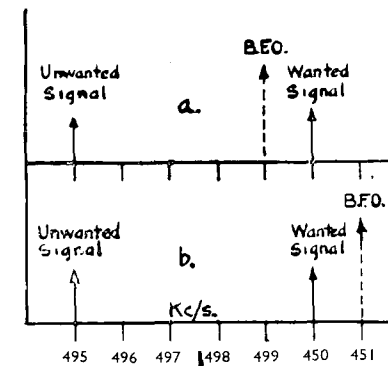


FIG. 2

zero, so that the B.F.O. frequency is 451 Kc/s, a 1,000 cycle note is still produced by the wanted signal, but the unwanted signal is 6,000 cycles away from this; so that conditions for reception of the wanted signal are very much improved.

If the unwanted signal was only a few Kc/s more remote, then its beat note would be beyond audibility and interference would be eliminated altogether. The same considerations apply if the unwanted signal produces a frequency higher than 450 Kc/s.

Should the wanted C.W. signal be of a strong character it will tend to overload the input circuit of the receiver, causing blocking and other troubles. To avoid this, the H.F. gain should be reduced and the L.F. gain adjusted so that the receiver functions at a volume level, suited to the strength of the incoming signal and amount of audio output favoured by the individual operator.

In connection with A.V.C., it will be obvious that with the B.F.O. operating and producing local oscillations, the A.V.C. will have to be switched off as otherwise it would be considerably affected by the oscillations (which can be likened to those from a local transmitter), reducing the gain of the receiver and making it extremely insensitive.

## OPERATING THE RECEIVER—continued.

## TELEPHONY.

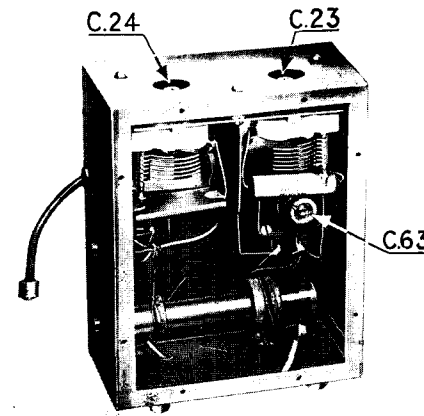
For the reception of telephony signals the B.F.O. is not required and should be switched off. If using Receiver type 358X, place selectivity switch into the normal or 5 Kc s bandwidth position.

The A.V.C. Circuit becomes of greater importance and should be switched on since it minimises fading and consequent distortion, automatically adjusting the gain of the Receiver input circuits so that a constant input level is maintained. The H.F. Gain still functions, but more as a fine control, and normally should be left in the maximum gain position.

If the wanted signal is very weak and difficult to locate, it can sometimes be found by switching on the B.F.O. with the dial set at "O," and tuning to the null point of the carrier wave and then switching off the B.F.O.

Care in the correct handling of the controls of the Receiver will more than repay, as correct operation will allow signals to be received at readable strength ; which incorrect operation would render difficult if not impossible.

## OPERATING THE RECEIVER—continued.



1st I.F. Unit, 358X.

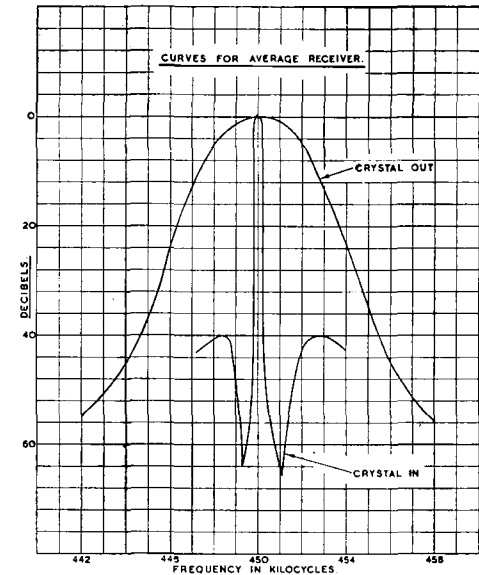


FIG. 3.

## BAND-PASS CRYSTAL FILTER UNIT.

Where the advantages of extremely high selectivity are required the use of some form of Quartz Crystal Filter becomes essential. There are two distinct types available, the single peaked and the band-pass. The latter type has many advantages and has, therefore, been incorporated in the 358X and 400X Receivers.

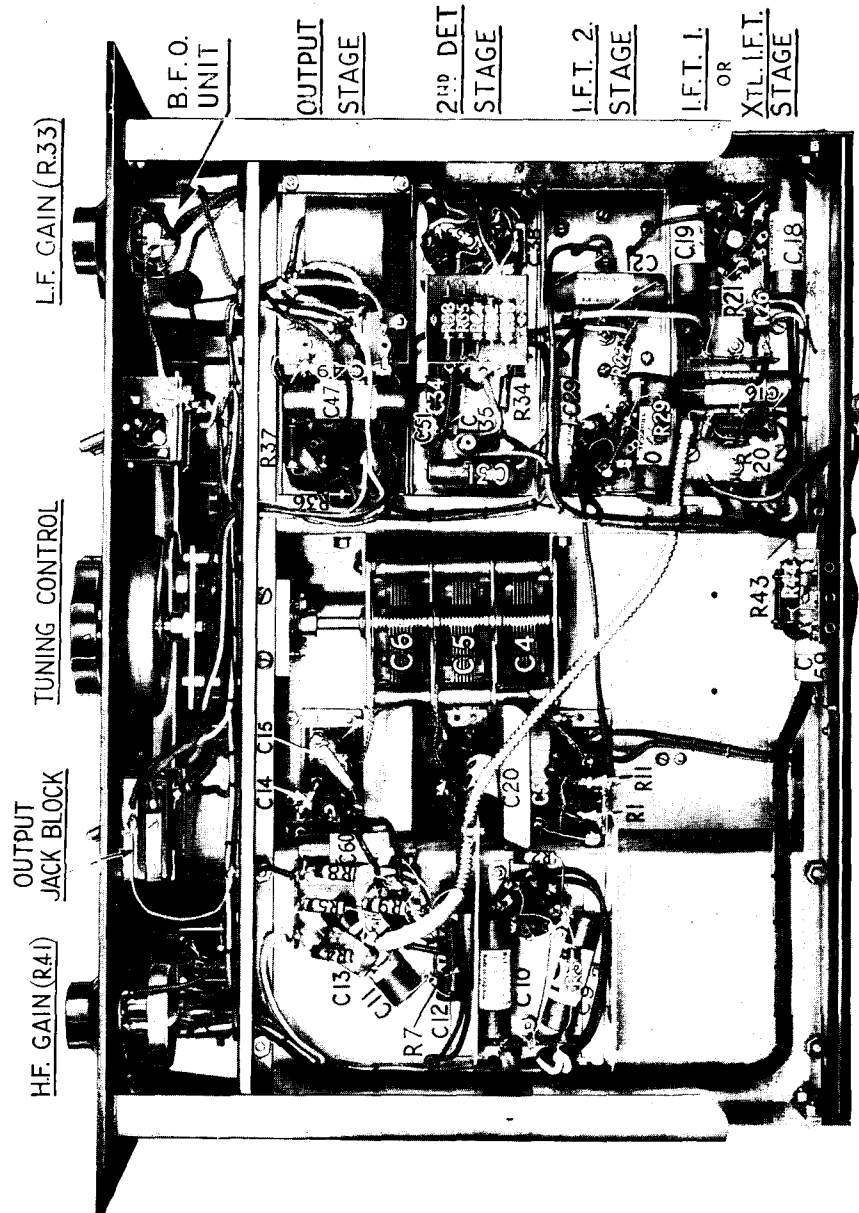
Two exactly similar crystals are used, but differing in frequency by the width of the band-pass required, which, in the case of the 358X, is 300 c.p.s., and in the 400X a matter of 250 c.p.s. These crystals are mounted in a special holder, which itself is fitted inside the screening box of the first I.F. Unit. A switch is provided, controlled from the front of the Receiver, allowing the crystal filter to be switched out of circuit at will, leaving the selectivity of the Receiver at the normal figure of 5 Kc's. (See Fig. 3).

Since the two crystals are connected in parallel in the circuit and the phasing condenser adjusted to compensate for the total parallel capacity of the two crystals and their holder, the circuit will behave as two complete crystal gates in parallel and will give a response curve having two sharp and distinct peaks. The voltage through them will be in opposite phase and at the output point of the circuit their combined effect will be very low. To overcome this trouble one crystal response curve must be completely reversed in phase so that the phase in the middle region becomes additive and this is carried out quite simply by placing the crystals in opposite arms of the bridge circuit and balancing out with the help of the phasing condenser.

The type of filter fitted, due to the improved rejection of interference outside the band, leads to an improvement in the Signal to Noise level and it is quite usual to get an improvement of 20db over the typical single crystal filter. One other advantage is the absence of ringing usually associated with crystal filter circuits of the single type. This can be simply explained, since whereas the carrier in the single crystal filter is carefully adjusted to resonance with the crystal, an ideal condition to excite ringing, the carrier in the band-pass arrangement will normally lie about midway in frequency between the two crystals used.

The use of band-pass crystal filters means one other great advantage, that being the absence of the Phasing Control and Selectivity Control, which are essential with single crystal filters, and only increase the number of controls to be manipulated correctly by the operator and which, in any good design, should be kept to a minimum.

# ALIGNMENT INSTRUCTIONS.



## ALIGNMENT INSTRUCTIONS—continued.

These instructions should be carried out with great care since, with correct operation of the Receiver, performance depends entirely upon adjustment of the various parts of the circuit.

The following apparatus is necessary :—

A signal generator with calibrated attenuator to generate at 450 Kc s, having modulation control allowing setting of 30%.

An output meter giving loads of 600 ohms and or 6,000 ohms.

Switch on Receiver and signal generator for at least 5 minutes before attempting to retrim, so that all valves may reach full operating temperature and frequency drift be at minimum.

A standard dummy aerial, as normally supplied with signal generators.

Before commencing alignment, one should make quite certain that the Receiver is otherwise in the same condition as it will be when operated. All valves should be tightly in place, and the earth connected.

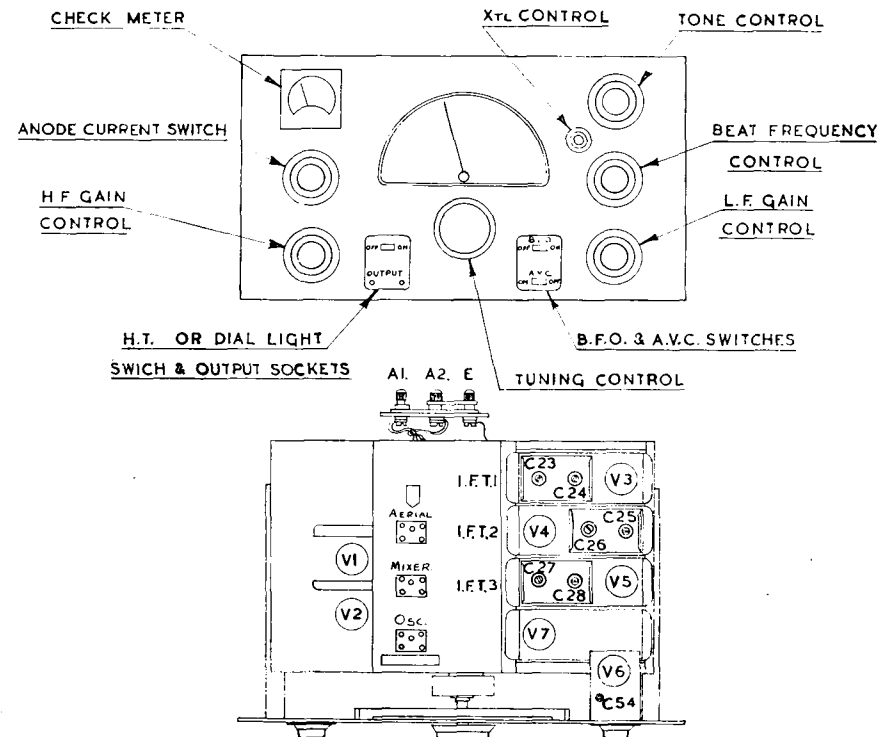


FIG. 4

## ALIGNMENT INSTRUCTIONS—continued.

## I.F. AMPLIFIER.

The first procedure is to align the I.F. amplifier and in this, a signal generator and output meter only are required.

For aligning the I.F. Amplifier stages, the lead from the generator should be direct, i.e., no dummy aerial in circuit, and must show continuity between the high and low potential leads.

It should be noted that the output jacks of the Receiver are engraved 120 ohms and 2,000 ohms. These values actually refer to the D.C. resistance of the telephones likely to be used under the operating conditions. The actual impedance of these two output jacks are 600 ohms and 6,000 ohms for the 120 ohms and 2,000 ohms positions respectively. As a matter of interest the impedance of 120 ohms and 2,000 ohms telephones at 400 cycles is approximate to 600 ohms and 6,000 ohms respectively.

## PROCEDURE.

Fig. 4 to be used to locate trimmers and controls for the following adjustments :—

Plug output meter into appropriate jack as outlined above.

Plug in Range B Coil Unit and set dial at about 13 Mc/s.

If the amplifier is only slightly misaligned, connect the generator leads between the grid of V2 (after removing the cap) and chassis. Set H.F. Gain and L.F. Gain controls to maximum position. Switch off the A.V.C. and B.F.O.

Set the generator to give a suitable deflection on the output meter, and adjust all six I.F. Trimmers, C28, C27, C26, C25, C24 and C23, to give maximum deflection. If no signal is obtained in this manner, proceed as follows :—

Connect the generator leads between grid of V4 (after removing clip) and chassis, and trim I.F.T.3. Transfer lead to grid of V3 trimming I.F.T.2, then repeat on V2 as already described. For alignment of Receiver type 358X, see separate instructions.

**A.V.C. and B.F.O. may be checked at this point.**

## A.V.C.

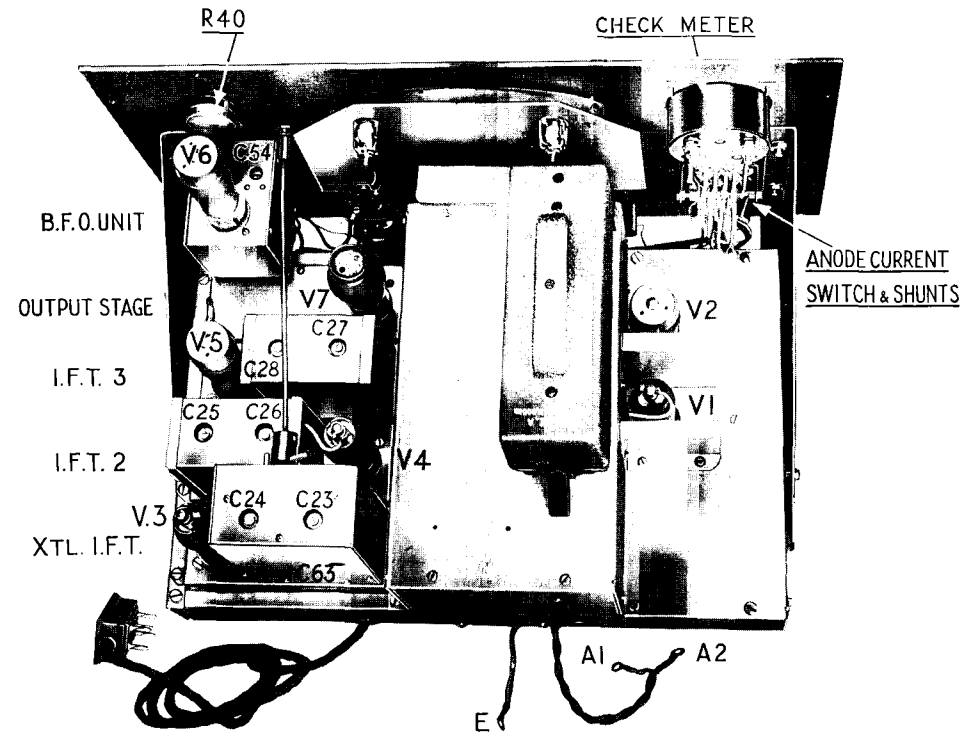
Switch this on and increase the input from the generator to 100 microvolts, reducing the L.F. gain to keep the output meter reading fairly low. Now switch off the A.V.C. and if the circuit is functioning correctly, a sharp rise will be indicated on the output meter.

## B.F.O.

With the signal still being injected, set the B.F.O. control at "0"; switch on the B.F.O. and adjust the trimmer C54 (located near valve and holder of V6) to zero beat.

RECEIVER TYPE 358X.  
(Circuit BP481).

## ALIGNMENT INSTRUCTIONS.



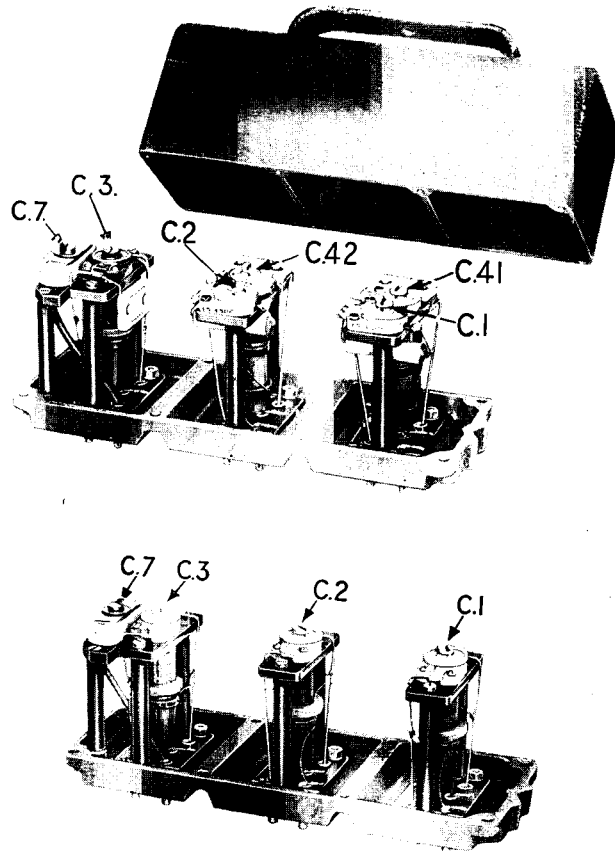
Chassis of 358X Receiver showing trimmer positions.

The same arrangement of test gear as with the type 358 Receiver is required. That is, injection between V2 grid and chassis of a 450 K.c carrier, but in this case, unmodulated. A level of about 20 microvolts is sufficient. Switch on the B.F.O. and adjust its control knob to either of the figure "5" engravings on the scale. Switch off A.V.C. and switch in the crystal. Now carefully rotate the Signal Generator Frequency control until a sharp upward deflection is observed on the output meter. Bring this peak to its maximum and then proceed to adjust trimmers C28, C27, C26 and C25 for maximum also. (Trimmer locking rings should first of all be slackened). A tolerance of plus or minus 50 cycles on Xtl band width is allowed in factory tests and as a result it may be possible to detect two distinct maximums on output meter as the signal generator is varied. If this be so adjust the signal generator so that the output meter indicates the "trough" or "hollow" between the two peaks and align the four previously mentioned trimmers to this. Now, VERY CAREFULLY, adjust C23 for maximum deflection. Having done this, switch off the B.F.O., switch out the crystal, switch in 30% modulation in the signal generator and adjust C24 for maximum deflection. Assuming that a level of 20 microvolts has been used throughout, it is possible that the needle of the output meter will tend to over-run the scale; this may be obviated by slightly reducing the gain of the I.F. by means of the H.F. Gain Control.

## ALIGNMENT INSTRUCTIONS—continued.

## COIL UNITS.

The coil units are very carefully adjusted before leaving the factory and the trimmers set to give the greatest possible efficiency. If however, it is found necessary to readjust these units, the methods which follow should be carried out systematically.



Reference to the photographs of the coil units will show that in some cases a variable oscillator tracking condenser C7 is fitted; this applies to ranges D, E, F, G, H, I and J. In ranges A, B, and C, C7 is a fixed condenser. Adjustment is made through the holes in the tops of the covers, by means of a non-metallic trimming tool; this is insulated to prevent short circuiting to chassis, of the high potential which is present on the trimmers.

For ranges A, B, C and D, use a dummy aerial consisting of a non-inductive 400 ohms resistor connected in the high potential lead from the generator. For other ranges a standard dummy aerial is used.

## ALIGNMENT INSTRUCTIONS—continued.

For location of trimmers refer to diagram (FIG. 5). It should be noted that the shorting strip should in all cases be connected to "A2" and "E" terminals of the Receiver.

In the following procedure the word minimum is used in referring to Gang minimum, this corresponding to the 100 end of the 0—100 outer engraved scale on the dial.

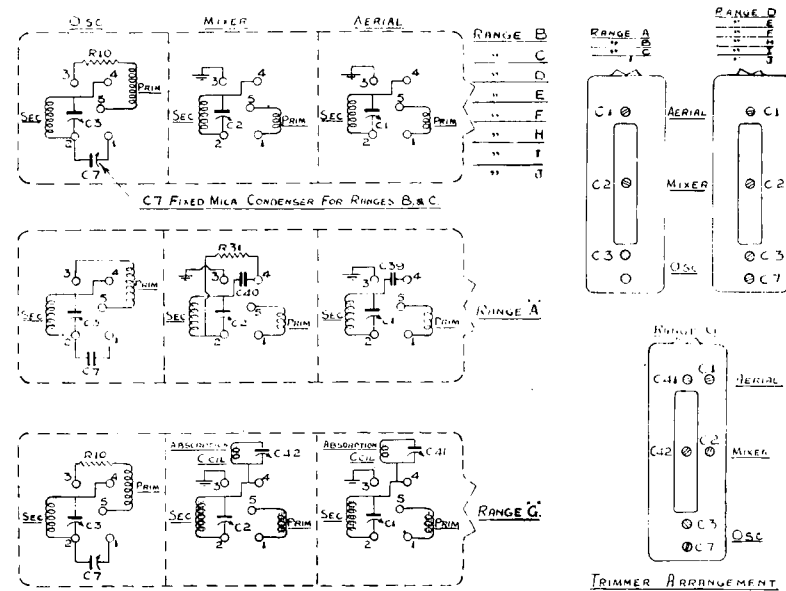


FIG. 5.

## RANGE A.

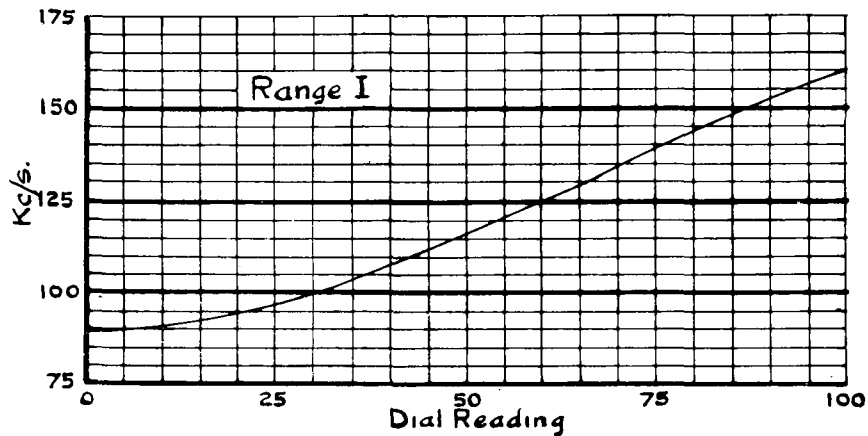
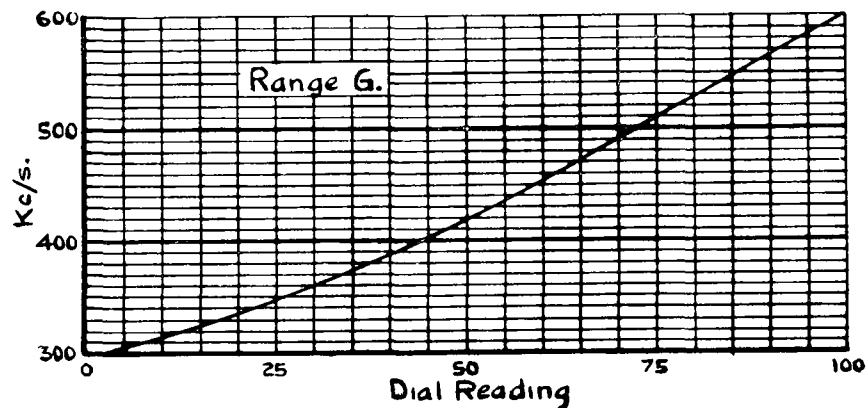
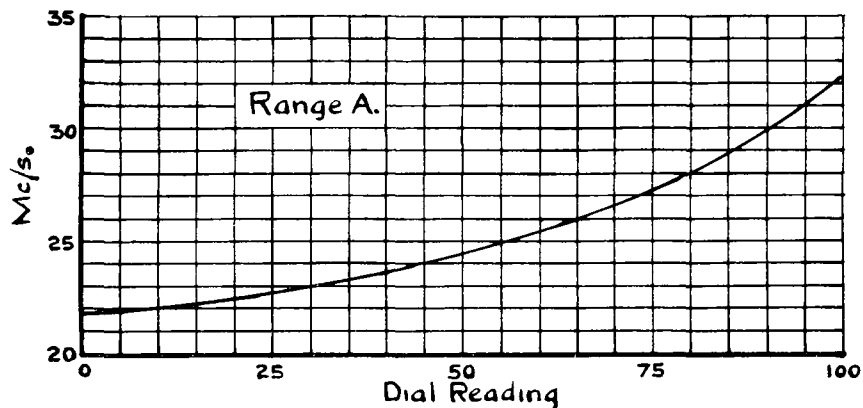
Set pointer on scale to minimum and inject 32 Mc's.

Adjust oscillator trimmer C3 until signal is heard. On this range and ranges B and C, make sure the correct beat is used, this being the lower frequency one of the two, which will be found on the generator scale. Now set the generator to 30 Mc's and tune in on the Receiver, again checking the correct beat, and adjust mixer trimmer C2 and aerial C1 trimmers for maximum output. In adjusting mixer trimmer C2 it will be necessary to constantly readjust tuning of the Receiver owing to slight "pulling" between this circuit and the oscillator circuit.

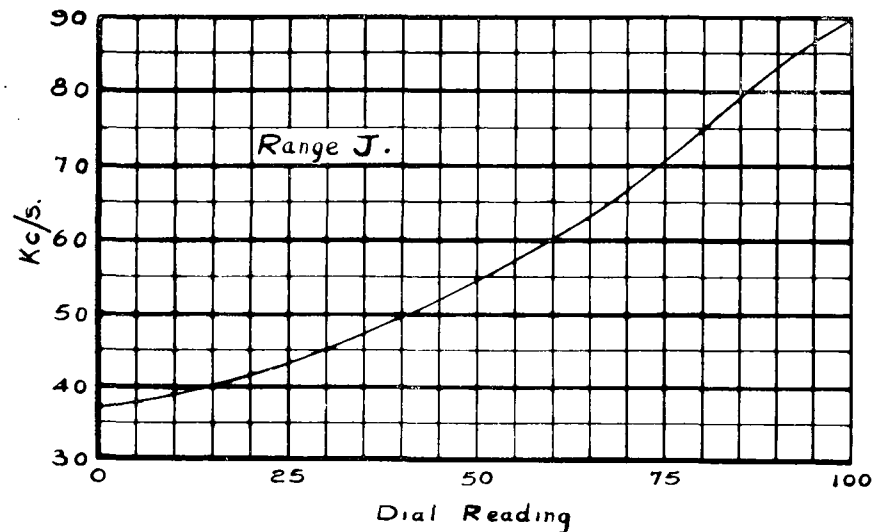
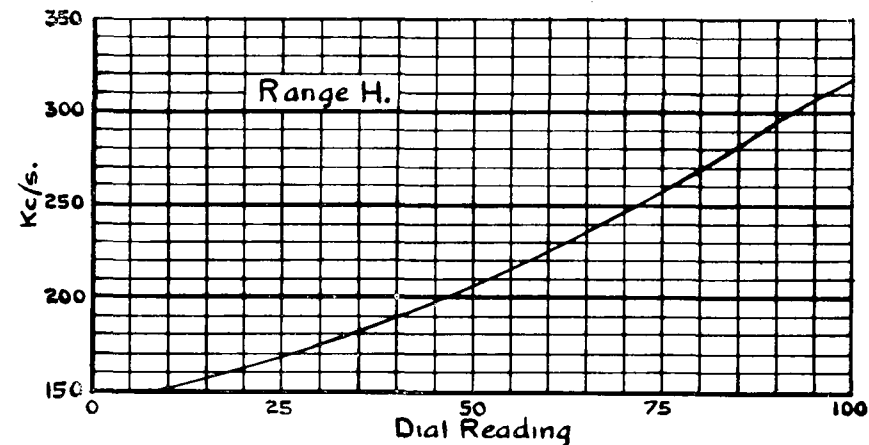
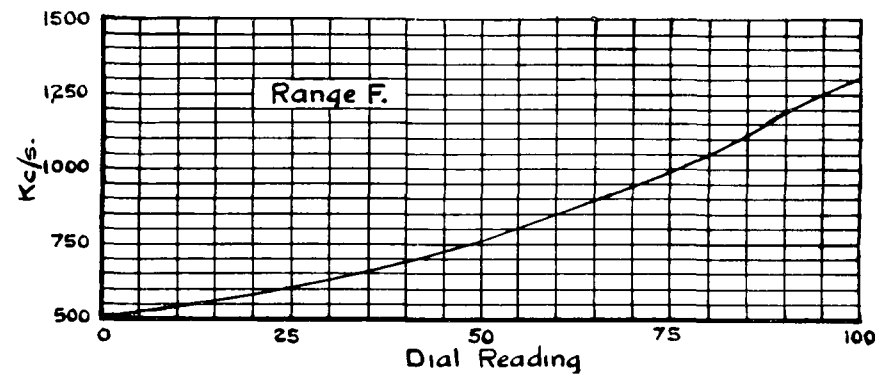
## RANGE B.

Set pointer at 21,000 Kc/s and inject this frequency from generator, noting, as in the case of Range A, that the lower frequency beat is being used. Now adjust oscillator trimmer C3 if necessary, till pointer registers exactly on 21,000 Kc's. Next adjust mixer and aerial trimmers for maximum deflection on output meter. As previously stated, it will be necessary to retune Receiver when adjusting the mixer trimmer C2 owing to the slight pulling. Assuming the inductances have not been interfered with, it will be found that all other frequencies fall automatically into place with a high degree of accuracy.

COIL CALIBRATION GRAPHS



COIL CALIBRATION GRAPHS



**ALIGNMENT INSTRUCTIONS—continued.****RANGE C.**

Proceed as with Range B, but using a pointer setting of 9,000 Kc/s.

**RANGE D.**

This and subsequent ranges incorporate a variable tracking condenser C7 for the purpose of correcting calibration at the low frequency end of the tuning scale.

Proceed as follows :—

Inject 4,500 Kc/s and adjust C3 till pointer registers correctly. Align C1 and C2. Now inject 2,000 Kc/s and adjust C7 for correct pointer setting on this engraved frequency. Return to 4,500 and readjust if necessary, as C7 and C3 are mutually interactive.

**RANGE E.**

As Range D, but using frequencies of 2,000 Kc/s and 1,200 Kc/s.

**RANGE F.**

On this and the subsequent ranges calibrations are supplied on graphs. The points utilised are referred to the 0 to 100 degrees scale.

Minimum : 1,300 Kc/s. Aerial and mixer trimmers should be aligned at 1,250 Kc/s.

Tracking Point : 530 Kc/s. This position will be found as the pointer approaches "0" end of scale.

This pointer position for the 530 Kc/s signal will be found as follows :—

Adjust tracking condenser and pointer simultaneously until the maximum deflection is obtained on the output meter.

**RANGE G.**

As for Range F, but using the following frequencies :—

Minimum : 600 Kc/s.

Aligning Point : 550 Kc/s.

Tracking Point : 320 Kc/s.

It will be found on this range that two additional trimmers are incorporated adjacent to the mixer and aerial trimmers respectively. These two trimmers C41 and C42 are used for tuning the absorption coils, one of which is incorporated in the aerial and mixer circuits respectively. These are adjusted as follows :—

Inject a signal of 450 Kc/s and tune Receiver for maximum deflection on output meter. Now adjust these two trimmers for *minimum* deflection. It may be found that a strong whistle is apparent as pointer approaches 450 Kc/s. In this case tune as close to 450 Kc/s as possible without allowing the whistle to unduly influence the deflection on output meter. When using this coil a "grunt" will be prominent as pointer travels through the region of 450 Kc/s. This is due to excessive gain as the R.F. coils come into tune with the I.F. Amplifier. This may be obviated by slightly reducing the H.F. Gain control.

**ALIGNMENT INSTRUCTIONS—continued.****RANGE H.**

As Range F, but using the following frequencies :—

Minimum : 316 Kc/s.

Alignment : 300 Kc/s.

Tracking Point : 160 Kc/s.

**RANGE I.**

As Range F, but using the following frequencies :—

Minimum : 160 Kc/s.

Alignment : 150 Kc/s.

Tracking Point : 90 Kc/s.

**RANGE J.**

As Range F, but using the following frequencies :—

Minimum : 90 Kc/s.

Alignment : 80 Kc/s.

Tracking Point : 40 Kc/s.

In conclusion, if a frequency standard unit is available in steps of 10 Kc/s, 100 Kc/s or 1,000 Kc/s, a very fine degree of accuracy can be attained provided some time and care is expended in the above process.

Great care should be taken to avoid any overloading of the output meter, as may be caused by leaving the H.F. Gain control full on, and injecting a signal from the Generator of sufficient output to cause the needle to go hard over against the stop and possibly become bent. The controls should be adjusted so that the signal is enough to give deflection on the meter to about 50% of the total scale of reading.

## VOLTAGES.

Consult Circuit Fig. 6. Voltages measured between points indicated and chassis, using high Resistance 20,000 ohms per volt type meter. Range B Coil Unit in use, and Receiver tuned to 22.5 Mc/s. with A.V.C. and B.F.O. switched off, the aerial being disconnected.

| Mullard Valves. | Contact Point. |
|-----------------|----------------|
| 175 volts.      | A.             |
| 85 volts.       | B.             |
| 1.75 volts.     | C.             |
| 160 volts.      | D.             |
| 75 volts.       | E.             |
| 50 volts.       | F.             |
| 2 volts.        | G.             |
| 175 volts.      | H.             |
| 85 volts.       | J.             |
| 3.25 volts.     | K.             |
| 160 volts.      | L.             |
| 75 volts.       | M.             |
| 2.1 volts.      | N.             |
| 50 volts.       | O.             |
| 1.0 volts.      | P.             |
| 175 volts.      | Q.             |
| 170 volts.      | R.             |
| 175 volts.      | S.             |
| 5 volts.        | T.             |

A variation of 5% in H.T. supply voltage is permissible.

## COMPONENT VALUES.

|                                   |                                     |
|-----------------------------------|-------------------------------------|
| R.1—1 megohm.                     | C.1 } See Coil Units.               |
| R.2—30,000 ohms. or 27,000 ohms.  | C.2 }                               |
| R.3—20,000 ohms. or 22,000 ohms.  | C.3 }                               |
| R.4—20,000 ohms. or 22,000 ohms.  | C.4 } 3 Gang 271.5 mmfd.            |
| R.5—30,000 ohms. or 27,000 ohms.  | C.5 } per section.                  |
| R.6—300 ohms. or 330 ohms.        | C.6 }                               |
| R.7—250 ohms. or 270 ohms.        | C.7—See Coil Units.                 |
| R.8—30,000 ohms. or 27,000 ohms.  | C.8—100pF.                          |
| R.9—30,000 ohms. or 27,000 ohms.  | C.9—1 mfd.                          |
| R.10—see Coil Units.              | C.10—1 mfd.                         |
| R.11—1 megohm.                    | C.11—1 mfd.                         |
| R.12—21 ohms.                     | C.12—1 mfd.                         |
| R.13—40 ohms.                     | C.13—500pF.                         |
| R.14—100 ohms.                    | C.14—75pF.                          |
| R.15—50 ohms.                     | C.15—75pF.                          |
| R.16—30 ohms.                     | C.16—1 mfd.                         |
| R.17—180 ohms.                    | C.17—0.1 mfd.                       |
| R.18—11 ohms.                     | C.18—1 mfd.                         |
| R.19—(15 ohms Triode).            | C.19—1 mfd.                         |
| (1.7 ohms Pentode).               | C.20—0.1 mfd.                       |
| R.20—5,000 ohms. or 4,700 ohms.   | C.21—1 mfd.                         |
| R.21—1 megohm.                    | C.22—0.1 mfd.                       |
| R.22—1 megohm.                    | C.23—50 mmfd. var.                  |
| R.23—5,000 ohms. or 4,700 ohms.   | C.24—50 mmfd. var. + 500pF Ceramic  |
| R.24—1 megohm.                    | C.25 }                              |
| R.25—1 megohm.                    | C.26 } 50 mmfd. var.                |
| R.26—1,000 ohms.                  | C.27 } plus 500pF.                  |
| R.27—1 megohm.                    | C.28 }                              |
| R.28—10,000 ohms.                 | C.29—1 mfd.                         |
| R.29—500 ohms. or 560 ohms.       | C.30—1 mfd.                         |
| R.30—50,000 ohms. or 47,000 ohms. | C.31—1 mfd.                         |
| R.31—See Coil Units, Range A.     | C.32—100pF.                         |
| R.32—5 megohm. or 47 megohm.      | C.33—100pF.                         |
| R.33—5 megohm var.                | C.34—0.1 mfd.                       |
| R.34—1,000 ohms.                  | C.35—10 mfd. Elect.                 |
| R.35—5 megohm. or 47 megohm.      | C.36—1 mfd.                         |
| R.36—25 megohm. or 27 megohm.     | C.37—100pF.                         |
| R.37—1 megohm.                    | C.38—300pF.                         |
| R.38—5 megohm. or 47 megohm.      | C.39 }                              |
| R.39—200 ohms (Pentode).          | C.40 } See Coil Units.              |
| (1,000 ohms Triode).              | C.41 }                              |
| R.40—50,000 ohms var.             | C.42 }                              |
| R.41—10,000 ohms var.             | C.45—1 mfd.                         |
| R.42—50,000 ohms. or 47,000 ohms. | C.46—5 mfd.                         |
| R.43—10,000 ohms.                 | C.47—0.1 mfd.                       |
| R.44—25 megohm. or 27 megohm.     | C.48—0.002 mfd.                     |
| *R.45—1.0 megohm.                 | C.49—10 mfd. Elect.                 |
|                                   | C.50—0.01 mfd.                      |
|                                   | C.51—0.1 mfd.                       |
|                                   | C.52—3pF.                           |
|                                   | C.53—0.003 mfd.                     |
|                                   | C.54—15-45pF.                       |
|                                   | C.55—3-10pF.                        |
|                                   | C.56—100pF.                         |
|                                   | C.57—0.1 mfd.                       |
|                                   | C.58—1 mfd.                         |
|                                   | C.59—4 mfd. 250v., wkg. (Elect.).   |
|                                   | C.60—1 mfd.                         |
|                                   | *C.61—40pF.                         |
|                                   | C.63—Incorporated in Cyldon Holder. |

\*Denotes items fitted to Type 358X only.

Owing to the use of preferred value resistors, alternative values are listed. No change in performance will result.



## COIL RANGES.

|              |       |   |                 |                   |                 |                    |
|--------------|-------|---|-----------------|-------------------|-----------------|--------------------|
| <b>C.1.</b>  | Range | A | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | B | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | C | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | D | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | E | 15-45pF.        | Type C.V.S.       | 11              | plus 20pF. Ceramic |
|              |       | F | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | G | 15-45pF.        | Type C.V.S.       | 11              | plus 20pF. "       |
|              |       | H | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | I | 15-45pF.        | Type C.V.S.       | 11              | plus 20pF. "       |
|              |       | J | 15-45pF.        | Type C.V.S.       | 11              |                    |
| <b>C.2.</b>  | Range | A | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | B | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | C | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | D | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | E | 15-45pF.        | Type C.V.S.       | 11              | plus 20pF. "       |
|              |       | F | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | G | 15-45pF.        | Type C.V.S.       | 11              | plus 20pF. "       |
|              |       | H | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | I | 15-45pF.        | Type C.V.S.       | 11              | plus 20pF. "       |
|              |       | J | 15-45pF.        | Type C.V.S.       | 11              |                    |
| <b>C.3.</b>  | Range | A | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | B | 3-5-20pF.       | Type C.V.S.       | 11              |                    |
|              |       | C | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | D | 3-5-20pF.       | Type C.V.S.       | 11              |                    |
|              |       | E | 15-45pF.        | Type C.V.S.       | 11              | plus 20pF. "       |
|              |       | F | 15-45pF.        | Type C.V.S.       | 11              |                    |
|              |       | G | 15-45pF.        | Type C.V.S.       | 11              | plus 75pF. "       |
|              |       | H | 15-45pF.        | Type C.V.S.       | 11              | plus 75pF. "       |
|              |       | I | 15-45pF.        | Type C.V.S.       | 11              | plus 245pF. "      |
|              |       | J | 15-45pF.        | Type C.V.S.       | 11              | plus 170pF. "      |
| <b>C.7.</b>  | Range | A | 100pF.          |                   |                 |                    |
|              |       | B | .0046mfd.       |                   |                 |                    |
|              |       | C | .002 mfd.       |                   |                 |                    |
|              |       | D | 1,000pF max.,   | Cyldon type ST14, | plus .0005 mfd. | Ceramic            |
|              |       | E | 1,000pF max.,   | Cyldon type ST14, | plus .0005 mfd. | "                  |
|              |       | F | 1,000pF max.,   | Cyldon type ST14. |                 |                    |
|              |       | G | 1,000pF. max.,  | Cyldon type ST14. |                 |                    |
|              |       | H | 250pF. max.,    | Cyldon type ST14, | plus 100pF.     | Ceramic            |
|              |       | I | 250pF max.,     | Cyldon type ST14, | plus 100pF.     | "                  |
|              |       | J | 150pF max.,     | Cyldon type ST14. |                 |                    |
| <b>C.39.</b> | Range | A | only, 95pF.     |                   |                 |                    |
| <b>C.40.</b> | Range | A | only, 85pF.     |                   |                 |                    |
| <b>C.41.</b> | Range | G | only, 15-45pF.  | Type C.V.S. 11,   | plus 100pF.     | "                  |
| <b>C.42.</b> | Range | G | only, 15-45pF.  | Type C.V.S. 11,   | plus 100pF.     | "                  |
| <b>R.10.</b> | Range | A | Nil.            |                   |                 |                    |
|              |       | B | 25 ohms,        | $\frac{1}{2}$ W.  |                 |                    |
|              |       | C | 50 ohms,        | $\frac{1}{2}$ W.  |                 |                    |
|              |       | D | 500 ohms,       | $\frac{1}{2}$ W.  |                 |                    |
|              |       | E | 1,000 ohms,     | $\frac{1}{2}$ W.  |                 |                    |
|              |       | F | 1,500 ohms,     | $\frac{1}{2}$ W.  |                 |                    |
|              |       | G | 3,000 ohms,     | $\frac{1}{2}$ W.  |                 |                    |
|              |       | H | 3,000 ohms,     | $\frac{1}{2}$ W.  |                 |                    |
|              |       | I | 3,000 ohms,     | $\frac{1}{2}$ W.  |                 |                    |
|              |       | J | 3,000 ohms,     | $\frac{1}{2}$ W.  |                 |                    |
| <b>R.31.</b> | Range | A | only, 1 megohm, | $\frac{1}{2}$ W.  |                 |                    |

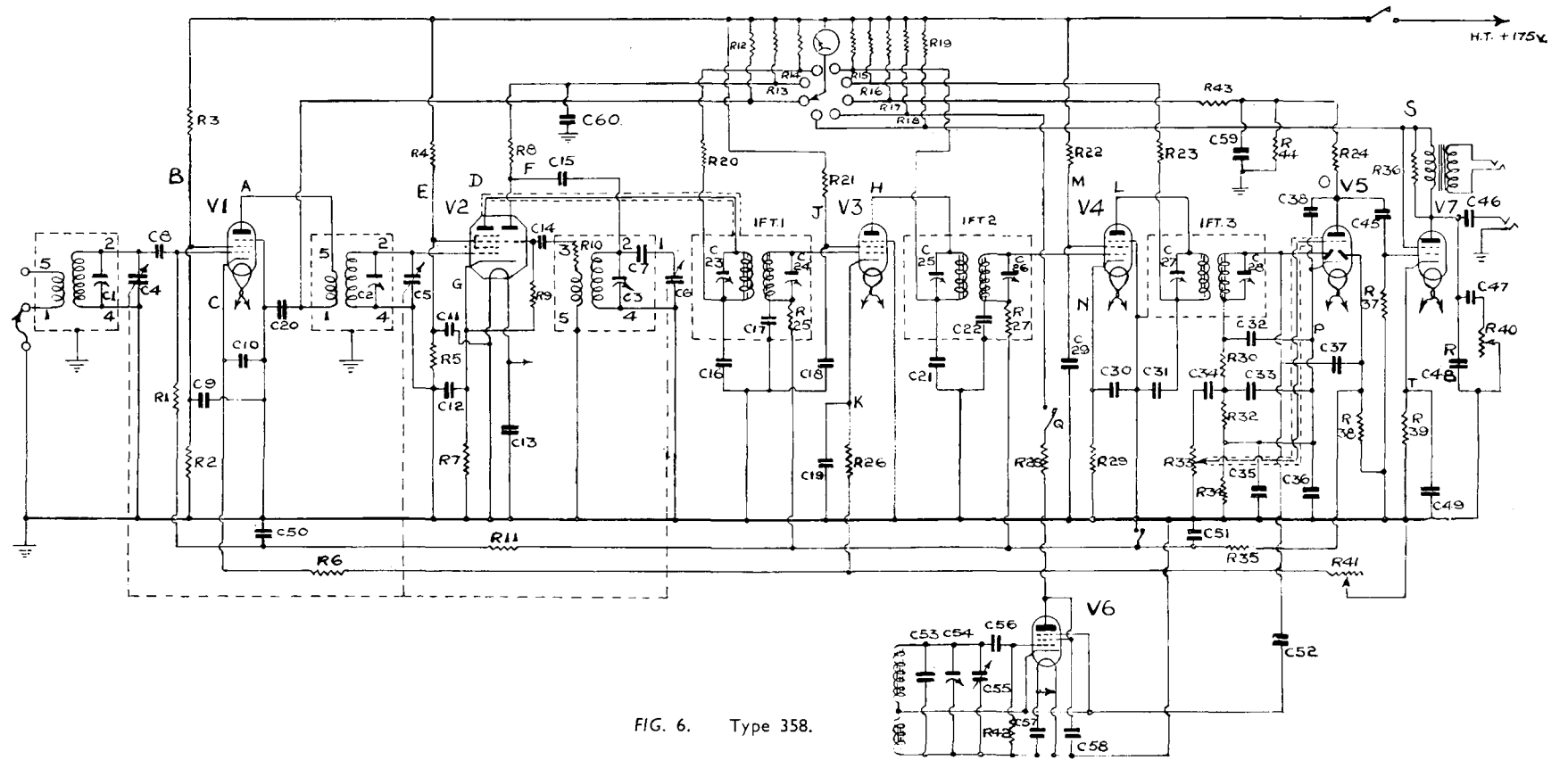


FIG. 6. Type 358.

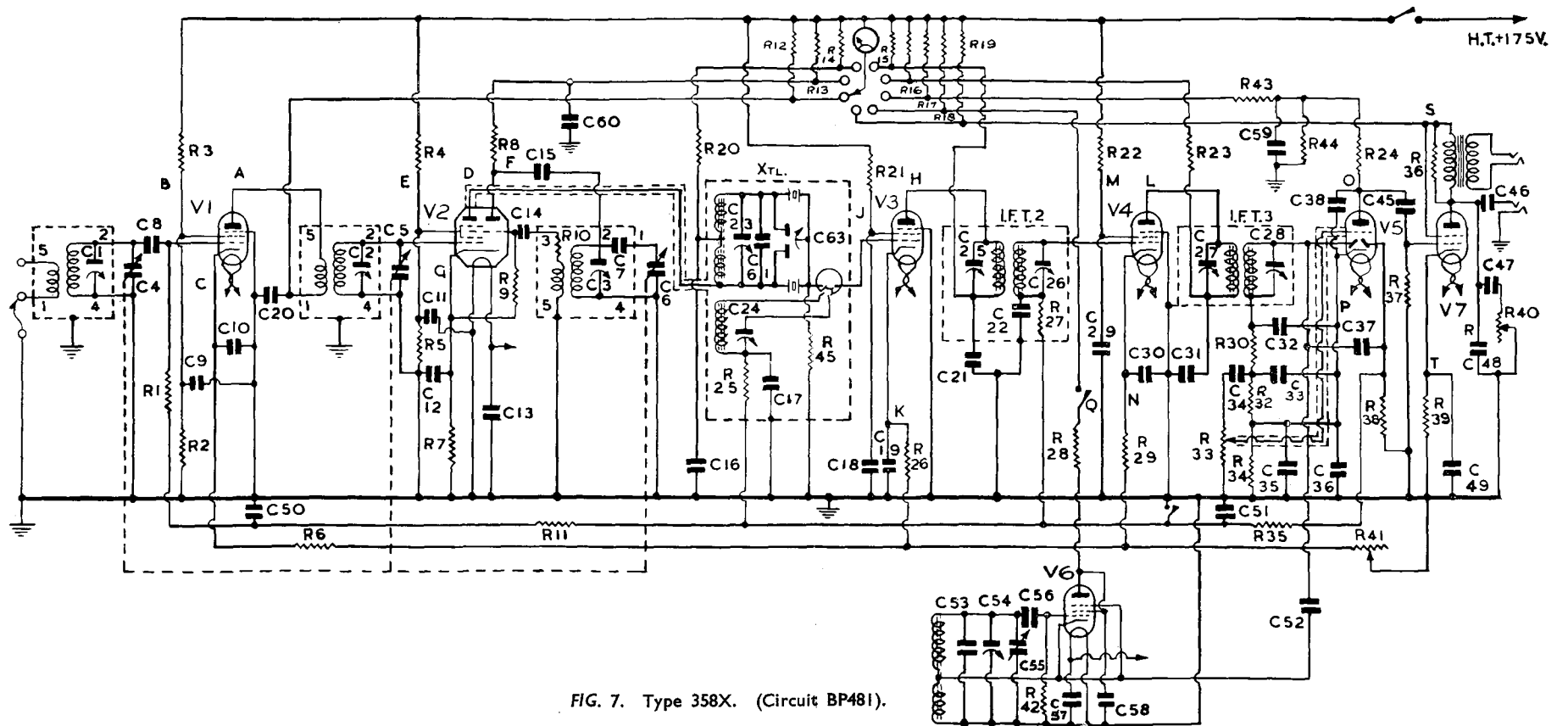


FIG. 7. Type 358X. (Circuit BP481).

Type 400X.

