

SPECIAL RECORDING EQUIPMENT "MONOSCHRIEBER b"

1. This is a sound recorder working on the magnetic tape principle. Sound i.e., speech and music are transformed into variation of magnetic flux of electromagnets called sound heads. These magnets have poles separated by a very small gap and the flux density is therefore, high; the recording tape moves across this gap completing the magtic circuit and any changes of flux are impressed permanently on to the tape. To repeat or play back what has been recorded the tape is passed across the poles of a similar magnet, the repeater head. The magtic field variations cause currents to flow in the repeater head and these are amplified by the repeater amplifier and passed to an external speaker or headphones.

I. The Recording Tape

2. The tape is a plastic compound and is apt to break if it undergoes permanent distortion or too sudden tension. It must, therefore, not be strained when it is in the working position. This is ensured by a careful system of motor synchronisation as explained below; apart from this, handling the tape must be reduced to the minimum necessary.

II. The Apparatus in General

3. The Apparatus is in two sets - the Recorder and the Amplifier and during working the Recorder is placed on the top of the Amplifier (Fig. I).

4. The supply voltage can be anything from 110-250 volts at 25-60 cycles per second. In the supply line there is a surge - suppressing choke Dr. 24-25 (Fig 7c). This is a double wound component arranged in the circuit so that the two chokes are in each line of the incoming supply; any heavy transients are blocked by the inductance of the chokes and by their antiphase winding.

5. The two meters used for voltage testing are shunted so that all test points show the same reading; the selection of test points is accomplished by two selector switches one for each meter (XII and XIII).

6. When the supply is switched on the double pole neon lights and the supply is available up to S7 (XIV in Fig. I); this switch puts the voltage on to a winding of the primary of the main supply transformer U3. The particular winding used is determined by S8 (Fig. 7c). U3 has in its primary circuit an overload switch, this has two contacts lightly soldered with a low m.p. solder and they are inserted in the core of the transformer. If the latter overheats, the solder softens and the contacts spring apart, thus breaking the primary circuit.

7. By putting the recording lever (I) to "Record" and the motor lever (II) to "Forward" the apparatus commences to record sound in the form of voltage variations received via the input lead. The tape runs from the left hand spool (III) over a roller (IV) and across three sound heads (V). The first is the "wiping" head (Va) which applies a saturation flux to the tape and removes any previous recording; the second head is the recording head (Vb) and the third is the monitoring or repeating head (Vc). From these the tape passes between a rubber roller (VI) and a steel roller (VII); the steel roller is controlled to the required speed by a tapping switch (VIII) on the Amplifier set and hence the tape speed is also controlled. During recording the left hand spool is idling and the right hand spool is being driven. For playing back the motor lever is put to the backward position and the tape is rewound on to the left hand spool. The motor lever is then returned to the forward position, the recording lever remaining at "Repeat", and the tape runs forward as during recording. The difference is that the wiping head and the recording head are out of circuit and only the repeater head is functioning.

8. The Amplifier set contains the recording amplifier, the repeating amplifier and an oscillator stage with push-pull output. The output from the recording head is taken to the recording amplifier and the output from the monitor or repeater head to the repeater amplifier. The oscillator whose frequency is variable by means of the tapping switch (VIII) controls the speed of a synchronous motor; on the shaft of this motor is the steel roller (VII). Hence the oscillator controls the tape speed.

III. Speed of Recording

9. There are nine speeds at which recordings may be made. They are 9,13,18, 26,36,52,72,104 and 120 cm. per second. Speech may be recorded at any speed but the optimum is at 52 due to slight unevenness in speed at lower rates and due to the synchronizing system. There must be no variation between recording and repetition speeds in speech recording otherwise unintelligible results may occur. That is if a record is made at 52 cm. per second then it must be played back at that speed.

K4 L

10. The speed of Morse recording varies according to transmitted speed; if this is high then in general the speed of recording should be high. The reason for this is that in order to read high speed Morse it may become necessary to slow down the repeating speed by as much as a quarter of the original speed. When a recording has to be slowed down on repetition the pitch may be then too low for audibility. The pitch may be increased by the use of the rotating monitor head (IX in Fig. I). This head consists of four electromagnets in one (Fig. II) arranged in circular form; when its associated motor is switched on the head rotates and presents a succession of sound heads to each part of the tape. This results in raising the pitch, but not the speed, of repetition. The motor speed is controlled by means of the knob X in Fig. I.

11. The total playing times of a full spool at various speeds is shown in Table I, the equivalent speeds in inches per second is indicated in Table 2.

IV. Overall Frequency Response

12. The overall frequency response of the complete apparatus shown in Fig. III with different tape speeds; the effect of the tone control (15 and P17 - See Para. 30) is clearly shown up to speeds of 36 cms./second. Above that speed there is no noticeable correction.

V. The Recorder Set

13. The Recorder Set (Figs. I and IV) contains :-

(i) Four motors **Mo.1 - Mo.4** Mo.1 is a synchronous motor and Mo.2 - 4 are a.c. motors. Mo.1 is not strictly a motor since it derives its motion directly by friction drive from Mo.4. All the motors have mechanical brakes applied to them by the motor lever S1.

(ii) Four sounds heads K1-K4.

- K1 Monitoring Head
- K2 Recording Head
- K3 Wiping or Stripping Head
- K4 Rotating Monitor.

(iii) Four switches S1-S4.

- S1 The motor lever. This controls the reversing clutch (XIX in Fig. I) for Mo.3, the brakes for all motors and the electrical switching.
- S2 The Recorder switch. This controls the electrical switching for the sound heads.
- S3 Switch controlling K4. When the knob is turned to "on" a potentiometer P8 is put in circuit and further turning of S3 gives a speed control for K4 by alteration of P8.
- S4 The Booster Press Button. This boosts the motors Mo.3 and Mo.4 by momentarily applying the full auto-transformer voltage to them; it is used to synchronise the motor speed with the electronic control in the Amplifier set.

14. Supplies to Mo.3 and Mo.4 are taken from an autotransformer U6 in the amplifier set. The supply is controlled by the tapping switch which also controls the oscillator frequency. The speed of Mo.1 is therefore regulated roughly by varying the input to Mo.4 and more accurately by the oscillator.

15. The switching sequence is as follows :-

- A to record - S1 to forward position, S2 to record.
- B to rewind - S1 to backward position S2 remains at repeat
- C to repeat - S1 to forward position S2 remains at repeat
- D to stop - S1 to stop, S2 remaining at repeat.

16. A Record

With S1 to forward and S2 to record the following occurs :-

- (1) All brakes removed from the motors.
- (2) Clutch (XV in Fig.1) operated to connect friction drive F3 to Mo.3
- (3) S1₂ and S1₅ connect supply to Mo.3 in the forward position and the right hand spool is driven.
- (4) S1₆ switches in the supply to Mo.4 and the supply to Mo.2 only as far as the next switch S3. Mo.2 always gets the full autotransformer output.
- (5) S1₈ switches in supply to Mo.3 via the preset resistance P.9.
- (6) S1 switches on supply to oscillator valves Ro.2 - Ro.4 (Fig.VII)
- (7) S2₇ switches in K2 to the recording amplifier.
- (8) S2₁ connects K3 to its source of DC supply in the Amplifier.

The apparatus is now recording. If the tape is too slack or the tension too great this may be remedied by changing the speed of Mo.3 relative to Mo.4. This alteration is done by the preset resistance P.9 (see section 5).

+ symbols of the form S1₂ indicate contact No.2 of switch No.1.

17. B Rewind

With S1₁ in the backward position and S2 remaining at repeat, the following sequence of operations occurs :-

- (1) All brakes removed from the motors.
- (2) S1₃ and S1₄ connect supply to Mo.3 in the reverse position and the left hand spool is driven.
- (3) The clutch charged to connect friction drive F4 to Mo.3.
- (4) S1₁ switches in supply to Mo.3 via the preset resistance W50. This supply is the full autotransformer output and the speed of Mo.3 on rewind is much higher than on record.
- (5) Both S2₁ and S2₂ are out of circuit and the recording head and the wiping head are inactive.

18. C Repeat

S1 is switched forward and S2 remains at repeat; the following sequence of operations occurs :-

- (1) All brakes removed from the motors.
- (2) Clutch operated to connect friction drive F3 to Mo.3.
- (3) S1₂ and S1₃ connect supply to Mo.3 in the forward position and the right hand spool is driven.
- (4) S1₆ switches in the supply to Mo.4 and to Mo.2. In the case of the latter the supply voltages is only up to the switch S3 (X in Fig. 1)
- (5) S1₈ switches in supply to Mo.3 via the preset resistance P.9.
- (6) S1₇ switches in supply to oscillator valves Ro.2-Ro.4 (Fig.VII).
- (7) S2₁ and S2₂ are out of circuit and the recording and wiping heads are inactive.

19. D Stop

S1 to stop and S2 remains at repeat.

- (1) All brakes on.
- (2) Clutch disengaged.
- (3) All contacts open.

VI. The Amplifier Set

20. The Amplifier set is in three main parts :-

- (a) The Oscillator stages.
- (b) The Recording amplifier.
- (c) The repeating or monitoring amplifier.

All of these as well as the Recorder set obtain their power supplies from a single transformer U3; all d.c. supplies are rectified by metal rectifiers. The smoothing is accomplished by choke-capacity methods in the usual way.

21. To avoid damaging the apparatus with D.C. supplies a double pole neon is provided across the supply lead; on DC only one pole lights but on A.C. supplies both poles light. Before connection to U3 via the switch S7 (Fig. I) the supply voltage is metered (Instrument II Fig. I). An adjustment can then be made to the primary tapping of U3 by a tapping switch S8.

22. Monitoring points are provided in the cathode of all valves. Two selector switches (XIII and XII Fig. I) connects all these points through Instruments I and II (Fig. 1) to earth. The HT for the driver valve and the two push-pull valves is only switched in when the motor lever S1 (II in Fig. I) is in the forward position. This is to ensure that Mo.1 is rotating so that the field resistance attains its maximum value as the HT is applied.

23. A The Oscillator Section.

This contains the four valves Ro31-Ro34. Ro31 is a pentode with anode, screen and suppressor strapped together as a triode. It is a conventional tuned anode oscillator with feedback from the grid. This feedback is by way of a tertiary wound transformer. The other functions of this transformer are :- coupling to next stage and feedback from push-pull stage. The oscillator frequency is low and variable and its variations are controlled by the tapping switch S6 (Fig. I). A fine control of frequency is effected by feed-back from the push-pull stage via U4 and the variable resistor P4 (Fig. 5 and XVIII in Fig. I).

24. The oscillator output is taken to the grid of a pentode acting as a triode with its screen and suppressor strapped to the anode; this valve is a driver for the push-pull stage; its output is taken to the primary of a phase-splitting transformer U5 the secondary of which is centre-tapped to earth. The anode loads of the two push-pull valves are the windings of the field of Mo1.

25. The actual process of speed control of Mo1 is as follows :-

For example consider a tape speed of 9 cm/sec. This means that the roller (VII in Fig. I) must rotate so that 9 cms. of tape are passed per second. Since the circumference of the roller is 11.9 cms. then it must have a speed of rotation of $\frac{9}{11.9}$ times per second.

The motor Mo1 has 29 poles on its rotor; hence for a speed of 9 cms. of the tape the number of rotor poles that have to pass a given point in one second is $\frac{9}{11.9} \times 29 = 22$. The oscillator frequency must therefore be 22 cps in order that the impulses given to each pole by the field are at this (22) rate per second. A table (III) in the appendix shows oscillator frequency plotted against tape speed.

26. B The Recording Amplifier

This comprises two stages; the first stage is a pentode with high gain. It is coupled to the next stage by an RC network of large time constant to avoid distortion. The second stage is a pentode acting as a triode with a transformer in its anode circuit; the transformer matches the output to the recorder head.

27. The first stage has a variable grid leak P1 (XV in Fig. I) which acts as a control over the input voltage. This control is monitored by taking a sidetone from the transformer U1 (Fig. 5). This sidetone is rectified and passed to Instrument I (Fig. I). Saturation of the amplifier must always be avoided and at low input frequencies the monitoring level should be well below the specified marking.

28. The output of the second stage is taken to the recording and wiping heads in the manner shown in Fig. 6. A standing current is passed through the wiping head and provides the A.C. field for removing previous recording. Part of this current flows through the recording head to pre-excite the magnetic tape so that it will be ready to receive the A.C. speech variations.

The control P2 alters the current distribution in this circuit so that more or less current flows in K2 according to whether P2 is increased or decreased. Monitoring of P2 is done on Instrument I. There is an optimum value for every sound head.

29. C The Repeating or Monitoring Amplifier

This is three-stage and RC coupled; the input from K1 to K4 is transferred by U2 (Fig. 7D) and applied to the grid of the first stage.

30. All three stages are pentodes. In the output circuit of the first stage Ro5 there is a tone correction network C15 and P7 is a variable resistor and is on the same shaft as the oscillator tapping switch S6. The mechanical friction of the tape against the sound heads gives rise to hiss and this increases in frequency with tape speed; C15 and P7 provide a shunt to the high frequency hiss which shunting effect remains practically constant in value over the whole frequency of tape hiss (due to P7).

31. In the output circuit of the second stage there is another filter circuit C19 and Dr3; this is an attempt to get rid of unwanted very low frequency noise and modulation from speed irregularities.

32. The third stage derives its grid input from a potentiometer in the usual way, this potentiometer P3 being the manual volume control (XVI in Fig. I). The output from the third (and last) stage is taken from the anode via a coupling condenser.

TABLE IV

LIST OF COMPONENTS

(A) RESISTORS FIXED AND SEMIVARIABLE

<u>REF.</u>	<u>No. in Circuit</u>	<u>Value (ohms)</u>	<u>Rating (watts)</u>	<u>Remarks</u>
	W. 1	900	1/2	
	2	40	1/2	
	3	250K	1/2	
	4	20K	1/2	
	5	100K	1/2	
	6	1.5K	1/2	
	7	1.4K	1/2	
	8	12.5	1/2	
	9	5K	1/2	
	10	5K	1/2	
	11	2K	1/2	
	12	20	1/2	
	13	600K	1/2	
	14	900	1/2	
	15	45	1/2	
	16	250K	1/2	
	17	20K	1/2	
	18	100K	1/2	
	19	1.5K	1/2	
	20	250K	1/2	
	21	12.5	1/2	
	22	600	1/2	
	23	60K	1/2	
	24	20K	1/2	
	25	600	1/2	
	26	12.5	1/2	
	27	60K	1/2	
	28	20K	1/2	
	29	170K	1/2	
	30	350K	1/2	
	31	50K	1/2	
	32	10K	1/2	
	33	50K	1/2	
	34	500K	1/2	
	35	20K	1/2	
	36	20	1/2	
	37	10M	1/2	
	38	2K	1/2	
	39	30K	1/2	
	40	1.4K	1/2	
	41	9	2	
	42	5K	4	
	43	20K	2	
	44	100K	1/2	
	45	10K	1/2	
	46	20K	1/2	
	47	100K	1/2	
	48	100K	6	
	49	1K		
	50	6.6		Wire wound Rating unknown
	51	6.6		" " " "
	52	1K	6W	" " " "
	53	5K	10W	" " " "
	54	Does not appear in Circuit diagram or in apparatus.		
	54	100K	2	
	55	250	1/2	
	56 } Does not appear in Circuit diagram or in apparatus.			
	57 }			
	58 }			
	59	3K	6W	
	60	500		Present wirewound resistor
	61 } Does not appear in Circuit diagram or in apparatus.			
	62 }			
	63	100K	1/2	
	64	100K	1/2	

TABLE V LIST OF NUMBERED CONTACTS

1.	Earth
2.)	Connections to Field of No.1 from Oscillator
3.)	
4.)	
5.)	
6.)	HT Supply To Ro3 and Ro4
7.)	Autotransformer to Mains
8.)	
9.)	
10.)	DC Supply to Wiping and recording Head
11.)	
12.)	
13.)	
14.)	
15.)	
17.)	Earth
18.)	Input to repeating amplifier
19.)	
20.)	AC Supply to Oscillator HT Rectifiers
21.)	
22.	Not connected.
23.)	Heater Supply for Ro31 - Ro34.
24.)	
25.	Connection from C15 to tone Control P7.
26.)	AC Supply to meter rectifiers (to measure supply voltage)
27.)	
28.)	Not connected.
29.)	
30.	DC Supply to wiping head.
31.)	Connection to recording head.
32.)	
33.	Connection to S2.
34.)	Connection to wiping head.
35.)	
36.	Earth.
37.)	Input to Repeater Amplifier.
38.)	
39.	Not connected.
40.)	Supply Voltage to Autotransformer.
41.)	

Numbered pins
on
Two Recorder
Plugs

- 2 -
Table VI - LIST OF COMPONENTS (Cont'd)

<u>REF.</u>	<u>No. in Circuit</u>	<u>Value (ohms)</u>	<u>Rating (watts)</u>	<u>Remarks</u>
	65	100K	$\frac{1}{2}$	
	66	100K	$\frac{1}{2}$	
	67	100K	$\frac{1}{2}$	
	68	500	$\frac{1}{2}$	
	69	5K	$\frac{1}{2}$	Proset wire-wound resistor.
	70 } 71 }	Do not appear in circuit diagram or apparatus.		
	72	Across Choke Dr. 22) In circuit diagram but not in apparatus.		
	73	From choke Dr. 23 to earth)		

(B) Resistors Variable.

P.	1	500K	
	2	100	
	3	500	
	4	1M	
	5	Does not appear in circuit except in some modified sets.	
	6	500K	
	7	25K	
	8	1K	
	9	1K	

(C) Chokes

DR.	1	Decoupling
	2	Decoupling
	3	Tone Correction
	4) 5) 6)	Smoothing
	7)	
	8	Does not appear in circuit diagram or apparatus.
	9) 10) 11) 12)	
	13) 14) 15) 16)	Smoothing chokes.
	17	Not in circuit diagram or apparatus.
	18) 19) 20) 21)	Spark Suppression.
	22) 23)	Smoothing
	24) 25)	Double wound choke: Surge Suppression.

(D) Transformers

U.	1	Output Transformer
	2	Input matching transformer.
	3	Main HT and Heater Transformer.
	4	Tertiary wound O/P transformer.
	5	Phase splitting Transformer.
	6	Autotransformer.

Table VI - LIST OF COMPONENTS (Cont'd)

REF.	No. in Circuit	Value (uF)	Rating (DC volts)	Remarks
C.1		.01	1500	Electrolytic.
2		20	8	
3		1	250	
4		1	250	
5		0.25	250	
6		20	8	Electrolytic.
7		300	8	"
8		.005	500	
9		300	8	"
10		1	250	
11		20	8	"
12		1	250	
13		4	250	
14		1	250	
15		.02	750	
16		1	250	
17		20	8	Electrolytic.
18		1	250	
19		.02	750	
20		.02	750	
21		20	8	Electrolytic.
22		1	250	
23		1	250	
24		50	100	Electrolytic.
25		50	100	"
26	Not in circuit diagram or apparatus.			
27		1	250	
28		1	250	
29		8	500	Electrolytic.
30		8	500	"
31		50	100	Electrolytic.
32		.005	1500	
33	Not in circuit diagram or apparatus.			
34		300	8	Electrolytic.
35		2	500	
36		0.25	250	
37		50	100	Electrolytic.
38		50	100	"
39		2	500	
40		2	500	
41		0.8	500	
42		0.45	500	
43		0.26	500	
44		0.18	500	
45		0.11	500	
46		0.055	500	
47		0.03	500	
48		0.023	500	
49		50	100	Electrolytic.
50		0.02	500	
51	Not in circuit diagram or apparatus.			
52	Not in circuit diagram or apparatus.			
53	Not in circuit diagram or apparatus.			
54	.05 + .05 + .05 + .05		500	} Special smoothing condenser. See circuit.
55				
56				
57				
58	.05 + .05 + .05 + .05		500	- do -
59	Not in circuit diagram or apparatus.			
60	Not in circuit diagram or apparatus.			
61	Not in circuit diagram or apparatus.			
62	.05 + .05 + .05 + .05		500	- do -
63	Not in circuit diagram or apparatus.			
64	Not in circuit diagram or apparatus.			

TABLE VI - LIST OF COMPONENTS (Cont'd).

<u>REF.</u>	<u>No. in Circuit.</u>	<u>Value (uF)</u>	<u>Rating DC volts</u>	<u>Remarks</u>
65 } 66 } 67 } 68 }	.05 + .05 + .05 + .05		500	Special smoothing condenser. See circuit.
69	.05		500	
70	.05		500	
71	.05		500	
72 } 73 }	.05 + .05		500	
74 } 75 }	.05 + .05		500	
76	.05		500	
77	.05		500	
78	.05		500	
79 } 80 }	.05 + .05		500	
81	See C86			
82 } 83 }	8 + 8		750	Electrolytic.
84 } 85 }	Not in circuit diagram or apparatus.			
86	(with C.81)	.05 + .05	500	
87		50	100	Electrolytic.
88		.05	500	
89		.05	500	
90		.05	500	
91 } 92 }	.05 + .05		500	
93 } 94 }	.05 + .05		500	
95		.05	500	
96		.05	500	
97		.005	500	
98 } 99 }	See c 106			
100		.05	750	
101		.05	750	
102		0.1	750	
103	Not in circuit diagram or apparatus			
104		.05	500	
105		.05	500	
106	(with C98 and C99)	.05 + .05 + 0.1	500	
107		.01	500	
108		.01	500	

TABLE I

PLATING TIME AT VARIOUS SPEEDS FOR
A FULL REEL

<u>Speed (CPS/Second)</u>	<u>Time (Hours and Minutes)</u>
9	2 hrs. 36 mins. ± 5 mins.
13	2 ± 5
18	1 ± 5
26	1 ± 5
36	44 ± 2
52	35 ± 2
72	25 ± 2
104	12 ± 1
120	

TABLE II

PLATE DIAMETER IN INCHES / SPEEDS

<u>CPS/Sec</u>	<u>Inches/Sec</u>
9	3.9
13	5.1
18	7.0
26	10.2
36	14.2
52	20.5
72	28.3
104	40.5
120	47.2

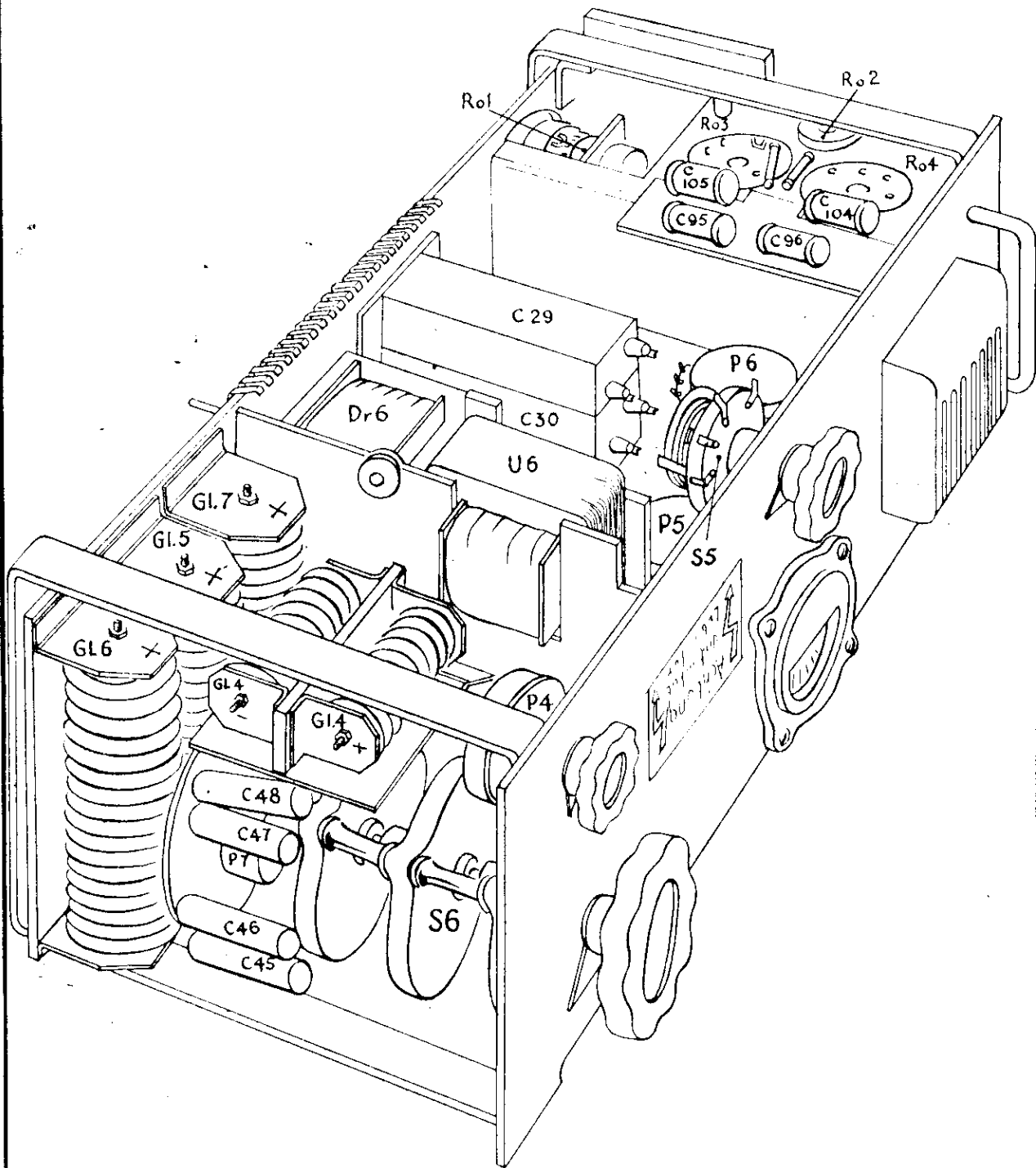


FIGURE 7B

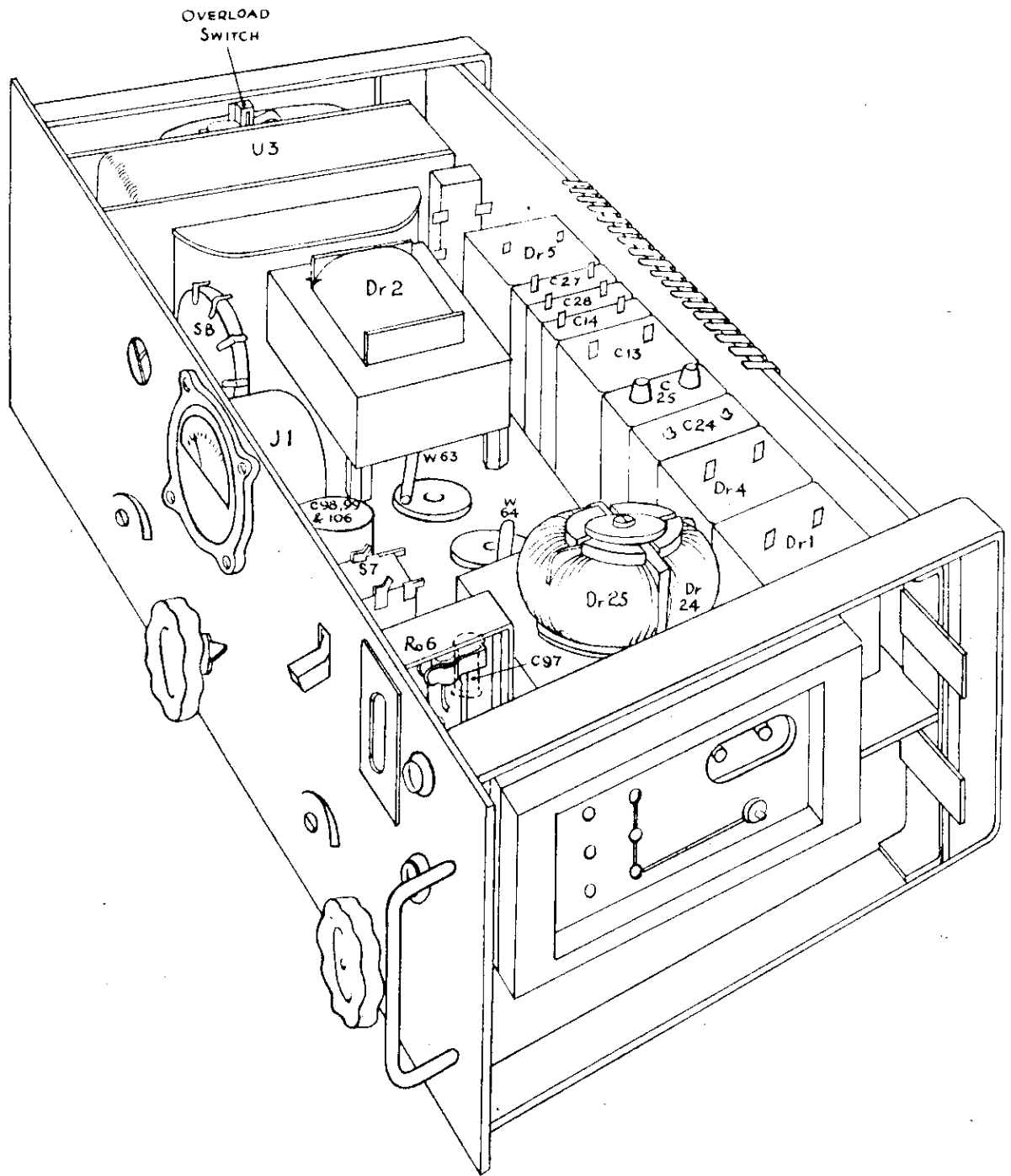


FIGURE 7C

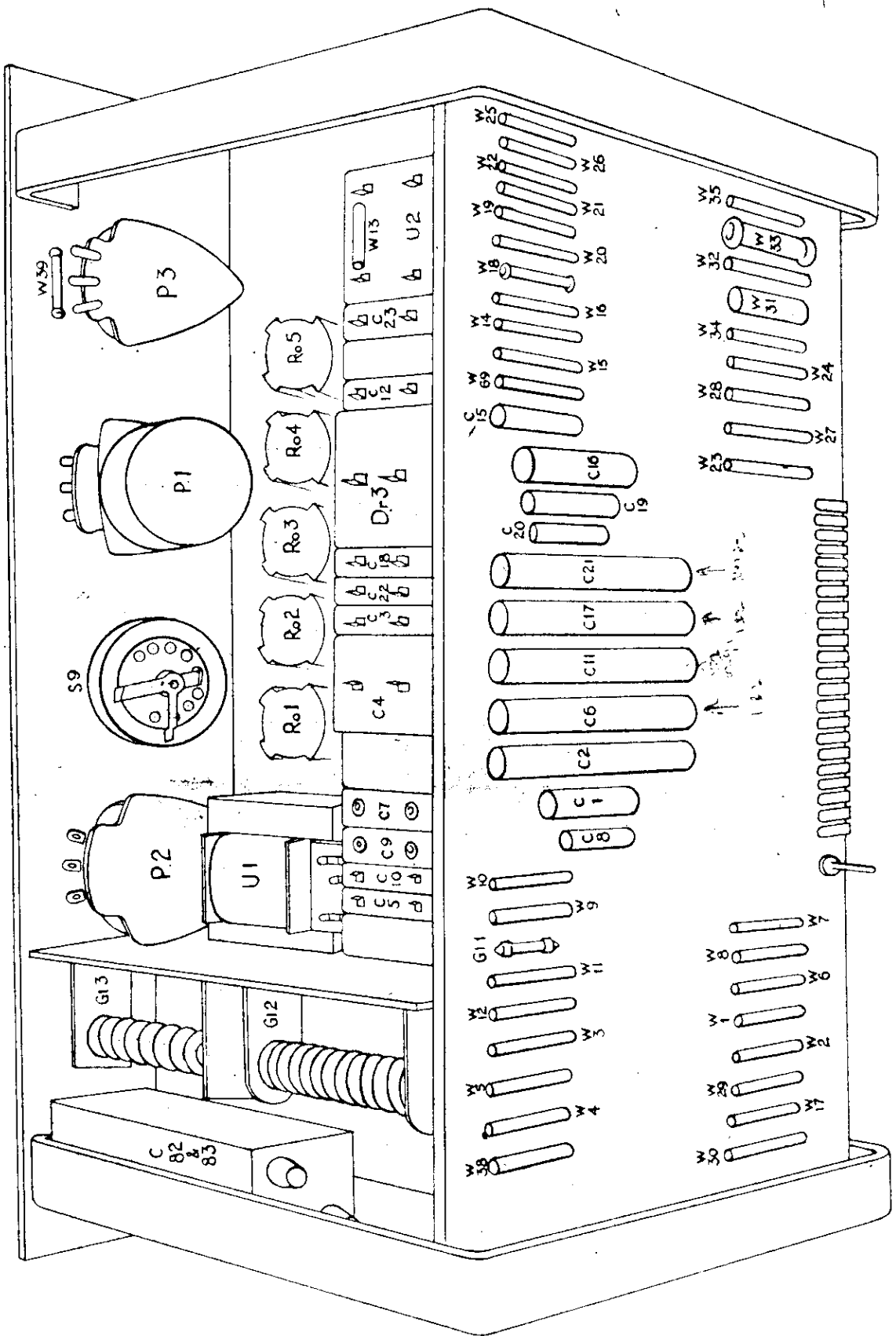


FIGURE 7 D

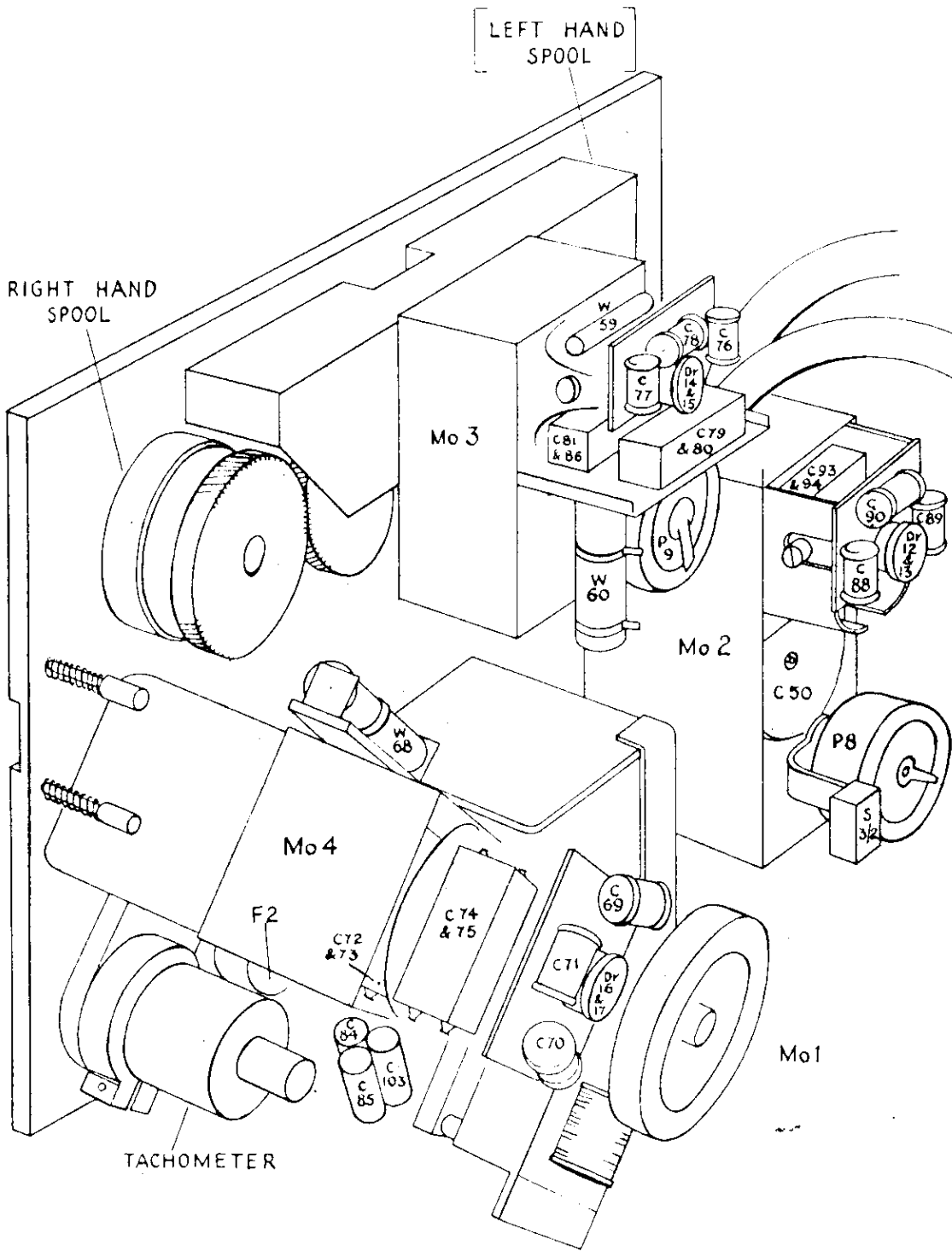


FIGURE 7E

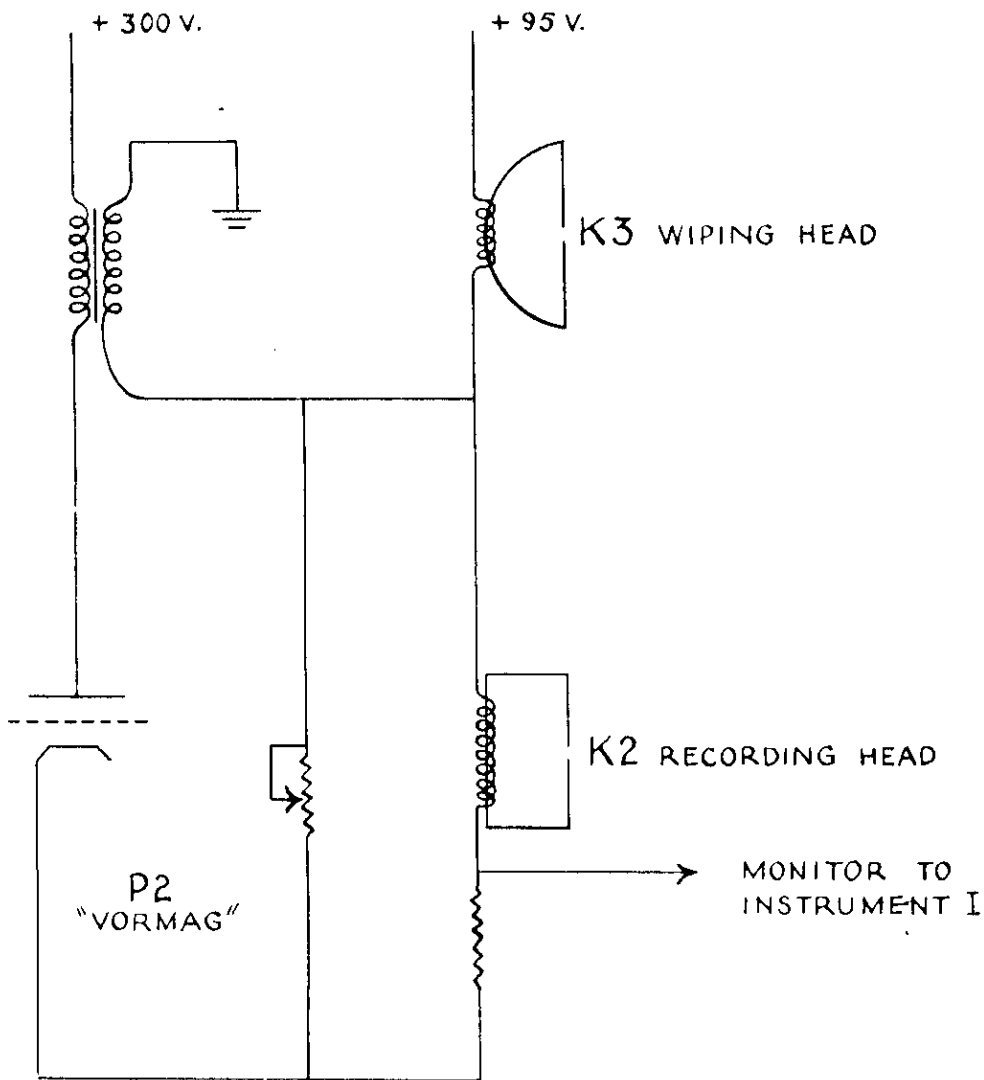


FIGURE VI : SIMPLIFIED CIRCUIT
OF COUPLING TO RECORDER HEAD.

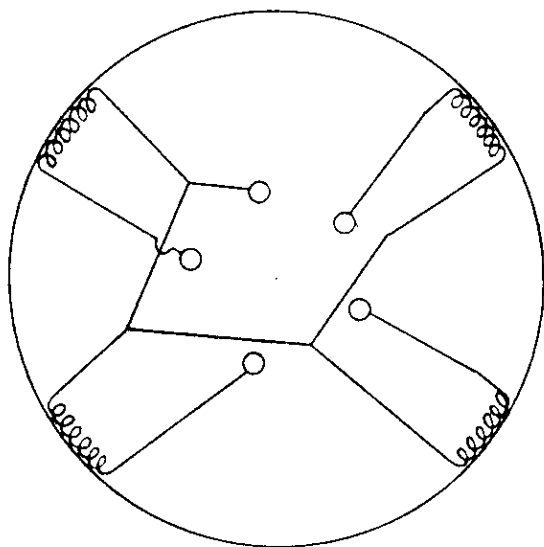
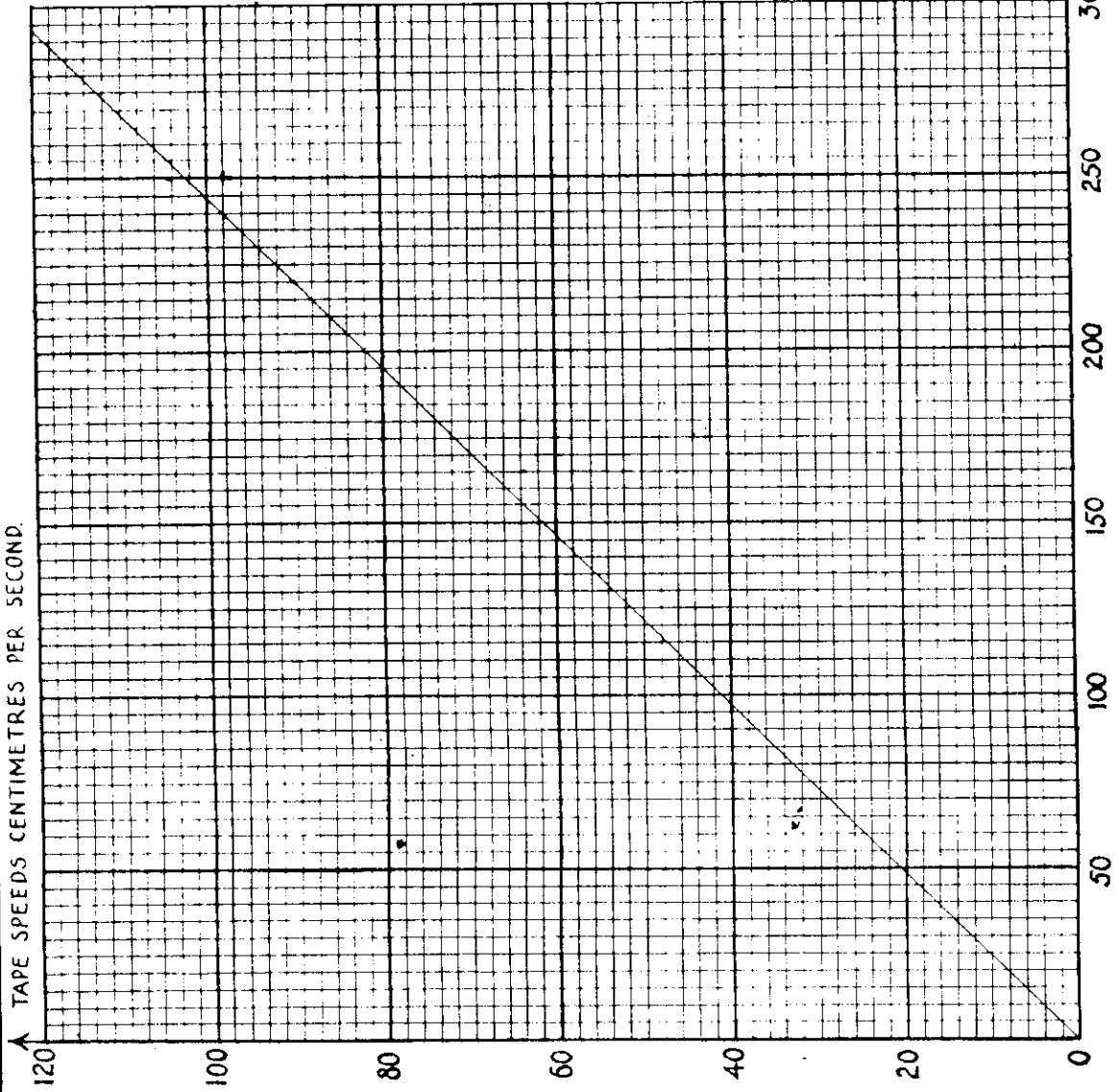


TABLE III

SHOWING CORRELATION BETWEEN
OSCILLATOR FREQUENCY AND TAPE
SPEED WITH GRAPH.

TAPE SPEED CMS/SEC.	OSCILLATOR FREQUENCY
9	22 C.P.S.
13	32
18	44
26	63
36	88
52	126
72	175
104	253
120	292



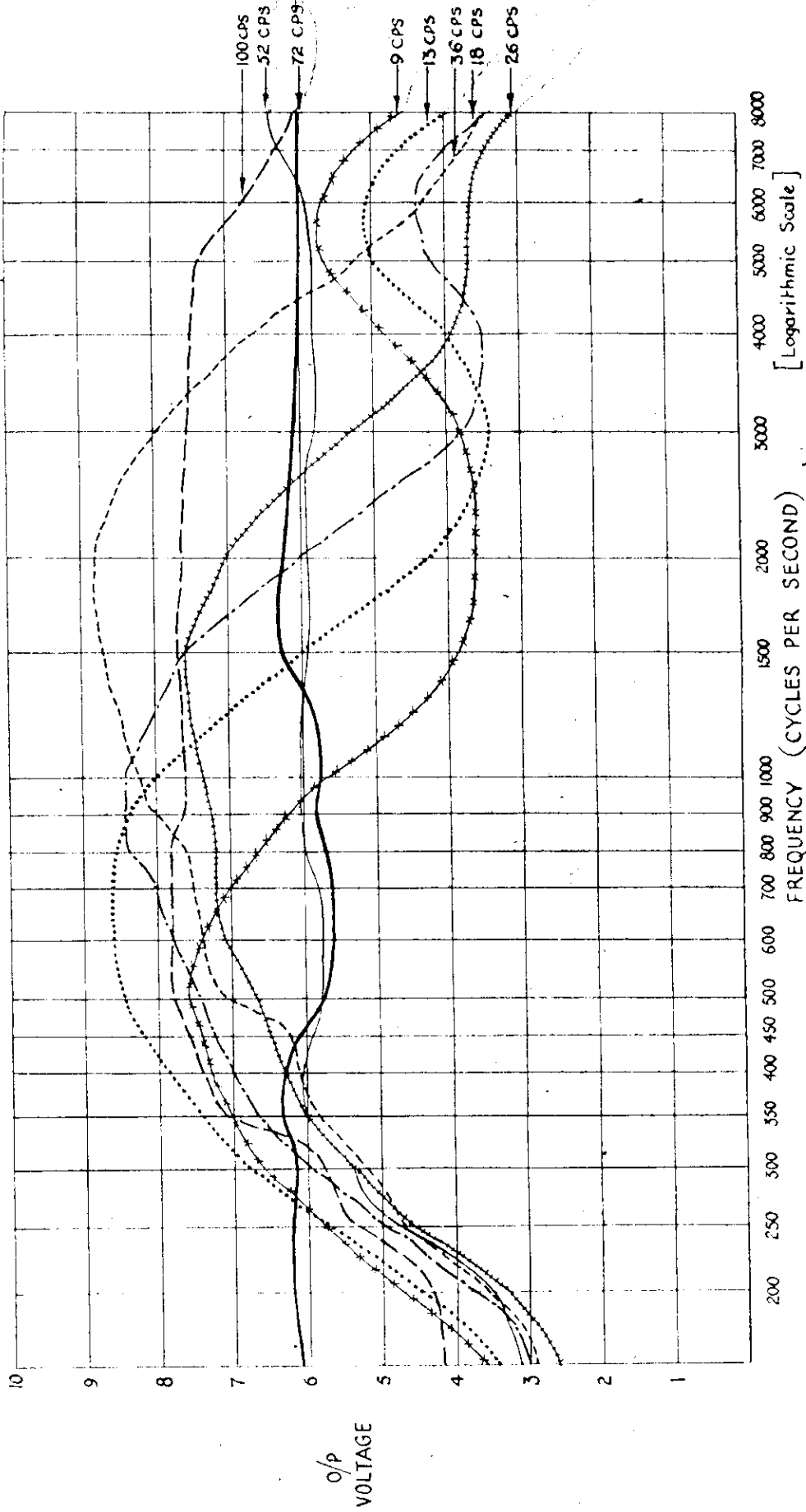
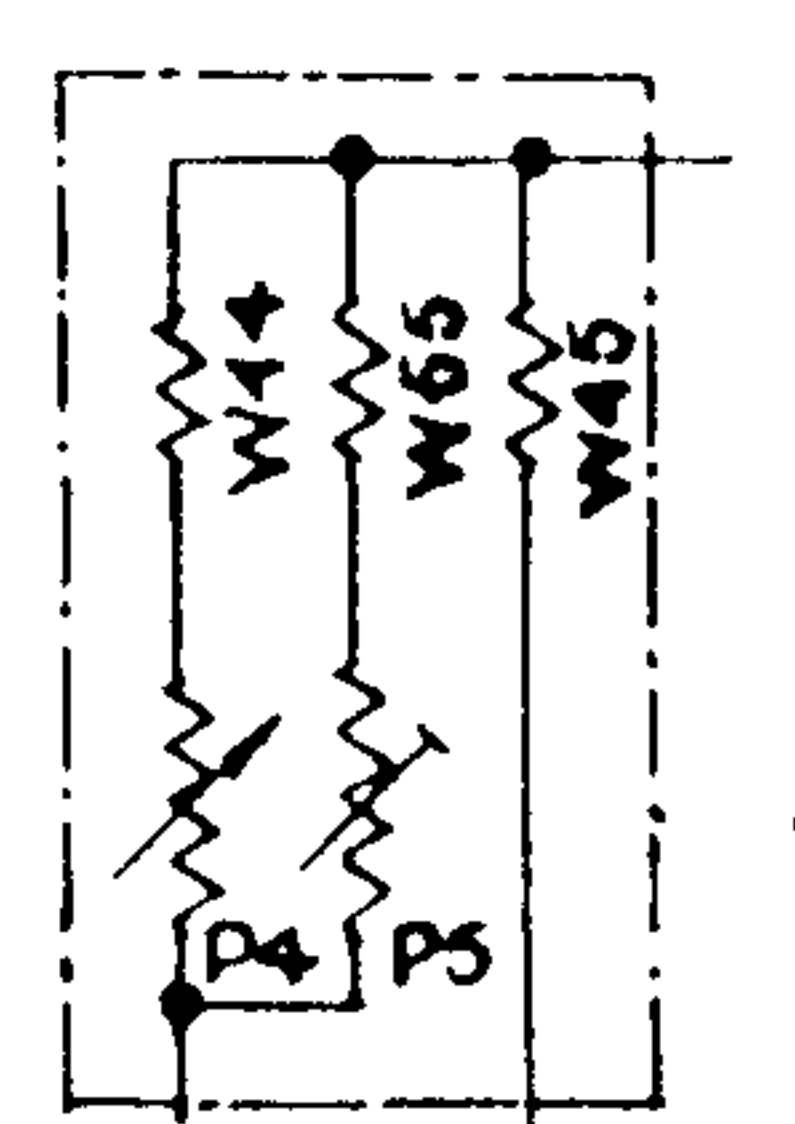
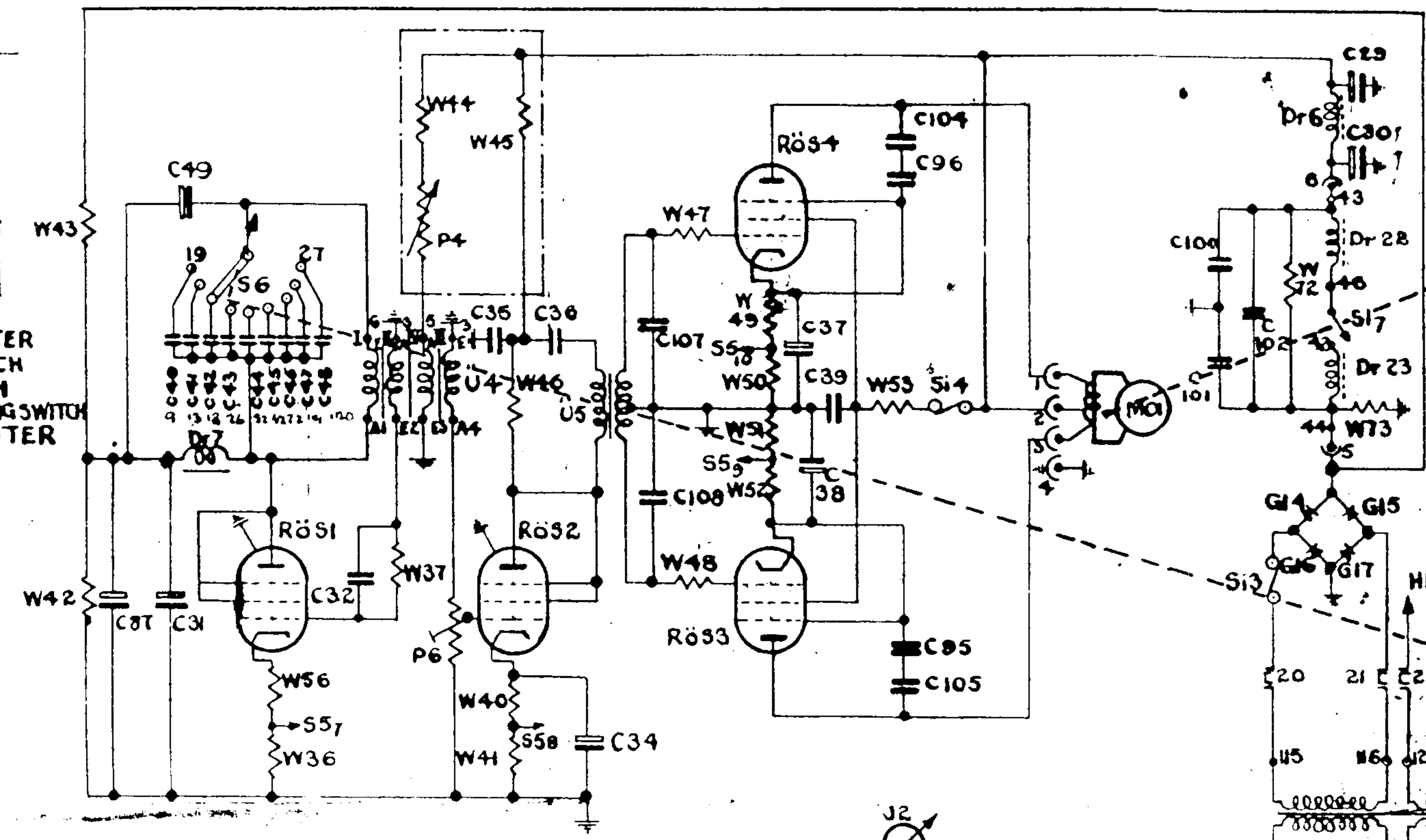


FIGURE III : FREQUENCY RESPONSE AT DIFFERENT TAPE SPEEDS.

INPUT : 0.6 VOLTS.



S5 EMISSION TESTER
 S6 TAPPING SWITCH
 S7 MAINS SWITCH
 S8 MAINS TAPPING SWITCH
 S9 EMISSION TESTER



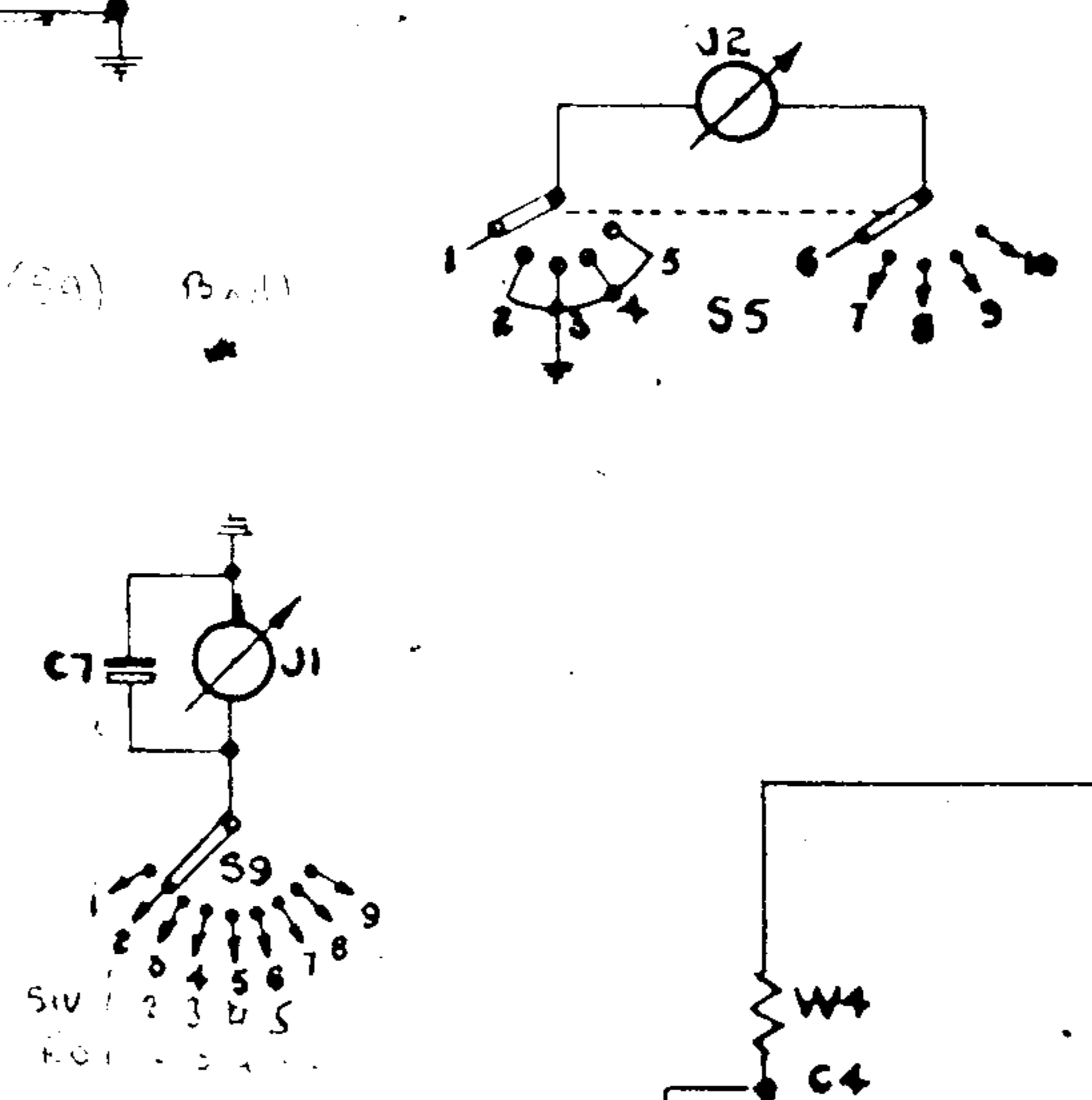
Faulty

Capacitors: 201-C6 20pF 2V (check) (80) B211
 S5: 13-240 24F 500V
 C43 0.26F 500V (S5)
 C44 1.0F 500V

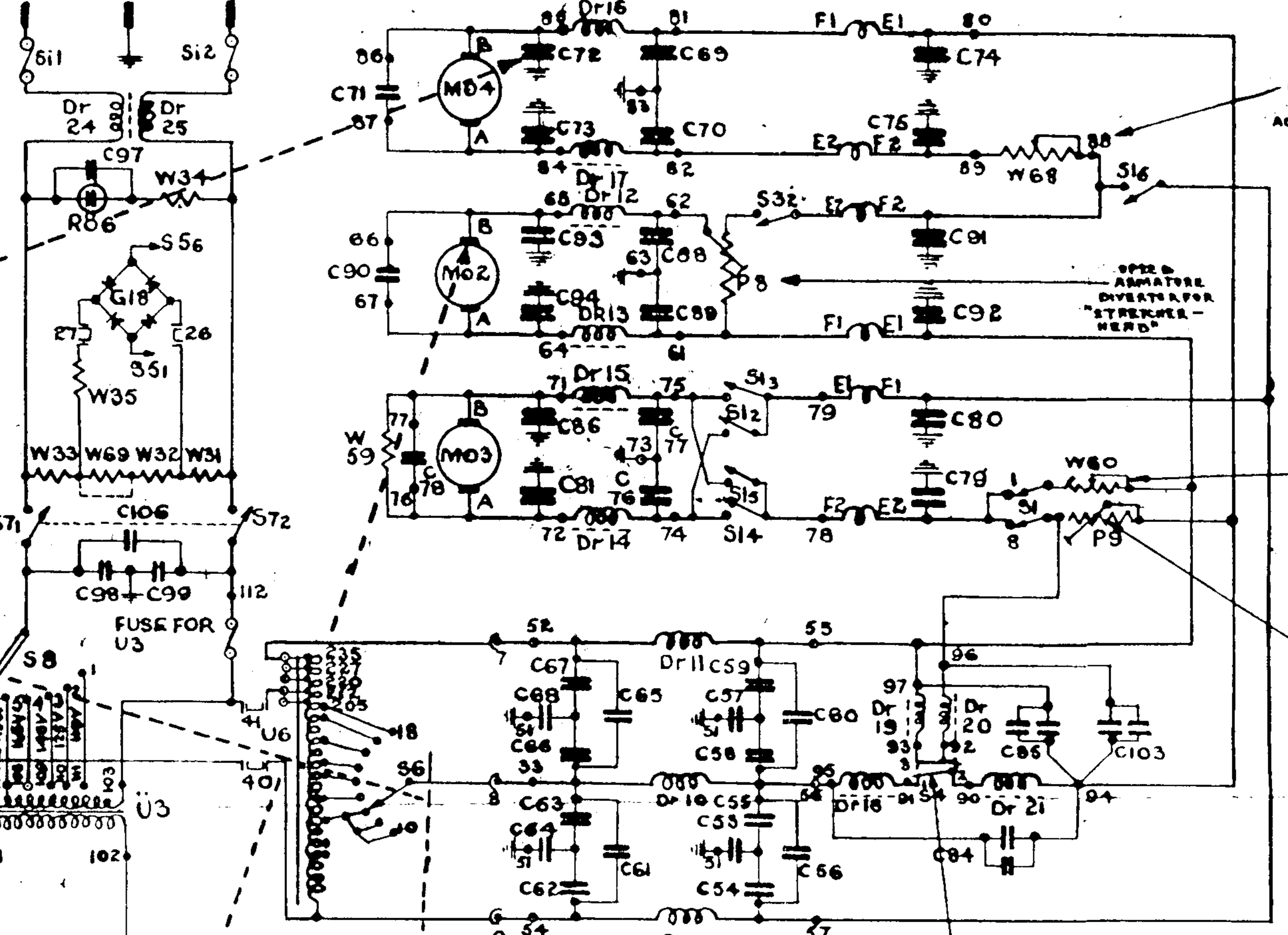
DANGER: C98 or C99 on side of
 0.5A 0.5 + 0.1 (on 150V)
 100PF 500V id

Test output L (h.v) AC side & back up
 AC plug in transformer (100)

WASER
 WAC AC to back of T. 100
 CINE



MAINS



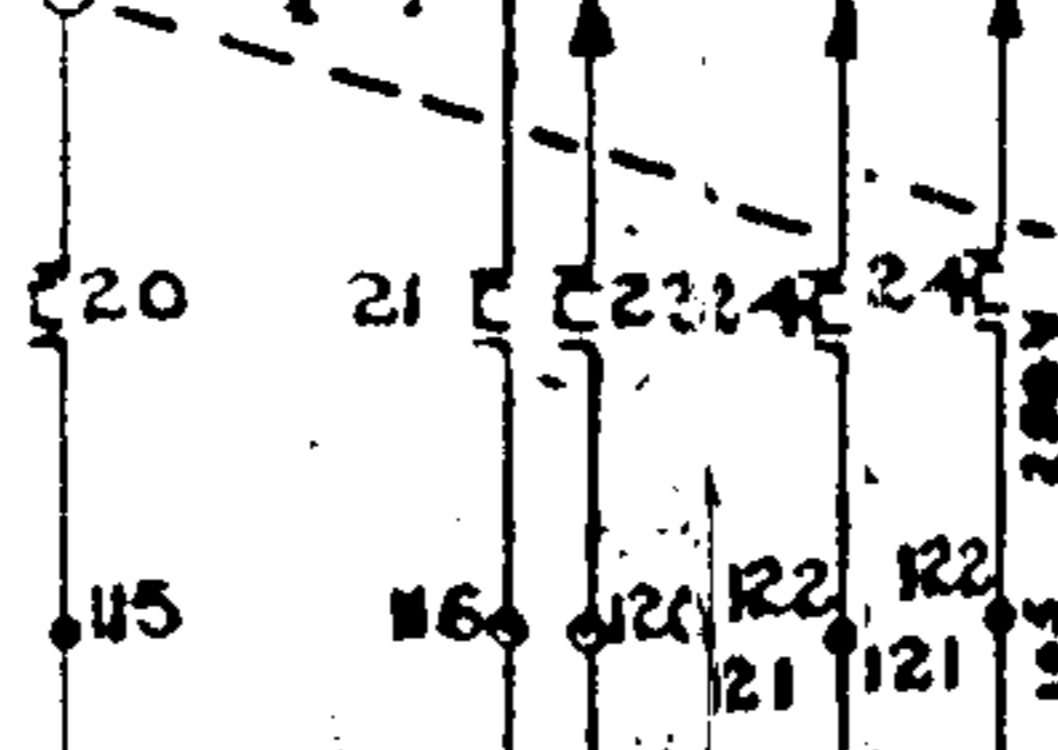
SYNCHRONISING MOTOR
 DRIVE WITH AC
 ASYNCHRONOUS WINDING (in a)
 ADAPTED IN CONNECTION WITH P

SPEED
 ARMATURE
 DIVERTER FOR
 "STRETCHER-
 HEADS"

WEEP OF WIND SAK

TAPLE TENSION

HEATER THERMISTERS



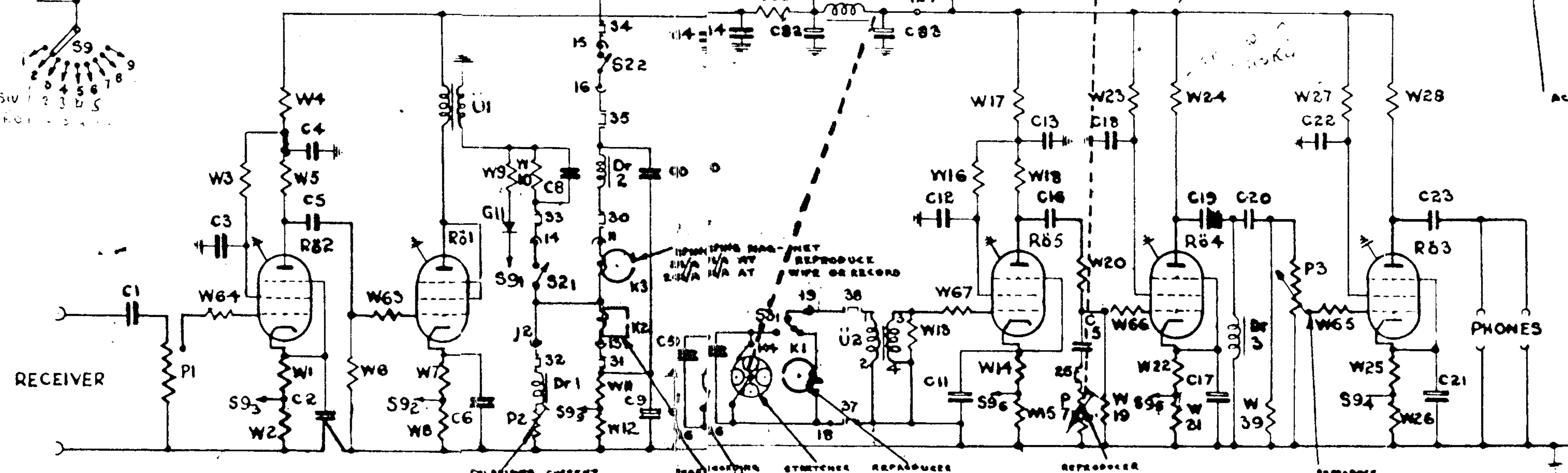
FUSE FOR U3

S1	1	2	3	4	5	6	7	8
STOP								
FORWARDS								
BACKWARDS								

SWITCH CONTACT SEQUENCE (FRONT VIEW)

M2	M1
113	
114	
115	
116	
117	
118	

ACCELERATION SWITCH



RECEIVER

PLANNING CURRENT
 RESET TO RECORDING HEAD.
 REPRODUCING
 HEAD
 STRETCHER
 PLAY-BACK
 HEAD
 REPRODUCER
 HEAD
 REPRODUCER
 TONE CONTROL
 OPERATOR'S CONNECTION
 WITH S4
 REPRODUCER
 VOLUME CONTROL

PHONES