Receiver type R.209

1. General

The Receiver R.209 is a 10 valve superheterodyne, with facilities for receiving 'Voice' (A.M. or F.M.) and C.W. Its is hermetically sealed, built on miniature lines and incorporates its own vibrator power supply unit driven by a 6 volt battery.

The R.209 may be used in the following stations:-
(a) Auxiliary station to replace R.107 in the W.S. Stations.
(b) Manpack Station.
(c) Vehicle/Animal Station.

Ten valves and a neon stabilizer are employed in the set which is extreme stable owing to the fact that the R.F. chassis is very rigid and the condenser drive is well constructed. A unit system of construction is used.

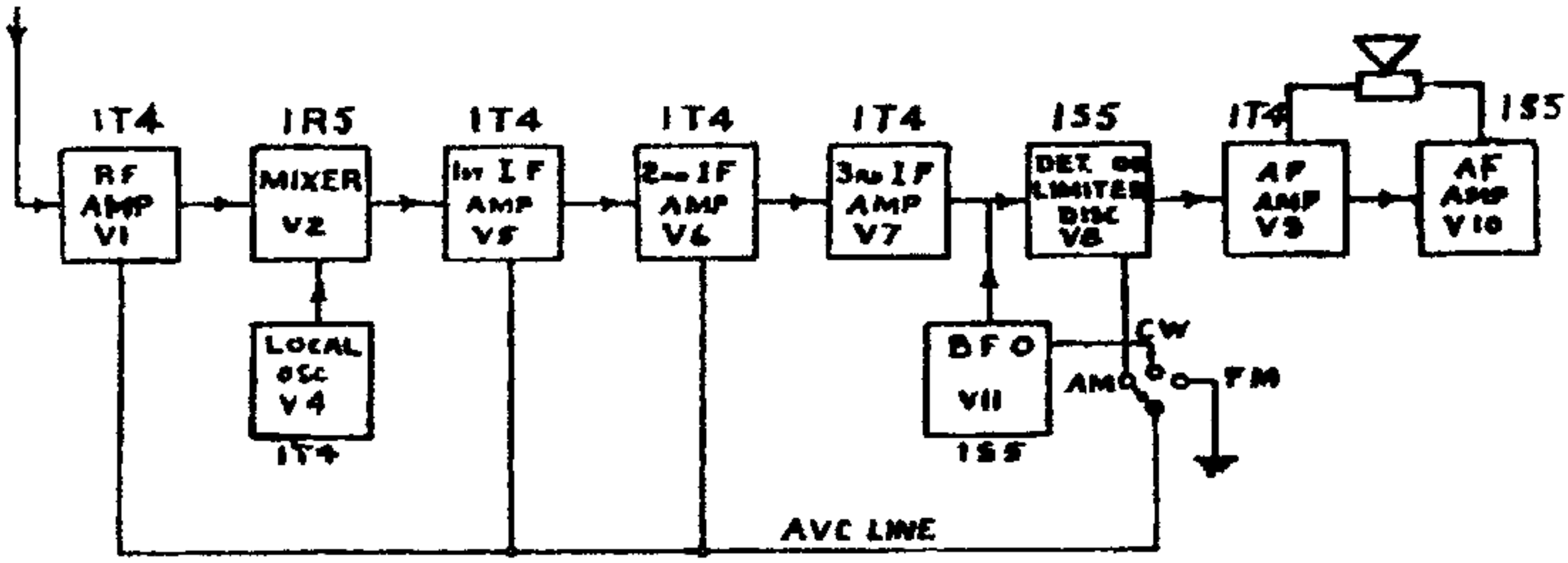
The frequency coverage is 1-20 Mc/s in four bands as follows:-

Range	1.	20	Mc/s -	12	Mc/s
"	2.	12.5	" -	5.5	"
"	3.	5.6	" -	2.3	"
"	4.	2.3	" -	1.0	"

The set may be operated with a rod, open wire or dipole aerial and has loudspeaker and 'phone output.

2. Brief circuit and description

The circuit consists of an R.F. Amplifier, Mixer, Local Oscillator, three I.F. Amplifiers, Detector or Limiter/Discriminator, Beat Frequency Oscillator, two push-pull output valves.



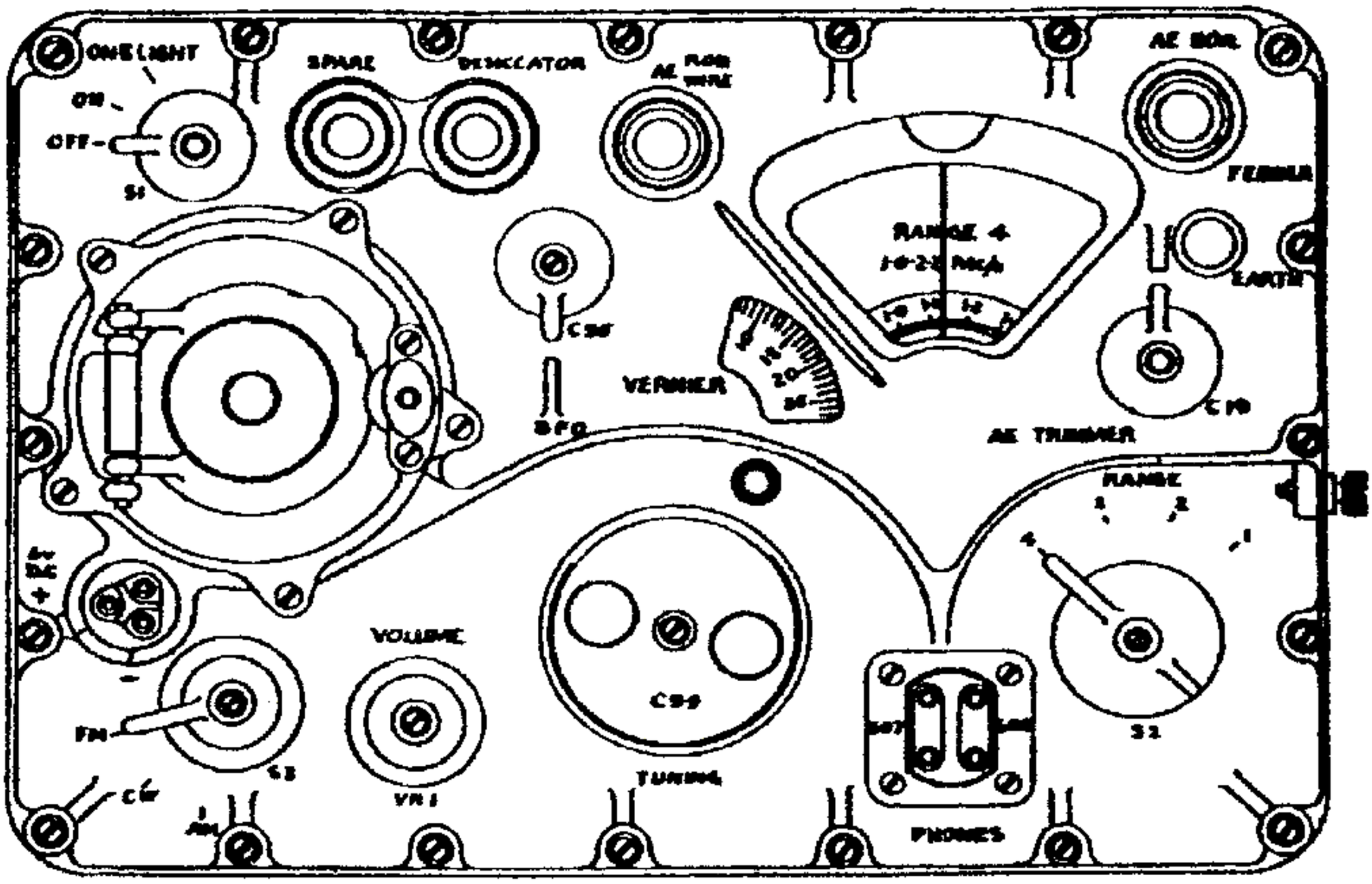
BLOCK DIAGRAM

Servicing and routine checks are greatly facilitated by the unit system of construction. The set may be roughly divided into separate sub-units as shown in Table.

Table

Designation	Contains:-
(a) Front Panel	All controls, Desiccator, 6V Input Socket, Aerial and Earth Terminals.
(b) R.F. Chassis	R.F. Amplifier, Mixer, Local Oscillator.
(c) I.F. Chassis	3 I.F. Amplifiers, Detector/Limiter-Discriminator.
(d) A.F. Chassis	Output Valves, Beat Frequency Oscillator.
(e) Power Unit	Vibrator, Rectifier, Smoothing Circuits.

The set is contained in a ribbed die-cast case and is hermetically sealed. The front panel-case seal is provided by a rectangular section rubber washer which is housed tightly in a square-section channel round the edge of the front panel. The panel is held to the case by 28 fixing screws. Terminals are sealed by a ring in compression against the panel and spindles by synthetic rubber glands. The scale window is sealed by a synthetic rubber gasket on to which the plate glass window beds down. The speaker is fitted into a sealed recess with a sealed terminal passing out for connection and is itself protected from moisture by a hinged sealed cover. A 'Desiccator' is provided in the front panel for drying the enclosed air. A spare one is carried on the front panel.



FRONT PANEL LAYOUT

3. Technical description

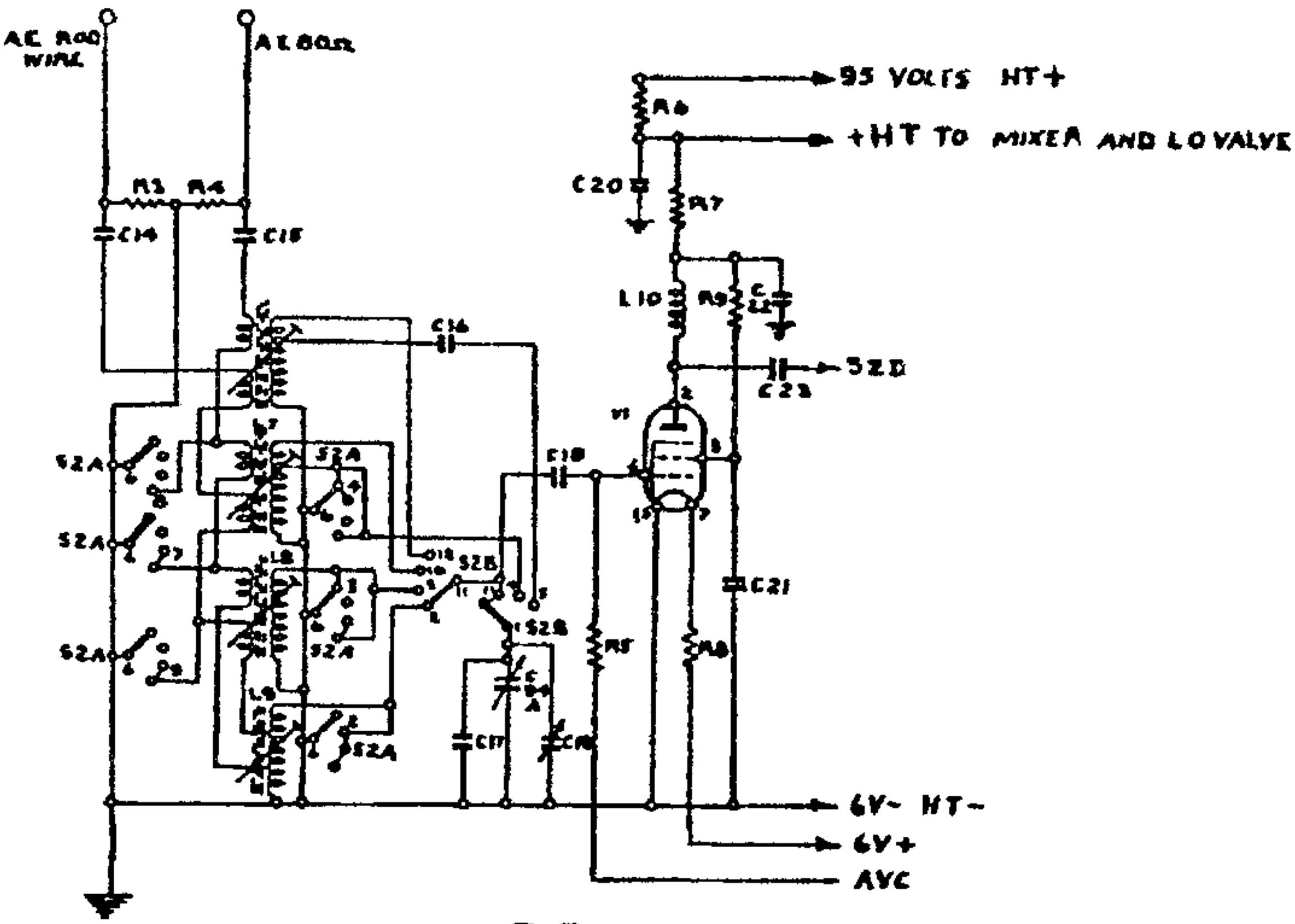
(a) Aerial input circuits

Provision is made for low and high-impedance aerials by the two inputs matching in at 80 ohms and 1,000 ohms respectively, with which the quick-release terminals labelled AE 80 and AE ROD WIRE respectively are associated. The terminals are connected to resistance-capacity networks (R4, C15 and R3, C14) designed to provide leakage paths to earth for any static charges which may accumulate on the aerials.

To obtain maximum gain in the aerial circuits, the inputs are correctly matched to the R.F. tuned circuits by the use of transformer couplings. For mechanical simplicity of the switching banks, the coupling coils for bands of higher frequency than the one in use are left in series with the aerial. This is possible since the inductance of these coils is small. Coupling coils for bands of lower frequency than the one in use are earthed.

(b) R.F. Amplifier

The tuned circuits in the grid of the R.F. amplifier V1 (type 1T4) are tuned by a section of C94. A 25 pF variable condenser C19 is fitted across this section of C94A and is controlled by the knob labelled "AE TRIMMER". This is used to compensate for different aerial capacitance purposes, and to obtain the highest "Q" are wound so that the required inductance is obtained with the core as far in as is compatible with a reasonable trimming range. On range 1 a condenser C16 is inserted in series with the main tuning condenser in this stage to give a more open coverage on the frequency scale. H.T. is applied to the anode through R6, R7 and R.F. choke L10, and to the screen through R6, R7 and R9. Automatic Volume Control is applied through R5. V1 is coupled to the Mixer valve through C23 and switch S2D.

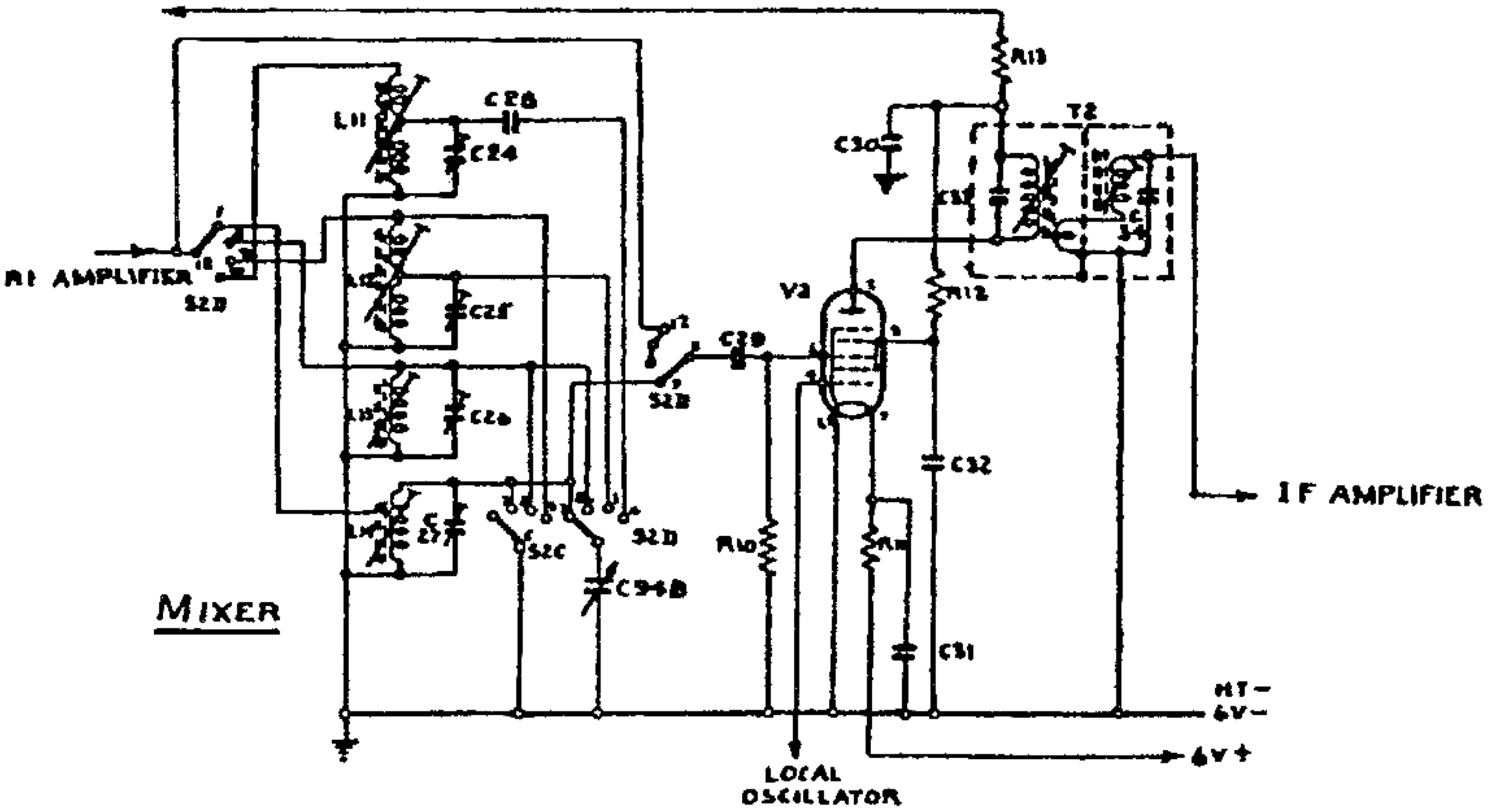


R.F. AMPLIFIER

(c) Mixer

The grid tuning circuits of the Mixer V2 (type 1R5) are shunt fed from the anode of the R.F. Amplifier, the R.F. anode load being the choke L10. This type of coupling is used so that no switch contacts or tuning coils are at H.T. potential. Tuning is carried out by the second section of the main ganged condenser C94. C28 is included in the circuit of Range 1 for the same purpose as C16 in the R.F. Amplifier Range 1.

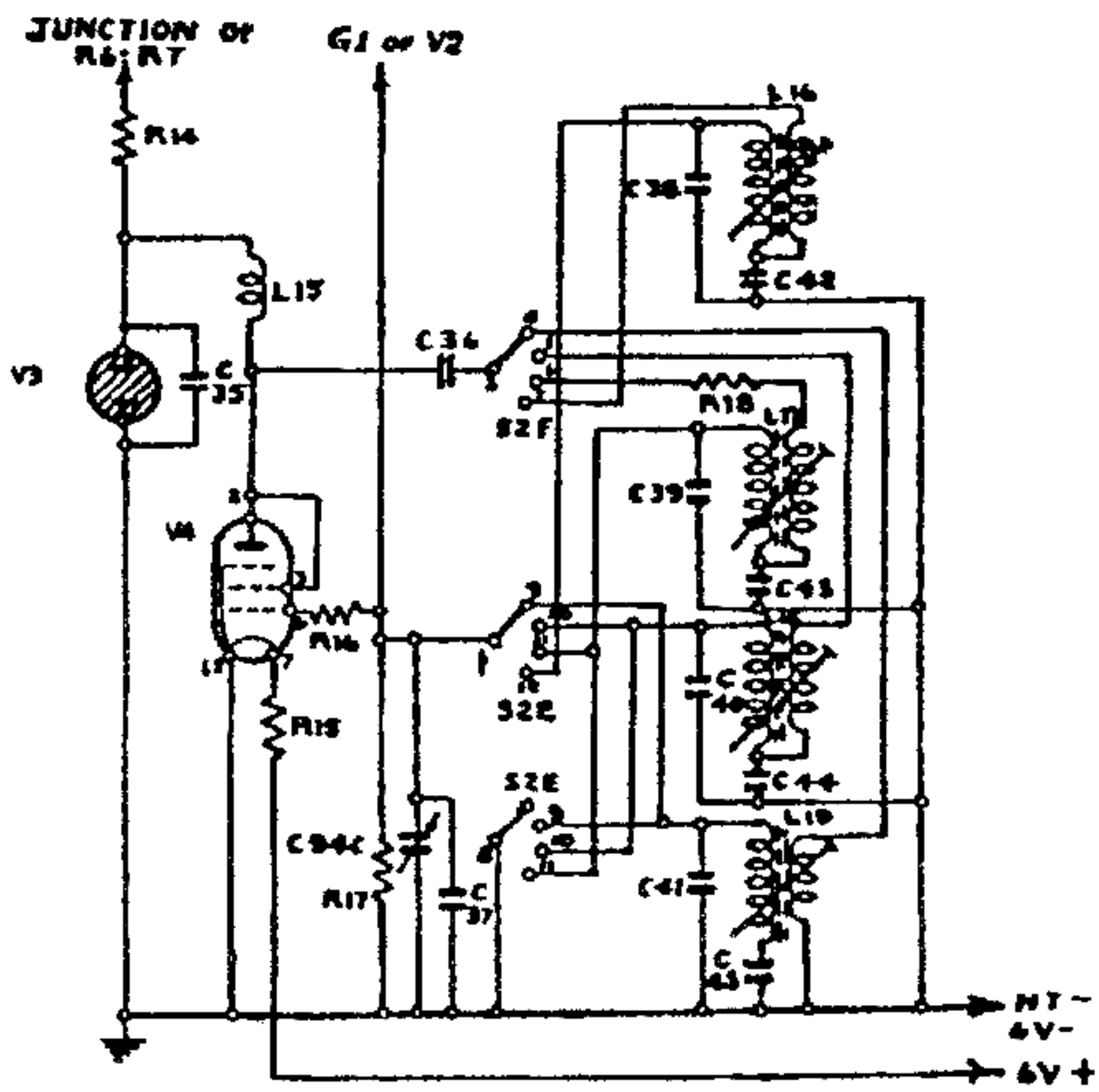
The Mixer is a pentagrid valve, signal frequency is fed at Grid 3 and the output of the Local Oscillator is injected at Grid 1 The intermediate frequency (I.F.) of 460 Kc/s is developed across the primary of T2, the secondary of which is connected to the first I.F. amplifier. H.T. is fed to the anode of V2 through R6, R13 and and the primary of T2 and to the screen via R12 which is taken to the junction of R13 and T2.



MIXER

(d) Local Oscillator

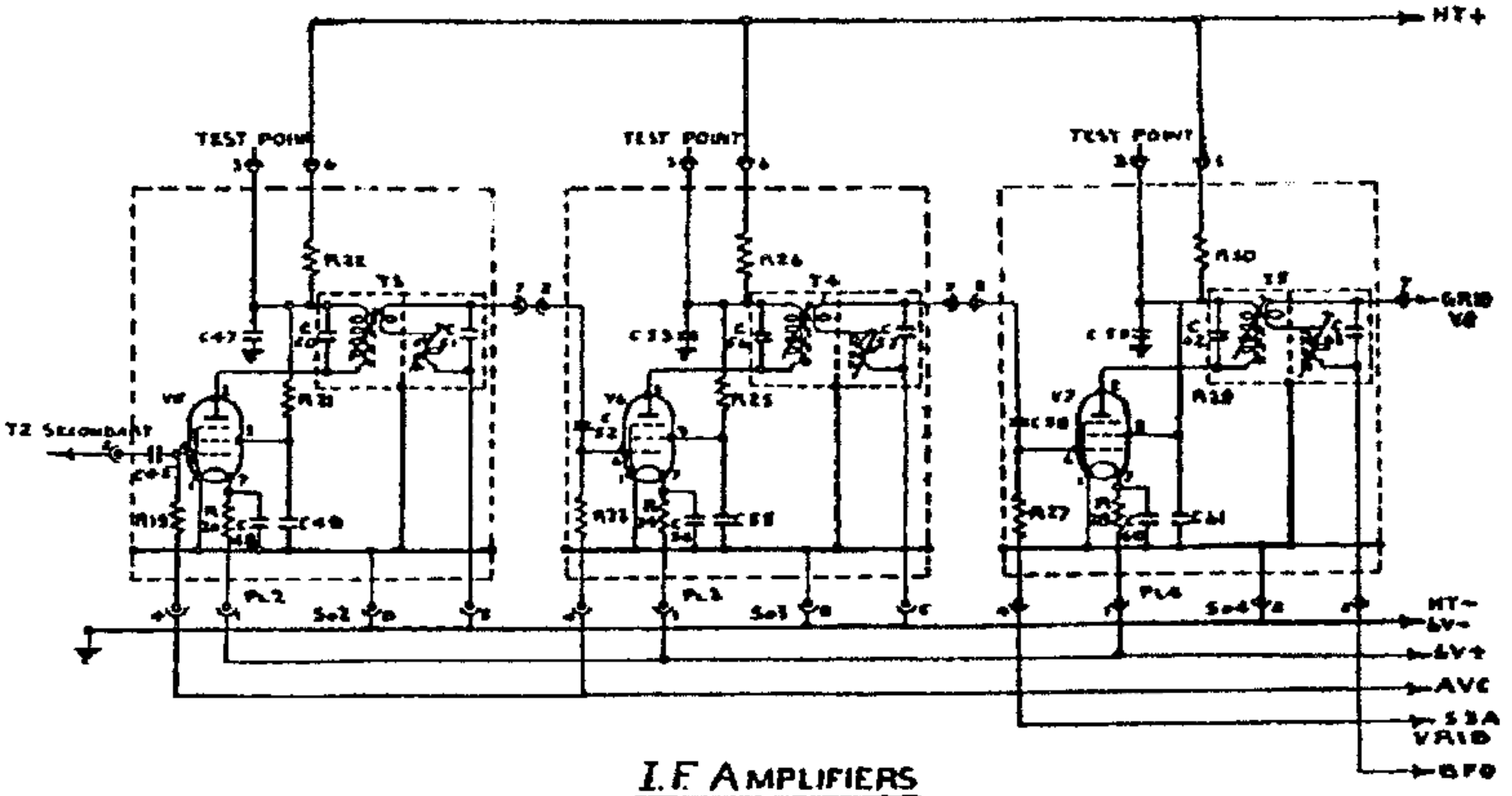
This is a tuned-grid reaction oscillator, employing a pentode valve V4 (type 1T4) with screen and anode strapped. The required oscillations are taken from the grid to grid 1 of the mixer valve. A 150 ohms resistor (R16) is inserted in the grid leads of V4 to prevent parasitic oscillations occuring. H.T. to V4 is stabilized by means of the neon V3, the working voltage of which is 68 volts. The oscillator coils are tuned by the third section of C94.



LOCAL OSCILLATOR

(e) I.F. Amplifiers

There are three stages of I.F. amplification V5, V6 and V7 (type 1T4). Each stage is constructed in unit form, being housed in an aluminium can mounted on a plug-in base. The stages are identical and plug into the sockets of the I.F. chassis which carries the inter-unit wiring. Trimming of the I.F. transformers is accomplished by means of adjustable screw in iron dust cores, the resonant frequency is 460 Kc/s. The overall bandwidth is 5 Kc/s at -6 db. A.V.C. is applied to the first two stages only. To prevent feedback the heater circuits are decoupled by separate 0.1 uF condensers.



I.F AMPLIFIERS

(f) Detector

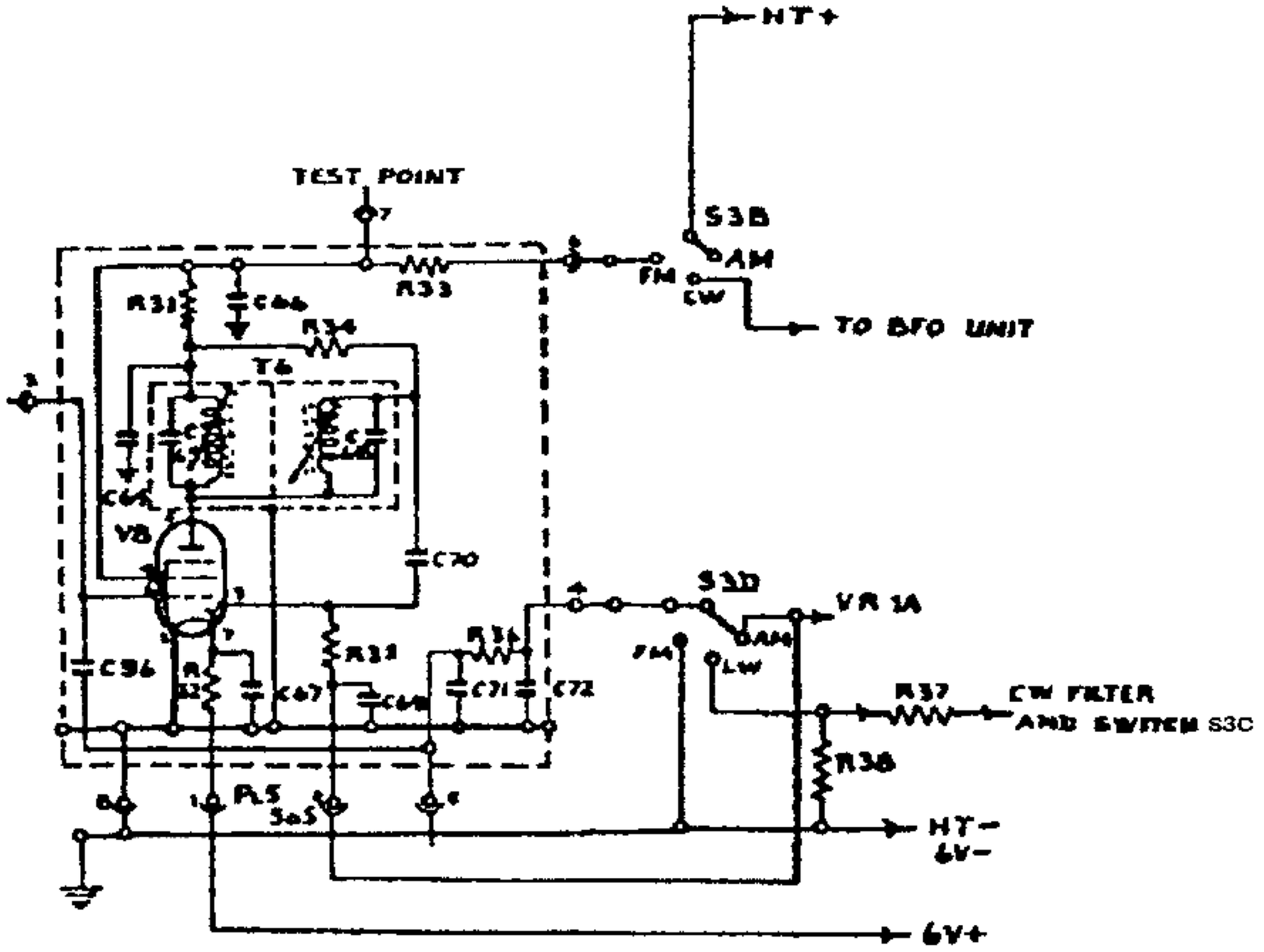
V8 (type 1S5) acts as a detector on A.M. and C.W. and as a limiter discriminator on F.M. The stage is built into a plug-in unit, similar in construction to those for the I.F. stages.

On R/T (A.M.) H.T. is removed from the valve, which then acts as a diode detector, the control grid and heater being the rectifying electrodes. The diode load is VR1A and the I.F. filter C71, C72 and R36. A portion of the A.F. voltage is taken from the slider of VR1A to the control grid of the first A.F. stage.

On C.W. V8 is used as for R/T (A.M.), the beat oscillator output being injected at the control grid. In this case the diode load is R38 and the A.F. voltage is fed to the grid of the first A.F. valve V9 through the resistor R37 and C.W. filter.

On F.M. H.T. is switched to the anode of the pentode section of V8 which is used as an amplitude limiter, and the diode section becomes the discriminator diode. Limiting is achieved by reducing the anode voltage, the normal screen voltage being used.

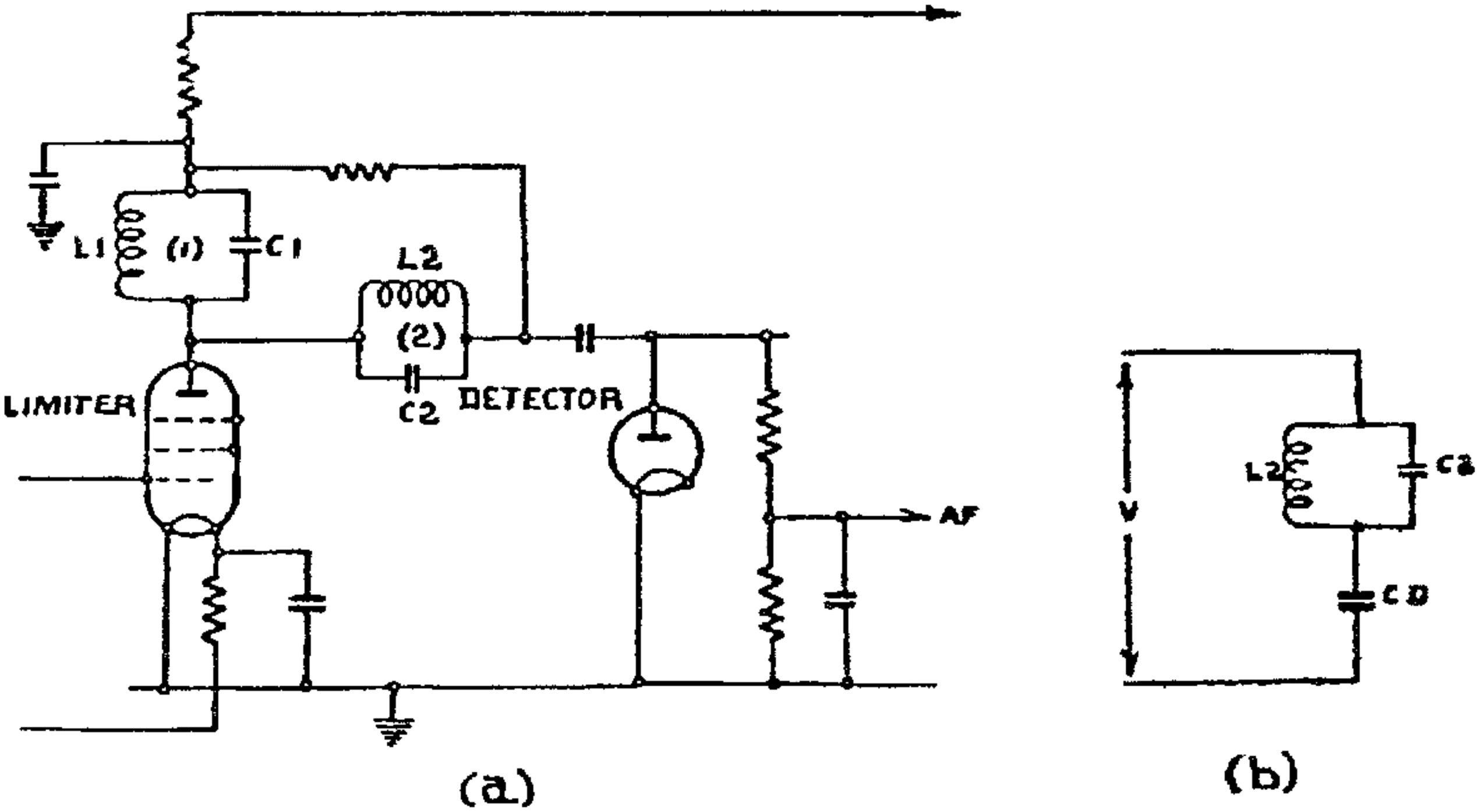
Test points for the plug-in units are provided by connecting the anode end of the H.T. feed resistor to a blank pin so that the voltage across this resistor can be measured to give an indication of the valve current.



DETECTOR/LIMITER DISCRIMINATOR STAGE

(g) The Discriminator

This is of the single diode type, designed for use with a directly heated valve. The diode used is that incorporated in the valve V8, and to simplify the explanation, a simplified drawing of the circuit is shown in Fig. below (a).



SIMPLIFIED DISCRIMINATOR CIRCUIT

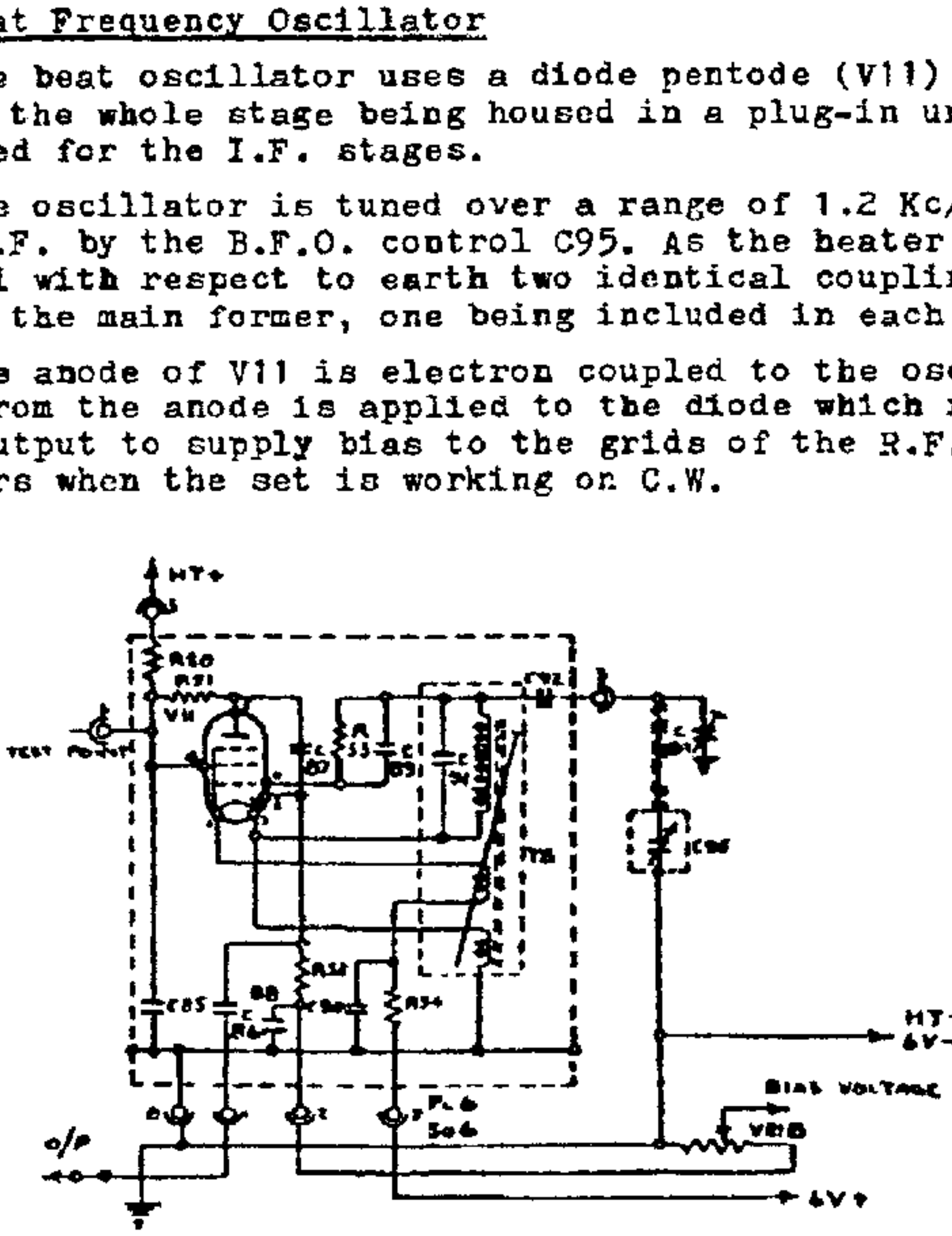
Two tuned circuits (1) and (2) are connected to the anode of the limiter. Circuit (1) tuned to about 450 Kc/s is effectively connected across the limiter, and, assuming perfect limiting, is so heavily damped that the voltage of the signal at the anode of of the limiter may be considered independent of frequency over the deviation band in use. Coupling to the tuned circuit (2) is by the capacity of the diode and stray capacities. The diagram may be further simplified to that of Fig. (b). A voltage, which remains constant in amplitude (V) and phase when the frequency is altered over the deviation band about the I.F. of 460 Kc/s, is applied across the tuned circuit (2) and the capacitor CD. The voltage appearing across the diode is the sum of V and the voltage developed across (2), due regard being paid to phase. This gives the desired discriminator characteristic, the A.F. voltage being developed across the diode load VR1A.

(h) Beat Frequency Oscillator

The beat oscillator uses a diode pentode (V11) in a Hartley circuit, the whole stage being housed in a plug-in unit similar to those used for the I.F. stages.

The oscillator is tuned over a range of 1.2 Kc/s either side of the I.F. by the B.F.O. control C95. As the heater is at R.F. potential with respect to earth two identical coupling coils are wound on the main former, one being included in each heater lead.

The anode of V11 is electron coupled to the oscillator, the output from the anode is applied to the diode which rectifies part of the output to supply bias to the grids of the R.F. and I.F. amplifiers when the set is working on C.W.



BEAT FREQUENCY OSCILLATOR

(i) Automatic Volume Control

On A.M. the A.V.C. is obtained from the detector diode load VR1A through R49 and is applied to the R.F. Amplifier V1 and the first two I.F. amplifiers, V5 and V6, A.V.C. delay is provided by by the diod section of V10 whose anode is connected to a potentiometer across the H.T. formed by the 20 meg-ohm resistor R48 on the H.T. side and R49 and VR1A in series on the earth side.

The diode therefore conducts continuously, acting as a short-circuit across the A.V.C. line, unless the negative A.V.C. voltage exceeds the positive voltage on the diode anode, when the excess of negative voltage will be applied to the A.V.C. line. The delay afforded is such that no A.V.C. voltage is applied until the incoming signal is strong enough to give a signal-to-noise ratio of 20 db.

On C.W. part of the beat oscillator output is rectified by the diode portion of V11 and is developed across VR1B. A portion of this rectified voltage is applied to the grids of V1, V5 and V6 through the A.V.C. line, and also to the grid of V7.

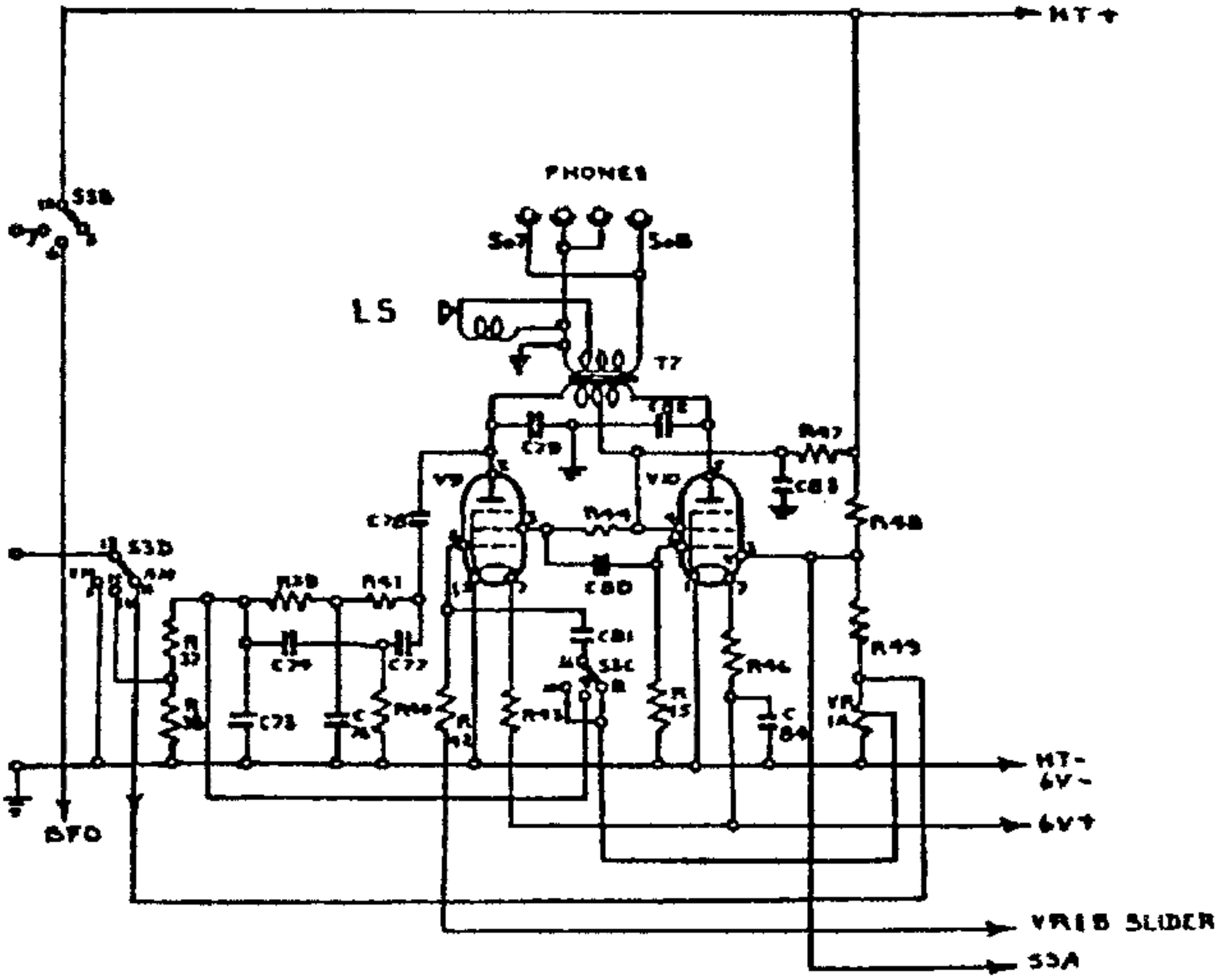
On F.M. the A.V.C. line is returned to earth and is therefore inoperative.

(j) Output Stages

Two valves, V9 (type 1T4) and V10 (type 1S5), are used as a self-drive, push-pull output stage. The signal input is taken in the normal manner to the grid of V9, the corresponding out-of-phase voltage to drive V10 is obtained from the screen of V9.

The output from these two valves is taken in the conventional manner to the ends of a centre-tapped primary on the output transformer.

Facilities are provided for loudspeaker output and two pairs of 150 ohms 'phones.



OUTPUT STAGE