SHOP PROCEDURES - ELECTRICAL TESTS
ELECTRONIC SECRETARY ® MODEL SP-2

CONTENTS PAGE

1. GENERAL

1.01 This Section presents technical data pertaining to the Model SP-2. Included are two tables, nine functional diagrams, nine circuit explanations, relay and switch contact layouts, d-c and a-c voltage checks, electrical adjustments and a schematic diagram. This data is intended for use by a maintenance technician when repairing the Model SP-2 in a shop.

1.02 Each functional diagram is accompanied by a brief explanation. The tables, functional diagrams, and explanations are intended to help the reader gain an understanding of how the Model SP-2 works. Table 1 shows the drawing symbols used to represent the various components that make up the unit. Table 2 defines the meaning of the symbols used in the sequence chart portion of each functional diagram.

1.03 A functional diagram consists of two parts: a time-based sequence chart on the left-hand side and associated signal paths on the right-hand side. The sequence chart shows "what" happens, "why" it happens, and "when" it happens . The signal paths show "how" it happens. A brief explanation of this activity accompanies each functional diagram.

2. FUNCTIONAL DIAGRAMS

2.01 The Model SP-2 performs nine basic functions. These are:

(a) Announcement Erase

(b) Announcement Dictate

(c) Announcement Check

(d) Automatic Answer (Announcement Message)

(e) Automatic Answer (Incoming Message)

(f) Playback

(g) Incoming Messages Erase

(h) Reset

(i) Index

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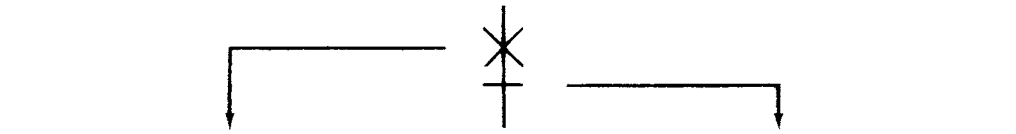
Table 1. Parts Symbols.

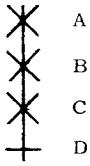
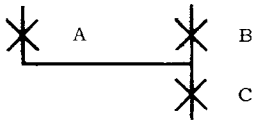
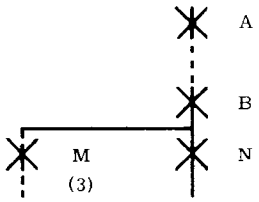
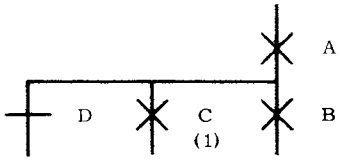
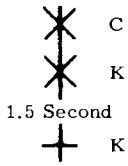
SYMBOL	DEVICE	SYMBOL	DEVICE	SYMBOL	DEVICE
B	Motor	K	Relay	Q	Transistor
C	Capacitor	L	Choke coil, or loading coil	R	Resistor
CR	Rectifier, or Zener diode	L1,L2	Tel. Line Terminals	RT	Thermistor
DS	Lamp	P	Plug	S	Switch
F	Fuse	PU	Record-play head,	T	Transformer
J	Jack	Q	Erase head	TB	Terminal board or block

Table 2. Legend for Sequence Charts.



Some device is energized, operated, started, discharged, made to conduct, or illuminated.

Some device is de-energized, released, stopped, charged, made non-conductive, or extinguished.

SYMBOL	EXPLANATION
	Simple sequential cause and effect relation. Relay A operates and causes the operation of B which, in turn, cause the operation of relay C. Relay C then releases relay D.
	Multiple causes for a single effect. Both relays A and B must operate before relay C operates.
	Dotted vertical line may indicate one of the following: (a) Indefinite time interval (b) Intermediate or simultaneous action which is shown elsewhere. Reference is made to the chart showing the action.
	Multiple effects from a single cause. Relay A operates and causes the operation of both relays B and C and the release of relay D. The operating circuit of relay C is shown on chart (1).
	Capacitor C discharges through coil of relay K, thus holding K operated for a time interval of 1.5 second (approximately). After interval has expired, relay K releases.

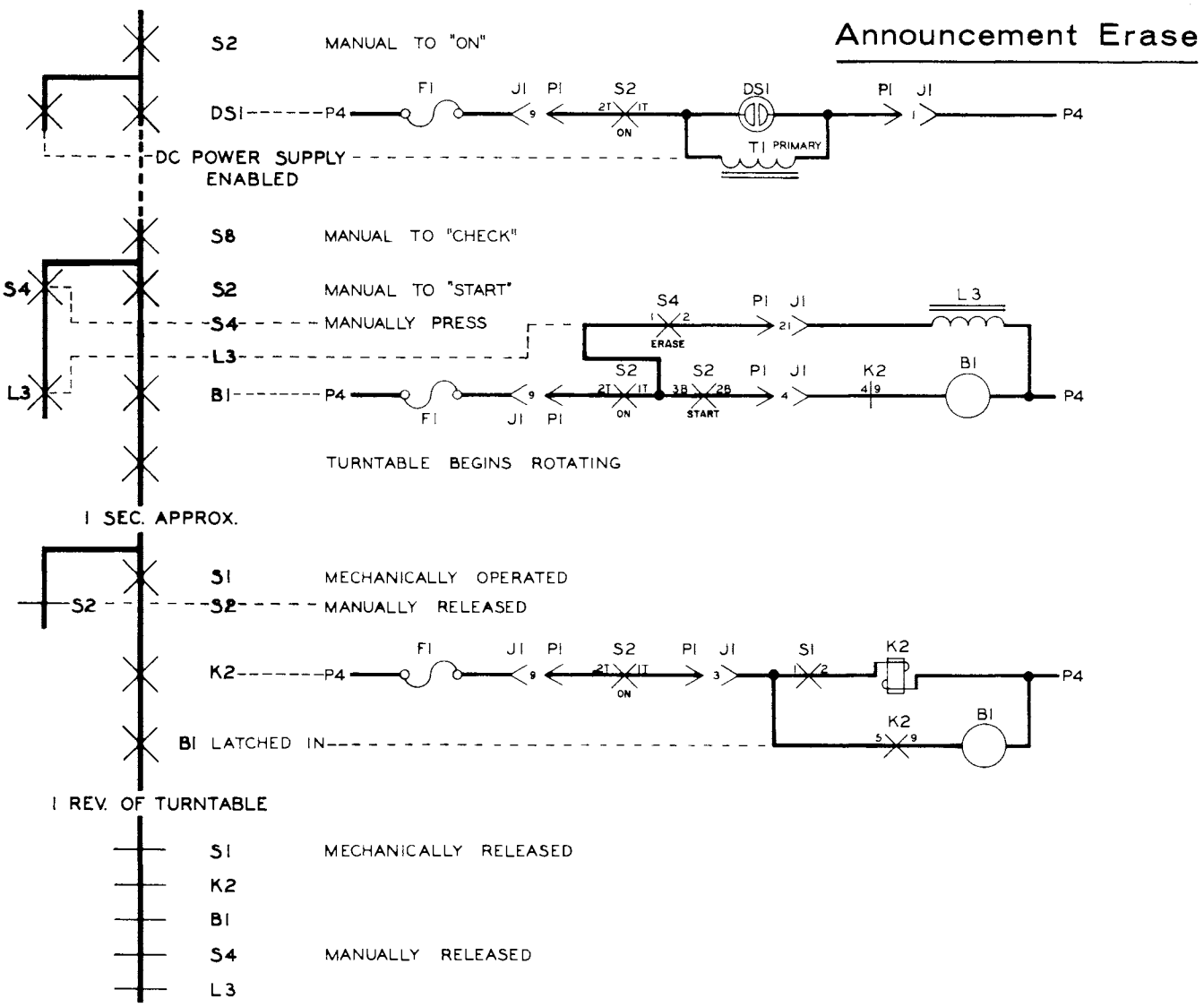


Figure 1. Announcement Erase Functional Diagram.

Announcement Erase

2.02 The selector switch S8 is rotated to "CHECK." START-ON-OFF lever switch S2 is moved momentarily to "START," energizing motor B1. ERASE button is depressed and held, energizing erase coil L3. Motor B1 drives the turntable which operates switch S1. S1 energizes relay K2 which forms a locking path for motor B1. As the turntable rotates past erase coil L3 the announcement message tape is erased. At the end of one revolution of the turntable S1 is mechanically released by the homing cam breaking the operate path to relay K2 and motor B1. The ERASE switch S4 is now released, de-energizing L3.

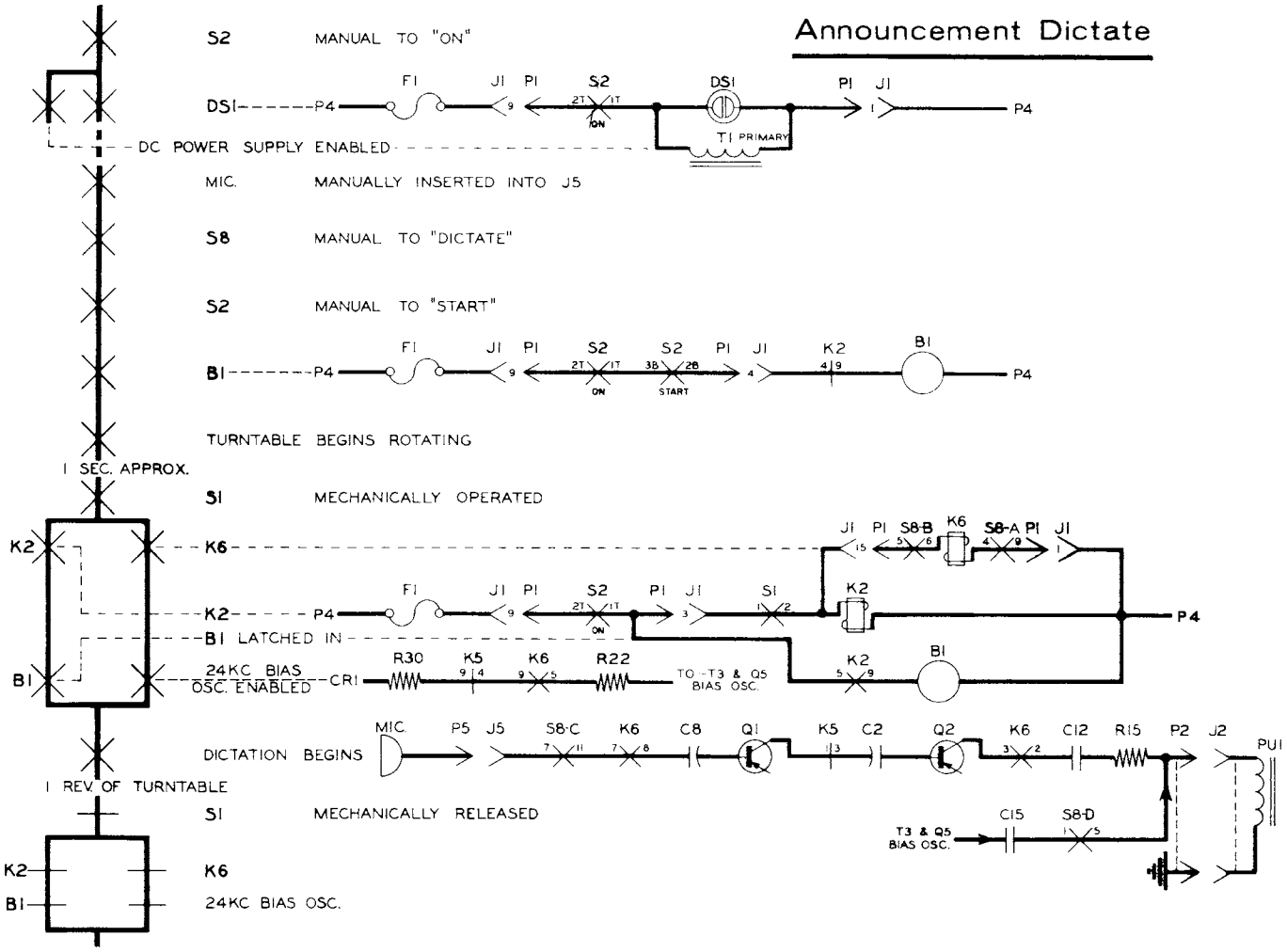


Figure 2. Announcement Dictate Functional Diagram.

Announcement Dictate

2.03 The selector switch S8 is rotated to "DICTATE" and the microphone inserted into the microphone jack J5. START-ON-OFF lever switch S2 is moved momentarily to "START," energizing motor B1. B1 drives the turntable and in approximately one second the homing cam allows switch S1 to operate. S1 energizes the coils of relays K2 and K6. Relay K2 forms a locking path for motor B1. Relay K6 connects the microphone to the input of the dictate amplifier Q1, Q2, and activates the bias oscillator Q5. The announcement message is now dictated and recorded. At the completion of the 15-second record interval (one revolution of turntable) the homing cam opens switch S1. Relays K2 and K6 release, breaking the operating path to motor B1 and the bias oscillator, returning the Model SP-2 to standby condition.

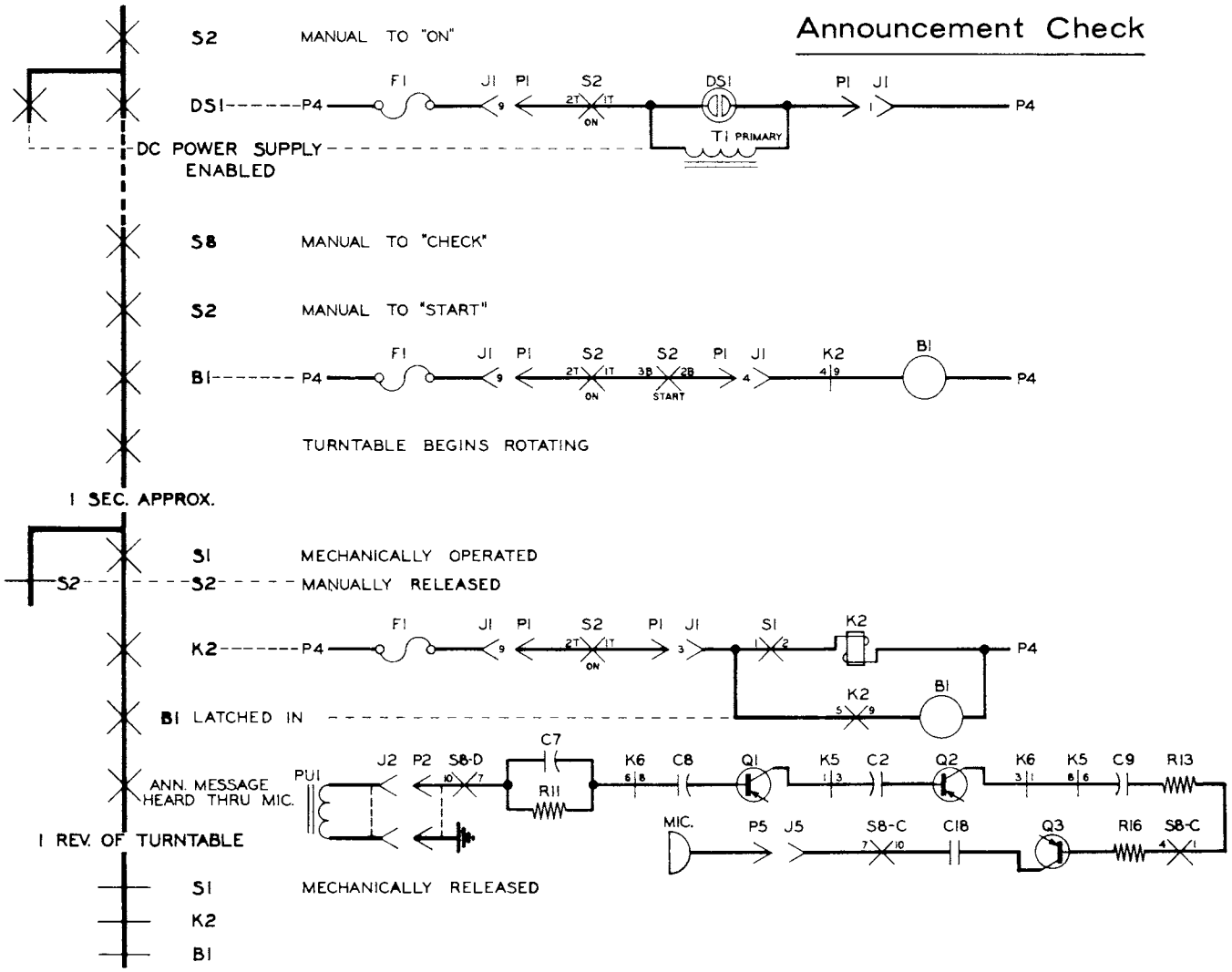


Figure 3. Announcement Check Functional Diagram.

Announcement Check

2.04 The selector switch S8 is rotated to "CHECK." START-ON-OFF lever switch S2 is moved momentarily to "START," energizing motor B1. B1 drives the turntable and in approximately one second the homing cam allows switch S1 to operate. Switch S1 energizes the coil of K2, which forms a locking path for motor B1. The announcement message is now heard through the microphone. At the end of the announcement message, or one revolution of the turntable, S1 is mechanically released by the homing cam, breaking the operate path to relay K2 and motor B1 returning the Model SP-2 to standby condition.

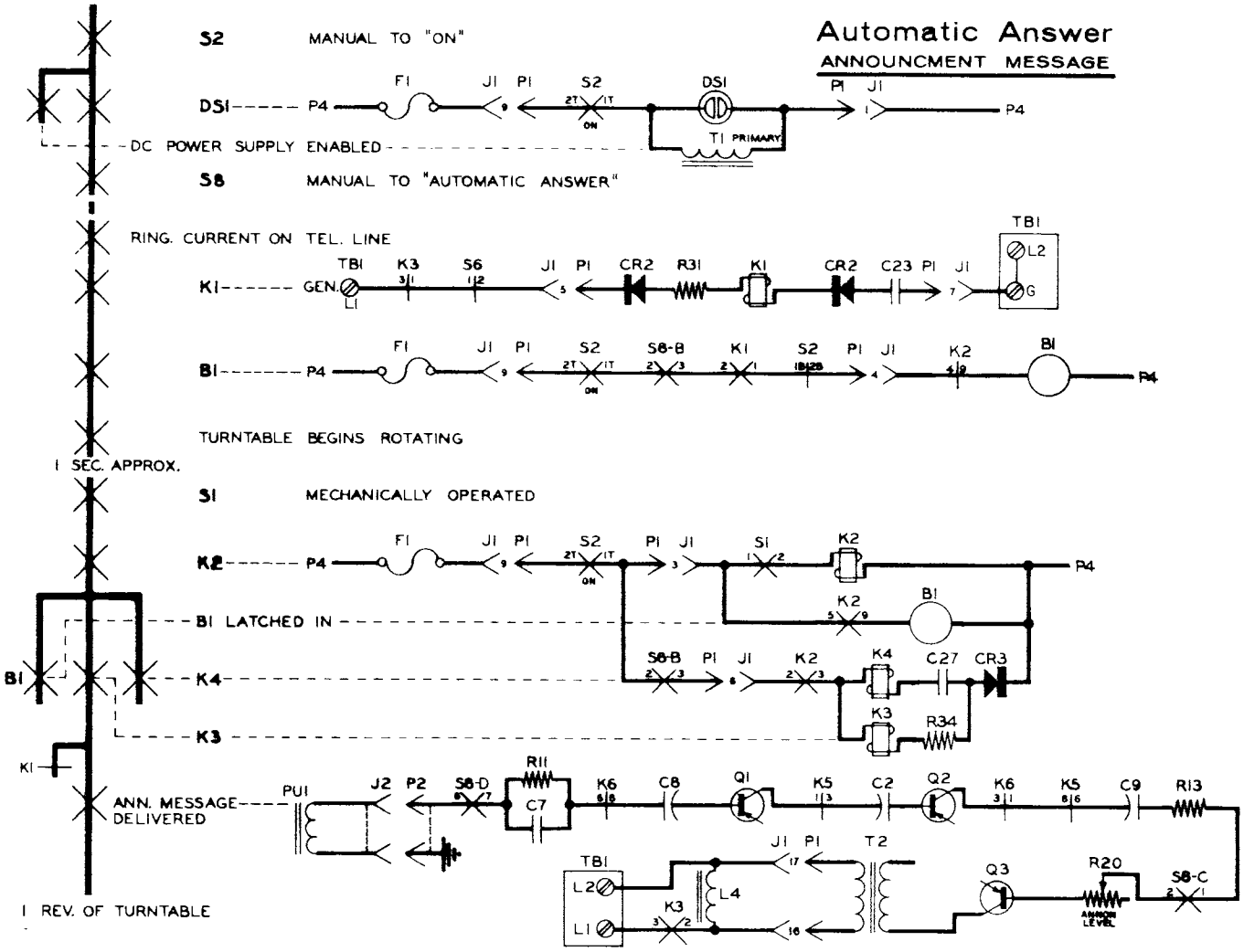


Figure 4. Automatic Answer (Announcement Message) Functional Diagram.

Automatic Answer (Announcement Message)

2.05 When ringing current is applied to K1 (ringing relay), K1 operates and energizes motor B1. B1 drives the turntable and approximately one second later the homing cam allows S1 to close, operating relay K2. Relay K2 forms a latch path for motor B1, operates K3 and pulses relay K4. Relay K3 connects L4 across the telephone line, loading the line and tripping the ring. Relay K4, because of the blocking action of capacitor C28, will pulse and being a ratchet relay will reset everytime it is pulsed to its opposite switching position. The turntable is now running and the announcement message is delivered.

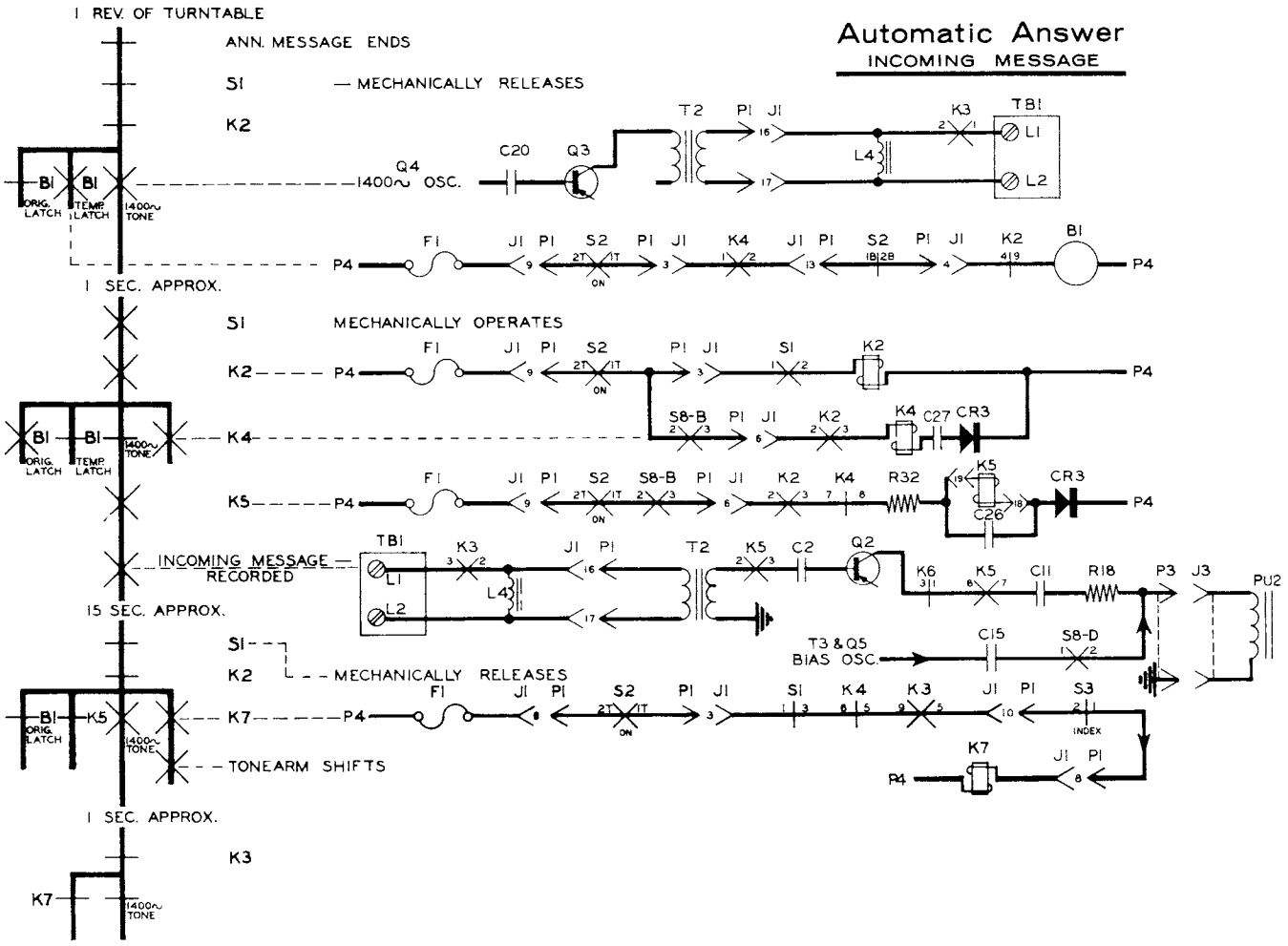


Figure 5. Automatic Answer (Incoming Message) Functional Diagram.

Automatic Answer (Incoming Message)

2.06 At mid-cycle (the beginning of the second revolution of the turntable), the homing cam switch S1 opens momentarily. K2 releases, but K3 remains operated during the transit time because of the discharge of capacitors C28 and C27. Relay K4 forms a temporary latching path for B1. K2 in releasing completes a return path to the tone oscillator thus transmitting a tone signal to the telephone line. After the turntable has moved far enough to move the homing cam past S1, S1 will again close, operating relay K2, and pulsing relay K4. Relay K3 is again latched in, and relay K5, the incoming record relay, is operated. The turntable is now on its second revolution and the Model SP-2 is prepared to record an incoming message. At the end of the second revolution of the turntable the homing cam again releases S1. This action causes relay K2 to release and again a tone signal is transmitted to the telephone line for one second. Because of the discharge time of capacitors C28 and C27, K3 will remain operated. Relay K7 operates causing the tone arm to shift to the next channel. C28 and C27 after discharge, release relay K3 thus terminating the automatic cycle.

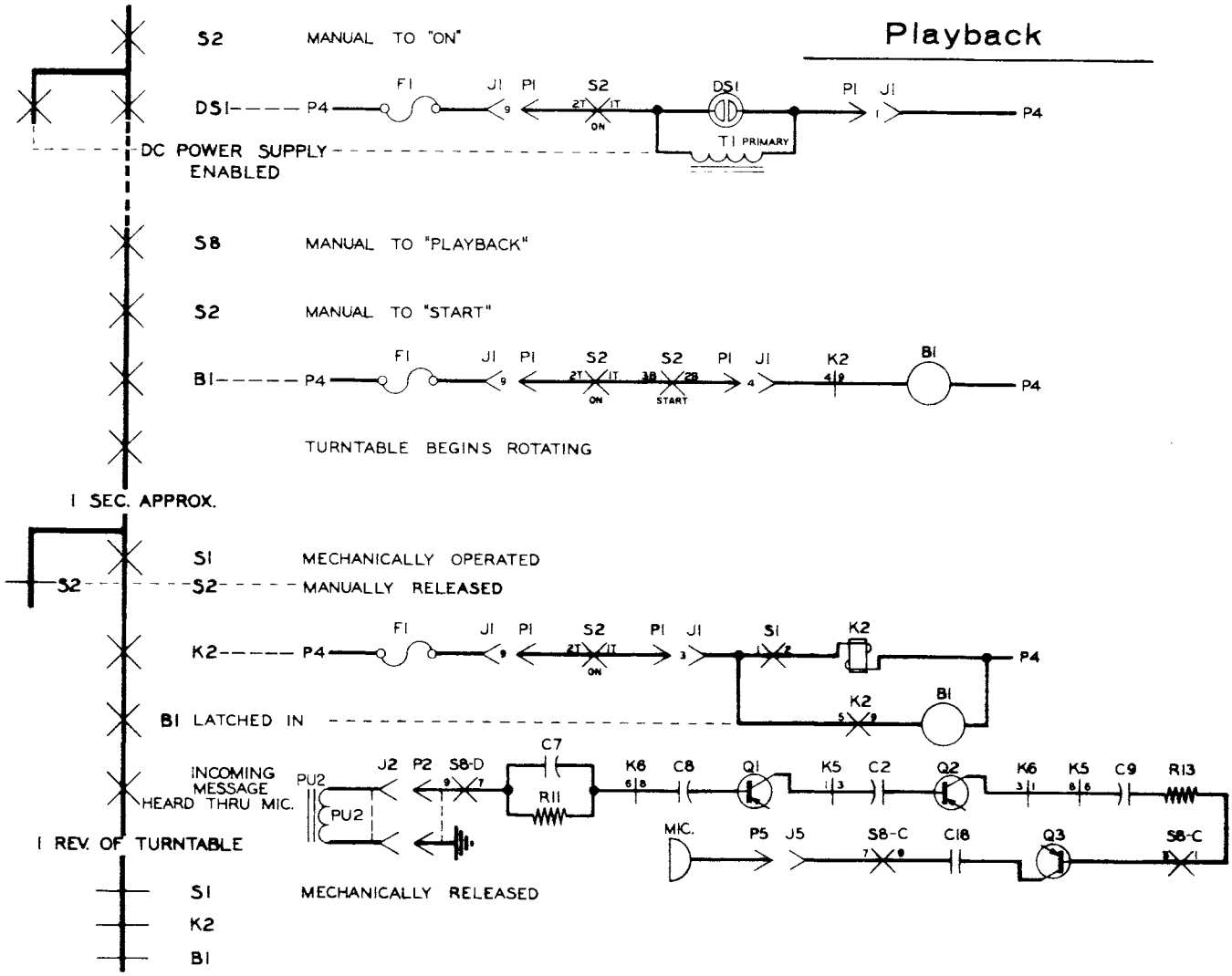


Figure 6. Playback Functional Diagram.

Playback

2.07 The selector switch S8 is rotated to "PLAYBACK." This action connects PU2 (Record/Playback head) and the playback amplifier to the microphone. START-ON-OFF switch S2 is moved momentarily to "START," energizing motor B1. B1 drives the turntable which operates switch S1. S1 energizes relay K2 which forms a locking path for motor B1. The incoming message playback can now be heard through the microphone. At the end of the message or one revolution of the turntable S1 is mechanically released by the homing cam breaking the operate path of relay K2 and motor B1 thus ending the cycle.

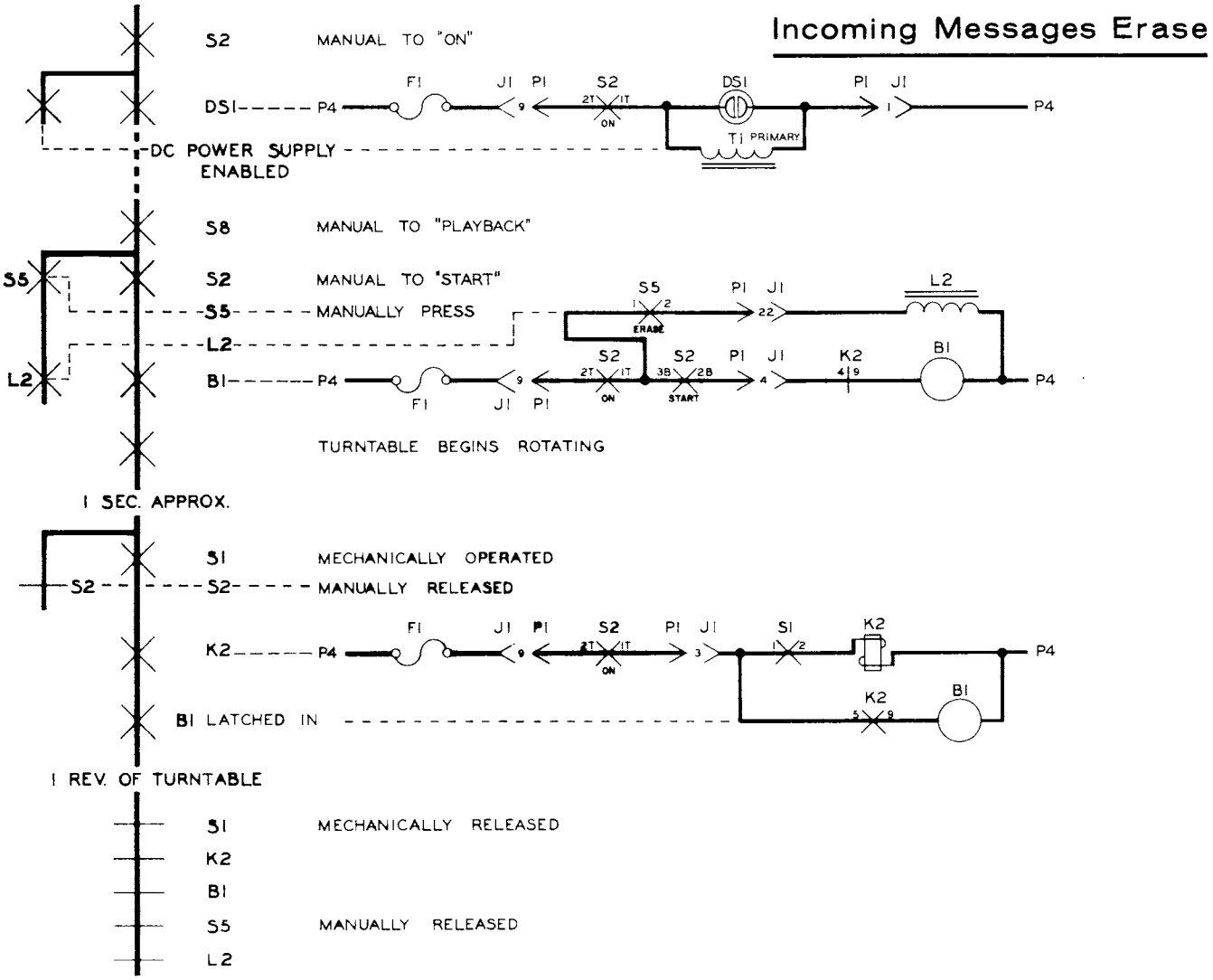


Figure 7. Incoming Messages Erase Functional Diagram.

Incoming Messages Erase

2.08 The selector switch is rotated to "PLAYBACK." START-ON-OFF lever switch S2 is moved momentarily to "START," energizing motor B1, and ERASE button switch S5 is depressed and held, energizing erase coil L2. Motor B1 drives the turntable which operates switch S1. S1 energizes relay K2 which forms a locking path for motor B1. As the turntable rotates past the erase coil L2 the a-c field erases all twelve channels at once. At the end of one revolution of the turntable, S1 is mechanically released by the homing cam breaking the operate path of relay K2 and motor B1, thus ending the cycle. The ERASE switch S5 is now released, de-energizing L2.

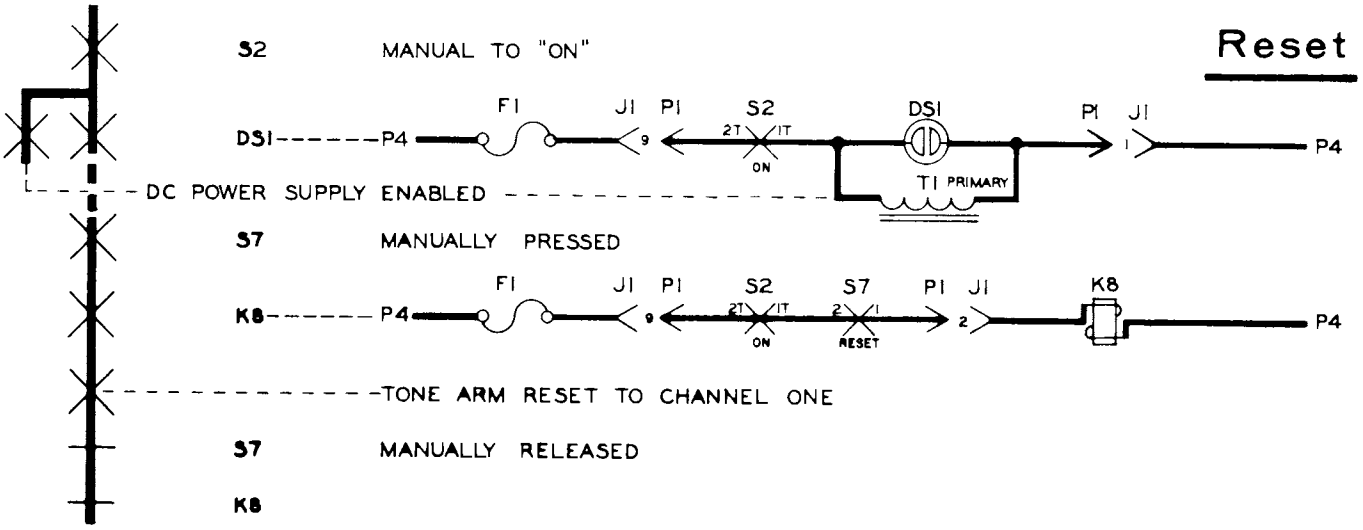


Figure 8. Reset Functional Diagram.

Reset

2.09 Pushbutton switch S7 is despressed, operating RESET relay K8. Operation of K8 activates the ratchet locking arm releasing the ratchet wheel and cam which, being spring loaded, returns the tone arm to channel "1."

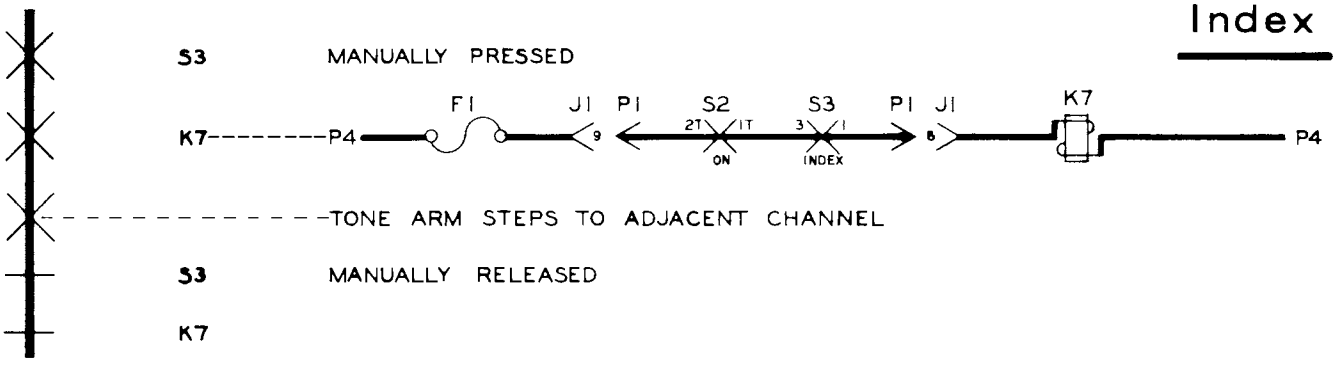


Figure 9. Index Functional Diagram.

Index

2.10 Pushbutton switch S3 is depressed, operating INDEX relay K7. Operation of K7 causes a pawl attached to the armature of K7 to engage a ratchet and rotates the ratchet a given number of degrees thus completing one step. A cam is attached to the ratchet wheel shaft and as the cam is moved it positions or steps the tone arm to the next channel.

3. MODEL SP-2 VOLTAGE CHECKS

3.01 The following d-c voltages should exist at the test points indicated while the Model SP-2 is performing the function shown. Refer to the Model SP-2 schematic diagram, WW-4729-54. The d-c voltage test points and respective voltage readings are shown in Table 3. The a-c voltage test points and respective voltage readings are shown in a separate table for each of the various functional tests.

D-C Voltage Tests

3.02 A line voltage of 115 V a-c, 60 cycles is used when performing these tests.

Table 3. D-C Voltages.

Test Point	FUNCTION				
	Automatic Outgoing Announcement	Automatic Beep Oscillator	Automatic Incoming Message	Dictate	Check - Playback
Power Transformer	21.3 V (a-c)			21.3 V (a-c)	21.3 V (a-c)
First Filter	-24.2			-24.2	-24.2
Second Filter	-13.2			-13.0	-13.2
Q1 Transistor Collector	-6.8			-6.7	-6.7
Q1 Transistor Base	-1.14			-1.15	-1.15
Q1 Transistor Emitter	-.97			-1.0	-1.02
Q2 Transistor Collector	-6.5		-5.6	-6.2	-6.4
Q2 Transistor Base	-1.1		-1.3	-1.1	-1.1
Q2 Transistor Emitter	-.92		-1.12	-1.0	-.97
Q3 Transistor Collector	-12.9				-13.0
Q3 Transistor Base	-5.1				-5.2
Q3 Transistor Emitter	-4.9				-5.0
Q4 Transistor Collector		-3.1			
Q4 Transistor Base		-1.28			
Q4 Transistor Emitter		-1.32			
Q5 Transistor Collector			-12.1	-12.2	
Q5 Transistor Base			+14.8	+14.9	
Q5 Transistor Emitter			-1.25	-1.25	

Automatic Outgoing Announcement

3.03 Prepare the unit as follows:

(1) Apply a 1.5-MV, 1,000 cycle signal to the dictate head.

(2) Set the outmessage potentiometer at maximum.

(3) Connect a 600-ohm resistor between L1 and L2 at the telephone block.

3.04 Check for the voltages shown in Table 4.

Table 4. AC Voltages - Automatic Outgoing Announcement.

	Q1	Q2	Q3
Collector	4.9 V	590 MV	2.4 V
Base	.47 V	4.8 MV	70 MV
Emitter	.38 MV	.62 MV	62 MV
Output across telephone block: +8.3 DBM			

Automatic Beep Oscillator

3.05 Prepare the unit as follows:

(1) Adjust the oscillator for 1400 cycles.

(2) Connect a 600-ohm resistor across the terminals of the telephone block.

3.06 Check for the voltages shown in Table 5.

Table 5. AC Voltages - Automatic Beep Oscillator.

	Q4
Collector	760 MV
Base	17.7 MV
Emitter	138 MV
Output across telephone block: -22.5 DBM	

Automatic Incoming Messages

3.07 Prepare the unit as follows:

(1) Place a 600-ohm resistor across the terminals of the telephone block.

(2) Apply a signal of -25 DBM at 1,000 cycles to the terminals of the telephone block.

(3) Connect a 470-ohm, 5% resistor from the second filter to ground.

(4) Remove transistor Q5.

3.08 Check for the voltages shown in Table 6.

Table 6. AC Voltages - Automatic Incoming Messages (Record Head Amplifier).

	Q2
Collector	1.34 V
Base	10.2 MV
Emitter	1.05 MV
Voltage across PU2: 147 MV	

3.09 For the second part of this test, prepare the unit as follows:

(1) Place the Q5 transistor into its socket.

(2) Remove the 470-ohm resistor connected between the second filter and ground.

(3) Adjust the oscillator for 24 KC.

3.10 Check for the voltages shown in Table 7.

Table 7. AC Voltages - Automatic Incoming Messages (Record Bias).

	Q5
Collector	5.75 V
Base	15.3 V
Emitter	1.72 V
PU2 Bias: 23.2 V	
T3 Secondary: 59V	

Dictate

3.11 Prepare the unit as follows:

(1) Apply a 1.5 mv, 1,000 cycle signal across terminals MIC.

(2) Place a 470-ohm, 5% resistor between the second filter and ground.

(3) Remove transistor Q5.

3.12 Check for the voltages shown in Table 8.

Table 8. AC Voltages - Dictate (Announcement Record Amplifier).

	Q1	Q2
Collector	16 MV	1.98 V
Base	1.52 MV	16.1 MV
Emitter	1.28 MV	3.5 MV
Voltage across PU2: 225 MV		

3.13 For the second part of this test prepare the unit as follows:

(1) Remove the 470-ohm resistor connected between the second filter and ground.

(2) Return transistor Q5 to its socket.

3.14 Check for the voltages shown in Table 9.

Table 9. AC Voltages - Dictate (Record Bias).

	Q5
Collector	5.8 V
Base	15.6 V
Emitter 1.74	1.74 V
PU2 Bias: 23.8 V	
T3 Secondary: 60 V	

Check

3.15 Prepare the unit as follows:

(1) Apply a 2 MV, 1,000 cycle signal to the recording head.

3.16 Check for the voltages shown in Table 10.

Table 10. AC Voltages - Check Function.

	Q1	Q2	Q3
Collector	6.2 MV	860 MV	3.4 V
Base	.62 V	6.2 MV	39 MV
Emitter	.51 MV	.67 MV	34 MV
Signal at MIC: 3.2 V			

Playback

3.17 Prepare the unit as follows:

(1) Apply a 1 MV, 1,000 cycle signal across the recording head.

3.18 Check for the voltages shown in Table 11.

Table 11. AC Voltages - Playback.

	Q1	Q2	Q3
Collector	3.2 MV	385 MV	3.25 V
Base	.29 MV	3.2 MV	38 MV
Emitter	.24 MV	.4 MV	33 MV
Signal at MIC: 3.0 V			

Voltage Across AC Relays

3.19 The voltages shown in Table 12 should exist across the relays indicated.

Table 12. Voltage Across AC Relays.

K-3	78 V D-C
K-4	100-170 V A-C (P-P) Approx.
K-5	78 V D-C

Equipment Condition

3.20 The following equipment conditions must exist when performing the OVERALL GAIN tests:

(1) Announcement Record Head Pressure: 30 GR

(2) Incoming Record Head Pressure: 30 GR

(3) Tape to announcement erase magnet spacing: 1/64 to 1/32 inch

(4) Tape to incoming record erase magnet spacing: 3/64 to 1/16 inch

Overall Gain (DICTATE-CHECK)

3.21 Check the overall gain as follows:

(1) Place Model SP-2 in "Dictate."

(2) Apply 1.5 MV, 1,000 cycle signal across the MIC terminals.

(3) Record 1 KC signal.

(4) Place the Model SP-2 in "Check."

(5) Check for the following signal at the microphone: 2 to 2.5 V a-c approx.

Overall Gain (INCOMING MESSAGE-PLAYBACK)

3.22 Check the overall gain as follows:

(1) Place a 600-ohm resistor across the terminals of the telephone block.

(2) Apply a -25 DBM, 1,000 cycle signal to the telephone block terminals.

(3) Place the head at channel six.

(4) Place the Model SP-2 in "Automatic Answer" (Incoming Message Position).

(5) Record the 1,000 cycle signal.

(6) Place the Model SP-2 in "Playback."

(7) Check for the following signal at microphone: 1 to 1.5 V a-c approx.

4. ELECTRICAL ADJUSTMENTS

4.01 Make no adjustments to the unit unless it fails to operate properly. If the unit does not operate properly, the mechanical adjustments in Section 997-402-500 and the following electrical adjustments may have to be made. Return the unit to the repair shop to perform these adjustments, or if more extensive repair is necessary. Performance of the following adjustments requires a signal generator, VTVM, and a 600-ohm resistor.

Announcement Message Level Adjustment

4.02 Record an announcement message. Rotate the selector switch to the "AUTOMATIC ANSWER" position. Remove the selector knob to gain access to the announcement level potentiometer, R20 (Figure 10). Initiate a call to the line associated with the SP-2, and adjust potentiometer R20 for a comfortable listening level.

Announcement Record/Playback Head Adjustment

4.03 Perform the mechanical adjustment of the announcement message record/playback head as indicated in Section 997-402-500.

4.04 Perform the electrical adjustment of the announcement record/playback head as follows:

(1) Rotate the selector knob to "DICTATE."

(2) Apply a 0.15 MV 1,000 cps test signal across the microphone jack terminals.

(3) Record the test signal by operating the START-ON-OFF switch to the "START" position.

(4) After the turntable stops, rotate the selector knob to "CHECK."

(5) Connect a VTVM across the microphone jack terminals.

(6) Operate the START-ON-OFF switch to the "START" position.

(7) Align the recording head for maximum output. The reading should be approximately 2.5 V a-c.

Incoming Message Record/Playback Head Adjustment

4.05 Perform the mechanical adjustment of the incoming message record/playback head as indicated in Section 997-402-500.

4.06 Perform the electrical adjustments of the incoming message record/playback head as follows:

(1) Depress the INDEX button until the message indicator shows the tone arm on channel 6.

(2) Rotate the selector knob to "AUTOMATIC."

(3) Connect a 600-ohm resistor across terminals L1 and L2 of the telephone block.

(4) Momentarily operate the START-ON-OFF switch to its "START" position to begin the automatic answer cycle.

(5) When the unit is in the incoming message portion of the cycle, apply a 43 MV or a -25 DBM 100 cps signal across L1 and L2.

(6) After recording this signal, connect an a-c VTVM across the microphone jack terminals.

(7) Rotate the selector knob to "PLAY-BACK."

(8) Momentarily depress the RESET button.

(9) Depress the INDEX button to return the tone arm to channel 6.

(10) Momentarily operate START-ON-OFF switch to "START."

(11) Align message head for maximum output by adjusting the three set screws located at the incoming message record/playback head. The reading should be approximately 1.5 V a-c.

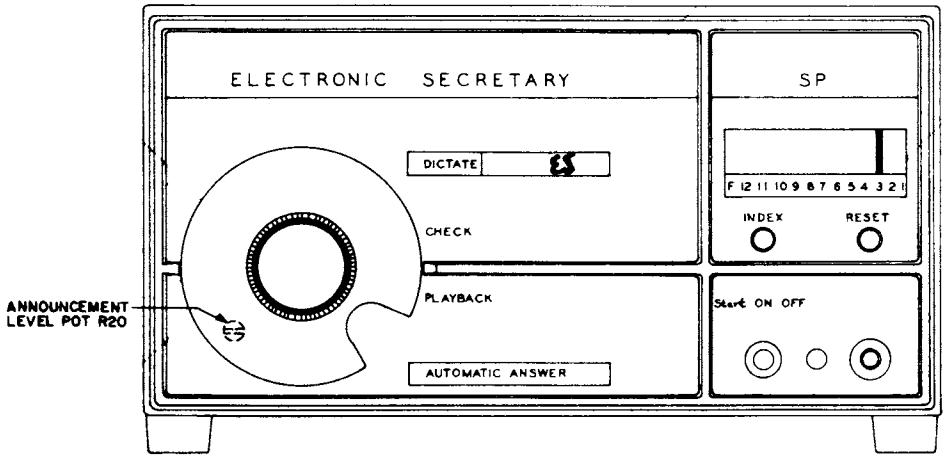
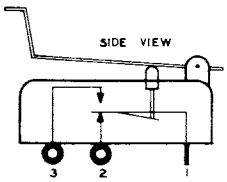
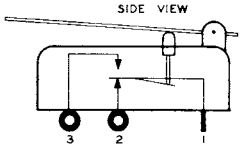


Figure 10. Front Panel, Model SP-2.

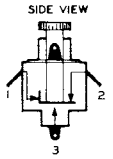
Switch Contact Layout



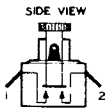
S1
PART NO. WW-5197-32



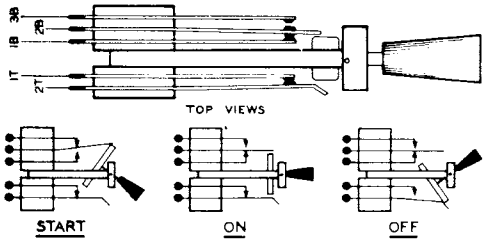
S6
PART NO. WW-1134-32



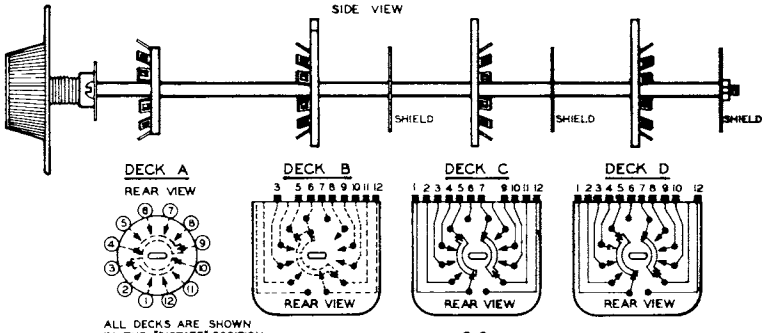
S3 INDEX - BLACK
PART NO. WW-4739-32



S4 ERASE PLAYBACK - RED
S5 ERASE CHECK - RED — PART NO. 4737-32
S7 RESET - BLACK — PART NO. 4738-32



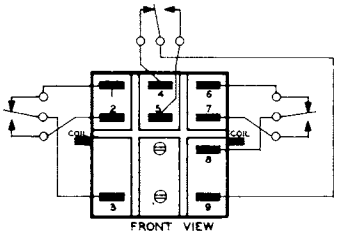
S2
PART NO. WW-4740-32



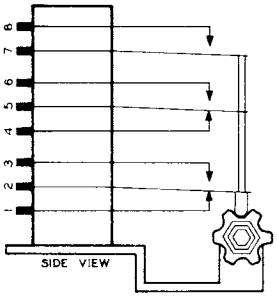
ALL DECKS ARE SHOWN IN THE "DICTATE" POSITION.

S8 ROTARY
PART NO. WW-4706-32

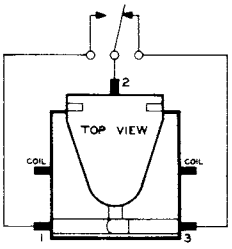
Relay Contact Layout



K2
K3 — PART NO. WW-1081-49
K5
K6 — PART NO. WW-4695-49

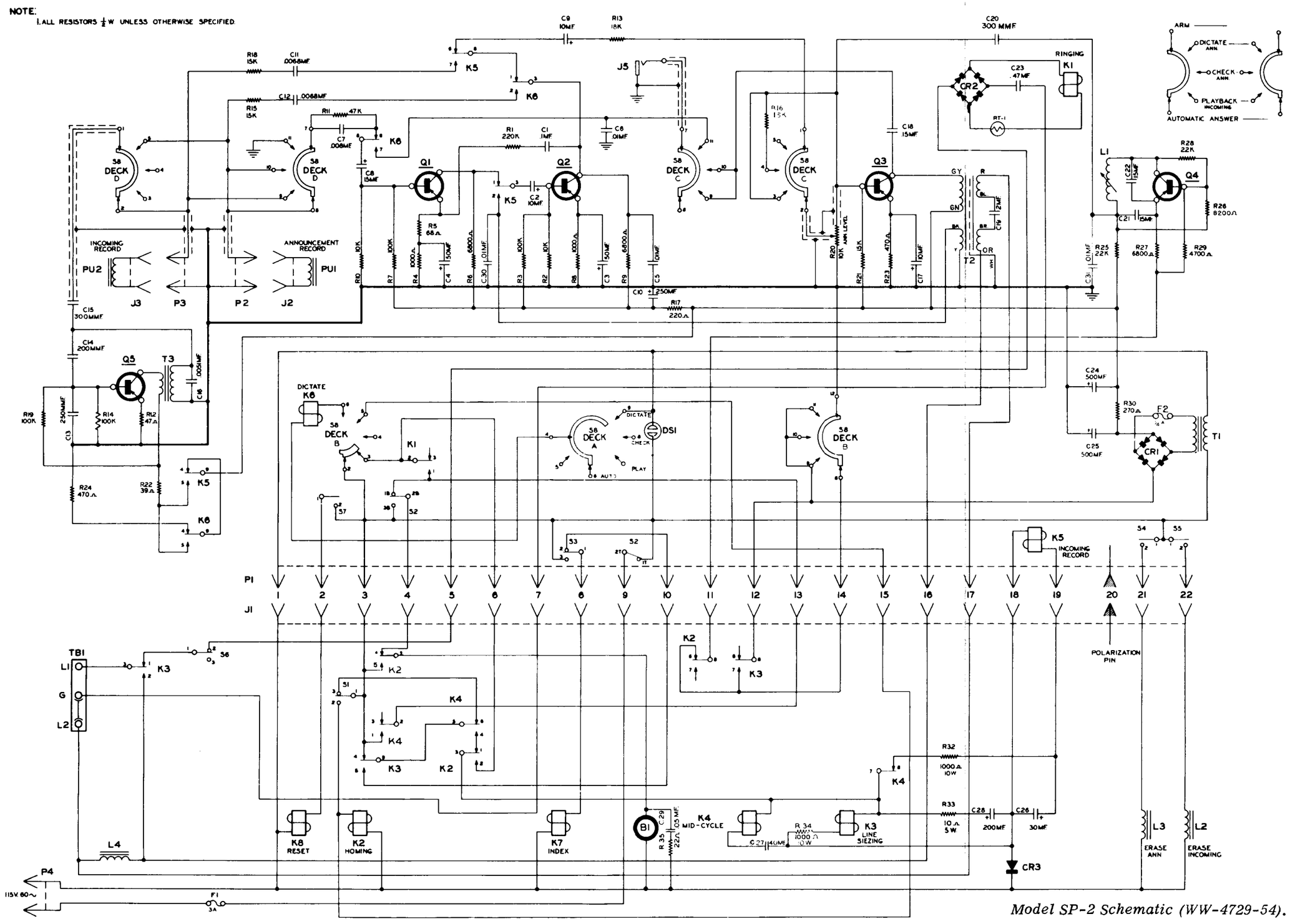


K4
PART NO. WW-4669-49



K1
PART NO. WW-4696-49

NOTE:
1. ALL RESISTORS ½ W UNLESS OTHERWISE SPECIFIED.



Model SP-2 Schematic (WW-4729-54).