RECEIVER AD 108

1. INTRODUCTION:

The AD. 108 is a lightweight superhet communication receiver. Its frequency coverage is as shown below:-

M.F.	260	-	510	Kc/s
H.F.	2	-	4.2	Mc/s
	4.2	-	8.8	Mc/s
	8.8	-	18.5	Mc/s

The bandwidth on "R/T" and "C.W. BROAD" is 3.6 Kc/s. On "C.W. NARROW" a crystal gate is switched into circuit which reduces the bandwidth to 1 Kc/s.

POWER SUPPLIES:

19 Volt regulated
28 Volt unregulated
250 Volt H.T. obtained from self-contained dynamotor.

2. CIRCUIT DETAILS:

The receiver consists of an R.F. amplifier, mixer with separate local oscillator, two I.F. amplifiers, a detector, A.G.C. rectifier, two A.F. amplifiers and a second local oscillator for C.W. working.

Fig. 1 shows the circuit of the receiver when it is switched to "RANGE 4" and "C.W. NARROW". The circuit is exactly similar on Ranges 3 and 2 . The circuit changes when the receiver is switched to RANGE 1 or to "C.W. BROAD" or "R/T" are shown in Figs. 2A and 2 B.

As the receiver is designed along conventional lines, only those details that are unusual will be mentioned.

2.1 I.F. TRAP:

When the receiver is switched to the M.F. range, it is necessary to introduce an I.F. Trap in the anode of the R.F. amplifier. Without this precaution, there is the danger that when the receiver is tuned to the 510 Kc/s end of the band, the small amount of coupling which exists between the last I.F. amplifier output, and the R.F. amplifier input circuit may be sufficient to cause the receiver to oscillate. The filter (L.13, C.71, C.11, R.4) is in the form of a bridged T, and is shown in Fig. 2B.

2.2 REDUCTION OF GAIN AT M.F.:

The gain of the receiver is reduced on M.F. by shunting V1 anode load with R.45, and by shunting V2 tuned grid circuit with R.42. This makes the gain more nearly equal over the four frequency bands.

2.3 BIAS ARRANGEMENTS FOR MIXER V.2

The negative grid bias on V.2 is due to the voltage drop across R.9. This bias is approximately 1.04 Volts.

In addition the suppressor must have a negative bias which exceeds the peak value of the local oscillator signal feed on to it. This bias, approximately 16.5 Volts, is due to the voltage drop across R.9 and R.10, since the suppressor is tied to Earth potential by R.37.

2.4 FREQUENCY COMPENSATION ON THE LOCAL OSCILLATOR V.3

The frequency control consists of a pancake coil mounted close to a metal plate. Between the plate and coil is fixed a heavily silvered bi-metal strip. As the temperature increases the strip bends away from the plate, reducing the capacity between it and the plate, and towards the coil, reducing the inductance by eddy current loss. The coil is connected across the L.O. coils on the H.F. range, and the capacity is connected across the L.O. tuning condenser. Since the change in capacity and inductance of the compensator, with temperature changes, is in opposite sense to the change of the value of the tuned circuit components, then the local oscillator frequency will not be greatly affected by temperature changes.

2.5 CRYSTAL GATE CIRCUIT

The bandwidth of the receiver may be changed from 3.6 Kc/s (BROAD) to 1 Kc/s (NARROW) by switching a crystal gate into the anode circuit of the mixer. Its operation can best be described by reference to Fig. 3A.

Ignore C.40, C.68 and L.13 C.32 for the time being. The I.F. signal produced in the mixer is developed across L. 14. C. 28. It is then coupled to the crystal circuit by transformer action, and by top capacity coupling.

The secondary L.15 is centre tapped to Earth. Therefore, the voltage between point A and EARTH will be in exact antiphase to the voltage between point B and Earth. Now assume that condenser C.31 is adjusted to equal exactly the capacity of the crystal holder. Thus ignoring the effect of the crystal the voltage which reaches the grid of V.4 through C.31 will exactly cancel the voltage which reaches the grid through the crystal holder capacity and the resultant voltage on the grid of V.4 will be zero. It is nothing more than a balanced bridge circuit as indicated in Fig. 3B.

Now consider the crystal. It can be represented by a series L.C.R. circuit of a very high Q, with a resonant frequency of 600 Kc/s. Thus at 600 Kc/s the intermediate frequency, the impedance is very low. The voltage reaching the grid of V.4 via the crystal will be much greater than that via C.31. There will thus be a resultant voltage on the grid of V.4. Another way of considering the effect is to consider the bridge circuit again and realise that now the bridge has been unbalanced by effectively short circuiting one arm of the bridge and there will, therefore, be energy fed to the valve V.4.

Since the crystal has a very high Q, its impedance will be very low at frequencies very close to 600 Kc/s, but at frequencies a few hundred cycles per second removed from 600 Kc/s, the impedance will be very high. Thus only frequencies very close to 600 Kc/s will pass through to V.4. At other frequencies since the crystal impedance is so high, it will have little effect on the circuit, and the bridge will be balanced.

The response of the gate will be as shown in Fig. 4A. Note that the skirt of the response curve below 600 Kc/s is steeper than that above 600 Kc/s.

It is often the practice to adjust C.31, the phasing condenser, to have a value lower than the capacity of the crystal holder. Let us assume that this is the case. The bridge is therefore unbalanced. Above 600 Kc/s however the crystal (series L.C.R. circuit) acts as an inductive reactance, and at one particular frequency above 600 Kc/s the value of this inductive reactance, added to the capacitive reactance of the holder, makes the latter equal to the capacity of C.31. Thus at this frequency, the bridge is balanced, and the input to V.4 will be zero. The response below 600 Kc/s will be increased due to the unbalance introduced, and will be as in Figure 4B.

The advantage of this arrangement is twofold. In the first place, the skirt above 600 Kc/s has been steepened, and secondly a strong interfering station may often be tuned to the point of zero (or minimum) response.

The crystal gate would give the receiver a bandwidth of approximately 100 c/s. In this receiver a bandwidth of 1 Kc/s was required, so the circuit is damped, to increase bandwidth by the addition of the tuned circuit L16, C32, which is switched into circuit at the same time as the crystal. The damping is increased by tapping down on L 16. The damping could have been produced by the use of a resistor, but this would have meant the same amount of damping at all frequencies, and would have produced a response curve with wide skirts. The tuned circuit produces sufficient damping at 600 Kc/s to widen the bandwidth to 1 Kc/s and produces even greater damping at frequencies off 600 Kc/s. This results in a response curve with a flat top and steep skirts.

To obtain broad bandwidth, the crystal is short circuited, and the damping circuit L.16, C.32 which is now no longer required, is switched out of circuit. The bridge is now unbalanced at all frequencies, so it is now only the I.F. transformer that decides the bandwidth.

It will be noticed that C.68, C.40 are switched into circuit at the same time as the crystal. Reference to Fig. 3A or 3B will show the need for this. It will be seen that C. 31 and the crystal holder are in series, across the tuned circuit C.29, L15. The resultant capacity across C.29, L.15 will be approximately half that of C.31. When the crystal is short circuited the capacity across the tuned circuit is now that of C.31. Thus on R/T and C.W. BROAD the capacity across the tuned circuit is approximately double that on C.W. NARROW. Therefore to keep the circuit in tune on C.W. NARROW it is necessary to switch in the additional capacity C.40, C.38.

2.6 I.F. AMPLIFIER:

The I.F. amplifier stages are coupled by critically coupled circuits. The H.F. gain is controlled manually by varying the value of the V.4 cathode resistor. The bias cannot be reduced to zero because of the inclusion of R.14.

2.7 DETECTOR AND A.F. AMPLIFIER:

The detector consists of a diode in a straight forward circuit. The I.F. is filtered from the output by R.24, R.25, C.48, C.49, C.50. Most of the A.F. voltage is developed across R.26. This voltage is applied to the grid of V.8 the A.F. amplifier via C.52 and then R.C. coupled to V.9 the output amplifier. The output transformer is designed to match the valve impedance to a nominal load of 100 ohms. This may be the input impedance of an intercommunication system, or the impedance of one pair of phones. With three pairs of 'phones in parallel, the impedance drops to 33 ohms. V.9 employs voltage negative feed back so that there will be negligable distortion even when the load is increased by the addition of extra telephones.

The feed back components are R.33, C.66, R.31. Voltage negative feed back lowers the valve impedance, and ensures that as the extra 'phones are added the output is increased accordingly, for as the 'phones are added in parallel, the impedance of the load is reduced. Therefore the voltage across the load is reduced. Thus the voltage feed back in antiphase is reduced. Because of this the gain is increased, and this enables the valve to supply enough power to feed the extra 'phones. A portion of any distortion produced because of a mismatch of impedance, will be fed back in anti-phase, will be amplified, and will partly cancel the distortion present.

The A.F. gain is controlled by varying the cathode resistor, R.44, and hence the bias of the vari-mu valve V.8. The bias cannot be reduced to zero because of the inclusion of R.32. This method of control is used, since it makes remote control so much easier. For remote working, it is only necessary to set R.44 to maximum and connect a potentiometer in the remote unit across. R.44. The same remarks apply to the I.F. gain control.

2.8 B.F.O.:

The B.F.O. is a Hartley oscillator, using a pentode strapped as a triode. Its operation can best be seen by referring to Fig. 5. The anode end of the tuned circuit is tied to Earth potential. Only a small alternating voltage therefore appears on the anode of V.7, and this is loosely coupled through C.53 to the detector.

2.9 A.G.C.

The A.G.C. diode of V.6 is fed from the primary of the last I.F. transformer, through C.43. The A.G.C. load consists of R.20, R.19, and R.22. R.22 is a negligible proportion of the total load and is there to provide a delay voltage to the diode. It is part of potentiometer across the H.T. (R.23, R32) and holds the cathode at approximately 16 Volts positive with respect to Earth. The anode is tied to Earth potential, and therefore there will be no A.G.C. voltage until the signal input to the diode exceeds 16 Volts. When the signal increases beyond this amplitude it will develop a voltage across R.20 and R.19. The full A.G.C. voltage is applied to the R.F. amplifier and first I.F. amplifier via common filtering components R.16, C.45 and separate components R.21, R.1, C.5, for the R.F. amplifier and R.11, C.35 for the I.F. amplifier. Approximately one third of the A.G.C. voltage is applied to the second I.F. amplifier via filtering components R.15, C.39.

With no A.G.C. voltage developed, the bias on the controlled valves will be that developed by their individual cathode resistors.

3. REMOTE CONTROL:

The receiver may be controlled remotely, by the addition of pecking motors to operate the master switch and frequency switch. The R.F. and A.F. gains are controlled by potentiometers connected across the existing gain potentiometers.

4. HEATER SUPPLY:

The heaters are arranged in a 3/3 series parallel circuit, and fed with controlled 19 Volts via F1, a 2.5 amp fuse.

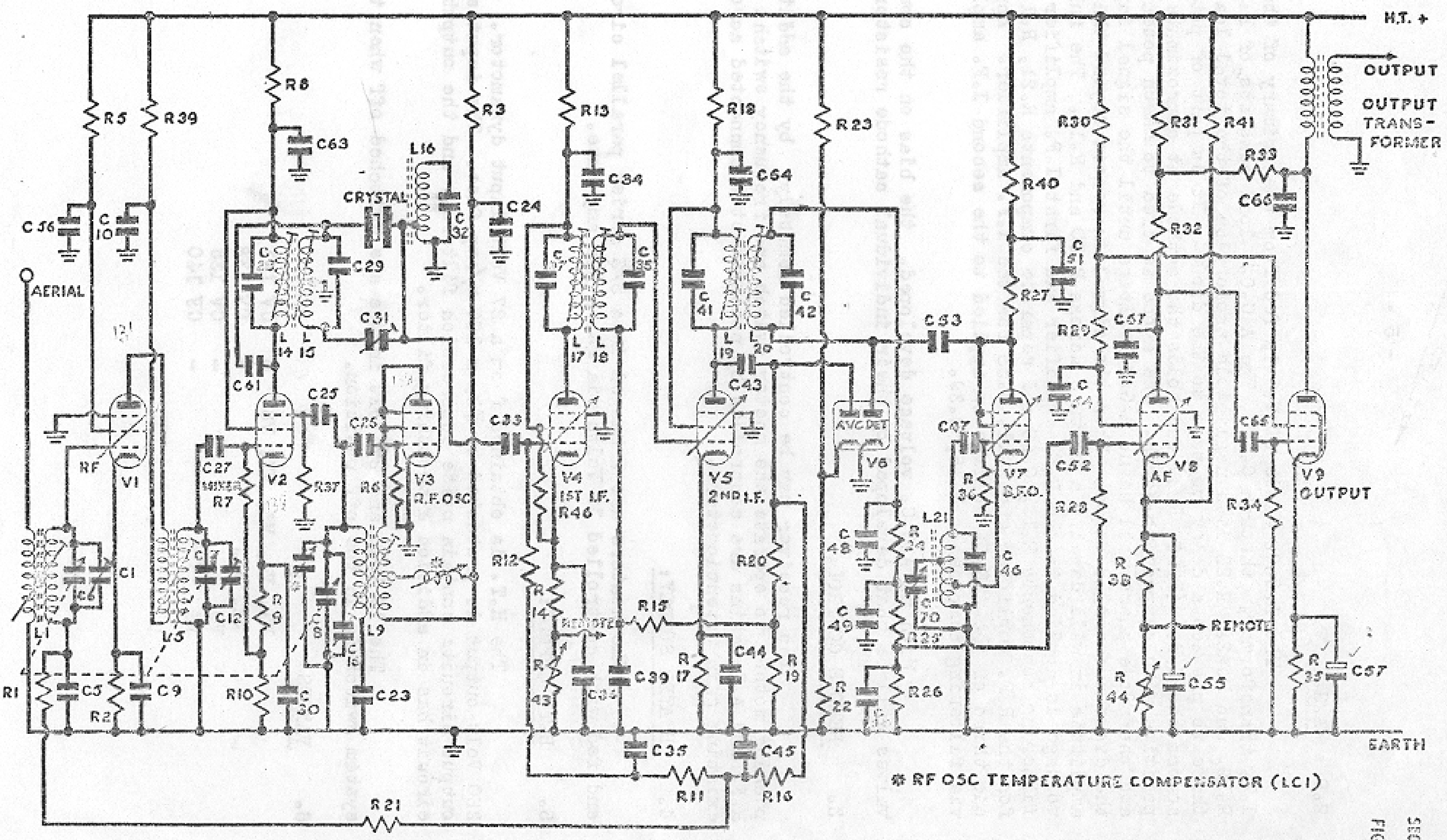
5. H.T. SUPPLY:

The H.T. is obtained from a 27 Volt input dynamotor. The 250 Volt output is protected by F2, a 150 m/amp fuse. The input and output circuits contain noise suppression filters, and the output circuit has in addition a smoothing filter.

The 19 Volt and 27 Volt inputs are switched off when the system switch is in the off position.

6. VALVES

V1, V4, V5, V7, V8	=	CV 131
V2, V3,	=	CV 138
V9	=	CV 136
V6	=	CV 140



* RF OSC TEMPERATURE COMPENSATOR (LC1)

RECEIVER AD108 CIRCUIT FOR H/F CW (NARROW BAND) WORKING.

FIG 1

NO-58063

B.S.A.L.

SECTION B APPENDIX B

AD.108 - COMPONENT VALUES

RESISTORS

Ref.	Value	Ref.	Value	Ref.	Value	Ref.	Value
R1	100K R	R13	22K	R25	100K	R37	470K
R2	220 R	R14 R	220	R26	680K	R38 R	1K
R3	4.7K R	R15 R	1.1M	R27	1K	R39	3.3K R
R4	150K	R16 R	1.1M	R28	1.1M	R40	220K
R5	22K R	R17	220	R29	2.2M	R41	330K R
R6	100K R	R18	3.3K	R30	22K R	R42	33CK
R7	1.1M R	R19 R	470K	R31	33K	R43	10K, Var.
R8	22K R	R20 R	680K	R32	330K	R44	33K, Var.
R9	220 R	R21 R	100K	R33	220K	R45	4.7K R
R10	3.3K R	R22	6.8K	R34	470K	R46	100K R
R11	100K R	R23	100K	R35	680 R		
R12	680K R	R24	68K	R36	330K		

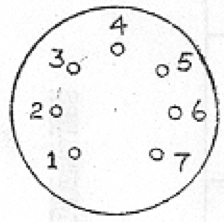
CONDENSERS

	Value		Value		Value		Value		Value		Value
C1		C12		C25	6.8pF	C38	300pF	C51	.01	C65	.005
C2	4.5-30pF	C13	4.5	C26	5pF	C39	.01 R	C52	.01 R	C66	.001
C3	Trimmers	C14	-30	C27	500pF	C40	20pF	C53	5pF	C67	200pF
C4		C15	F	C28	200pF	C41	200pF	C54	.05	C68	25pF
C5	.01 R	C16	Trimmers	C29	200pF	C42	200pF	C55	25 R	C69	.05
C6	3 x 163	C17		C30	0.1	C43	500pF	C56	.01	C70	50pF
C7	pF Variable	C18		C31	20pF	C44	0.1	C57	25 R	C71	5pF
C8	3-gang	C19		C32	200pF	C45	.01 R	C58	8	C72	25pF
C9	0.1	C20	150pF	C33	500pF	C46	200pF	C59	.05	C75	5
C10	.01 R	C21	820pF	C34	.05	C47	4pF	C60	0.1	C76	12
C11	150pF	C22	.0018	C35	.01 R	C48	100pF	C61	4pF	C77	5
		C23	.0036	C36	0.1	C49	50pF	C63	0.1	C78	5
		C24	.01 R	C37	200pF	C50	50pF	C64	.05	C79	5

SECTION B

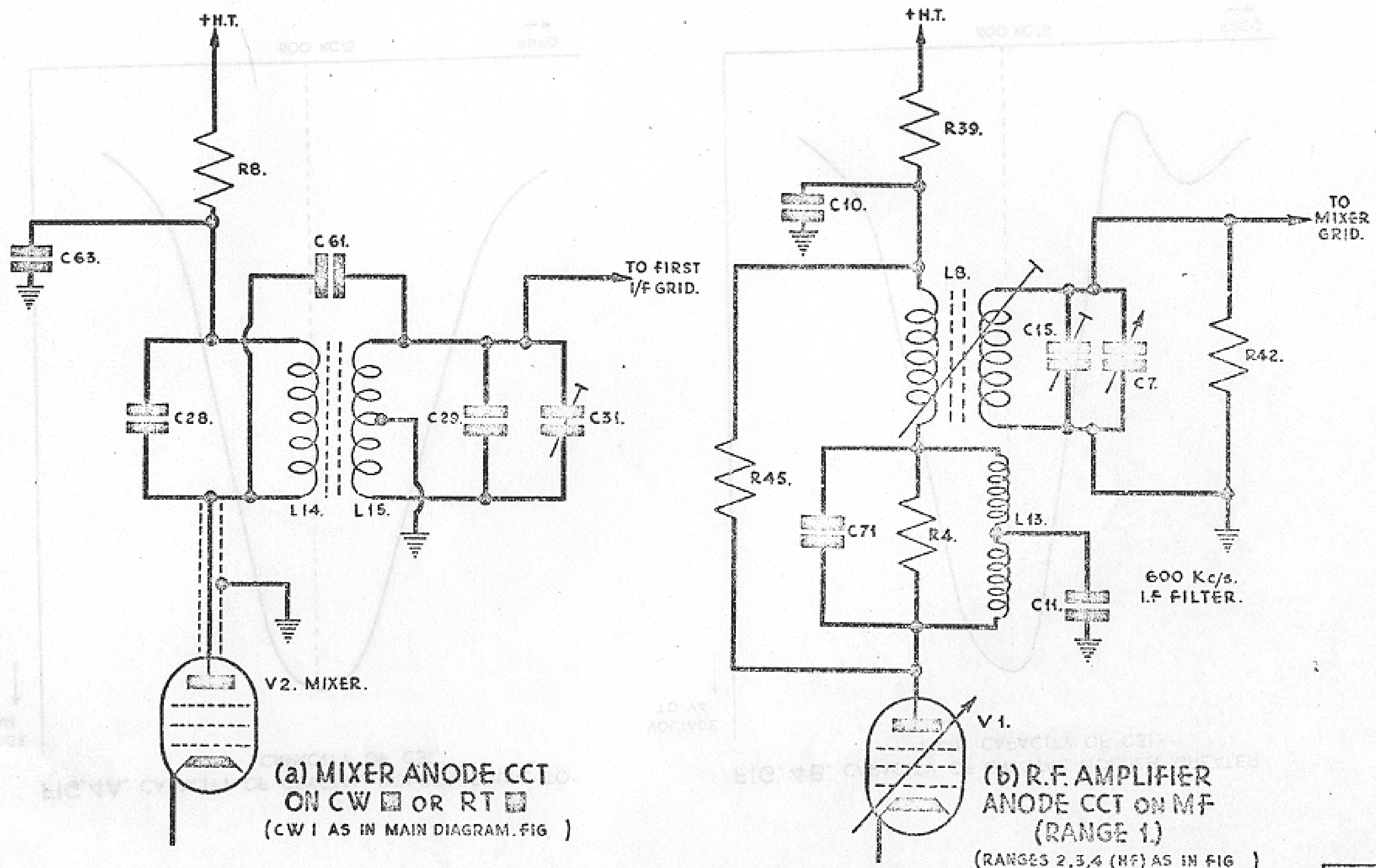
APPENDIX A

AD.108 VALVE EQUIVALENTS AND BASE CONNECTIONS



B 7 G Base

Valve Type	EQUIVALENTS	BASE	PIN NUMBERS						
			1	2	3	4	5	6	7
C V 131	EF92; 9D6; W77; V884	B 7 G	G1	C	H	H	A	Sh G3	G2
C V 136	EL91; 7D9; N77	B 7 G	G1	G3 C	H	H	A	-	G2
C V 138	EF91; 8D3; Z77; 6F12; V888	B 7 G	G1	C	H	H	A	Sh G3	G2
C V 140	EB91; D77; 6AL5	B 7 G	C	A	H	H	C	Sh	A



(a) MIXER ANODE CCT ON CW ▣ OR RT ▣
(CW I AS IN MAIN DIAGRAM. FIG)

(b) R.F. AMPLIFIER ANODE CCT ON M.F. (RANGE 1.)
(RANGES 2,3,4 (HF) AS IN FIG)

AD.108. CIRCUIT CHANGES FOR MF AND BROAD BANDS.

SECTION B FIG 2

FIG. 4A. CAPACITY OF CRYSTAL HOLDER EQUAL TO CAPACITY OF C31.

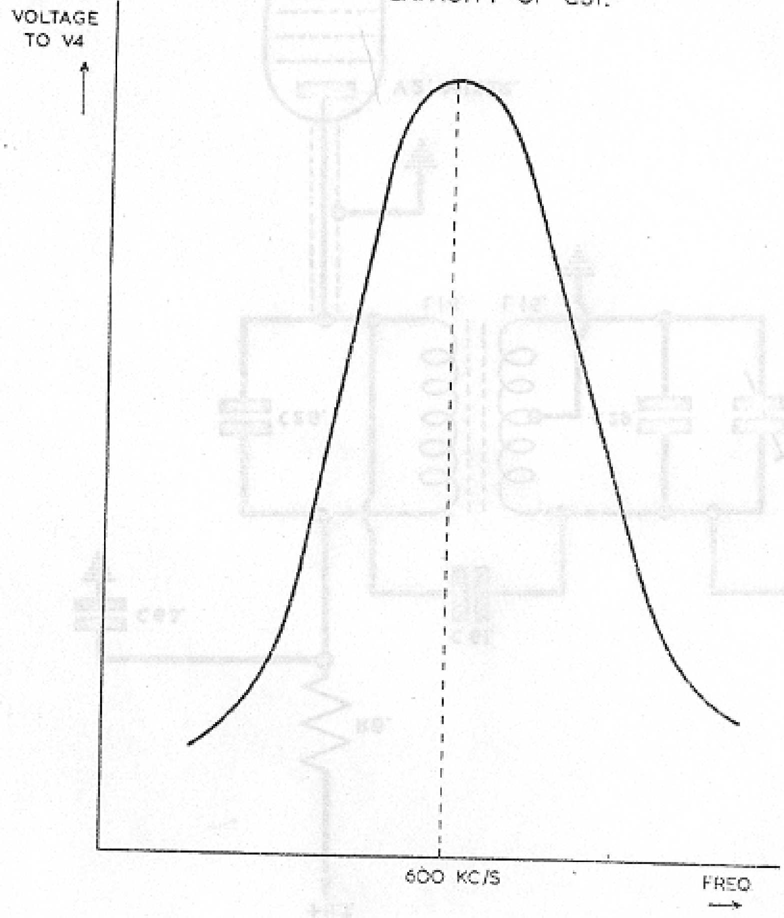
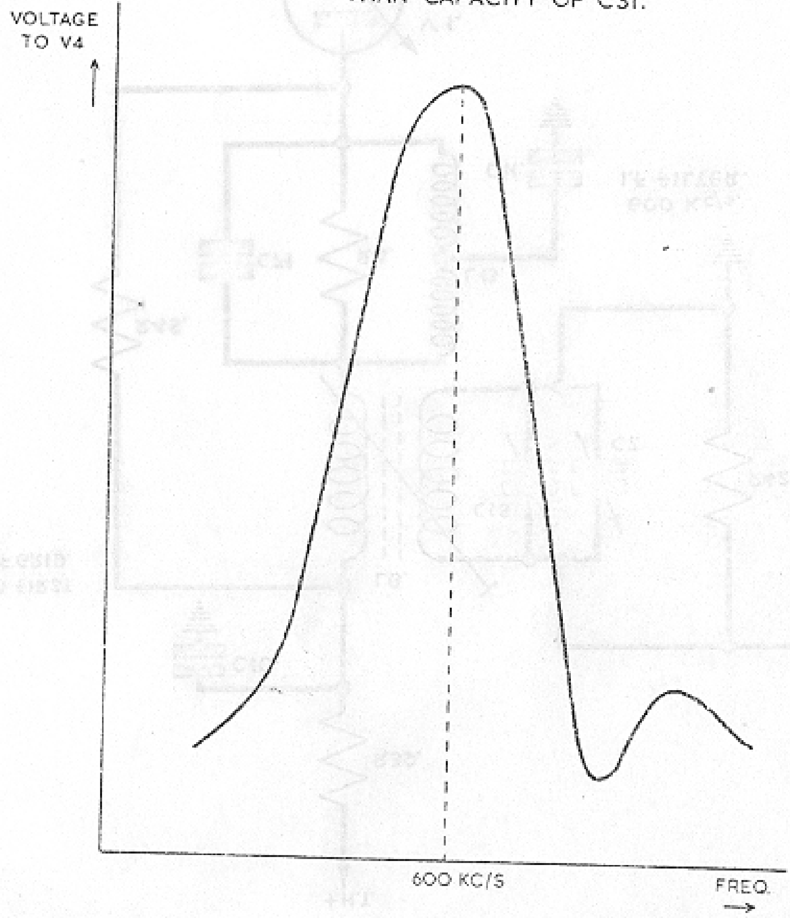


FIG. 4B. CAPACITY OF CRYSTAL HOLDER GREATER THAN CAPACITY OF C31.

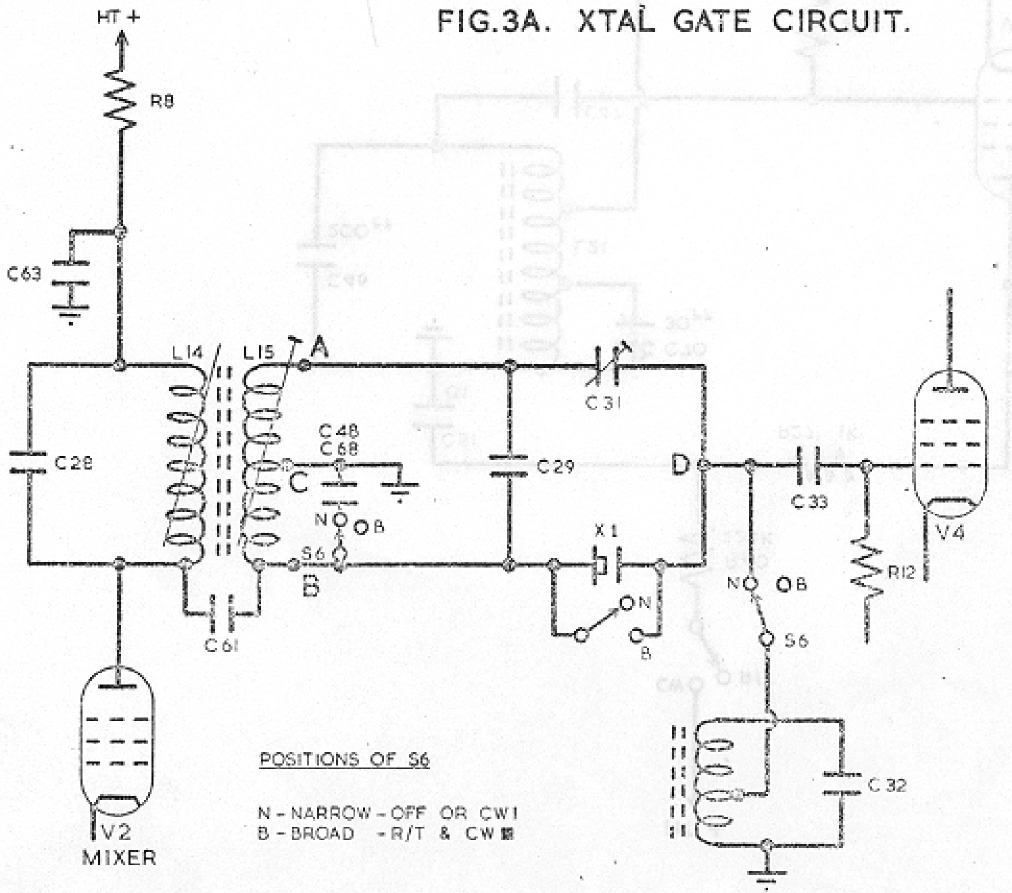


AD 108. RESPONSE OF CRYSTAL GATE.

SECTION 3
FIG. 4

HO/BH/53

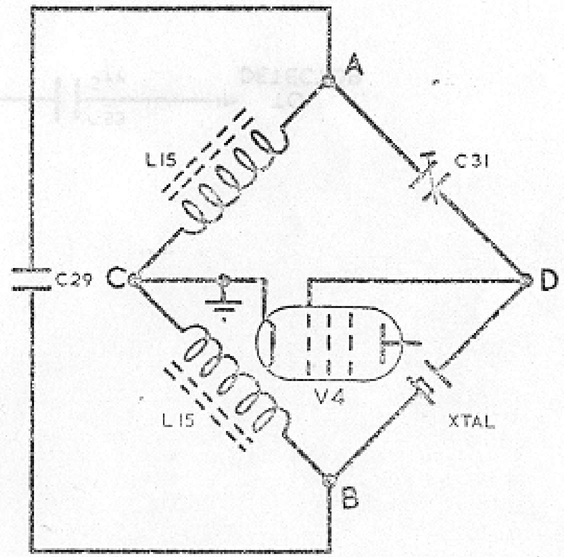
FIG. 3A. XTAL GATE CIRCUIT.



POSITIONS OF S6

N - NARROW - OFF OR CW1
B - BROAD - R/T & CW

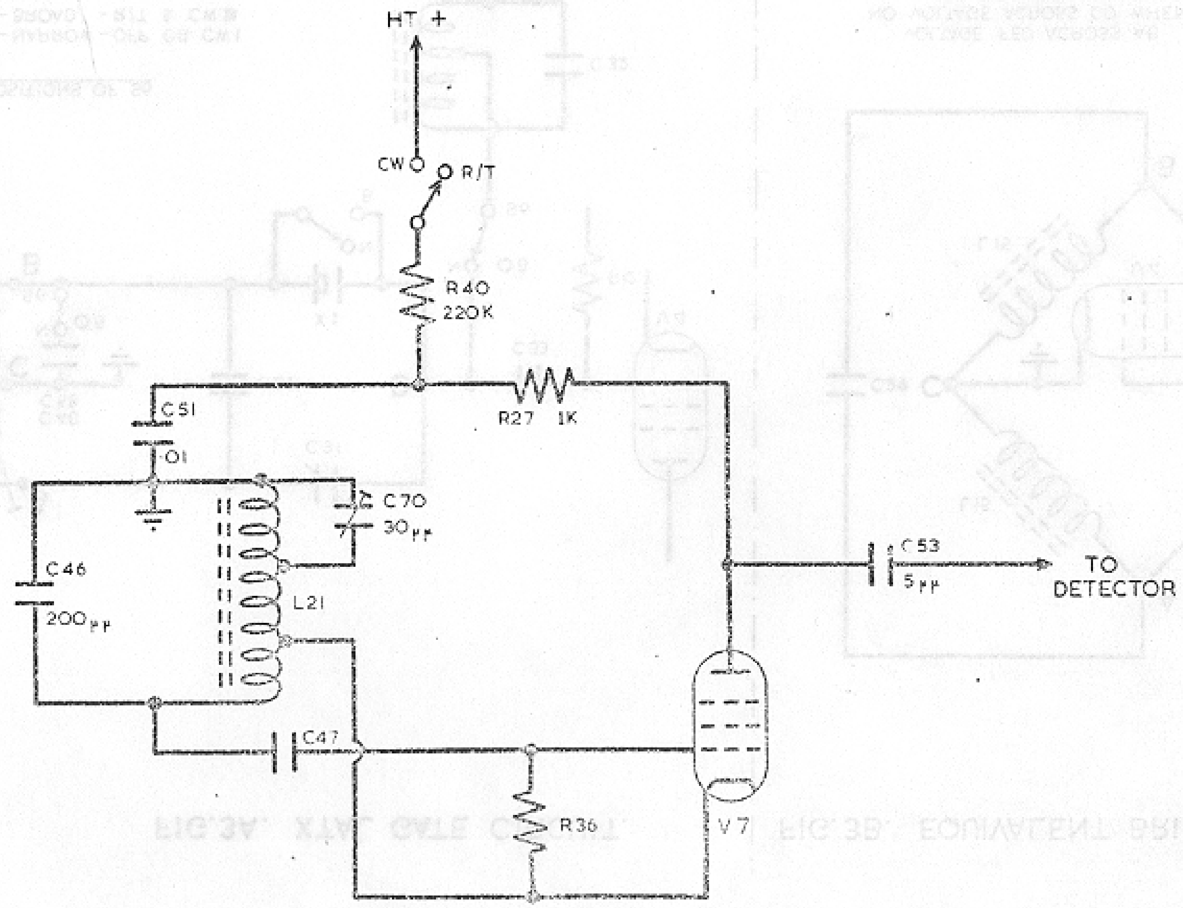
FIG. 3B. EQUIVALENT BRIDGE CCT.



VOLTAGE FED ACROSS AB
NO VOLTAGE ACROSS CD WHEN
THE BRIDGE IS BALANCED.

AD 108. RECEIVER.

HO/BH/52



AD 108. B.F.O. CIRCUIT.

HO/BH/54

SECTION B
FIG. 5

2.1. The AD.108 is a multivalve communications equipment, the alignment of which requires special equipment only available in a properly equipped radio workshop. No internal adjustment of any kind must be attempted by the Radio Officer, and servicing en route should be confined entirely to changing fuses and valves.

2.2. Fuses

There are two fuses in the power supply system and both are located at the rear of the unit which must be withdrawn from the backplate to gain access.

F.1. is at the right-hand side of the unit and is a 2.5 amp.type in the 19 volt heater supply system. It is in series with the sub-circuit breaker on the radio crate. If the fuse blows instantly on replacement it is necessary to change the unit. If it does not blow again immediately and the equipment is still not operating satisfactorily, the fault may be cleared by changing a valve. See Below.

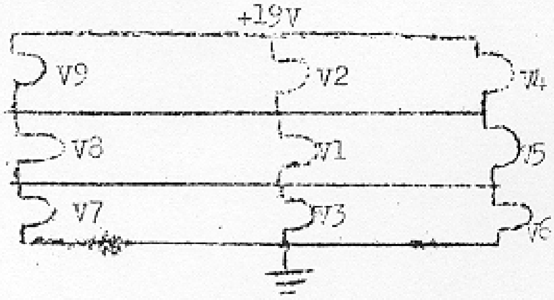
F.2. is at the left-hand side of the unit and is a 150 m/a type in the 250 volt HT supply system. Again, if the fuse blows immediately on replacement the unit must be changed. If it does not blow again but the equipment is still not satisfactory changing a valve may cure the trouble. No metering facilities are provided therefore diagnoses of faults will be of a rather negative character.

2.3. Power Unit

The power unit of the AD.108 is interchangeable with the power unit of the AD.7092B - A.D.F.

2.4. Valves

Nine valves are used and the heaters are connected in three parallel banks, each bank consisting of three valves with the heaters in series.



An open circuit heater in one valve has little effect on the remaining eight, therefore, the symptoms for an open circuit heater and a faulty valve due to other causes will be similar.

2.5. Faults

There is not much one can do to clear faults on the AD.108, but if minor faults occur, as detailed below, some attempt can be made to clear them.

No power on switching "ON"	-	Check 19V C/B, 28V C/B, HT fuse, LT fuse, Backplate connections. Power Unit Brushes.
No signals on C.W.	-	Check for signals on R/T and MCW. If O.K. change V.7 (B.F.O.) (See Fig.9).

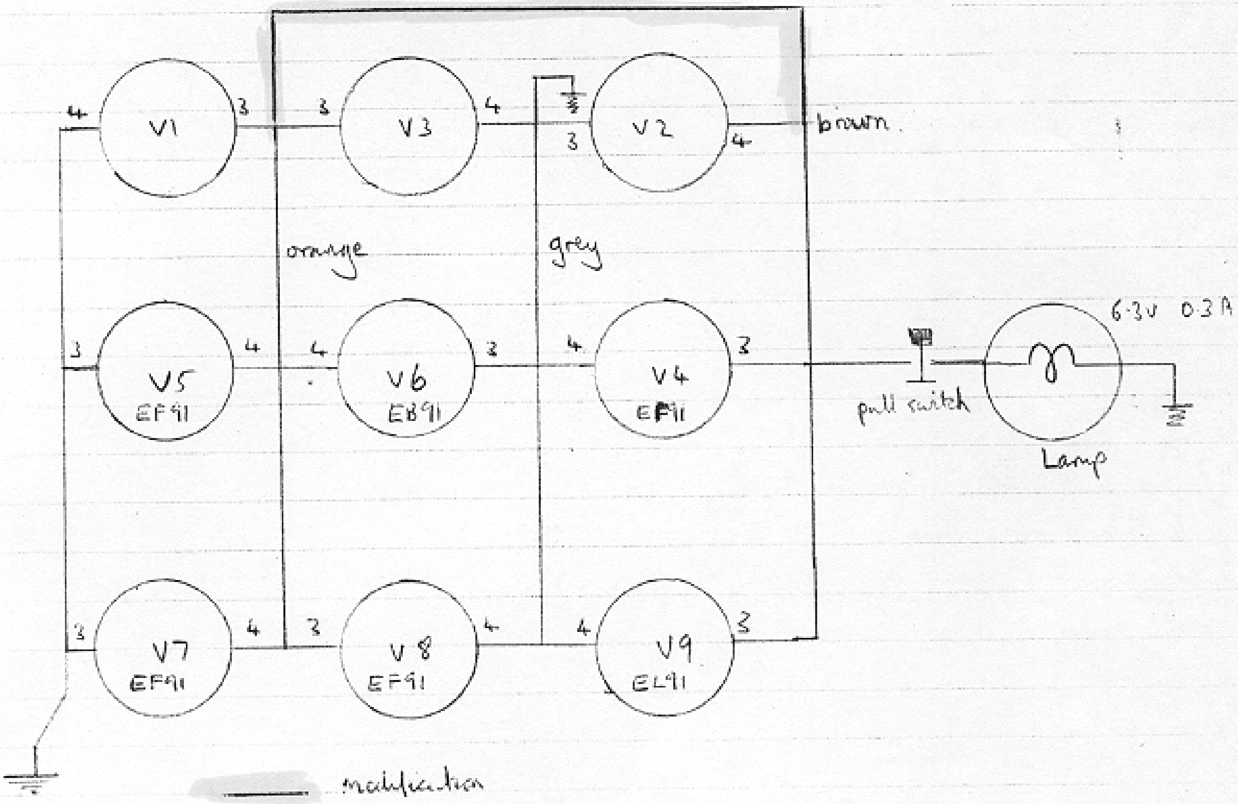
-continued-

2.5. Faults (cont.)

No signals on any Range	-	Check V9, V8, V1, V2. If no improvement change other valves progressively. If still no signals change unit. (See Fig.9).
Complete silence	-	HT fuse or dynamotor failure.
Signal/Noise Ratio	-	Poor signal/noise ratio can be caused by [illegible] plate connections on the 19V supply to the "A" coil of the keying relay.
Rough and noisy reception	-	Dynamotor brushes worn, or dirty commutator. (In emergency use A.D.F. dynamotor).

MARCONI ADIO Sd RECEIVER

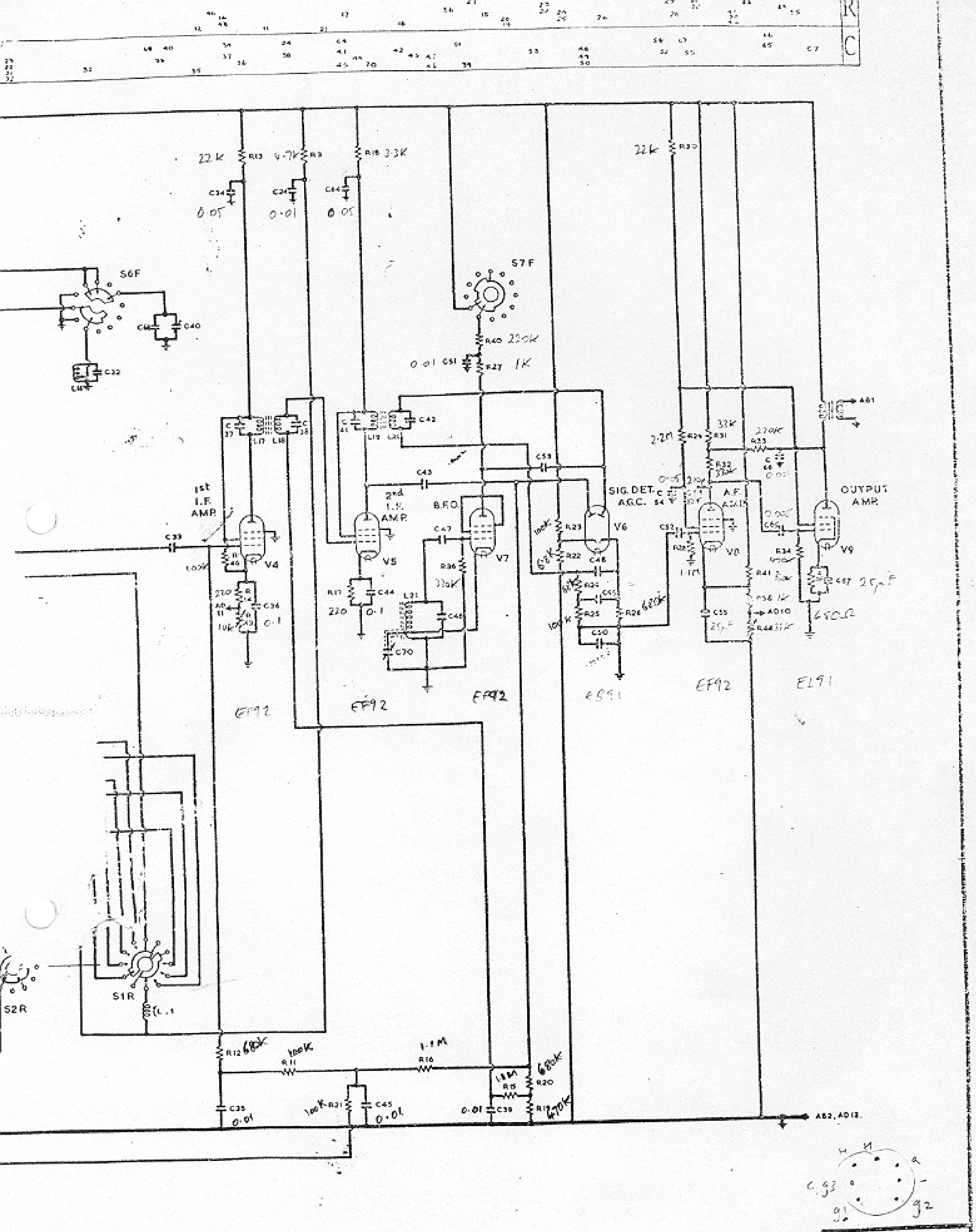
Heater circuit 6.3v (modified from 18.9v)



orange is 6.3v line.

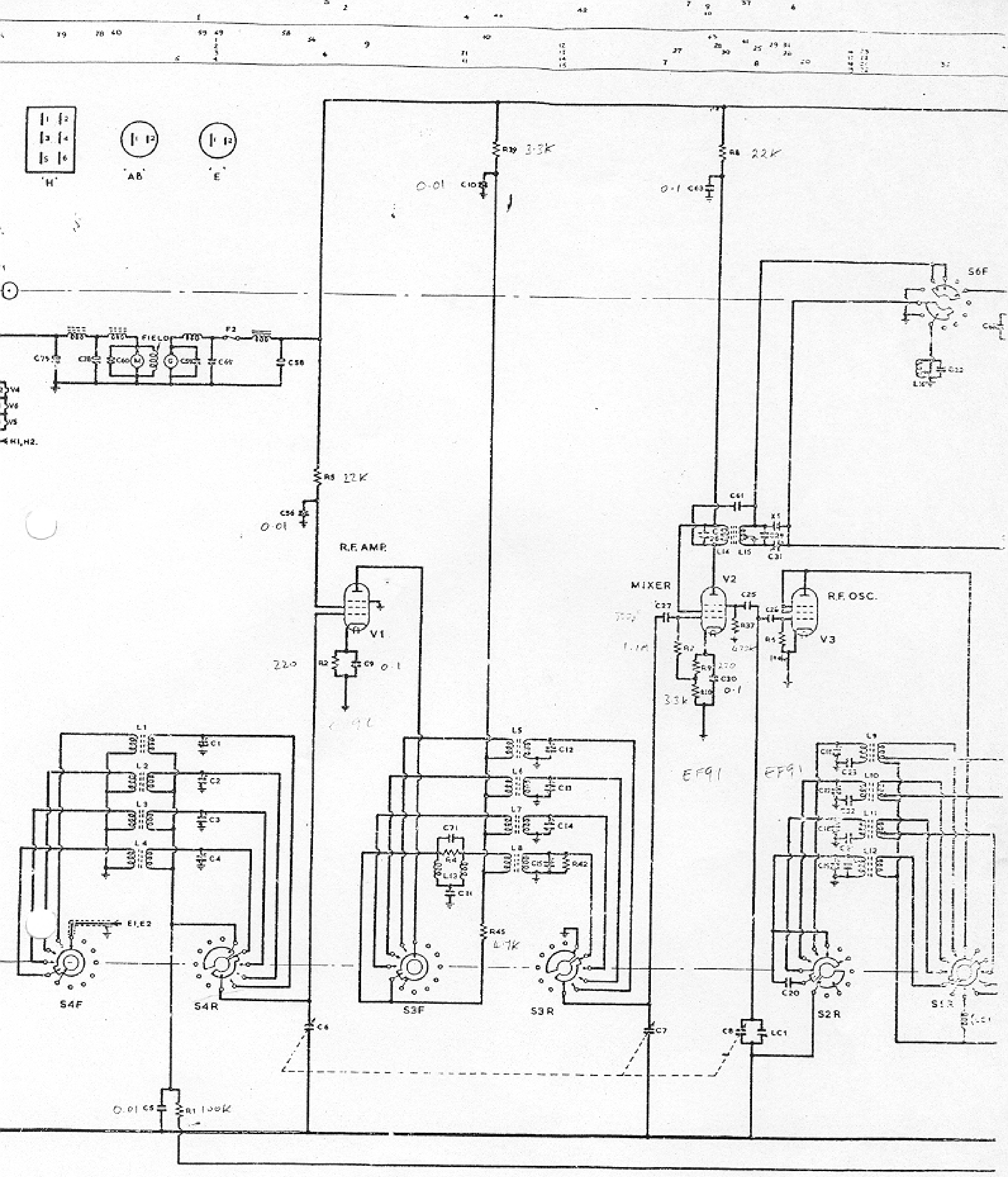
Heater current consumption 3.0 A max.

H.T. line consumption mA at 250v

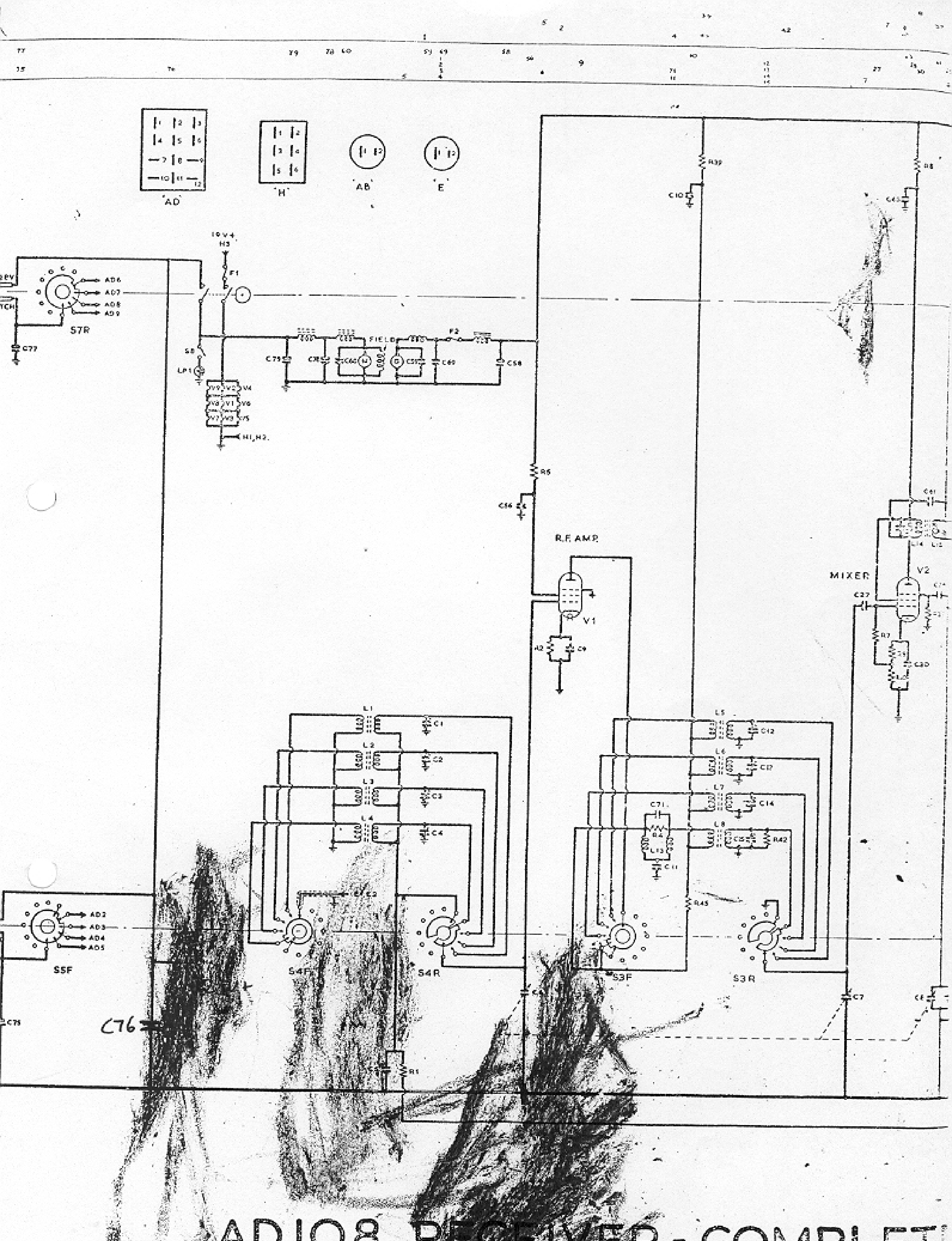


CIRCUIT DIAGRAM.

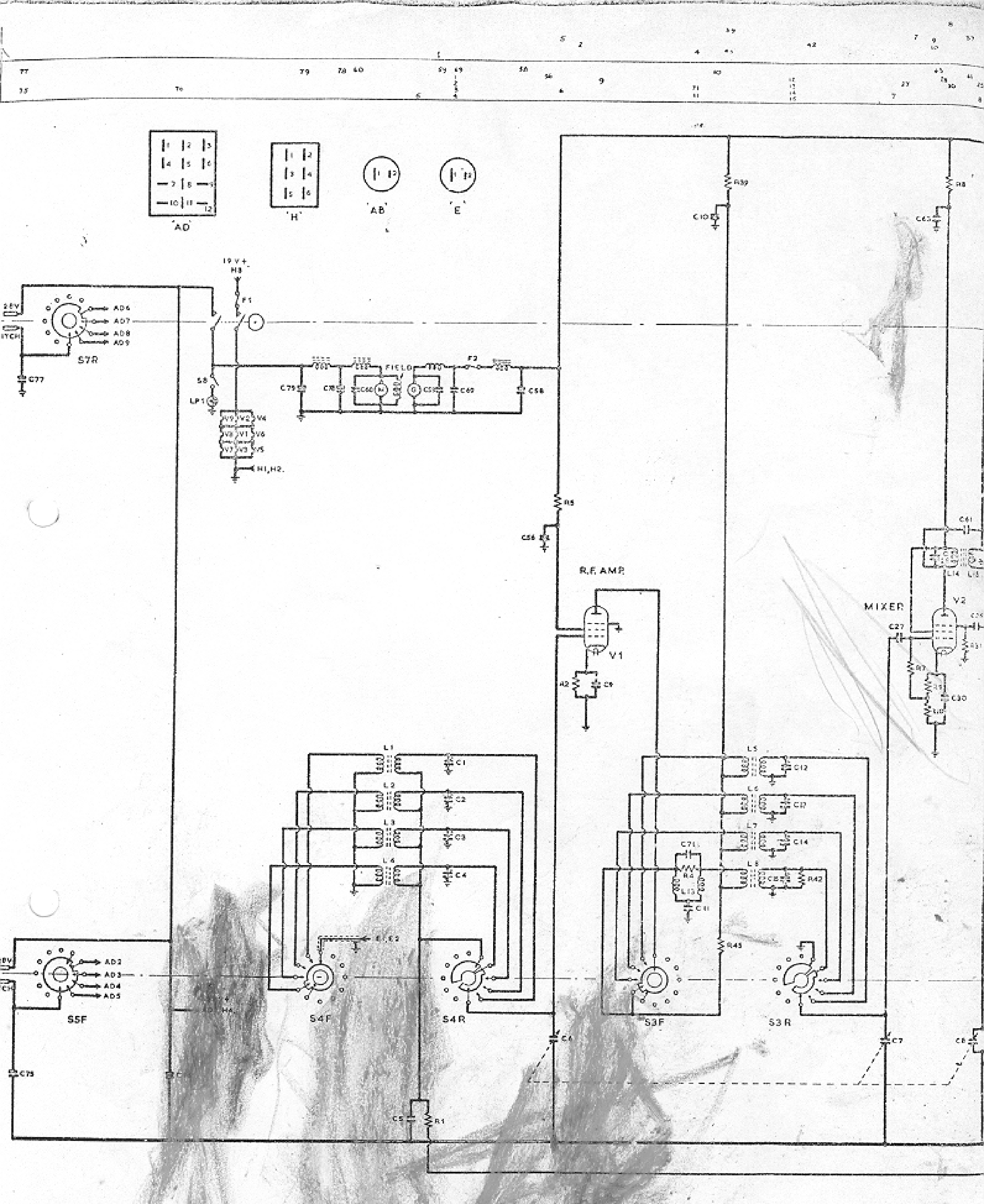
SECTION B
FIG. 6



ADIO8 RECEIVER - COMPLETE CIRCUI



AD108 RECEIVER - COMPLET



AD108 RECEIVER - COMPLET