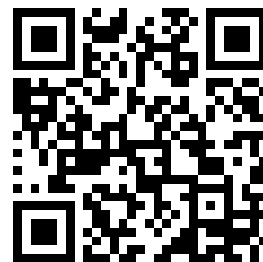


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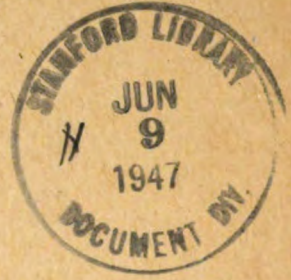




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# TM 11-2542

WAR DEPARTMENT TECHNICAL MANUAL



## SPEECH RECORDER MC-502

**RESTRICTED.**

*DISSEMINATION OF RESTRICTED MATTER.*

The information contained in restricted documents and the essential characteristics of restricted material may be given to any person known to be in the service of the United States and to persons of undoubted loyalty and discretion who are cooperating in Government work, but will not be communicated to the public or to the press except by authorized military public relations agencies. (See also par. 23b, AR380-5, 15 March 1944.)



**SPEECH RECORDER**  
**MC-502**



WAR DEPARTMENT

2 NOVEMBER 1944

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**WAR DEPARTMENT;  
WASHINGTON 25, D. C., 2 November 1944.**

**TM 11-2542, Speech Recorder MC-502, is published for the information and guidance of all concerned.**

[A. G. 300.7 (27 July 44).]

**BY ORDER OF THE SECRETARY OF WAR:**

**G. C. MARSHALL,**  
*Chief of Staff.*

**OFFICIAL:**

**J. A. ULIO,**  
*Major General,*  
*The Adjutant General.*

**DISTRIBUTION:**

**IBn 11(3); IC 11(3).**  
**(For explanation of symbols see FM 21-6.)**

# TABLE OF CONTENTS

---

	Paragraph	Page
<b>SECTION I. Description</b>		
General	1	1
List of components	2	3
Table of Specifications	3	4
Amplifier system	4	5
Backspacer	5	5
Carriage housings	6	5
Change-over assembly	7	5
Connections	8	6
Control lever interlock	9	7
Controls	10	7
Constant groove speed	11	8
Dashpot	12	8
Drive	13	8
Drive mandrel	14	8
Feed nut	15	8
Feed screw	16	9
Flywheel	17	9
Gear train	18	9
Idler mandrel	19	9
Injector-ejector	20	9
Machine covers	21	10
Motor	22	10
Recorder	23	10
Recorder carriage guide	24	10
Recorder mount bracket assembly	25	11
Recorder stylus	26	11
Reduction pulley	27	12
Reproducer	28	13
Reproducer carriage guide	29	13
Reproducer mount bracket assembly	30	14
Reproducer stylus	31	14
Change record switch	32	15
Ready record switch	33	15
Reproducer safety switch	34	15
Shock mounting	35	15
Signal lights	36	15
Simultaneous or separate recording and reproduction	37	17

## TABLE OF CONTENTS

	Paragraph	Page
<b>SECTION II. Installation and Operation</b>		
General .....	38	18
Unpacking .....	39	18
Installing record loading .....	40	19
Operating recorder carriage control levers .....	41	21
Electrical connections .....	42	21
Setting controls for speech recording .....	43	23
Setting controls for code recording .....	44	23
Recording .....	45	24
Changing, record reloading .....	46	25
Reproducing .....	47	25
Recording level suggestions .....	48	26
 <b>III. Functioning of Parts</b>		
General .....	49	27
Amplifier system .....	50	28
Backspacer assembly .....	51	35
Carriage housings .....	52	35
Change-over mechanism .....	53	35
Circuits .....	54	38
Connections .....	55	39
Control lever interlock .....	56	39
Controls .....	57	43
Dashpot .....	58	50
Drive .....	59	50
Drive mandrel assembly .....	60	51
Feed nut assembly .....	61	51
Feed screw assembly .....	62	51
Flywheel .....	63	51
Gear train assembly .....	64	51
Idler mandrel assembly .....	65	52
Injector-ejector assembly .....	66	52
Motor assembly .....	67	52
Recorder .....	68	53
Recorder carriage guide .....	69	54
Recorder mount bracket assembly .....	70	54
Recorder stylus .....	71	54
Reduction pulley assembly .....	72	55

## TABLE OF CONTENTS

	Paragraph	Page
<b>SECTION III. Functioning of parts (contd.)</b>		
Reproducer.....	73	55
Reproducer carriage guide.....	74	55
Reproducer mount bracket assembly.....	75	56
Reproducer stylus.....	76	56
Change record switch.....	77	58
Ready record switch.....	78	58
Reproducer safety switch.....	79	58
Shock mounting.....	80	58
Signal lights.....	81	59
Simultaneous or separate recording and reproduction.....	82	59
 <b>IV. Maintenance</b>		
General.....	83	60
Amplifier system.....	84	60
Backspacer.....	85	79
Carriage housings.....	86	84
Change-over assembly.....	87	84
Control lever interlock.....	88	89
Dashpot.....	89	95
Drive mandrel.....	90	96
Feed nut.....	91	100
Feed screw.....	92	100
Flywheel.....	93	105
Gear train.....	94	107
Idler mandrel.....	95	109
Injector-ejector.....	96	111
Machine covers.....	97	115
Motor.....	98	115
Recorder.....	99	119
Recorder carriage guide.....	100	119
Recorder mount bracket assembly.....	101	120
Recorder stylus.....	102	120
Reduction pulley.....	103	125
Reproducer.....	104	126
Reproducer carriage guide.....	105	127
Reproducer mount bracket assembly.....	106	128
Reproducer stylus.....	107	128

## TABLE OF CONTENTS

	Paragraph Page	
<b>SECTION IV. Maintenance (contd.)</b>		
Change record switch.....	108	129
Ready record switch.....	109	131
Reproducer safety switch.....	110	131
Shock mounting.....	111	132
Signal lights.....	112	132
Physical inspection.....	113	132
Recording check.....	114	133
Lubrication.....	115	133
Maintenance charts.....	116	135
Failures and remedies.....	117	135
Moistureproofing and fungiproofing.....	118	136
<b>V. Supplementary Data</b>		
Tube pin data.....	119	144
Amplifier tube socket voltage data.....	120	144
Power supply filter section--volts to ground.....	121	145
Amplifier resistance test chart.....	122	145
Reference parts list for Speech Recorder MC-502 and Speech Reproducer MC-503.....	123	145
Maintenance parts list for Speech Recorder MC-502.....	124	152

# LIST OF ILLUSTRATIONS

Fig. No.	Title	Page
1	Complete equipment, case closed . . . . .	x
2	Power and motor foot control cables . . . . .	1
3	Complete equipment, case opened . . . . .	2
4	External and internal connections . . . . .	6
5	Recorder . . . . .	11
6	Recorder stylus . . . . .	12
7	Reproducer . . . . .	13
8	Reproducer stylus . . . . .	14
9	Interior of amplifier compartment . . . . .	16
10	Operating ejector . . . . .	19
11	Placing record on mandrels . . . . .	20
12	Inserting record . . . . .	20
13	Operating injector . . . . .	21
14	Operating recorder carriage control lever . . . . .	22
15	Audio input circuit . . . . .	29
16	Compressor rectifier circuit . . . . .	30
17	Negative feedback diagram . . . . .	31
18	Reproduce amplifier schematic . . . . .	32
19	Change-over mechanism perspective . . . . .	36
20	Motor circuit . . . . .	37
21	Signal light circuit . . . . .	38
22	Audio circuit . . . . .	39
23	Power circuit . . . . .	40
24	Control lever interlock and injector-ejector perspective . . . . .	41
25	4-1 Compression circuit . . . . .	42
26	2-1 compression circuit . . . . .	44
27	Code limiter circuit . . . . .	45
28	Meter circuit . . . . .	46
29	Motor "Two-Speed" control circuit . . . . .	47
30	Recorder Tone control circuit . . . . .	49
31	Recorder, cross-section . . . . .	53
32	Reproducer, cross-section . . . . .	56
33	Switches . . . . .	57
34	Amplifier, front . . . . .	61
35	Amplifier, right, front . . . . .	61
36	Amplifier, bottom . . . . .	62

## LIST OF ILLUSTRATIONS

Fig. No.	Title	Page
37	Amplifier, top.....	63
38	Amplifier, top (diagram).....	64
39	Amplifier schematic.....	69
40	Amplifier, pictorial.....	71
41	Machine schematic.....	73
42	Machine pictorial, audio.....	75
43	Machine pictorial, power.....	77
44	Top of equipment, machine covers off.....	81
45	Backspacer assembly.....	82
46	Unit plate, raised.....	83
47	Bottom of unit plate.....	85
48	Change-over assembly.....	87
49	Control lever interlock assembly.....	91
50	Top of equipment, machine covers on.....	93
51	Dashpot assembly.....	94
52	Control interlock, ready switch, and dashpot assembly.....	97
53	Drive mandrel assembly.....	99
54	Carriage and feed nut assembly.....	101
55	Feed screw assembly.....	103
56	Gear train assembly.....	106
57	Idler mandrel assembly.....	108
58	Injector-ejector assembly.....	110
59	Injector-ejector control assembly.....	113
60	Motor mount.....	114
61	Recorder carriage assembly.....	117
62	Reduction pulley assembly.....	121
63	Reduction pulley assembly, (diagram).....	123
64	Reproducer carriage assembly.....	125
65	Ready switch assembly.....	130
66	Top Side of unit plate with machine covers in place.....	137
67	Under side view of unit plate of speech recorder.....	138
68	Case for speech recorder.....	139
69	Front and side view of amplifier.....	140
70	Top and rear panel of amplifier.....	141
71	Bottom view of amplifier.....	142

## DESTRUCTION NOTICE

**WHY** — To prevent the enemy from using or salvaging this equipment for his benefit.

**WHEN** — When ordered by your commander.

**HOW** — 1. Smash — Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. Cut — Use axes, handaxes, machetes.

3. Burn — Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. Explosives — Use firearms, grenades, TNT.

5. Disposal — Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

### USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

**WHAT** — 1. Smash — Meters, controls, panels, recorders, reproducers.

2. Cut — Cables and all wiring.

3. Burn — Resistors, capacitors, this technical manual.

4. Bury or scatter — Any or all of the above pieces after destroying their usefulness.

## DESTROY EVERYTHING





TL 94297

*Figure 1. Complete equipment, case closed*

# RESTRICTED

## SECTION I

### Description

#### 1. GENERAL (figs. 1, 2, and 3).

Speech Recorder MC-502 (fig. 3) is a portable recorder-reproducer, consisting of dual recording-reproducing units and an associated record-reproduce amplifier, all contained in a single field case. This equipment is designed to afford continuous recording of voice and code signals, and reproduction simultaneously with, or separately from, recording.

a. **Cables (fig. 2).** The two cables which are a part of the complete equipment are shown in figure 2. The power cable, with plugs attached, is shown at the left (fig. 2). The foot control switch and 25 foot cable, with plugs attached, is shown at the right (fig. 2).

b. **Records.** Six recording belts (for test purposes) are packed with this equipment. They are flexible, non-breakable, plastic, belt type, permanent records.

c. **Dual Units (fig. 3).** Speech Recorder MC-

502 equipment (fig. 3) consists of two separate and identical recording-reproducing machine units, located at top of equipment, interlocked with an automatic electro-mechanical change-over mechanism, which latter provides for continuous recording.

d. **Two-speed Motors (fig. 3).** Two-speed motors are provided with this equipment. By means of a switch (fig. 3) at top right center of the equipment, it is possible to set the motor speed for a 15 minute or a 30 minute record.

e. **Cover-base (figs. 1 and 3).** When the cover of the portable carrying case (fig. 1) is removed, it is used as a base for the machine (fig. 3).

f. **Control Panel (fig. 3).** The control panel (fig. 3) is located at front center of the equipment.

g. **Amplifier (fig. 3).** The amplifier system is behind the control panel. The latter is attached to the amplifier (fig. 3).

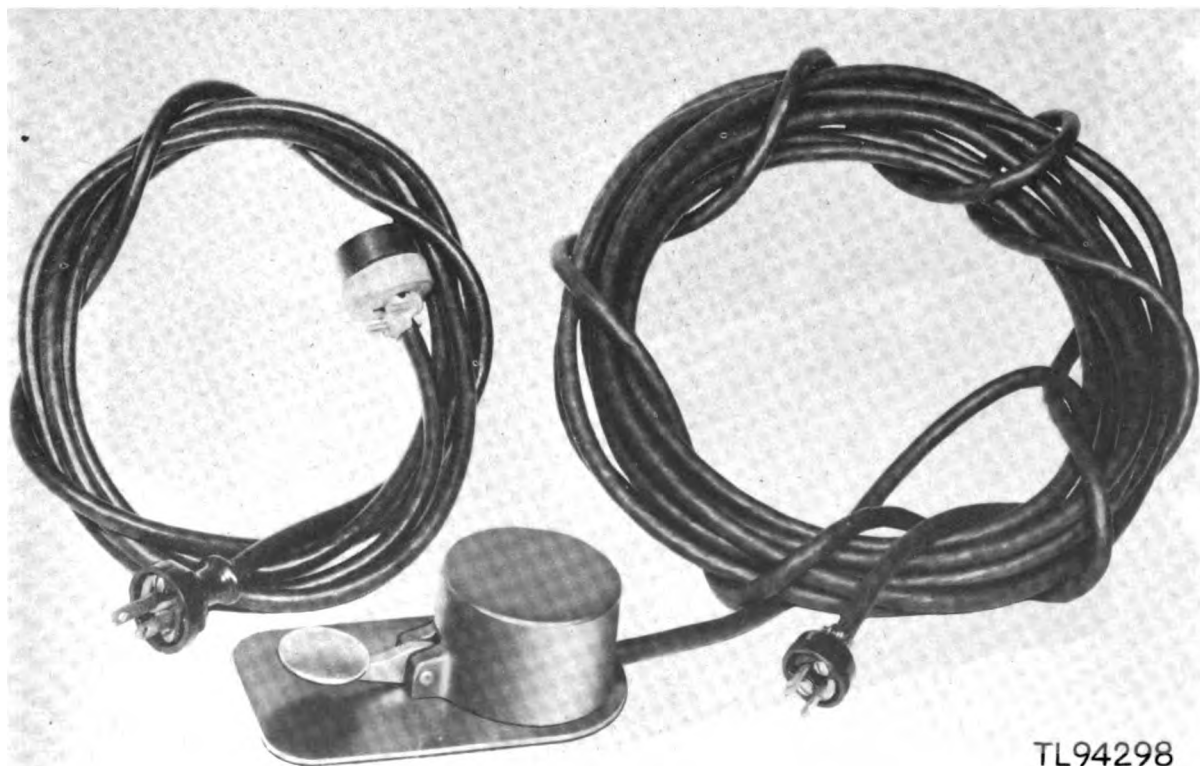


Figure 2. Power and motor foot control cables

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*Figure 3. Complete equipment, case opened*

## 2. LIST OF COMPONENTS.

Quan	Description	Height	Width	Dimensions (in)		Weight (lb)
				Length	Diam	
1	Speech Recorder MC-502, complete	26	14½ 16*	20 21†		133
1	Power cable			120		0.56
1	Foot control and cable	1⅝	3	5⅜ 300 (cable only)		1.5 1.18 (cable and plug only)
6	Recording belt (Record) <sup>1</sup> (thick)	0.0055	3.5	12.0 (Cir.)		0.01
2	Flywheel drive belt			55	⅜	0.007
2	Motor drive belt			26	⅜	0.004
5	Pilot light	1½			⅞	0.007
1	Magnetic recorder	1⅝	1¼	1½		0.17
1	Crystal reproducer	1⅜	1	1¼		0.07
30	Spare tubes as follows:					
9	JAN-6SK7 (VT-117)	3⅛			1⅝	0.077
3	JAN-6H6 (VT-90)	1⅝			1⅝	0.046
3	JAN-6J5 (VT-94)	2½			1⅝	0.06
8	JAN-6V6GT (VT-107)	3⅛			1⅝	0.076
3	JAN-6SL7GT (VT-229)	2⅞			1⅝	0.06
4	JAN-5Y3GT (VT-197A)	3⅝			1⅝	0.064

\*Including handles.

†Including hasps.

### 3. TABLE OF SPECIFICATIONS.

Audio input channels (high sensitivity)	500 ohms		
(bridging)	5,000 ohms		
Audio input power	Control any 60 db range between -80 and +20 db		
Audio output channels	600 ohms		
	5,000 ohms		
Audio output power	2.0 watts		
Background noise continuous	25 db or more below the maximum signal at 1,000 cycles		
Crosstalk in playback when recording	At least 20 db below normal recording level		
Distortion content (over-all)	10 percent		
Frequency response from 300 to 2,500 cycles	within $\pm 3.0$ db		
Mandrel speed (15' record)	78.0 $\pm$ 2.0 rpm		
(30' record)	39.0 $\pm$ 1.0 rpm		
Mechanical "Motion"	adequate for speech and code recording		
"Overlap" Time at change-over	(15' record)	10.0 to 15.0 Seconds	
	(30' record)	20.0 to 30.0 Seconds	
Playbacks per record	50		
	Record Time in mins	30'	15'
Power consumption (watts maximum)		130	170
(2) Motors		60	100
Record-reproduce amplifier		70	70
Power supply	115/230 volts — 50/60 cycles		
Record amplifier compression time (2/1)	0.030 sec.		
Record amplifier compression time (4/1)	0.330 sec.		
Record amplifier compression time (Code)	0.100 sec.		
Record amplifier release time (2/1)	0.450 sec.		
Record amplifier release time (4/1)	0.415 sec.		
Record amplifier release time (Code)	7.000 sec.		
Record stylus pressure	4 $\frac{3}{4}$ oz.		
Reproducer stylus pressure	0.75 oz.		
Recording belt (record) capacity, Playing time			
	(high speed)	15.0 minutes	
	(low speed)	30.0 minutes	
Recording belt (record) circumference	12.000 in. to 12.062 in.		
Recording belt (record) thickness	0.0055 in. $\pm$ 0.0005 in.		
Recording belt (record) width	3.468 in. to 3.500 in.		
Temperature range (operating)	+35°F to +120°F at 0/90% humidity		
	+35°F to +130°F at 0/75% humidity		
Temperature range (withstanding)	-40°F to +140°F at 0/95% humidity		
Tone groove velocity (high)	43.3 ft/min		
(low)	21.65 ft/min		
Tone grooves per inch	200		
Type of recording	lateral swaging		

#### 4. AMPLIFIER SYSTEM (figs. 35 and 39).

a. **General.** The amplifier system is composed of a record amplifier, a reproduce amplifier, and their common power rectifier supply. This equipment is mounted on one chassis, as shown pictorially in figure 35, and schematically in figure 39. There are no solid connections to this unit. It can be readily unplugged and removed from service, complete with its associated control panel, by removing a few plugs.

b. **Power Rectifier.** The power rectifier is a standard full-wave type of rectifier, employing one tube, working into a filter circuit of standard resistance-capacitor design.

c. **Record Amplifier.** The record amplifier is a six tube 4-stage "compression" type amplifier.

d. **Reproduce Amplifier.** The reproduce amplifier is a standard two tube 3-stage linear type amplifier.

**NOTE:** See paragraph 8 for connections and paragraph 10 for controls.

#### 5. BACKSPACER (figs. 44 and 45).

a. **General.** The backspacer (fig. 45) is a mechanism composed of three principal parts; a backspacer pawl (39); a backspacer pawl spring (35), and a backspacer rack (38).

b. **Location.** The backspacer pawl (39) and the backspacer pawl spring (35), together with their associated minor parts, are located on the top of the reproducer carriage (261 in fig. 44). The backspacer rack (38) is located adjacent to, and to the rear of, the reproducer carriage (261), and is mounted independently of the other two principal backspacer parts, on the main frame of the machine. Part of the backspacer mechanism then, is mounted on the reproducer carriage (261) and the remainder is mounted on the main frame of the machine.

c. **Use.** (1) When the backspacer mechanism is operated, it moves the reproducer carriage to the left three tone grooves ( $\pm 1$ ).

(2) The backspacer, then, is used to aid in locating the portion of the record to be played back, or to repeat a section of the record already reproduced.

#### 6. CARRIAGE HOUSINGS (figs. 44 and 54).

a. **General.** The recorder and reproducer carriage housings (fig. 54) are the same, except for the recorder carriage left-hand limit "stop" (98), which latter provides a means of controlling the left-hand margin on the record.

b. **Location.** The recorder carriage housing ((243 in fig. 44) is located on the feed screw cover (108)) at the top front of each dual recording-reproducing machine unit. The reproducer carriage housing (261 in fig. 44), is mounted on the feed screw cover at the top rear of each dual unit. The carriage housing assembly is about  $3\frac{1}{2}$  inches long and can be identified because the carriage control levers (36) are attached thereto.

c. **Use.** (1) The carriage housings are the main body support and guide for the recorder and reproducer assemblies.

(2) The carriage housings carry the recorder and reproducer assemblies in a lateral direction, at constant speed, with relation to the speed of the drive mandrel.

(3) Due to their constant lateral travel, relative to the rotation of the drive mandrel, and subsequently the recording belt, they cause the recorder stylus to trace a spiral tone groove in the recording belt of constant pitch, 200 grooves per inch, during recording. During reproduction, the carriage housings cause the reproducer stylus to track the spiral tone groove traced by the recorder stylus.

(4) The carriage housings provide the mounting surface for the feed nut assembly.

(5) The carriage housings provide a support for the carriage control levers, the carriage control lever stops, and the time indicator pointers.

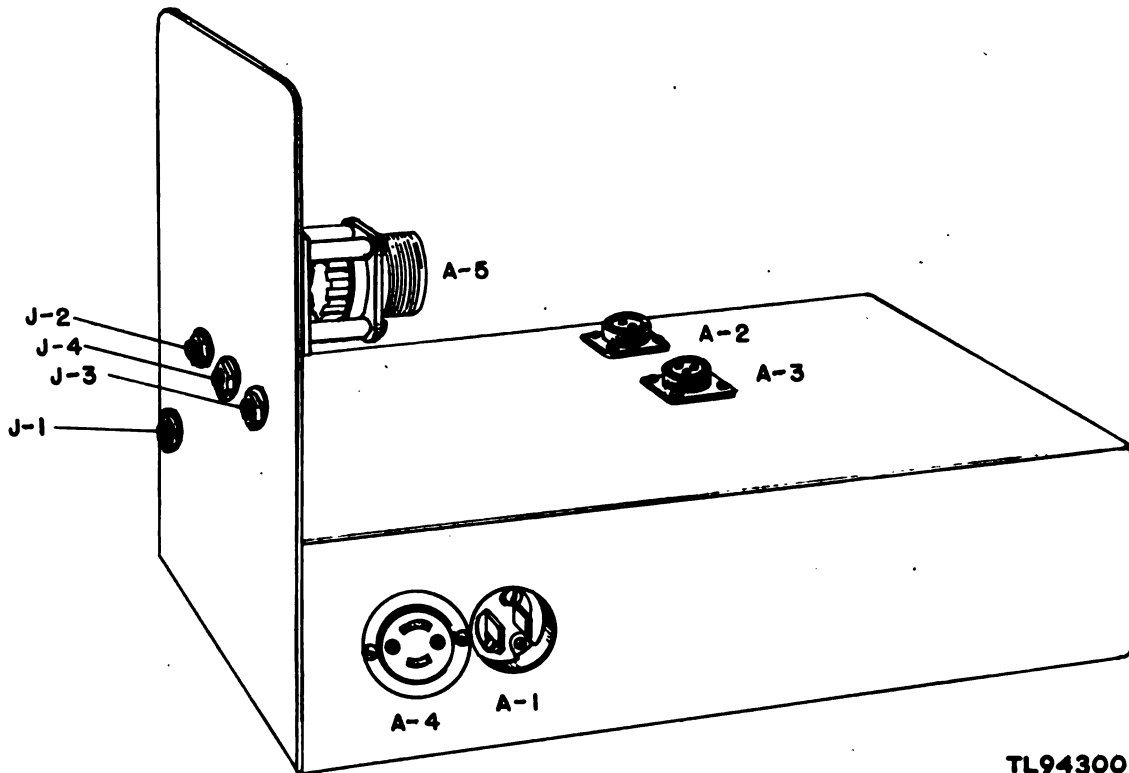
(6) In the case of the reproducer carriage, the carriage housings supply the mounting surface for the backspacer mechanism.

(7) The carriage housings supply the mounting surface for the recorder and reproducer carriage guides.

#### 7. CHANGE-OVER ASSEMBLY (figs. 47 and 48).

a. **General.** The change-over assembly (fig. 48) is an electro-mechanical assembly consisting of two single pole single throw micro-switches (3), and slidable actuating members (6 and 7), all assembled to a common mounting plate (47). The change-over assembly is the mechanism that automatically causes the recording to "change-over" from one dual unit to the other, with an "overlap" in the recording, thereby providing continuous, uninterrupted recording.

b. **Location.** This assembly is centrally located (4 in fig. 47) and mounted on the bottom side of the unit plate, between the two motors.



TL94300

Figure 4. External and internal connections

c. Use. (1) The automatic operation of the change-over assembly mechanism, applies power to the motor of the alternate dual recording-reproducing machine unit, at the beginning of the "change-over" or "overlap", and, at the end of the "change-over" period opens the motor circuit of the initial machine, and leaves the motor circuit of the alternate machine closed.

(2) It also operates as a safety device in case the equipment is left in operation, unattended. In this case it automatically opens both motor circuits when both records are fully recorded.

## 8. CONNECTIONS (Fig. 4).

a. General. Two external connections are necessary for recording; 115/230 volt, 50/60 cycle power supply input (A-1) and the audio input (J-1). If desired, the remote motor control cable (A-4), and foot switch can be used. Reproduction is provided by plugging in a pair of headphones or loud-speaker (J-3, J-4).

b. Audio Input. The audio input jack (J-1) is located at the lower left of the control panel.

c. Audio Output (Record Amplifier Monitor). The record amplifier output monitor jack

(J-2) is the left-hand jack of the three which are located in the center of the control panel. This is an 8.0-ohm output.

d. Audio Output (Reproduce Amplifier, 600 Ohms). The 600-ohm output of the reproduce amplifier is terminated at the center jack (J-4) of the three which are located at the center of the control panel.

e. Audio Output (Reproduce Amplifier, 5,000 Ohms). The 5,000-ohm reproduce amplifier output is terminated at the right-hand jack (J-3) of the three which are located in the center of the control panel.

f. Power Supply Input. The 115/230 volt, 50/60 cycle power supply input receptacle (A-1) is the rear receptacle of the two which are located on the right-hand side of the amplifier chassis, just to the rear of the control panel.

g. Remote Motor Control. The remote motor control receptacle (A-4) is the front receptacle of the two which are located on the right-hand side of the amplifier chassis.

h. Unit Plate Power. The unit plate power receptacle (A-5) is located at top right of the con-

trol panel. Through this receptacle and its associated plug and cable, pass the 115/230 volt, 50/60 cycle power circuits for the two dual machine motors and the signal lights.

## 9. CONTROL LEVER INTERLOCK (figs. 49 and 52).

a. **General.** The control lever interlock (fig. 49) is an assembly composed of four principal parts; a mount bracket (245); and an intermediate lever (11); a lock lever (12), and an interlock slide cam bar (10).

b. **Location.** The control lever interlock (244) in (fig. 52) is mounted on the machine frame horizontally and is located at the top left of the machine between the two feed screw assemblies.

c. **Use.** (1) The control lever interlock prevents the ejection of a recording belt, when either the recorder or reproducer carriage control lever is in the "operate" position, and thus avoids the possibility of damaging record or stylii.

(2) It prevents the operation of either the recorder or reproducer carriage control lever with the ejector mechanism in the "ejected" position, thus preventing lowering the recorder stylus to the metal recording anvil, or the reproducer stylus to the surface of the drive mandrel, with no recording belt on the machine. This also prevents damage to stylii.

(3) The control lever interlock prevents the operation of either the recorder or reproducer carriage control lever with the ejector in the "injected" position, but with no recording belt on the machine. Here again, damage to stylii is prevented.

## 10. CONTROLS (figs. 34 and 50).

a. **General.** All controls with the exception of the motor two-speed control, are located on the control panel on the front of the machine (fig. 34). See paragraph 10g.

b. **Compression Selector Switch.** The compression selector switch is located at lower center of the control panel. This switch has three positions which are, starting at the most counter-clockwise position and reading in a clockwise direction:

- (1) 4-1 compression
- (2) 2-1 compression
- (3) CODE

c. **Input Selector Switch.** The input selector switch is located at the lower left of the control panel. This switch has five positions which are,

starting at the most counter-clockwise position and reading in a clockwise direction:

- (1) CODE.....5,000 ohms
- (2) +20 db.....5,000 ohms
- (3) +10 db.....5,000 ohms
- (4) 0 db.....5,000 ohms
- (5) -20 db..... 500 ohms

d. **Meter Selector Switch.** The meter selector switch is located at left-center of the control panel, under the power level meter. This switch has three positions for obtaining the audio power level as follows:

- (1) **REPRODUCE.** Output of the reproduce amplifier for either speech or code.
- (2) **SPEECH.** Output of the record amplifier for speech.
- (3) **CODE.** Output of the record amplifier for code.

**NOTE:** The only difference between the second and third positions of this switch is that a 10 db loss is inserted in the meter circuit. The third position, then, is a protective or stand-by position.

e. **Motor "On-Off" Switch, Local.** The local MOTOR "ON-OFF" switch is located at right center of the control panel for local control of the recording machine motors.

f. **Motor "On-Off" Switch, Remote.** The remote MOTOR "ON-OFF" foot switch is located at the end of the remote motor control cable. This cable is plugged into the front receptacle of the two which are located on the right-hand side of the amplifier chassis.

g. **Motor "Two-Speed Control".** The motor "two-speed" control is a two position switch located on the top right center of the unit plate (fig. 50). Pushing this switch control handle to the rear provides low speed operation (a 30' record), and placing the control handle in the vertical position provides high speed operation (a 15' record).

h. **Power Switch.** The 115/230-volt power switch is located at the lower right of the control panel. The "Up" position is for a 115-volt, 50/60-cycle power supply, and the "Down" position for a 230-volt, 50/60-cycle power supply.

i. **Record Tone.** The RECORD TONE control is the center control of the three that are located at the top of the control panel. The RECORD TONE control provides a means of modifying the frequency characteristic of the audio-frequency energy prior to recording.



i. **Record Volume.** The **RECORD VOLUME** control is the left-hand control of the three that are located at the top of the control panel. The **RECORD VOLUME** control provides a means of "continuously varying" the output level of the record amplifier (the input level to the recording head), whereas the **INPUT** selector switch (par. 10c) provides a "step-control". The **INPUT** selector switch adjusts the input circuit of the record amplifier to the level of the source of audio energy to be recorded and provides for operating the **RECORD VOLUME** control within its normal range.

k. **Reproduce Volume.** The **REPRODUCE VOLUME** control is the right-hand control of the three which are located at the top of the control panel.

## 11. **CONSTANT GROOVE SPEED.**

a. **Uniform Frequency Response.** Uniform over-all frequency response is obtained, from one end of the record to the other, because of the fact that the lateral tone groove swaged in the plastic record, is recorded at "constant groove speed".

b. **Cylinder Record.** "Constant groove speed" is accomplished due to the shape of the record (cylindrical shape) which inherently provides for "constant linear tone groove velocity" (i.e. constant groove speed). This is to be contrasted with a disk record, for instance, where the "linear tone groove velocity" is much higher near the outside of the record than near the center, and the high frequency response is therefore much better near the outside than near the inside of the record.

## 12. **DASHPOT (figs. 51 and 52).**

a. **General.** The recorder dash pot (fig. 51) is a hydro-mechanical device consisting essentially of a cylinder (66) filled with oil, and a piston (65) moving therein.

b. **Location.** The recorder dashpot (246 in fig. 52) is located at the top left of the machine, in the immediate vicinity of the **READY RECORD** switch, below the control interlock assembly (244).

c. **Use.** (1) The recorder dashpot prevents too rapid lowering of the recorder stylus to the recording belt and thus avoids damage to stylus or record. (2) The dashpot provides a cushioning or damping action to the lowering of the recorder stylus to the record.

## 13. **DRIVE (figs. 47, 52, and 62).**

a. **General.** The electric driving motor (187)

for each of the dual recording-reproducing machine units is mounted on four suspension springs under the unit plate (fig. 47). Each electric motor provides the rotational energy for driving the recording belt under the recorder and reproducer stylii, and for driving the recorder and reproducer stylii laterally across the recording belt to trace or track, as the case may be, the spiral tone grooves in the record.

### b. **Elements in Drive System.**

- (1) Electric motor (187 in fig. 62).
- (2) Motor drive belt (249).
- (3) Reduction pulley assembly (248).
- (4) Flywheel drive belt (250).
- (5) Flywheel (71).
- (6) Pinion gears (120), on gear train assembly (253 in fig. 52).
- (7) Feed screw gears (103).
- (8) Feed screw assemblies (252).
- (9) Recorder and reproducer carriages (243) and (261).
- (10) Drive mandrel (87).
- (11) Recording belt (254).
- (12) Idler mandrel (134).

## 14. **DRIVE MANDREL (figs. 44 and 53).**

a. **General.** The drive mandrel (87 in fig. 53) is a cylindrically shaped streamlined plastic member.

b. **Location.** It is located towards the rear of each dual recording-reproducing machine unit (fig. 44).

c. **Use.** (1) The drive mandrel operates as a pulley to properly guide and drive the recording belt.

(2) The drive mandrel also provides a backing for the reproducer stylus, in the course of reproduction, when the reproducer stylus engages the recording medium.

## 15. **FEED NUT (figs. 52 and 54).**

a. **General.** The feed nut assembly (fig. 54) consists of a U-shaped segment of a nut (92) and a spring (89). The feed nut spring (89) is mounted on the feed nut by means of the feed nut spring screws (90).

b. **Location.** The feed nut assembly (251 in fig. 52) is mounted on the left-hand member of the carriage housing by means of the feed nut assembly screws (88 in fig. 54). The feed nut assembly is installed on the rear of the carriage housing, the latter being located, in the case of the recorder,

at the top front of each dual recording-reproducing machine unit, and in the case of the reproducer, at the top rear.

**c. Use.** (1) The feed nut assembly is the mechanical connection between the carriage and the feed screw, and it is by this means that the carriage is driven in a lateral direction across the recording belt.

(2) This mechanical connection between the carriage and the feed screw (provided by the feed nut assembly) causes the recorder stylus to trace (by swaging) a spiral tone groove in the record.

(3) In the case of the feed nut assembly in the reproducer carriage assembly, the reproducer stylus is caused to track the tone groove traced by the recorder stylus.

#### **16. FEED SCREW (figs. 44 and 55).**

**a. General.** The feed screw assembly (fig. 55) consists of a feed screw cover (108) of tubular construction, which houses the feed screw (109). The feed screw is visible through the slotted opening in the feed screw cover. There is a feed screw assembly associated with each recorder and each reproducer.

**b. Location.** The feed screw assemblies (252 in fig. 44) for the recorders are mounted at the top front of each dual unit and those for the reproducers are mounted at the top rear.

**c. Use.** (1) The feed screw cover is used as a guide and main bearing support for the recorder or reproducer carriage.

(2) The feed screw operates as a gear, directly connected with the drive mandrel, to drive the feed nut, which in turn drives the carriage, which latter carries the recorder assembly in one case and the reproducer assembly in the other case, laterally across the rotating recording belt, to record or reproduce, either separately or simultaneously, the laterally modulated tone grooves.

#### **17. FLYWHEEL (figs. 44 and 53).**

**a. General.** The flywheel ((71) in fig. 53) is a heavy cast-iron wheel which is mounted solidly on the drive mandrel shaft.

**b. Location.** The flywheel (71) is located at the left side of each of the dual recording-reproducing machine units (fig. 44).

**c. Use.** (1) The flywheel, because of its inertia, resists sudden changes in speed, thus aiding in providing satisfactory motion for recording and reproduction.

(2) It also operates as a reduction pulley in the drive system between the jack shaft and the drive mandrel.

#### **18. GEAR TRAIN (figs. 52 and 56).**

**a. General.** The gear train assembly (fig. 56) consists of a plate (115) on which three gears are mounted (one intermediate gear (119) and two pinion gears (120)). The three gears in the gear train assembly engage the recorder and reproducer feed screw gears (103) on each dual unit and the drive mandrel gear (72).

**b. Location.** The gear train assembly ((253) in fig. 52) is mounted on the main frame casting between the flywheel and the casting.

**c. Use.** (1) The gear train assembly governs the pitch of the tone grooves in the record during recording, and provides the correct lateral travel of the reproducing head, during reproduction, for proper tracking of the reproducer stylus in the tone grooves.

#### **19. IDLER MANDREL (figs. 44 and 57).**

**a. General.** The idler mandrel (fig. 57) is a cylindrically shaped streamlined plastic member.

**b. Location.** The idler mandrel ((134) in fig. 44) is located in the front of the machine directly beneath the recorder carriage.

**c. Use.** (1) The idler mandrel (134) operates as a pulley for the recording belt, and, together with the drive mandrel (87), constitutes the system for supporting and rotating the recording belt (254) in the machine.

(2) The idler mandrel provides tension to maintain the recording belt taut, thus creating the friction necessary for the drive mandrel to drive the recording belt.

(3) The idler mandrel provides the "crawl control" for the recording belt, through the medium of the adjustments possible in this assembly. The "crawl control" is the alignment of the idler mandrel which causes the recording belt to "crawl" towards the left against the idler mandrel flange, to maintain the proper position of the record in the machine.

#### **20. INJECTOR-EJECTOR (figs. 44 and 58).**

**a. General.** The injector-ejector assembly (fig. 58) is a mechanical device consisting essentially of a stationary member (19), the framework, and a slidable member (150) operating on this stationary framework. This assembly contains the recording anvil (20) which is located on the top side

of the assembly. This recording anvil is the supporting surface for the recording belt and the point where the recording actually takes place. There is a control mechanism ((15) in fig. 44) for operating the ejector which consists of a control handle and the necessary links connecting it with the injector-ejector assembly.

**b. Location.** The injector-ejector assembly (255 in fig. 44) is located between the drive and idler mandrels and is mounted on the machine main frame casting. The control handle for the ejector (15) is located at right front of each dual recording-reproducing machine unit.

**c. Use.** (1) The injector-ejector assembly aids in quickly installing a recording belt on the machine.

(2) It facilitates quickly removing a recording belt from the machine.

(3) It provides a support for the recording anvil.

## 21. MACHINE COVERS (fig. 50).

**a. General.** The machine covers (256) are the metal covering for the dual recording-reproducing machine units (fig. 50).

**b. Location.** They are located on the top of the dual units, which latter are mounted to the top of the unit plate (fig. 50).

**c. Use.** (1) The machine covers provide a mounting surface for the time indicator plates (257).

(2) They facilitate operation of the carriage control levers (36).

(3) They also provide a means of keeping as much dust as possible out of the mechanisms they cover.

## 22. MOTOR (fig. 47).

**a. General.** (1) There is a separate electric motor ((187) in fig. 47) associated with each of the dual recording-reproducing machine units.

(2) Each motor is a two-speed capacitor-run induction motor.

(3) Each motor operates as a two-phase motor and the phase difference between the two phases is obtained by a capacitor in series with one of the stator windings.

(4) The motor rotor is of the squirrel cage type.

(5) Each motor is designed for operation from a 115-volt, 50/60 cycle power supply.

(6) For high speed, the motor operates as a two-pole motor and develops 3,450 rpm at 60 cycles.

(There would be a 20 percent speed reduction at 50 cycles.)

(7) At the low speed, the motor operates as a four-pole motor and develops 1,650 rpm at 60 cycles. (The speed would be 20 percent lower at 50 cycles.)

(8) Since this is an induction motor, it does not operate at synchronous speed—there is a “slip”. Since the synchronous speeds are 3,600 and 1,800 rpm respectively, for the high speed and the low speed, and since the actual operating speeds are 3,450 and 1,650, there is a 150 rpm “slip” in each case.

**b. Location.** The two motors ((187) in fig. 47) are mounted on the under side of the unit plate.

**c. Use.** (1) The motor supplies the driving power for the rotating mechanisms throughout the machine through the medium of belts and pulleys.

(2) Ultimately, this accomplishes driving the recording belt under the recorder and reproducer stylii, in the course of recording and reproducing, and in moving the recorder and reproducer stylii across the record, as the latter rotates, to trace a spiral tone groove during recording and to track this spiral tone groove during reproduction.

## 23. RECORDER (figs. 5, 44, and 61).

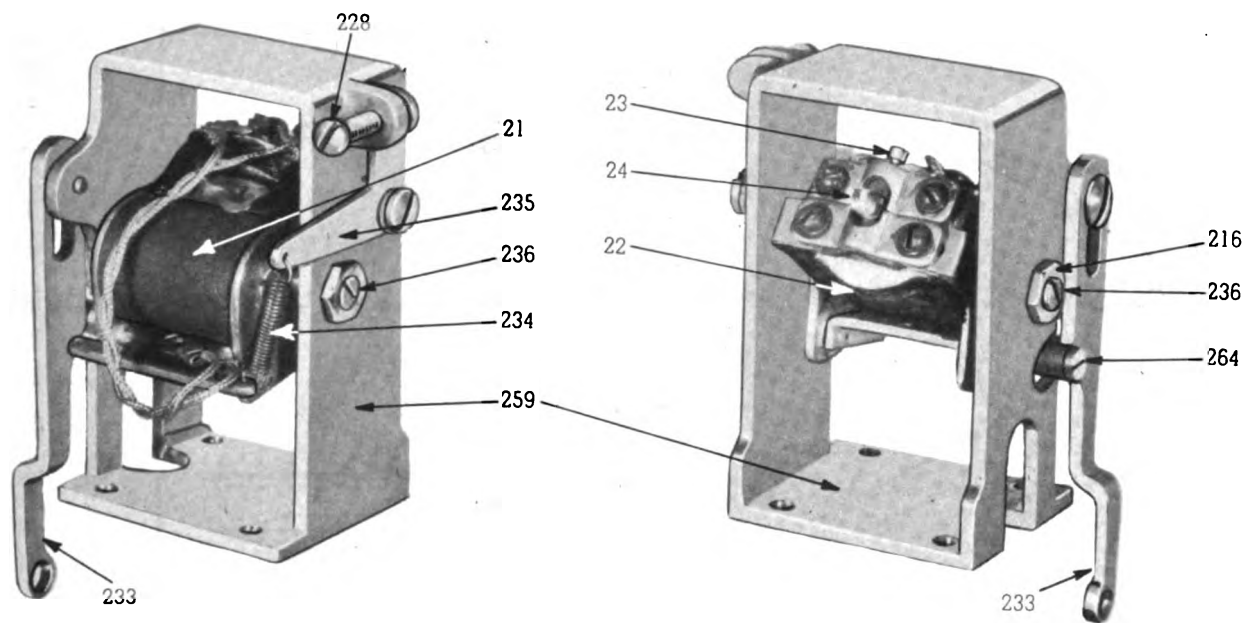
**a. General.** The magnetic recorder (fig. 5) is an electro-mechanical device consisting of a permanent magnet (21), a field coil (22); and a moving armature ((25) in fig. 31). The latter holds the recorder stylus (24).

**b. Location.** The magnetic recorder assembly (258) is installed in its mount bracket (259) in the recorder carriage assembly (243) as shown in figure 61. The recorder carriage assembly (243)—including the recorder assembly (258)—is located at the top front of each dual recording-reproducing machine unit (fig. 44).

**c. Use.** The recording head translates electrical energy into mechanical energy and then, through the medium of the recorder stylus, translates this mechanical energy into a laterally modulated tone groove in the plastic recording belt.

## 24. RECORDER CARRIAGE GUIDE (figs. 44 and 61).

**a. General.** The recorder carriage guide ((237) in fig. 61) is a bronze casting attached to the recorder carriage assembly (243). The end of the recorder carriage guide (237) and the adjustable recorder carriage guide prong (206) engage and slide along on the recorder carriage guide rod (208).



TL 94350

Figure 5. Recorder

**b. Location.** The recorder carriage guide (237) is located at the front of each of the dual recording-reproducing machine units (fig. 44). One of these guides is attached to the front of each recorder carriage assembly (243).

**c. Use.** (1) The recorder carriage guide maintains the recorder carriage assembly in proper alignment as the latter travels back and forth along its bearing surface.

(2) The recorder carriage guide, in conjunction with the recorder carriage guide rod, maintains a constant relation between the recorder stylus and the recording belt as the recorder carriage assembly moves along its bearing, with the recorder carriage control lever in the "operate" position, or, with this control lever in the "neutral" position.

(3) The recorder carriage guide, in conjunction with the recorder carriage guide rod, functions to prevent rotation of the recorder carriage assembly on its bearing.

**25. RECORDER MOUNT BRACKET ASSEMBLY (figs. 5, 44, and 61).**

**a. General.** The recorder mount bracket assembly ((259) in fig. 61) is a rectangular part, held

to the recorder carriage assembly (243) by four mounting screws (217). (See fig. 5 also.)

**b. Location.** The recorder mount bracket assembly (259) is located on the rear surface of the right-hand member of the recorder carriage assembly (243) and is located at the top front of each dual recording-reproducing machine unit (fig. 44).

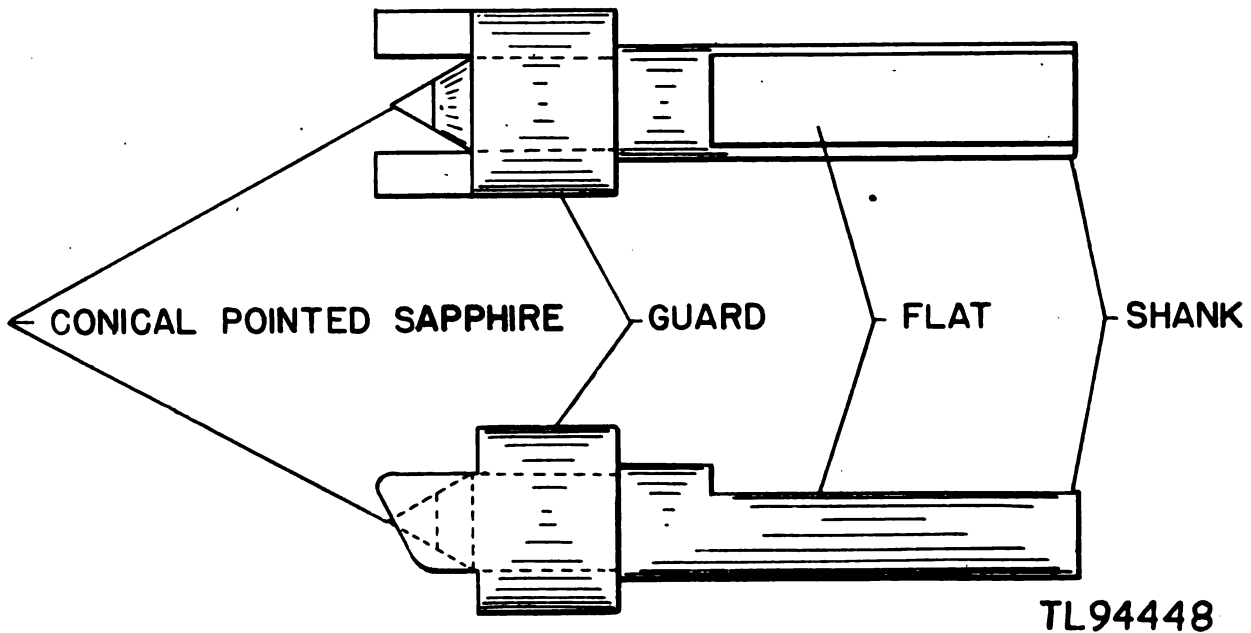
**c. Use.** (1) The recorder mount bracket assembly supports the recorder assembly.

(2) It also supports the cam member (233) which controls the travel of the recorder stylus (24) to and from the record anvil (20).

(3) It is also a support for the pressure arm (235) which controls the recorder pressure spring (234) (figs. 5 and 61).

**26. RECORDER STYLUS (figs. 5, 6, and 61).**

**a. General.** The recorder stylus (fig. 6) consists of a conical pointed sapphire mounted in a duralumin shank, which latter has a "flat" on one side to afford proper alignment of the stylus when it is installed in the recording head. A "stylus guard" is attached to the stylus to prevent the stylus tip from being inadvertently pushed through the recording belt, due to some abnormal condition,



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Figure 6. Recorder stylus

thus being caused to pierce the metal record anvil with subsequent damage to stylus and anvil. The stylus guard allows the stylus tip to project 0.003 inches, and since the recording belt is 0.0055 inches in thickness, the stylus tip is protected. The over-all length of the recorder stylus is  $15/32$  inches; the diameter of the sapphire is about 0.040 inches, and the diameter of the duralumin shank is approximately  $1/16$  inch.

**b. Location.** The recorder stylus ((24) in fig. 61) is held in place in the recording head (258) by the recorder stylus clamping screw (23). (See fig. 5 also.)

**c. Use.** (1) The recorder stylus is the element in the machine that swages the lateral tone groove in the plastic record.

(2) In the course of swaging (or engraving) this tone groove, the recorder stylus translates the mechanical energy imparted to it by the recording head, into a laterally modulated spiral tone groove in the recording belt.

## 27. REDUCTION PULLEY (figs. 47, 62, and 63).

**a. General.** The reduction pulley assembly

(fig. 63) consists of a reduction pulley (166), a reduction pulley shaft (176), two idler pulleys (164) and (165), and two idler brackets (173) and (178), all mounted on a bracket (162).

**b. Location.** The reduction pulley assembly (248) is mounted on the under side of the unit plate, below and directly to the rear of each flywheel (fig. 47).

**c. Use.** (1) The reduction pulley assembly (248) provides a portion of the reduction between the motor (187) and the drive mandrel shaft, to which latter the flywheel (71) is rigidly mounted. (2) The total reduction between the motor and the drive mandrel shaft is accomplished through the reduction between the motor drive pulley (273) and the large diameter on the reduction pulley (166), this reduction being multiplied by the reduction between the small diameter on the reduction pulley (166) and the flywheel (71).

(3) The reduction pulley assembly (248) also supports the two idlers (164) and (165) which take up the slack portion of the double-wrap flywheel drive belt (250) and motor drive belt (249) respectively (i.e. the slack on the fourth strand, three strands being taut at all times).

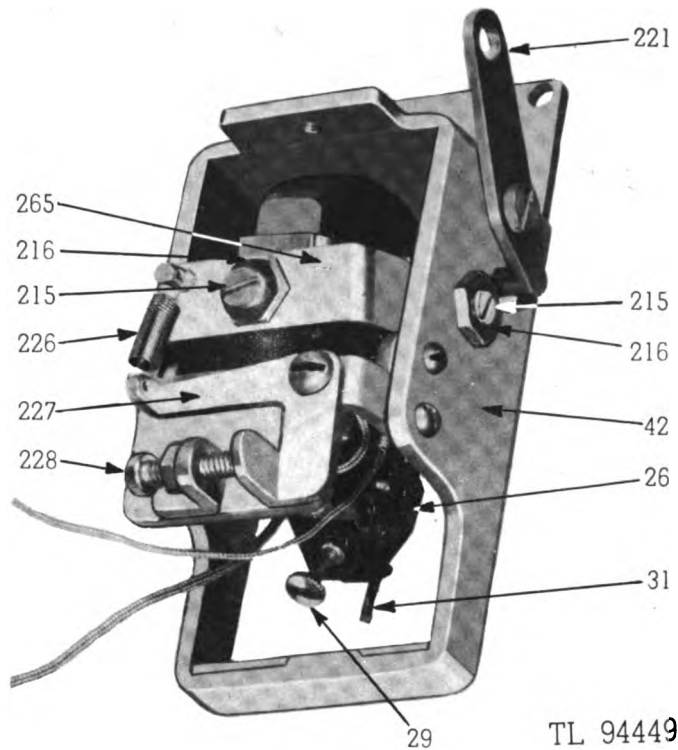


Figure 7. Reproducer

**28. REPRODUCER (figs. 7, 44, and 64).**

**a. General.** The crystal reproducer (fig. 7) is an electro-mechanical device consisting of a high temperature crystal element in a case (26). One end of an armature is attached to the crystal element in the case (26) and the end of the armature has a hole in which the reproducer stylus (31) is inserted, the latter being clamped in place by the stylus clamping screw (29). Figure 7 shows the reproducer in its mount bracket (42).

**b. Location.** The reproducer assembly ((229) in fig. 64) is shown mounted in the reproducer mount bracket assembly (42), which is a part of the reproducer carriage assembly (261). The position of the reproducer assembly (229) at the rear of each dual recording-reproducing machine unit, is shown in figure 44.

**c. Use.** (1) The reproducer translates mechanical energy into electrical energy.

(2) The modulations in the recorded tone grooves are translated into mechanical vibrations at the reproducer stylus, which is a part of the reproducer assembly, and it becomes the job of the reproducer to transform these mechanical vibrations into

electrical energy and transmit this electrical energy on to the input of the reproduce amplifier.

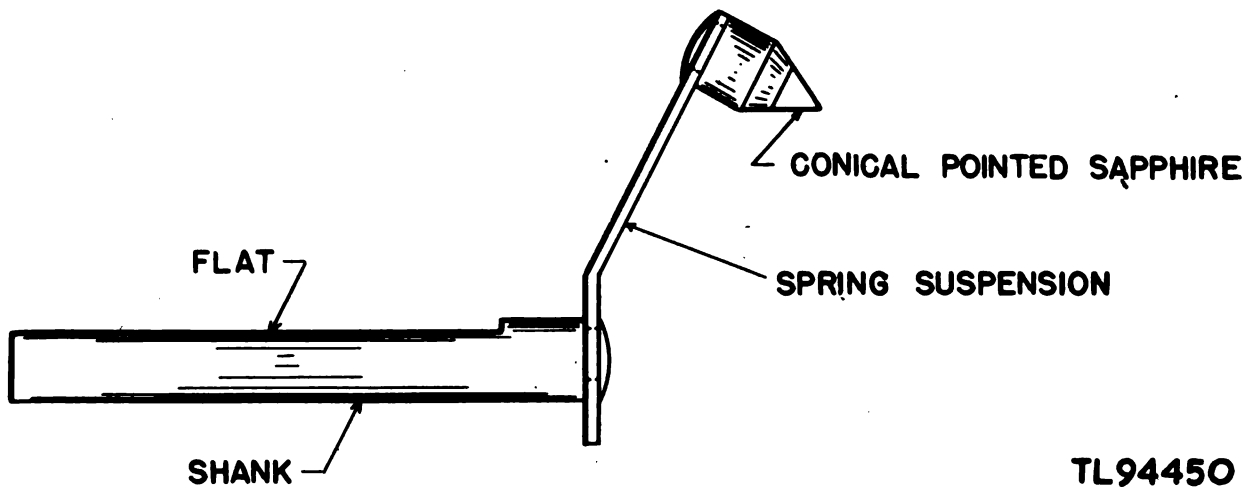
**29. REPRODUCER CARRIAGE GUIDE (figs. 33-C and 64).**

**a. General.** The reproducer carriage guide (205) is a right-angle metal bar. A close-up of the reproducer carriage guide (205) is shown in figure 33-C.

**b. Location.** The reproducer carriage guide (205) is shown mounted to the reproducer carriage assembly (261) by the two screws ( 213) in fig. 64). There is a reproducer carriage guide (205) mounted on each of the two reproducer carriage assemblies (261), at the rear of each dual recording-reproducing machine unit.

**c. Use.** (1) The reproducer carriage guide (205) maintains the reproducer carriage assembly (261) in proper alignment as the latter travels back and forth along its bearing surface.

(2) The reproducer carriage guide (205), in conjunction with the reproducer carriage guide rod (208), maintains a constant relation between the reproducer stylus (31) and the recording belt, as the reproducer carriage assembly (261) moves



TL94450

Figure 8. Reproducer stylus

along its bearing, with the reproducer carriage control lever in the "operate" position, or with this control lever in the "neutral" position.

(3) The reproducer carriage guide (205), in conjunction with the reproducer carriage guide rod (208), prevents rotation of the reproducer carriage assembly (261) on its bearing.

**30. REPRODUCER MOUNT BRACKET ASSEMBLY (figs. 7, 44, and 64).**

a. **General.** The reproducer mount bracket ((42) in fig. 7) is a rectangular metal mounting part.

b. **Location.** The reproducer mount bracket ((42) in fig. 64) is installed on the reproducer carriage assembly (261) by the four screws (217). The reproducer mount bracket ((42) in fig. 44) is located at the rear of each dual recording-reproducing machine unit.

c. **Use.** (1) The reproducer mount bracket ((42) in fig. 7) supports the reproducer assembly.

(2) The reproducer mount bracket (42) provides a mounting surface for the reproducer lift lever (221) which controls the travel of the reproducer stylus

(31) to and from the recording belt on the drive mandrel.

(3) The reproducer mount bracket (42) provides a mounting surface for the reproducer pressure arm (227) which controls the reproducer pressure spring (226) the latter controlling the reproducer stylus pressure when the reproducer carriage control lever is in the "operate" position.

(4) The reproducer mount bracket (42) provides a mounting surface for the reproducer pressure arm adjusting screw (228) which provides for reproducer pressure adjustment.

**31. REPRODUCER STYLUS (figs. 7, 8, and 64).**

a. **General.** The reproducer stylus (fig. 8) consists of a conical pointed sapphire, 0.015 inches tip radius, mounted in a spring suspension which latter is attached to the end of the stylus shank. There is a "flat" ground on one side of the stylus shank to provide for proper alignment of the reproducer stylus in the reproducer assembly.

b. **Location.** The reproducer stylus ((31) in fig. 7) is mounted in the reproducer assembly and clamped in place by means of the reproducer

clamping screw (29). The position of reproducer stylus (31) in the machine, can be seen by looking at figure 64 which shows the reproducer stylus (31) installed in the reproducer assembly (229).

**c. Use.** (1) The reproducer stylus is the element that translates the laterally modulated tone grooves in the plastic recording belt into mechanical energy.

(2) While the recorder stylus translates mechanical energy into laterally modulated tone grooves in the recording belt, during recording the reproducer stylus does just the opposite when it translates the laterally modulated tone grooves into mechanical energy as it tracks the record the recorder stylus traced.

### **32. CHANGE RECORD SWITCH (figs. 47).**

**a. General.** The CHANGE RECORD switch is a single-pole, single-throw, micro-switch. The contacts of this switch are "normally open" and it is provided with a "roller type" actuating lever.

**b. Location.** The CHANGE RECORD switch (3) associated with the front machine is shown at the top right of the view of the bottom of the unit plate shown in figure 47, and the CHANGE RECORD switch (3) associated with the rear machine is shown at the right a little below center.

**c. Use.** (1) The CHANGE RECORD switch closes a signal light circuit to indicate that the record on the machine with which it is associated is fully recorded and should be changed.

(2) The operation of the CHANGE RECORD switch, with the subsequent signal light indication, aids in providing for "continuous recording" by indicating that a record needs changing.

### **33. READY SWITCH (figs. 52 and 65).**

**a. General.** The READY switch ((186) in fig. 65) is a single-pole, single throw, micro-switch. This micro-switch has a "spring type" actuating lever and its contacts are "normally open".

**b. Location.** The positioning of the READY switch (186) on the inside left-hand face of the main frame casting, is shown in figure 65. The location of the READY switch (186) in the machine is shown in figure 52. (Only the tip of the actuating lever of READY switch (186) can be seen in figure 52.)

**c. Use.** (1) The READY switch closes a signal light circuit to indicate that the recorder carriage control levers of both dual recording-reproducing

machine units are in the "operate" position and the equipment is ready for "continuous recording".

### **34. REPRODUCER SAFETY SWITCH (fig. 44).**

**a. General.** The REPRODUCER SAFETY switch is a single pole, single throw, micro-switch. It has a "roller type" actuating lever and its contacts are "normally closed".

**b. Location.** The REPRODUCER SAFETY switch (209) in fig. 44) is located at the rear of each dual recording-reproducing machine unit.

**c. Use.** (1) The REPRODUCER SAFETY switch opens the motor circuit of the particular machine with which it is associated, as the reproducer carriage assembly (261) on that particular machine, reaches its right-hand limit of travel.

(2) By this operation, the REPRODUCER SAFETY switch protects the feed nut and feed screw threads on the reproducer carriage assembly, should the machine be left with motor running, and the reproducer carriage control lever (36) in the "operate" position.

### **35. SHOCK MOUNTING (figs. 9 and 46).**

**a. General.** The shock mounts are resilient mounting units designed for the particular loads they support. The amplifier system and the unit plate are separately shock mounted.

**b. Location.** The frame which supports the amplifier system is shown in the amplifier compartment in figure 9. There is one shock mount under each of the four corners of the amplifier system supporting frame. The shock mounts for the unit plate are shown in figure 46. There is one shock mount under each of the four corners of the unit plate. The front of the unit plate has holes therein which allow the unit plate to slip over the top of the front shock mounts. The rear of the unit plate is hinged to the two rear shock mounts at the two rear corners.

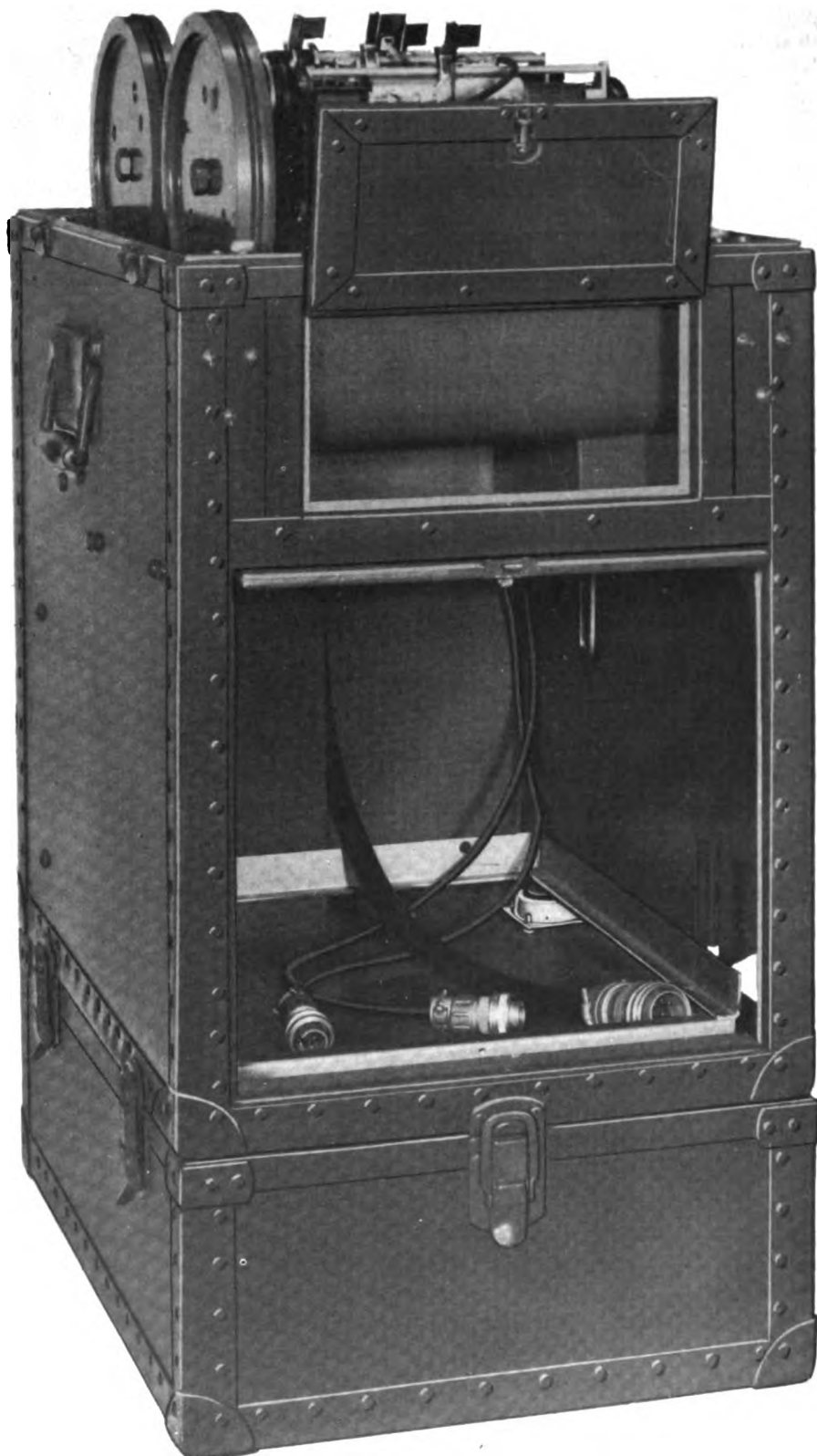
**c. Use.** The shock mounts are designed to isolate the mechanisms which they support from vibration, thus providing for mobile operation.

### **36. SIGNAL LIGHTS (fig. 34).**

**a. General.** The five signal lights for this equipment are of the "glow lamp type". They are neon signal lights, and are protected in their mounts by clear cover lenses.

**b. Location.** There is one group of four signal lights at the top of the control panel (fig. 34)





TL 9445I

*Figure 9. Interior of amplifier compartment*

and there is one signal light at lower right of the control panel.

**c. Use.** (1) The **READY** signal light indicates that both recorder carriage control levers on the dual recording-reproducing machine units are in the "operate" position and the machine is **READY** for "continuous recording".

(2) The **FRONT** signal light indicates that the **FRONT** machine motor is in operation.

(3) The **REAR** signal light indicates that the **REAR** machine motor is in operation.

(4) The **CHANGE RECORD** signal light indicates that a record on one or both of the dual recording-reproducing machine units is fully recorded and needs changing.

(5) The **AMP** signal light indicates that power has been applied to the primary winding of the power transformer in the **AMPLIFIER** system.

### **37. SIMULTANEOUS OR SEPARATE RECORDING AND REPRODUCTION.**

**a. General.** Reproduction can be had simultaneously with, or separately from, recording. Playback of any portion of the record, to within approximately  $\frac{1}{2}$  second of the recording (for a 15' record), or 1 second of the recording (for a 30' record), can be obtained from whichever one of the dual recording-reproducing machine units is in operation.

**b. Use.** (1) This provides a means for "monitoring" recording to make sure that the record is being satisfactorily recorded.

(2) This feature also makes it possible to playback material recorded quite a few minutes previously.

(3) The reproduction of the record on the machine in operation can be played back without interfering with the recording of incoming messages.

## SECTION II

# Installation and Operation

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### 38. GENERAL.

a. **Speech Recorder MC-502 Equipment.** Speech Recorder MC-502 equipment includes the following:

- (1) 1 recording machine.
- (2) 1 power cable.
- (3) 1 foot control and 25 Foot Cable.
- (4) 6 recording belts.
- (5) 2 Speech Recorder MC-502 instruction manuals.

#### b. Running Spares.

- (1) 2 motor drive belts.
- (2) 2 flywheel drive belts.
- (3) 5 pilot lights.
- (4) 6 reproducer stylii.
- (5) 6 recorder stylii.
- (6) 1 magnetic recorder.
- (7) 1 crystal reproducer.
- (8) 2 Fuses - 1½ amp.
- (9) 2 fuses 1 amp.
- (10) 9 tubes JAN-6SK7 (VT-117).
- (11) 3 tubes JAN-6H6 (VT-90).
- (12) 3 tubes JAN-6J5 (VT-94).
- (13) 8 tubes JAN-6V6GT (VT-107).
- (14) 3 tubes JAN-6SL7GT (VT-229).
- (15) 4 tubes JAN-5Y3GT (VT-197A).

### 39. UNPACKING.

a. **Shipping Box.** The shipping box is a two section watertight wood container. A large section for the machine and a small section for the auxiliary equipment.

b. **Procedure.** (1) Remove the two steel straps from around the box. Cut them.

- (2) Remove lid of box marked "top". The lid is screwed and cemented on.
- (3) Remove the top corrugated cushion by inserting a screwdriver, or any other convenient instrument, under the edge of the cushion, and prying up.
- (4) Remove Coroflex filler sheets which are on top of the equipment.
- (5) Lift machine out of box by pulling up on the two canvas straps which are around the equipment.

(6) Remove canvas straps. Cut them.

(7) Remove outer Coroflex sheet which is wrapped around the equipment.

(8) Cut open the Butvar envelope which encases the machine and remove the envelope from the machine.

(9) Remove the two Speech Recorder MC-502 instruction manuals which are on top of the equipment, under the Butvar envelope.

(10) Remove the Coroflex sheet which is wrapped around the machine, under the Butvar envelope.

(11) Remove cover (fig. 1) of portable field case, by unclasp the six hasps which secure the cover.

(12) Place cover on floor (fig. 3), open end up, and place machine on cover, using the latter as a base. Clasp the six hasps to secure the cover-base to the machine case proper.

(13) Raise the unit plate to its open position (fig. 46) by loosening the two catches at left and right front of the top of the unit plate, and raising the unit plate to its open position by means of the handle at top front center of the unit plate. Let the unit plate rest on its two side support arms, making sure that both of these side support arms are in their LOCKED position.

(14) Remove the two Silica-Gel dehydrating bags which are wrapped around the two motors, on the under side of the unit plate.

(15) Lower unit plate to its normal operating position by releasing the two side support arms from their locked position, and lowering unit plate by means of the handle at top front center.

(16) Remove the Silica-Gel cushion (consisting of four 4-ounce bags enclosed in one "cushion"), which is wrapped around the two dual recording-reproducing machine units.

(17) Open the amplifier compartment doors, the larger of the two doors in the front of the equipment case (fig. 1), and slide it up and back into its wide-open position (fig. 3).

(18) Release the catch at the lower front center of the control panel and pull the amplifier (which is attached to the control panel) forward a few inches, to allow for removing the Silica-Gel cushion which

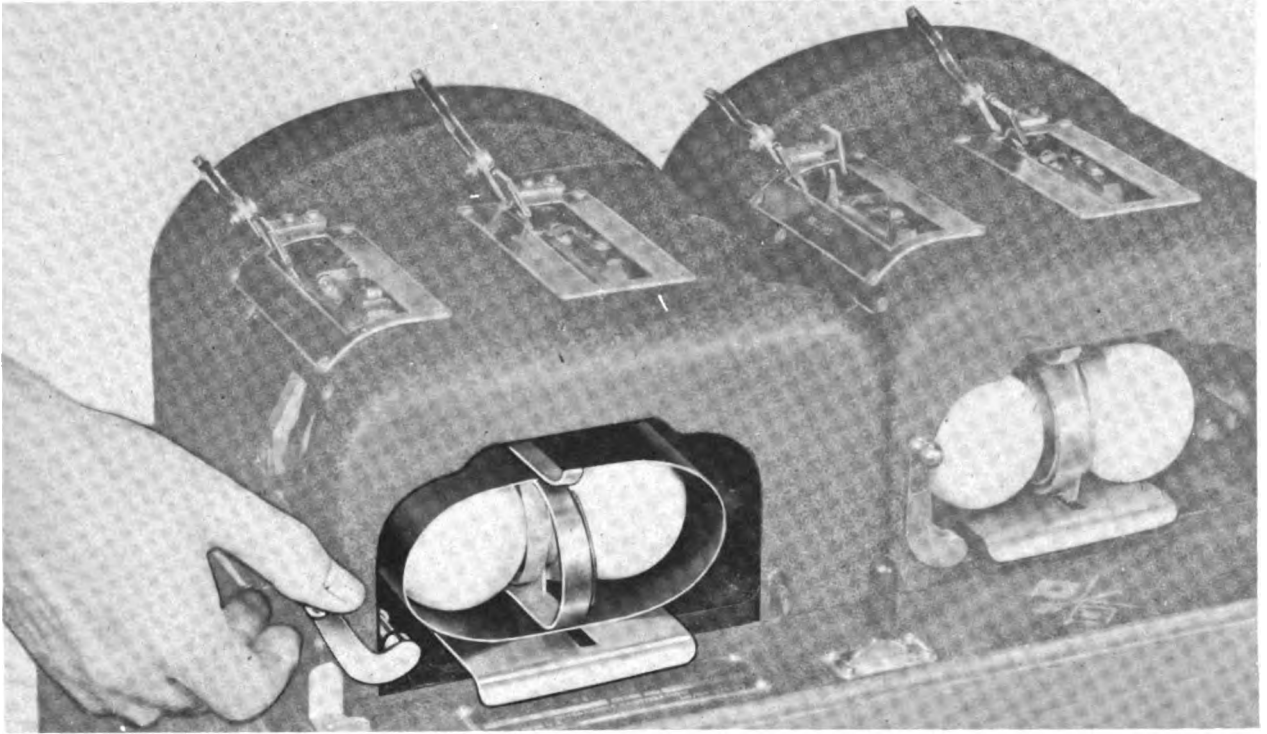


Figure 10. Operating ejector

TL94452

is packed behind the control panel, and attached to the two side braces of the control panel.

(19) Push the amplifier back into its normal operating position and secure the catch at lower front center of the control panel.

(20) Remove the two tapes securing the two recording belt ejector control handles, which latter are located at the right front corner of each of the dual recording-reproducing machine units.

(21) Unpack auxiliary equipment from the second (small) compartment in the shipping box.

#### 40. INSTALLING RECORD, LOADING (figs. 10, 11, 12, 13, and 50).

a. **Operating Ejector (figs. 10 and 50).** (1) Unlock each carriage control lever lock ((262) in fig. 50), by lifting it up and over to the left in a counterclockwise direction. There are four carriage control lever locks (262) mounted on the top of the two machine covers (256). The front one locks the recorder carriage control lever (36), and the rear one the reproducer carriage control lever (36), on each of the dual recording-reproducing machine units.

(2) The recorder and reproducer carriage control levers (36) are now in the "neutral" position, and their respective carriages are at the extreme left-

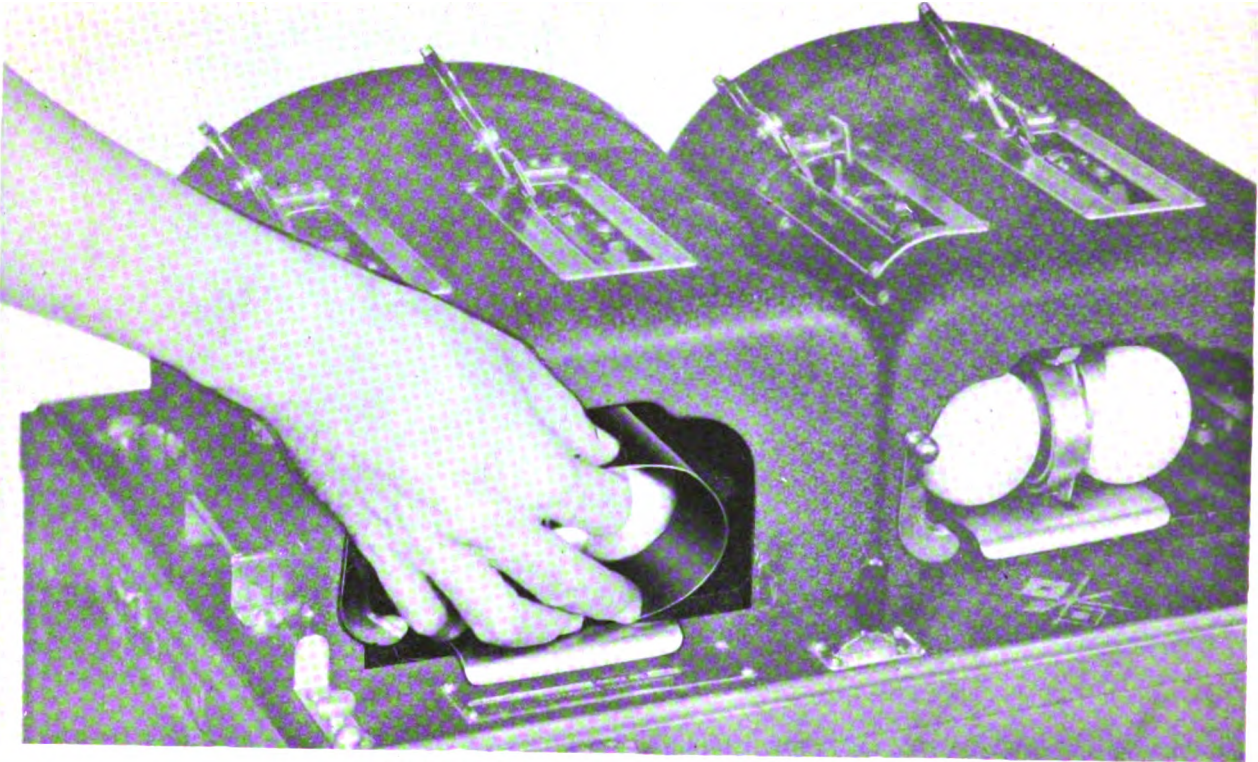
hand unit of travel, at the beginning of the record.

(3) Place the injector-ejector mechanism in the "eject" position by pulling forward on the ejector control lever which is located at the right front corner of each dual unit (fig. 10).

**NOTE:** The injector-ejector mechanism cannot be "ejected" unless the carriage control levers (36) in (fig. 50) are in the "neutral" position — carriage control levers (36) aligned with carriage control lever stops (95 and 101). The rear carriage control lever (36) in (fig. 50) is in the "neutral" position. The other three are in the "operate" position.

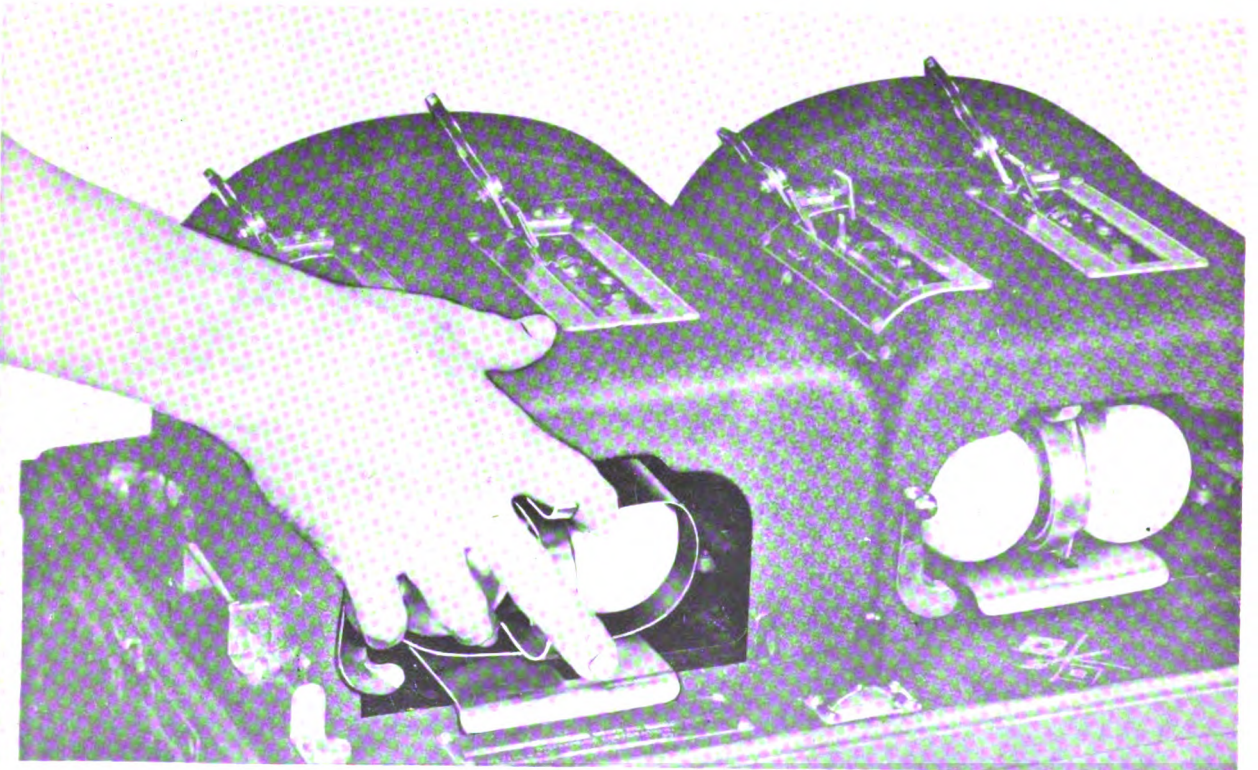
b. **Inserting Record (figs. 11 and 12).** (1) Insert the recording belt on the supporting mandrels by grasping it at one edge, between the thumb and forefinger, placing the other three fingers inside the recording belt, and pressing lightly with these three fingers against the bottom surface of the record, to spread it into a nearly cylindrical shape (fig. 11).

**CAUTION:** THERE IS AN ARROW-HEAD ON THE LEFT-HAND EDGE OF THE RECORDING BELT. ALWAYS INSERT THE RECORDING BELT WITH THE ARROW-HEAD TO THE LEFT.



*Figure 11. Placing record on mandrels*

TL94453



*Figure 12. Inserting record*

TL94454

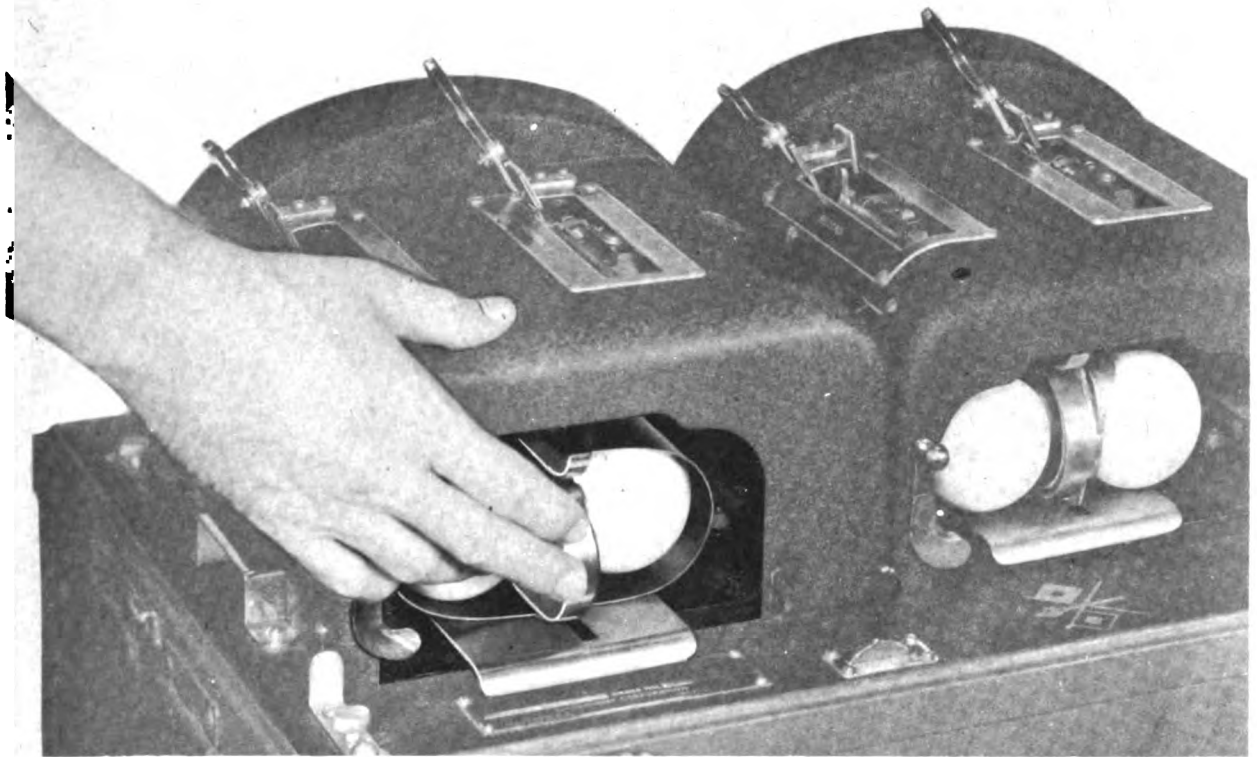


Figure 13. Operating injector

TL94455

(2) With the recording belt open in this manner, slide it over the two mandrels, pushing it to the left as far as it will go, until the left-hand edge of the record rests against the injector-ejector guard (fig. 12).

**c. Operating Injector (fig. 13).** (1) Inject the record by pushing to the left on the extreme right-hand end of the U-shaped frame in the injector mechanism (fig. 13). As the injector is pushed **POSITIVELY** to the left, the injector fingers carry the record to its proper position on the two mandrels.

(2) When the injector mechanism reaches its left-hand limit of travel, the left-hand edge of the recording belt will rest against the idler mandrel flange. At this point, the injector-ejector mechanism will unlock the idler mandrel, which latter will move into the operating position, thus placing the proper tension on the record.

(3) Install the record on the rear machine in the same manner.

#### 41. OPERATING RECORDER CARRIAGE CONTROL LEVERS (fig. 14).

a. With the recorder carriages on the dual

units at their left-hand limit of travel, place each recorder carriage control lever in the "operate" position.

b. To do this, grasp the recorder carriage control lever, and the control lever stop, between the thumb and first finger. Use the carriage control lever "stop" as the pivot point for a counterclockwise rotary motion, to place the recorder in its "operate" position (fig. 14).

**CAUTION: DO NOT USE A DIRECT PUSHING MOTION WHEN OPERATING THE RECORDER CARRIAGE CONTROL LEVER, TO AVOID DAMAGING STYLUS, ANVIL, OR RECORD. DO NOT PUSH ON THE CARRIAGE CONTROL LEVER AFTER IT HAS BEEN OPERATED AND THE DASHPOT CYCLE HAS BEEN COMPLETED.**

#### 42. ELECTRICAL CONNECTIONS (figs. 4 and 34).

a. Power Supply Switch (fig. 34). (1) The 115/230-volt power supply switch is located at the lower right on the control panel (fig. 34).

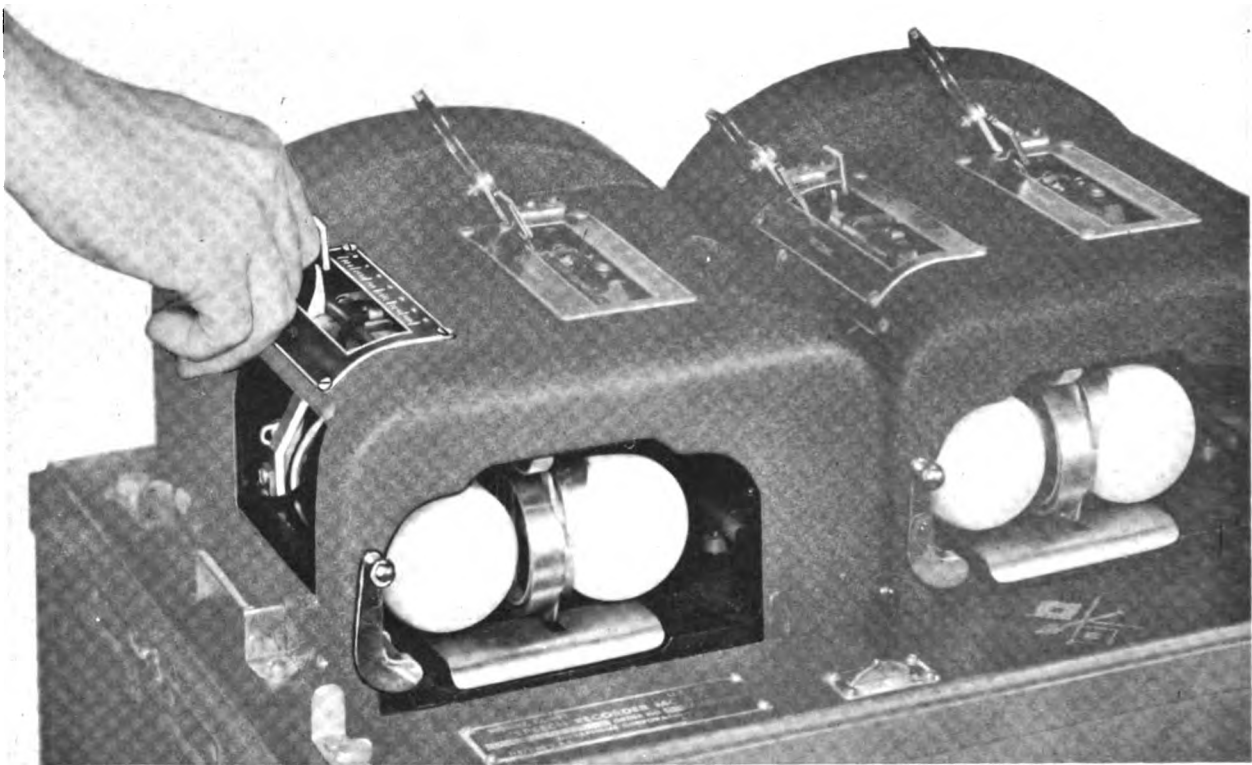


Figure 14. Operating recorder carriage control lever

TL94456

(2) Push the control lever on this switch down for a 230 volt 50/60-cycle power supply, and push it up for a 115-volt, 50/60-cycle power supply.

**CAUTION: BE SURE THAT THIS SWITCH IS SET IN ITS PROPER POSITION BEFORE PLUGGING IN THE POWER CABLE.**

**b. Power Cable (fig. 4).** Remove the power cable from the storage compartment in the front of the machine cabinet and plug the female end into the male power receptacle (A-1) on the right-hand side of the amplifier chassis (fig. 4). A small door in the side of the machine cabinet allows for insertion of the power cable.

**c. "Amp" and "Ready" Signal Lights (fig. 34).** (1) When the power cable is plugged into this equipment, the AMP signal light at the lower right of the control panel (fig. 34) will light to indicate that power is applied to the amplifier.

(2) The READY signal light will light when the power cable is plugged into this equipment if both recorder carriage control levers are in the "operate" position. The READY signal light is the first

light (reading from left to right) in the group of four that are located at the top of the control panel. If lighted it indicates that the equipment is ready for continuous recording.

**d. Remote Motor Control Cable (fig. 4).** (1) Plug the remote motor control cable into the female receptacle (A-4) on the right-hand side of the amplifier chassis (fig. 4), if the remote motor control foot switch is to be used.

**e. Audio Input (fig. 4).** Plug the audio input into the INPUT jack (J-1) located at lower left of the control panel (fig. 4).

**f. Headphones or Loudspeaker (fig. 4).** (1) Plug headphones or loudspeaker into one of the output jacks on the front panel (fig. 4).

(2) There is a group of three output jacks in the center of the control panel. The left-hand RECORD MONITOR jack (J-2) provides for monitoring the output of the record amplifier. The center 600 ohm REPRODUCE OUTPUT jack (J-4) provides a low impedance output from the reproduce amplifier. The right-hand 5,000 ohm REPRODUCE OUTPUT jack (J-3) provides a high impedance output from the reproduce amplifier.

**CAUTION: USE THE 600 OHM REPRODUCE OUTPUT JACK (J-4) FOR MONITORING THE REPRODUCE AMPLIFIER OUTPUT WITH CRYSTAL HEADPHONES.**

#### **43. SETTING CONTROLS FOR SPEECH RECORDING (figs. 34 and 50).**

**a. COMPRESSION Selector Switch (fig. 34).** Set the COMPRESSION selector switch on either the 2-1 or 4-1 position. This switch is located at lower center of the control panel.

**b. INPUT Selector Switch (fig. 34).** Set the INPUT selector switch on the +20 db position. This switch is located at the lower left of the control panel.

**c. METER Selector Switch (fig. 34).** (1) Set the METER selector switch on the SPEECH position, to provide an indication of the power level output of the record amplifier.

(2) The METER selector is located just below the meter at the left of the control panel.

(3) The METER selector switch is placed in the CODE position for protection of the meter only. Place it in the SPEECH position for setting the recording level, but always leave it in the CODE position for stand-by.

**d. Motor "Two-Speed" Switch (fig. 50).**

(1) The motor "two-speed" control switch (263) in fig. 50) is located at top right center of the unit plate.

(2) Push the control handle on this switch to the rear for recording a 30-minute record, and place it in a vertical position, central position, for recording a 15-minute record.

**NOTE:** Record a 15-minute record in the case of high-speed code and wide-range speech. Record a 30-minute record for slow-speed code and medium-range speech, for long-recording time. A 15-minute record allows for a 15/1 speed reduction on Speech Reproducer MC-503. A 30-minute record allows for 7.5/1 speed reduction on Speech Reproducer MC-503.

**e. RECORD TONE Control (fig. 34).** (1) The HIGH-LOW RECORD TONE control is the middle control of the group of three at top center of the control panel.

(2) In the case of a 15-minute speech record, turn the RECORD TONE control to the 12 o'clock position for "medium highs".

(3) For a 30-minute speech record, turn the RECORD TONE control to the maximum counterclockwise position for "maximum highs".

(4) For either a 15 or 30 minute code recording turn the RECORD TONE control to the maximum counterclockwise position for "maximum highs".

**f. RECORD VOLUME Control (fig. 34).**

(1) The RECORD VOLUME control is the left-hand control of the group of three at top center of the control panel.

(2) Turn the RECORD VOLUME control counterclockwise to its minimum position.

(3) Turn on the speech to be recorded, at the source. This source is plugged into the machine at the INPUT jack at the lower left of the control panel (par. 42c).

(4) Turn the RECORD VOLUME control clockwise, until there is an indication on the power level meter.

(5) Normal speech recording is obtained when the meter needle peaks reach (13), and the average indication is about mid-scale.

(6) If it is necessary to turn the RECORD VOLUME control further clockwise than 2 o'clock, turn it back to the minimum position and reset the INPUT selector switch to that position which will provide for normal recording at a setting of the RECORD VOLUME control between 10 and 2 o'clock.

**CAUTION: THE -20 db POSITION OF THE INPUT SELECTOR SWITCH IS FOR A 500 OHM INPUT. BE SURE THAT THIS POSITION IS NOT USED IN CONNECTION WITH A LINE THAT WILL BE OVERLOADED THEREBY.**

#### **44. SETTING CONTROLS FOR CODE RECORDING (figs. 34 and 50).**

**a. COMPRESSION Selector Switch.** Set the COMPRESSION selector switch on the CODE position.

**b. INPUT Selector Switch.** Set the INPUT selector switch on the CODE position.

**c. METER Selector Switch.** Set the METER selector switch on the SPEECH position while making adjustments for obtaining the proper recording level, and then set it on the CODE position for operation.



**d. Motor "Two-Speed" Switch.** (1) The motor "two-speed" control switch is located at top right center of the unit plate (263) in fig. 50.

(2) Push the control handle on this switch to the rear for recording a 30-minute record, and place it in a vertical position, central position, for recording a 15-minute record.

**NOTE:** Record a 15-minute record in the case of high-speed code because a 15-minute record allows for a 15/1 speed reduction on Speech Reproducer MC-503. Record a 30-minute record for slow-speed code because it provides double the recording time per record and still allows for 7.5/1 speed reduction on Speech Reproducer MC-503.

**e. RECORD TONE Control.** (1) The **HIGH-LOW RECORD TONE** control is the middle control of the group of three at top center of the control panel.

(2) For either a 15- or 30-minute code recording, turn the tone control to the maximum counterclockwise position for "maximum highs".

**f. RECORD VOLUME Control.** (1) Turn the **RECORD VOLUME** control counterclockwise to its minimum position. This is the left-hand control of the group of three at top center of the control panel.

(2) Turn on the signal at the source, which is plugged into the **INPUT** jack at lower left of the control panel.

(3) Turn the **RECORD VOLUME** control clockwise until there is an indication on the power level meter.

(4) Normal code recording is obtained when the meter needle indicates full-scale on high-speed code signals. Adjust the signal at the source to provide for normal recording level at a setting of the **RECORD VOLUME** control between 10 and 2 o'clock.

(5) After the recording level is properly adjusted, set the **METER** selector switch on the **CODE** position.

**g. Recorder Resonance.** (1) The resonance point of the magnetic recording head in Speech Recorder MC-502 equipment is about 3,800 cycles and the response (sensitivity) of the recording head drops off rapidly at frequencies above 3,800 to 4,000 cycles per second.

(2) On this basis, it is evident that if the pitch of the received code signals is much over 4,000 cycles, the sensitivity of the recording head will be so low that the record will be "under-recorded," or not fully modulated.

(3) On the other hand, the higher the speed of the incoming code signals, the greater the speed reduction required for transcription, and subsequently the higher the received signal pitch should be to allow for maximum speed reduction in transcription.

(4) Considering the preceding paragraphs it is evident that although a high-pitched received code signal is necessary for maximum speed reduction in transcription, there is an upper limit to this pitch, namely, about 4,000 cycles.

#### **h. Words Per Minute Versus Signal Pitch.**

<b>WPM</b>	<b>Signal Pitch</b>
200.....	4,000
100.....	3,000
50.....	2,000
20.....	1,000

### **45. RECORDING (fig. 34).**

**a. MOTOR Control Switch.** (1) Place the recording machine in operation for recording by closing the **MOTOR "ON-OFF"** switch located at top right on the control panel.

(2) The recording machine can also be placed in operation by closing the motor remote control foot switch located at the end of the extension cable which is plugged into the right-hand side of the amplifier chassis.

(3) **ABNORMAL CONDITIONS** of the equipment could prevent one or both of the dual machine motors from operating, and, it could be possible for both motors to operate simultaneously, when the **MOTOR "ON-OFF"** switch is closed.

(4) One example could be that the "**REPRODUCER SAFETY**" switch has been closed because the reproducer carriage control lever has been left in the "operate" position and the motor previously left running until the reproducer carriage reached the end of its travel and the "**REPRODUCER SAFETY**" switch automatically opened the motor circuit. If the motor does not operate when the **MOTOR** switch is closed, check to see that this condition does not exist.

(5) Both recording machine motors could operate simultaneously, when the **MOTOR** switch is

closed, if by some previous operation, the change-over mechanism had been left in the "overlap" position with both motors running when the MOTOR switch was opened.

(6) If this condition exists, place the recorder carriage control lever on the machine to be stopped, in the "neutral" position, and move the recorder carriage **POSITIVELY** to the right to fully operate the change-over mechanism.

**b. FRONT Machine Signal Light.** (1) Either the **FRONT** or **REAR** machine signal light will light when the **MOTOR "ON-OFF"** switch is closed, indicating that either the front or rear machine motor is running.

(2) These are the middle two signal lights in the group of four located at the top of the control panel.

**c. Change-Over.** (1) When recording progresses on one of the dual units to the end of the record, this recorder carriage operates the change-over switch which places the alternate machine in operation, and, after a 10- to 15-second overlap (for a 15-minute record), or a 20- to 30-second overlap (for a 30-minute record), the motor on the first machine, the machine with the completed record, is automatically turned off, while the motor on the alternate machine continues to operate.

(2) During the "change-over" period, both the **FRONT** and **REAR** signal lights will be on.

**d. CHANGE RECORD Signal Light.** (1) When the recorder carriage on either machine reaches its right-hand limit of travel, it closes the "**CHANGE RECORD**" switch on that machine to light the **CHANGE RECORD** signal light on the control panel.

(2) This is the right-hand signal light in the group of four located at the top of the control panel and it indicates a record on one of the machines is fully recorded and needs changing.

(3) When the **CHANGE RECORD** light first comes on, it indicates that a record on one of the machines has just been completely recorded and the time during which this record can be replaced with a blank record, is the time that it takes to fully record the record on the alternate machine.

(4) If the fully recorded record is not changed before the record on the alternate machine is completely recorded, when the recorder carriage on the alternate machine reaches its right-hand limit of travel, its motor will automatically shut off, leav-

ing both motors inoperative until the machine is attended.

#### **46. CHANGING RECORD RELOADING (fig. 50).**

**a. Recorder Carriage.** (1) When a record has been fully recorded, place the recorder carriage control lever (36) on this machine in the "neutral" position, (i.e. align it with carriage control lever "stop" (95)).

(2) Move the recorder carriage to the left slightly, and then move it to the right again, as far as it will go, to make sure that the change-over mechanism has been fully operated.

(3) Move this recorder carriage to its extreme left-hand position and leave the recorder carriage control lever (36) in the "neutral" position.

**b. Eject Record.** (1) With both the recorder and reproducer carriage control levers (36) on this machine in the "neutral" position, eject the recording belt by pulling the injector-ejector control lever (15) forward. This lever is located at the front right-hand corner of each of the dual recording-reproducing machine units.

(2) Remove the completely recorded record from the machine and install a new one as explained in paragraph 40.

**c. Recorder Carriage Control Lever.** Place recorder carriage control lever (36) in the "operate" position as explained in paragraph 41.

#### **47. REPRODUCING (figs. 34 and 50).**

**a. General (fig. 34).** (1) Reproduction can be obtained simultaneously with, or independently of, recording, on the dual unit in operation at the time a playback is desired.

(2) The **MOTOR "ON-OFF"** switch on the control panel (fig. 34) can be operated independently of the remote control foot switch at the end of the remote control extension cable. These two switches are in parallel.

**b. Headphones or Loudspeaker (fig. 34).** Plug headphones or loudspeaker into one of the **REPRODUCE OUTPUT** jacks on the control panel. These are the middle and right-hand jacks in the group of three at top center of the control panel.

**CAUTION: IF USING HEADPHONES, PLUG THEM INTO THE 600-OHM REPRODUCE OUTPUT JACK, THE MIDDLE JACK. CRYSTAL HEAD-**

PHONES MIGHT BE OVERLOADED IF PLUGGED INTO THE 5,000-OHM REPRODUCE OUTPUT, THE RIGHT-HAND JACK. ADVANCE THE REPRODUCE VOLUME CONTROL IN A CLOCKWISE DIRECTION, CAUTIOUSLY, BECAUSE THE OUTPUT OF THE REPRODUCE AMPLIFIER IS 2.0 WATTS.

c. **MOTOR Switch** (fig. 34). Close the MOTOR "ON-OFF" switch.

d. **Locating Desired Portion of Record** (fig. 50). (1) With the reproducer carriage control lever (36) in fig. 50) in the "neutral" position (aligned with carriage control lever "stop" (101)), move the reproducer carriage to the approximate location of the recording to be played back.

(2) Place the reproducer carriage control lever (36) in the "operate" position (towards the rear of the machine from reproducer carriage control lever "stop" (101)).

**CAUTION: DO NOT USE A PUSHING MOTION IN OPERATING THE REPRODUCER CARRIAGE CONTROL LEVER (36). USE THE REPRODUCER CARRIAGE CONTROL LEVER STOP (101) AS THE PIVOT POINT FOR A COUNTERCLOCKWISE ROTARY MOTION, TO AVOID THE POSSIBILITY OF CHIPPING THE SAPPHIRE POINT ON THE REPRODUCER STYLUS.**

(3) If the desired section of the record is not located on the first trial, return the reproducer carriage control lever (36) to its "neutral" position and move the reproducer carriage to the right or to the left to locate the recording desired.

e. **Backspacer.** (1) The reproducer is automatically backspaced three grooves ( $\pm 1$ ) (about 4.16 seconds of recording for a 15-minute record and 8.32 seconds of recording for a 30-minute

record) when the reproducer carriage control lever (36) is moved from the "neutral" to the "operate" position.

(2) Therefore, if the reproducer stylus has been located at a point a few grooves ahead of the desired recording, return the reproducer carriage control lever (36) to the "neutral" position, and then place it in the "operate" position again. This provides a three groove backspace.

(3) If a few more grooves of backspacing are needed, repeat this procedure the necessary number of times.

(4) If the recording to be played back is a considerable distance away from the point where the reproducer stylus is positioned, it is quicker and easier to place the reproducer carriage control lever (36) in the "neutral" position and slide the reproducer carriage to approximately the desired position.

**CAUTION: USE REASONABLE CARE IN BACKSPACING. MOVING THE REPRODUCER CARRIAGE CONTROL LEVER (36) RAPIDLY BACK AND FORTH TO OBTAIN A NUMBER OF BACKSPACES MAY EXERT UNDUE PRESSURE ON THE REPRODUCER STYLUS TIP AND CAUSE IT TO CHIP.**

f. **Conclusion.** After reproduction has been completed, open the MOTOR switch.

#### **48. RECORDING LEVEL SUGGESTIONS.**

a. **Overloading.** An "overloaded" record is indicated in reproduction by "echo". (Low level sounds in the background, during reproduction, due to overmodulations in adjacent tone grooves.)

b. **Under Recording.** A record that has been recorded at too low a level, "under recorded," is indicated in reproduction by a high setting of the REPRODUCE VOLUME control, a setting near the furthestmost clockwise position.

# SECTION III

## Functioning of Parts

### 49. GENERAL.

a. The main part of this is devoted to the detailed explanation of the different elements in Speech Recorder MC-502 equipment. First, however, it is desirable to explain the basic principles underlying the operation of this type of equipment. This is done in subparagraphs b through c below.

b. **Seven Energy Conversion Steps.** (1) Sound is airborne acoustic energy. If sound is to be recorded and reproduced, it is necessary to start with acoustic energy at the time it originates, and finish at any desired future time with a faithful reproduction of the original airborne acoustic energy. The seven "steps" in these different "energy conversions" are given in the seven paragraphs below.

(2) A microphone does a double conversion job. It translates the sound at the source from acoustic energy into mechanical energy and then into electrical energy.

(3) The record amplifier is not a converter of energy. It is an amplifier of energy. It changes the energy from low level to high level. It amplifies the low level electrical energy supplied to it, to the point where it will satisfactorily drive the recording head.

**NOTE:** Speech Recorder MC-502 equipment will record from audio circuits whose maximum levels are as low as -20 db and as high as +20 db. This means that in the case of a microphone source, a pre-amplifier must be installed between the microphone and this equipment.

(4) A recording head is a double conversion device. It receives the amplified electrical energy from the output of the record amplifier and translates it into mechanical energy. This mechanical energy is passed on to the recorder stylus in the form of lateral vibrations, and the stylus traces a laterally modulated tone groove in the record.

(5) The recording medium or recording belt, is not an energy converter. It is the storage point. Up to this point, all of the events have taken place simultaneously with the sounds originating at the

source. At this point, the sound is recorded and the result is a laterally modulated tone groove in the record.

**NOTE:** In the case of Speech Recorder MC-502 equipment, the record embodied in the tone grooves can be played back at the same time it is being recorded, with a lag of about  $\frac{1}{2}$  second (for a 15-minute record); it can be reproduced immediately upon completion of recording, or it can be reproduced a year or more hence. The record is a **PERMANENT** record.

(6) A reproducing head is a double conversion device. The reproducer stylus installed in the reproducing head tracks the tone grooves traced by the recorder stylus. The tone grooves drive the reproducer stylus, and lateral vibrations are imparted to the stylus, which vibrations should be a faithful reproduction of the lateral vibrations of the recorder stylus which prevailed at the time the recording was originally made. Thus, at this point, the laterally modulated tone grooves are translated into mechanical energy at the reproducer stylus, and subsequently the reproducing head translates this mechanical energy into electrical energy and passes it on to the input of the reproduce amplifier.

(7) A reproduce amplifier is not a converter of energy. It is an amplifier of energy. It changes the energy from low level to high level. It receives the minute electrical energy in the output circuit of the reproducing head and amplifies this energy to a point where it is sufficient to drive headphones or loudspeaker.

(8) A loudspeaker (or headphones) is a double conversion device. It translates the electrical energy in the output of the reproduce amplifier into mechanical energy, and then into acoustic energy. The latter should be a faithful reproduction of the original sounds originating at the source when the recording was made.

### c. Summary of Energy Transformations.

- |  |              |
|--|--------------|
| (1) Source of sound.....                         | Acoustic     |
| (2) Air medium.....                              | Air Pressure |
| (3) Microphone diaphragm (air pressure operated) | Mechanical   |

- (4) Microphone output ..... Electrical
- (5) Record amplifier ..... Electrical
- (6) Recorder armature (electrically operated) ..... Mechanical
- (7) Recorder stylus ..... Mechanical
- (8) Recording medium (record) ..... Tone Grooves
- (9) Reproducer stylus ..... Mechanical
- (10) Reproducer armature (tone groove operated) ..... Mechanical
- (11) Reproducer output ..... Electrical
- (12) Reproduce Amplifier ..... Electrical
- (13) Loudspeaker diaphragm (electrically operated) ..... Mechanical
- (14) Loudspeaker output ..... Air Pressure
- (15) Ear ..... Acoustic

**d. Major Elements.** (1) **MECHANICAL SYSTEM.** This element is for moving the recording medium under a recorder stylus and under a reproducer stylus at sufficiently constant speed to afford speech and code recording and reproduction which provides adequate intelligibility for the job intended.

(2) **RECORD AMPLIFIER.** The record amplifier has sufficient amplification to increase the low level signals at its input, to a value high enough to normally operate the recording head and subsequently drive the recorder stylus to a point where it fully modulates the tone grooves in the record.

(3) **RECORDING HEAD.** This element can be used to swage the tone grooves in the record thus translating electrical variations into an engraved record.

(4) **REPRODUCING HEAD.** The reproducing head can be used to translate the laterally modulated tone grooves in the record into electrical variations, which can be passed on to the input of the reproduce amplifier.

(5) **REPRODUCE AMPLIFIER.** The reproduce amplifier has sufficient amplification to increase the low-level signals supplied to it from the reproducing head, to a point where this energy will satisfactorily operate a monitoring device. (Headphones or loudspeaker.)

(6) **MONITORING DEVICE.** This element consists of the headphones or loudspeaker which can be used to transform the electrical variations in the output of the reproduce amplifier into audible sounds.

(7) **SIGNAL LIGHT AND CONTROL SYSTEM.** The signal light and control system aids in operating the equipment in a convenient and efficient manner.

**e. Major Units.** (1) One major unit is that which includes all the equipment mounted to the unit plate both above and below.

(2) The second major unit is the amplifier system, with its associated control panel.

**f. Major Circuits.** (1) Motor circuit.

(2) Signal light circuit.

(3) Speech or audio circuit, (i.e. recording and reproducing circuit).

(4) Power-supply circuit (in the case of Speech Recorder MC-502 equipment 115/230 volt, 50/60 cycle).

**50. AMPLIFIER SYSTEM (figs. 15, 16, 17, 18, and 39).**

**a. General.** (1) Pictures and diagrams relating to the amplifier system are shown in figures 34 through 39.

(2) Figure 39 is the schematic diagram of the amplifier system.

(3) The amplifier system includes a record amplifier, a reproduce amplifier, and their commonpower rectifier supply, all mounted on one chassis, the front end of which supports the control panel.

**b. Record Amplifier, General (fig. 39).** (1) The record amplifier can be divided into several major circuits, as follows:

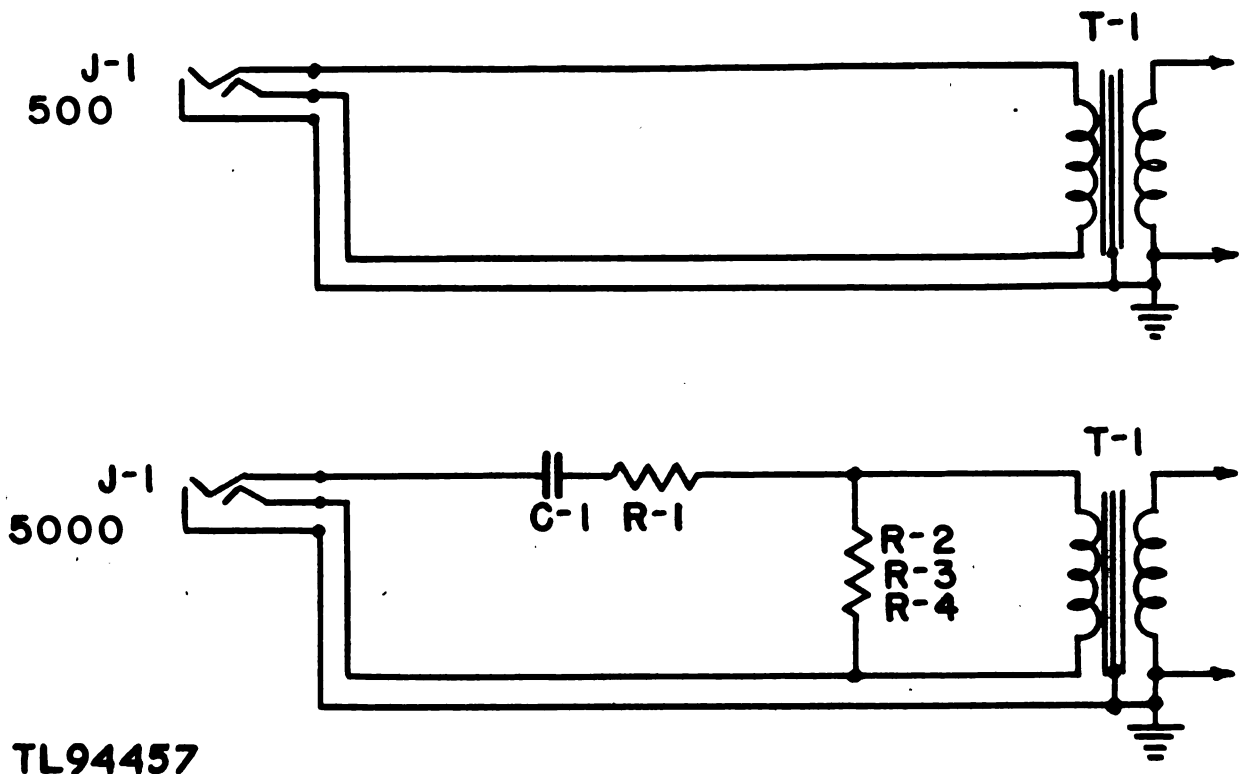
- Speech circuit
- Ground or B- circuit
- Compression circuit
- Plate supply or B+ circuit

**c. Record Amplifier Speech Input Circuit (figs. 15 and 39).**

(1) Figure 15 is a schematic diagram of the record amplifier input circuit.

(2) Legend for figure 15.

Des.	Value	Rating	Service
C-1	0.05 mfd.	600 v	Isolating, coupling, and d-c blocking capacitor.
J-1	3-way	Jack	Audio input.
R-1	4,700 ohm	1/2 watt	Input series resistor.
R-2	22.0 ohm	1/2 watt	Input shunt resistor.
R-3	100.0 ohm	1/2 watt	Input shunt resistor.
R-4	510.0 ohm	1/2 watt	Input shunt resistor.
T-1	500 ohm to grid		Record amplifier input transformer.



TL94457

Figure 15. Audio input circuit

(3) The 5,000 ohm input has (C-1) and (R-1) in series with, and either (R-2), (R-3), or (R-4), in shunt with, the primary winding of the audio input transformer (T-1).

(4) These inputs are under the control of the INPUT selector switch (S-1) in fig. 39), as explained in paragraph 57d.

**d. Compression, General.** (1) The record amplifier in this machine is of the "compression" type, to maintain "volume level perspective", and at the same time to compress the signals supplied to its input, to such a degree, that they can be recorded within the volume range available in this type of recording equipment (25.0 db).

(2) "Compression" then is to be contrasted with the "automatic volume control" (AVC) type of amplifier where the amplifier-output levels are maintained practically constant over a wide variation in input level.

(3) A "compression" amplifier is a "non-linear" amplifier. In an amplifier having 2-1 compression, a 4-db increase in input level produces a 2-db increase in output level; an 8-db increase in input level, a 4-db increase in output level; a 16-db

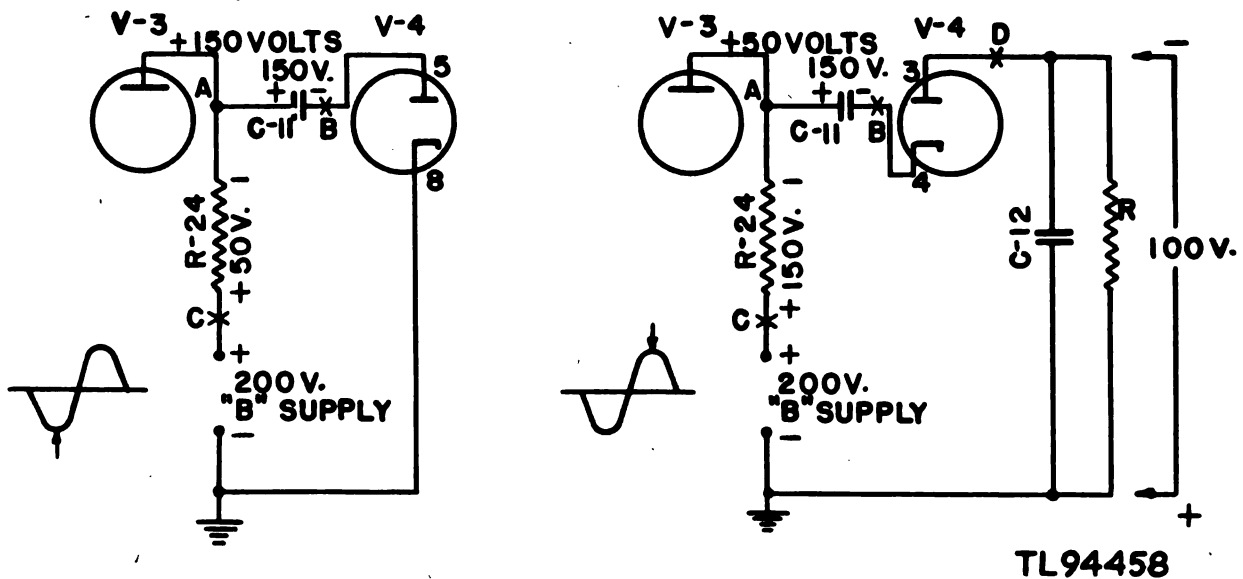
increase in input level, an 8-db increase in output level, etc.

(4) In an amplifier having 4-1 compression, a 4-db increase in input level produces a 1-db increase in output level; an 8-db increase in input level, a 2-db increase in output level; a 16-db increase in input level, a 4-db increase in output level, etc.

(5) From the above, then, it is evident that a "compression" type amplifier maintains "volume level perspective" whereas an amplifier equipped with "avc" tends to maintain a constant output level, and thus the latter eliminates "volume level perspective".

(6) It is possible to obtain a much faster "operating" time in the case of the "compression" type of amplifier than in the case of the "avc" type.

(7) Compression is based on the fact that one method of changing the amplification of a vacuum tube is to vary the value of the d-c voltage applied to its grid. The more negative this d-c voltage (grid bias) the less the amplification of the tube. Basically, the idea is to automatically supply more negative d-c voltage to the grid of the amplifier tubes being controlled, when the signal strength applied to the amplifier input becomes greater, and



TL94458

Figure 16. Compressor rectifier circuit

vice versa. This is done by rectifying a portion of the audio-frequency energy applied to the amplifier input and using this varying d-c voltage for control.

(8) This d-c voltage will vary in proportion to the input signal strength.

**e. Record Amplifier Compression Section (fig. 39).** The first two tubes in the record amplifier, ((V-1) and (V-2) in fig. 39), compose the "compression section" of the record amplifier, because these are the two tubes that are controlled to provide the desired amount of compression.

**f. Record Amplifier Compressor Amplifier Stage (fig. 39).** The audio-frequency energy to be rectified for compression control, must first be amplified, to provide sufficient d-c voltage for the control desired, hence the compressor amplifier tube (V-3).

**g. Record Amplifier Compressor Rectifier Stage (figs. 16 and 39).** (1) The record amplifier compressor rectifier tube is shown at ((V-4) in figure 39).

(2) Figure 16 aids in explaining the operation of the duo-diode compressor rectifier tube (V-4). Two

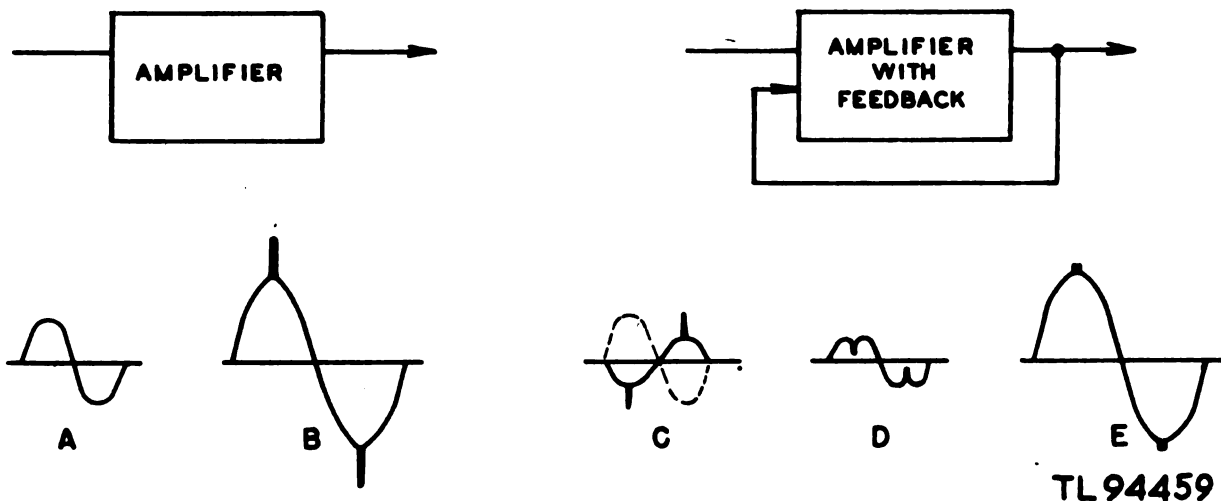
simplified diagrams have been drawn on figure 16 for this explanation. In both of these diagrams the power supply source has been represented by "200 v B SUPPLY".

(3) In the drawing at the left (fig. 16), only that section of the duo-diode tube (V-4) which is used on the negative half of the speech wave has been shown. In the drawing at the right (fig. 16), the part of the diode which is used on the positive half of the speech wave is shown.

(4) In the diagram at the right (fig. 16), the load resistors which appear in figure 39 as (R-25), (R-26), (R-27), and (R-28) with the COMPRESSION selector switch (S-2) in the 4-1 and 2-1 positions, and as (R-30) in the CODE position of the COMPRESSION switch (S-2), are grouped here in the right-hand diagram (fig. 16) as (R).

(5) In both diagrams (fig. 16), the plate of the compressor amplifier tube (V-3) has been shown.

(6) Assume that speech voltage has appeared on the grid of (V-3) and that it is the maximum negative part of the speech voltage cycle. This means that maximum negative bias voltage is applied to the grid of the tube (V-3) so that it



TL94459

Figure 17. Negative feedback diagram

draws a minimum amount of current from the plate supply.

(7) This minimum amount of plate current flowing through the plate load resistor (R-24) causes a minimum voltage drop across the resistor (R-24) so that the voltage appearing at point (A) can be assumed to be approximately +150 volts with respect to ground.

(8) Since a capacitor has no impedance to the first surge of voltage when it is not charged, charging current flows through the capacitor (C-11) and through the half of the duo-diode tube (V-4) shown in the diagram at the left, until capacitor (C-11) becomes fully charged and thus 150 volts appears across (C-11), with the side connected to (A) being positively charged.

(9) For operation during the next half cycle of the speech wave, refer to the diagram on the right (fig. 16). Assume that the speech voltage applied to the grid of (V-3) has reached the maximum positive point in its cycle.

(10) This means that minimum negative bias voltage is applied to the grid of (V-3), and V-3 therefore draws maximum plate current.

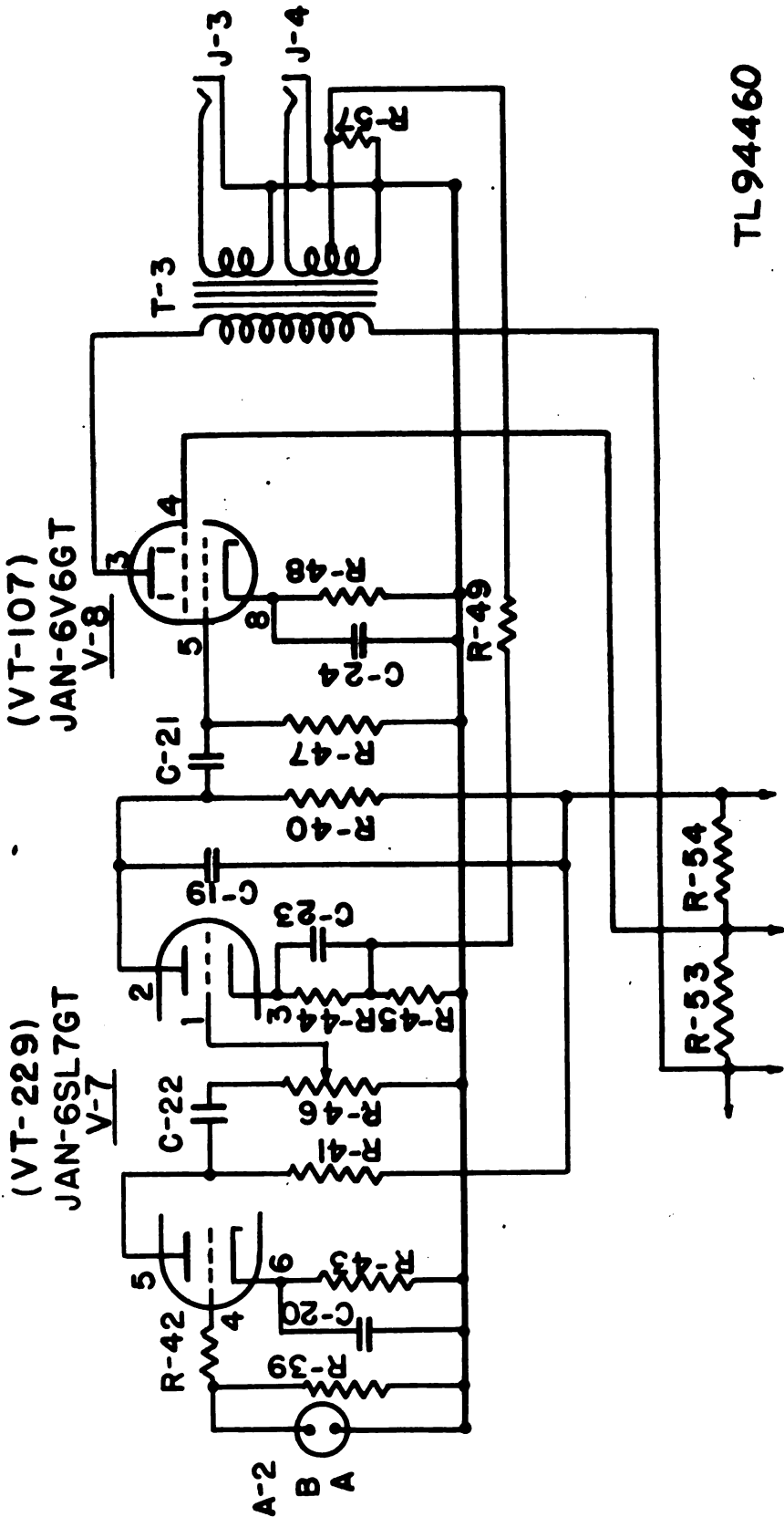
(11) Maximum plate current flowing through resistor (R-24) causes a maximum voltage drop across (R-24) which can be assumed to be 150 volts, so that now the voltage at point (A) is +150 volts with respect to ground.

(12) Capacitor (C-11) has remained charged with its 150 volts.

(13) Starting at point (B), point (A) is positive with respect to point (B) by 150 volts due to the charge on capacitor (C-11). Between (A) and the positive plate of the "B" supply, there is a 150 volt drop with point (A) negative with respect to the other end of resistor (R-24). Adding these two voltages algebraically, there is a difference of potential of 300 volts between (C) and (B) with point (C) positive with respect to point (B).

(14) The 200-volt "B" supply is between point (C) and ground, the positive side of the "B" supply being connected to point (C). This 200 volts must also be added algebraically, and when this is done, it is found that there is a resultant potential between (B) and ground of 100-volts ( $+300 - 200 = 100$  volts) with ground positive with respect to the point (B).





TL94460

Figure 18. Reproduce amplifier schematic

(15) At this instant the point (D) is at ground potential because there is no current flowing through (R) and therefore there is a difference of potential of 100 volts between point (D) and point (B), with (D) positive with respect to (B).

(16) When this condition exists, the plate of one section of the diode (V-4) is positive with respect to the cathode, and this section of tube (V-4) conducts current. When current flows through this section of the diode (V-4), capacitor (C-12) becomes charged to the value of voltage appearing across the circuit which is 100 volts.

(17) When current flows through this section of (V-4), capacitor (C-11) becomes discharged through (C-12). As capacitor (C-11) is discharged, it is ready for charging again on the next negative cycle of grid voltage at (V-3) and the same sequence of events takes place again.

(18) The current flowing through the diode circuit from (D) to (B) charges capacitor (C-12) so that the ground side of (C-12) is positive with respect to the other side.

(19) This same voltage to which capacitor (C-12) is charged, appears across resistor (R) so that the ground end of (R) is positive with respect to the other end. Resistance (R) in this particular diagram represents the sum of the four resistors ((R-25), (R-26), (R-27), and (R-28) in fig. 39) so that with respect to ground, the maximum negative voltage appears at the end of resistor (R-26) which is connected to the plate 3 of diode (V-4).

(20) The voltages between the other resistors, (which are included in (R)), and ground, are less negative than the voltages across the sum of the resistors. These resistors have been selected so that proper voltage values are available for the control of the controlled tubes (V-1) and (V-2) in the record amplifier.

**h. Record Amplifier Output Section (fig. 39).** (1) The two output stages of the record amplifier, ((V-5) and (V-6) in figure 39), are connected in the conventional manner.

(2) (V-5) is a voltage amplifier tube in the "driver" stage and (V-6) is a power amplifier tube in the "output" stage.

**i. Negative Feedback (figs. 17 and 39).** (1) Negative feedback is used in the record amplifier. The negative feedback circuit includes the capacitor ((C-18) in fig. 39) and the resistors (R-32), (R-33), (R-36), and (R-38). ((R-38) is the record amplifier tone control.)

(2) The two diagrams (fig. 17) will aid in explaining the operation of negative feedback.

(3) The diagram at the left (fig. 17) represents a standard amplifier which DOES NOT HAVE negative feedback, and below, the waveform of the input signal (A) and the output signal (B). Distortion takes place in this amplifier as indicated by the sharp peak on the top of the negative and positive crests of the wave (B).

(4) The diagram at the right (fig. 17), (a line indicating that part of the output voltage is fed back to the input of the amplifier), illustrates a standard amplifier which HAS negative feedback. In this case, the waveform of that portion of the amplifier output voltage which is fed back to the input of the amplifier, is shown at (C). This voltage which is fed back to the input of the amplifier, has the same distortion in it that the output waveform has, but this feedback voltage is opposite in phase to the signal voltage applied to the amplifier input, at the point where the feedback voltage is applied.

(5) These two voltages combine to form the total amplifier input voltage and the waveform of this new input voltage is shown at (D). This new input voltage waveform has valleys in place of the peaks, which latter are shown to indicate distortion.

(6) When this new input voltage (D) is amplified, it tends to neutralize the distortion created in the feedback portion of the amplifier, and the final voltage, therefore, has much less distortion than in the case of the amplifier which has no feedback. This final waveform is shown at (E).

(7) Negative feedback is used to reduce distortion arising in that section of the amplifier where negative feedback is applied; to flatten the over-all frequency response characteristic, and to provide a convenient method for "tone control".

**j. Reproduce Amplifier (figs. 18 and 39).**

(1) Figure 18 is a schematic diagram of the reproduce amplifier.

(2) Legend for figure 18.

Des	Value	Rating	Service
A-2	2-way	Female	Reproduce amplifier audio input receptacle.
C-20	25.0 mf	25 v	Cathode by-pass capacitor.
C-19	0.001 mf	600 v	Stabilizing capacitor.
C-21	0.01 mf	600 v	Coupling capacitor.
C-22	0.01 mf	600 v	Coupling capacitor.
C-23	25.0 mf	25 v	Cathode by-pass capacitor.
C-24	25.0 mf	25 v	Cathode by-pass capacitor.
J-3	1-way	Jack	Reproduce amplifier output (5,000 ohms).

Des	Value	Rating	Service
J-4	1-way	Jack	Reproduce amplifier output (600 ohms).
R-39	0.47 meg	½ watt	Grid resistor.
R-40	0.47 meg	½ watt	Plate load resistor.
R-41	0.47 meg	½ watt	Plate load resistor.
R-42	47,000 ohm	½ watt	Filter resistor.
R-43	4,700 ohm	½ watt	Cathode resistor.
R-44	4,700 ohm	½ watt	Cathode resistor.
R-45	240 ohm	½ watt	Cathode resistor.
R-46	0.5 meg	POT.	Reproduce amplifier volume control.
R-47	0.47 meg	½ watt	Grid resistor.
R-48	360 ohm	1.0 watt	Cathode resistor.
R-49	4,700 ohm	½ watt	Filter resistor.
R-53	10,000 ohm	½ watt	Power rectifier filter circuit resistor.
R-54	10,000 ohm	½ watt	Power rectifier filter circuit resistor.
R-57	56.0 ohm	½ watt	Reproduce amplifier output load resistor.
T-3	8,000 ohm to 8.0/600/5,000 ohm		Reproduce amplifier output transformer.
V-7	JAN-6SL7GT VT-229		First and second reproduce amplifier stages.
V-8	JAN-6V6GT VT-107		Reproduce amplifier output stage.

(3) The reproduce amplifier is a two-tube 3-stage amplifier. Two stages of amplification are obtained within one tube envelope.

(4) Negative feedback, through the medium of the resistors (R-45) and (R-49), is employed in the reproduce amplifier.

(5) The 56.0-ohm-resistor (R-57) is connected across the 8.0-ohm winding of the output transformer (T-3) to stabilize the output of the reproduce amplifier so that the output voltage will not become too high when no external load (headphones or loudspeaker) is connected to the reproduce amplifier output.

(6) Negative feedback voltage is obtained from the high side of the 8.0-ohm secondary winding of reproduce amplifier output transformer (T-3) and is applied through the 4,700 ohm resistor (R-49) to the bottom side of the cathode resistor (R-44) in the second reproduce amplifier stage at (V-7).

(7) The second resistor in the negative feedback circuit is (R-45) and it is through this network that the proper amount of voltage in its correct phase relationship, is applied to the input of the second reproduce amplifier stage (V-7).

**k. Power Rectifier Supply.** (1) The common power supply for the record and reproduce amplifiers (fig. 39) is of standard design, using a full-wave rectifier tube and a resistance capacity filter for smoothing the ripples out of the rectified voltage.

(2) The end of the high-voltage secondary winding of the power transformer (T-4) which is connected to the number 4 plate of (V-9), becomes alternately positive and then negative with respect to ground. The other end of the high-voltage secondary winding of power transformer (T-4) which is connected to number 6 plate of (V-9), becomes alternately negative and then positive with respect to ground, 180° out of phase with plate number 4. In other words, when one end of the high-voltage secondary winding of (T-4) is positive with respect to ground, the other end is negative with respect to ground.

(3) When plate number 4 of (V-9) is positive with respect to ground, current flows between the plate and filament and then back to ground through capacitor (C-25) until this capacitor (C-25) is fully charged.

(4) When plate number 6 becomes positive, current flows between it and filament and through capacitor (C-25) back to ground, until capacitor (C-25) is again fully charged.

(5) Since capacitor (C-25) is charged when each end of the secondary winding becomes positive with respect to ground, the capacitor (C-25) receives a charge 120 times every second. This charge on capacitor (C-25) is continually leaking off, because of the drain on the power supply, but the charge is renewed each time the rectifier tube (V-9) passes current.

(6) This constant charging of (C-25), and leaking off again, causes a varying value of the d-c voltage across capacitor (C-25). This variation is known as a ripple. The ripple, if it exists in the B+ supply to the amplifier tubes, can be heard in the amplifier output in the form of a hum.

(7) To reduce this ripple to a minimum, the rectified voltage is fed from the input capacitor (C-25), through a series of resistors, (R-50), (R-51), (R-52), (R-53), (R-54). These resistors have large capacitors connected across them to form a filter network.

(8) The voltage across the output of the filter network (from the end of (R-54) to ground), while it is lower in value than the voltage at the input to the filter network (from the input end of (R-50) to ground), the output voltage from the filter is extremely smooth. It has no components and is therefore free from ripple.

(9) Because of the fact that the B+ voltage supply to the output tube of an amplifier is not

followed by succeeding amplification, it is allowable to have more ripple at this point than in the B+ voltage supplied to tubes which are followed by stages of amplification. It is for this reason that it is permissible to take the B+ supply for the output tubes in the record and reproduce amplifiers, from an early section of the power rectifier supply filter, where the voltage is higher yet has more ripple, but a ripple which is not manifested in the output of either amplifier.

(10) In the case of the record amplifier tube (V-1) the B+ supply is taken from the end of the power rectifier supply filter, where the ripple is lowest. Even a slight amount of ripple present in the B+ supply to (V-1) would be amplified by succeeding stages to the point where it would be manifested in the record amplifier output in the form of a loud hum.

(11) The first two resistors in the power rectifier filter network (R-50) and (R-51) are of higher power rating (5.0 and 2.0 watts respectively) because of the larger amount of current drawn through them. The last three resistors in the power rectifier supply filter (R-52), (R-53), and (R-54), are  $\frac{1}{2}$  watt resistors, since the current drawn through them is relatively small.

(12) The first two capacitor sections connected across the power rectifier filter network are 20.0 microfarad sections (C-25). These capacitors have a relatively high value to reduce the ripple as much as possible at these two points. The next four capacitor sections are 10.0 microfarads each (C-26).

## 51. BACKSPACER ASSEMBLY (fig. 45).

a. **General.** The backspacer mechanism (fig. 45) operates each time the reproducer carriage control lever (36) is placed in the "operate" position.

b. **Sequence of Events.** (1) As the reproducer carriage control lever (36) is placed in the "operate" position, the cam surface of the reproducer carriage control lever (36) engages the tip of the backspacer pawl (39) causing it to engage the teeth of the backspacer rack (38).

(2) Further travel of reproducer carriage control lever (36) toward its full "operate" position causes cam action between the reproducer carriage control lever (36) and the backspacer pawl (39) to cause the reproducer carriage to be forced to the left a distance of  $\frac{1}{64}$  inch (3, plus or minus 1, tone grooves).

**NOTE:** All of the preceding action takes place during the first portion of the travel of the reproducer carriage control lever (36) as shown at "A" and "B" in figure 45.

(3) During the next portion of the travel of reproducer carriage control lever (36), the feed nut is permitted to engage the feed screw; the reproducer stylus is presented to the record, and, because of the action of the backspacer spring (35), the backspacer pawl (39) is pulled out of engagement with the backspacer rack (38) as shown at "C" in figure 45.

(4) As the reproducer carriage control lever (36) is moved back to the "neutral" position the reproducer stylus is lifted away from the record; the feed nut is disengaged from the feed screw, and as the cam surface of the reproducer carriage control lever (36) passes the tip of the backspacer pawl (39), the latter is pulled to the left by the backspacer spring (35).

## 52. CARRIAGE HOUSINGS (fig. 54).

The carriage housings (fig. 54) are supporting members. Their movement along their bearing surfaces (the recorder and reproducer feed screw covers) is due to the mechanical connection between the carriages and the feed screw. This mechanical connection is obtained by means of the feed nut assembly which operation is explained in paragraph 61.

## 53. CHANGE-OVER MECHANISM (figs. 19 and 48).

a. **General.** Figure 19 is a perspective drawing which will aid in explaining the operation of the change-over mechanism.

b. **Operation.** (1) The change-over actuating levers (1) in fig. 19) are operated by the pins (2) on the recorder carriages. The change-over actuating levers (1) operate the CHANGE RECORD switches (3). There are two of these CHANGE RECORD switches on the under side of the unit plate, at the end of the actuating levers (1).

(2) The change-over actuating levers (1) also actuate the change-over slide mechanism (4).

(3) On the front machine, the change-over actuating lever (1), through a change-over connecting arm (5), acts on sliding member (6) of the change-over mechanism (4).

(4) The change-over actuating lever (1) on the rear machine acts on sliding member (7) of the change-over mechanism (4).

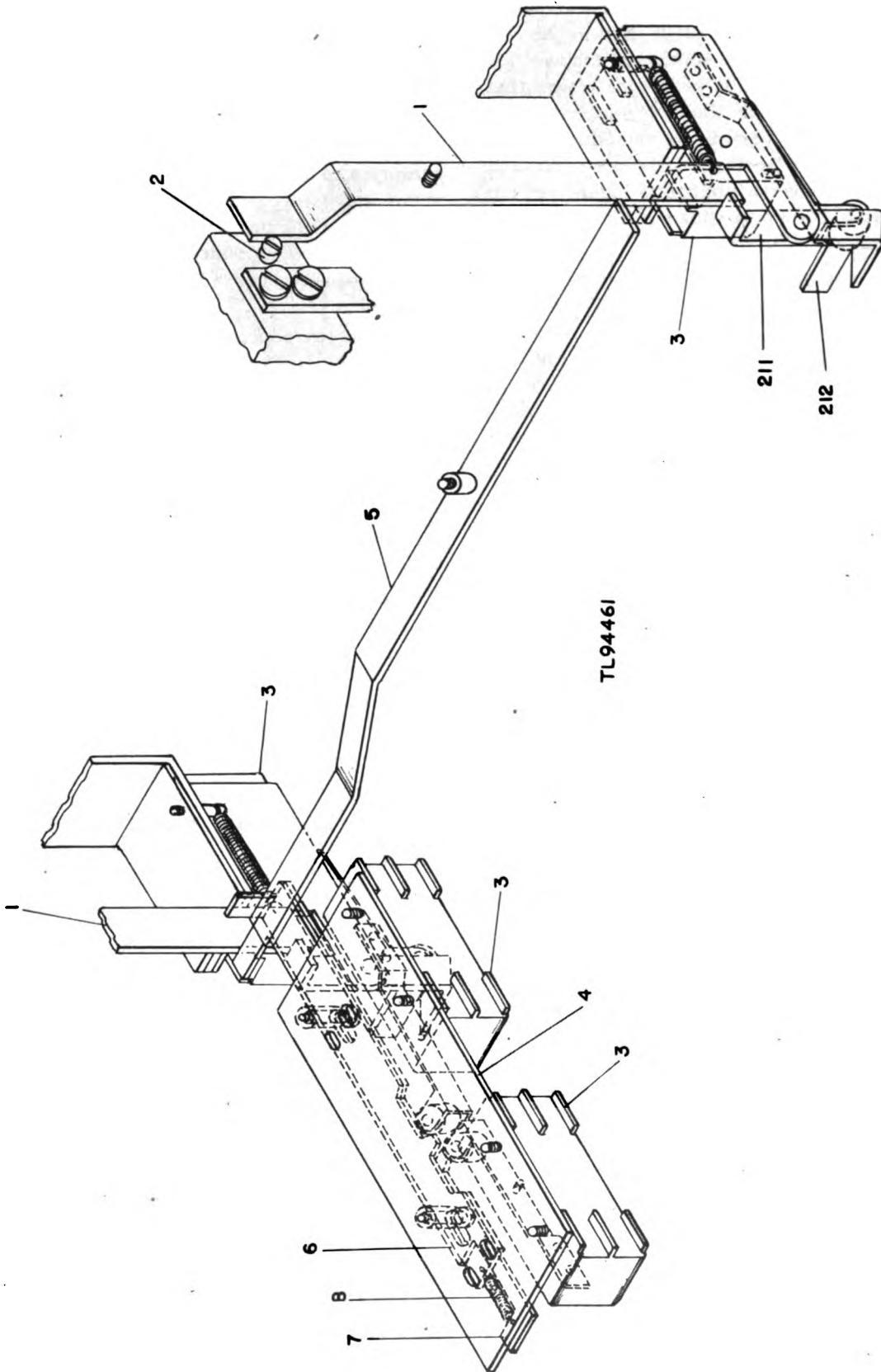


Figure 19. Change-over mechanism perspective

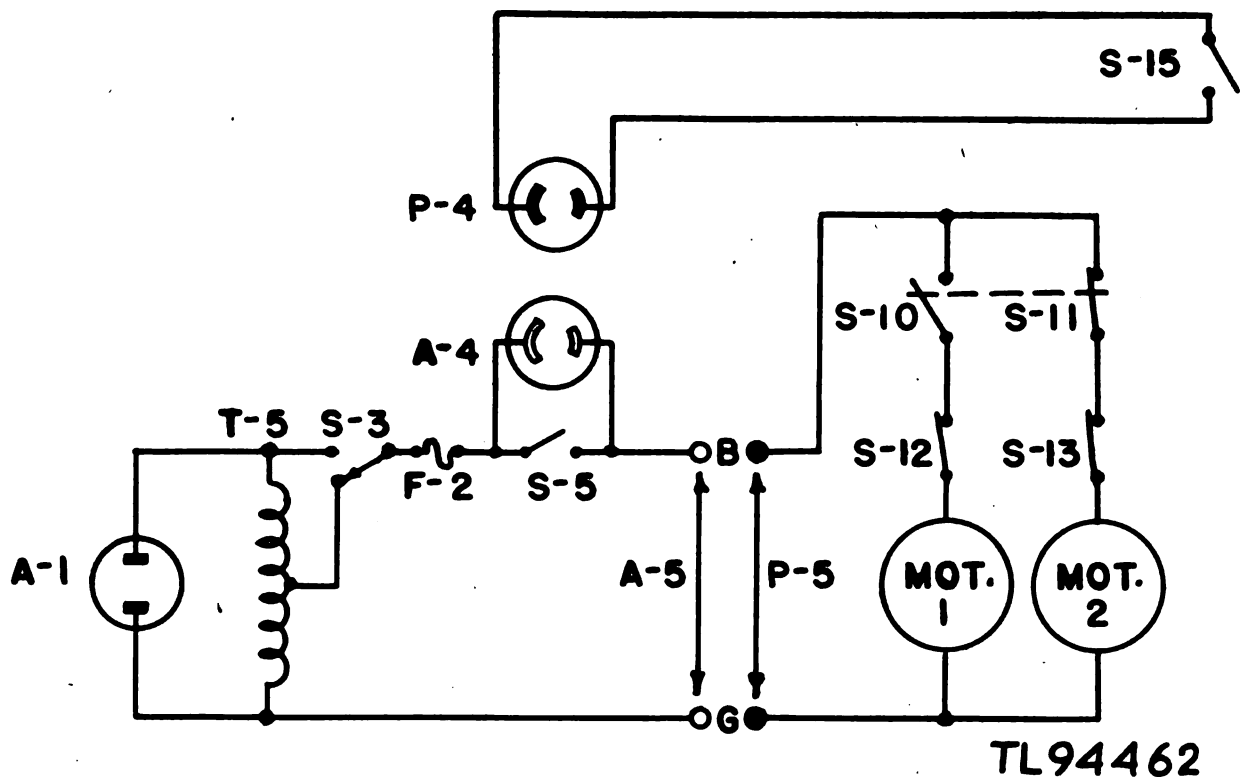


Figure 20. Motor circuit

(5) Sliding members (6) and (7) operate as an integral unit due to the action of spring (8) which holds the sliding members (6) and (7) together.

(6) Spring (8) is strong enough to insure that the cam surfaces on members (6) and (7) will operate the change-over switches (3) on change-over mechanism (4) when sliding member (6) is moved toward the left, or sliding member (7) toward the right.

(7) When both recorder carriages reach the end of their limit of travel, and the equipment is unattended, sliding member (6) is moved to the right and sliding member (7) to the left, spring (8) stretching to allow for this, and both change-over switches (3) on change-over mechanism (4) are operated, thereby opening both motor circuits.

(8) In the condition shown in figure 48 which shows right-hand change-over switch (3) operated, the rear motor is in operation. As the recorder carriage on this dual unit approaches its right-hand limit of travel, the change-over actuating lever (1) is operated by the pin (2) on the recorder carriage.

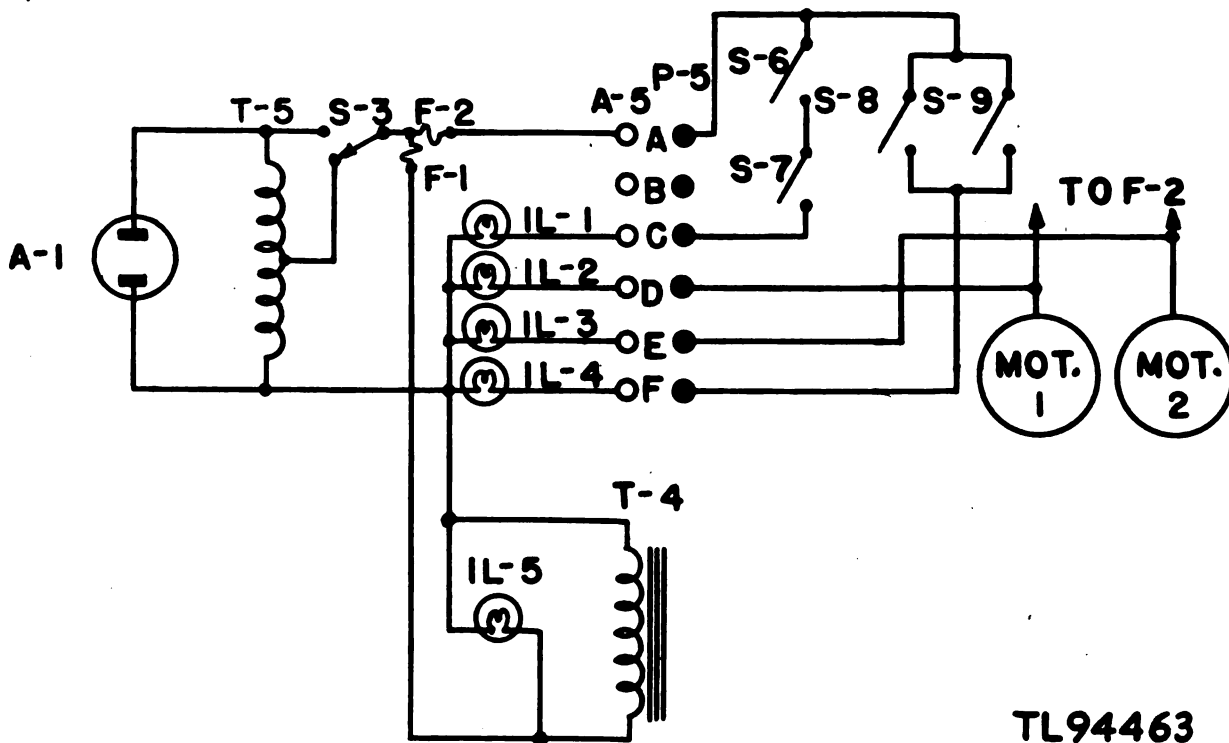
(9) Change-over actuating lever (1) operates change-over connecting arm (5) in fig. 19) and

connecting arm (5) bears against sliding member (7) starting the two sliding members (6) and (7) moving as an integral unit toward the left.

(10) As the sliding members (6) and (7) approach the mid-point of their travel, the left-hand change-over switch (3) on change-over assembly (4) will be operated. This closes the motor circuit of the front machine.

(11) As the recorder carriage on the rear machine continues to move towards its right-hand limit of travel, sliding members (6) and (7) continue to move towards the left, and as the sliding members approach the left-hand limit of their travel, right-hand change-over switch (3) on change-over assembly (4) is opened, the left-hand switch (3) remaining closed for continued operation of the motor on the front machine.

(12) As the recorder carriage (243) on the front machine reaches its right-hand limit of travel, and the rear machine has been reloaded with a new recording belt and its recorder carriage control lever placed in the "operate" position at the start of the record, the same series of events will take place in reverse order.



TL94463

Figure 21. Signal light circuit

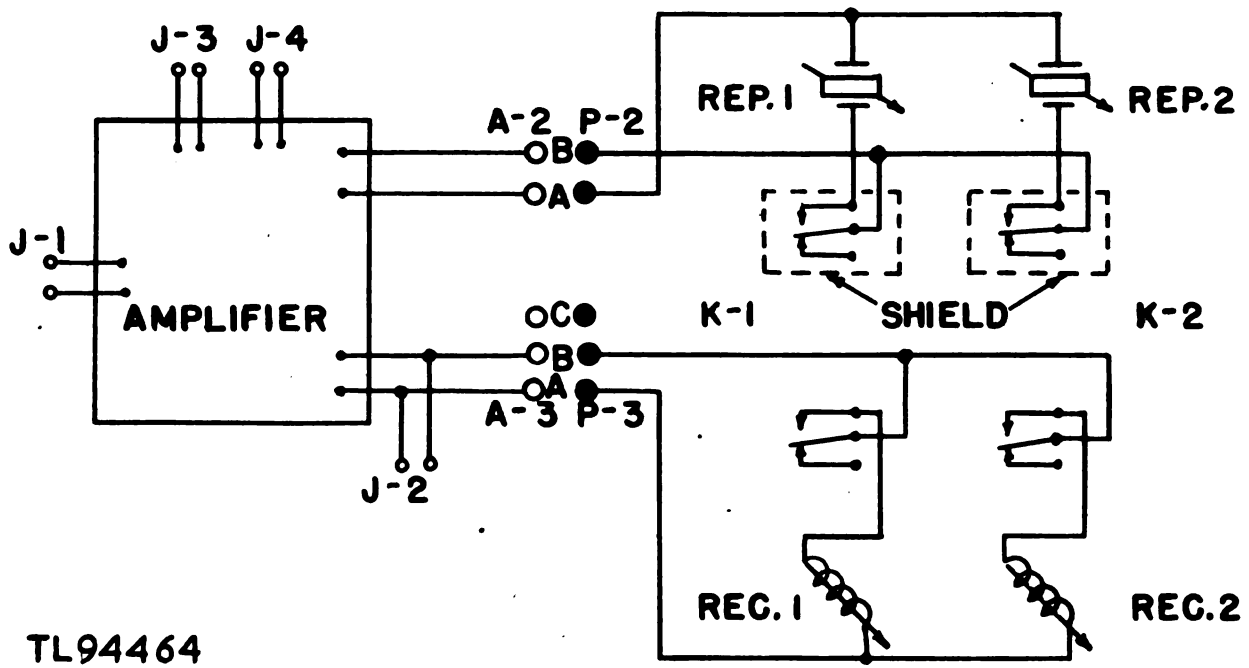
54. CIRCUITS (figs. 20, 21, 22, and 23).

a. Motor Circuit (fig. 20).

Des.	Value	Rating	Service
A-1	2-way	Male	115/230 volt power input receptacle.
A-4	2-way	Female	Remote motor control receptacle.
A-5	8-way	Female	Unit plate power receptacle.
F-2	1.5 amp	Fuse	Motor circuit.
MOT-1	115 v, 50/60 cycle		"TWO-SPEED" motor, front machine.
MOT-2	115 v, 50/60 cycle		"TWO-SPEED" motor, rear machine.
P-4	2-way	Male	Remote motor control plug.
P-5	8-way	Male	Unit plate power plug.
S-3	SPDT		115/230 volt power supply switch.
S-5	SPST	NO	Motor (local) "ON-OFF" switch.
S-10	SPST	NO	CHANGE-OVER switch, front machine.
S-11	SPST	NO	CHANGE-OVER switch, rear machine.
S-12	SPST	NC	REPRODUCER SAFETY switch, front machine.
S-13	SPST	NC	REPRODUCER SAFETY switch, rear machine.
S-15	SPST	NO	Motor (remote,) "ON-OFF" switch.
T-5	115/230 v, 50/60 cyc.		Line transformer.

b. Signal Light Circuit (fig. 21).

Des.	Value	Rating	Service
A-1	2-way	Male	115/230-volt power input receptacle.
A-5	8-way	Female	Unit plate power receptacle.
F-1	1.0 amp	Fuse	Amplifier circuit.
F-2	1.5 amp	Fuse	Motor circuit.
IL-1	Neon	115 v	READY signal light.
IL-2	Neon	115 v	FRONT signal light.
IL-3	Neon	115 v	REAR signal light.
IL-4	Neon	115 v	CHANGE RECORD signal light.
IL-5	Neon	115 v	AMPLIFIER signal light.
MOT-1	115 v, 50/60 cycle		"TWO-SPEED" motor, front machine.
MOT-2	115 v, 50/60 cycle		"TWO-SPEED" motor, rear machine.
P-5	8-way	Male	Unit plate power plug.
S-3	SPDT		115/230-volt power supply switch.
S-6	SPST	NO	READY switch, front machine.
S-7	SPST	NO	READY switch, rear machine.
S-8	SPST	NO	CHANGE RECORD switch, front machine.
S-9	SPST	NO	CHANGE RECORD switch, rear machine.
T-5	115/230 v, 50/60 cyc.		Line transformer
T-4	115 v to 6.3, 5.0, 350-0-350 volt		Power transformer



TL94464

Figure 22. Audio circuit

c. Speech Circuit, Audio Circuit (fig. 22).

Des.	Value	Rating	Service
A-2	2-way	Female	Reproducer amplifier audio input.
A-3	3-way	Female	Recorder amplifier audio output receptacle.
J-1	3-way	Jack	Audio input.
J-2	1-way	Jack	Record amplifier output.
J-3	1-way	Jack	Reproduce amplifier output (5,000-ohm).
J-4	1-way	Jack	Reproduce amplifier output (600-ohm).
K-1	DPDT	115 v	Record-reproduce relay for front unit.
K-2	DPDT	115 v	Record-reproduce relay for rear unit.
P-2	2-way	Male	Reproduce amplifier audio input plug.
P-3	3-way	Male	Record amplifier audio output plug.
REC.1			Magnetic recording head, front machine.
REC.2			Magnetic recording head, rear machine.
REP.1			Crystal reproducing head, front machine.
REP.2			Crystal reproducing head, rear machine.

d. Power Circuit (fig. 23).

Des.	Value	Rating	Service
A-1	2-way	Male	115/230-volt power input receptacle.
F-1	1.0 amp	Fuse	Amplifier circuit.
F-2	1.5 amp	Fuse	Motor circuit.
T-5	115/230 v, 50/60 cyc.		Line transformer.

55. CONNECTIONS (figs. 35, 35 and 39).

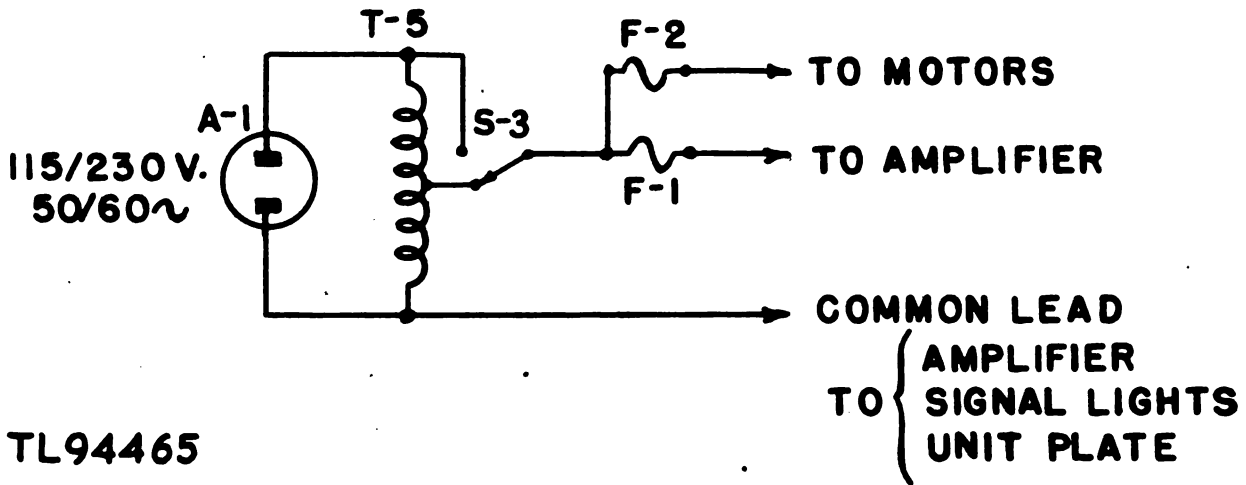
- a. External. (1) Audio input, record amplifier, (figs. 35 and 39).  
 (2) Audio output, record amplifier, J-2, (figs. 35 and 39).  
 (3) Audio output, reproduce amplifier (600-ohms), J-4, (figs. 35 and 39).  
 (4) Audio output, reproduce amplifier (5,000-ohms), J-3, (figs. 35 and 39).  
 (5) Power input, A-1, (figs. 35 and 39).  
 (6) Remote motor control, A-4, (figs. 35 and 39).

- b. Internal. (1) Audio input, reproduce amplifier, A-2, (figs. 38 and 39).  
 (2) Audio output, record amplifier, A-3, (figs. 38 and 39).  
 (3) Unit plate power, A-5, (figs. 35 and 39).

56. CONTROL LEVER INTERLOCK (fig. 24).

- a. Carriage Control Lever in "Operate" Position. (1) With either the recorder or reproducer carriage control lever in the "operate" position, slide bar (10) will be moved to its rear position.





TL94465

Figure 23. Power circuit

(2) When slide bar (10) moves to the rear, the right-hand end of interlock intermediate lever (11) moves forward.

(3) With a recording belt in normal position on the machine and with ejector operating lever (15) in "neutral" position, the movement of interlock intermediate lever (11) forward causes lock lever (12) to lock the ejector operating lever assembly (15) in its "neutral" position, at stud (13).

(4) Under this condition, with either the recorder or reproducer carriage control lever in the "operate" position, it is impossible to operate the ejector operating lever (15).

**b. Injector-ejector Mechanism in "Ejected" Position.** (1) When a recording belt is ejected by the operation of the ejector operating lever (15), lock release lever (17) moves along to the rear to trip the catch thus allowing the recording belt ejector to function.

(2) With lock release lever (17) in the rear position, lock release lock lever (18) moves to the right and locks ejector lock release lever (17) in its rear position.

(3) With lock release lever (17) in its rear position,

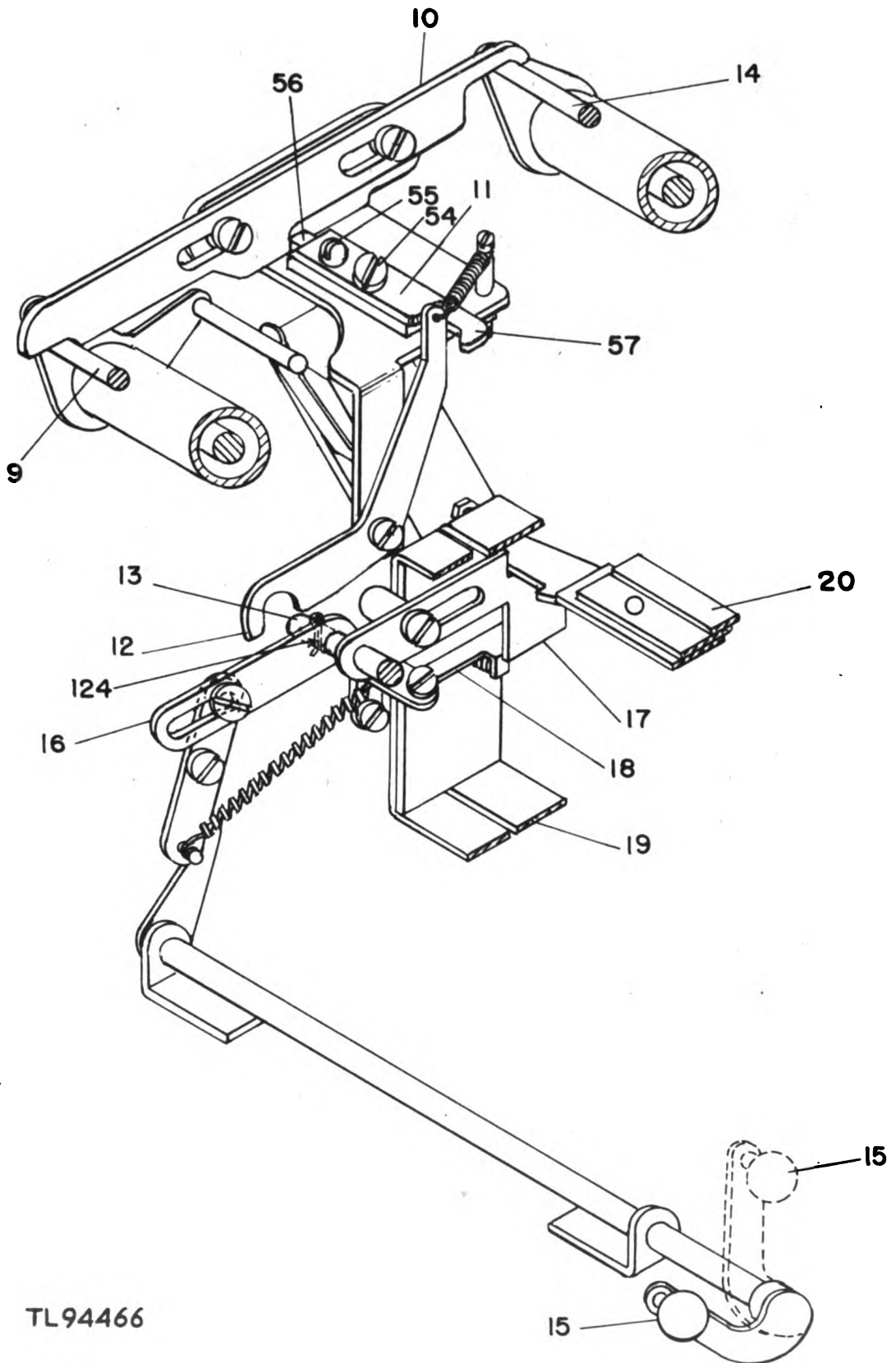
stud (13) is to the rear of the opening in lock lever (12). Therefore, it is now impossible to place either the recorder or reproducer carriage control lever in the "operate" position because of the interference between lock lever (12) and stud (13).

**c. Injector-Ejector Mechanism in "Injected" Position, No Record.** (1) When a recording belt is installed on the machine, through the operation of the injector mechanism, lock release lock lever (18) is pushed to the left as the injector-ejector mechanism reaches its "injected" position, thereby releasing lock release lever (17) allowing the latter to move forward.

(2) Since lock release lever (17) is attached to the idler mandrel assembly, the latter also moves forward.

(3) The forward movement of the idler mandrel is limited by the recording belt. With the idler mandrel in its normal operating position, with a recording belt on the machine, lock release lever (17) moves forward sufficiently to hold lock release lock lever (18) in its left-hand position, and stud (13) is directly under the opening in lock lever (12).

(4) However, if there is no recording belt on the



TL94466

Figure 24. Control lever interlock and injector-ejector perspective

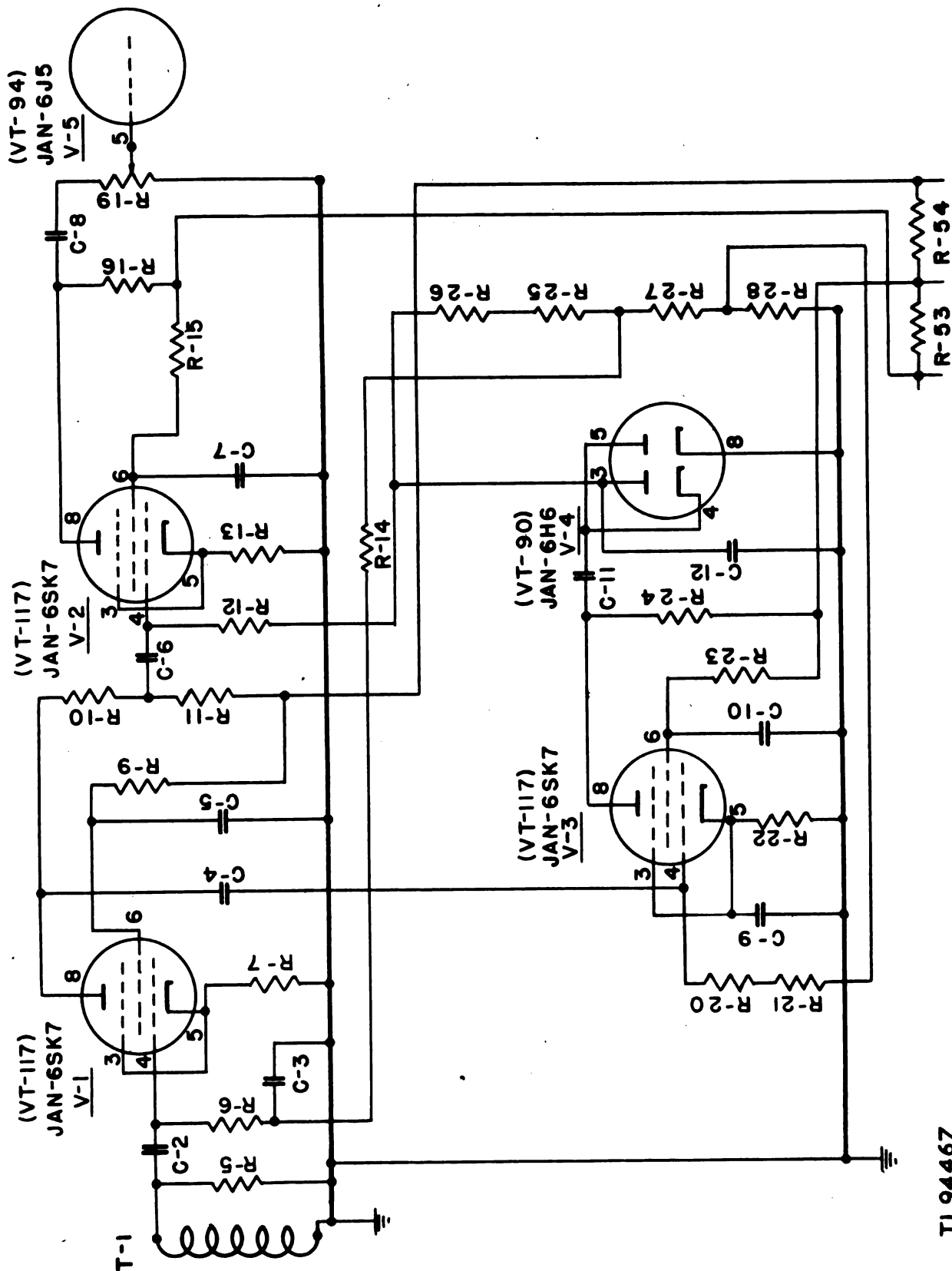


Figure 25. 4-1 Compressor circuit

TL94467

machine, the forward movement of the idler mandrel is not limited by the recording belt, and moves to its full forward position, which places stud (13) just forward of the opening in lock lever (12).

(5) Under these conditions, it is impossible to place either the recorder or reproducer carriage control lever in its "operate" position because of the interference between lock lever (12) and stud (13).

## 57. CONTROLS (figs. 25, 26, 27, 28, 29, 30 and 39).

a. **COMPRESSION Selector Switch, 4-1 Position (figs. 25 and 39).** (1) With the COMPRESSION selector switch (S-2) in fig. 39 set at its furthest counterclockwise position, the 4-1 position, the first tube (V-1) in the compression section of the record amplifier, is connected as a pentode. (This tube is triode-connected in the CODE position.) Connecting this tube as a pentode is accomplished by the number 1 pole of the COMPRESSION selector switch (S-2), by connecting the screen grid terminal 6 of the tube (V-1) to the B+ supply through the 1.0 meg voltage-dropping resistor (R-9).

(2) Pole number 2 connects the screen grid terminal 6 of (V-2) to the B+ supply through the 1.0 meg voltage-dropping resistor (R-15).

(3) The number 3 pole of (S-2) shorts the 2,700 bias resistor (R-8) in the cathode circuit of (V-1), to obtain normal bias for pentode operation.

(4) Pole number 4 supplies grid excitation to (V-3) by connecting its grid terminal 4 to the plate 8 of (V-1), through the 0.001 capacitor (C-4).

(5) Pole number 5 biases the grid 4 of (V-3), negative, with 8 percent of the d-c voltage in the output circuit of (V-4). This is accomplished by tapping off the output circuit of (V-4), at a point between the 2,700-ohm load resistor (R-28) and the 0.1 meg resistor (R-27), applying this voltage to the grid 4 of (V-3), through the number 5 pole of (S-2), the 0.15 meg resistor (R-21), the 1.0 meg resistor (R-20), and the number 4 pole of the COMPRESSION selector switch (S-2).

(6) Pole number 6 closes the compressor rectifier tube (V-4) load circuit, composed of load resistors (R-25), (R-26), (R-27), (R-28), by connecting one end of the 0.1 meg load resistor (R-26) to the diode plate 3 of (V-4).

**NOTE:** 100 percent of the d-c voltage in the output circuit of the compressor rectifier tube (V-4) is applied, permanently,

to the grid 4 of the record amplifier tube (V-2), through the 1.0 meg resistor (R-12).

**NOTE:** About 40 percent of the d-c voltage in the output of the compressor rectifier tube (V-4) is applied permanently to the grid 4 of the first tube (V-1) in the compression section of the record amplifier, through the 0.47 meg resistor (R-14) and the 0.1 meg resistor (R-6). This control voltage is removed from the grid 4 of the tube (V-1) when the COMPRESSION selector switch (S-2) is in the CODE position, because of the fact that the 327,000 compressor rectifier load circuit composed of resistors (R-25 to R-28 inclusive) is removed, and the 10.0 meg load circuit composed of resistor (R-30) is substituted in its place, through the number 6 pole on (S-2).

**NOTE:** "Permanently", as used in the notes above, indicates a direct connection and not a connection through the contacts of COMPRESSION selector switch (S-2).

b. **Compression Selector Switch, 2-1 Position, (figs. 26 and 39).** (1) Pole number 1 same as in 4-1 position.

(2) Pole number 2 same as in 4-1 position.

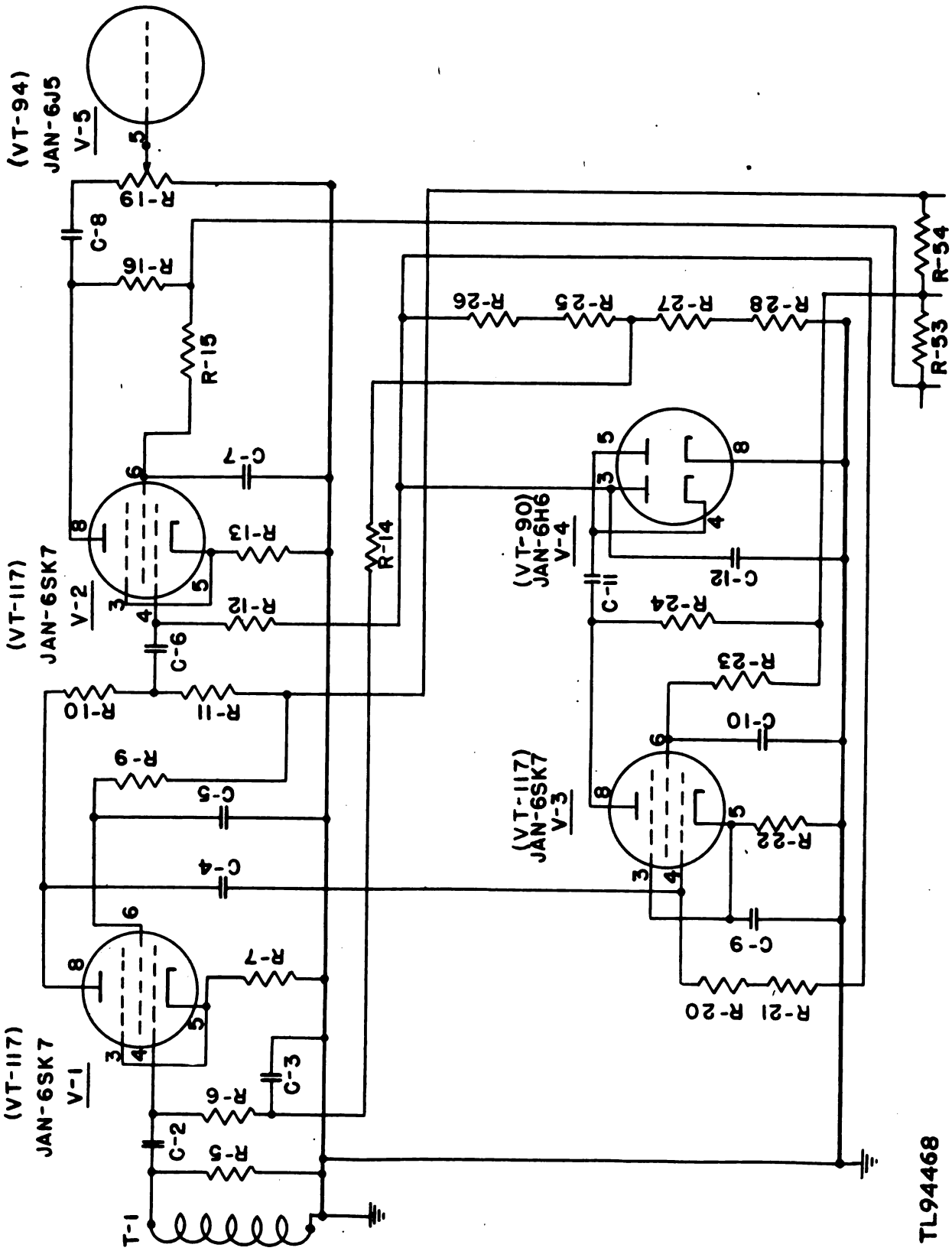
(3) Pole number 3 same as in 4-1 position.

(4) Pole number 4 same as in 4-1 position.

(5) Pole number 5 biases the grid 4 of the compressor amplifier tube (V-3), negatively, with 100 percent of the d-c voltage in the output circuit of the compressor rectifier tube (V-4). This is accomplished by connecting the plate end of the 0.1 meg load resistor (R-26) to the grid 4 of (V-3) through pole number 5 of (S-2), the 0.15 meg resistor (R-21), the 1.0 meg resistor (R-20), and pole number 4 of (S-2).

(6) Pole number 6 same as in 4-1 position.

**NOTE:** All conditions are the same in the 4-1 and 2-1 positions of the COMPRESSION selector switch excepting the circuit condition established by pole number 5 of (S2). This is evident upon observing the connections to the COMPRESSION selector switch (S-2) in (fig. 39) and noting that the 4-1 and 2-1 terminals, in the case of each pole, are strapped together, with the exception of pole number 5.



TL94468

Figure 26. 2-1 Compressor circuit

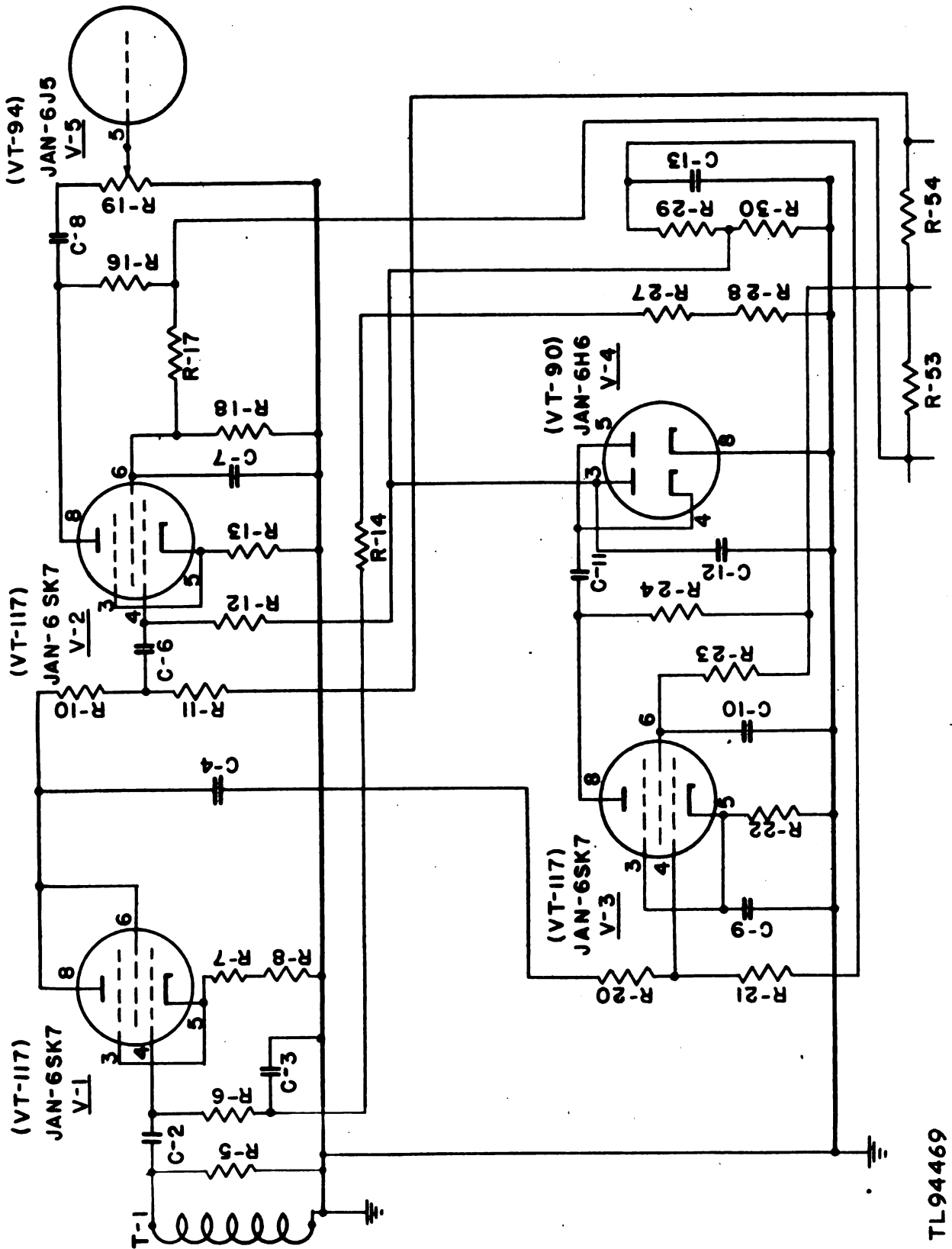


Figure 27. Code limiter circuit

TL94469

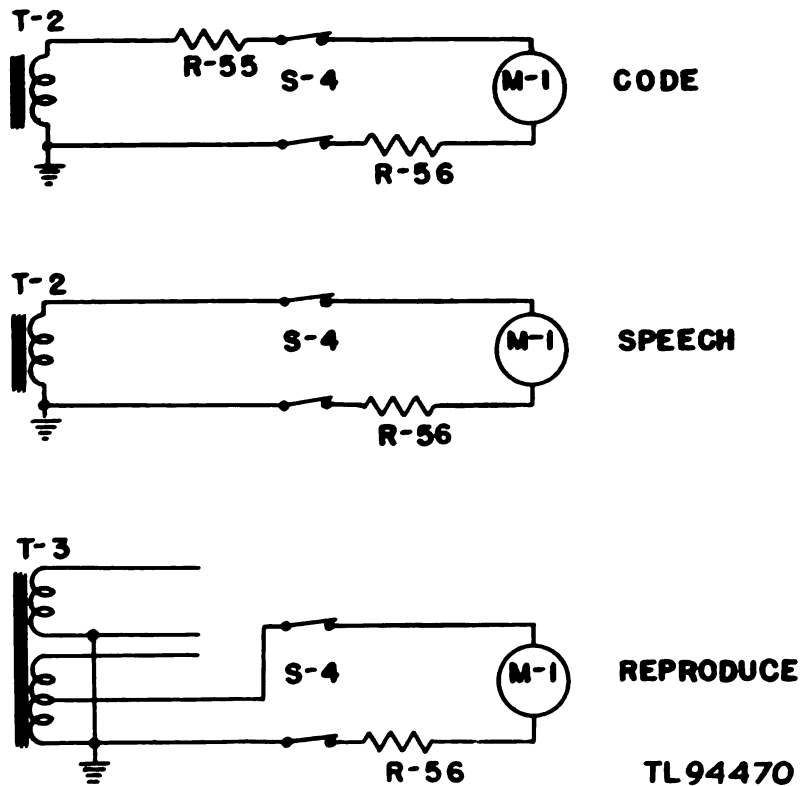


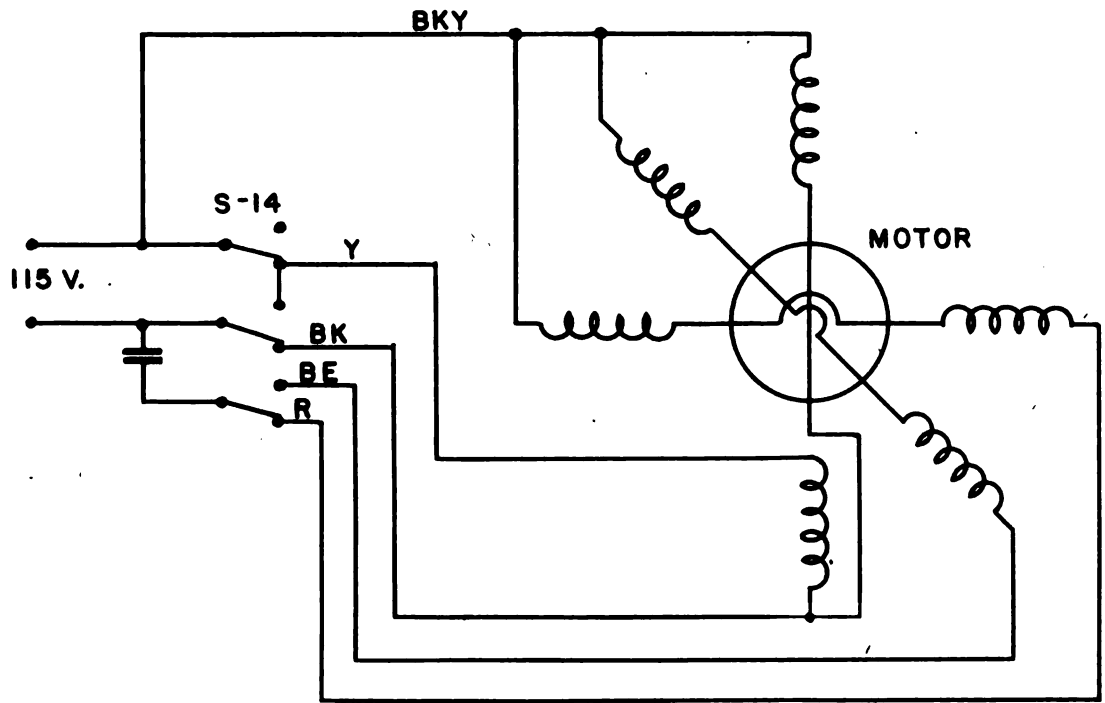
Figure 28. Meter circuit

c. Compression Selector Switch, Code Position, (figs. 27 and 39). (1) Pole number 1 connects tube (V-1) as a triode (this tube is pentode-connected in the 4-1 and 2-1 positions). This is accomplished by connecting the screen grid 6 of tube (V-1) to the plate 8 of the same tube (V-1). (2) Pole number 2 connects grid 6 of the tube (V-2) to the B+ supply, through the voltage dividing network composed of the 0.47 meg resistor (R-17) and the 0.15 meg resistor (R-19). This connection modifies the "control" characteristic of this tube (V-2), providing a "limiter" characteristic instead of a "compression" characteristic. (3) Pole number 3 removes the "short" from across the 4,700-ohm bias resistor (R-8), which places high negative bias on this triode-connected tube (V-1), causing it to operate as a unity-gain tube. Control voltage is removed from the tube (V-1) in the CODE position because it is no longer desirable to have this control voltage so connected, since it is now necessary to speed up the "operate" time ("compression" time). (For further details see the explanation under paragraph 57c. (6) below.) (4) Pole number 4 inserts the 1.0 meg resistor (R-20) in series in the grid excitation circuit of

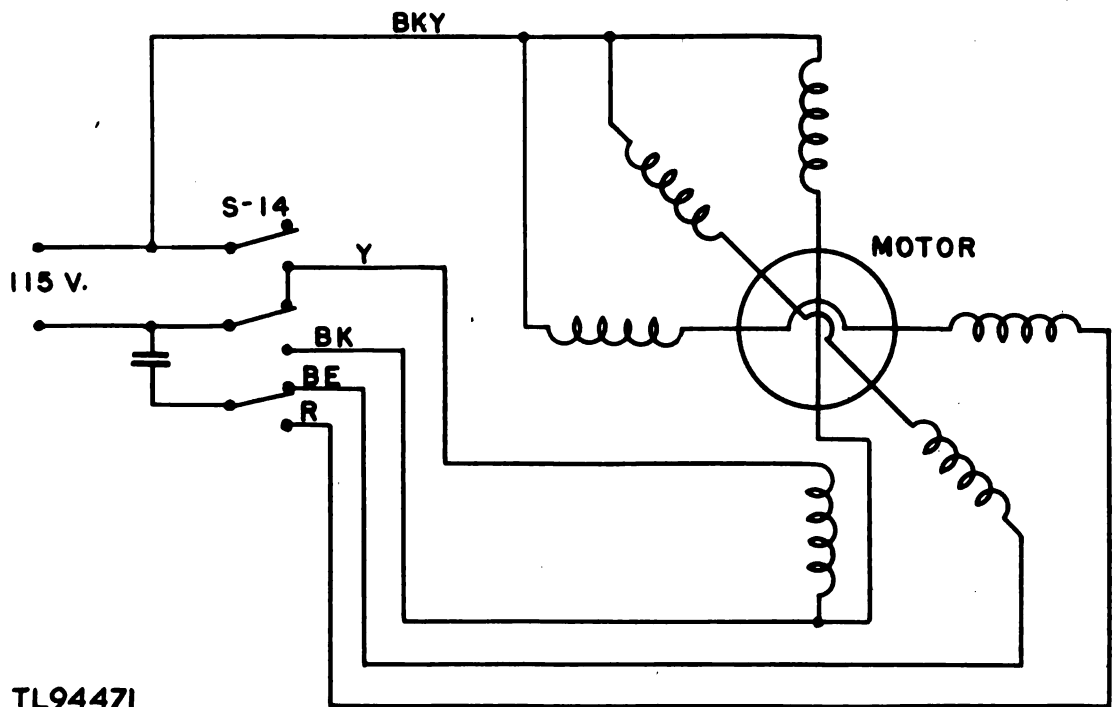
the compressor amplifier tube (V-3), thereby reducing the grid excitation to (V-3). In the CODE position the efficiency of the compressor circuit is increased by switching from a 327,000 ohm compressor rectifier load (R-25 to R-28 inclusive), to a 10.0 meg load (R-30). Therefore, this increase in efficiency is compensated for by reducing the grid excitation to (V-3).

(5) Pole number 5 biases the grid of (V-3) negative with 100 percent of the d-c voltage in the output circuit of (V-4), but this energy is fed through an added resistance of 1.0 meg (R-29) which, in conjunction with the 0.25 mf capacitor (C-13) delays the "control" voltage to the compressor amplifier tube (V-3), and tends to speed up the "operate" ("compression" time).

(6) Pole number 6 removes the "control" voltage from (V-1). This is accomplished when the 10.0 meg load resistor (R-30) is substituted for the 327,000-ohm load resistor (R-25 to R-28 inclusive). 100 percent of the d-c voltage in the output of the compressor rectifier tube (V-4) is still fed to the grid of (V-2) but the change in the value of the compressor rectifier load resistance from 0.327 meg to 10.0 meg increases the "release" time.



2-POLE



TL94471

4-POLE

Figure 29. Motor "two-speed" control circuit



**d. INPUT Selector Switch.** (1) The INPUT selector switch ((S-1) in fig. 39) has five positions. Starting with the furthest counterclockwise position, the first four positions all accommodate a 5,000-ohm input to INPUT jack (J-1) because the 47,000 resistor (R-1) is connected in series with the 500-ohm primary winding of the audio input transformer (T-1), and is also in series with the 0.5 mf capacitor (C-1).

(2) In the number 2, number 3, and number 4 positions of the INPUT selector switch (S-1) the resistance shunting the primary winding of the audio input transformer (T-1) is varied, in steps, from 22.0 ohms to 510.0 ohms. (The number 1 and number 3 positions of (S-1) have the same value of shunt resistance.)

(3) In the number 5 position of the INPUT selector switch (S-1) the series resistor-capacitor section of the input circuit (R-1) and (C-1) is removed and the INPUT jack (J-1) is connected directly across the primary winding of the audio input transformer (T-1) with no shunt resistance in the circuit. This provides a high sensitivity (-20 db) 500 ohm input.

**e. METER Selector Switch (figs. 28 and 39).**

(1) The schematic diagrams shown in figure 28 will aid in the explanation of the METER selector switch ((S-4) in fig. 39).

(2) In the REPRODUCE position of the METER selector switch (S-4) the power level meter (M-1) is connected across the 8.0-ohm secondary winding of the reproduce amplifier output transformer (T-3) with the series resistor (R-56) in circuit.

NOTE: The 1,500-ohm resistor (R-56) is in series with the power level meter (M-1) in all three positions of the METER selector switch (S-4).

(3) In the SPEECH position of the METER selector switch (S-4) the power level meter (M-1) is connected across the 8.0 ohm secondary winding of the record amplifier output transformer (T-2).

(4) In the CODE position of the METER selector switch (S-4), the 4,700-ohm resistor (R-55) is connected in series with the power level meter (M-1) to provide a 10 db loss in the meter circuit. This prevents the meter needle from being damaged during code recording.

**f. Motor "On-Off" Switch (figs. 20 and 41).**

(1) The MOTOR local and remote "ON-OFF" switches are shown schematically in figure 41.

They are also shown in the functional diagram (fig. 20).

(2) The local control MOTOR switch ((S-5) in fig. 41) is in parallel with the remote MOTOR CONTROL switch ((S-15) in fig. 20).

**g. Motor "Two-Speed" Control (figs. 29 and 39).** (1) The MOTOR "two-speed" control is shown schematically in figure 29.

(2) With the MOTOR "two-speed" switch (S-14) in the high-speed (15-minute record) position, the motor operates like a 2-pole motor, speed 3,450 rpm at 60 cycles.

(3) With the "two-speed" MOTOR switch (S-14) in the low-speed (30-minute record) position, the motor operates like a 4-pole motor, speed 1,650 rpm at 60 cycles.

(4) The 115-volt, 50/60-cycle supply is connected to each dual unit motor through the "two-speed" switch (S-14), which switch accomplishes the 2-pole or 4-pole connection, as desired (fig. 29).

**h. Power Switch (fig. 39).** (1) The 115/230-volt, 50/60-cycle power supply switch ((S-3) in fig. 39) connects the equipment for either the high-voltage or low-voltage supply, employing the line transformer (T-5).

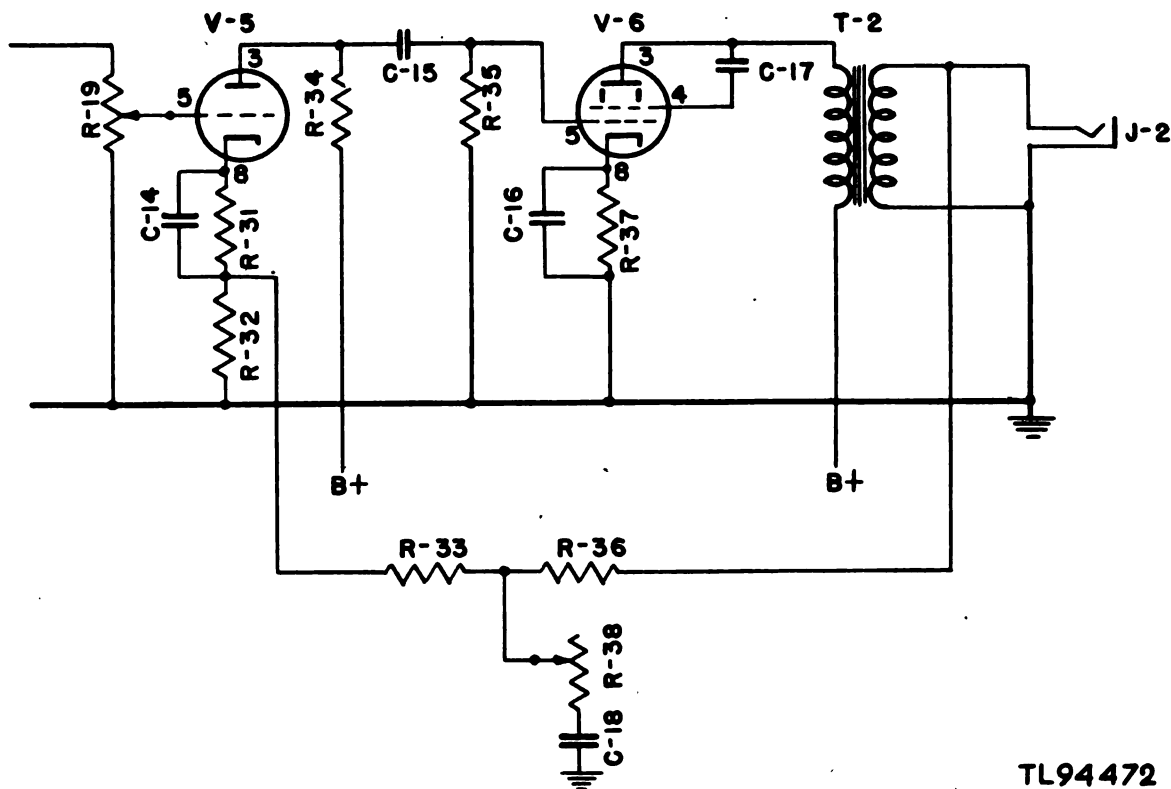
(2) When a 115-volt supply is plugged into the power input receptacle (A-1), switch (S-3) connects Speech Recorder MC-502 power circuits to the terminals of the line transformer (T-5) for maximum voltage.

(3) When a 230 volt supply is plugged into power input receptacle (A-1), switch (S-3) connects Speech Recorder MC-502 power circuits to the mid-tap on the line transformer (T-5).

**i. Record Tone (fig. 30).** (1) The record amplifier tone control circuit is shown schematically in figure 30.

(2) LEGEND FOR FIGURE 30.

Des	Value	Rating	Service
C-14	25.0 mf	25 v	Cathode by-pass capacitor.
C-15	0.01 mf	500 v	Coupling capacitor.
C-16	25.0 mf	25 v	Cathode by-pass capacitor.
C-17	0.002 mf	600 v	Stabilizing capacitor.
C-18	0.25 mf	200 v	Phase shifting capacitor.
J-2	1-way	Jack	Record amplifier output.
R-19	0.5 meg.	POT	Record amplifier volume control.
R-31	3,300 ohm	½ watt	Cathode resistor.
R-32	240 ohm	½ watt	Cathode resistor. Also part of negative feedback network.
R-33	1,000 ohm	½ watt	Negative feedback network voltage dropping resistor.



TL94472

Figure 30. Recorder tone control circuit

Des	Value	Rating	Service
R-34	0.1 meg	½ watt	Plate load resistor.
R-35	0.47 meg	½ watt	Grid resistor.
R-36	1,000 ohm	½ watt	Negative feedback voltage dropping resistor.
R-37	360 ohm	1.0 watt	Cathode resistor.
R-38	10,000 ohm	Rheo	Record amplifier tone control.
T-2	8,000 to 8 ohm		Record amplifier output transformer.
V-5	JAN-6J5	VT-94	Record amplifier driver tube.
V-6	JAN-6V6GT	VT-107	Record amplifier power output tube.

(3) Signal energy from the output of the record amplifier is fed back from the high side of the record amplifier output transformer (T-2), through the voltage dropping resistors (R-33) and (R-36), to the grid circuit of (V-5), at a point between the resistors (R-31) and (R-32).

(4) The feedback voltage appearing across (R-32) combines with the original signal voltage at the grid 5 of the driver tube (V-5).

(5) The capacitor (C-18) in series with the variable resistor (R-38) provides a path to ground for the signal energy in the feedback circuit.

(6) Since it is the inherent property of a capacitor to offer lower impedance to high frequency energy

than to low frequency energy, the value of (C-18) is chosen so that it will provide a shunt circuit to ground for energy at the high-frequency end of the range of this recording system.

(7) With less feedback energy appearing at the grid 5 of (V-5), at the high-frequency end of the frequency range, because of the action of (C-18), and since this feedback voltage is in opposition to the original signal voltage appearing at the grid 5 of (V-5), the less the high-frequency feedback energy appearing at grid 5 of (V-5), the greater the high-frequency response of the record amplifier.

(8) Since the variable resistor (R-38), the record amplifier tone control, controls the effectiveness of (C-18), as the value of (R-38) becomes maximum, high-frequency feedback energy becomes maximum, and the high-frequency response of the record amplifier becomes minimum. Conversely, as the value of (R-38) becomes minimum, the high-frequency feedback energy at the grid 5 of (V-5) becomes minimum, and the high-frequency response of the amplifier becomes maximum.

(9) It is in this manner that the variable resistor (R-38) controls the high-frequency response of the record amplifier.

**j. Record Volume.** (1) The record volume control (R-19) is shown schematically in figure 39.

(2) The volume control (R-19) is a potentiometer, which is connected across the grid input circuit to (V-5), with the variable contact on (R-19) connected to the grid terminal 5 of (V-5).

(3) By varying the position of the contact arm on (R-19) the signal voltage applied to the grid of (V-5) can be varied to provide the proper recording level.

**k. Reproduce Volume.** (1) The reproduce volume control (R-46) in fig. 39) is a potentiometer, which is connected across the grid input circuit to the second reproduce amplifier stage (V-7), with its variable contact arm connected to the grid terminal 1 of (V-7).

(2) By varying the position of the contact arm on (R-46) the signal voltage applied to the second stage of amplification (V-7) in the reproduce amplifier, can be varied to provide the desired output volume.

#### **58. DASHPOT (figs. 51 and 52).**

**a. General.** (1) The recorder dashpot (fig. 51) is operated by the recorder carriage control lever as the latter is moved from the "neutral" to the "operate" position.

(2) The recorder carriage control lever operates the dashpot through the medium of dashpot yoke (70).

(3) The dashpot yoke (70) is also illustrated in figure 52. The dashpot yoke (70) is operated by the recorder carriage bail actuating pin (185), which is a part of recorder carriage bail assembly (9).

(4) The recorder carriage bail assembly (9) is operated by the recorder carriage control lever (36).

**b. Operation.** (1) When the recorder carriage control lever is moved from the "neutral" to the "operate" position, dashpot piston yoke (70) is moved from its maximum upper to maximum lower position.

(2) As piston yoke (70) moves downward, piston check (64) moves toward piston (65), preventing the flow of oil through the holes in the piston (65).

(3) There is a bleeder slot in piston (65) which controls its rate of travel. It is the limitation of the flow of oil through this bleeder slot and around piston (65) that controls the rate of travel of the piston (65) in its downward travel.

(4) This control creates resistance to the movement of the recorder carriage control lever in its travel from the "neutral" to the "operate" position.

(5) When the recorder carriage control lever is moved from the "operate" to the "neutral" position, piston yoke (70) moves from its maximum lower to its maximum upper position.

(6) As piston yoke (70), with piston (65) attached, moves upward, piston check (64) moves down away from piston (65), allowing a free flow of oil through the holes in piston (65).

(7) This free flow of oil through the holes in piston (65) provides practically no resistance to the travel of piston (65) in an upward direction, and subsequently to the travel of the recorder carriage control lever from the "operate" to the "neutral" position.

(8) It is in this manner that the dashpot provides a cushioning or damping effect in one direction only, bilateral damping.

#### **59. DRIVE (figs. 44, 47, and 62).**

**a. General.** (1) Figure 47 shows a general view of the mechanical drive system, which is traced from each dual unit motor, through the reduction pulley assembly (248), to the flywheel (71).

(2) The drive mandrel, (which drives the recording belt), is rigidly attached to the flywheel (71) through the drive mandrel shaft.

(3) Figure 62 is a close-up picture of the reduction pulley assembly, showing the drive motor on the one side, and the flywheel (71) on the other.

**b. Operation.** (1) The rotational energy of the driving motor is transmitted via the motor drive pulley (273) on the end of the motor shaft (fig. 62).

(2) The rotation of the motor drive pulley (273) is transmitted to the large pulley on the reduction pulley (166) by the motor drive belt (249).

(3) The rotation of the reduction pulleys (166) is transmitted to the flywheel (71) from the small pulley on the reduction pulley (166) by the flywheel drive belt (250).

(4) The rotation of the flywheel (71) is transmitted to the drive mandrel (87), (one of the supports for the recording belt), because the drive mandrel (87) and flywheel (71) are both attached to the same shaft.

(5) The idler mandrel receives rotational energy from the drive mandrel through the medium of the recording belt, which is supported in the machine by these two mandrels.

(6) The rotational energy of the drive mandrel shaft is transmitted to the gear train assembly by means of a gear on the drive mandrel shaft.

(7) The gear train assembly transmits rotational energy to the recorder and reproducer feed screws, by means of which the recorder and reproducer carriages and their associated styli, are driven laterally across the recording belt.

#### **60. DRIVE MANDREL ASSEMBLY (fig. 53).**

**a. General.** Rotary motion is imparted to the drive mandrel (87) because it is rigidly attached to the drive mandrel shaft, to which shaft the flywheel (71) is attached, the flywheel operating as a pulley in the mechanical drive system.

**b. Operation.** The drive mandrel shaft (86) is attached to the flywheel (71) by means of the flywheel retaining screw (75).

#### **61. FEED NUT ASSEMBLY (fig. 54).**

**a. General.** Although the recorder and reproducer carriages, to which the feed nut assembly is mounted, are slightly different, the feed nut assembly in each case is identical, and operates in the same manner.

**b. Operation.** (1) There is a cam surface on the carriage control lever (36) which operates inside the "U" in feed nut (92).

(2) When carriage control lever (36) is placed in the "operate" position, the cam surface on carriage control lever (36) is moved far enough away from the inside of feed nut (92), to allow the feed nut to engage the feed screw which runs through the center of the carriage housing.

(3) With the carriage control lever (36) in the "operate" position, the feed nut (92) engages the feed screw and feed nut (92) is driven laterally to the right as the feed screw revolves.

(4) Since feed nut (92) is attached to the carriage housing by feed nut assembly screws (88), the lateral motion is imparted to the carriage, and the entire carriage assembly moves to the right.

(5) When the carriage control lever (36) is placed in the "neutral" position, parallel to the carriage control lever stop, the cam surface on the carriage control lever (36), which operates on the inside of the "U" in feed nut (92), engages the feed nut

(92) and pushes it away from the feed screw, thus removing the mechanical connection between the feed screw and the carriage.

(6) When the carriage control lever (36) is placed in the "operate" position, feed nut (92) engages the feed screw; the stylus is presented to the record, and the lateral movement of the carriage depends upon the rotation of the feed screw.

#### **62. FEED SCREW ASSEMBLY (fig. 55).**

**a. General.** The feed screw is driven by the gear train assembly (fig. 56), which latter is driven by drive mandrel gear ((72) in fig. 53) on the drive mandrel shaft ((186 in fig. 53).

**b. Operation.** (1) The feed screw operates in a rotary direction only, with no end play, which latter is prevented by the pressure of spring ((113) in fig. 55) on plunger (112) on the right-hand end of the feed screw. This action of spring (113) on plunger (112) is passed on to the feed screw shaft through the medium of the thrust ball (111), creating a thrust towards the left on bearing (107) at all times, with a minimum amount of friction because of thrust ball (111).

(2) The load of the recorder or reproducer is always toward the left. This insurance of freedom from end play is necessary to maintain an even tone groove pitch.

#### **63. FLYWHEEL (fig. 53).**

**a. General.** The flywheel (71) provides inertia to improve the mechanical motion of the recording belt drive, thereby minimizing the chance of obtaining poor quality of reproduction, because of poor mechanical motion.

**b. Operation.** (1) The flywheel (71) provides this desired inertia because it is solidly connected to the drive mandrel shaft (86) by flywheel retaining screw (75).

(2) The two grooves in the periphery of the flywheel (71) provide the guidance for the flywheel drive belt which latter transmits rotational energy to the flywheel.

#### **64. GEAR TRAIN ASSEMBLY (fig. 56).**

**a. General.** The gear train assembly receives rotational energy from the drive mandrel gear (72) and transmits rotational energy to the recorder and reproducer feed screw gears (103).

**b. Operation.** (1) Drive mandrel gear (72) engages intermediate gear (119) in the gear train assembly.

(2) Intermediate gear (119) drives pinion gear assemblies (120).

(3) The pinions on pinion gear assemblies (120) drive the recorder and reproducer feed screw gears (103).

#### **65. IDLER MANDREL ASSEMBLY (fig. 57).**

**a. General.** In the course of operation, the idler mandrel (134) rotates freely on its shaft (125), when a recording belt is in place on the machine, and the idler mandrel assembly is creating tension on the recording belt.

**b. Operation.** (1) The tension on the recording belt, as supplied by the idler mandrel (134), is created by the action of spring (133).

(2) The idler mandrel shaft assembly (125) is supported by the idler mandrel support (274), and is free to oscillate on the lower left-hand section of the idler mandrel shaft assembly (125).

(3) By means of the adjustment available in the idler mandrel assembly it is possible to change the location of the axis of the idler mandrel shaft with relation to the drive mandrel shaft.

(4) Fundamentally, in a belt and pulley system, it is possible to modify the travel of the belt, to cause it to crawl, by shifting the axis of one pulley shaft with respect to that of the other. Therefore, in this case, the recording belt can be made to "crawl" in one direction or the other, by changing the relation of the idler mandrel shaft axis with respect to that of the drive mandrel shaft axis.

(5) This adjustment is accomplished by means of top castellated nuts (128) since their adjustment raises or lowers the right-hand tip of the idler mandrel.

(6) Proper operation calls for the recording belt to crawl to the left until it touches the flange of the idler mandrel, and because of the rigidity of the recording belt itself, causes the recording belt to maintain its position in the machine, that is, it causes the recording belt to track properly.

#### **66. INJECTOR-EJECTOR ASSEMBLY (figs. 24, 58, and 59).**

**a. General.** (1) Figure 24 will aid in the explanation of the operation of the injector-ejector assembly. It is a perspective sketch showing the control interlock mechanism and some of the elements in the injector-ejector control assembly.

(2) Figure 58 is a drawing of the injector-ejector assembly.

(3) Figure 59 is a sketch of the injector-ejector control assembly.

**b. Operation.** (1) A recording belt is installed on the machine by placing it over the drive and idler mandrels and pushing the recording belt to the left as far as it will go, until the left-hand edge of the recording belt rests against, and inside of the "U"-shaped extremities of the injector-ejector guide.

(2) To inject the recording belt the injector-ejector mechanism is pushed toward the left by pushing on ejector slide (150) in fig. 58).

(3) When the injector mechanism almost reaches the left-hand limit of its travel, it passes lock lever (141) which springs into position to lock the injector-ejector mechanism in its injected position.

(4) As the injector mechanism is pushed a little further to the left it presses against lock release lock lever (18) in fig. 24) which latter releases lock release lever (17) to allow the idler mandrel to move forward into normal recording position to place tension on the recording belt.

(5) When the recording belt is placed in proper position on the two mandrels prior to injection, with the injector-ejector mechanism in the ejected position, the recording belt injector fingers (148) in fig. 58) are drawn together to allow clearance for the insertion of the recording belt.

(6) As the injector mechanism is pushed toward the left to inject the recording belt, the recording belt injector fingers (148) move apart to carry the recording belt into proper position on the machine.

(7) To eject a recording belt, the ejector operating lever (15) in fig. 24) is pulled forward.

(8) Through the medium of a link mechanism, the idler mandrel is thereby pushed to the rear towards the drive mandrel.

(9) When the lock release lever (17) goes by the lock release lock lever (18), the lock release lever (17) is locked by it, retaining the idler mandrel in its neutral position and thus removing tension from the recording belt.

(10) As the lock release lever (17) moves to the rear, it releases the catch which holds the injector-ejector mechanism in its injected position, allowing the injector-ejector mechanism to spring to the right to eject the record.

#### **67. MOTOR ASSEMBLY (fig. 41).**

**a. General.** The motor associated with each dual recording-reproducing machine unit (MOT

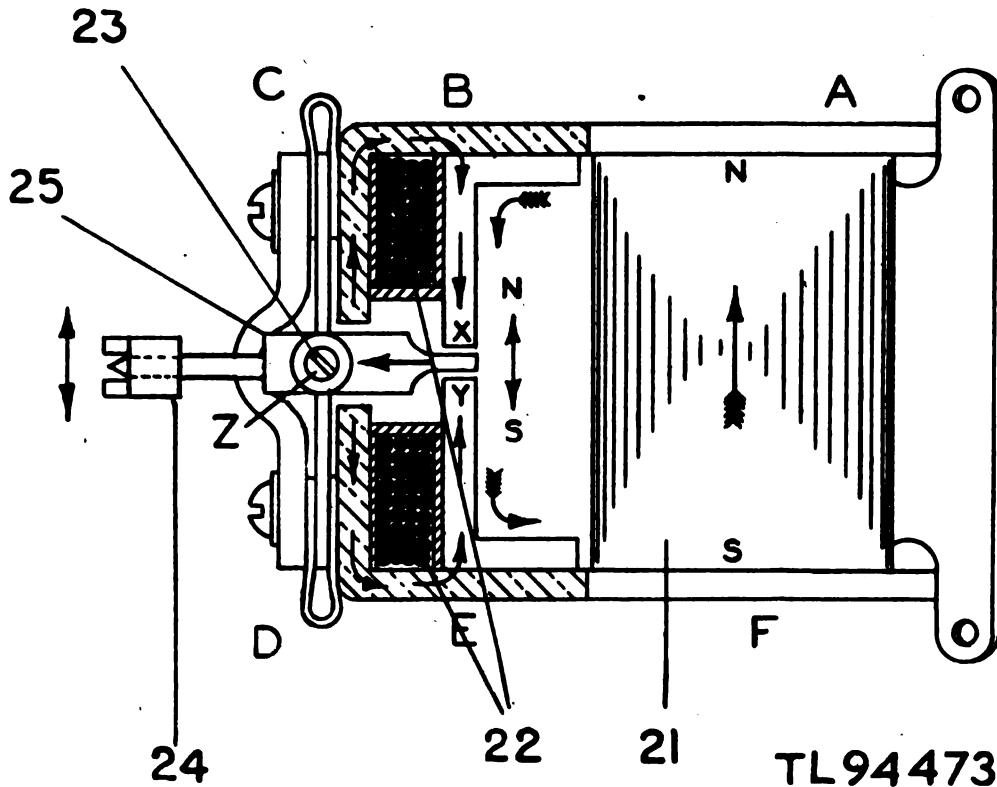


Figure 31. Recorder cross-section

1) and (MOT. 2) in fig. 41) supply rotary motion, through the medium of drive belts and pulleys, to the flywheel and thence to the moving parts which are actuated by the drive motor.

b. Operation. (1) The motor is operated by the local MOTOR "ON-OFF" switch ((S-5) in fig. 41) which is located at top right of the control panel.

(2) The remote MOTOR "ON-OFF" foot switch (S-15) can be used to open and close the motor circuit.

(3) The motor circuit is also under the control of the change-over switches (S-10) and (S-11) and the reproducer safety switches (S-12) and (S-13).

(4) Switching to provide "two-speed" operation is provided by the 15/30 minute switch (S-14) which is located at top right center of the unit plate (paragraph 57g).

**68. RECORDER (fig. 31).**

a. General. (1) The sketch (fig. 31) will aid in explaining the operation of the magnetic recording head.

(2) The permanent magnet (21) in the recorder

assembly has the letters "N" and "S" at its extremities to indicate its north and south poles.

(3) Letters and arrows in figure 31 aid in explaining the direction of the magnetic flux through the recorder elements during its operation.

b. Operation. (1) Magnetic flux flows out from the north pole (N) of the permanent magnet (21) and is concentrated in the magnetic flux path (ABCDEF).

(2) It is true that there is some leakage flux from permanent magnet (21) which follows the path (ABCDEF), but the "Useful" flux, the magnetic flux with which we are concerned, follows the first mentioned path through the pole pieces (X) and (Y).

(3) Because of the flux from permanent magnet (21), pole piece (X) becomes a north pole and pole piece (Y) becomes a south pole.

(4) The moving armature (25) of the magnetic recorder is pivoted at (Z) with one end centrally located between the pole pieces (X) and (Y), with the recorder stylus (24) installed in the other end and clamped in place by recorder stylus clamping screw (23).

TL94473

(5) When audio-frequency current flows through the windings of field coil (22), an additional magnetic flux is produced which has two principal flux paths. One path is traced through the armature to (ZCBX), across the air gap and back into the armature again. The other path is traced through the armature to (ZDEY), across the air gap and back into the armature.

(6) Because of the audio-frequency current, there is at this instant, a south pole at the end which is in the air gap between pole pieces (X) and (Y). Furthermore, the strength of pole (X) is increased since the magnetic flux produced at this point by the permanent magnet (21) and by the field coil (22) is additive. On the other hand, the strength of pole (Y) is decreased, since the flux at this point, due to field coil (22), opposes the flux produced by permanent magnet (21).

(7) Since "like poles repel and unlike poles attract", at this particular instant the armature (25) will be attracted toward pole piece (X). The magnitude of this movement of armature (25) will depend upon the amplitude of the audio-frequency current flowing through field coil (22).

(8) Since the audio-frequency current flowing through field coil (22), sometimes called the "speech" current or the "signal" current, is an alternating current, an instant later it may be "equal and opposite" (of equal amplitude but flowing in the opposite direction).

(9) At this latter instant, with the current in field coil (22) reversed, the magnetic flux will thread the magnetic circuits in the opposite direction. One flux path is now traced through the armature, across the air gap, to (XBC) and back into the armature again at (Z). The other flux path is traced from the armature, across the air gap, to (YED), and back into the armature again at (Z).

(10) In this case, the end of armature (25) in the air gap between pole pieces (X) and (Y) will have become a north pole, and will be drawn toward pole piece (Y).

(11) This movement of the armature (25) back and forth between pole pieces (X) and (Y) will not only have a magnitude depending upon the amplitude of the current applied to field coil (22), but will have a frequency established by the frequency of the signal currents flowing through field coil (22).

(12) Since armature (25) is pivoted at (Z), the lateral motion established at the end of armature (25) between the pole pieces (X) and (Y) will be transmitted to the tip of the recorder stylus (24)

which latter, as it engages the recording belt, will swage a lateral tone groove in the record.

#### **69. RECORDER CARRIAGE GUIDE (fig. 61).**

**a. General.** The recorder carriage guide performs its function because of its rigid connection to the recorder carriage assembly and its sliding contact with recorder carriage guide rod (208).

**b. Operation.** (1) The recorder carriage guide (237) operates then, because it is mounted to the recorder carriage assembly by the two screws (213), the end of the recorder carriage guide (237) and the recorder carriage adjustable guide prong (206) providing proper contact with recorder carriage guide rod (208).

(2) The connection between the recorder carriage assembly and the recorder carriage guide rod (208) prevents any rotation of the recorder carriage assembly on its bearing surface.

#### **70. RECORDER MOUNT BRACKET ASSEMBLY (fig. 61).**

**a. General.** The recorder mount bracket is a supporting member. The recorder mount bracket, together with the parts it supports, constitutes the recorder mount bracket assembly (259).

**b. Operation.** The recorder assembly (258) and its associated parts which are installed in the recorder mount bracket assembly (259) are operated by the recorder carriage control lever (36) and its associated link mechanisms.

#### **71. RECORDER STYLUS (fig. 61).**

**a. General.** The recorder stylus (24) swages a laterally modulated tone groove in the recording belt (254), due to the forces applied to it and to the recording belt.

**b. Operation.** (1) The recorder stylus (24) receives the lateral vibrations which it subsequently imparts to the recording belt (254) in the form of a modulated tone groove, through the operation of the magnetic recording head (258). (The operation of the recording head (258) is explained in paragraph 68.)

(2) The recorder stylus (24) contacts the recording belt (254) when the latter passes over the anvil (20). Sufficient pressure (4.75 ounces) is applied to the recorder stylus (24) to cause it to swage, or trace, a tone groove of satisfactory depth in the recording belt (254) when the recorder carriage control lever (36) is in the "operate" position.

(3) When the recorder carriage control lever (36) is placed in the "operate" position, the recorder lift cam (233) is moved towards the rear of the machine, and, operating on recorder lift cam roller (264), allows the recorder assembly (258) to rotate on its pivots (236), in a clockwise direction (when facing the ejector side of the machine), thereby presenting the recorder stylus (24) to the recording belt (254) at normal pressure, which is provided by the tension of recorder pressure spring (234).

(4) As the recording belt (254) is rotated by the drive mandrel (87), the recorder stylus (24) swages the tone groove. This is a spiral tone groove due to the fact that the entire recorder carriage assembly moves from left to right, through the action of the feed nut and the feed screw, as the recording belt is rotated.

(5) The guard around the tip of the recorder stylus protects the stylus tip from being damaged. The recorder stylus guard allows the stylus tip to protrude about 0.003 inches beyond the end of the stylus guard. Since the recording belt is approximately 0.0055 inches in thickness, if the recorder stylus receives a downward jolt, the stylus guard will prevent the stylus from going all the way through the recording belt and digging into the recording anvil, with subsequent damage to both stylus and anvil.

## **72. REDUCTION PULLEY ASSEMBLY (figs. 62 and 63).**

**a. General.** The reduction pulley assembly is shown pictorially in figure 62 and diagrammatically in figure 63.

**b. Operation.** (1) As the motor pulley (273) rotates, the motor drive belt (249) rotates reduction pulley (166) in a counterclockwise direction (looking at the flywheel side of the machine).

(2) The reduction pulley (166) drives the flywheel drive belt (250), which in turn drives the flywheel (71).

(3) Motor idler (165) under tension of motor idler tension spring (58), takes up the slack in the motor drive belt (249), by operating on one strand only. Flywheel idler (164), under tension of flywheel idler tension spring (161), takes up the slack in a similar manner on the flywheel drive belt (250).

## **73. REPRODUCER (fig. 32).**

**a. General.** (1) Two views of the high temperature crystal reproducer are shown in figure 32. The left-hand sketch in figure 32 shows the crystal

reproducing head, with one side of the case (26) removed, showing how the crystal element (28) is mounted inside the reproducer case (26) and how the crystal element is attached to the armature (32) and subsequently to the reproducer stylus (31).

(2) The right-hand sketch in figure 32 is an end view of the crystal element (28), removed from its case (26), but with armature (32) and stylus (31) attached.

**b. Operation.** (1) During reproduction, the reproducer stylus (31) tracks in the tone grooves traced by the recorder stylus when the record was recorded.

(2) The laterally modulated tone grooves in the record produce lateral vibrations of the reproducer stylus (31).

(3) These lateral vibrations of reproducer stylus (31) are transmitted to armature (32) and then to one corner of crystal element (28).

(4) Since the armature (32) oscillates back and forth on its bearings (30), the crystal element (28) is bent back and forth at one corner, by the end of the armature (32).

(5) It will be noted that the crystal element (28) is only free to move at one corner, it being clamped in the reproducer case (26) by the clamping pads (27).

(6) When a crystal element of this type is exerted to the pressure imposed by bending it back and forth, a voltage is produced across the surfaces of the crystal element. Electrical connections made to the surfaces of the crystal, carry the electrical energy so produced, from the output of the reproducer head to the input of the reproduce amplifier.

(7) It is in this manner, that the reproducing head translates the modulations in the tone grooves in the record into mechanical vibrations, and then into varying electric currents.

## **74. REPRODUCER CARRIAGE GUIDE (fig. 64).**

**a. General.** The reproducer carriage guide (205) performs its function because of its rigid connection to the reproducer carriage assembly (261) and its sliding contact with the reproducer carriage guide rod (208).

**b. Operation.** (1) The reproducer carriage guide (205) is attached to the reproducer carriage assembly (261) by means of the two screws (213).



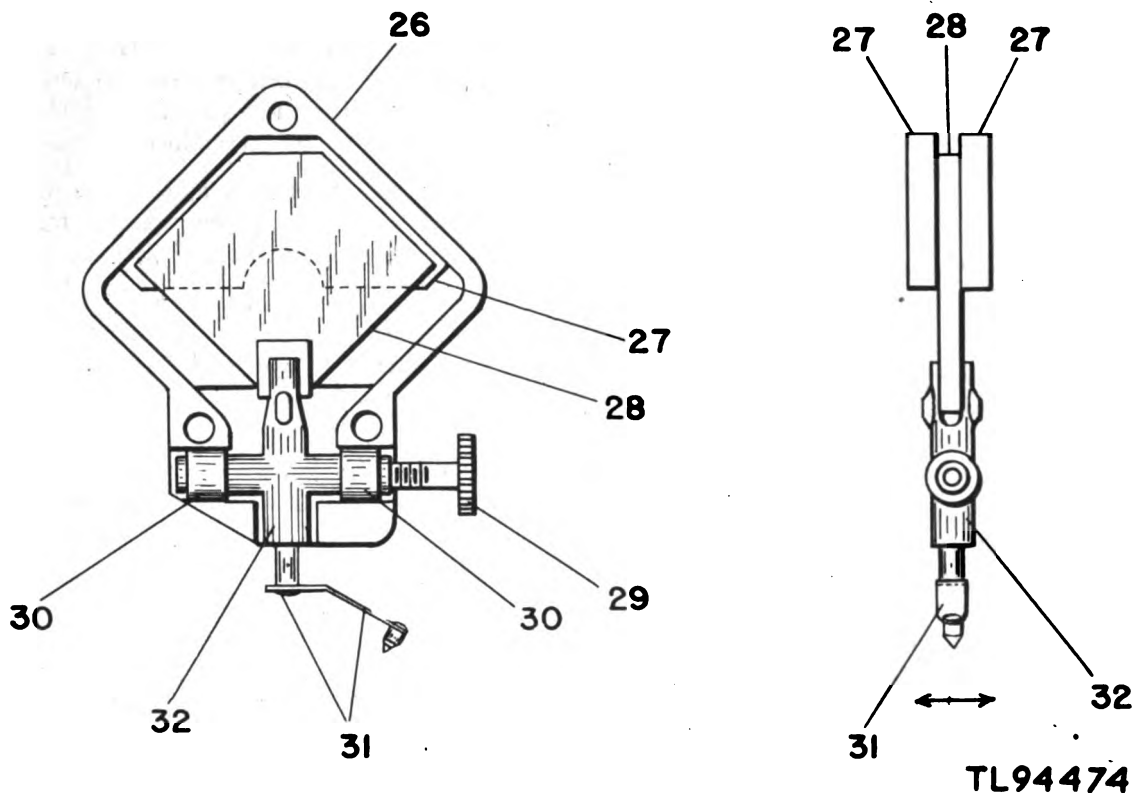


Figure 32: Reproducer cross-section

(2) The end of the reproducer carriage guide (205), together with the adjustable reproducer carriage guide prong (206) provides the sliding contact on the reproducer carriage guide rod (208).

(3) This rigid, but slidable, connection between the reproducer carriage assembly (261) and the reproducer carriage guide rod (208) prevents any rotation of the reproducer carriage assembly on its bearing.

**75. REPRODUCER MOUNT BRACKET ASSEMBLY (fig. 64).**

**a. General.** The reproducer mount bracket is a supporting member. The reproducer mount bracket, together with the mechanisms which it supports, constitute the reproducer mount bracket assembly (42).

**b. Operation.** The mechanisms supported in the reproducer mount bracket assembly (42) are operated by the reproducer carriage control lever (36) through the medium of its associated links.

**76. REPRODUCER STYLUS (fig. 64).**

**a. General.** The reproducer stylus (31) engages the tone grooves in the recording belt (254)

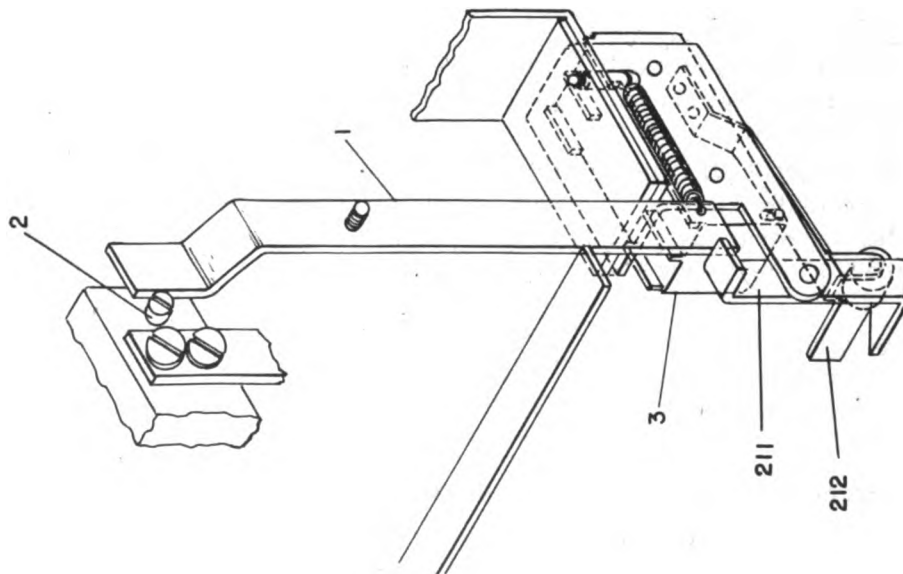
as the recording belt passes around and rotates with the drive mandrel (87), and when the reproducer carriage control lever (36) is in the "operate" position.

**b. Operation.** (1) When the reproducer carriage control lever (36) is placed in the "operate" position, reproducer stylus (31) is presented to the recording belt (254) with sufficient pressure to provide satisfactory reproduction from the record.

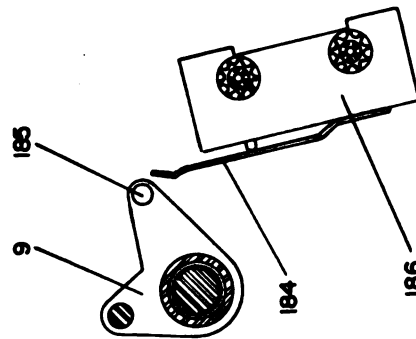
(2) As reproducer carriage control lever (36) is moved towards the rear of the machine into the "operate" position, reproducer carriage control lever link (218) operates reproducer lift lever (221).

(3) Because of the contact between the pin on the end of reproducer lift lever (221) and reproducer lateral pivot bracket (265), the reproducer assembly (229) is allowed to rotate in a clockwise direction (when looking at the ejector side of the machine) due to the tension provided by reproducer pressure spring (226).

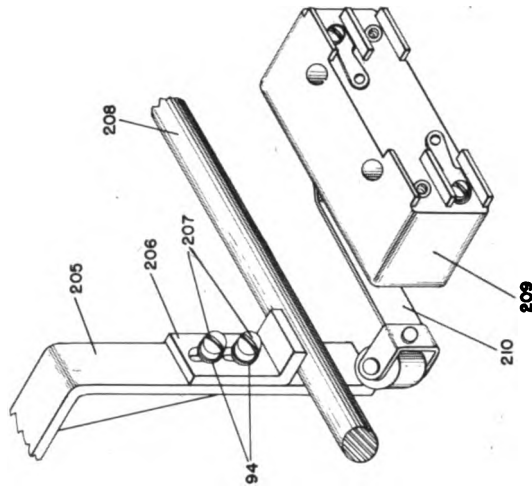
(4) As reproducer lateral pivot bracket (265) rotates in a clockwise direction, the reproducer stylus (31) is presented to the recording belt (254), at the surface of the drive mandrel (87), at normal pres-



A. Change record switch



B. Ready Switch



C. Reproducer safety switch

TL94475

Figure 33. Switches

sure (0.75 ounce), due to reproducer pressure spring (226).

(5) The reproducer (229) is not held rigidly in its mount as in the case of the recorder, but rather, has a certain amount of lateral compliance because of the action of the two lateral pivot screws (215) in the reproducer lateral pivot bracket (265).

(6) As the reproducer carriage assembly (261) is fed laterally across the recording belt, the lateral compliance afforded by reproducer lateral pivot bracket (265) and its associated pivot screws (215), allows the reproducer stylus (31) to track properly in the tone grooves in the record.

(7) The spring type of suspension provided in reproducer stylus (31) for the sapphire point, affords a sufficient amount of vertical compliance to the reproducer stylus (31) to make it inefficient in a direction normal to the recording belt at the point of engagement, thus making the crystal reproducing head (229) unresponsive to any hill-and-dale modulations in the tone grooves.

#### **77. CHANGE RECORD SWITCH (fig. 33).**

**a. General.** The CHANGE RECORD switch, which is operated when the recorder carriage reaches its right-hand limit of travel, is shown in diagram A of figure 33.

**b. Operation.** (1) When the recorder carriage (243) on either of the dual recording-reproducing machine units reaches its right-hand limit of travel, change-over actuating lever (1) is pushed to the right by actuating pin (2).

(2) As change-over actuating lever (1) moves to the right, CHANGE RECORD switch actuating cam (211) is moved to the left at its top end and subsequently moved to the right at its bottom end because of the pivot point at its center.

(3) When the lower end of CHANGE RECORD switch actuating cam (211) moves to the right, it engages the roller on the actuating lever of CHANGE RECORD switch (3), thus closing the contacts of this switch.

(4) There is a "stop" (212) to limit the travel of the roller on the actuating lever on the CHANGE RECORD switch (3), to prevent it from overshooting actuating cam (211).

#### **78. READY RECORD SWITCH (fig. 33).**

**a. General.** The diagram (fig. 33, B) will aid in explaining the operation of the READY record switch. This switch is operated by the

recorder carriage bail actuating pin (185) which pin also operates the recorder dashpot.

**b. Operation.** (1) The READY record switch is operated during a portion of the travel of the recorder carriage control lever.

(2) In the operation of the recorder carriage control lever, there is an over travel which takes place after the feed nut has been released to engage the feed screw. It is during this over travel that READY record switch (186) must be operated, and remain in the "operate" position.

(3) As the recorder carriage control lever is placed in the "operate" position, the recorder carriage bail assembly (9) is operated, causing actuating pin (185) to move in a clockwise direction, engaging READY record switch actuating lever (184).

(4) READY record switch actuating lever (184), when operated, closes the contacts of ready switch (186).

#### **79. REPRODUCER SAFETY SWITCH (fig. 33).**

**a. General.** (1) The diagram (fig. 33, C) will aid in the explanation of the operation of the reproducer safety switch (209).

(2) There is a reproducer safety switch (209) associated with each of the dual recording-reproducing machine units. These two micro-switches differ from the other micro-switches installed on this equipment, in that the contacts of the reproducer safety switch (209) are normally closed, and therefore, when the switch is operated, the contacts are opened.

**b. Operation.** (1) The reproducer safety switch (209) is operated by the projection on the reproducer carriage guide (205).

(2) When the reproducer carriage reaches a point within  $\frac{1}{32}$  inch of its right-hand limit of travel (when looking at the front of the machine), the roller on the end of reproducer safety switch actuating lever (210) engages the end of the reproducer carriage guide (205), and the reproducer safety switch (209) is operated thereby.

(3) When the reproducer safety switch (209) is operated in this manner, its contacts are opened.

#### **80. SHOCK MOUNTING (fig. 9).**

**a. General.** (1) Basically, the shock mount units for the amplifier and the unit plate function in a similar manner.

(2) The four amplifier shock mount units support a rectangular bracket which latter supports the amplifier system in the machine.

(3) The four unit plate shock mounts support the unit plate assembly, directly, at the four corners.

(4) The different shock mount units are designed to be more or less resilient for the weight they have to sustain. Beyond this, the unit plate rear shock mount assemblies provide for hinging the rear edges of the unit plate, and the unit plate front shock mount units provide for locking the unit plate at its front edge.

**b. Operation.** (1) Fundamentally, each shock mount unit consists of an inner core which holds the load to be sustained, and an outer shell which is attached to the mounting surface (in the case of this equipment, the sides of the portable field case provide the mounting surfaces).

(2) Between the inner core and the outer shell, there is an adequate rubber interconnecting insulator, which latter is vulcanized to the core and the shell.

## **81. SIGNAL LIGHTS (fig. 21).**

**a. General.** The five signal lights (IL-1), (IL-2), (IL-3), (IL-4), and (IL-5) located on the control panel are all of the neon type. They draw negligible current but provide sufficient light to afford satisfactory indication, through the clear cover glass mounted over each of the signal lights.

**b. Operation.** The different signal light circuits are completed through the action of the associated control switches as shown schematically in figure 21.

## **82. SIMULTANEOUS OR SEPARATE RECORDING AND REPRODUCTION**

**a. General.** "Simultaneous or separate recording and reproduction" is possible because of the elements mentioned in the following paragraphs.

**b.** There is a separate recording and a separate reproducing head on each of the recording-reproducing machine units.

**c.** There is a separate feed mechanism for the recording head and a separate feed mechanism for the reproducing head.

**d.** There is a separate record amplifier and a separate reproduce amplifier.

# SECTION IV

## Maintenance

**NOTE: Failure or unsatisfactory performance of equipment will be reported on W.D., A.G.O. FORM No. 468. If this form is not available, see TM39-250.**

### 83. GENERAL.

a. When using this section of the instruction manual, refer to the figure or figures mentioned as the instructions are read, and, if the figures are "fold-in" figures, fold each one out to a position where it can be seen as the instructions are read.

b. Before proceeding with any of the operations outlined, read the instructions over completely, once, before proceeding, being particularly careful to read the CAUTIONS and NOTES.

**CAUTION: IN GENERAL, BEFORE PROCEEDING WITH ANY MAINTENANCE WORK, ALWAYS PLACE THE CARRIAGE CONTROL LEVERS IN "NEUTRAL", AND, WHEREVER FEASIBLE, HAVE A RECORDING BELT ON THE MACHINE.**

IN ANY PROCEDURE WHICH INVOLVES TEMPORARILY REMOVING THE NORMAL CONTROL OF THE RECORDER AND REPRODUCER STYLII, BE VERY CAREFUL TO AVOID DAMAGING THE STYLII. IF NECESSARY, REMOVE THE STYLII (PARS. 102 and 107).

NOTE: Reference is made throughout this section to placing the recorder and reproducer carriage control levers in the "neutral" and "operate" position. In figure 50 both carriage control levers (36) on the front machine are in the "operate" position. The recorder carriage control lever (36) on the rear machine is in the "operate" position, pushed to the rear of the recorder carriage control lever stop (95), and the reproducer carriage control lever (36) is in the "neutral" position, aligned with reproducer carriage control lever stop (101).

c. The general outline which is followed in the presentation of the instructions in this section (wherever logical) is as follows:

- (1) Removal.
- (2) Disassembly.
- (3) Reassembly.
- (4) Installation.
- (5) Adjustment.
- (6) Tests.

d. In the following instructions, all references to direction (left, right, etc.) are made on the basis of facing the front of the machine, unless otherwise stated.

e. When performing any of the following operations, leave one of the dual recording-reproducing machine units intact to serve as a guide while working on the other unit.

### 84. AMPLIFIER SYSTEM (figs. 3, 4, 9, 34, and 37).

a. Removal (figs. 3 and 4). (1) Remove the audio input from INPUT jack (J-1).

(2) Remove any audio output plug which is plugged into REPRODUCE OUTPUT jacks (J-2), (J-3), or (J-4).

(3) Remove the power supply input plug from the power input supply receptacle (A-1) on the right-hand side of the amplifier chassis.

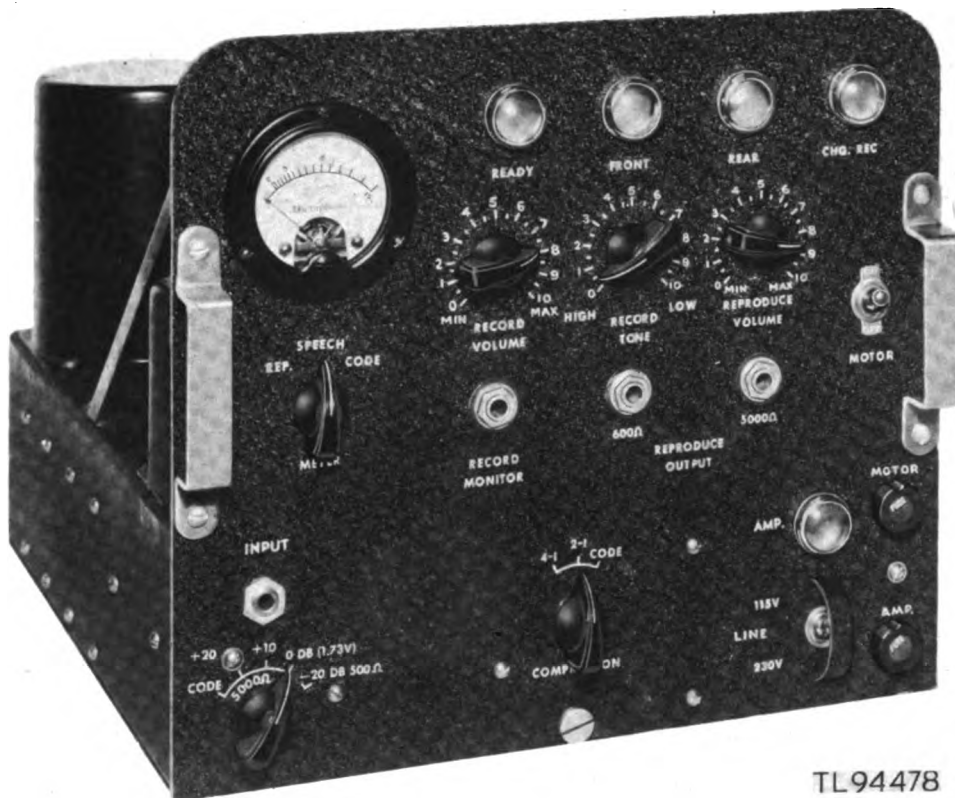
(4) Remove the remote motor control plug from the MOTOR CONTROL receptacle (A-4) on the right-hand side of the amplifier chassis.

(5) Release the catch at bottom front center of the control panel, which secures the amplifier and its associated control panel into place.

(6) Pull the amplifier forward a few inches to provide access to the internal connection plugs.

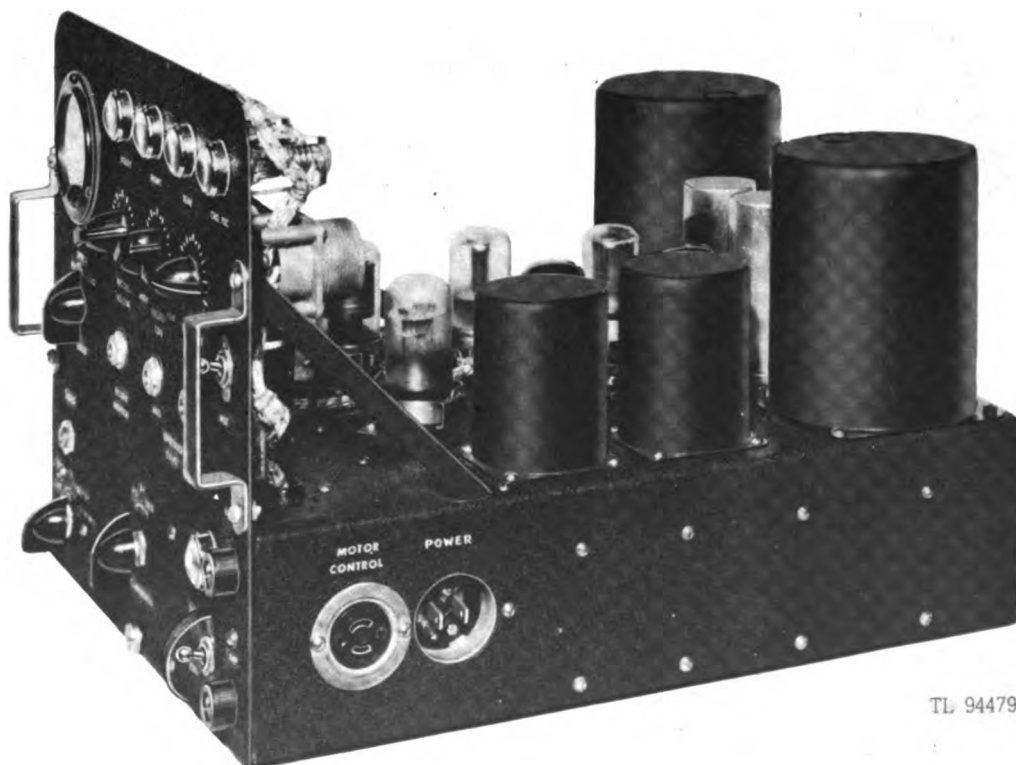
(7) Remove the reproduce amplifier input plug from receptacle (A-2) on the top left of the amplifier chassis.

(8) Remove the record amplifier output plug from receptacle (A-3) on top right of the amplifier chassis.



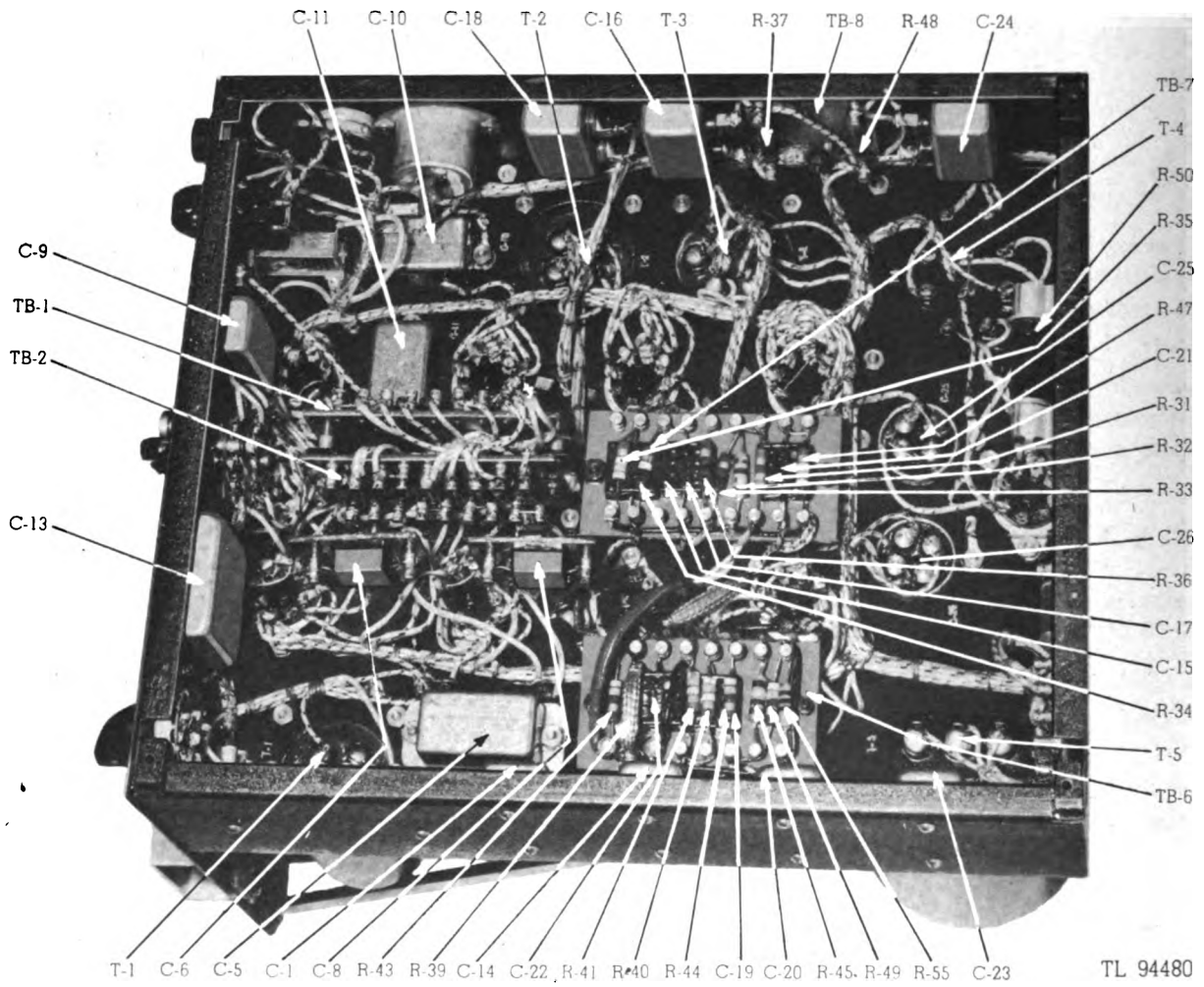
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Figure 34. Amplifier — front

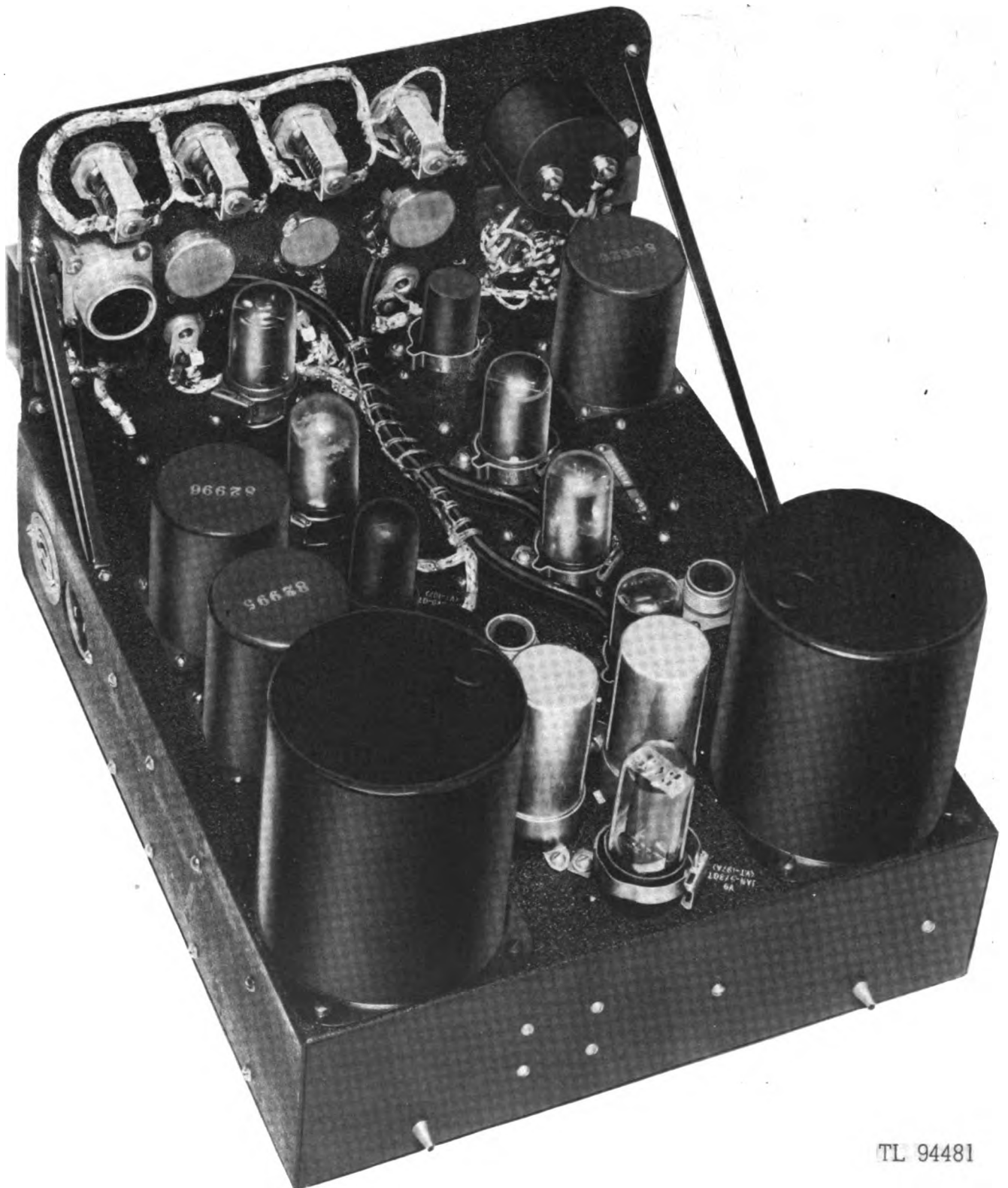


TL 94479

Figure 35. Amplifier — right front



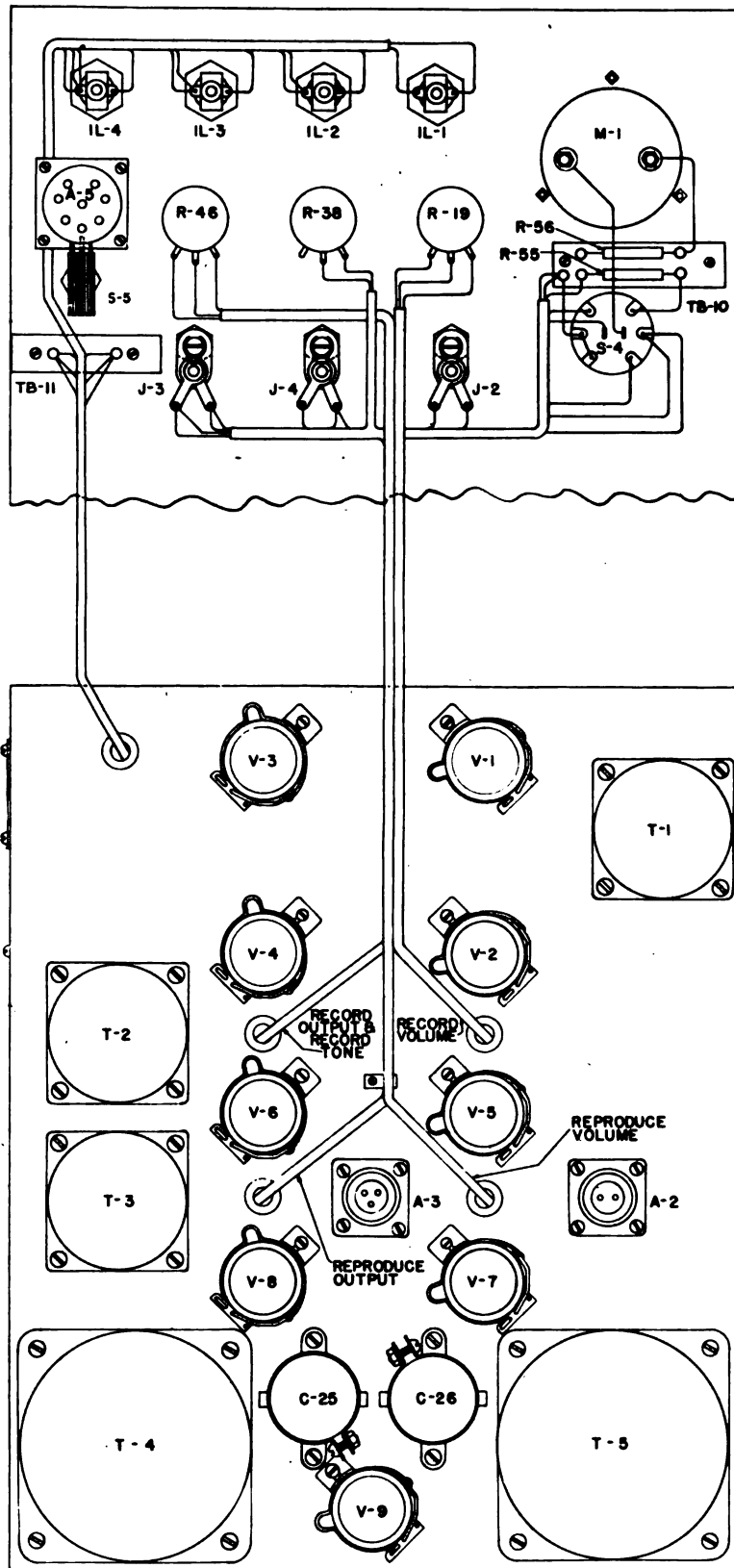
**Figure 36. Amplifier — bottom**



TL 94481

Figure 37. Amplifier — top





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Figure 38. Amplifier — top (diagram)

(9) Remove the unit plate power plug from receptacle (A-5) at top right rear of the control panel.

(10) Pull the amplifier out of the machine.

(11) Figure 9 shows the interior of the amplifier compartment in the portable field case, with the amplifier removed.

(12) Figure 34 is a front view of the amplifier.

(13) Figure 35 is a right, front view of the amplifier.

(14) Figure 36 is a bottom view of the amplifier with the bottom cover removed. This bottom cover is removed by removing the four corner screws.

(15) Figure 37 is a top view of the amplifier unit.

**b. Installation.** Install the amplifier unit by following the removal procedure in reverse order.

**c. Amplifier Schematic (fig. 39).** Figure 39 is a schematic diagram of the amplifier.

#### LEGEND FOR FIGURE 39

Des	Value	Rating	Service
A-1	2-way	Male	115/230-volt power input receptacle.
A-2	2-way	Female	Reproduce amplifier audio input receptacle.
A-3	3-way	Female	Recorder amplifier audio output receptacle.
C-1	0.05 mf	600 v	Isolating and coupling capacitor in the 5,000 ohm record amplifier input circuit. Functions as a d-c blocking capacitor.
C-2	0.006 mf	600 v	Isolating capacitor in the input circuit in the first stage (V-1) in the record amplifier. Prevents d-c in the compressor circuit from finding a path to ground.
C-3	0.25 mf	200 v	Filter capacitor for compressor circuit (also affects the time constant).
C-4	0.001 mf	600 v	Coupling capacitor between the plate circuit of the first record amplifier stage (V-1), and the grid circuit of the compressor amplifier stage (V-3).
C-5	0.05 mf	600 v	Screen grid by-pass capacitor in the first record amplifier stage (V-1).
C-6	0.01 mf	600 v	Coupling capacitor between the output circuit of the first record amplifier stage (V-1), and the input circuit of the second record amplifier stage (V-2).
C-7	0.05 mf	600 v	Screen grid by-pass capacitor in second record amplifier stage (V-2).
C-8	0.01 mf	600 v	Coupling capacitor between second record amplifier stage (V-2) and third record amplifier stage (V-5).
C-9	25.0 mf	25 v	Cathode by-pass capacitor in compressor amplifier stage (V-3) in record amplifier.
C-10	0.05 mf	600 v	Screen grid by-pass capacitor in compressor amplifier stage (V-3) in record amplifier.
C-11	0.05 mf	600 v	Coupling capacitor between the output circuit of the compressor amplifier stage (V-3) and the compressor amplifier rectifier stage (V-4) in the record amplifier.
C-12	0.25 mf	200 v	Compressor circuit time constant capacitor.
C-13	0.25 mf	200 v	Compressor circuit time constant capacitor for CODE position of COMPRESSION selector switch only.
C-14	25.0 mf	25 v	Cathode by-pass capacitor in third record amplifier stage (V-5).
C-15	0.01 mf	600 v	Coupling capacitor between third record amplifier stage (V-5) and record amplifier output stage (V-6).
C-16	25.0 mf	25 v	Cathode by-pass capacitor in record amplifier output stage (V-6).

Des	Value	Rating	Service
C-17	0.002 mf	600 v	Stabilizing capacitor within section of amplifier containing negative feedback.
C-18	0.25 mf	200 v	Phase shifting capacitor in negative feedback circuit in record amplifier, to provide tone control.
C-19	0.001 mf	600 v	Stabilizing capacitor in shunt with plate load resistor in second reproduce amplifier stage (V-7).
C-20	25.0 mf	25 v	Cathode by-pass capacitor in first reproduce amplifier stage (V-7).
C-21	0.01 mf	600 v	Coupling capacitor between second reproduce amplifier stage (V-7) and reproduce amplifier output stage (V-8).
C-22	0.01 mf	600 v	Coupling capacitor between output of first reproduce amplifier stage (V-7) and input of second reproduce amplifier stage (V-7).
C-23	25.0 mf	25 v	Cathode by-pass capacitor in second reproduce amplifier stage (V-7).
C-24	25.0 mf	25 v	Cathode by-pass capacitor in reproduce amplifier output stage (V-8).
C-25	10.0 mf	450 v	Electrolytic capacitor in power rectifier filter circuit (Four 10.0 mf. 450 volt sections).
	10.0 mf	450 v	
	10.0 mf	450 v	
	10.0 mf	450 v	
C-26	10.0 mf	450 v	Electrolytic capacitor in power rectifier filter circuit (Four 10.0 mf. 450 volt sections).
	10.0 mf	450 v	
	10.0 mf	450 v	
	10.0 mf	450 v	
F-1	1.0 amp	Fuse	Amplifier circuit
F-2	1.5 amp	Fuse	Motor circuit.
IL-5	Neon	115 v	Amplifier signal light.
J-1	3-way	Jack	Audio input
J-2	1-way	Jack	Record amplifier output.
J-3	1-way	Jack	Reproduce amplifier output (5,000 ohms).
J-4	1-way	Jack	Reproduce amplifier output. (600 ohms).
K-1	DPDT	115 v	Record-reproduce relay for front unit.
K-2	DPDT	115 v	Record-reproduce relay for rear unit.
M-1			Power level meter.
P-2	2-way	Male	Reproduce amplifier audio input plug.
P-3	3-way	Male	Record amplifier audio output plug.
R-1	4,700 ohms	½ watt	Input attenuator series resistor in 5000 ohm record amplifier input circuit.
R-2	22.0 ohms	½ watt	Input attenuator shunt resistor in record amplifier audio input circuit.
R-3	100.0 ohms	½ watt	Input attenuator shunt resistor in record amplifier audio input circuit.
R-4	510.0 ohms	½ watt	Input attenuator shunt resistor in record amplifier audio input circuit.
R-5	47,000 ohms	½ watt	Loading resistor across secondary winding of record amplifier input transformer T-1.

Des	Value	Rating	Service
R-6	0.1 meg	½ watt	Grid resistor in first record amplifier stage (V-1).
R-7	1,500 ohms	½ watt	Cathode resistor in first record amplifier stage (V-1).
R-8	27,000	½ watt	Cathode resistor in first record amplifier stage (V-1).
R-9	2.2 meg	½ watt	Voltage dropping resistor in screen grid circuit of first record amplifier stage (V-1).
R-10	0.15 meg	½ watt	Plate load resistor in first record amplifier stage (V-1). Also part of signal voltage dividing network between the output of (V-1) and the input of (V-2).
R-11	0.1 meg	½ watt	Plate load resistor in first record amplifier stage (V-1). Also part of signal voltage dividing network between the output of (V-1) and input of (V-2).
R-12	1.0 meg	½ watt	Grid resistor in second record amplifier stage (V-2).
R-13	1,000 ohm	½ watt	Cathode resistor in second record amplifier stage (V-2).
R-14	0.47 meg	½ watt	Filter resistor in compressor amplifier rectifier output (V-4). Also affects time constant of compression circuit. (Connected between output of (V-4) and input of (V-1).)
R-15	1.0 meg	½ watt	Voltage dropping resistor in screen grid circuit of second record amplifier stage (V-2).
R-16	0.22 meg	½ watt	Plate load resistor in second record amplifier stage (V-2).
R-17	0.47 meg	½ watt	Resistor in voltage dividing network in screen grid circuit of second record amplifier stage (V-2).
R-18	0.15 meg	½ watt	Resistor in voltage dividing network in screen grid circuit of second record amplifier stage (V-2).
R-19	0.5 meg	Pot.	Record volume control in the grid circuit of the third record amplifier stage (V-5).
R-20	1.0 meg	½ watt	Signal voltage dropping resistor between plate of first record amplifier stage (V-1) and the grid of the compressor amplifier stage (V-3), in the "CODE" position of the selector switch (S-3). It also functions as a control voltage filter resistor between the d-c output of the compressor amplifier rectifier stage (V-4) and the grid of the compressor amplifier stage (V-3), in the 4-1 and 2-1 positions of the COMPRESSION selector switch (S-3).
R-21	0.15 meg	½ watt	Control voltage dropping resistor between the d-c output of the compressor amplifier rectifier stage (V-4) and the grid of the compression amplifier stage (V-3).
R-22	1,500 ohms	½ watt	Cathode resistor in compressor amplifier stage (V-3) in record amplifier.
R-23	1.0 meg.	½ watt	Voltage dropping resistor in screen grid circuit of compressor amplifier stage (V-3).
R-24	0.22 meg	½ watt	Plate load resistor in compressor amplifier stage (V-3) in record amplifier.
R-25	0.1 meg	½ watt	Load resistor in compressor amplifier rectifier output circuit (V-4).
R-26	0.1 meg	½ watt	Load resistor in compressor amplifier rectifier output circuit (V-4).
R-27	0.1 meg	½ watt	Load resistor in compressor amplifier rectifier output circuit (V-4).

Des	Value	Rating	Service
R-28	27,000 ohms	½ watt	Load resistor in compressor amplifier rectifier output circuit (V-4).
R-29	1.0 meg	½ watt	Filter resistor between output of compressor amplifier rectifier stage (V-4) and the grid of the compressor amplifier stage (V-3), in the CODE position of the COMPRESSION selector switch (S-3).
R-30	10.0 meg	½ watt	Time constant resistor in compressor amplifier rectifier output circuit (V-4), in the CODE position of the COMPRESSION selector switch (S-3).
R-31	3,300 ohms	½ watt	Cathode resistor in third record amplifier stage (V-5).
R-32	240.0 ohms	½ watt	Cathode resistor in third record amplifier stage (V-5).
R-33	1,000 ohms	½ watt	Resistor in negative feedback network in record amplifier.
R-34	0.1 meg	½ watt	Plate load resistor in the third record amplifier stage (V-5).
R-35	0.47 meg	½ watt	Grid resistor in record amplifier output stage (V-6).
R-36	1,000 ohms	½ watt	Resistor in negative feedback network in record amplifier.
R-37	360.0 ohms	1.0 watt	Cathode resistor in record amplifier output stage (V-6).
R-38	10,000 ohms	Rheo.	RECORD TONE control.
R-39	0.47 meg	½ watt	Grid resistor in first reproduce amplifier stage (V-7).
R-40	0.47 meg	½ watt	Plate load resistor in second reproduce amplifier stage (V-7).
R-41	0.47 meg	½ watt	Plate load resistor in first reproduce amplifier stage (V-7).
R-42	47,000 ohms	½ watt	Filter resistor in grid of first reproduce amplifier stage (V-7). Prevents radio-frequency interference from getting into the grid of the first reproduce amplifier stage (V-7).
R-43	4,700 ohms	½ watt	Cathode resistor in first reproduce amplifier stage (V-7).
R-44	4,700 ohms	½ watt	Cathode resistor in second reproduce amplifier stage (V-7). Also part of the reproduce amplifier negative feedback network.
R-45	240.0 ohms	½ watt	Cathode resistor in second reproduce amplifier stage (V-7). Also a part of the reproduce amplifier negative feedback network.
R-46	0.5 meg	Pot.	REPRODUCE VOLUME control.
R-47	0.47 meg	½ watt	Grid resistor in reproduce amplifier output stage (V-8).
R-48	360.0 ohms	1.0 watt	Cathode resistor in reproduce amplifier output stage (V-8).
R-49	4,700 ohms	½ watt	Filter resistor in reproduce amplifier negative feedback network.
R-50	500.0 ohms	5.0 watt	Power rectifier filter circuit resistor.
R-51	10,000 ohms	2.0 watt	Power rectifier filter circuit resistor.
R-52	10,000 ohms	½ watt	Power rectifier filter circuit resistor.
R-53	10,000 ohms	½ watt	Power rectifier filter circuit resistor.
R-54	10,000 ohms	½ watt	Power rectifier filter circuit resistor.
R-55	4,700 ohms	½ watt	Signal voltage dropping resistor connected in series with power level meter in the CODE position.

De

R-1

R-1

S-1

S-2

S-3

S-4

T-K7

T-1

T-2

T-3

T-4

T-5

RE

RE

RE

V-1

V-2

V-3

V-4

V-5

V-6

V-7

V-8

V-9

V-10

V-11

V-12

V-13

V-14

V-15

V-16

V-17

V-18

V-19

V-20

V-21

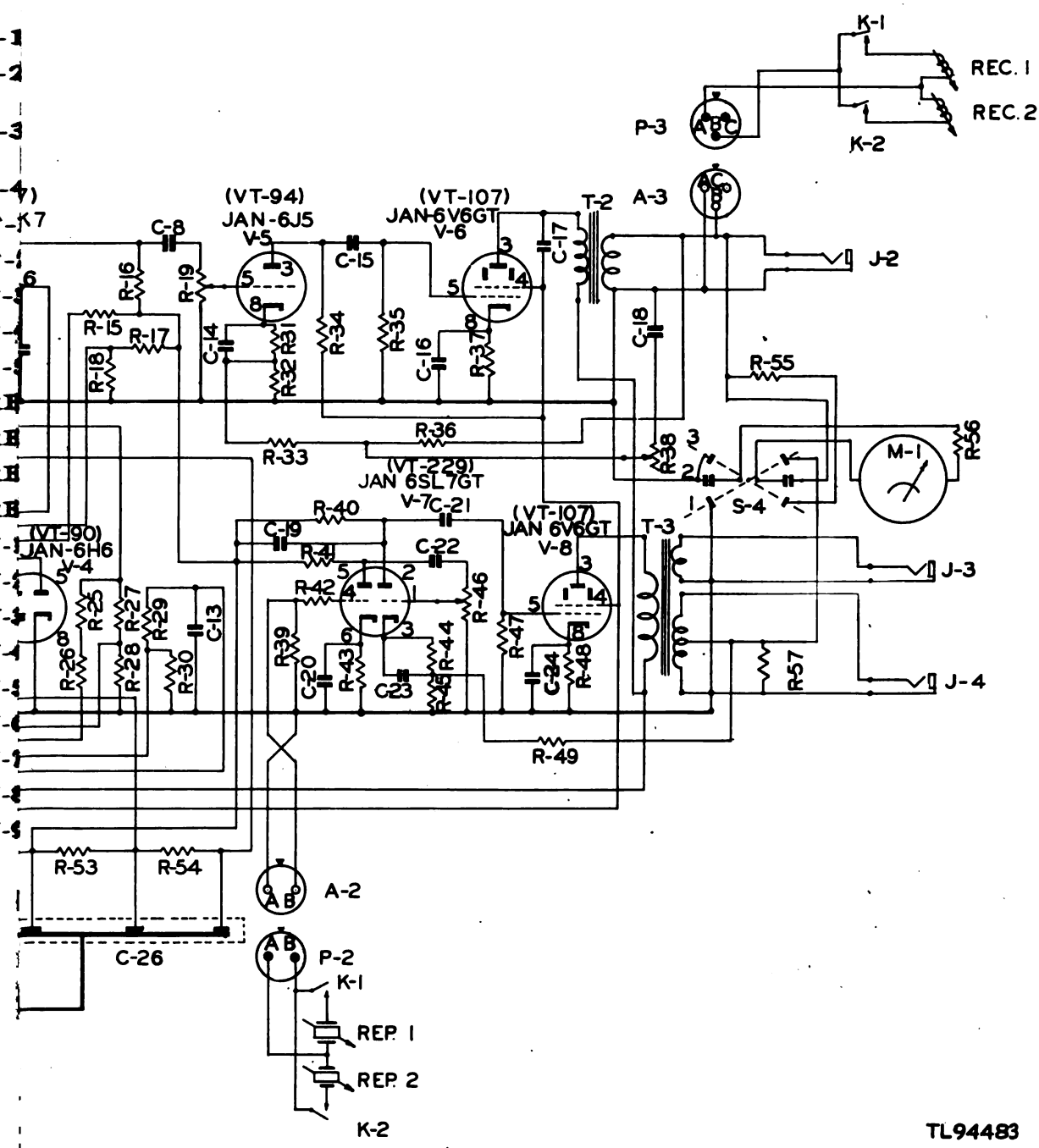
V-22

V-23

V-24

V-25

V-26



TL94483

ifier schematic

# SECTION IV

## Maintenance

**NOTE: Failure or unsatisfactory performance of equipment will be reported on W.D., A.G.O. FORM No. 468. If this form is not available, see TM38-250.**

### 83. GENERAL.

a. When using this section of the instruction manual, refer to the figure or figures mentioned as the instructions are read, and, if the figures are "fold-in" figures, fold each one out to a position where it can be seen as the instructions are read.

b. Before proceeding with any of the operations outlined, read the instructions over completely, once, before proceeding, being particularly careful to read the CAUTIONS and NOTES.

**CAUTION: IN GENERAL, BEFORE PROCEEDING WITH ANY MAINTENANCE WORK, ALWAYS PLACE THE CARRIAGE CONTROL LEVERS IN "NEUTRAL", AND, WHEREVER FEASIBLE, HAVE A RECORDING BELT ON THE MACHINE.**

**IN ANY PROCEDURE WHICH INVOLVES TEMPORARILY REMOVING THE NORMAL CONTROL OF THE RECORDER AND REPRODUCER STYLII, BE VERY CAREFUL TO AVOID DAMAGING THE STYLII. IF NECESSARY, REMOVE THE STYLII (PARS. 102 and 107).**

**NOTE:** Reference is made throughout this section to placing the recorder and reproducer carriage control levers in the "neutral" and "operate" position. In figure 50 both carriage control levers (36) on the front machine are in the "operate" position. The recorder carriage control lever (36) on the rear machine is in the "operate" position, pushed to the rear of the recorder carriage control lever stop (95), and the reproducer carriage control lever (36) is in the "neutral" position, aligned with reproducer carriage control lever stop (101).

c. The general outline which is followed in the presentation of the instructions in this section (wherever logical) is as follows:

- (1) Removal.
- (2) Disassembly.
- (3) Reassembly.
- (4) Installation.
- (5) Adjustment.
- (6) Tests.

d. In the following instructions, all references to direction (left, right, etc.) are made on the basis of facing the front of the machine, unless otherwise stated.

e. When performing any of the following operations, leave one of the dual recording-reproducing machine units intact to serve as a guide while working on the other unit.

### 84. AMPLIFIER SYSTEM (figs. 3, 4, 9, 34, and 37).

a. Removal (figs. 3 and 4). (1) Remove the audio input from INPUT jack (J-1).

(2) Remove any audio output plug which is plugged into REPRODUCE OUTPUT jacks (J-2), (J-3), or (J-4).

(3) Remove the power supply input plug from the power input supply receptacle (A-1) on the right-hand side of the amplifier chassis.

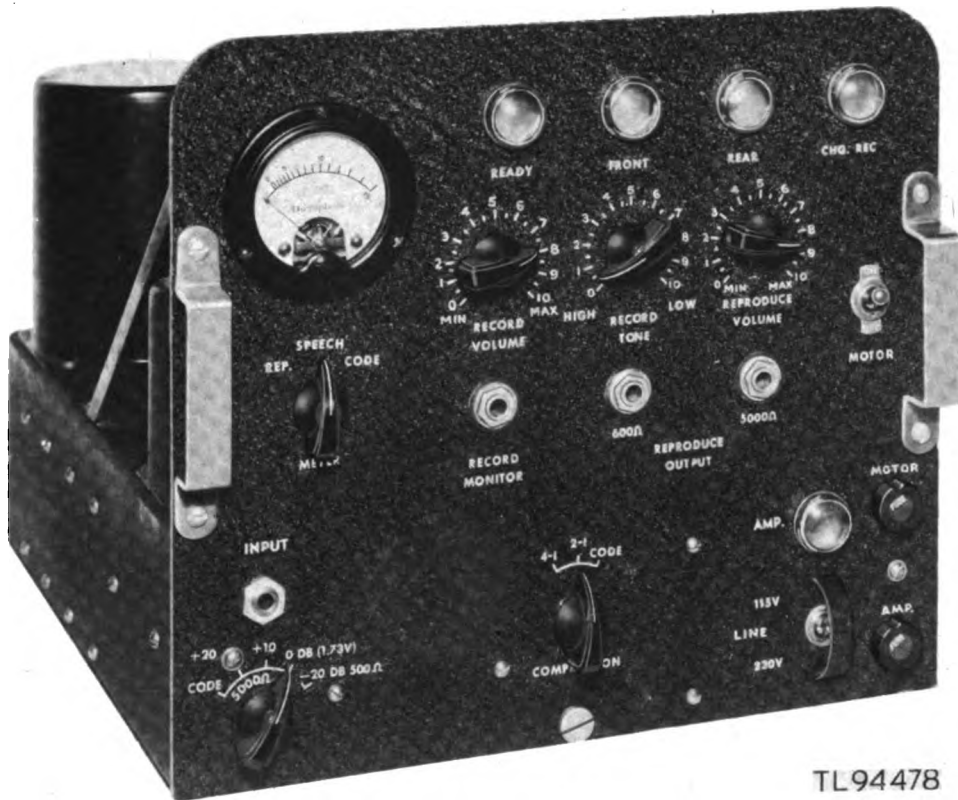
(4) Remove the remote motor control plug from the MOTOR CONTROL receptacle (A-4) on the right-hand side of the amplifier chassis.

(5) Release the catch at bottom front center of the control panel, which secures the amplifier and its associated control panel into place.

(6) Pull the amplifier forward a few inches to provide access to the internal connection plugs.

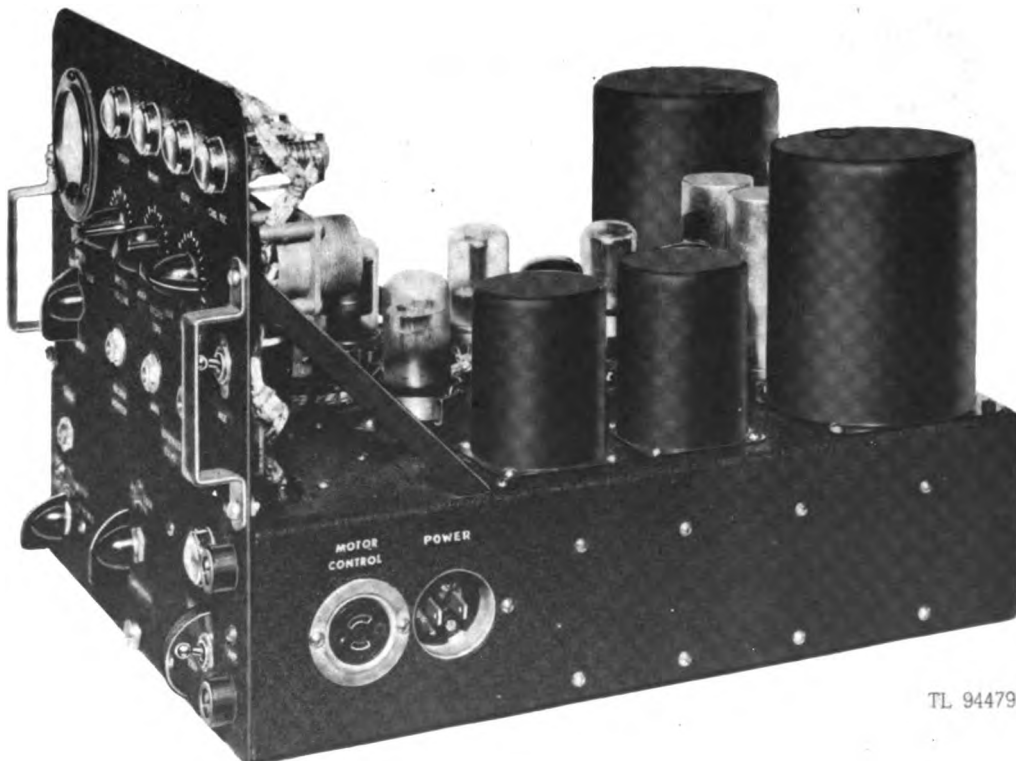
(7) Remove the reproduce amplifier input plug from receptacle (A-2) on the top left of the amplifier chassis.

(8) Remove the record amplifier output plug from receptacle (A-3) on top right of the amplifier chassis.



TL94478

Figure 34. Amplifier — front

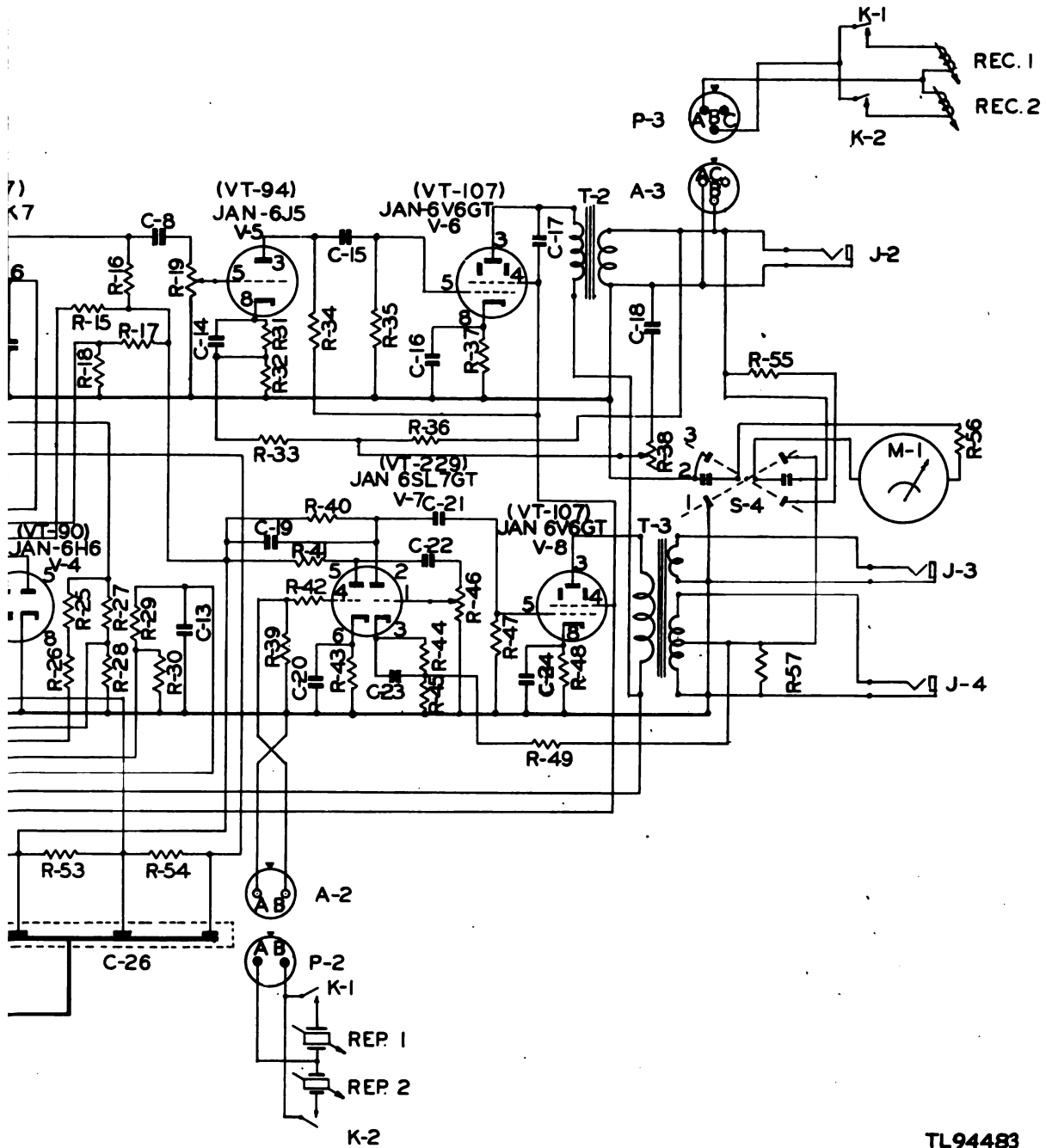


TL 94479

Figure 35. Amplifier — right front

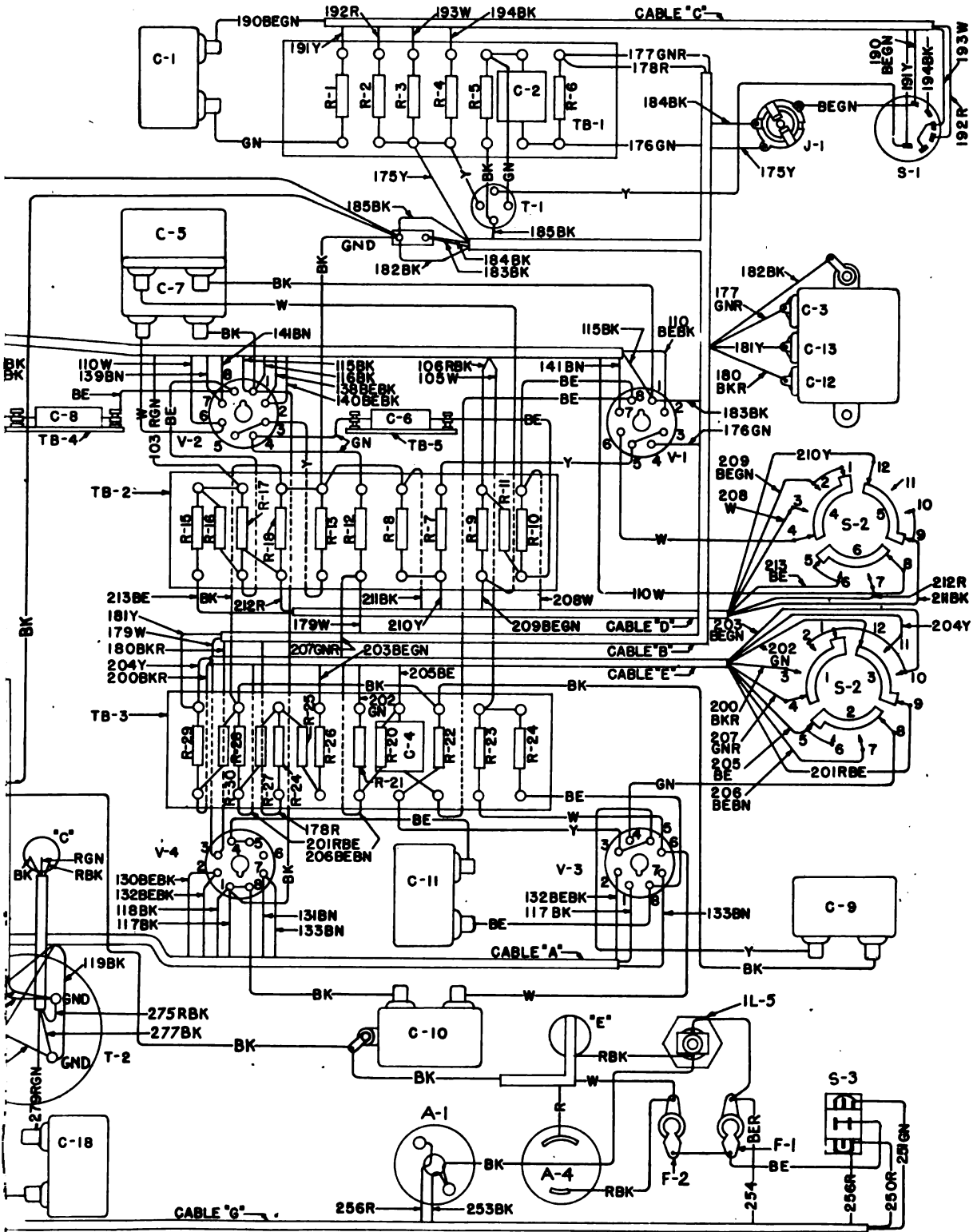


Des	Value	Rating	Service
R-28	27,000 ohms	½ watt	Load resistor in compressor amplifier rectifier output circuit (V-4).
R-29	1.0 meg	½ watt	Filter resistor between output of compressor amplifier rectifier stage (V-4) and the grid of the compressor amplifier stage (V-3), in the CODE position of the COMPRESSION selector switch (S-3).
R-30	10.0 meg	½ watt	Time constant resistor in compressor amplifier rectifier output circuit (V-4), in the CODE position of the COMPRESSION selector switch (S-3).
R-31	3,300 ohms	½ watt	Cathode resistor in third record amplifier stage (V-5).
R-32	240.0 ohms	½ watt	Cathode resistor in third record amplifier stage (V-5).
R-33	1,000 ohms	½ watt	Resistor in negative feedback network in record amplifier.
R-34	0.1 meg	½ watt	Plate load resistor in the third record amplifier stage (V-5).
R-35	0.47 meg	½ watt	Grid resistor in record amplifier output stage (V-6).
R-36	1,000 ohms	½ watt	Resistor in negative feedback network in record amplifier.
R-37	360.0 ohms	1.0 watt	Cathode resistor in record amplifier output stage (V-6).
R-38	10,000 ohms	Rheo.	RECORD TONE control.
R-39	0.47 meg	½ watt	Grid resistor in first reproduce amplifier stage (V-7).
R-40	0.47 meg	½ watt	Plate load resistor in second reproduce amplifier stage (V-7).
R-41	0.47 meg	½ watt	Plate load resistor in first reproduce amplifier stage (V-7).
R-42	47,000 ohms	½ watt	Filter resistor in grid of first reproduce amplifier stage (V-7). Prevents radio-frequency interference from getting into the grid of the first reproduce amplifier stage (V-7).
R-43	4,700 ohms	½ watt	Cathode resistor in first reproduce amplifier stage (V-7).
R-44	4,700 ohms	½ watt	Cathode resistor in second reproduce amplifier stage (V-7). Also part of the reproduce amplifier negative feedback network.
R-45	240.0 ohms	½ watt	Cathode resistor in second reproduce amplifier stage (V-7). Also a part of the reproduce amplifier negative feedback network.
R-46	0.5 meg	Pot.	REPRODUCE VOLUME control.
R-47	0.47 meg	½ watt	Grid resistor in reproduce amplifier output stage (V-8).
R-48	360.0 ohms	1.0 watt	Cathode resistor in reproduce amplifier output stage (V-8).
R-49	4,700 ohms	½ watt	Filter resistor in reproduce amplifier negative feedback network.
R-50	500.0 ohms	5.0 watt	Power rectifier filter circuit resistor.
R-51	10,000 ohms	2.0 watt	Power rectifier filter circuit resistor.
R-52	10,000 ohms	½ watt	Power rectifier filter circuit resistor.
R-53	10,000 ohms	½ watt	Power rectifier filter circuit resistor.
R-54	10,000 ohms	½ watt	Power rectifier filter circuit resistor.
R-55	4,700 ohms	½ watt	Signal voltage dropping resistor connected in series with power level meter in the CODE position.



ifier schematic

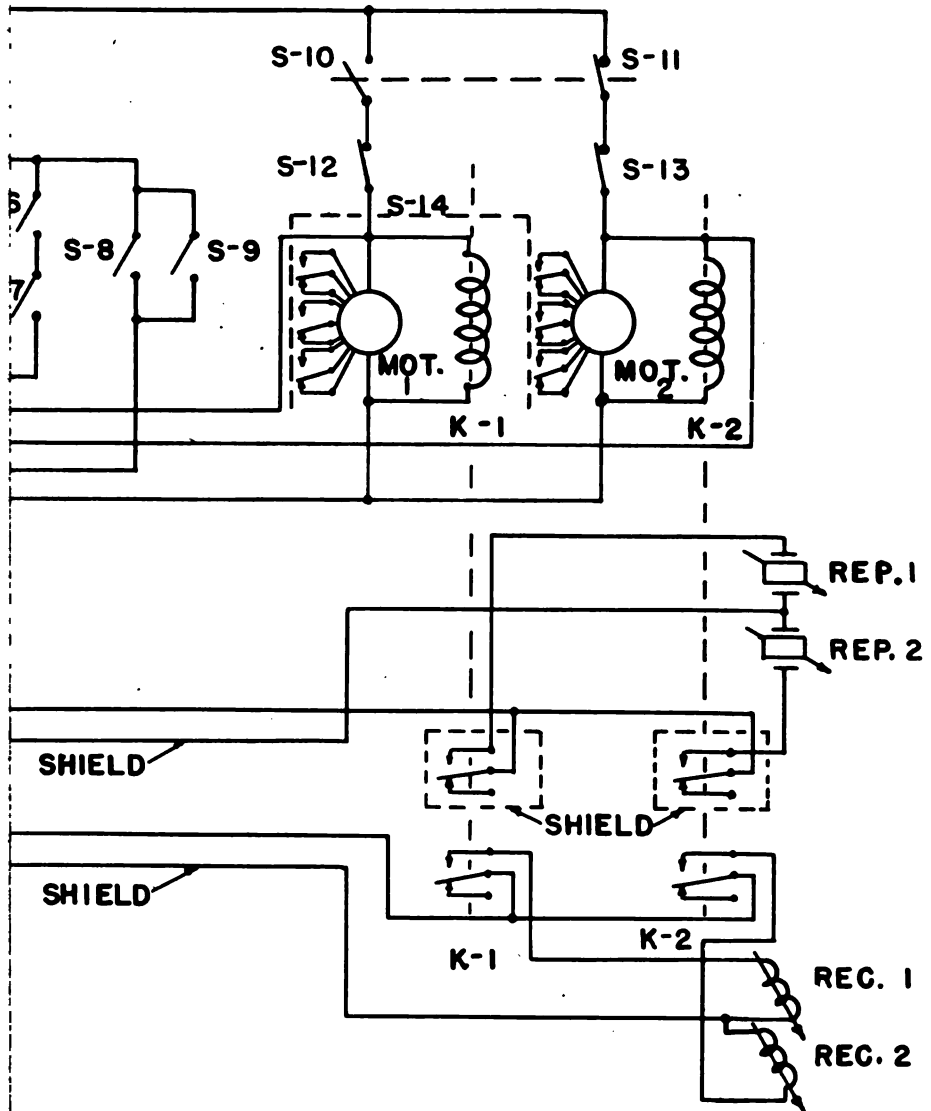




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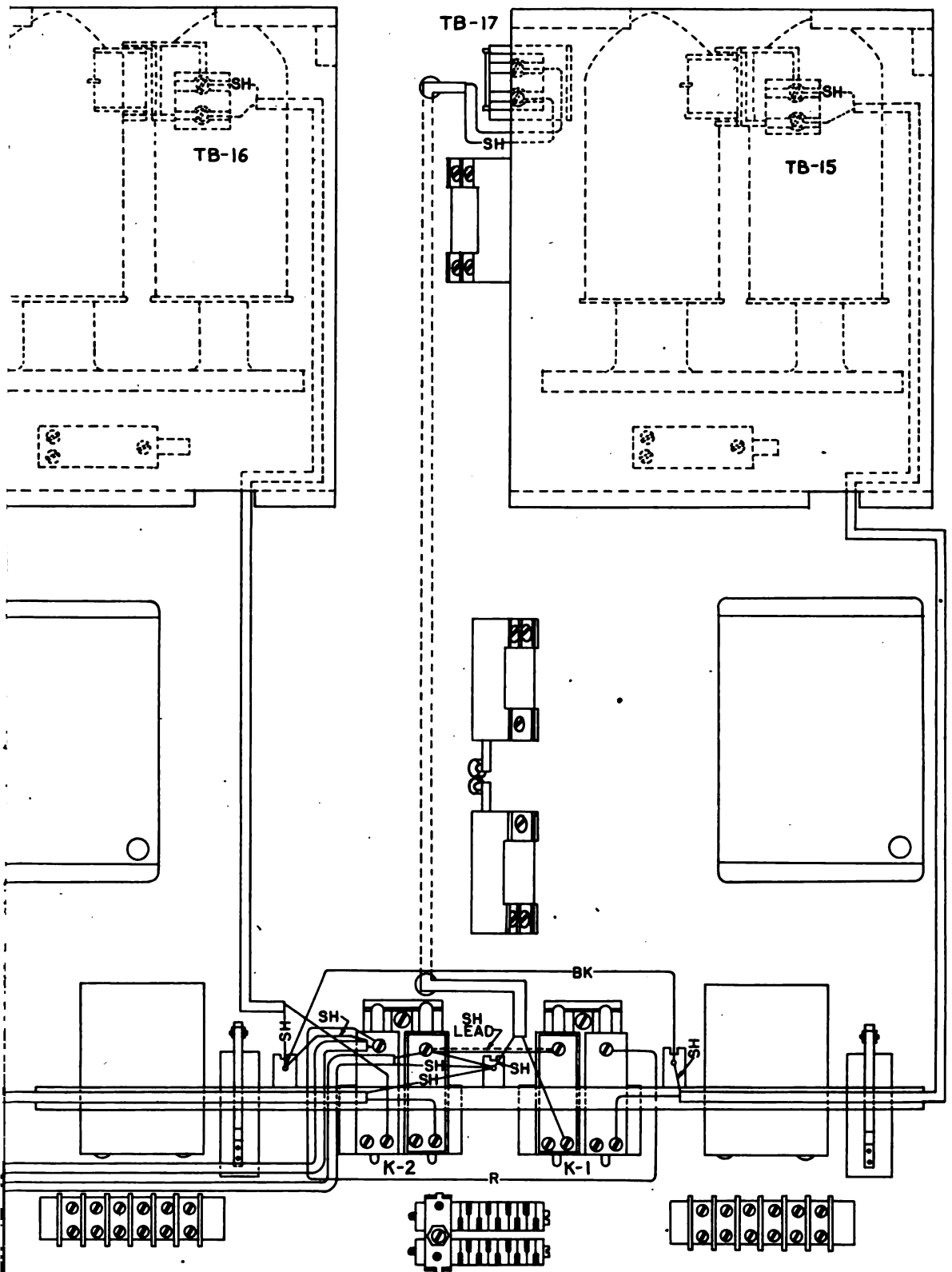
Des	Value
A-1*	2-way
A-2	2-way
A-3	3-way
A-4	2-way
A-5	8-way
F-1	1.0 amp
F-2	1.5 amp
IL-1	Neon
IL-2	Neon
IL-3	Neon
IL-4	Neon
K-1	DPDT
K-2	DPDT
MOT. 1	
MOT. 2	
P-2	2-way
P-3	3-way
P-4	2-way
P-5	8-way
REC. 1	
REC. 2	
REP. 1	
REP. 2	
S-3	SPDT
S-5	SPST
S-6	SPST
S-7	SPST
S-8	SPST
S-9	SPST
S-10	SPST
S-11	SPST
S-12	SPST
S-13	SPST
S-14	6P3pos.
S-15	SPST
T-5	



line schematic

\*NO, Normally Open  
†NC, Normally Closed

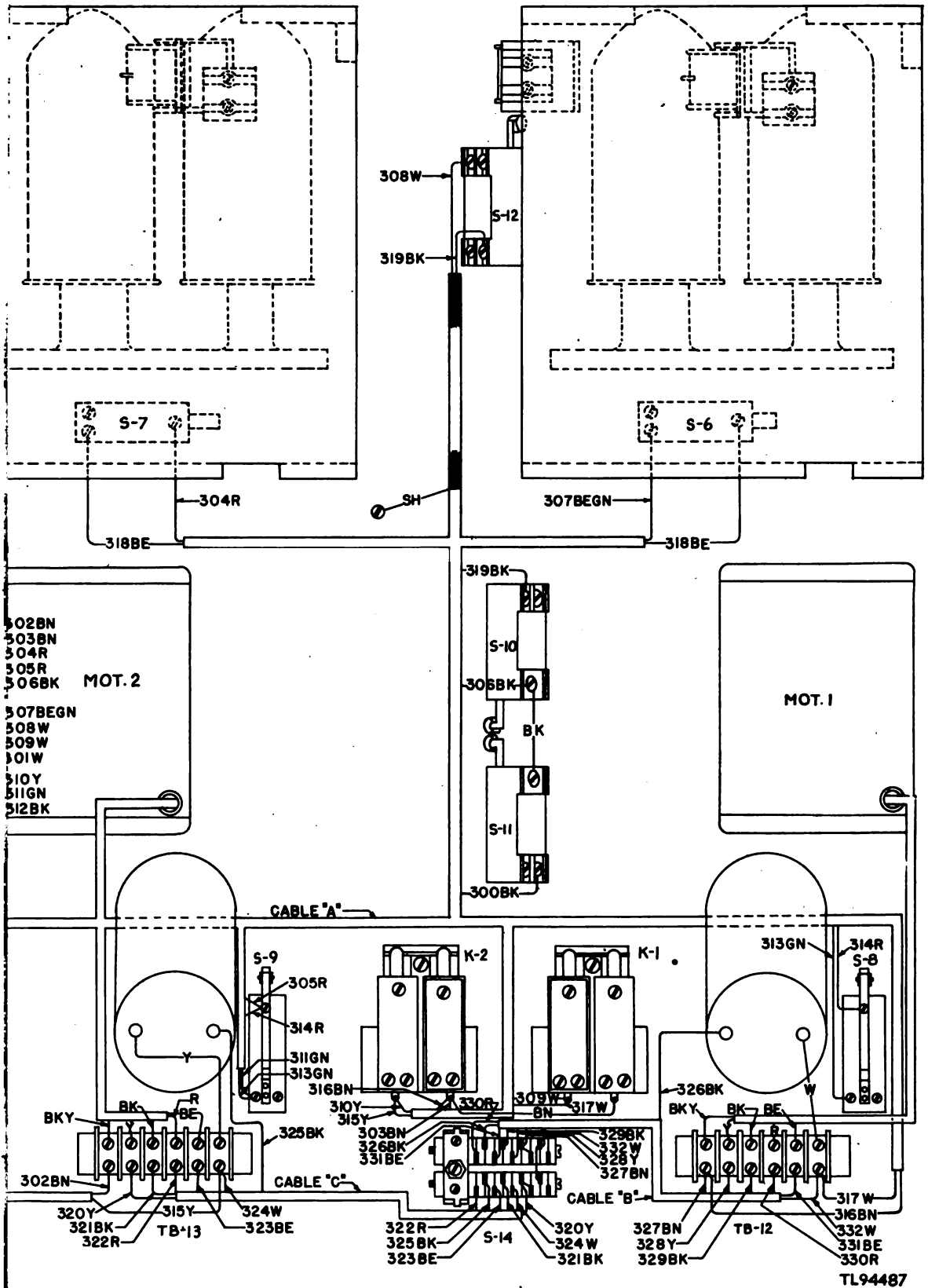




TL94486







ictorial — power



## 85. BACKSPACER (Fig. 45).

**a. Removal.** (1) Remove the backspacer rack (38) by removing screw (37) and the two screws (43).

(2) Remove the backspacer spring (35) by unhooking it from backspacer pawl spring bracket (34) and backspacer pawl (39).

(3) Unless backspacer spring (35) needs replacement, leave it hooked to backspacer pawl (39).

**CAUTION: WHEN REMOVING BACKSPACER PAWL ADJUSTING SCREW (41) BE VERY CAREFUL NOT TO LOSE THE SPACER DIRECTLY UNDER THE HEAD OF THE SCREW.**

(4) Remove screw (41) and the spacer beneath it, and lift the backspacer pawl (39) off the reproducer carriage.

**b. Installation.** Install the backspacer mechanism by following the removal procedure in the reverse order.

**c. Adjustment.** (1) Loosen the three backspacer rack mounting screws, one (37) at the left-hand end of the rack and two (43) at the right-hand end of the rack, and adjust backspacer rack (38) so that it is parallel to the travel of the carriage.

(2) Adjust backspacer rack (38) so that it is within  $\frac{1}{32}$  inch of the reproducer mount bracket (42), at the right-hand end of the backspacer rack (38) and also at the left-hand end of the backspacer rack (38).

(3) Place the reproducer carriage control lever (36) in the "neutral" position and move the reproducer carriage to its extreme left and right-hand positions, testing for this clearance between backspacer rack (38) and reproducer mount bracket (42).

(4) Although  $\frac{1}{32}$  inch is the recommended clearance between the teeth on the backspacer rack (38) and the reproducer mount bracket (42), this clearance may vary from  $\frac{1}{32}$  inch maximum to  $\frac{1}{64}$  inch minimum and still provide satisfactory operation.

(5) Uniform clearance between backspacer rack (38) and reproducer mount bracket (42) is necessary, to maintain uniform backspacing from one end of the backspacer rack to the other.

(6) To adjust the backspacer mechanism, remove the effect of backspacer pawl spring (35) by removing it from bracket (34).

(7) Loosen screw (41) and push backspacer

pawl (39) to the right as far as possible. Then tighten screw (41), temporarily.

(8) Holding the reproducer carriage firmly, hold backspacer pawl (39) to the left (to simulate the normal effect of backspacer pawl spring (35) which has been temporarily disconnected), and place the reproducer carriage control lever (36) in the "operate" position. This should result in no backspace action.

**CAUTION: THE NEXT ADJUSTMENT MUST BE MADE VERY CAREFULLY.**

(9) Holding the reproducer carriage and backspacer pawl (39), loosen screw (41). During this adjustment be careful that the teeth in the backspacer pawl (39) engage the teeth in the backspacer rack (38) squarely, and that the backspacer pawl (39) is parallel with the rack (38).

(10) In loosening screw (41), loosen it only slightly, allowing it to remain snug enough to afford movement of the backspacer pawl (39) when the latter is tapped lightly with a screwdriver bit.

(11) Backspacer pawl (39) should be moved to the left  $\frac{1}{64}$  inch by this tapping operation. Retighten screw (41) and move reproducer carriage control lever (36) to its "operate" position and test for backspace.

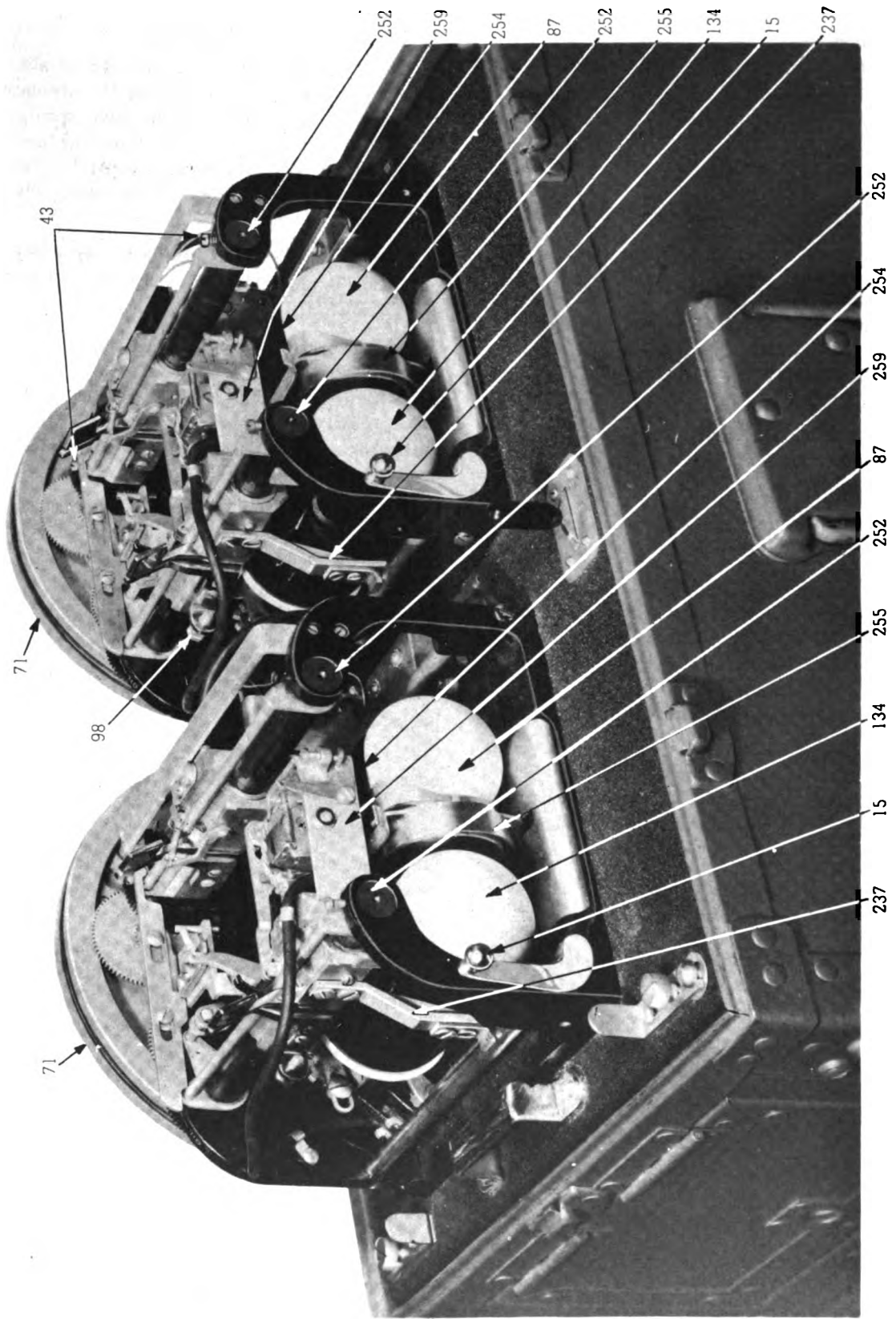
(12) If the backspace operation is obtained, connect spring (35) to spring bracket (34) and operate reproducer carriage control lever (36). This should provide a  $\frac{1}{64}$ -inch backspace.

(13) The pitch of the teeth in the backspacer pawl (39) is 64 (i.e. from the tip of one tooth to the tip of the next tooth is  $\frac{1}{64}$  inch).

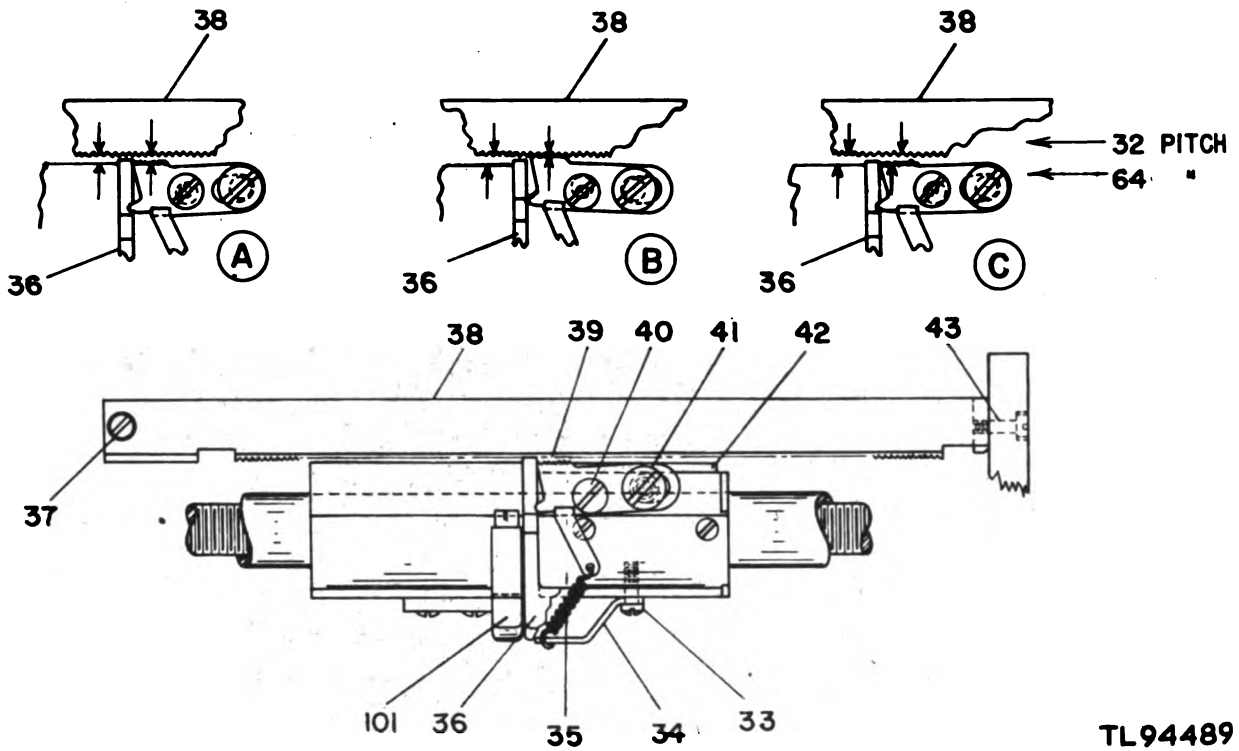
(14) The pitch of the teeth in the backspacer rack (38) is 32, (i.e. from the tip of one tooth to the tip of the next tooth is  $\frac{1}{32}$  inch). Therefore, one backspace operation backspaces  $\frac{1}{2}$  of one tooth on the backspacer rack (38).

(15) Should the backspacer adjustment be unsatisfactory, unhook spring (35) from spring bracket (34) and readjust. Then replace spring (35) and test again for proper backspace operation. Repeat this procedure until normal backspace operation is obtained.

(16) In adjusting spring bracket (34) for proper operation, it should be positioned to hold the backspacer pawl (39) away from the backspacer rack (38) and should also pull the backspacer pawl (39) to the left, so that the backspacer



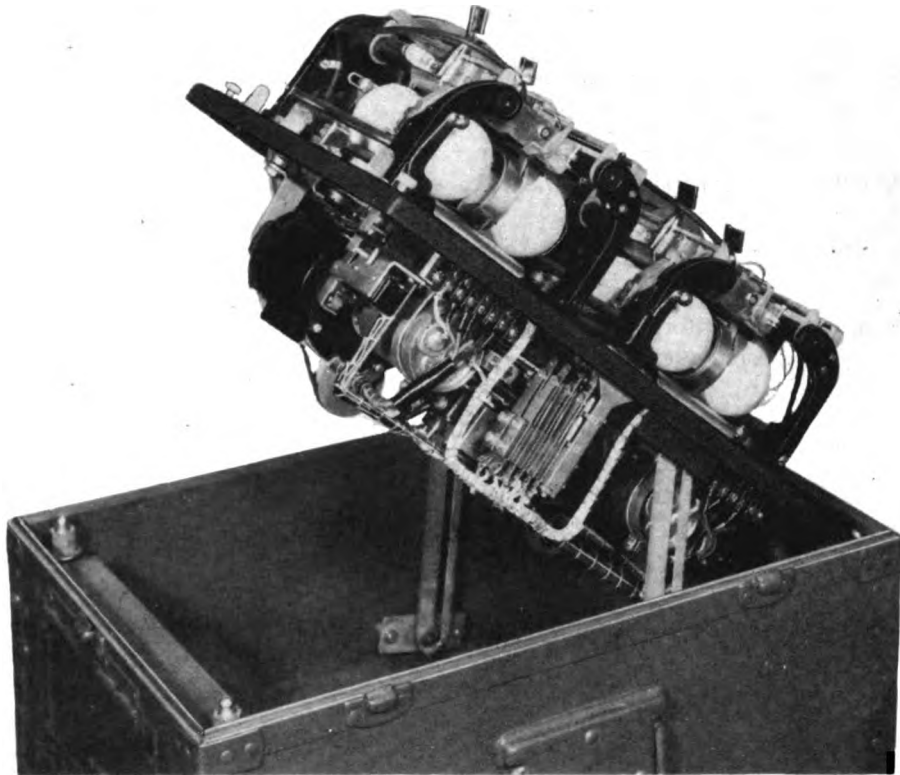




TL94489

Figure 45. Backspacer assembly

Reference No.	Description
33	Backspacer pawl spring bracket mounting screw
34	Backspacer pawl spring bracket
35	Backspacer pawl spring
36	Carriage control lever
37	Backspacer rack holding screw (LH)
38	Backspacer rack
39	Backspacer pawl
40	Backspacer pawl holding screw
41	Backspacer pawl adjusting screw
42	Reproducer mount bracket
43	Backspacer rack holding screw (RH)
101	Reproducer carriage control lever stop
242	Backspacer assembly, complete



TL 94490

*Figure 46. Unit plate raised*

pawl (39) will be ready for the next backspace operation.

(17) The backspacer spring (35) should create tension in a direction towards the front and towards the left.

(18) Adjust spring bracket (34) by loosening screw (33) and rotating spring bracket (34), either clockwise or counterclockwise until the tension of spring (35) is such that after a backspace operation has been completed and, with the reproducer carriage control lever (36) in the "operate" position, the backspacer pawl (39) will be away from the backspacer rack (38), with about  $\frac{1}{64}$  inch clearance.

(19) Place reproducer carriage control lever (36) in the "neutral" and observe that the backspacer pawl (39) moves to the left, to be ready for the next backspace operation.

**CAUTION: BE SURE THAT ALL SCREWS ARE TIGHT AND THAT REPRODUCER PAWL HOLDING SCREW (40) IS ALSO TIGHT. SCREW (40) PREVENTS EXCESSIVE VERTICAL TRAVEL OF THE BACKSPACER**

**PAWL (39) DURING THE OPERATION OF THE BACKSPACER MECHANISM.**

**d. Test.** (1) Make the following three-point test to determine whether or not the backspacer mechanism is properly adjusted.

(2) Move the reproducer carriage to the extreme right-hand limit of its travel and, placing a scale on the backspacer rack (38), operate the reproducer carriage control lever (36) four times and observe that the reproducer carriage moves to the left  $\frac{1}{16}$  inch (i.e.  $\frac{1}{64}$  inch per backspace, or 4 backspaces per  $\frac{1}{16}$  inch).

(3) Place the reproducer carriage  $\frac{1}{2}$  inch from its extreme left-hand position and repeat the test described in sub paragraph d (2) above.

(4) Place the reproducer carriage in its extreme left-hand position and operate the reproducer carriage control lever (36) and note that there is no excess binding and that the teeth of the backspacer pawl (39) operate on a portion of the backspacer rack (38) where there are no teeth, thereby producing no backspacing or jamming.



## 86. CARRIAGE HOUSINGS (figs. 54, 61, and 64).

NOTE: See CAUTION in paragraph 83b.

a. **Removal.** (1) Remove the mount bracket assembly as explained in paragraphs 101a. and 106a.

(2) Remove the feed screw assembly as explained in paragraph 92a.

(3) After the feed screw assembly has been removed, lift the carriage housing out of the machine, being careful to properly guide the bail which the carriage control lever (36) engages.

b. **Disassembly.** (1) In the case of the recorder carriage, remove the recorder carriage guide by removing the two screws (213) in fig. 61).

(2) In the case of the reproducer carriage, remove the reproducer carriage guide by removing the two screws (213) in fig. 61).

(3) Remove the carriage control lever stop ((95) in fig. 54-A) and ((101) in fig. 54-B) by removing the two screws (96).

(4) Remove the two screws ((37) in fig. 54).

(5) Slide right-hand carriage body (93) off of left-hand carriage body (99). The sleeve for right-hand carriage body (93) is an integral part of left-hand carriage body (99).

(6) Slide carriage control lever (36) off the carriage housing assembly.

### c. Reassembly.

**CAUTION: BE SURE THAT ALL PARTS ARE CLEAN BEFORE PROCEEDING WITH THE REASSEMBLY.**

Reassemble the carriage housings by following the disassembly procedure in the reverse order, but do not tighten screws (37), and do not replace the carriage guide until after adjustment.

d. **Installation.** Install the carriage housing by following the removal procedure in the reverse order, making sure that the bail operated by the carriage control lever, is resting in its approximate normal position.

e. **Adjustment.** (1) Rotate right-hand carriage body (93) first in one direction and then the other, finally placing it at a point mid-way between these limits of rotational travel.

(2) Move left-hand carriage body (99) towards right-hand carriage body (93) until the carriage

control lever (36) binds (i.e. does not operate freely), when not engaging the feed nut.

(3) By moving carriage control lever (36) to the right or to the left slightly, left-hand carriage body (99) will move towards the left slightly, allowing sufficient clearance for the carriage control lever (36) to operate freely.

(4) Maintaining this lateral adjustment, rotate left-hand carriage body (99) first in one direction and then the other, finally placing it at a point mid-way between these limits of rotational travel.

(5) Tighten screws (37).

(6) Install carriage guide and adjust as explained in paragraphs 100 and 105.

(7) Check the left-hand margin on the record; it should be  $\frac{1}{8}$ ". Readjust left-hand limit stop screw (98) if necessary.

## 87. CHANGE-OVER ASSEMBLY (fig. 48).

a. **Removal.** (1) Disconnect the 115/230-volt, 50/60-cycle power supply from the equipment.

(2) Disconnect the wiring to the change-over switches (3).

(3) Remove the two screws (45) and the two spacers (46).

(4) Lift the change-over assembly mounted on plate (47) out of the machine.

b. **Disassembly.** (1) Remove the slide members (6) and (7) by removing the two screws (48) and the two spacers (44).

(2) Remove spring (8) by disconnecting it from slide members (6) and (7).

(3) Remove the two change-over switches (3) by removing the four screws (49) and the four lock-washers (50).

c. **Reassembly.** Reassemble the change-over assembly by following the disassembly procedure in the reverse order.

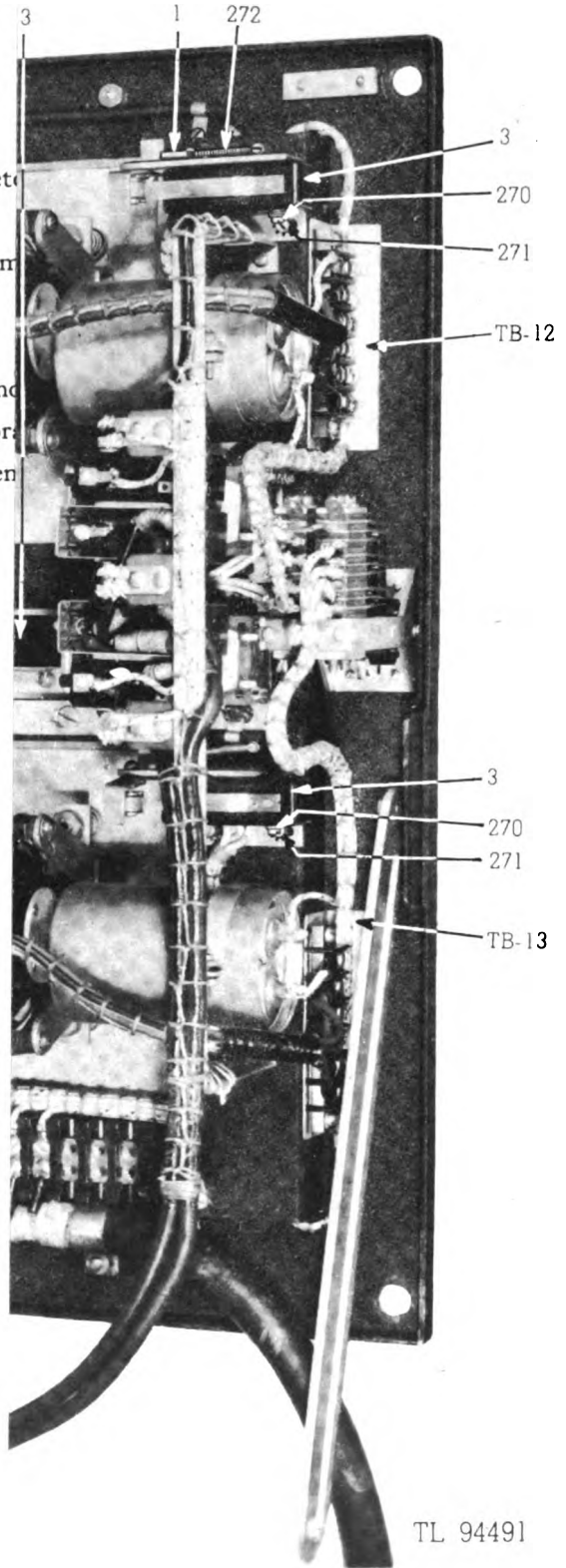
d. **Installation.** Install the change-over assembly by following the removal procedure in the reverse order.

e. **Adjustment.** (1) There are two adjustments to be made on the change-over assembly. First, "overlap time at change-over", and second, "equalization".

(2) Loosen screws (45) and adjust the change-over mounting plate (47) so that screws (45) are in the center of the slide holes in the mounting plate (47). Retighten screws (45).

**Reference No.**

- 1      **Change-over actuating lever**
- 3      **Change-over switch**
- 3      **CHANGE RECORD switch**
- 4      **Change-over assembly, complete**
- 187    **Motor (MC-502)**
- 248    **Reduction pulley assembly, complete**
- 249    **Motor drive belt**
- 250    **Flywheel drive belt**
- 270    **CHANGE RECORD switch motor**
- 271    **CHANGE RECORD switch bracket**
- 272    **Change-over actuating lever tensioner**
- 273    **Motor (MC-502) drive pulley**
- TB-12 **Motor terminal block (front)**
- TB-13 **Motor terminal block (rear)**



TL 94491

*m of unit plate*



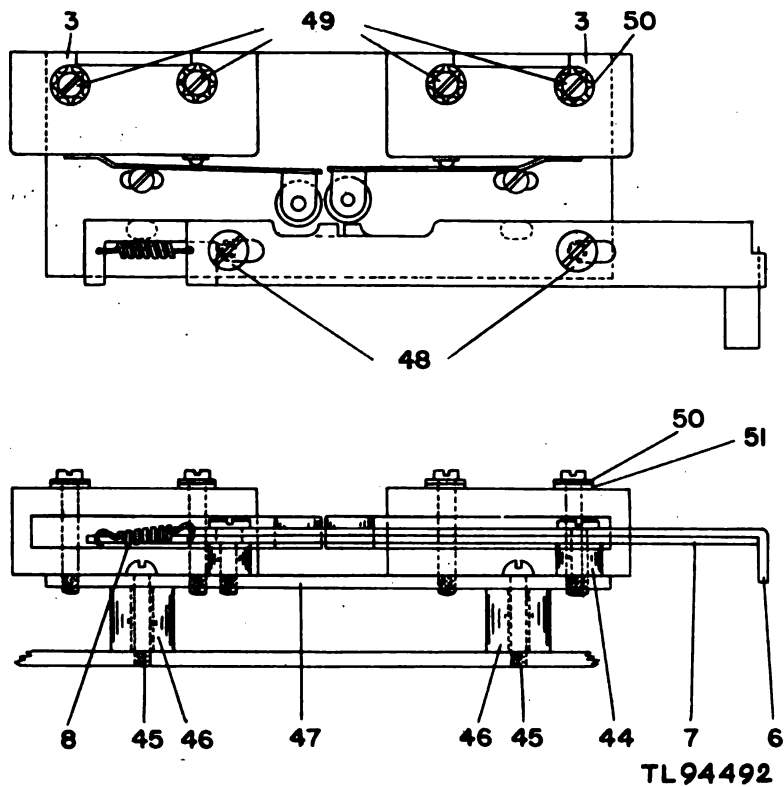


Figure 48. Change-over assembly

Reference No.	Description
3	Change-over switch
6	Change-over assembly sliding member for front machine
7	Change-over assembly sliding member for rear machine
8	Change-over assembly sliding member spring
44	Change-over slide member spacer
45	Change-over slide assembly holding screw
46	Change-over slide assembly spacer
47	Change-over slide assembly mounting plate
48	Change-over slide member holding screw
49	Change-over switch mounting screw
50	Change-over switch mounting screw lockwasher
51	Change-over switch mounting screw washer
4	Change-over assembly, complete

- (3) Loosen the four change-over switch screws (49) so that there will be no action of the change-over switches (3) on slides (6) and (7), and the slides can be tested for freedom of movement.
- (4) Be sure that the slides (6) and (7) operate freely on their mounting screws (48), and that when slide (7) is held in the extreme left-hand position, slide (6) can be pulled to its extreme right-hand position.
- (5) Then, due to the action of spring (8), slide (6) should move back again to a position against slide (7), which in the meantime had been held to its extreme left-hand position.
- (6) Reverse this procedure, testing the action of slide (7) when holding slide (6) in the extreme right-hand position, and forcing slide (7) to the left-hand position, so that that spring (8) will restore slide (7) to the extreme right-hand position.
- (7) With both slides (6) and (7) in the extreme right-hand position, adjust right-hand change-over switch (3) so that its roller engages the projection on slide (7).
- (8) Adjust further until an audible click in right-hand change-over switch (3) is heard, and tighten the two screws (49) to retain this adjustment.
- (9) Move both slide members (6) and (7) to the extreme left-hand position, and repeat the procedure described in the preceding paragraphs, on the left-hand change-over switch (3).
- (10) Should adjustments be necessary beyond that obtainable by adjusting with screws (49), using pliers or spring bending tool, bend the change-over switch actuating arm to the desired position.
- (11) To test this entire assembly, hold slide (6) in the extreme right-hand position, and while holding it there, force slide (7) to its extreme left-hand position. This should cause the right-hand change-over switch (3) to make an audible click, thus opening the motor circuit on the rear machine.
- (12) Follow this same procedure in reverse order by holding slide (7) to the extreme left-hand position and sliding slide (6) to the extreme right-hand position. This should cause the left-hand change-over switch (3) to make an audible click, and open the circuit of the motor on the front machine.
- (13) Should the spring (8) fail to operate either slide lever, when making this test it indicates that the adjustment on the change-over switch (3) has been excessive. Therefore, loosen screws (49) holding whichever switch (3) is involved and move that switch (3) away until a satisfactory operation is obtained.
- (14) To further check the timing of this assembly, slide both slide members (6) and (7) together very slowly, and before sliding these members towards the left-hand extreme position, observe that the right-hand change-over switch (3) does not click until after the left-hand change-over switch (3) has clicked.
- (15) Further travel of the two slides (6) and (7) will cause the right-hand change-over switch (3) to click, opening the motor circuit of the rear machine.
- (16) Reverse the above procedure to test the operation of the left-hand switch (3).
- (17) Push slide members (6) and (7) together to either the right or left extreme positions.
- (18) Lower the unit plate and install a recording belt on each dual recording-reproducing machine unit.
- (19) Place both recorder carriages near their right-hand limit of travel.
- (20) Plug in the power supply cable and make the following test under power, with motors running.
- (21) Note when the change-over operation begins to take place, and time the period during which both machines are in operation.
- (22) This is the "overlap time at change-over" during which both change-over switches (3) have been operated because of their being in their intermediate position, half-way between the right and left extreme positions.
- (23) This time of operation, "overlap" or "change-over" time, for both machines, should be approximately 10 to 15 seconds for a 15-minute record and 20 to 30 seconds for a 30-minute record. Adjust the change-over switches (3) until such change-over timing is obtained.
- (24) Check the above procedure in the reverse order, changing over from the rear to the front machine if the first check was made by changing over from the front to the rear machine.
- (25) It is desirable that the pin (2) in fig. 19) on the recorder carriage on each machine operates the change-over mechanism at approximately the same distance from the extreme right-hand limit of travel. This is accomplished by changing the position of the entire change-over assembly which is mounted on plate (47), to the right or to the left.

(26) This is called the "equalization" adjustment on the change-over assembly. This adjustment is made by adjusting the position of plate (47) through the medium of screws (45). This will not disturb the previous adjustments made for "overlap" timing.

### **88. CONTROL LEVER INTERLOCK** (figs. 24, 49, and 52).

**a. Removal.** (1) Have a recording belt on the machine, and both carriage control levers (36), recorder and reproducer, in the "neutral" position.

(2) Remove the two screws which are inserted through mounting holes (53) in fig. 49) and remove the control lever interlock assembly from the machine.

**NOTE:** It may be necessary to push interlock intermediate lever (11) out of the way to get at the mounting screw in right-hand mounting hole (53).

**b. Disassembly.** (1) Remove lock lever spring (58) from pin (59) and remove lock lever (12) by removing its holding screw (52).

(2) Remove the two screws (52) to remove the slide bar (10).

(3) Remove interlock intermediate lever (11) by removing its holding screw (54).

**c. Reassembly.** Reassemble the control lever interlock assembly by following the disassembly procedure in the reverse order.

**d. Installation.** Install the control lever interlock assembly by following the removal procedure in the reverse order.

**e. Adjustment.** (1) Pull forward on the ejector control handle (15) in fig. 24) to lock the idler mandrel in position for ejecting a recording belt, but do not pull the control lever (15) far enough to trip the ejector mechanism.

(2) The operation described in the preceding paragraph consists of pulling control lever (15) forward; actuating link (16), and subsequently stud (13) move towards the rear of the machine; ejector lock release lever (17) moves towards the rear just far enough to allow lock release lock lever (18) to move to the right to lock release lever (17), and subsequently stud (13), in its normal position for the ejection and injection of a recording belt.

(3) This places stud (13) in the position where the control interlock must prevent the operation of the carriage control levers.

(4) With interlock intermediate lever holding screw (54) in fig. 49) loose, move interlock intermediate lever (11) forward, thus moving the front end of lock lever (12) down towards stud (13).

**CAUTION: DURING THIS OPERATION, BE SURE THAT LOCK LEVER (12) DOES NOT CATCH ON ACTUATING LINK (16) BUT GOES ALL THE WAY DOWN TO STUD (13).**

(5) With interlock intermediate lever adjustment screw (55) loose, push lower lever (56) in interlock intermediate lever assembly (11), forward as far as it will go, against slide bar (10) in the position shown in figure 24.

(6) Tighten interlock intermediate lever adjustment screw (55) and make a preliminary test by operating ejector control lever (15) a number of times to be sure that there is no bind between the camming surface of lock lever (12) and stud (13).

(7) If there is a bind, remove the recording belt; place the injector-ejector mechanism in the "injected" position, and, holding the idler mandrel with the thumb, allow the idler mandrel to come back slowly to the point where binding occurs.

(8) At this point, tap the top of lock lever (12) lightly, to slip the two sections of interlock intermediate lever (11).

(9) Release the idler mandrel slowly, with the thumb, and if the bind has been removed, tighten interlock intermediate lever holding screw (55).

(10) For a final test, place a recording belt in position on the machine, move the forward end of lock lever (12) down towards stud (13) by pulling forward on the right-hand end of interlock intermediate lever (11) and check for freedom of intermediate lever (11) operation.

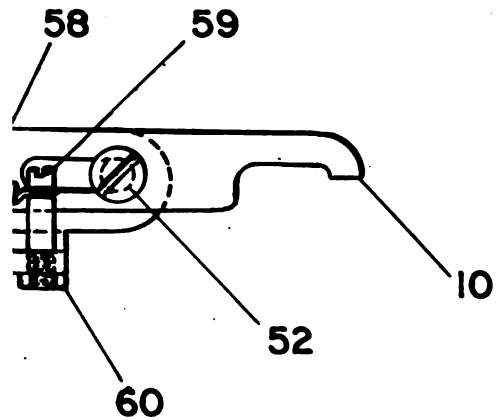
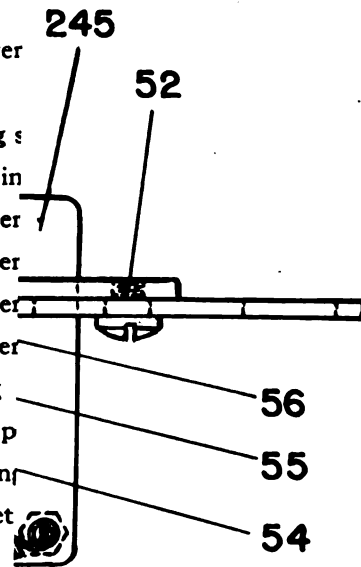
(11) If there is a slight bind in interlock intermediate lever (11), it can be relieved by a light sharp tap between interlock intermediate lever holding screw (54) and the end of lock lever (12) adjacent to intermediate lever (11).

**CAUTION: EVERY TIME INTERLOCK INTERMEDIATE LEVER ADJUSTMENT SCREW (55) IS TURNED, CHECK TO SEE THAT THERE HAS BEEN NO CHANGE IN THE RELATIVE POSITION OF LOWER LEVER (56) AND UPPER LEVER (57).**



**Reference No.**

- 10 Control interlock slide bar
- 11 Control interlock intermediate lever
- 12 Control interlock lock lever
- 52 Control interlock slide bar holding s
- 53 Control interlock assembly mountin
- 54 Control interlock intermediate lever
- 55 Control interlock intermediate lever
- 56 Control interlock intermediate lever
- 57 Control interlock intermediate lever
- 58 Control interlock lock lever spring
- 59 Control interlock lock lever spring p
- 245 Control interlock assembly mounting
- 244 Control interlock assembly, complet



52

TL94493

*r interlock assembly*





Reference No.	Description
15	Injector-ejector operating lever assembly, complete
36	Carriage control lever
95	Recorder carriage control lever stop
101	Reproducer carriage control lever stop
214	Machine cover knurled screw
230	Machine cover shoulder screw
256	Machine cover
257	Time indicator plate
262	Carriage control lever lock
263	Motor (MC-502) "Two-speed" switch

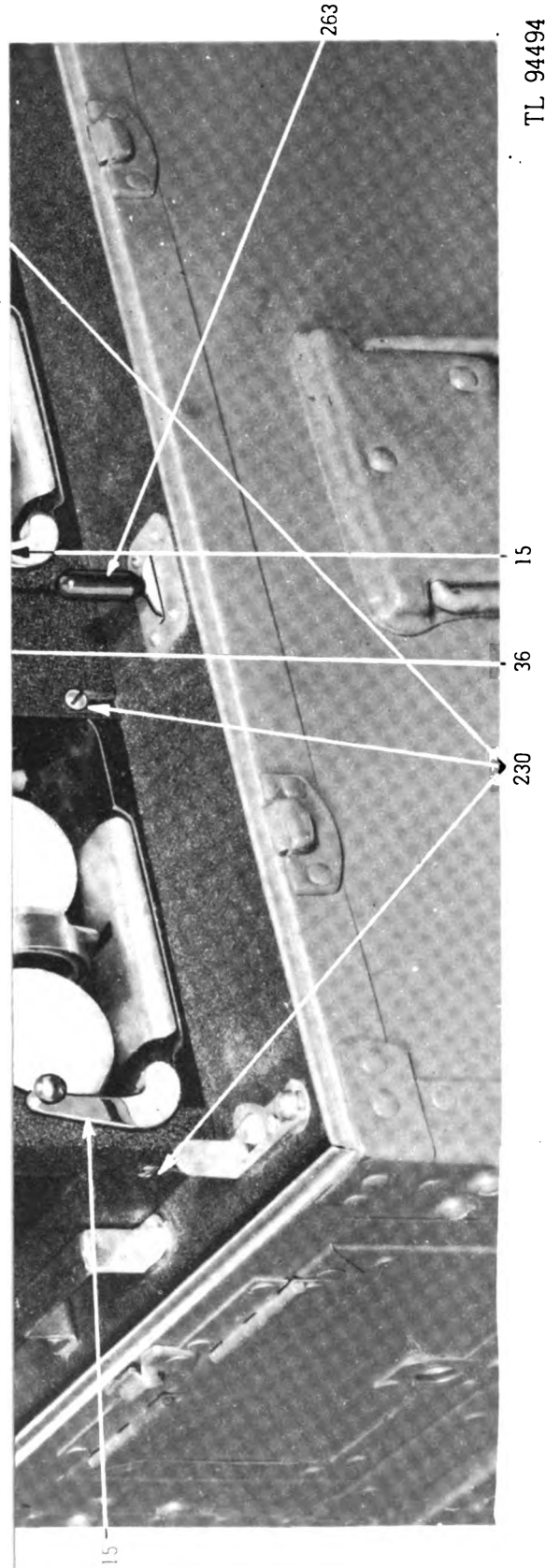


Figure 50. Top of equipment --- machine covers on

TL 94494

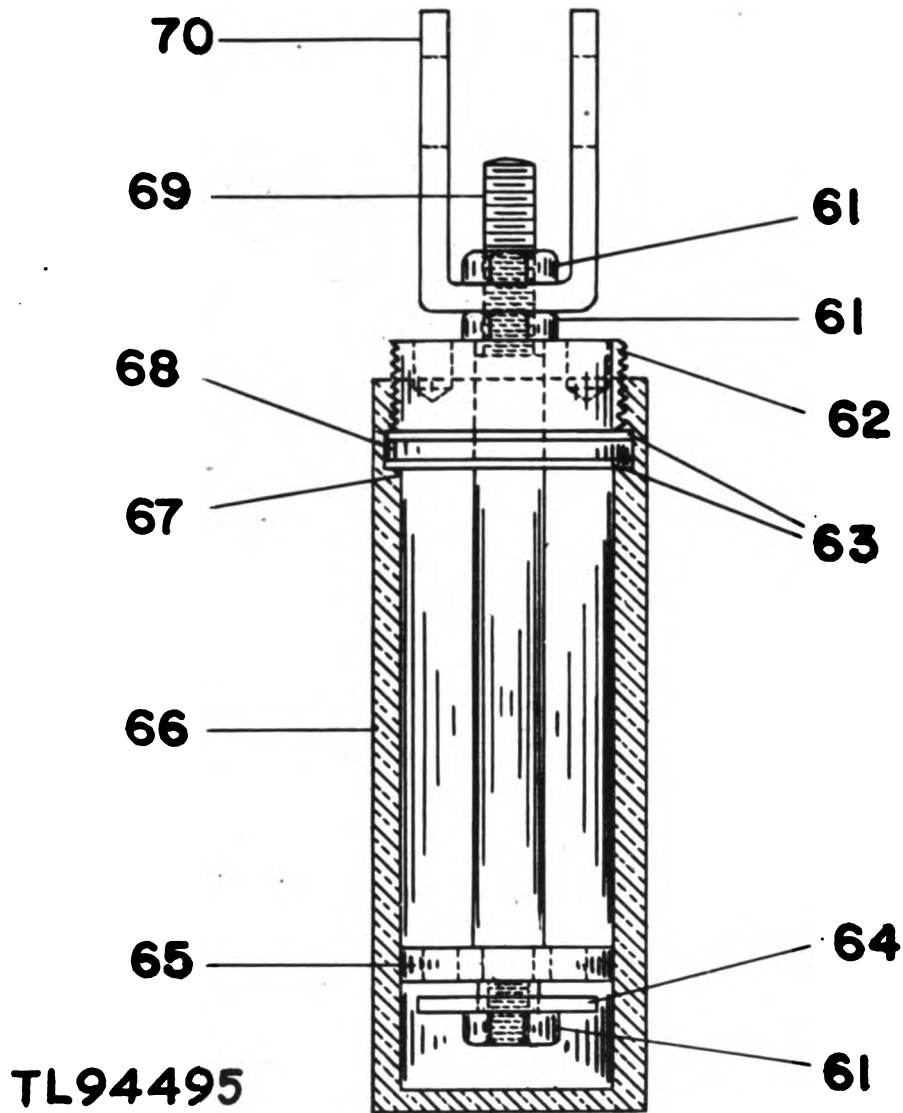


Figure 51. Dashpot assembly

Reference No.	Description
61	Dashpot piston yoke nut
62	Dashpot cylinder cap
63	Dashpot retaining washer
64	Dashpot piston check
65	Dashpot piston
66	Dashpot cylinder
67	Dashpot cylinder inside shoulder
68	Dashpot (Neoprene) packing washer
69	Dashpot piston rod
70	Dashpot piston yoke
246	Dashpot assembly, complete

(12) Adjusting interlock intermediate lever (11) with ejector control handle (15) pulled forward to place stud (13) in the position it normally occupies when the injector-ejector is in the ejected position, establishes a condition which prevents the recess in lock lever (12) from engaging stud (13), due to the interference between the camming surface on lock lever (12) and stud (13). This interference prevents the operation of either carriage control lever.

(13) Check to see that the control lever interlock operates properly under the three different conditions where it is designed to function. (See paragraph 56.)

### **89. DASHPOT ASSEMBLY (figs. 51 and 52).**

#### **a. Removal (figs. 51 and 52).**

**NOTE:** See CAUTION in paragraph 83b.

(1) Remove the control lever interlock assembly as explained in paragraph 88a.

**CAUTION: IN REMOVING THE DASHPOT ASSEMBLY, BE CAREFUL NOT TO BEND THE PISTON ROD (69) TO WHICH YOKE (70) IS ATTACHED.**

(2) Remove dashpot clamping screw (269) and its associated nut.

(3) Remove recorder carriage control lever connecting screw (231).

(4) By rotating the recorder carriage control lever (36) and bail assembly (9) in a counterclockwise direction (when looking at the ejector side of the machine), it will be easy to remove the dashpot yoke (70) from the actuating pin (185) on the recorder carriage bail assembly (9).

#### **b. Disassembly (fig. 51).**

**CAUTION: HOLD THE DASHPOT ASSEMBLY FIRMLY IN A VERTICAL POSITION WHILE PROCEEDING WITH THE FOLLOWING INSTRUCTIONS.**

(1) Loosen locknut (61) on bottom side of yoke (70).

(2) Remove nut (61) on top side of yoke (70).

(3) Remove yoke (70).

(4) Remove nut (61) on bottom side of yoke (70).

(5) Holding the dashpot assembly firmly in a vertical position, against a flat surface, a table top will do, remove cylinder cap (62), using the tips

of a pair of long nosed pliers. Insert the tips of the pliers in the two holes in cylinder cap (62) and remove cap (62) from cylinder (66).

(6) Using a small screwdriver, or any other fine pointed instrument, remove top washer (63), NEOPRENE washer (68), and bottom washer (63).

**NOTE:** To facilitate removal of top washer (63) pull piston rod (69) to its upper most position and move it from side to side to tip top washer (63) in one direction and then the other, to allow insertion of an instrument for its removal.

(7) Slide piston rod assembly carefully out of cylinder (66).

#### **c. Reassembly (fig. 51).**

**CAUTION: USE S.A.E. NO. 20 OIL ONLY IN THIS DASHPOT. TO USE ANY OTHER THAN S.A.E. NO. 20 OIL WILL NOT PROVIDE SATISFACTORY OPERATION.**

(1) Before reassembling, see that the oil level in cylinder (66) is about  $\frac{3}{16}$  inch below shoulder (67) on the inside of cylinder (66).

(2) Check the piston rod assembly before reinstallation, by making sure that nut (61) below piston check (64) is tight on the end of piston rod (69), and that piston (64) operates freely on bottom nut (61), in a direction to and from piston (65). In tightening bottom nut (61) be careful not to strip the threads.

**CAUTION: BE SURE THAT BOTTOM WASHER (63) IS INSTALLED ON PISTON ROD (69) BEFORE NEOPRENE WASHER (68) IS INSTALLED.**

(3) Push the piston rod assembly about half-way into the dashpot cylinder (66) and let bottom washer (63) seat against shoulder (67) on the inside of cylinder (66).

(4) Using a small screwdriver, gently work NEOPRENE washer (68) down into the recess below the threads in cylinder (66).

**CAUTION: DO NOT REPLACE NEOPRENE WASHER (68) WITH ANYTHING BUT A NEOPRENE WASHER. A RUBBER WASHER USED HERE WOULD DETERIORATE RAPIDLY.**

(5) Install top washer (63).

(6) Reinstall cylinder cap (62) and tighten with tips of a pair of long-nosed pliers, until this cap is

snug, being careful not to tighten too tightly, to avoid excessive twisting on the NEOPRENE washer (68).

(7) Install nut (61) below yoke (70) on piston rod (69) to a point approximately  $\frac{1}{32}$  inch from the shoulder on piston rod (69).

(8) Install yoke (70) and nut ((61) above yoke (70)) on piston rod (69). When installing yoke (70) tighten lower nut (61) to lock yoke (70) into position.

**CAUTION: BE CAREFUL NOT TO TIGHTEN LOWER NUT (61) TOO TIGHTLY, TO AVOID STRIPPING THE THREADS. BE CAREFUL NOT TO BEND THE PISTON ROD (69) DURING ANY OF THE ABOVE OPERATIONS.**

(9) Check the operation of the dashpot assembly by manually operating the piston rod (69) through its entire stroke, two or three times.

(10) There should be considerable resistance to the downstroke, due to dashpot action, and very little resistance to the up stroke, due to the lack of dashpot action.

**d. Installation (fig. 52).** Reinstall the dashpot assembly by following the removal procedure in the reverse order, but do not tighten screw (269).

**e. Adjustment (fig. 52).**

**CAUTION: TO PROPERLY ADJUST THE DASHPOT ASSEMBLY, BE SURE THAT THE RECORDER CARRIAGE CONTROL LEVER (36) IS IN THE "NEUTRAL" POSITION.**

(1) While holding the recorder carriage control lever (36) in the "neutral" position, move the dashpot assembly until the front edges of the slots in yoke (70) are resting against the actuating pin (185) on recording bail assembly (9).

(2) When the dashpot assembly is in its proper position, tighten screw (269).

**f. Test (fig. 52).** (1) With a recording belt on the machine, operate the recorder carriage control lever (36) to see that the dashpot operates satisfactorily.

(2) With reasonable pressure on the recorder carriage control lever (36) the dashpot should offer sufficient resistance to allow the recorder stylus to be presented to the record, slowly and smoothly.

(3) If such is not the case, readjust by loosening screw (269) slightly, and moving the dashpot assembly to the required position.

**90. DRIVE MANDREL (fig. 53).**

**a. Removal.** (1) Remove idler mandrel as explained in paragraph 95a.

(2) Unlock ejector mechanism by pressing in on ejector lock lever ((141) in fig. 58) with a screwdriver.

(3) Push the end of ejector lock lever (141) out of the way to allow for loosening upper injector-ejector holding screw (138).

(4) Rotate lock release lock lever ((18) in fig. 24) to the right and to the front, away from upper injector-ejector assembly holding screw (138) to make the latter accessible for loosening.

(5) Loosen the two injector-ejector mechanism holding screws (138) about two turns.

(6) With the flywheel retaining screw ((75) in fig. 53) and drive mandrel sleeve (76) removed, remove the drive mandrel assembly from the right-hand side of the machine, by cocking the injector-ejector assembly slightly forward. Remove spacers ((73) and (74)) and drive mandrel gear (72).

**b. Installation and Adjustment.** (1) Install drive mandrel, replacing drive mandrel spacer ((73) and (74)), drive mandrel gear (72), drive mandrel sleeve (76), and flywheel retainer screw (75). Do not replace flywheel (71).

(2) Loosen drive mandrel bushing setscrew, ((276) in fig. 44).

(3) Remove all the drive mandrel end play with right-hand adjusting nut (81), being careful to see that washer (83) is square, (or flat, against the face of the casting).

(4) Tighten left-hand adjusting nut (81).

(5) Tighten drive mandrel bushing setscrew (276), lightly.

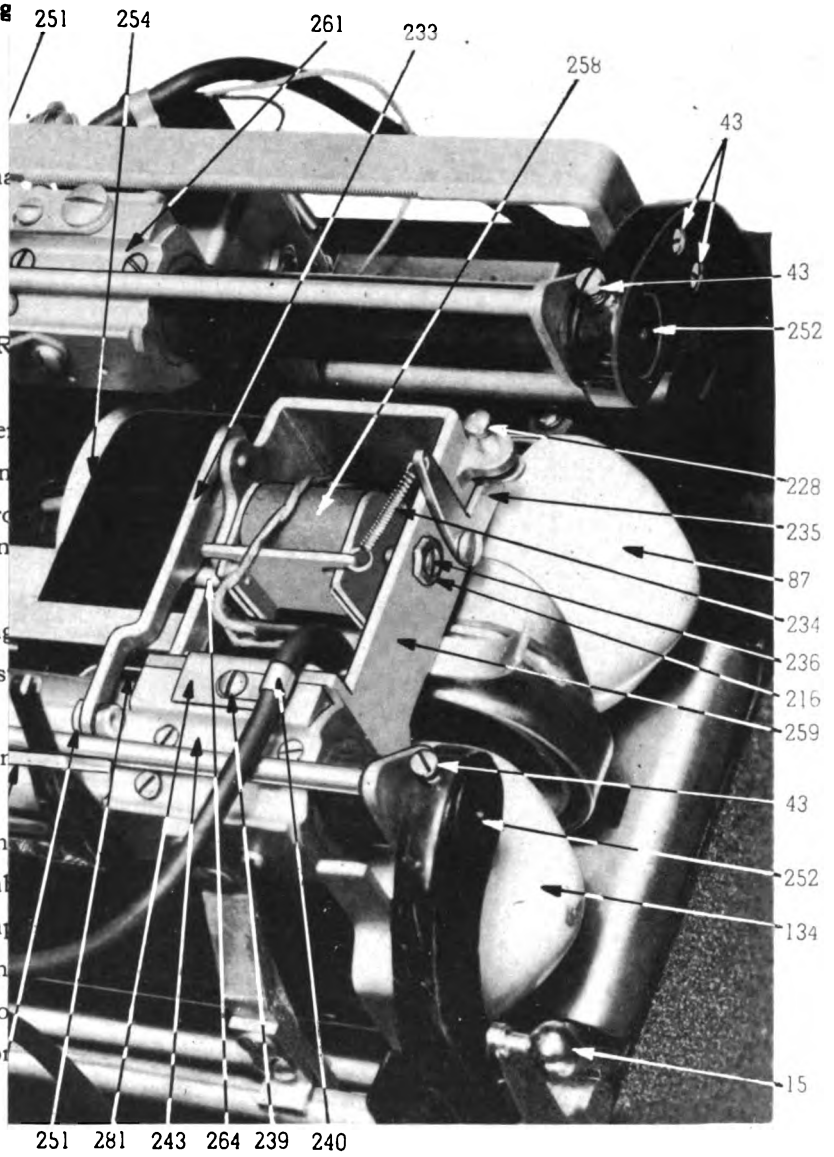
(6) Tap lightly on end of flywheel retaining screw (75) to properly seat beveled washer (82).

(7) Fully tighten drive mandrel bushing setscrew (276).

**CAUTION: EXCESSIVE TIGHTENING OF SETSCREW (276) WILL CAUSE DISTORTION OF DRIVE MANDREL SHAFT BUSHING.**

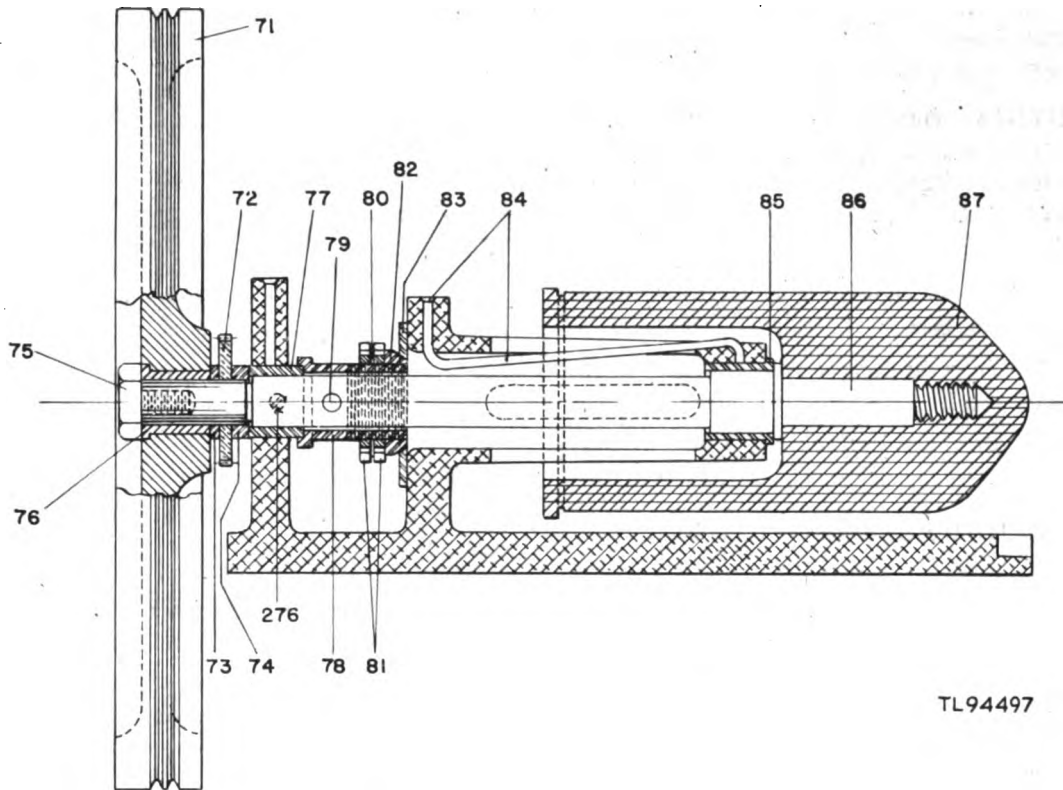
**Reference No.**

- 9 Recorder carriage bail ar
- 15 Injector-ejector operatin
- 36 Carriage control lever
- 37 Backspacer rack holding
- 43 Backspacer rack holding
- 70 Dashpot piston yoke
- 71 Flywheel
- 87 Drive mandrel
- 98 Recorder carriage left-ha
- 103 Feed screw gear
- 120 Gear train pinion gear
- 134 Idler mandrel
- 185 Recorder carriage bail R
- 186 READY switch
- 216 Recorder and reproduce
- 228 Reproducer pressure arr
- 231 Recorder carriage contro
- Reproducer carriage con
- 233 Recorder lift cam
- 234 Recorder pressure spring
- 235 Recorder pressure adjust
- 236 Recorder pivot screw
- 239 Recorder cable clamp ar
- 240 Recorder cable clamp
- 243 Recorder carriage assem
- 244 Control interlock assem
- 246 Dashpot assembly, comp
- 251 Feed nut assembly, com
- 252 Feed screw assembly, co
- 253 Gear train assembly, cor
- 254 Recording belt
- 258 Recorder
- 259 Recorder mount bracket
- 261 Reproducer carriage ass
- 264 Recorder lift cam roller
- 269 Dashpot cylinder clamp
- 281 Recorder terminal block



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Figure 53. Drive mandrel assembly

Reference No.	Description
71	Flywheel
72	Drive mandrel gear
73	Drive mandrel gear spacer (LH)
74	Drive mandrel gear spacer (RH)
75	Flywheel retaining screw
76	Drive mandrel sleeve
77	Drive mandrel shaft bearing (LH)
78	Drive mandrel end play adjusting sleeve
79	Drive mandrel shaft hole
80	Drive mandrel end play adjusting nut washer
81	Drive mandrel end play adjusting nut
82	Drive mandrel aligning spacer
83	Drive mandrel thrust washer
84	Drive mandrel shaft bearing (RH) oil tube
85	Drive mandrel shaft bearing (RH)
86	Drive mandrel shaft
87	Drive mandrel
276	Drive mandrel bushing setscrew



(8) Test the drive mandrel for freedom of operation. When properly adjusted, the drive mandrel rotates freely with a minimum of end play.

**CAUTION: BE SURE TO TIGHTEN INJECTOR-EJECTOR HOLDING SCREWS ((138) in fig. 58) BEFORE INSTALLING THE DRIVE MANDREL.**

(9) Return lock release lock lever ((18) in fig. 24) to its normal position.

(10) Return injector-ejector mechanism to the injected position.

(11) Install idler mandrel as explained in paragraph 95d.

## **91. FEED NUT ASSEMBLY (fig. 54).**

### **a. Removal.**

**NOTE:** See CAUTION in paragraph 83b.

Remove screws (88) and lockwashers (94), and lift the feed nut and spring assembly out of the machine.

**b. Disassembly.** Remove screws (90) and lockwasher (91).

**c. Reassembly.** Reinstall the two screws (90) and the lockwasher (91) and tighten temporarily. Be careful not to strip the threads.

**CAUTION: ON REASSEMBLY BE SURE THAT THE SIDE OF THE FEED NUT (92) WHICH HAS A STUD PROTRUDING ON THE INSIDE OF THE "U" SLOT, IS NEAREST THE BEND IN THE SPRING (89).**

**d. Installation.** Install the feed nut and spring assembly by following the removal procedure in the reverse order.

**CAUTION: BEFORE INSTALLING, INSPECT THE FEED NUT (92) FOR BURRS, DIRT, ETC.**

**e. Adjustment.** (1) Place the carriage control lever (36) in the "operate" or forward position.

(2) Loosen the two feed nut assembly screws (88).

(3) Loosen the two feed nut screws (90) and hold the feed nut (92) in against the feed screw so that the nut bottoms properly on the feed screw. Still holding the feed nut (92) in this position, tighten screws (90), one at a time. Be careful not to strip the threads.

(4) If feed nut (92) binds in the carriage slot, loosen the two screws (37) on the right-hand carriage body (93) and rotate carriage body (93) slightly to eliminate the binding. Tighten screws (37).

(5) While pressing in on feed nut (92), press on the screw (90) which is farthest away from screws (88), to tip the feed nut (92) slightly, in a direction away from screws (88). Tighten the screw (88) which is nearest feed nut (92). Then tighten the other screw (88).

(6) Test for movement of feed nut (92) by operating carriage control lever (36), which controls the movement of feed nut (92) to and from the feed screw.

(7) If binding persists on the right-hand carriage body (93), loosen the two screws (37), and move right-hand carriage body (93) to the right, slightly, so that feed nut (92) moves freely when actuated by carriage control lever (36). Tighten screws (37).

(8) Adjustments on carriage bodies (93) and (99) can be easily made by tapping lightly with a screwdriver handle or light leather mallet, to get the right amount of adjustment.

(9) If the foregoing adjustments are properly made, it should not be possible to "slip" the feed nut, (i.e. slide the carriage to the left with the feed nut in the engaged position with the recorder carriage control lever in the "operate" position).

## **92. FEED SCREW ASSEMBLY (figs. 44 and 55).**

**a. Removal (fig. 44).** (1) Remove the flywheel as explained in paragraph 93a.

(2) Remove the feed nut assembly as explained in paragraph 91a.

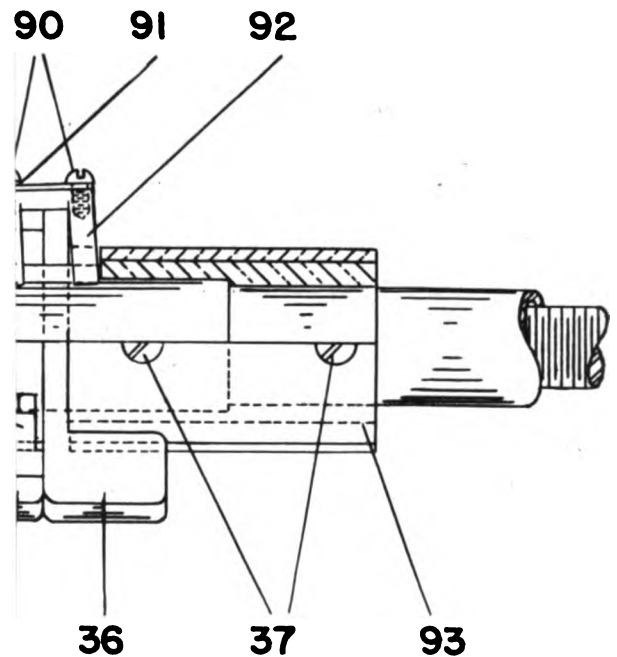
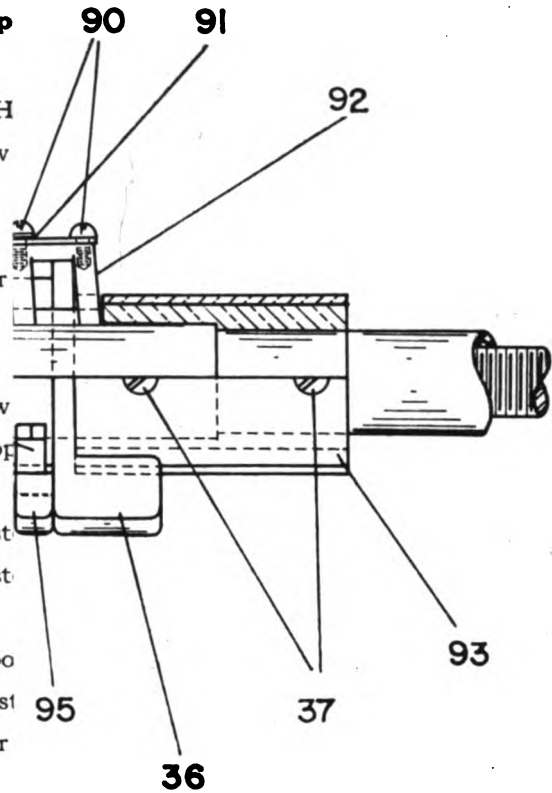
(3) Remove the gear train assembly as explained in paragraph 94a.

(4) Loosen the two setscrews ((43) in fig. 44), one at each end of feed screw assembly (252).

(5) Holding the carriage housing in the right hand, grasp feed screw gear (103) with the left hand slide feed screw assembly (252) toward the left, out of the machine.

**CAUTION: IN REMOVING THE FEED SCREW ASSEMBLY FROM THE MACHINE, BE CAREFUL NOT TO DROP THE CARRIAGE OR ANY OF THE OTHER PARTS, AGAINST THE MANDREL, OR AGAINST ANY**

Reference No.	Descrip
36	Carriage control lever
37	Backspacer rack holding screw (LH)
88	Feed nut assembly mounting screw
89	Feed nut spring
90	Feed nut holding screw
91	Feed nut holding screw lockwasher
92	Feed nut
93	Carriage body (RH)
94	Feed nut assembly mounting screw
95	Recorder carriage control lever stop
96	Carriage control lever stop screw
97	Recorder carriage left-hand limit st
98	Recorder carriage left-hand limit st
99	Carriage body (LH)
100	Recorder carriage time indicator po
101	Reproducer carriage control lever st
102	Reproducer carriage time indicator



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nd feed nut assembly



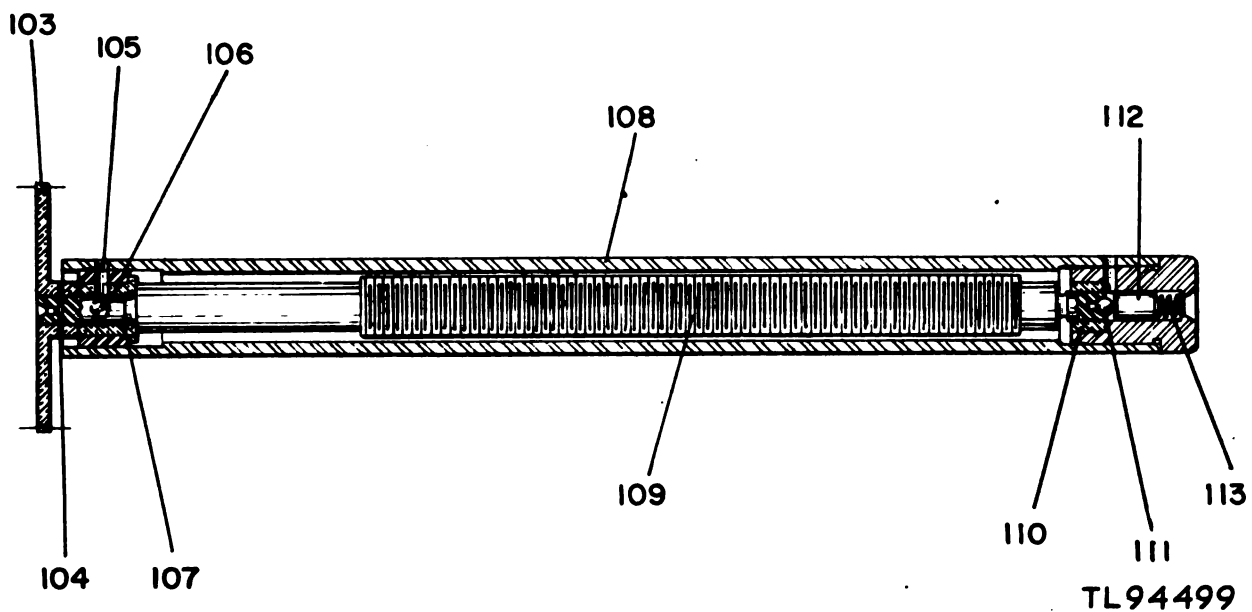


Figure 55. Feed screw assembly

Reference No.	Description
103	Feed screw gear
104	Feed screw gear pin
105	Feed screw bearing (LH) oil hole
106	Feed screw setscrew
107	Feed screw bearing (LH)
108	Feed screw cover
109	Feed screw
110	Feed screw bearing (RH)
111	Feed screw thrust ball
112	Feed screw plunger
113	Feed screw plunger spring
252	Feed screw assembly, complete

**PARTS OF THE MACHINE. HANDLE THE CARRIAGE CAREFULLY DURING THESE OPERATIONS. WHILE REMOVING THE FEED SCREW, BE CAREFUL TO KEEP ALL OF THE ASSOCIATED PARTS ALIGNED TO FACILITATE REMOVAL.**

b. **Disassembly (fig. 55).** Remove setscrew (106) and, holding the entire feed screw assembly vertically, with the gear (103) at the top, lift the feed screw and gear assembly out of the feed screw cover (108).

**CAUTION: WHEN DISASSEMBLING THE FEED SCREW ASSEMBLY, BE CAREFUL NOT TO DENT THE FEED SCREW THREADS ON THE FEED SCREW COVER.**

**NOTE:** This procedure will avoid dropping feed screw thrust ball (111), plunger (112), or spring (113), during disassembly.

c. **Reassembly (fig. 55).**

**CAUTION: WHEN REASSEMBLING THE FEED SCREW AND GEAR ASSEMBLY, BE CAREFUL NOT TO DENT THE FEED SCREW THREADS AGAINST THE FEED SCREW COVER. BE SURE THAT ALL PARTS ARE CLEAN PRIOR TO REASSEMBLY.**

(1) Inspect the feed screw and gear assembly, making sure that pin (104) is secure in its proper position; that bearing (107) rotates freely on feed screw (109), and that the oil hole (105) in bearing (107) is clean and not plugged with dirt.

**CAUTION: BE SURE THAT THE FLAT SURFACE ON THE END OF PLUNGER (112) IS ADJACENT TO THE THRUST BALL (111) AS SHOWN IN FIGURE 55.**

(2) If any dirt is found in the feed screw threads or any burrs are discovered thereon, reassemble the feed screw as explained below, in subparagraphs (9) and (10), disregarding the lubrication instructions.

(3) Using the feed nut as a die or thread cutter, hold the feed nut firmly by hand against the feed screw threads, making sure that the proper alignment between the feed nut and feed screw is

obtained, so that the feed nut threads will match the feed screw threads (i.e. the spring in the feed nut assembly should point toward the feed screw gear, when the feed nut properly held).

(4) Rotate the feed screw gear, thus causing the feed nut to feed along through the feed screw threads.

(5) Continue to rotate the feed screw gear so that the feed nut will pass through the burrs or dirty section, which may involve the entire length of the feed screw or possibly only a portion of it. It might be necessary to repeat this operation several times before a deep burr is removed.

**CAUTION: CAREFULLY REINSPECT THE FEED SCREW THREADS FOR BURRS AND NICKS.**

(6) Pack spring (113) and plunger (112) with a light grease when reassembling.

(7) Before reassembling the feed screw assembly, place a small amount of oil in the oil hole (105) and in bearing (107) and rotate the bearing by hand several times to be sure that the oil has completely surrounded the feed screw shaft.

(8) Oil the feed screw threads throughout its length by means of a cloth dipped in oil and rotate the feed screw while oiling the feed screw threads.

(9) Install the feed screw assembly in the feed screw cover (109), making sure that the tapped hole in bearing (107) is in line with the large clearance hole in the feed screw cover (108).

(10) Install setscrew (106). Be careful to see that this setscrew is tightened to a point where it does not protrude above the surface of the feed screw cover (108).

d. **Installation (fig. 44).** (1) Install the feed screw assembly by following the removal procedure in the reverse order.

(2) Guide the feed screw assembly carefully through the carriage bail assembly, the carriage assembly, and the machine casting and support.

(3) Hold all parts in their proper alignment so that this installation is not difficult (i.e. does not have to be forced) and make sure that there is no binding.

(4) Align the feed nut clearance slot in the carriage housing with the feed nut clearance slot in the feed screw cover, temporarily tightening screws (43) at each end of the feed screw cover (108).

**e. Adjustment (fig. 44).** (1) Adjust the feed screw assembly (252) by, loosening setscrews (43), at each end of the feed screw assembly (252). These screws secure the feed screw assembly (252) to the machine main frame casting.

(2) With the feed nut and carriage in place, rotate the feed screw assembly in one direction as far as it will go and then in the other direction as far as it will go.

(3) Now rotate the feed screw assembly to a point mid-way between the two limits of travel just established, and tighten setscrews (43).

(4) Make sure that the right-hand end of the feed screw assembly (252) is flush, or does not protrude beyond the right-hand support of the main casting more than  $\frac{1}{64}$  inch, before tightening setscrews (43).

**CAUTION: BE SURE THAT FEED SCREW GEAR (103) DOES NOT RUB ON PINION GEAR (120). IF THESE GEARS RUB, LATERAL ADJUSTMENT WILL BE NECESSARY, BECAUSE IF THEY ARE ALLOWED TO RUB, IT WILL RESULT IN POOR OR UNEVEN TONE GROOVE PITCH, WHICH WILL SUBSEQUENTLY CAUSE ECHO, SKIPPING, OR POSSIBLY FADING, IN REPRODUCTION.**

(5) Lateral adjustment is made by loosening setscrews (43) and sliding the feed screw assembly (252) to the right, being careful not to change the rotational adjustment established above.

(6) The clearance between the feed screw gear (103) and the pinion gear (120) should be approximately  $\frac{1}{16}$  inch. Now tighten setscrews (43).

### **93. FLYWHEEL (fig. 53).**

**a. Removal.** NOTE: See CAUTION in paragraph 83b.

**CAUTION: PLACE THE RECORDER AND REPRODUCER CARRIAGE CONTROL LEVERS IN THE "NEUTRAL" POSITION, AND PLACE THE INJECTOR-EJECTOR MECHANISM IN THE "EJECTED" POSITION.**

(1) Remove the flywheel drive belt from the flywheel (71). It is not necessary to completely remove the flywheel drive belt from the machine.

(2) Remove the flywheel retaining screw (75) with a wrench, while grasping the flywheel firmly by hand.

**NOTE: The flywheel retaining screw (75) has a left-hand thread.**

(3) Remove the drive mandrel sleeve (76) by sliding flywheel and sleeve partially off the drive mandrel shaft (86). Then slide the flywheel back towards the machine until the drive mandrel sleeve (76) is accessible for removal with the fingers.

(4) Remove flywheel (71) from drive mandrel shaft (86).

### **b. Installation and Adjustment.**

**CAUTION: WHEN REINSTALLING THE FLYWHEEL (71) BE SURE THAT SPACER (74) IS BETWEEN THE DRIVE MANDREL SHAFT GEAR (72) AND THE MAIN FRAME CASTING. THIS IS THE THICKER OF THE TWO SPACERS ADJACENT TO GEAR (72) AND MUST BE INSTALLED WITH ITS BEVELED SIDE ADJACENT TO DRIVE MANDREL SHAFT BEARING (77). THE THINNER SPACER (73) OF THE TWO (73) AND (74) IS INSTALLED ON THE OUTSIDE OR THE FLYWHEEL SIDE OF GEAR (72).**

**BE SURE THAT GEAR (72) IS MESHED WITH THE INTERMEDIATE GEAR ((119) IN FIG. 56) ON THE GEAR TRAIN ASSEMBLY, BEFORE ATTEMPTING TO INSTALL THE FLYWHEEL AND DRIVE MANDREL SLEEVE (76).**

**BE SURE THAT THE DRIVE MANDREL SHAFT (86) IS IN ITS EXTREME LEFT-HAND POSITION WHEN REINSTALLING THE FLYWHEEL (71). THIS IS ASSURED BY PUSHING TOWARDS THE LEFT ON THE DRIVE MANDREL (87).**

**WHEN THE FLYWHEEL IS INSTALLED PROPERLY, THE DRIVE BELT GROOVES ARE NEAREST THE INSIDE EDGE OF THE FLYWHEEL--NEAREST THE GEAR TRAIN.**

**IF AN ATTEMPT IS MADE TO INSTALL THE FLYWHEEL BACKWARDS, THERE IS A POSSIBILITY OF DAMAGING THE GEARS.**

**WHEN THE FLYWHEEL IS INSTALLED PROPERLY, THE COUN-**

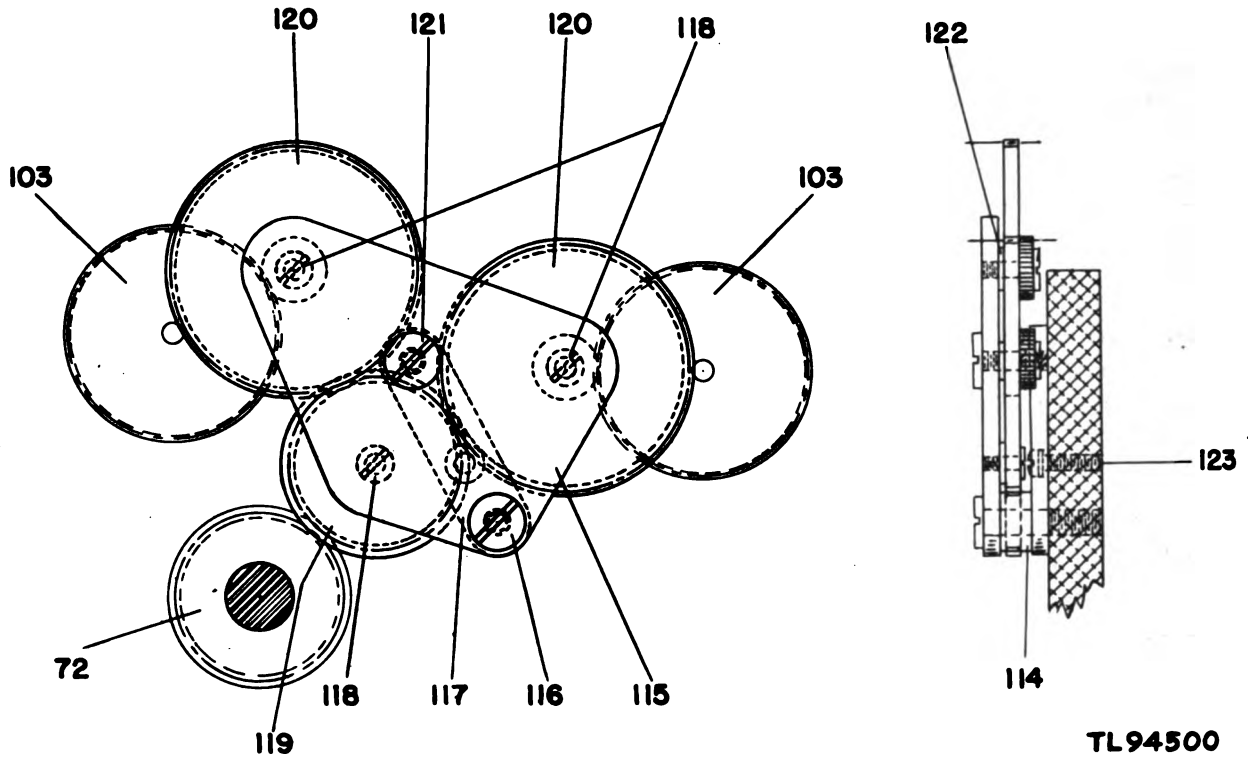


Figure 56. Gear train assembly

Reference No.	Description
72	Drive mandrel gear
103	Feed screw gear
114	Gear train assembly spacer (lower)
115	Gear train assembly mounting plate
116	Gear train assembly holding screw (lower)
117	Gear train assembly mounting strip
118	Gear train intermediate gear holding screw
	Gear train pinion gear holding screw
119	Gear train intermediate gear
120	Gear train pinion gear
121	Gear train assembly holding screw (upper)
122	Gear train assembly spacer (upper)
123	Gear train mounting strip holding screw
253	Gear train assembly, complete (MC-502).

**TER-BORED PORTION INTO WHICH THE FLANGE OF THE DRIVE MANDREL SLEEVE (76) FITS, IS TOWARD THE OUTSIDE, WHERE THE RETAINING SCREW (75) IS INSTALLED.**

- (1) Place flywheel in position on drive mandrel shaft (86).
- (2) Lifting the flywheel slightly, place drive mandrel sleeve (76) into place.
- (3) Reinstall retaining screw (75) remembering that **THIS IS A LEFT-HAND THREAD**. Do not tighten retaining screw (75) at this time.
- (4) While pressing on the drive mandrel (87) with the right hand, (to force the drive mandrel shaft (86) all the way to the left), tighten the flywheel retaining screw (75) with the fingers of the left hand.
- (5) Rotate the flywheel slightly, in a counterclockwise direction (i.e. counterclockwise when facing the flywheel side of the machine), making sure that the gears are properly meshed. Then, tighten flywheel retaining screw (75) with a wrench.
- (6) Rotate the flywheel in a counterclockwise direction and see whether or not it runs true.
- (7) If the flywheel does not run true, loosen retaining screw (75) and rotate the flywheel from 10° to 20°, holding the drive mandrel (87) stationary. Retighten retaining screw (75).
- (8) Rotate the flywheel again in a counterclockwise direction and see whether or not it runs true. Repeat the operation explained in paragraph 93b (7) until the flywheel runs true.
- (9) To reinstall the flywheel drive belt (250) as shown in figure 62, raise the unit plate to its open position.
- (10) To raise the unit plate, unlock the two catches located at front left and right of the top of the unit plate and lift the unit plate to its open position by lifting on the handle mounted at top front center of the unit plate. Support the unit plate on its two support arms.
- (11) Assuming that the flywheel drive belt (250) is still properly wrapped around the reduction pulley (166), make sure that the two strands of the flywheel drive belt continue in parallel, from the two grooves in the reduction pulley, to the rear of the flywheel. The portion of the flywheel drive belt in the outside groove of the reduction pulley should continue on into the outside groove of the flywheel.

(12) Guiding the two strands of the flywheel drive belt from the two grooves in the reduction pulley, around the grooves in the flywheel in a clockwise direction, continue to guide them entirely around the flywheel thus bringing the cross-over towards the front of the machine, between the flywheel and the reduction pulley, for proper operation of flywheel idler (164).

(13) If a new flywheel drive belt is to be installed, place the proper twist in the drive belt by suspending the drive belt in a normal manner on the fingers of the two hands with the fingers held in a vertical position. Twist the belt by rotating the fingers of either hand in a counterclockwise direction (when looking at the back of the hand). After making this twist, bring the two end loops of the belt together to form a double wrap belt with a cross-over, and proceed with the flywheel drive belt installation as outlined above.

(14) Check to see that flywheel idler (164) acts properly at the cross-over, and compare with figure 62.

#### **94. GEAR TRAIN ASSEMBLY (fig. 56).**

**CAUTION: IN PERFORMING THE FOLLOWING OPERATIONS BE SURE THAT THE CARRIAGE CONTROL LEVERS ARE IN THE "NEUTRAL" POSITION AND THAT THERE IS NO RECORDING BELT ON THE MACHINE. THE REASON FOR HAVING NO RECORDING BELT ON THE MACHINE AT THIS TIME IS TO AVOID HAVING ANY MISLEADING IDLER MANDREL LOAD ENTER INTO THESE ADJUSTMENTS.**

**a. Removal.** (1) Remove the flywheel as explained in paragraph 93a, leaving spacer (73) on the drive mandrel shaft (86) and replacing drive mandrel sleeve (76) and retaining screw (75) as shown in figure 53.

**CAUTION: IN PROCEEDING WITH THE REMOVAL OF THE GEAR TRAIN ASSEMBLY, DO NOT REMOVE THE SCREWS NOR THE SPACERS, BUT HOLD THE SCREWS, SPACERS, AND GEAR TRAIN ASSEMBLY TOGETHER, ON REMOVAL OR INSTALLATION, TO AVOID DROPPING PARTS DOWN INTO THE MACHINE.**



snug, being careful not to tighten too tightly, to avoid excessive twisting on the NEOPRENE washer (68).

(7) Install nut (61) below yoke (70) on piston rod (69) to a point approximately  $\frac{1}{32}$  inch from the shoulder on piston rod (69).

(8) Install yoke (70) and nut (61) above yoke (70) on piston rod (69). When installing yoke (70) tighten lower nut (61) to lock yoke (70) into position.

**CAUTION: BE CAREFUL NOT TO TIGHTEN LOWER NUT (61) TOO TIGHTLY, TO AVOID STRIPPING THE THREADS. BE CAREFUL NOT TO BEND THE PISTON ROD (69) DURING ANY OF THE ABOVE OPERATIONS.**

(9) Check the operation of the dashpot assembly by manually operating the piston rod (69) through its entire stroke, two or three times.

(10) There should be considerable resistance to the downstroke, due to dashpot action, and very little resistance to the up stroke, due to the lack of dashpot action.

**d. Installation (fig. 52).** Reinstall the dashpot assembly by following the removal procedure in the reverse order, but do not tighten screw (269).

**e. Adjustment (fig. 52).**

**CAUTION: TO PROPERLY ADJUST THE DASHPOT ASSEMBLY, BE SURE THAT THE RECORDER CARRIAGE CONTROL LEVER (36) IS IN THE "NEUTRAL" POSITION.**

(1) While holding the recorder carriage control lever (36) in the "neutral" position, move the dashpot assembly until the front edges of the slots in yoke (70) are resting against the actuating pin (185) on recording bail assembly (9).

(2) When the dashpot assembly is in its proper position, tighten screw (269).

**f. Test (fig. 52).** (1) With a recording belt on the machine, operate the recording carriage control lever (36) to see that the dashpot operates satisfactorily.

(2) With reasonable pressure on the recorder carriage control lever (36) the dashpot should offer sufficient resistance to allow the recorder stylus to be presented to the record, slowly and smoothly.

(3) If such is not the case, readjust by loosening screw (269) slightly, and moving the dashpot assembly to the required position.

## **90. DRIVE MANDREL (fig. 53).**

**a. Removal.** (1) Remove idler mandrel as explained in paragraph 95a.

(2) Unlock ejector mechanism by pressing in on ejector lock lever ((141) in fig. 58) with a screwdriver.

(3) Push the end of ejector lock lever (141) out of the way to allow for loosening upper injector-ejector holding screw (138).

(4) Rotate lock release lock lever ((18) in fig. 24) to the right and to the front, away from upper injector-ejector assembly holding screw (138) to make the latter accessible for loosening.

(5) Loosen the two injector-ejector mechanism holding screws (138) about two turns.

(6) With the flywheel retaining screw ((75) in fig. 53) and drive mandrel sleeve (76) removed, remove the drive mandrel assembly from the right-hand side of the machine, by cocking the injector-ejector assembly slightly forward. Remove spacers ((73) and (74)) and drive mandrel gear (72).

**b. Installation and Adjustment.** (1) Install drive mandrel, replacing drive mandrel spacer ((73) and (74)), drive mandrel gear (72), drive mandrel sleeve (76), and flywheel retainer screw (75). Do not replace flywheel (71).

(2) Loosen drive mandrel bushing setscrew, ((276) in fig. 44).

(3) Remove all the drive mandrel end play with right-hand adjusting nut (81), being careful to see that washer (83) is square, (or flat, against the face of the casting).

(4) Tighten left-hand adjusting nut (81).

(5) Tighten drive mandrel bushing setscrew (276), lightly.

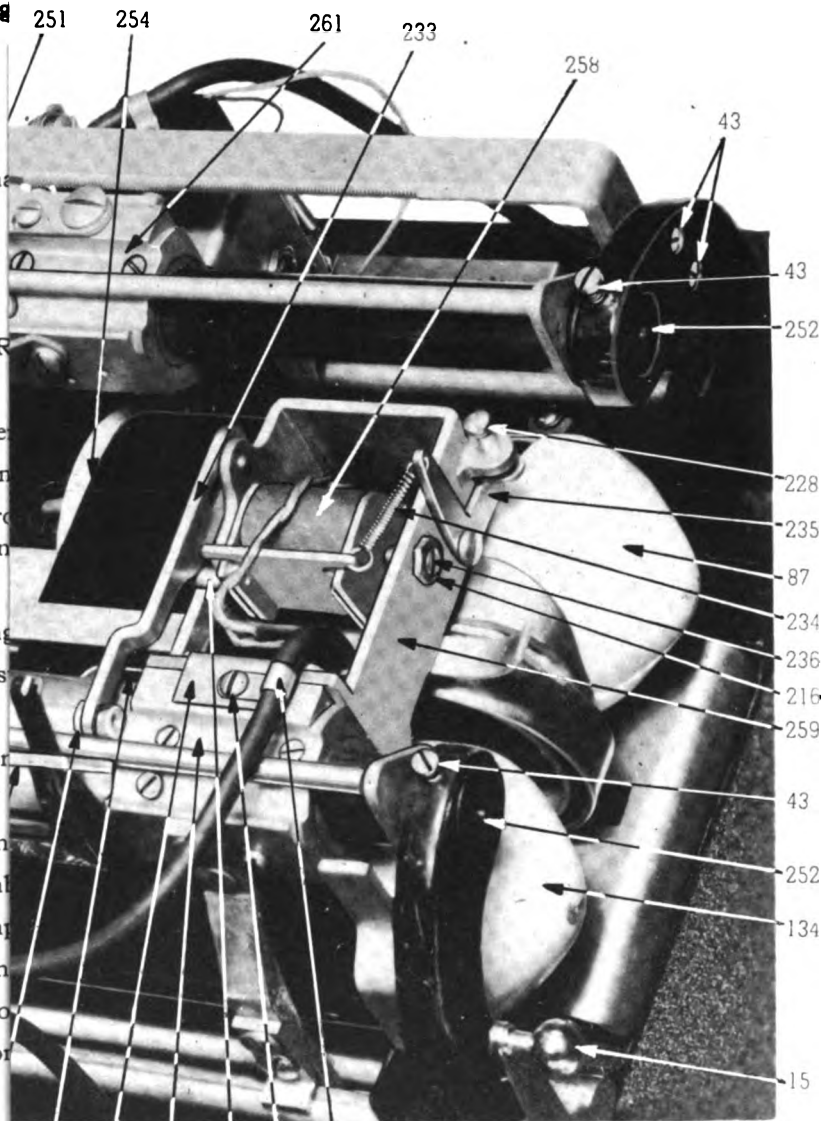
(6) Tap lightly on end of flywheel retaining screw (75) to properly seat beveled washer (82).

(7) Fully tighten drive mandrel bushing setscrew (276).

**CAUTION: EXCESSIVE TIGHTENING OF SETSCREW (276) WILL CAUSE DISTORTION OF DRIVE MANDREL SHAFT BUSHING.**

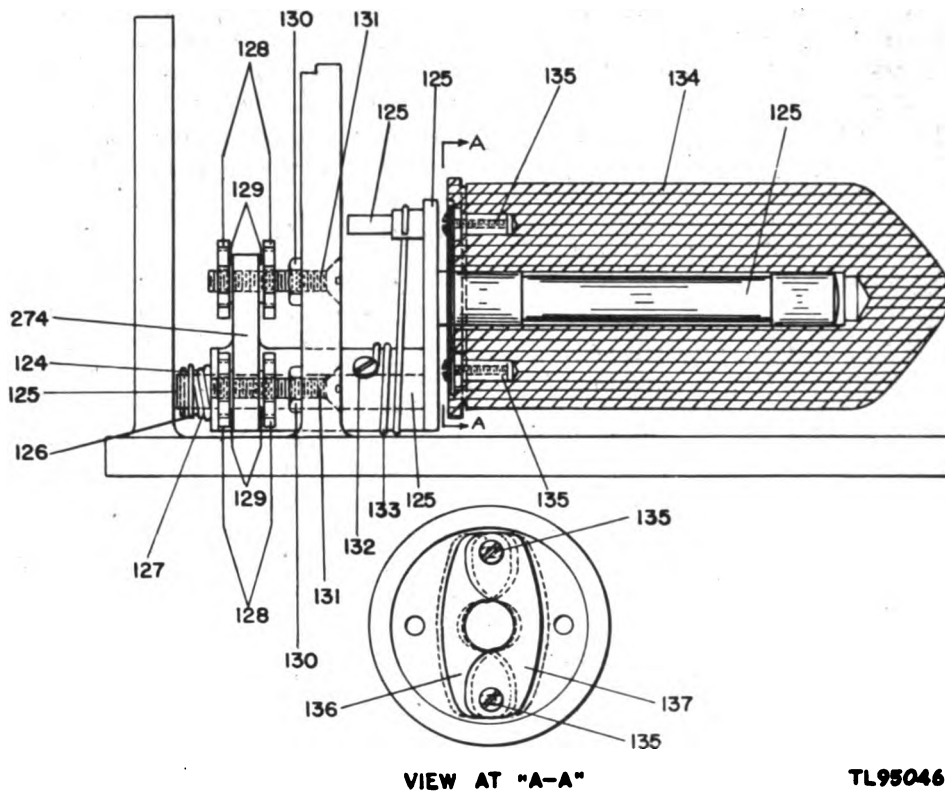
**Reference No.**

- 9 Recorder carriage bail at
- 15 Injector-ejector operatin
- 36 Carriage control lever
- 37 Backspacer rack holding
- 43 Backspacer rack holding
- 70 Dashpot piston yoke
- 71 Flywheel
- 87 Drive mandrel
- 98 Recorder carriage left-h
- 103 Feed screw gear
- 120 Gear train pinion gear
- 134 Idler mandrel
- 185 Recorder carriage bail R
- 186 READY switch
- 216 Recorder and reproduce
- 228 Reproducer pressure arm
- 231 Recorder carriage contro
- Reproducer carriage con
- 233 Recorder lift cam
- 234 Recorder pressure spring
- 235 Recorder pressure adjust
- 236 Recorder pivot screw
- 239 Recorder cable clamp an
- 240 Recorder cable clamp
- 243 Recorder carriage assem
- 244 Control interlock assem
- 246 Dashpot assembly, comp
- 251 Feed nut assembly, com
- 252 Feed screw assembly, co
- 253 Gear train assembly, co
- 254 Recording belt
- 258 Recorder
- 259 Recorder mount bracket
- 261 Reproducer carriage asse
- 264 Recorder lift cam roller
- 269 Dashpot cylinder clamp
- 281 Recorder terminal block



251 281 243 264 239 240

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Figure 57. Idler mandrel assembly

Reference No.	Description
124	Idler mandrel shaft cotter pin
125	Idler mandrel shaft, complete
126	Idler mandrel shaft tension spring washer
127	Idler mandrel shaft tension spring
128	Idler mandrel shaft positioning nut (castellated)
129	Idler mandrel shaft positioning nut washer
130	Idler mandrel assembly support screw nut
131	Idler mandrel assembly support screw
132	Idler mandrel tension spring screw
133	Idler mandrel tension spring
134	Idler mandrel
135	Idler mandrel retainer screw
136	Idler mandrel retainer (inside)
137	Idler mandrel retainer (outside)
274	Idler mandrel shaft support

(2) Unscrew gear train assembly holding screws (116) and (121) until they are completely out of the threaded holes into which they belong, and lift the entire gear train assembly, with screws and spacers, out of the machine.

(3) Remove the gear train mounting strip (117) by removing screw (123).

b. **Disassembly.** Remove the three screws (118) and then remove the gears from their studs.

c. **Reassembly.**

**CAUTION: ON REASSEMBLING THE GEARS TO THE GEAR TRAIN PLATE (115), DO NOT LUBRICATE THE GEAR TEETH. THEY SHOULD RUN DRY. (THIS CAUTION ONLY APPLIES TO THE TEETH. IT IS DESIRABLE TO HAVE LUBRICATION ON THE BEARINGS.)**

(1) Reassemble the gear train assembly by following the disassembly procedure in the reverse order.

(2) Check the operation of the gears on the mounting plate (115) to see that they are free running. If there is a bind in the assembly, check for dirt in the bearings and check for damage to gear teeth.

d. **Adjustment and Installation.** (1) Reinstall the gear train mounting strip (117).

**NOTE:** In the following instructions concerning the installation and adjustment of the gear train assembly, two variables affecting proper adjustment are involved; the adjustment of the gear train mounting strip (117), and the adjustment provided in the large clearance holes in the gear train mounting plate (115) for gear train assembly holding screws (116) and (121).

(2) Check the location of gear train mounting strip (117) by loosening screw (123) to see that the large clearance hole in mounting strip (117) is squarely over the associated hole in the main frame casting directly adjacent to it. Temporarily tighten screw (123).

(3) Install the gear on mounting plate (115) by using the screws and spacers previously removed, and adjust this assembly so that all gears run freely.

(4) Should there be a bind when this assembly is mounted, loosen the two gear train assembly mounting screws (116) and (121), and lift on the entire plate assembly to take up any play in the mounting screw holes.

(5) Rotate the gear train assembly either clockwise or counterclockwise, about the mounting screw (116), and temporarily tighten screw (116), but do not tighten too tightly, so that light tapping with screwdriver will move the mounting plate (115) **ONLY** in a rotary direction about the screw (116).

(6) Check the gears for binding again. Should they continue to bind, tap the mounting plate (115) either clockwise or counterclockwise (as the case may be) to insure proper tolerances between pinion gear assemblies (120), and the respective feed screw gears (103) with which they are engaged.

(7) At this point, remove the gear train mounting assembly and tighten the gear train mounting strip holding screw (123).

(8) Should further adjustment be needed beyond that which can be obtained by manipulating screws (116) and (121), it can be obtained by altering the adjustment on the gear train mounting strip (117) by loosening screw (123), and moving gear train mounting plate (115).

(9) Retighten screw (123). Remount the gear train plate assembly (115) and follow the same procedure as outlined above.

(10) When the proper adjustment is obtained, remove the gear train plate assembly (115) and securely tighten screw (123).

(11) Reinstall the gear train assembly, obtaining the remainder of the adjustment with screws (116) and (121).

## **95. IDLER MANDREL (figs. 24 and 57).**

a. **Removal.** (1) Remove the flywheel as explained in paragraph 93a. Replace drive mandrel sleeve (76) and retainer screw ((75) in fig. 53).

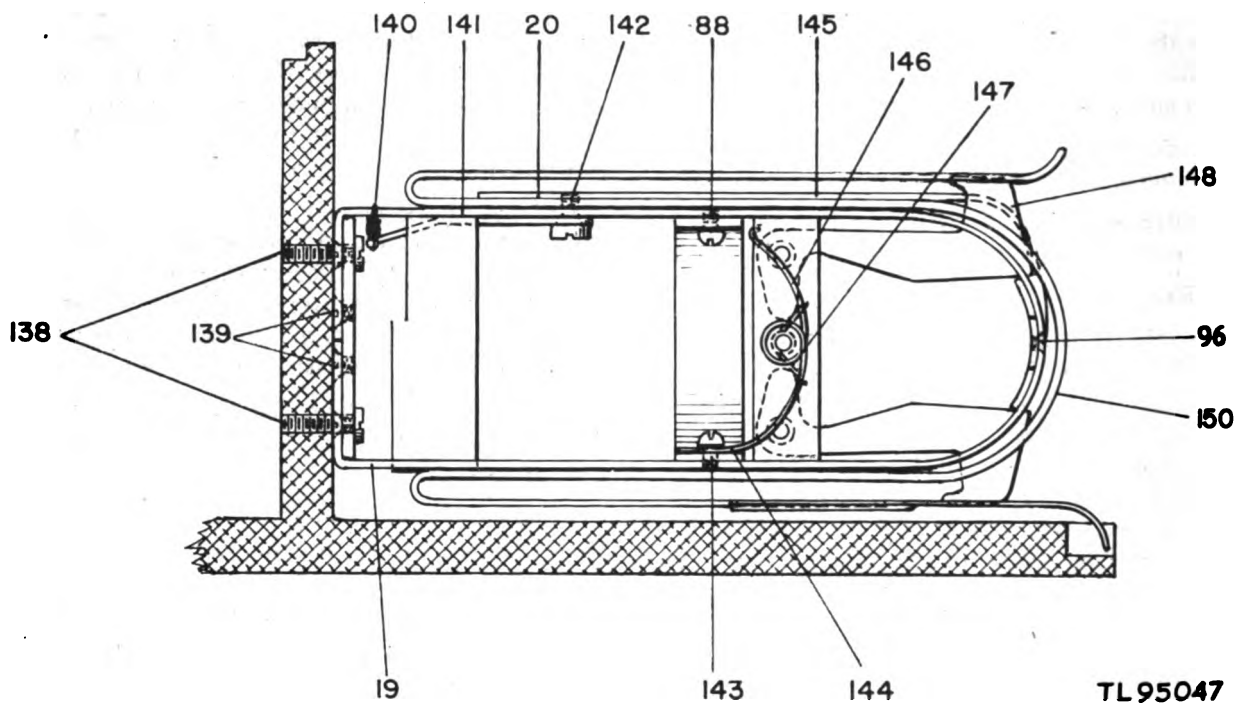
(2) Remove cotter pin ((124) in fig. 57), tension spring washer (126), and tension spring (127), from idler mandrel shaft (125).

(3) Remove the second cotter pin ((124) in figure 24), which is located on stud (13).

(4) Slide the idler mandrel assembly to the right out of the machine, disengaging tension spring (133).

**NOTE:** If the idler mandrel assembly sticks about half way out of the machine, check to see that the idler mandrel flange clears the injector-ejector apron ((260) in fig. 44) by pushing down on the latter.

b. **Disassembly.** Loosen idler mandrel retainer screws ((135) in fig. 57); slide idler mandrel



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Figure 58. Injector-ejector assembly

Reference No.	Description
19	Recorder anvil assembly frame
20	Recorder anvil
88	Feed nut assembly mounting screw
96	Injector-ejector guide tie piece screw
138	Injector-ejector assembly holding screw
139	Injector-ejector guide — anvil assembly frame holding screw
140	Injector-ejector lock lever spring
141	Injector-ejector lock lever
142	Injector-ejector lock lever holding screw
143	Injector-ejector spring and guide center strip holding screw
144	Injector-ejector spring and guide center strip holding screw washer
145	Recorder anvil assembly, complete
146	Injector-ejector spring
147	Injector-ejector finger spring
148	Injector-ejector finger
150	Injector-ejector slide member

retainers (136) and (137) apart, and slide idler mandrel (134) off of idler mandrel shaft (125).

**c. Adjustment and Reassembly.** (1) Install idler mandrel (134) on idler mandrel shaft (125).

(2) Slide the two idler mandrel retainers (136) and (137) together to take up the end play of the idler mandrel (134) on idler mandrel shaft (125).

**NOTE:** In squeezing the two retainers (136) and (137) together, do so in such a manner that as much bearing surface as possible is obtained between retainers (136) and (137) and idler mandrel shaft (125).

(3) Test for freedom of rotation of idler mandrel (134) on idler mandrel shaft (125).

**NOTE:** The idler mandrel (134) should rotate freely on idler mandrel shaft (125) with practically no end play.

**d. Installation.** Install the idler mandrel assembly by following the removal procedure in the reverse order.

**e. Lateral Adjustment.** (1) The idler mandrel shaft assembly (125) is supported by the idler mandrel support (274) which is held to the main frame casting by support screws (131). The idler mandrel shaft assembly (125) is free to oscillate on the lower left-hand section of this shaft assembly (125).

(2) The positioning of the idler mandrel support (274), and subsequently the idler mandrel (134), is accomplished by means of the three sets of castellated nuts (128).

(3) Looking at the flywheel side of the machine, these three sets of castellated nuts (128) are located at the three corners of a triangle; one set at the top and two sets at the two corners at the base of the triangle.

(4) The lateral adjustment of the idler mandrel is accomplished by manipulating all three sets of castellated nuts (128) to move idler mandrel (134) to the right or to the left.

(5) The idler mandrel should be so adjusted laterally that its left-hand flange is sufficiently to the right of the drive mandrel flange (i.e.  $\frac{1}{64}$ ) to allow the idler mandrel left-hand flange to provide guidance for the recording belt in the course of operation.

**f. Parallel Adjustment.** (1) Parallel adjustment of the idler mandrel is accomplished by

manipulation of the two bottom sets of castellated nuts (128).

(2) By manipulating these bottom two sets of castellated nuts (128) it is possible to move the right-hand tip of the idler mandrel (134) forward or backward to line up the idler mandrel parallel with the drive mandrel.

**g. Crawl Adjustment.** (1) The crawl adjustment of the idler mandrel is accomplished by manipulation of the top set of castellated nuts (128).

(2) It is by means of this crawl adjustment that the recording belt can be made to crawl towards the idler mandrel left-hand flange, sufficiently to allow the idler mandrel flange to properly guide the recording belt as it is rotated in the course of operation.

(3) When properly adjusted, a recording belt should crawl to the left, towards the idler mandrel flange,  $\frac{1}{2}$  inch in from 18 to 25 revolutions of the idler mandrel.

(4) Lowering the right-hand tip of idler mandrel (134) by means of the top pair of castellated nuts (128) increases the rate of recording belt crawl towards the idler mandrel flange, and raising the right-hand tip of idler mandrel (134) decreases the rate of recording belt crawl to the left toward the idler mandrel flange.

## **96. INJECTOR-EJECTOR ASSEMBLY** (figs. 44, 58, and 59).

### **a. Removal.**

**NOTE:** See CAUTION paragraph 83b.

(1) Remove the idler mandrel assembly as explained in paragraph 95a.

(2) To facilitate removal of the injector-ejector assembly, unlock the ejector mechanism by pressing towards the rear with a screwdriver on the end of ejector lock lever (141) nearest spring ((140) in fig. 58).

(3) Remove ejector lock release lever ((17) in fig. 59) by removing screw (153) and washer (51).

(4) Rotate lock release lock lever (18) out of the way to facilitate removal of uppermost injector-ejector mechanism holding screw ((138) in fig. 58).

(5) Disconnect spring (140) from injector-ejector assembly, and swing ejector lock lever (141) out of the way.

(6) Remove the two injector-ejector mechanism holding screws (138) and lift the injector-ejector assembly out of the machine.

- (7) Disconnect spring (58) from the stud on actuating link (151) in fig. 59).
- (8) With the cotter pin removed from stud (13), remove link (16) by removing screw (154).
- (9) Remove link (151) by removing screw (153) and the spacer (152) beneath link (151).
- (10) Remove screws (157) and their associated lockwashers, and lift the ejector control assembly (15) out of the machine.
- (11) Remove lock release lock lever (18) by removing screw (155).
- (12) With screws (157) removed, remove bracket (156).

**b. Disassembly.** (1) Unhook spring (146) from the crossbar on the ejector slide (150).

- (2) Lift one end of spring (147) over the projection on which it operates on one of the injector fingers (148). Since this single spring (147) acts on both injector fingers (148), lifting it over the projection on one of the injector fingers (148) will render it ineffective and allow it to float freely.
- (3) Remove spring (146) by removing screw (143) and washer (144).
- (4) Remove ejector guide center strip screw (88) and ejector guide tie piece screw (96).
- (5) Remove ejector guide from anvil frame (19) by removing the two screws (139).
- (6) Lift ejector slide (150) out of frame (19).
- (7) Remove ejector lock lever (141) by removing screw (142).

**c. Reassembly.** (1) Reassemble the injector-ejector mechanism by following the disassembly procedure in the reverse order, with two exceptions, namely, do not connect spring (146) to the crossbar as shown in figure 58, and do not place spring (147) in the operating position.

- (2) Hold the entire injector-ejector assembly in a vertical position, with the end which mounts to the main frame casting, uppermost.
- (3) Make sure that the entire slide mechanism operates freely, because of gravity alone, through the entire limit of its downward travel.
- (4) Now, invert the injector-ejector mechanism and see that the slide drops back to its normal position, due to gravity alone.
- (5) In the event there is a bind in the ejector slide mechanism, check for any dirt or foreign matter which may be present, causing sluggish operation.

- (6) If there is a bind, loosen screws (88) and (143) and move the members of the ejector frame farther apart, to allow greater freedom of operation of slide (150). Retighten screws (88) and (143).
- (7) With the ejector slide (150) in the "eject" position, check to see that injector fingers (148) operate freely because of gravity alone.
- (8) Place springs (146) and (147) in their proper operating position as shown in figure 58.

**CAUTION: BE SURE THAT SCREWS (88), (139), (142), (143), and (96) ARE TIGHT, BEFORE REINSTALLING THE INJECTOR-EJECTOR ASSEMBLY — ESPECIALLY SCREW (142). IF SCREW (142) IS LOOSE IT WILL SCRAPE ON THE DRIVE MANDREL.**

- (9) Move ejector lock lever (141) to the release or "eject" position, with a screwdriver, and see that ejector slide (150) travels upward to the extreme end of its travel in that direction, or at least to within  $\frac{1}{4}$  inch of the extreme end of travel, due to the action of spring (146).
- (10) Be sure that the injector fingers (148) close together because of the action of spring (147) when making the test explained in the preceding paragraph (i.e. be sure that the injector fingers (148) retract enough to allow for installing or removing a recording belt).

**d. Installation.** Install the injector-ejector assembly by following the removal procedure in the reverse order.

**CAUTION: BEFORE INSTALLING THE INJECTOR-EJECTOR ASSEMBLY BE CAREFUL TO WIPE THE MOUNTING SURFACE ON THE CASTING CLEAN, AND BE CAREFUL TO WIPE THE MOUNTING SURFACE ON THE INJECTOR-EJECTOR ASSEMBLY CLEAN, ALSO.**

**CAUTION: CHECK LOCK RELEASE LOCK LEVER (18) FOR FREEDOM OF MOVEMENT PRIOR TO INSTALLING THE INJECTOR-EJECTOR ASSEMBLY.**

**CAUTION: CHECK EJECTOR ACTUATING LINK (151) FOR FREEDOM OF MOVEMENT AND BE SURE THAT SCREW (153) IS TIGHT.**

**BE SURE SCREWS (157) ARE TIGHT.**

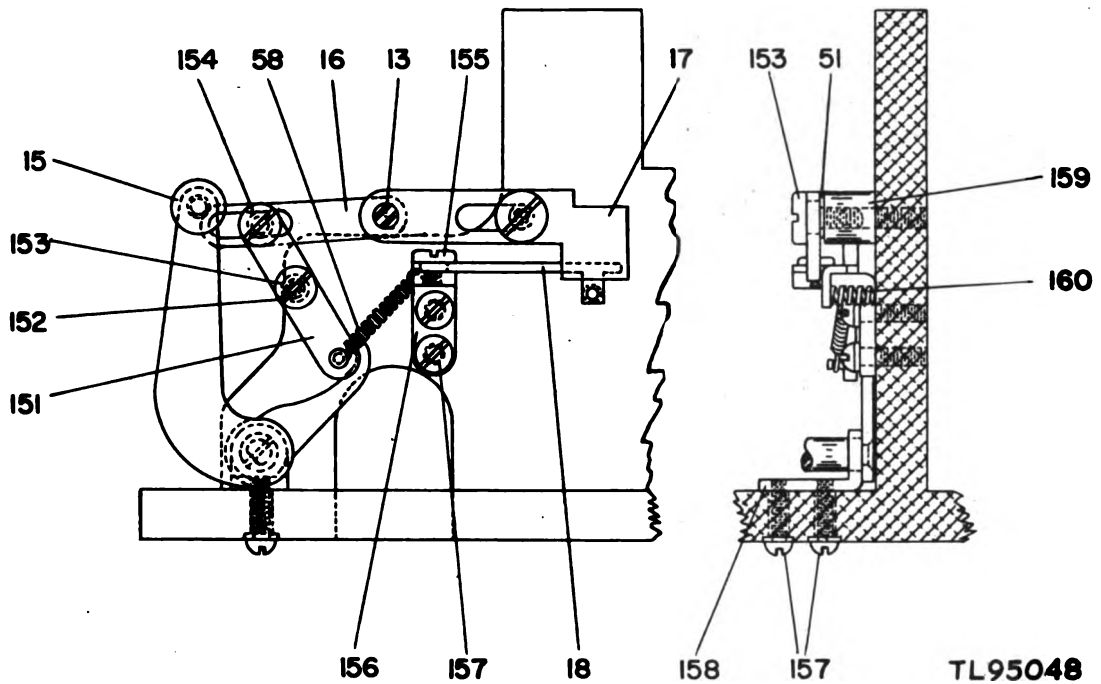


Figure 59. Injector-ejector control assembly

Reference No.	Description
13	Control interlock lock stud
15	Injector-ejector operating lever assembly, complete
16	Injector-ejector operating lever assembly actuating link
17	Injector-ejector lock release lever
18	Injector-ejector lock release lever lock lever
51	Injector-ejector operating lever assembly intermediate link holding screw washer
151	Injector-ejector operating lever assembly intermediate link
152	Injector-ejector operating lever assembly intermediate link spacer
153	Injector-ejector operating lever assembly intermediate link holding screw Injector-ejector lock release lever holding screw
154	Injector-ejector operating lever assembly intermediate link — actuating link connecting screw
155	Injector-ejector lock release lock lever holding screw
156	Injector-ejector lock release lock lever assembly bracket
157	Injector-ejector lock release lock lever assembly bracket mounting screw
158	Injector-ejector operating lever assembly bracket
159	Injector-ejector lock release lever mounting stud
160	Injector-ejector lock release lock lever spring



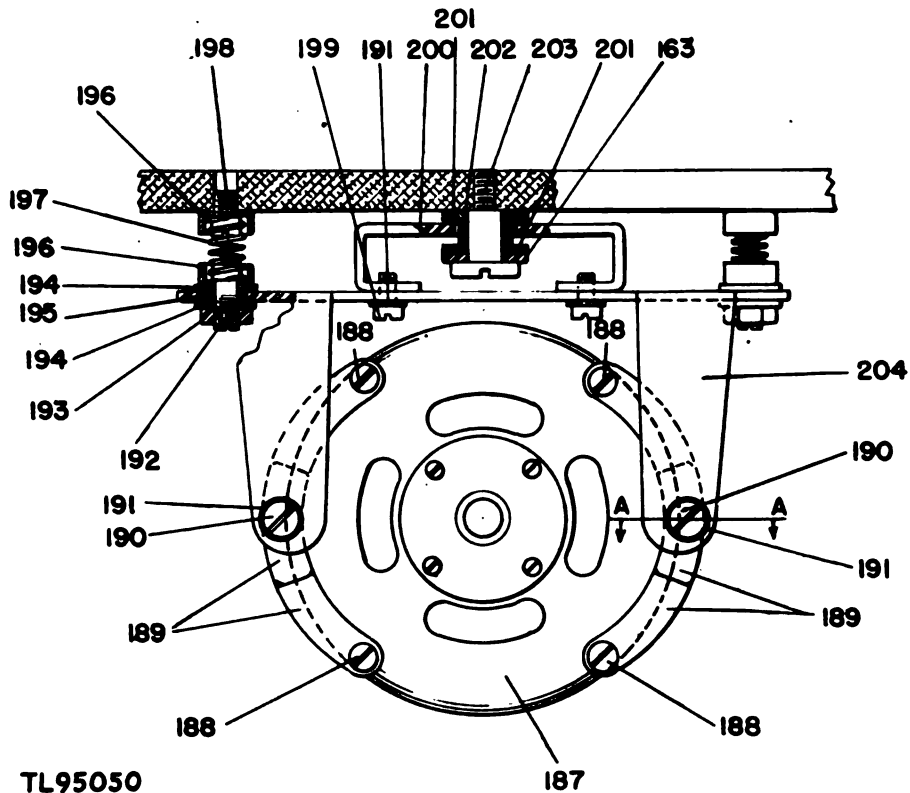


Figure 60. Motor mount

Reference No.	Description
163	Motor safety mount steel washer
187	Motor (MC-502)
188	Motor (MC-502) end cap screw
189	Motor (MC-502) torque-mount
190	Motor (MC-502) torque-mount mounting screw
191	Motor (MC-502) torque-mount mounting screw lockwasher
192	Motor suspension stud (motor)
193	Motor suspension stud nut
194	Motor suspension insulating washer
195	Motor suspension insulating sleeve
196	Motor suspension cup washer
197	Motor suspension spring
198	Motor suspension stud (frame)
199	Motor safety mount mounting screw (motor)
200	Motor safety mount bracket
201	Motor safety mount mounting screw (frame) washer (rubber)
202	Motor safety mount mounting screw (frame) sleeve
203	Motor safety mount mounting screw (frame)
204	Motor mount bracket

**e. Adjustment.** (1) Remove the idler mandrel from the idler mandrel shaft as explained in paragraph 95b.

(2) Reinstall the idler mandrel shaft assembly, less the idler mandrel as explained in paragraph 95d.

(3) To adjust the timing between lock release lock lever (18) and lock release lever (17), make sure while operating injector control lever (15), that lock release lock lever (18) locks lock release lever (17), before ejector lock lever (141) releases ejector slide (150).

(4) If this timing is not obtained, loosen screws (157), and slide bracket (156) forward, taking advantage of the tolerance in the mounting holes, to obtain the proper timing.

**NOTE:** The reason that this timing is so essential is as follows:

Failure of lock release lock lever (18) to lock the ejector lock release lever (17) prior to the operation of the ejector slide (150), will cause the idler mandrel to maintain tension on the recording belt, when the ejector slide (150) is trying to eject the recording belt, thus causing jamming of the ejector mechanism, and damage to the recording belt.

This will only happen if the ejector control lever (15) is not pulled through its full travel, when this "out-of-timing" condition exists.

(5) Before reinstalling the idler mandrel, lubricate the cam surface on the injector fingers (148) with grease.

(6) Remove the idler mandrel shaft assembly and reinstall the idler mandrel on its shaft as explained in paragraph 95c.

(7) Reinstall the idler mandrel assembly as explained in paragraph 95d.

## **97. MACHINE COVERS (fig. 50).**

### **a. Removal.**

**CAUTION:** BEFORE ATTEMPTING TO REMOVE MACHINE COVERS (256), BE SURE THAT THE CARRIAGE CONTROL LEVERS (36) ARE IN THE "NEUTRAL" POSITION, AND THAT THE CARRIAGES ARE MOVED TO APPROXIMATELY THEIR CENTRAL POSITION, TO

**AVOID CATCHING THE COVERS (256) OR TIME INDICATOR PLATES (257) ON THE CARRIAGE CONTROL LEVERS (36) DURING REMOVAL.**

**ALWAYS REMOVE THE FRONT MACHINE COVER (256) FIRST.**

(1) To remove the front machine cover (256) remove screw (214) and loosen the two screws (230) about two turns.

(2) There is a detent on the lower left-hand edge of cover (256) in the center, which hooks the cover to the unit plate. In removing the cover (256), press in on the lower left-hand edge of the cover, to release this detent. Then lift cover (256) vertically off the machine.

(3) In removing the rear machine cover (256), follow the above procedure, with the exception that there is no screw (214) to remove. Simply loosen the one screw (230) about two turns.

### **b. Installation.**

**CAUTION:** WHEN INSTALLING THE MACHINE COVERS (256) ALWAYS INSTALL THE REAR MACHINE COVER FIRST, AND BE SURE TO REPLACE EACH COVER ON THE PARTICULAR MACHINE (FRONT OR REAR) FROM WHICH IT WAS REMOVED.

**BE CAREFUL NOT TO PINCH THE REPRODUCER CABLE BETWEEN THE MACHINE COVER AND THE UNIT PLATE.**

**USE A "HINGING MOTION" WHEN INSTALLING THE MACHINE COVERS, AS THOUGH THE COVERS WERE HINGED AT THE LOWER FRONT EDGE.**

(1) Installing the machine covers (256) by following the removal procedure in the reverse order.

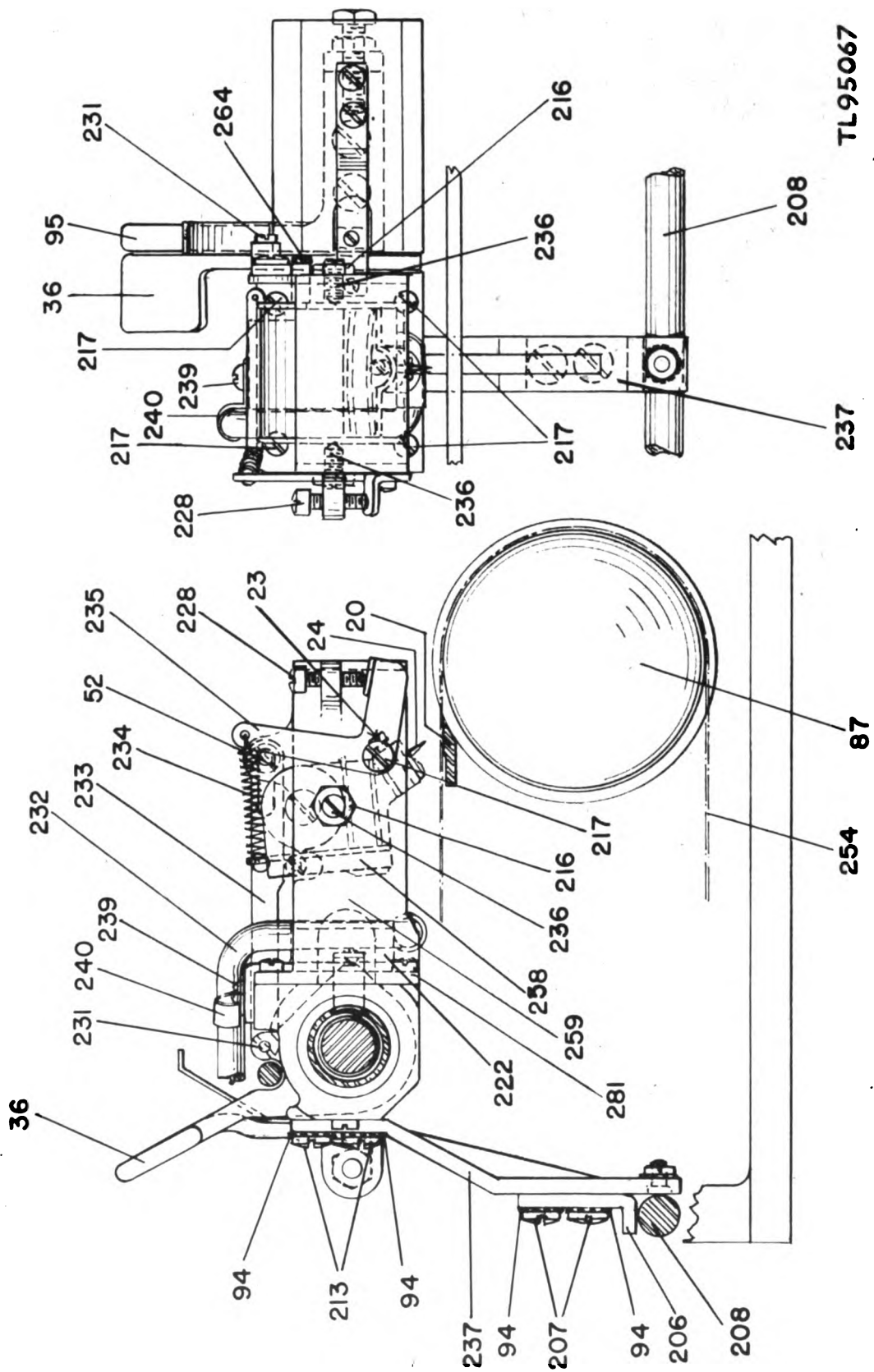
(2) After the covers have been installed, move the recorder and reproducer carriages to their extreme right and left-hand positions to test for freedom of movement.

## **98. MOTOR ASSEMBLY (figs. 47, 60, and 62).**

### **a. Removal.**

**CAUTION:** DISCONNECT POWER SUPPLY FROM EQUIPMENT. WHEN PROCEEDING WITH THE

Reference No.	Description
20	Recorder anvil
23	Recorder stylus clamping screw
24	Recorder stylus
36	Carriage control lever
52	Recorder lift cam holding screw
87	Drive mandrel
94	Feed nut assembly mounting screw lockwasher
95	Recorder carriage control lever stop
206	Reproducer carriage guide prong (adjustable)
207	Reproducer carriage guide prong (adjustable) holding screw
208	Reproducer carriage guide rod
213	Reproducer carriage guide
216	Recorder and reproducer pivot screw locknut
217	Recorder and reproducer mount bracket mounting screw
222	Recorder and reproducer terminal block
228	Recorder and reproducer pressure arm adjusting screw
231	Recorder and reproducer carriage control lever connecting screw
232	Recorder cable (front and rear cables are different lengths)
233	Recorder lift cam
234	Recorder pressure spring
235	Recorder pressure adjusting arm
236	Recorder pivot screw
237	Recorder carriage guide
239	Recorder cable clamp and terminal block bracket screw
240	Recorder cable clamp
243	Recorder carriage assembly, complete
258	Recorder
259	Recorder mount bracket assembly, complete
264	Recorder lift cam roller pin
281	Recorder terminal block bracket



TL95067

Figure 61. Recorder carriage assembly

**FOLLOWING INSTRUCTIONS BE CAREFUL TO AVOID DROPPING THE MOTOR TO CAUSE IT TO HANG ON ANY ONE OF THE MOTOR SUSPENSION SPRINGS ((197) in fig. 60) THEREBY TENDING TO DEFORM THE SPRINGS OR STRETCH THEM OUT OF SHAPE.**

- (1) Remove motor drive belt ((249) in fig. 60) from motor drive pulley (273).
- (2) Remove the five motor leads from terminal board ((TB-12) in fig. 47) in the case of the front machine and (TB-13) in the case of the rear machine.
- (3) Remove the two motor safety-mount mounting screws ((199) in fig. 60) and the two lock-washers (191).
- (4) To remove the motor (187) from the four suspension supports, remove suspension stud nut (193), being careful not to rotate stud (192) while doing so. This is accomplished by inserting a screwdriver in the screwdriver slot in stud (192), holding the screwdriver stationary in this position, while removing suspension stud nut (193), allowing the latter to slide down the screwdrive bit.
- (5) Remove insulating washers (194) and lift the motor assembly out of the machine.

**CAUTION: BE CAREFUL NOT TO LOSE ANY OF THE VARIOUS PARTS ASSEMBLED ON MOTOR SUSPENSION STUD (192).**

- b. Disassembly.** (1) Loosen the two motor pulley setscrews (43) and remove motor pulley (273) from the motor pulley shaft (fig. 62).
- (2) Remove the two motor mount brackets (204), one on either end of the motor, by removing the four motor torque-mount mounting screws (190), two for each bracket, and their associated lock-washers (191).
- (3) Remove the four motor torque-mounts, two on each end of the motor, by removing the two motor end cap screws (188) associated with each torque-mount.
- (4) Disassemble the motor by removing either of the end caps, which makes the armature and the spacers on the armature shaft accessible for removal.
- (5) Disassemble the motor suspension spring assembly (after insulating washers (194) have been

removed) by removing insulating sleeve (195) from stud (192).

- (6) Remove cup washer (196) and unscrew stud (192) from motor suspension spring (197).
- (7) Unscrew stud (198) from the machine.

**CAUTION: THIS IS A LEFT-HAND THREAD.**

**c. Reassembly.** (1) Reassemble the motor suspension spring assembly by following the disassembly procedure in the reverse order.

**CAUTION: ON REASSEMBLY BE CAREFUL TO REASSEMBLE EXACTLY AS SHOWN IN FIGURE 60.**

- (2) Reassemble the motor assembly by following the disassembly procedure in the reverse order.
- (3) Check to see that the motor armature rotates freely. If there is a bind in the motor armature, tap lightly with a screwdriver handle on the motor drive shaft, to relieve the bind. It should not require more than one or two light taps with a screwdriver handle to accomplish the desired result.
- (4) When the bearings are aligned, check the end play at four points, through one complete revolution of the armature, thus checking every 90°.
- (5) The motor drive shaft should rotate freely and should move endwise freely at any one of the four points checked.
- (6) Check to see that the two motor drive pulley setscrews (43) are tight, thus securing the motor drive pulley (273) tightly to the motor shaft.

**d. Installation.** (1) Reinstall the motor assembly by following the removal procedure in the reverse order.

- (2) Reinstall the motor drive belt (249).
- (3) If a new motor drive belt is to be installed, place the proper twist in the motor drive belt by suspending it in a normal manner on the fingers of the two hands with the fingers held in a vertical position. Twist the motor drive belt by rotating either hand in a clockwise direction, when facing the back of the hand. After making this twist, bring the two end loops of the motor drive belt together to form a double wrap belt, with a cross-over and proceed with the motor drive belt installation, aligning the belt as shown in figure 62.

**e. Tests.** (1) Test the motor for proper operation by starting and stopping it by means of the

MOTOR "ON-OFF" switch on the control panel or the remote MOTOR CONTROL foot switch.

(2) Check to see that the motor pulley (273) is properly aligned with reduction pulley (166).

## 99. RECORDER (figs. 52 and 61).

**a. Removal.** (1) Remove screw (239) which holds recorder cable clamp (240) and the recorder terminal block bracket.

(2) Lift recorder terminal block bracket (281), with recorder terminal block (222) attached, far enough out of the machine to remove the terminal block cover.

(3) Remove the two recorder leads from the recorder terminal block (222); replace the recorder cable leads; replace the recorder terminal block cover, and lay the terminal block one side, attached to the recorder cable, until it is needed for reinstallation.

(4) Unhook recorder pressure spring (234) from recorder pressure adjusting arm (235).

(5) Unscrew lift cam roller pin (264).

**CAUTION: WHEN REMOVING ROLLER PIN (264), BE CAREFUL NOT TO ALLOW THE RECORDER STYLUS (24) TO HIT THE ANVIL (20) AND BE DAMAGED.**

THERE ARE TWO ROLLERS ON ROLLER PIN ASSEMBLY (264), ONE BRASS AND ONE STEEL ROLLER. THE STEEL ROLLER SHOULD BE ADJACENT TO THE HEAD OF THE SCREW IN ROLLER PIN ASSEMBLY (264). SHOULD THERE BE ANY QUESTION REGARDING THEIR IDENTITY, CHECK BY BRINGING THEM NEAR THE PERMANENT MAGNET IN RECORDER (258). THE STEEL ROLLER WILL BE ATTRACTED BY THE MAGNET.

(6) Rotate recorder assembly (258) in a counterclockwise direction (when looking at the ejector side of the machine) and remove recorder stylus (24) by loosening clamping screw (23).

(7) Loosen lock nut (216) and pivot screw (236) ON ONE SIDE ONLY all the way out and remove recorder assembly (258) from the machine.

**NOTE:** Removing only one pivot screw (236) maintains the recorder "central" adjustment and eliminates the necessity

for readjusting recorder carriage assembly stop screw (98) for left-hand  $\frac{1}{8}$ " margin on the record, upon reinstallation.

**b. Installation.** Install recorder assembly (258) by following the removal procedure in the reverse order.

**c. Adjustment.** (1) Check to see that recorder assembly (258) is centrally located between the two sides of recorder mount bracket (259).

(2) Adjust pivot screw (236) so that recorder assembly (258) pivots freely under its own weight (with pressure spring (234) disconnected) and without end play.

(3) Check recorder stylus pressure by means of a pressure gauge, hooked to the guard at the stylus tip and observe the indication on the pressure gauge when the recorder stylus is lifted so that it just clears, by not more than the thickness of an ordinary sheet of paper, the recording belt, with the recorder carriage control lever (36) in the "operate" position.

**NOTE:** The recorder stylus pressure should be 4.75 ounces.

(4) Adjust the recorder stylus pressure by means of adjusting screw (228) which moves adjusting arm (235) to increase or decrease the tension on recorder pressure spring (234).

## 100. RECORDER CARRIAGE GUIDE (fig. 61).

**a. Removal.** Remove the two screws (213) and their associated lockwashers, which hold recorder carriage guide (237) to the recorder carriage assembly.

**CAUTION: BE CAREFUL NOT TO DAMAGE THE RECORDER STYLUS (24) WHEN PROCEEDING WITH THE FOLLOWING INSTRUCTIONS BECAUSE WHEN RECORDER CARRIAGE GUIDE (237) IS REMOVED, RECORDER STYLUS (24) IS FREE TO GO TO RECORDING ANVIL (20) AND IS NOT UNDER THE CONTROL OF CARRIAGE CONTROL LEVER (36).**

**b. Installation and Adjustment.** (1) When installing recorder carriage guide (237) by means of the two screws (213) and their associated lockwashers, have the two screws (207) loose, and, moving recorder carriage guide (237) to the right

and to the left, locate it at approximately the mid-point in this lateral travel, and tighten screws (213).

(2) Applying pressure (towards the rear of the machine) to the recorder carriage at the back of recorder carriage control lever stop (95), to make sure guide (237) is squarely against the back surface of recorder carriage guide rod (208), pull adjustable guide prong (206) down against the top surface of recorder carriage guide rod (208) and see that it seats squarely thereon. Tighten screws (207).

(3) With recorder carriage control lever (36) in the "neutral" position, move the recorder carriage to the right and to the left to check for freedom of movement and to see that there is no bind between recorder carriage guide (237) and recorder carriage guide rod (208).

(4) If there is a bind, slight tapping with a screwdriver handle at the elbow in recorder carriage guide (237) will aid in freeing the bind.

(5) Properly adjusted, recorder carriage guide (237) should move freely on recorder carriage guide rod (208) with practically no play.

#### **101. RECORDER MOUNT BRACKET ASSEMBLY (figs. 52 and 61).**

**a. Removal.** (1) Remove screw (239) which holds recorder cable clamp (240) and recorder terminal block bracket (281).

(2) Lift recorder terminal block bracket (281), with recorder terminal block (222) attached, far enough out of the machine to remove the terminal block cover.

(3) Remove the two recorder leads from recorder terminal block (241); replace the recorder cable leads; replace the recorder terminal block cover, and lay terminal block (241) to one side attached to the recorder cable, until it is needed for reinstallation.

(4) Unhook recorder pressure spring (234) from recorder pressure adjusting arm (235).

**NOTE:** This procedure is suggested by way of making ready to remove the recorder stylus (24) to avoid damage thereto, prior to removal of recorder mount bracket assembly (259).

(5) Unscrew lift cam roller pin (264).

**CAUTION:** WHEN REMOVING ROLLER PIN (264), BE CAREFUL NOT TO ALLOW RECORDER STYLUS (24)

TO HIT THE ANVIL (20) AND BE DAMAGED.

THERE ARE TWO ROLLERS ON ROLLER PIN ASSEMBLY (264), ONE BRASS AND ONE STEEL ROLLER. THE STEEL ROLLER SHOULD BE ADJACENT TO THE HEAD OF THE SCREW IN ROLLER PIN ASSEMBLY (264). SHOULD THERE BE ANY QUESTION REGARDING THEIR IDENTITY, CHECK BY BRINGING THEM NEAR THE PERMANENT MAGNET IN RECORDER (258). THE STEEL ROLLER WILL BE ATTRACTED BY THE MAGNET.

(6) Rotate recorder assembly (258) in a counterclockwise direction (when looking at the ejector side of the machine) and remove recorder stylus (24) by loosening clamping screw (23).

(7) Remove screw (231) connecting recorder carriage control lever (36) and recorder lift cam (233).

(8) Remove the four recorder mount bracket mountings screws (217) and lift recorder mount bracket assembly (259) out of the machine.

**b. Disassembly.** For removal and replacement of recorder assembly (258) see paragraph 99.

**c. Installation.** Install recorder mount bracket assembly (259) by following the removal procedure in reverse order.

#### **102. RECORDER STYLUS (figs. 52 and 61).**

**a. Removal.** (1) Remove screw (239) which holds recorder cable clamp (240) and recorder terminal block bracket (281).

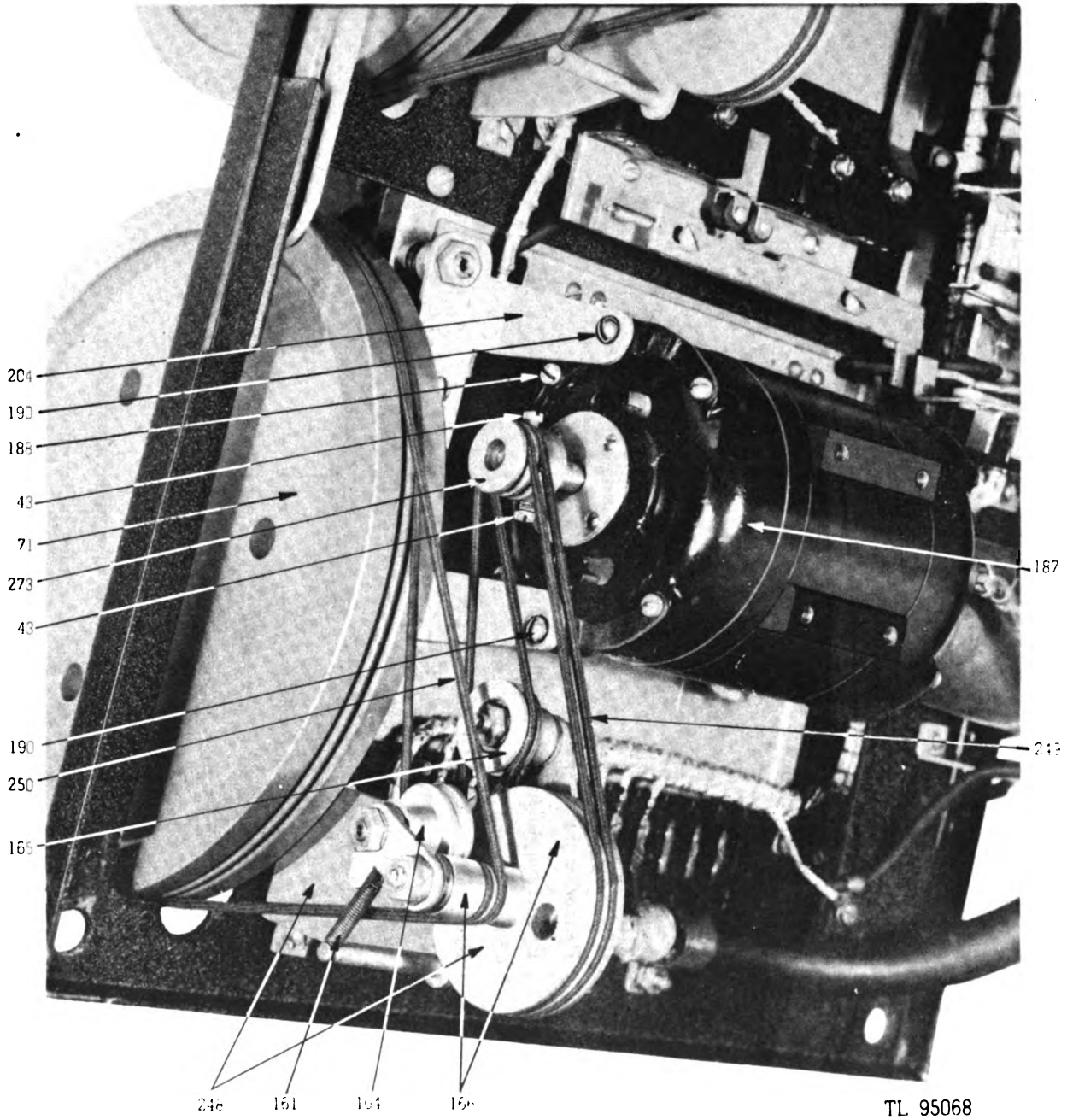
(2) Lift recorder terminal block bracket (281), with recorder terminal block (222) attached, out of the way to allow freedom of movement of recorder assembly (258) when lift cam roller pin (264) is removed.

(3) Unhook recorder pressure spring (234) from recorder pressure adjusting arm (235).

(4) Unscrew lift cam roller pin (264).

**CAUTION:** WHEN REMOVING ROLLER PIN (264), BE CAREFUL NOT TO ALLOW THE RECORDER STYLUS (24) TO HIT THE ANVIL (20) AND BE DAMAGED.

THERE ARE TWO ROLLERS ON ROLLER PIN ASSEMBLY (264), ONE BRASS AND ONE STEEL ROLLER.

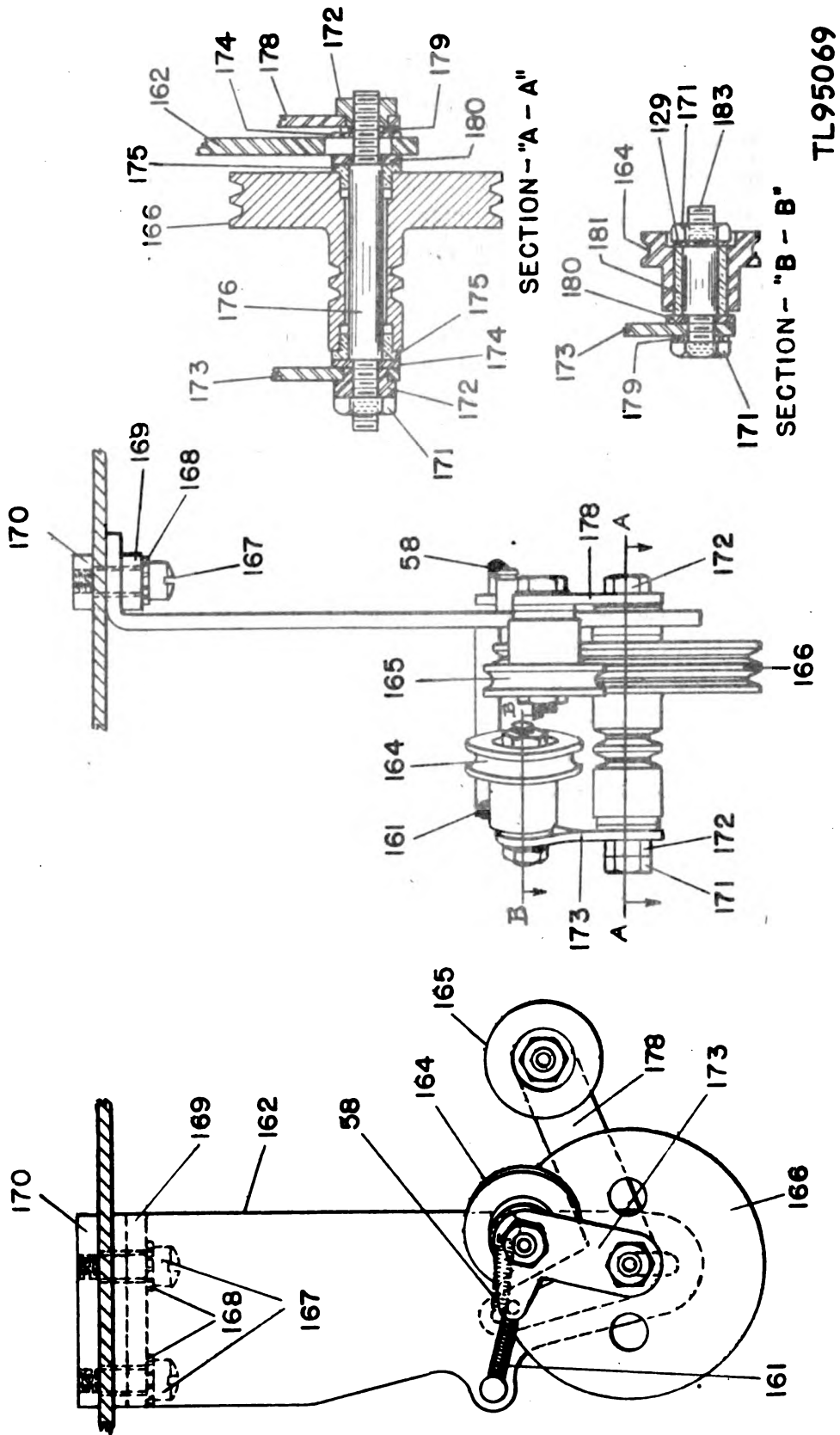


**Figure 62. Reduction pulley assembly**

TL 95068



Reference No.	Description
58	Reduction pulley motor idler tension spring
129	Reduction pulley flywheel and motor idler pulley shaft washer
161	Reduction pulley flywheel idler tension spring
162	Reduction pulley bracket
164	Reduction pulley flywheel idler
165	Reduction pulley motor idler
166	Reduction pulley
167	Reduction pulley assembly holding screw
168	Reduction pulley assembly holding screw lockwasher
169	Reduction pulley assembly metal strip mounting washer
170	Reduction pulley assembly metal strip mounting nut
171	Reduction pulley shaft nut
	Reduction pulley flywheel idler shaft nut
	Reduction pulley motor idler shaft nut
172	Reduction pulley shaft shoulder nut
173	Reduction pulley flywheel idler bracket
174	Reduction pulley shaft washer
175	Reduction pulley shaft bearing
176	Reduction pulley shaft
178	Reduction pulley motor idler bracket
179	Reduction pulley shaft lockwasher
180	Reduction pulley shaft washer
	Reduction pulley flywheel idler shaft washer
	Reduction pulley motor idler shaft washer
181	Reduction pulley flywheel and motor idler pulley shaft bearing
183	Reduction pulley flywheel and motor idler pulley shaft
248	Reduction pulley assembly, complete



TL95069

Figure 63. Reduction pulley assembly (diagram)

<b>Reference No.</b>	<b>Description</b>
29	Reproducer stylus clamping screw
31	Reproducer stylus
33	Reproducer pressure arm pivot screw
36	Carriage control lever
38	Backspacer rack
42	Reproducer mount bracket assembly
60	Control interlock lock lever spring, pin nut
87	Drive mandrel
205	Reproducer carriage guide
206	Reproducer carriage guide prong (adjustable)
207	Reproducer carriage guide prong (adjustable) holding screw
208	Reproducer carriage guide rod
213	Reproducer carriage guide
215	Reproducer pivot screw
216	Recorder and reproducer pivot screw locknut
217	Recorder and reproducer mount bracket mounting screw
218	Reproducer carriage control lever    reproducer lift lever connecting link
219	Reproducer cable clamp and terminal block cover screw
220	Reproducer cable clamp
221	Reproducer lift lever
222	Reproducer terminal block
223	Reproducer cable (front and rear cables are different length)
224	Reproducer lead counter balance
225	Reproducer pressure spring pin
226	Reproducer pressure spring
227	Reproducer pressure arm
228	Reproducer pressure arm adjusting screw
229	Reproducer
231	Reproducer carriage control lever    Reproducer link connecting screw
254	Recording belt
261	Reproducer carriage assembly, complete
265	Reproducer pivot bracket, lateral

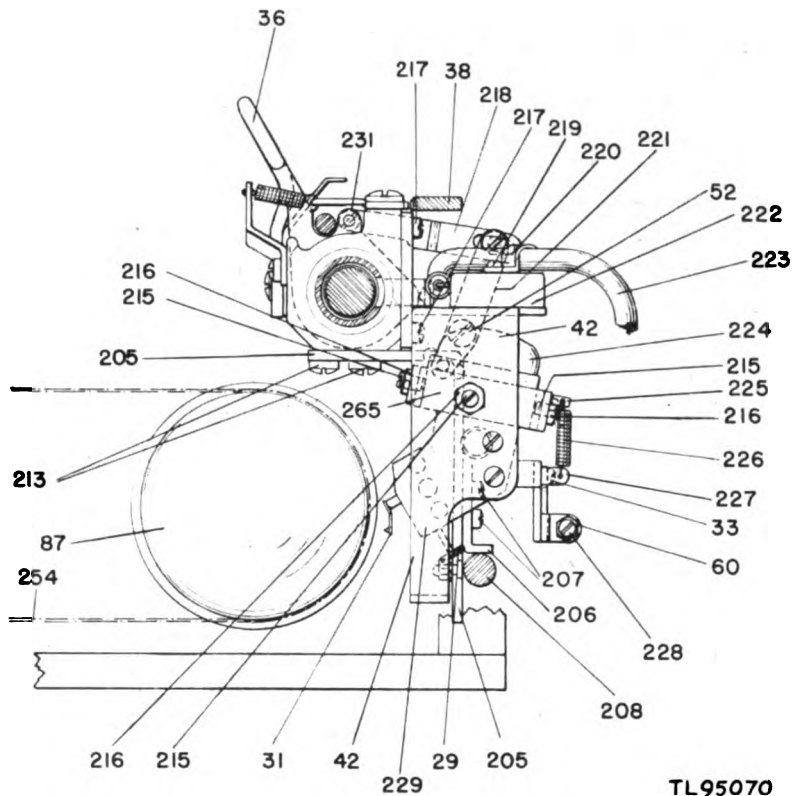


Figure 64. Reproducer carriage assembly

THE STEEL ROLLER SHOULD BE ADJACENT TO THE HEAD OF THE SCREW IN ROLLER PIN ASSEMBLY (264). SHOULD THERE BE ANY QUESTION REGARDING THEIR IDENTITY, CHECK BY BRINGING THEM NEAR THE PERMANENT MAGNET IN RECORDER (258). THE STEEL ROLLER WILL BE ATTRACTED BY THE MAGNET.

(5) Rotate recorder assembly (258) in a counter-clockwise direction (when looking at the ejector side of the machine) and remove recorder stylus (24) by loosening clamping screw (23).

**b. Installation.** Install recorder stylus (24) by following the removal procedure in reverse order.

**103. REDUCTION PULLEY ASSEMBLY (figs. 62 and 63).**

**a. Removal.** (1) Disconnect motor idler tension spring (58) and flywheel idler tension spring (161).

(2) Remove motor drive belt (249) and flywheel drive belt (250).

(3) Remove reduction pulley assembly (248) by removing the two screws (167), the two lockwashers (168), and washer (169). Nut (170) is a threaded strip which is welded onto the unit plate.

**b. Disassembly.** (1) Remove reduction pulley shaft nut (171) and shoulder nut (172) to remove flywheel idler bracket (173).

(2) Remove shoulder nut (172) to remove motor idler bracket (178).

(3) Remove lockwasher (179) and washer (174) to remove reduction pulley bracket (162).

(4) Remove reduction pulley (166) from reduction pulley shaft (176) removing remaining washers (174) and (180).

(5) Disassemble flywheel idler bracket assembly (173) by removing nut (171) and lockwasher (179) on the flywheel idler shaft (183).

(6) Disassemble the motor idler assembly the same as the flywheel idler assembly.

**c. Reassembly.** Reassemble the reduction pulley assembly (248) by following the disassembly procedure in the reverse order.

**CAUTION: ON REASSEMBLING FLYWHEEL IDLER (164) AND MO-**

TOR IDLER (165) TO THEIR RESPECTIVE BRACKETS (173 and 178), BE SURE TO CLEAN THEM CAREFULLY WITH A CLOTH. DO NOT WASH WITH GASOLINE OR ANY OTHER SOLVENT AS THESE ARE OILITE BUSHINGS. APPLY ABOUT 2 DROPS OF OIL (SEE PARAGRAPH 115) TO EACH BUSHING BEFORE REINSTALLING. THIS CAUTION ALSO APPLIES WHEN INSTALLING REDUCTION PULLEY (166) IN ITS ASSEMBLY.

d. **Installation.** Install the reduction pulley assembly (248) by following the removal procedure in the reverse order.

e. **Adjustment.** (1) To adjust the reduction pulley assembly (248), loosen screws (167) holding bracket (162) to the unit plate.

(2) Slide the entire reduction pulley assembly (248) in a direction away from the motor, until motor idler (165) is in such a position that it will not allow that portion of the belt operated on by motor idler (165) to touch any other portion of the belt, since motor idler (165) operates between two strands of the motor drive belt (249) at a point approximately mid-way between the two strands as shown in figure (62).

**CAUTION: BE SURE TO ALIGN THE REDUCTION PULLEY ASSEMBLY (248) BEFORE TIGHTENING THE SCREWS (167) HOLDING BRACKET (162) TO THE UNIT PLATE, SO THAT THE GROOVES IN FLYWHEEL IDLER (164) ARE IN LINE WITH THE GROOVES IN THE FLYWHEEL (71).**

(3) Tighten screws (167) holding bracket (162) to the unit plate.

**CAUTION: CHECK TO SEE THAT MOTOR IDLER PULLEY (165) IS IN LINE WITH MOTOR PULLEY (273).**

(4) Should motor idler pulley (165) and motor pulley (273) be out of line, loosen the two motor pulley setscrews (43) and slide motor pulley (273) to the proper position to bring the double wrap motor drive belt (249) in line, and to bring the motor pulley (273) and motor idler pulley (165) in line.

(5) Tighten motor pulley setscrews (43).

(6) A slot is provided in bracket (162) for vertical adjustment of reduction pulley (166).

(7) Reduction pulley (166) should be adjusted so that the front edge of flywheel idler (164) is flush with the front edge of flywheel drive belt (250) when facing the machine from the flywheel side.

(8) The front edge of flywheel idler (164) means that edge nearest the front of the machine, and the front edge of flywheel drive belt (250) means that edge of the flywheel drive belt (250) nearest the front of the machine on that portion of flywheel drive belt (250) which is not in contact with flywheel idler (164).

#### **104. REPRODUCER (figs. 7, 44 and 64).**

a. **Removal.** Remove the reproducer mount bracket assembly (42) as explained in paragraph 106a.

b. **Disassembly.** (1) Unhook reproducer pressure spring (226) from the pin on reproducer lateral pivot bracket (265).

**NOTE:** While still referring to figures 44 and 64, now refer to figure 7 also, which is a close-up view of the reproducer mount bracket assembly.

**NOTE:** Lateral pivot bracket (265) and lateral pivots (215) mounted therein, provide for lateral movement of the reproducing head. Vertical pivots (215) which are installed through the sides of reproducer mount bracket (42) provide for vertical movement of the reproducing head.

(2) Loosen vertical pivot locknut (216) and loosen vertical pivot (215) a number of turns, remembering the number of turns it was loosened to aid in relocating the reproducer quickly upon reinstallation.

(3) Loosen the other vertical pivot locknut (216) and unscrew the other vertical pivot (215) all the way out.

(4) Remove the reproducer, in its lateral pivot bracket (265), from reproducer mount bracket (42).

(5) Remove lateral pivot locknuts (216) and loosen lateral pivots (215) to remove the reproducer from the lateral pivot bracket (265).

b. **Reassembly and Adjustment.** (1) Reassemble the reproducer assembly by following the disassembly procedure in reverse order, observing the following instructions.

(2) Replace the reproducer in lateral pivot bracket (265) as shown in figure 7, with the reproducer pressure spring pin on reproducer lateral pivot bracket (265) aligned adjacent to reproducer pressure spring (226) when the reproducer stylus (31) is properly positioned.

(3) Install the reproducer in lateral pivot bracket (265) so that there is equal spacing on either side of the reproducer, between the reproducer and the lateral pivot bracket. Tighten the locknut (216) on one side of lateral pivot bracket (265).

(4) Screw the other lateral pivot screw (215) into place, then back off on pivot screw (215), screwing it in and out a few times until it stops without force, to indicate that it is tightly seated; then back off  $\frac{1}{8}$  turn and tighten its locknut (216) making sure that pivot screw (215) does not turn when locknut (216) is tightened.

(5) Replace the reproducer, in its lateral pivot bracket (265), in reproducer mount bracket assembly (42), and reset the vertical pivot screw (215) which was not removed to its original position, and tighten its locknut (216).

(6) Install the other vertical pivot screw (215), with locknut (216) attached, the latter backed off to the end of pivot screw (215), and tighten vertical pivot screw (215).

(7) Adjust this vertical pivot screw (215) by tightening the screw lightly until it stops; then back off pivot screw (215) not more than  $\frac{1}{16}$ th turn.

**CAUTION: THIS LAST ADJUSTMENT IS CRITICAL AND SHOULD BE MADE VERY CAREFULLY.**

(8) Tighten locknut (216) and be sure pivot screw (215) does not turn as locknut (216) is tightened.

(9) When properly adjusted, the reproducer should pivot freely but with no appreciable play.

(10) Replace reproducer pressure spring (226) on the pin on reproducer lateral pivot bracket (265).

**c. Installation.** Install the reproducer mount bracket assembly (42) by following paragraph 106a. in reverse order.

**d. Reproducer Stylus Pressure Adjustment.**

(1) Check the reproducer stylus pressure by means of a pressure gage hooked to the end of the stylus shank.

(2) Read the pressure gage indication when the reproducer stylus is lifted (with the carriage control lever in the "operate" position) so that the

stylus clears the recording belt by about the thickness of a sheet of paper.

**NOTE:** The reproducer stylus pressure should be 0.75 ounce.

(3) Adjust the reproducer stylus pressure by means of adjusting screw (228) which moves pressure arm (227) to increase or decrease the tension on pressure spring (226).

**105. REPRODUCER CARRIAGE GUIDE (figs. 44 and 64).**

**a. Removal.** (1) Remove left-hand backspacer rack mounting screw (37) in fig. 44) and the two right-hand backspacer rack mounting screws (43), and remove backspacer rack (38) from the machine.

(2) Remove reproducer cable clamp (238) by removing its holding screw.

(3) Loosen screw (157) which holds reproducer carriage guide rod (208).

(4) Line up one of the two holes in flywheel (71) with the end of reproducer carriage guide rod (208) and slide the guide rod out through the flywheel so that it will be out of the way for rotating the reproducer carriage assembly on its bearing.

**CAUTION: BE CAREFUL NOT TO DAMAGE THE REPRODUCER STYLUS BECAUSE THE REMOVAL OF REPRODUCER CARRIAGE GUIDE ROD (208) ALLOWS REPRODUCER STYLUS (31) TO GO TO THE SURFACE OF THE DRIVE MANDREL (87).**

(8) Loosen the two screws (43) which secure feed screw assembly (252).

(9) With recorder carriage assembly (243) at the right-hand limit of its travel, (end of record position), and with reproducer carriage assembly (261) moved towards the flywheel so that the reproducer carriage guide rod (205) will clear reproducer safety switch (209), rotate reproducer carriage assembly (261) in a counterclockwise direction (when looking at the ejector side of the machine) until reproducer carriage guide rod mounting screws (213) are accessible for removal.

(10) Remove the two screws (213) and remove reproducer carriage guide (205) from the machine.

**b. Installation.** Install reproducer carriage guide (205) by following the removal procedure in reverse order.

**c. Adjustment.** (1) With the two holding screws (207) for adjustable reproducer carriage guide prong (206) loose, and with pressure on the reproducer carriage control lever stop (101) to bring reproducer carriage guide (205) squarely against the reproducer carriage guide rod (208), seat adjustable guide prong (206) squarely on the top of reproducer carriage guide rod (208) and tighten screws (207).

**NOTE:** The procedure outlined above can be accomplished by pressing on the reproducer carriage control lever stop with the little finger and at the same time using the thumb nail to push adjustable guide prong (206) down squarely on top of reproducer carriage guide rod (208).

(2) With the reproducer carriage control lever (36) in the "neutral" position, move the reproducer carriage assembly (261) back and forth on its bearing to test for freedom of movement. See that there is no bind between reproducer carriage guide (205) and reproducer carriage guide rod (208).

(3) If there is a slight bind, tap lightly downward on reproducer carriage guide prong (206) to remove the bind.

(4) When properly adjusted there should be no bind between reproducer carriage guide (205) and reproducer carriage guide rod (208) and there should be practically no play.

(5) Adjust feed screw assembly (252) as explained in paragraph 92e.

(6) Adjust backspacer rack (38) as explained in paragraph 85c.

## **106. REPRODUCER MOUNT BRACKET ASSEMBLY (figs. 44 and 64).**

**a. Removal.** (1) Remove left-hand backspacer rack mounting screw ((37) in fig. 44) and the two right-hand backspacer rack mounting screws (43), and lift backspacer rack (38) out of the machine.

(2) Remove reproducer cable clamp ((220) in fig. 64) by removing screw (219).

(3) Remove the cover of terminal block (222) and remove the two reproducer leads.

(4) Leave reproducer cable (223) connected to reproducer terminal block (222).

(5) Replace the cover on terminal block (222) and set to one side, with reproducer cable attached, until it is needed for reinstallation.

(6) Loosen screw ((157) in fig. 44) holding reproducer carriage guide rod (208).

(7) Line up one of the two holes in flywheel (71) with the end of reproducer carriage guide rod (208) and slide guide rod (208) out through the flywheel.

**CAUTION: BE CAREFUL NOT TO DAMAGE THE REPRODUCER STYLUS (31) BECAUSE WHEN REPRODUCER CARRIAGE GUIDE ROD (208) IS REMOVED, REPRODUCER STYLUS (31) IS FREE TO GO TO THE SURFACE OF DRIVE MANDREL (87).**

(8) Loosen screws (43) which secure feed screw assembly (252).

(9) Remove reproducer carriage control lever connecting screw (231). See figure 52.

(10) Remove lift lever pivot screw (52) and remove lift lever (221) and carriage control lever connecting link (218) in a unit

(11) Holding the reproducer carriage assembly firmly to safeguard reproducer stylus (31), and with recorder carriage assembly (243) at its right-hand limit of travel, (end-of-record position), move reproducer carriage assembly (261) towards the flywheel until reproducer carriage guide (205) clears reproducer safety switch (209), and rotate reproducer carriage assembly (261) in a counter-clockwise direction (when looking at the ejector side of the machine), until the four reproducer mount bracket assembly holding screws (217) are readily accessible for removal.

(12) Remove the four reproducer mount bracket assembly holding screws (217) and remove reproducer mount bracket assembly (42) from the machine.

**b. Disassembly, Reassembly, and Adjustment.** For disassembly, reassembly, and adjustment of the reproducer mount bracket assembly (42), see paragraph 104.

**c. Installation.** Install the reproducer mount bracket assembly by following the removal procedure in reverse order.

**d. Adjustment.** (1) Adjust feed screw assembly (252) as explained in paragraph 92e.

(2) Adjust backspacer rack (38) as explained in paragraph 85c.

## **107. REPRODUCER STYLUS (figs. 44 and 64).**

**a. Removal.** (1) Remove left-hand backspacer rack mounting screw ((37) in fig. 44) and

the two right-hand backspacer rack mounting screws (43), and lift backspacer rack (38) out of the machine.

(2) Remove reproducer cable clamp (238) by removing its holding screw.

(3) Loosen screw (157) which secures reproducer carriage guide rod (208).

(4) Line up one of the two holes in the flywheel (71) with the end of reproducer carriage guide rod (208) and slide the guide rod out through flywheel (71).

**CAUTION: BE CAREFUL NOT TO DAMAGE THE REPRODUCER STYLUS (31) BECAUSE WHEN REPRODUCER CARRIAGE GUIDE ROD (208) IS REMOVED, REPRODUCER STYLUS (31) IS FREE TO GO TO THE SURFACE OF DRIVE MANDREL (87).**

(5) Loosen the two screws (43) which secure feed screw assembly (108).

(6) With recorder carriage assembly (243) moved to its right-hand limit of travel, end of record position, and with reproducer carriage assembly (261) moved towards the flywheel (71) so that reproducer carriage guide (205) clears reproducer safety switch (209), rotate reproducer carriage assembly (261) in a counterclockwise direction, (when looking at the ejector side of the machine), until reproducer stylus (31) is accessible for removal.

(7) Remove reproducer stylus (31) by loosening clamping screw (29).

**b. Installation.** Install reproducer stylus (31) by following the removal procedure in reverse order.

**c. Adjustment.** (1) Adjust feed screw assembly (252) as explained in paragraph 92e.

(2) Adjust backspacer rack (38) as explained in paragraph 85c.

## **108. CHANGE RECORD SWITCH** **(figs. 19 and 47).**

**CAUTION: DISCONNECT POWER SUPPLY CABLE FROM MACHINE.**

**NOTE:** The front machine change record switch (3) is located at top right of the view of the bottom of the unit plate shown in figure 47, and the rear machine change record switch (3) is located at right center of the view in figure 47.

**a. Removal.** (1) Disconnect the wiring (two leads) to the change record switch.

(2) Remove the two CHANGE RECORD switch mounting screws (270) and their associated lock-washers and washers, and remove the CHANGE RECORD switch (3) from the machine.

**b. Installation.** Reinstall the CHANGE RECORD switch (3) by following the removal procedure in the reverse order.

**CAUTION: MAKE SURE THAT THE CHANGE-OVER ACTUATING LEVER ((1) IN figs. 44 and 47) OPERATES ON ITS PIVOT FREELY, BY DISCONNECTING SPRING ((272) IN fig. 47) AND CHECKING FOR FREEDOM OF OPERATION.**

**c. Adjustment.** (1) Place the recorder carriage in its extreme right-hand position so that full movement of the change-over actuating lever (1) is obtained.

(2) Adjust the CHANGE RECORD switch (3), toward the CHANGE RECORD switch actuating cam ((211) in fig. 19), so that the roller on the CHANGE RECORD switch (3) bears on the actuating cam (211).

(3) Adjust until the CHANGE RECORD switch (3) makes an audible click showing that the switch contacts are closed.

(4) Tighten the two CHANGE RECORD switch holding screws ((270) in fig. 47) to retain this adjustment.

(5) Move the recorder carriage from its extreme right-hand position, to the left, and see that change-over actuating lever spring (272) returns the actuating lever (1) to its normal position.

(6) Should this spring (272) fail to operate properly, it indicates that the CHANGE RECORD switch is adjusted too tightly against the actuating cam (211).

(7) Restore the recorder carriage to its extreme right-hand position and adjust the CHANGE RECORD switch (3), so that its actuating lever is moved away slightly from actuating cam (211) and test again for normal operation.

(8) If sufficient adjustment cannot be obtained through the medium of CHANGE RECORD switch holding screws (270), further adjustment can be achieved by bending the CHANGE RECORD switch actuating lever.

(9) When adjusted properly, the change-over actuating lever (1) can be moved to its extreme position when the recorder carriage is moved to its extreme



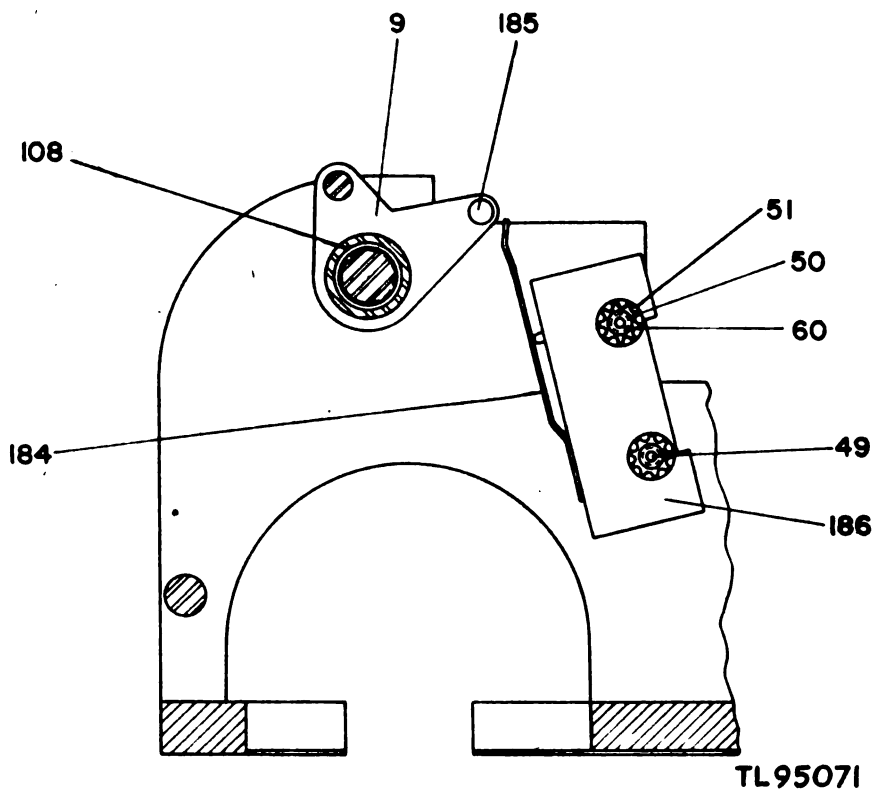


Figure 65. Ready switch assembly

Reference No.	Description
9	Recorder carriage bail assembly, complete
49	READY switch mounting screw
50	READY switch mounting screw lockwasher
51	READY switch mounting screw washer
60	READY switch mounting screw nut
108	Feed screw cover
184	READY switch actuating lever
185	Recorder carriage bail READY switch actuating pin
186	READY switch

right-hand position. Then, when the recorder carriage is moved to the left, the change-over actuating lever (1) is restored to its normal position by spring (272), and as it is restored the CHANGE RECORD switch (3) will open its contacts and an audible click will be heard.

(10) When properly adjusted, the CHANGE RECORD switch will operate during the change-over period, i.e. during the overlap from one machine to the other, or, while both machines are in operation.

(11) This timing is essential, to avoid having the CHANGE RECORD signal light indicate that a recording belt needs changing, before the alternate machine is in operation and the motor on the machine with the fully recorded record, stopped.

**CAUTION: DO NOT USE OIL ON THE ROLLERS OF THE CHANGE RECORD SWITCHES (3).**

#### **109. READY RECORD SWITCH (fig. 65).**

**CAUTION: DISCONNECT POWER SUPPLY CABLE FROM MACHINE.**

**NOTE:** See CAUTION in paragraph 83b. It will not be necessary to remove the control lever interlock, gear train assembly, or flywheel, unless replacement of the ready switch (186) is necessary.

If it is just a case of bending ready switch actuating lever (184), or tightening nut (60) on the ends of screws (49), these operations can be performed without following the disassembly procedure explained below.

**a. Removal.** (1) Remove flywheel as explained in paragraph 93a.

(2) Remove the gear train assembly and its mounting strip as explained in paragraph 94a.

(3) Remove the control lever interlock assembly as explained in paragraph 88a.

(4) Disconnect the wiring from READY switch (186), being careful to remember to which terminals these wires are connected.

(5) Remove the two screws (49), the two lock-washers (50), the two washers (51), and the two nuts (60), holding the READY switch (186) against the main frame casting while doing so, to avoid dropping parts down into the machine. Then remove the READY switch (186) from the machine.

**b. Installation.** Install the READY switch (186) by following the removal procedure in the reverse order.

**c. Adjustment.** The adjustment of READY switch (186) requires a bending of its actuating lever (184). This can be done with a pair of pliers or with a spring-bending tool.

**CAUTION: THE READY SWITCH (186) MUST BE ADJUSTED SO THAT IT OPERATES DURING THE OVER TRAVEL OF THE RECORDER CARRIAGE CONTROL LEVER AND SO THAT IT STAYS IN THE "OPERATE" POSITION WHEN THE RECORDER CARRIAGE CONTROL LEVER IS IN THE "OPERATE" POSITION. (i.e. THE OVER TRAVEL OF THE RECORDER CARRIAGE CONTROL LEVER TAKES PLACE AFTER THE FEED NUT HAS BEEN RELEASED TO ENGAGE THE FEED SCREW.)**

**BE SURE THAT THE CHANGE RECORD SWITCH (186) IS NOT IN THE "OPERATE" POSITION (CONTACTS CLOSED) BEFORE THIS OVER TRAVEL TAKES PLACE.**

**NOTE:** It is necessary for the READY switch to operate during the over travel of the recorder carriage control lever to avoid having the READY light on before the recorder stylus is properly presented to the recording belt, and the feed nut properly engaged with the feed screw.

**d. Tests.** Move the recorder carriage control lever, slowly, towards its full "operate" position, and make sure that the feed nut engages the feed screw before the READY switch clicks.

#### **110. REPRODUCER SAFETY SWITCH (figs. 33 and 44).**

**CAUTION: BE SURE A RECORDING BELT IS ON THE MACHINE. THE REASON FOR THIS IS TO AVOID DAMAGE TO THE REPRODUCER STYLUS.**

**a. Removal.** (1) Disconnect the power supply cable from the equipment.

(2) Disconnect the two wires connected to the REPRODUCER SAFETY switch (209).

(3) Remove the two **REPRODUCER SAFETY** switch screws (282) and lift the **REPRODUCER SAFETY** switch (209) out of the machine.

**b. Installation.** To install the **REPRODUCER SAFETY** switch (209) follow the removal procedure in the reverse order.

**c. Adjustment.** (1) Place the reproducer carriage in the extreme right-hand position.

(2) Operate the reproducer carriage control lever (36) twice in succession to obtain two backspaces, and leave the reproducer carriage control lever (36) in the "operate" position, upon the completion of the second backspace. This places the reproducer carriage  $\frac{1}{32}$  inch to the left of its extreme right-hand limit of travel.

(3) The reason for placing the reproducer carriage control lever (36) in the "operate" position upon completion of the second backspace, is to avoid moving the reproducer carriage while making the following adjustments on the **REPRODUCER SAFETY** switch.

(4) Loosen the **REPRODUCER SAFETY** switch mounting screws (282) and carefully move the **REPRODUCER SAFETY** switch in a direction toward the drive mandrel, until the roller on the **REPRODUCER SAFETY** switch actuating lever, contacts the extension on the reproducer carriage guide. Then carefully move reproducer safety switch (209) a bit further, in the same direction, until an audible click is heard from the **REPRODUCER SAFETY** switch. Tighten screws (282).

(5) Return the reproducer carriage control lever (36) to the "neutral" position and slide the reproducer carriage to the right, to test for reproducer **SAFETY** switch operation.

(6) The **REPRODUCER SAFETY** switch should click when the reproducer carriage is brought to a position within  $\frac{1}{32}$  inch of its extreme right-hand limit of travel.

(7) If sufficient adjustment cannot be obtained through adjusting with screws (282), the **REPRODUCER** safety switch actuating lever (210) may be bent slightly, with pliers, to provide the necessary adjustment.

**CAUTION: DO NOT USE OIL ON THE ROLLER OF THE REPRODUCER SAFETY SWITCH ACTUATING LEVER (210).**

## 111. SHOCK MOUNTING (figs. 9 and 46).

**a. Removal.** (1) All of the shock mounts are attached to the portable field case by means of screws.

(2) The four shock mounts which support the unit plate are attached by means of three screws for each, which are inserted through the outside of the field case, near the top, and screwed into tapped holes in the shock mount mounting brackets.

(3) The four shock mounts that support the amplifier system are attached to the base of the portable field case by means of four screws for each shock mount, these screws are inserted from the bottom of the case and secured by means of nuts and lockwashers on the inside of the case.

(4) In the case of the four shock mounts that support the amplifier system, each is secured to the amplifier supporting bracket by means of one screw which passes through the shock mount unit and is secured by a nut and lockwasher on the underside.

(5) Remove the unit plate shock mounts by removing the shock mount bracket holding screws.

(6) Remove the amplifier shock mounts by first removing the amplifier bracket with the four shock mounts attached. Then remove the four shock mounts from the amplifier bracket.

**b. Installation.** To install the shock mount units, follow the removal procedure in the reverse order.

## 112. SIGNAL LIGHTS (fig. 34).

**a. Removal.** (1) Remove the cover glass over each neon signal light by prying it out from the front of the control panel.

(2) Unscrew the neon lamp bulb from the front of the control panel, with the tips of the fingers.

**NOTE:** Small suction-cup tools are sometimes available for removing small signal lights of this type.

**b. Installation.** Install the neon signal lights by following the removal procedure in the reverse order.

## 113. INSPECTION.

**a. Mechanical.** (1) See that the machine, and all the parts, are free from dust and dirt at all times.

(2) Observe that there is no misalignment of any of the parts.

(3) See that there are no broken parts.

**b. Electrical.** (1) Make sure that there are no blown fuses or signal lights.

(2) See that the signal lights operate properly when their respective control switches are operated.

(3) See that there are no misaligned electrical elements.

(4) Check for loose wires and poor connections.

**NOTE:** The above inspection refers to what can be included within a few minutes observation.

#### **114. RECORDING CHECK.**

**a. General.** (1) Check recordings from each dual unit on each equipment periodically, to make sure that the recordings from both units match fairly closely and that both recordings are normal.

(2) Due to the "simultaneously recording and reproduction" feature, the record on the unit in operation at any particular time can be monitored whenever and wherever desired.

(3) One record can be played back at a point near the end of the record and subsequently, after change-over, the alternate recording belt can be played back at a point near the beginning of the record, to provide a comparison between the recording and reproduction on the two units.

(4) When time allows, and at least once a day in the case of equipment in continuous operation, a record recorded on the front unit should be played back on the front unit and then played back on the rear unit. Any difference in the quality of reproduction is a difference in the performance of the front machine and rear machine reproducing heads.

(5) Make a recording on the front machine; remove the recording belt, place it on the rear machine and make another recording adjacent to the first. These recordings, played back on either one of the dual units, manifest the difference in the performance of the recording heads on the two units by the difference in the quality of reproduction.

(6) From the above discussion, it is apparent that two recordings may be made on a recording belt, one on the front machine and one on the rear machine, the reproduction of these two recordings, on both units thus providing a measure of the relative performance of both recording heads and both reproducing heads.

#### **115. LUBRICATION.**

**CAUTION: USE (OE) OIL, ENGINE, SAE #10 SPECIAL U.S. ARMY SPEC NO. 2-104/B.**

**CAUTION: USE (GL) GREASE, LUBRICATING, SPECIAL, ORDNANCE DEPARTMENT SPEC NO. AXS-637.**

##### **a. Monthly Lubrication.**

(1) Drive mandrel main bearings, 2 to 4 drops of oil.  
(2) Drive mandrel horn bearings, 2 to 4 drops of oil.  
(3) Recorder feed screw bearings (right), 1 drop of oil.

(4) Reproducer feed screw bearings (right), 1 drop of oil.

(5) Carriage bearings, wipe carriage bearings with an oily rag.

(6) Carriage guide rods, wipe carriage guide rods with an oily rag.

(7) Feed screws, wipe feed screws with an oily rag.

(8) Motor idler pulley bearings, 1 drop of oil.

(9) Flywheel idler pulley bearings, 1 drop of oil.

**CAUTION: IN APPLYING OIL TO THE IDLER PULLEYS MENTIONED ABOVE, BE SURE TO WIPE OFF THE EXCESS OIL IMMEDIATELY, SO THAT IT WILL NOT CREEP INTO THE DRIVE BELT.**

##### **b. Quarterly Lubrication.**

(1) Remove the setscrew and insert 1 drop of oil.

(2) Reproducer feed screw bearing (left), remove the setscrew and insert one drop of oil.

(3) Control lever interlock, place a small amount of grease on the camming and sliding parts.

(4) Injector-ejector, place a small amount of grease on the finger camming surfaces and on the main ejector spring operating surfaces **ONLY**.

(5) Backspacer, place a small amount of grease on the camming surfaces.

##### **c. Semi-annual Lubrication.**

(1) Gear train bearings, 1 small drop of oil on each bearing.

**DO NOT LUBRICATE GEAR TEETH.**

##### **d. Annual Lubrication.**

(1) Idler mandrel assembly pivot shaft, repack with grease.

(2) Idler mandrel bearing, repack with grease.

**NOTE:** All of the lubrication points outlined in the previous paragraphs are above the unit plate on which the mandrels are mounted, with the exception of the idler pulley bearings which are on the other side. Access to these lubrication points above the unit plate can be made by removing both of the machine covers which protect the two pairs of mandrels. Remove the machine cover by following the procedure outlined in paragraph 97a.

**e. Location.**

**NOTE:** With both machine covers removed, there appear two identical pairs of mandrels. Inasmuch as these units are identical in every respect, the location of the above-mentioned lubrication points will be for only one pair of mandrels as follows:

**(1) Monthly Lubrication Points Above Unit Plate.**

(a) **Drive Mandrel Main Bearing.** Located at the extreme left side of the machine in line with the drive mandrel. It is indicated by the lower arrowhead of the two-headed arrow.

(b) **Drive Mandrel Horn Bearing.** Located just at the left side of the machine in line with drive mandrel. It is indicated by the arrow. Keep in mind that the oil applied to the oil hole must pass through a long tube to reach the bearing. Be sure this tube is clear.

(c) **Recorder Feed Screw Bearing (right).** Oil is applied through the small hole located near the right-hand end of the carriage bearing supporting the recorder stylus.

(d) **Reproducer Feed Screw Bearing (Right).** Oil is applied through the small hole located near the right-hand end of the carriage bearing supporting the reproducer stylus.

(e) **Carriage Bearings and Carriage Guide Rods.** These are the bearings and guide rods which support and guide the recorder and reproducer carriage assemblies.

(f) **Feed Screws.** Located inside the carriage bearings. Access through a slit on the back of the carriage bearing which latter is also the feed screw cover.

**(2) Quarterly Lubrication Points Above Unit Plate.**

(a) **Recorder Feed Screw Bearing (Left).** Re-

move the raised screw on the left-hand end of the carriage bearing indicated by arrow.

(b) **Reproducer Feed Screw Bearing (Left).** Remove the raised screw on the left-hand end of the carriage bearing indicated by the upper arrowhead of the two-headed arrow.

(c) **Injector-ejector.** Located between the two mandrels. It is the sliding part on which the records are placed into the machine and ejected from it. This part requires a small amount of grease as indicated.

(d) **Backspacer.** Consists of the rack, pawl, and spring, located on the reproducer carriage. The camming surfaces require grease as indicated.

**(3) Semi-annual Lubrication Points Above Unit Plate.**

**Gear Train Bearings.** The bearings of the two bright finished metal gears located to the left of the mandrels adjacent to the flywheel. The oil should be applied on the flywheel side of the bearing. Care should be exerted to keep oil from the gear teeth.

**(4) Annual Lubrication Points Above Unit Plate.**

(a) **Idler Mandrel Assembly Pivot Shaft Bearing.** In order to repack this bearing, it is necessary to remove the complete assembly from the bearing. To do this, remove the cotter pin, washer, and spring from the end of the shaft extending through the bearing. Remove the cotter pin from the idler mandrel shaft arm stud. Slide the complete idler shaft assembly out of the machine. Pack the bearing with grease, reverse the procedure to reassemble.

(b) **Idler Mandrel Bearing.** The bearing on which the idler mandrel rotates. Access to this bearing may be made by removing one of the two small screws on the left side of the idler mandrel. This will require use of an offset screwdriver unless accomplished at the time the complete mandrel assembly is removed from the idler pivot shaft bearing. Loosen the other screw on the same face. Separate the overlapping semicircular retainers and remove the mandrel. Pack with grease. Reverse the procedure to reassemble.

**(5) Monthly Lubrication Points Below Unit Plate.**

**NOTE:** The remaining points which require monthly lubrication are located below the unit plate. Access to these points

below the unit plate may be obtained by releasing the slide catches in the front corners of the unit plate. With these slide catches released, the unit plate may be raised upward, pivoting on the hinges in the rear, and can be supported on its two side brackets and locked in this position.

(a) With the unit plate in the raised position, it is now possible to lubricate the three idler pulley bearings, namely, the motor idler, the flywheel idler, and the jackshaft idler. By loosening and removing the nut on the end of each of the shafts mounted in the bearings, the pulleys may be removed and the oil applied.

(b) When this operation is completed and the pulleys have been returned to position, the unit plate should be returned to its horizontal position and the slide catches fastened.

## 116. MAINTENANCE CHARTS.

**a. Inspection Charts.** Maintenance inspection charts are a considerable help in servicing this equipment properly. These charts should list the various points which need periodical inspection, and check marks should be entered along side the dates inspection is made.

**b. Lubrication Charts.** It is also efficient maintenance procedure to keep lubrication charts associated with each equipment, so that check marks can be entered, to indicate what points have been lubricated, and the dates on which this has been done.

## 117. FAILURES AND REMEDIES.

**a. Too Many "Highs".** (1) Recorder stylus chipped. See paragraph 102 for "removal" and "replacement" of the recorder stylus.

(2) Recorder pressure too low. See paragraph 99c for recorder pressure adjustment.

(3) Reproducer pressure too low. See paragraph 104d for reproducer pressure adjustment.

(4) Loose recorder lead terminal screws at recorder terminal block (222) in recorder mount bracket assembly (259) in fig. 44).

(5) Rosin, or cold soldered joint, at recorder terminal block in recorder mount bracket assembly (259) in fig. 44), or at reproducer terminal block which is on top of reproducer mount bracket assembly (42) in fig. 44).

**b. Insufficient "Highs".** (1) Recorder pressure too high. See paragraph 99c for recorder pressure adjustment.

(2) Reproducer pressure too high. See paragraph 104d for reproducer pressure adjustment.

(3) Recorder stylus chipped. See paragraph 102 for recorder stylus "removal" and "replacement".

(4) Reproducer stylus chipped. See paragraph 107 for reproducer stylus "removal" and "replacement".

(5) Defective recording belt.

**c. Fading.** (1) Recorder or reproducer stylus chipped. See paragraphs 102 or 107.

(2) Recorder or reproducer pivots loose or sticky. See paragraphs 99c or 104d.

(3) Recorder or reproducer pressure too low. See paragraphs 99c or 104d.

(4) Varying feed; uneven pitch.

(5) Excessive end play in drive mandrel. See paragraph 90c.

(6) Improper recording belt "crawl". See paragraph 95e.

(7) Mandrels not parallel in vertical plane. See paragraph 95e.

**d. High Noise Level.** (1) Defective recording belt.

(2) Recorder or reproducer stylus chipped or broken. See paragraphs 102 or 107.

(3) Recording level too low. See paragraphs 43, 44, and 48b.

(4) Recorder or reproducer pressures too high. See paragraphs 99c or 104d.

(5) Rumble; caused by loose reproducer pivots. See paragraph 104b.

**e. High Crosstalk.** (1) Reproducer shield grounded on relays, at terminal block, or at reproducer volume control.

(2) Grounded reproduce monitor jack.

(3) Recording circuit ground leads loose.

(4) Defective recorder or reproducer stylus. See paragraphs 102 or 107.

**f. High Distortion.** (1) Recorder or reproducer armature off center.

(2) Recording level too high. See paragraphs 43, 44, and 48a.

(3) Defective recorder stylus or reproducer stylus. See paragraphs 102 or 107.

(4) Defective recording belt.

(5) Defective amplifier; distortion in amplifier.

**g. Poor Motion "Flutter" or "Wows".** (1) "Bumpy" motor drive belt. See paragraph 98d for replacement of motor drive belt.

(2) Sticky reduction pulley idlers. See paragraph 103.

(3) Improper drive belt alignment. See paragraph 103.

(4) Binding, causing drive belt slippage. See paragraph 103.

(5) Poor feed.

(6) Tight motor bearings. See paragraph 98.

**h. Mechanical Noise Pick-Up With Reproduce Volume Control Maximum.** (1) Check the points above under paragraph 117g.

(2) Check for scraping gears.

(3) Check for dry motor bearings and dry motor spacer washers.

**i. No Recording.** (1) When there are no modulations in the tone grooves being swaged in the recording belt, proceed as follows.

(2) Check external signal source to see that signal is being applied to the input of this equipment.

(3) Check relay operation ((K-1) and (K-2) in fig. 39). Be sure the relay contacts are "closed" when the relay is energized.

(4) Check recording head for "opens" or "grounds".

(5) Check amplifier.

(6) Check wiring.

## **118. MOISTUREPROOFING AND FUNGI-PROOFING.**

**a. General.** The operation of Signal Corps equipment in tropical areas where temperature and relative humidity are extremely high requires special attention. The following items represent problems which may be encountered in operation:

(1) Resistors, capacitors, coils, chokes, transformer windings, etc., fail.

(2) Electrolytic action takes place in resistors, coils, chokes, transformer windings, etc., causing eventual break-down.

(3) Hook-up wire and cable insulation break down. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs and crosstalk.

(5) Moisture provides leakage paths between battery terminals.

**b. Treatment.** A moistureproofing and fungi-proofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish (Lacquer, Fungus-resistant, Spec No. 71-2202 (Stock No. 6G1005.3), or equal) applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing and the description and use of tools and materials.

**CAUTION: VARNISH SPRAY MAY HAVE TOXIC EFFECTS IF INHALED. TO AVOID INHALING SPRAY, USE RESPIRATOR IF AVAILABLE; OTHERWISE, FASTEN CHEESECLOTH OR OTHER CLOTH MATERIAL OVER NOSE AND MOUTH.**

### **c. Step-by-step Instructions for Treating Speech Recorder MC-502.**

(1) **PREPARATION.** Make all repairs and adjustments necessary for proper operation of the equipment.

(2) **DISASSEMBLY.**

(a) Release trunk latches and remove cover (cover not shown in illustrations).

(b) Open lower panel door in front and slide it into position in case at top of panel.

(c) Release pivot catch on front of control panel of amplifier.

(d) Remove the amplifier from its mountings as follows:

1. Slide the amplifier forward and out of case.

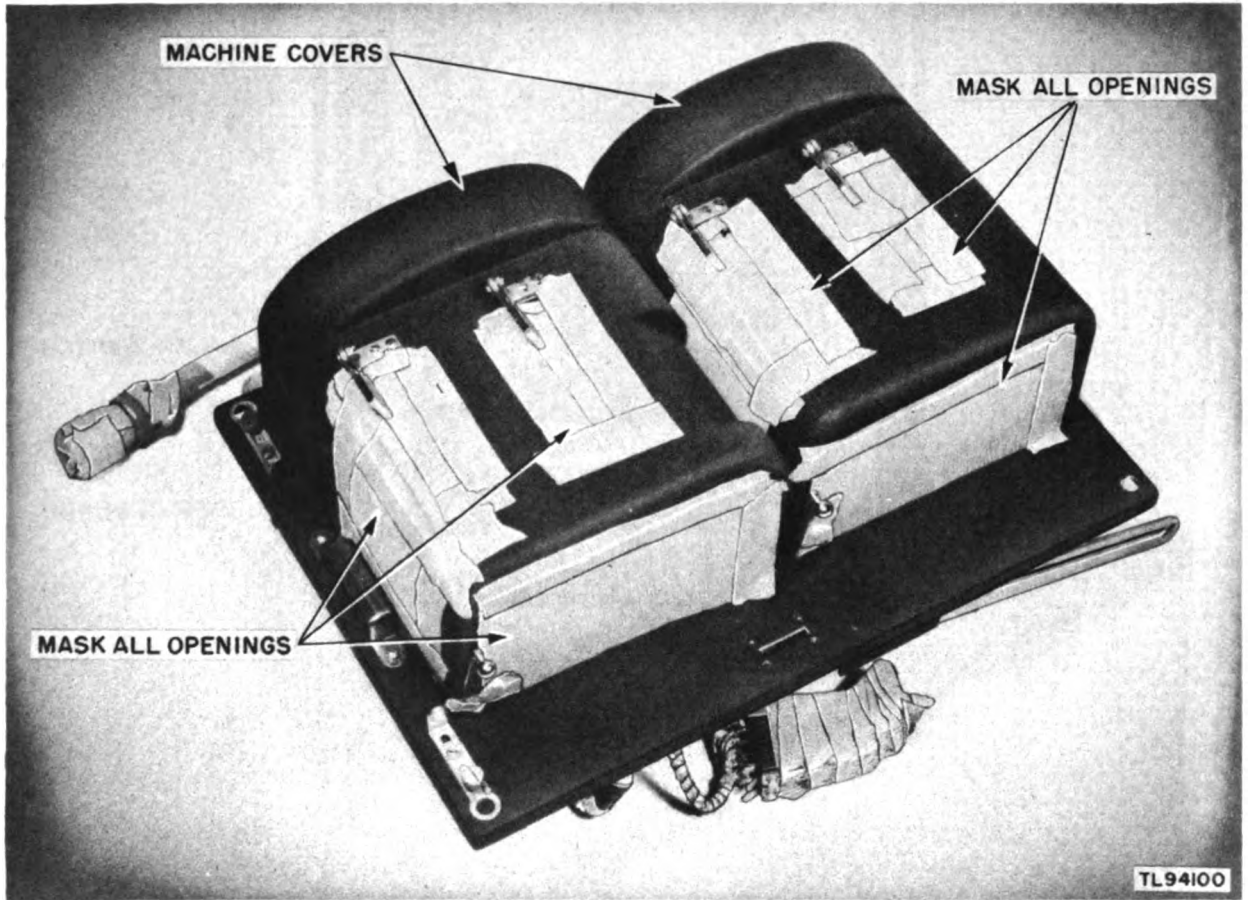
2. Disconnect the three connecting plugs from the rear.

3. Place the amplifier aside; it will be further disassembled and masked as described in subparagraphs (4) and (5) below.

(e) Release the pivot catches on the front corners of the unit plate.

(f) Remove the two mounting screws in the rear of the unit plate.

(g) Remove the nuts and washers on which the support rods are guided. These are located on the inside sides of the case.



*Figure 66. Top side of unit plate with machine covers in place*



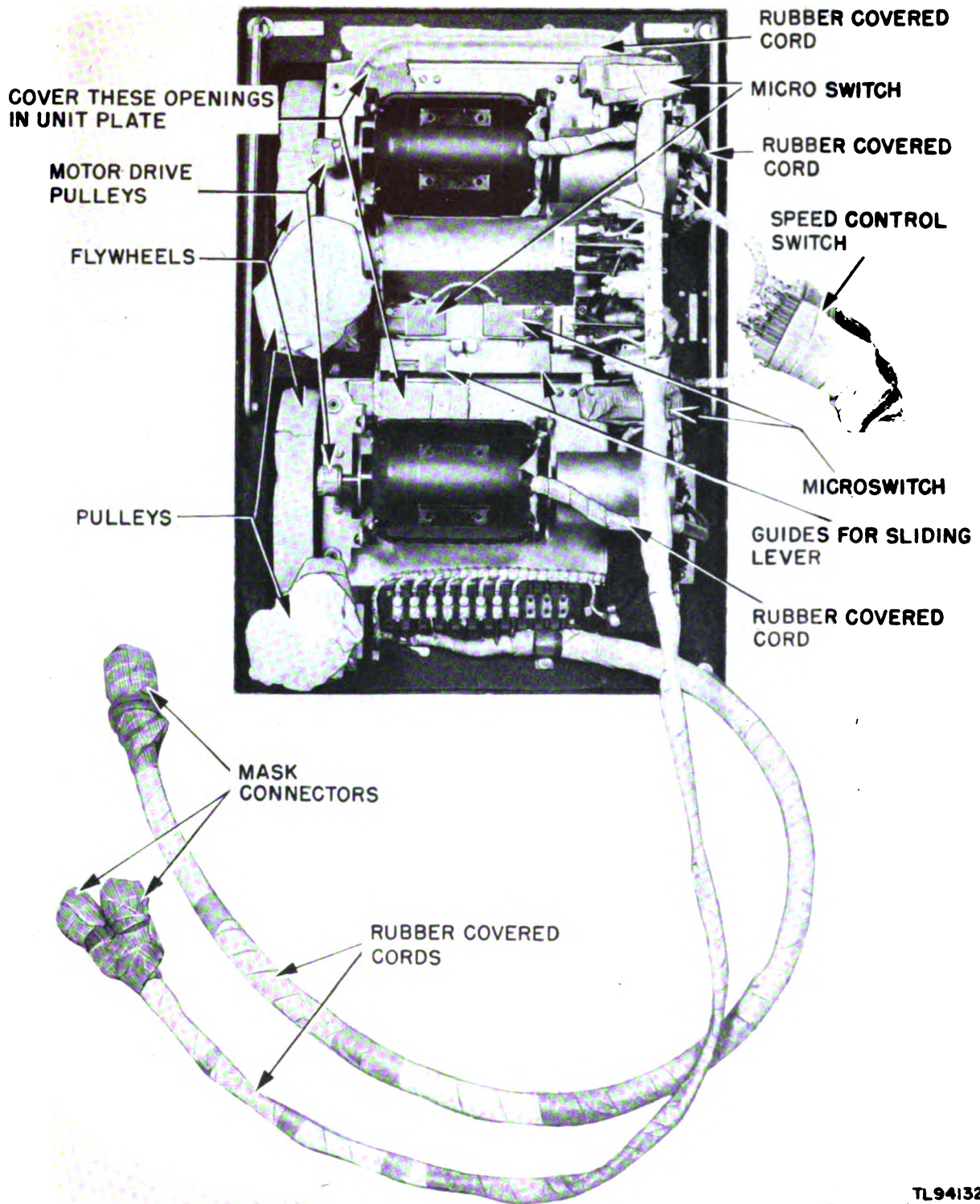


Figure 67. Under side view of unit plate of speech recorder mc-502

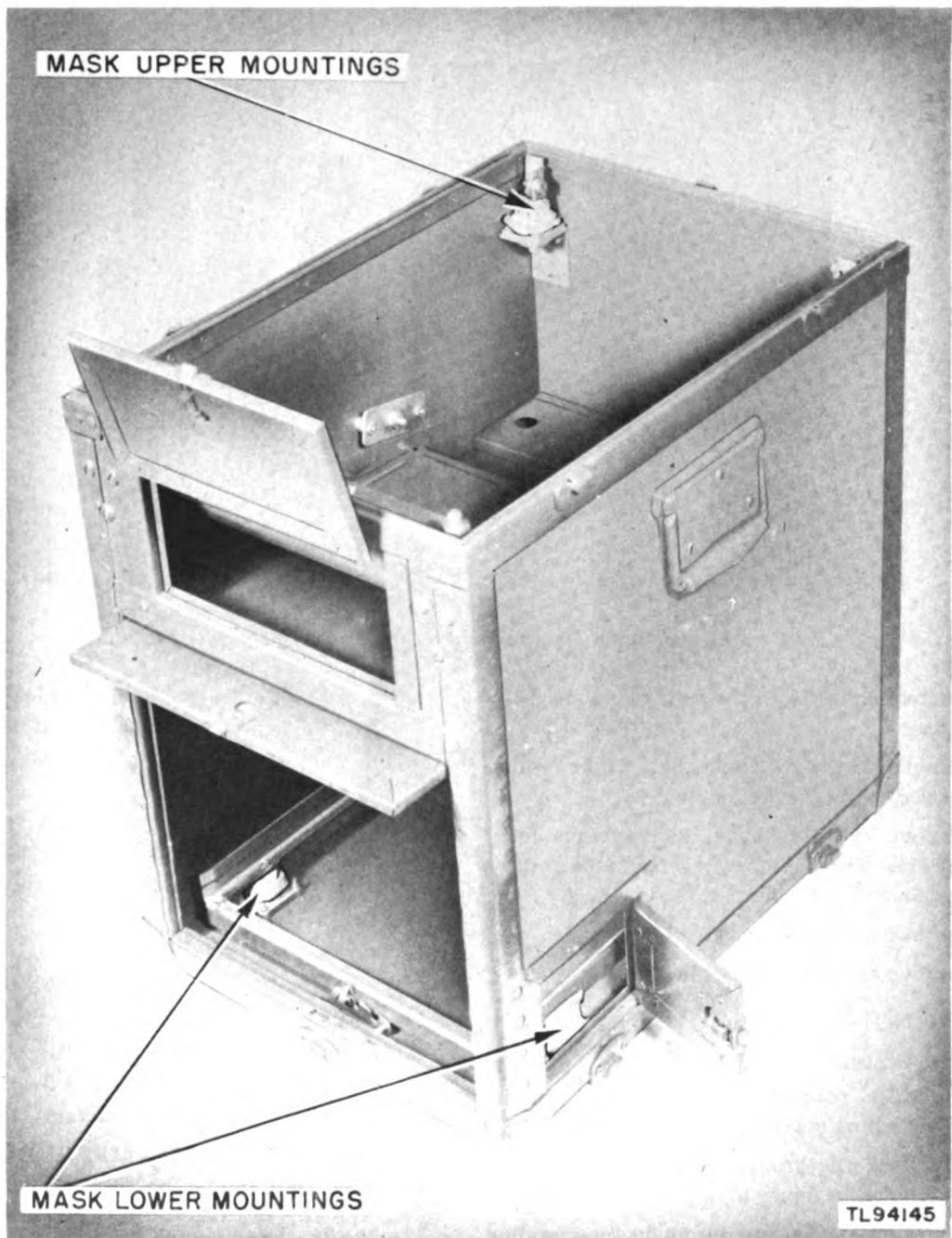


Figure 68. Case for speech recorder mc-502 .

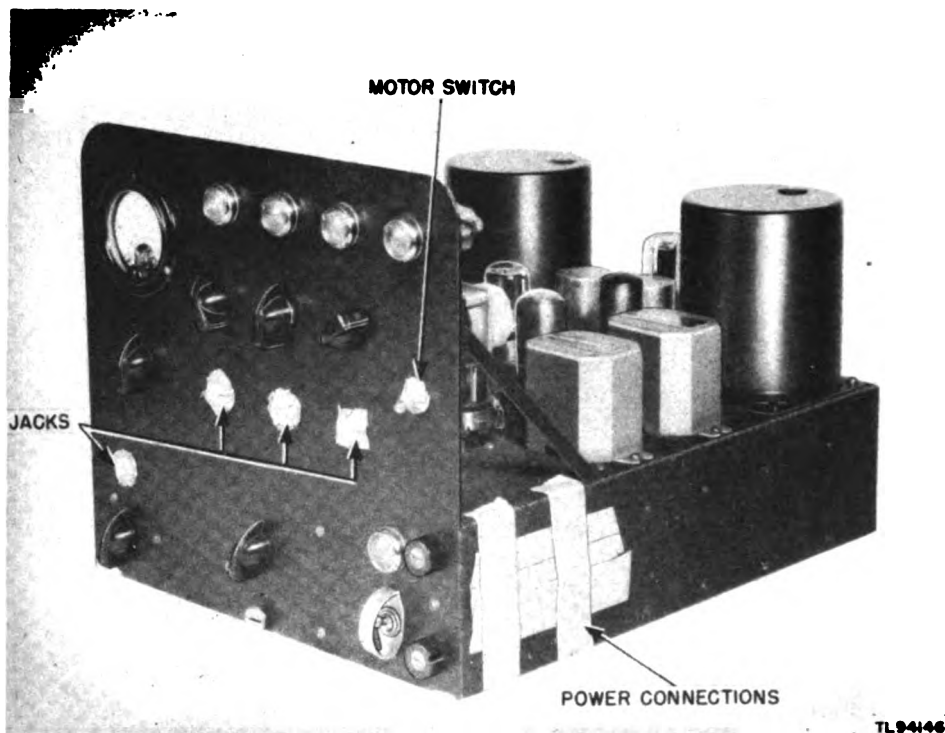


Figure 69. Front and side view of amplifier, speech recorder mc-502

(h) Remove completely the unit plate assembly from the case.

(i) Remove screws, handle, and plate which hold the speed-control switch in place.

(j) Remove both flywheel idler springs from their positions between the flywheel idler pulley studs and the main idler bracket studs.

(k) Remove the flywheel drive belts.

(l) Remove the motor drive belts.

### (3) MASKING.

#### (a) Unit Plate.

1. Mask completely all openings in the machine covers as shown in figure 66.
2. Mask the grooves in both flywheels as shown in figure 67.
3. Mask each group of pulleys by wrapping them in a piece of paper and sealing them in place with masking tape (fig. 67).
4. Mask grooves on motor drive pulley (fig. 67).
5. Mask the four microswitches (fig. 67).

6. Mask the guides on which the sliding lever rides, which actuates the microswitches located between the motors (fig. 67).

7. Mask the speed-control switch completely covering all contact leaves.

8. Mask completely all rubber-covered cords (fig. 67).

9. Mask connectors.

10. Unit plate is ready for drying.

#### (b) Case.

1. Mask completely all the rubber shock mountings as shown in figure 68.

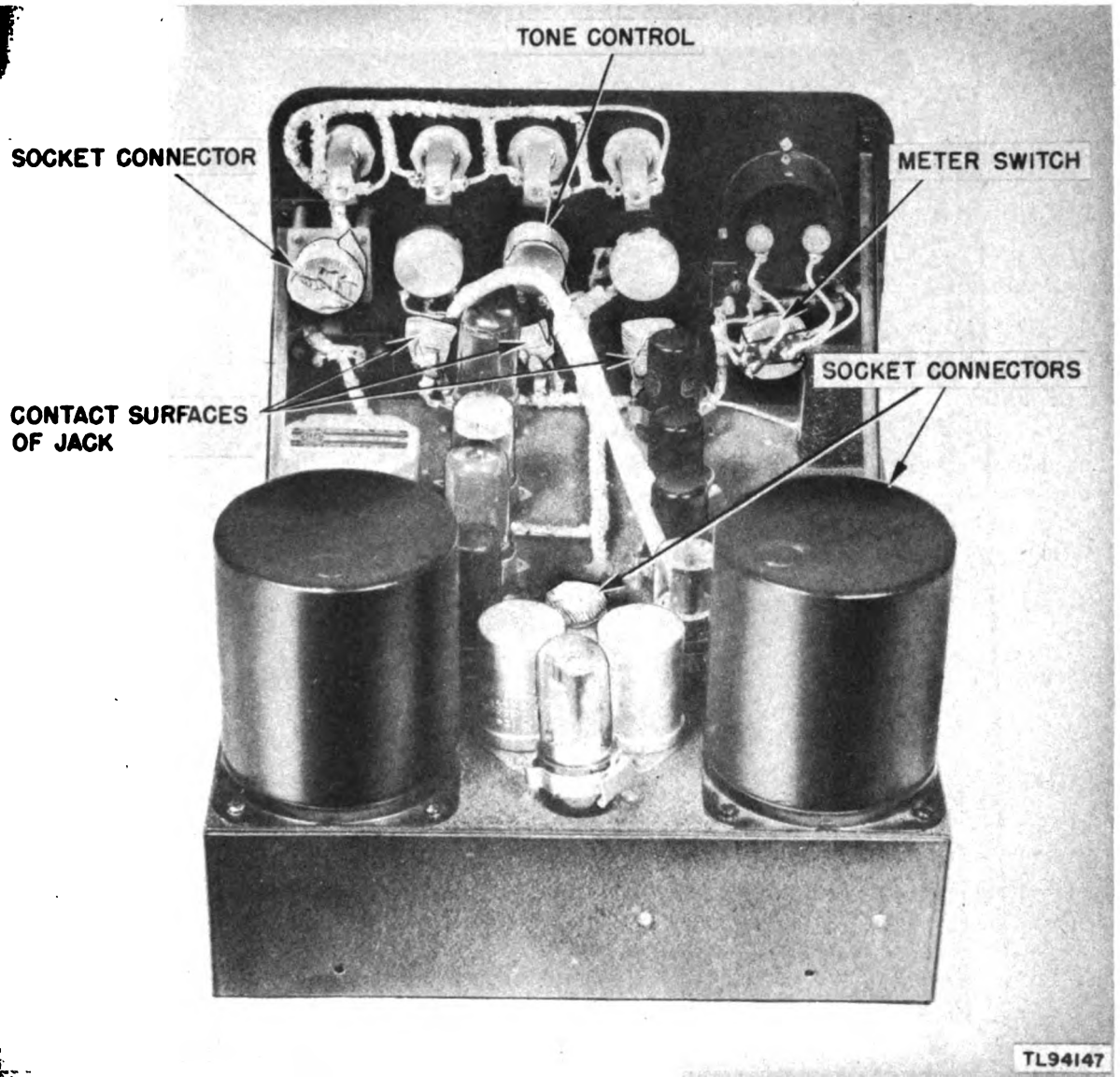
2. Case is ready for baking.

(4) **DISASSEMBLY OF AMPLIFIER.** Remove the lacing that binds the cable of wires running along the top of chassis from between the tubes to the jacks on the panel.

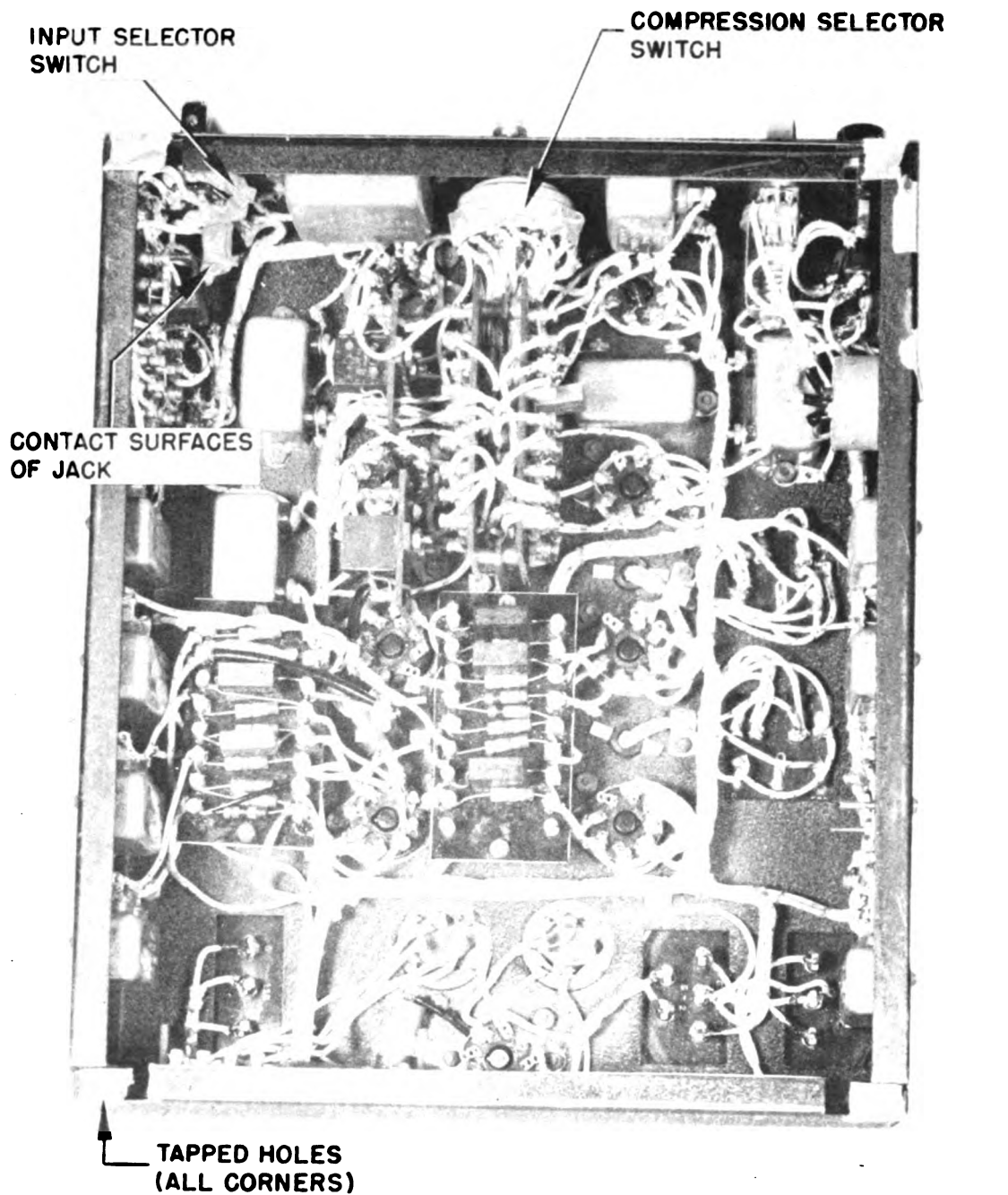
### (5) MASKING OF AMPLIFIER.

#### (a) Front and Right Side (fig. 69).

1. Mask the four jacks.
2. Mask the motor switch.
3. Mask the power connectors.



*Figure 70. Top and rear panel of amplifier for speech recorder mc-502*



TL94148

Figure 71. Bottom view of amplifier for speech recorder mc-502

**(b) Top and Rear Panel (fig. 70).**

1. Mask contact surfaces of the jacks.
2. Mask the edges of the tone control.
3. Mask all holes in the meter switch.
4. Mask all socket connectors.

**(c) Bottom (fig. 71).**

1. Mask open edges of the **COMPRESSION** selector switch.
2. Mask open edges of the **INPUT** selector switch.
3. Mask contact surfaces of jack.
4. Mask all tapped holes.
5. The complete amplifier is now ready for drying.

**(6) DISASSEMBLY OF UNIT PLATE.** To complete the moistureproofing and fungiproofing of the parts under the machine covers on the top side of the unit plate, it is necessary to remove both machine covers ( (256) in fig. 50) as follows:

**(a)** Remove the screw (214) on the front left side of the front machine cover.

**(b)** Loosen the screw (230) on the front right side of the same cover.

**(c)** Loosen the screw (230) on the rear of the right-hand side of the cover.

**(d)** Remove the front machine cover.

**(e)** Remove the rear cover by loosening the screw (230) on the rear of the right-hand side of the cover.

**(7) DRYING.** Place all the disassembled components, the case, the cover, the amplifier, and the unit plate assembly in oven or under heat lamps and dry for 4 hours and 140°F. **DO NOT EXCEED 140°F.**

**(8) VARNISHING.**

**(a)** Spray three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant,

Spec No. 71-2202 (Stock No. 6G1005.3), or equal) on the components listed in subparagraph c (2) and (4).

**(b)** Spray the inside of each of the covers (see subparagraph c (6) ).

**(c)** The following parts should be treated by applying the varnish or lacquer with a small brush, after removal of the cover.

1. The flywheels, except the grooves previously masked.
2. All the mounting castings painted black. In coating these parts, take care not to get the varnish or lacquer in the oil holes, bearings and gear teeth.
3. The backspacer rack with the exception of the teeth.
4. The reproducer carriage; that is, all parts other than the camming surfaces, pivot points, or sliding parts.

**NOTE:** Take care to keep the varnish off the mandrels, pivots, sliding surfaces, and gears, and out of tapped holes and oil holes when applying the varnish or lacquer to all parts under the machine cover.

**(9) REASSEMBLY.**

**(a)** Make sure that all parts that have been sprayed or brushed are dry.

**(b)** Remove all masking tape.

**(c)** Clean all contacts with varnish remover, and burnish the contacts.

**(d)** Reassemble the equipment by reversing the procedures for disassembly and test its operation.

**(10) MARKING.** Mark the equipment with "MFP" and the date of treatment.

**EXAMPLE:** MFP - 10 Sep 1944.

# SECTION V

## Supplementary Data

### 119. TUBE PIN DATA.

TUBE TYPE	PIN (TERMINAL) NUMBERS							
	1	2	3	4	5	6	7	8
JAN 5Y3GT (VT-197A)	—	H	—	P	—	P	—	H
JAN 6H6 (VT-90)	Sh	H	Dp	K	Dp	—	H	K
JAN 6J5 (VT-94)	Sh	H	P	—	G	—	H	K
JAN 6SK7 (VT-117)	Sh	H	Su	G	K	Sc	H	P
JAN 6SL7GT (VT-229)	G <sub>2</sub>	P <sub>2</sub>	K <sub>2</sub>	G <sub>1</sub>	P <sub>1</sub>	K <sub>1</sub>	H	H
JAN 6V6GT (VT-107)	Sh	H	P	Sc	G	—	H	K

### NOMENCLATURE

Dp — Diode Plate

P — Plate

G — Grid

Sc — Screen Grid

H — Heater

Sh — Shell

K — Cathode

Su — Supressor Grid

### 120. AMPLIFIER TUBE SOCKET VOLTAGE DATA

All voltages measured to ground using 1,000-ohm/volt meter

\* Use 0-10 volt range

∅ Use 0-250 volt range

# Use 0-100 volt range

X Use 0-500 volt range

The tubes at (V-1), (V-2), and (V-3), have different voltages with the COMPRESSION selector switch in the "CODE" position.

The tubes (V-4) to (V-9) inclusive, have the same voltages for all positions of the COMPRESSION selector switch.

SOCKET NUMBER	TUBE TYPE	1	2	3	4	5	6	7	8
V-1	JAN 6SK7 (VT-117)	0	3.15 AC	0.82*	0	0.82*	14.5∅	3.15 AC	24.∅
V-1	(Code Position)	0	3.15 AC	4.4*	0	4.4*	58.†∅	3.15 AC	58.†∅
V-2	JAN 6SK7 (VT-117)	0	3.15 AC	0.75*	0	0.75*	20. ∅	3.15 AC	39. ∅
V-2	(Code Position)	0	3.15 AC	0.6 *	0	0.6 *	24.†∅	3.15 AC	45.†∅
V-3	JAN 6SK7 (VT-117)	0	3.15 AC	0.95*	0	0.95*	20. ∅	3.15 AC	34. ∅
V-3	(Code Position)	0	3.15 AC	0.95*	0	0.95*	22.†∅	3.15 AC	38. ∅
V-4	JAN 6H6 (VT-90)	0	3.15 AC	0.3 *	0.2*	0.2 *	0	3.15 AC	0
V-5	JAN 6J5 (VT-94)	0	3.15 AC	94. ∅	0	0	0	3.15 AC	3.65*
V-6	JAN 6V6GT (VT-107)	0	3.15 AC	310.X	240.X	0	240. X	3.15 AC	13. #
V-7	JAN 6SL7GT (VT-229)	0	50. ∅	1.*	0	46.∅	.9*	3.15 AC	3.15 AC
V-8	JAN 6V6GT (VT-107)	0	3.15 AC	310.X	240.X	0	0	3.15 AC	13. #
V-9	JAN 5Y3GT (VT-197A)	0	360. X	0	HVAC	0	HVAC	0	360. X

†Leave test prod in contact for 15 seconds to allow code circuit AVC to fully release.

Measurements taken on 115V — 60 cycle line.

**121. POWER SUPPLY FILTER SECTIONS, VOLTS TO GROUND (fig. 39).**

In the following table:

Point (1) is at pin (8) at tube (V-9) (ahead of R-50).....	340-365 volts X
Point (2) is between R-50 and R-51.....	300-325 volts X
Point (3) is between R-51 and R-52.....	210-235 volts X
Point (4) is between R-52 and R-53.....	185-210 volts X
Point (5) is between R-53 and R-54.....	170-190 volts X
Point (6) is beyond R-54 (on the load side).....	160-180 volts X

**122. AMPLIFIER RESISTANCE TEST CHART (fig. 39).**

JUMPER CONNECTED ACROSS C-26 TO GROUND. RESISTANCE MEASURED FROM SOCKET PIN TO GROUND

Tube	Pin #1	Pin #2	Pin #3	Pin #4	Pin #5	Pin #6	Pin #7	Pin #8
V-1 CODE	0	H	26,500	.695 MEG	26,500	0.29 MEG	H	0.29 MEG
V-1 2-1	0	H	1,500	.695 MEG	1,500	1.04 MEG	H	0.29 MEG
V-1 4-1	0	H	1,500	.695 MEG	1,500	1.04 MEG	H	0.29 MEG
V-2 CODE	0	H	1,000	11.0 MEG	1,000	0.115 MEG	H	0.24 MEG
V-2 2-1	0	H	1,000	1.325 MEG	1,000	1.02 MEG	H	0.24 MEG
V-2 4-1	0	H	1,000	1.325 MEG	1,000	1.02 MEG	H	0.24 MEG
V-3 CODE	0	H	1,500	11.15 MEG	1,500	1.03 MEG	H	0.25 MEG
V-3 2-1	0	H	1,500	1.475 MEG	1,500	1.03 MEG	H	0.25 MEG
V-3 4-1	0	H	1,500	1.175 MEG	1,500	1.03 MEG	H	0.25 MEG
V-4 CODE	0	H	10.0 MEG				H	0
V-4 2-1	0	H	0.325 MEG				H	0
V-4 4-1	0	H	1.325 MEG				H	0
V-5 VOL. CONT. MAX.	0	H	.11 MEG		0.5 MEG		H	3,550
V-6	0	H	280	0.01 MEG	.47 MEG	0.01 MEG	H	360
V-7 VOL. CONT. MAX.	0.5 MEG	.49 MEG	4950	0.52 MEG	.49 MEG	4,700	H	H
V-8	0	H	500	0.01 MEG	.47 MEG	0	H	360
V-9		500		160	0	160		500

NOTE: CONSIDER PLUS OR MINUS 10% RESISTOR TOLERANCE WHEN COMPARING ACTUAL RESISTANCE MEASUREMENTS WITH FIGURES ABOVE.

**123. REFERENCE PARTS LIST FOR SPEECH RECORDER MC-502 AND SPEECH REPRODUCER MC-503**

Reference No.	Description	Figure No.	
		TM11-2542 MC-502 Manual	TM11-2543 MC-503 Manual
1	Change-over actuating lever	19, 33, 44, 47	
2	Change-over actuating lever actuating pin	19, 33	
3	CHANGE RECORD switch	19, 33, 47, 48	
4	Change-over assembly, complete	19, 47	
5	Change-over assembly connecting arm	19, 33	
6	Change-over assembly sliding member for front machine	19, 48	
7	Change-over assembly sliding member for rear machine	19, 48	
8	Change-over assembly sliding member spring	19, 48	
9	Recorder carriage bail assembly, complete	24, 33, 52, 65	
10	Control interlock slide bar	24, 49	18, 33
11	Control interlock intermediate lever, complete	24, 49	18, 33
12	Control interlock lock lever	24, 49	18, 33
13	Control interlock lock stud	24, 59	18, 40
14	Reproducer carriage bail assembly, complete	24	18
15	Injector-ejector operating lever assembly, complete	24, 44, 50, 52, 59	3, 18, 31, 40



**123. REFERENCE PARTS LIST FOR SPEECH RECORDER MC-502 AND SPEECH REPRODUCER MC-503 (Continued)**

Reference No.	Description	Figure No.	
		TM11-2542 MC-502 Manual	TM11-2543 MC-503 Manual
16	Injector-ejector operating lever assembly actuating link	24, 59	18, 40
17	Injector-ejector lock release lever	24, 59	18, 40
18	Injector-ejector lock release lever lock lever	24, 59	18, 40
19	Recorder anvil assembly frame	24, 58	18, 39
20	Recorder anvil	24, 58, 61	18, 39
21	Recorder (permanent) magnet	5, 31	
22	Recorder field coil	5, 31	
23	Recorder stylus clamping screw	5, 31, 61	
24	Recorder stylus	5, 31, 61	
25	Recorder armature	31	
26	Reproducer case	7, 32	5, 22
27	Reproducer crystal element clamp	32	22
28	Reproducer crystal element	32	22
29	Reproducer stylus clamping screw	7, 32, 64	5, 22, 44
30	Reproducer armature bearing (rubber)	32	22
31	Reproducer stylus	7, 32, 64	5, 22, 44
32	Reproducer armature	32	22
33	Backspacer pawl spring bracket mounting screw	45	32
	Reproducer pressure arm pivot screw	64	44
34	Backspacer pawl spring bracket	45	32
35	Backspacer pawl spring	45	32
36	Carriage control lever	44, 45, 50, 52, 54, 61, 64	3, 31, 32, 35, 44
37	Backspacer rack holding screw (LH)	44, 45, 52, 54	32, 35
38	Backspacer rack	44, 45, 64	32, 44
39	Backspacer pawl	45	32
40	Backspacer pawl holding screw	45	32
41	Backspacer pawl adjusting screw	45	32
42	Reproducer mount bracket	7, 44, 45, 64	5, 31, 32, 44
43	Backspacer rack holding screw (RH)	44, 45, 52	31, 32
	Motor (MC-502) pulley setscrew	62	
44	Change-over slide member spacer	48	
45	Change-over slide assembly holding screw	48	
46	Change-over slide assembly spacer	48	
47	Change-over slide assembly mounting plate	48	
48	Change-over slide member holding screw	48	
49	Change-over switch mounting screw	48	
	READY switch mounting screw	65	
50	Change-over switch mounting screw lockwasher	48	
	READY switch mounting screw lockwasher	65	
51	Change-over switch mounting screw washer	48	
	Injector-ejector operating lever assembly intermediate link holding screw washer	59	40
	READY switch mounting screw washer	65	
52	Control interlock slide bar holding screw	49	33
	Recorder lift cam holding screw	61	
53	Control interlock assembly mounting holes	49	33

**e. Adjustment.** (1) Remove the idler mandrel from the idler mandrel shaft as explained in paragraph 95b.

(2) Reinstall the idler mandrel shaft assembly, less the idler mandrel as explained in paragraph 95d.

(3) To adjust the timing between lock release lock lever (18) and lock release lever (17), make sure while operating injector control lever (15), that lock release lock lever (18) locks lock release lever (17), before ejector lock lever (141) releases ejector slide (150).

(4) If this timing is not obtained, loosen screws (157), and slide bracket (156) forward, taking advantage of the tolerance in the mounting holes, to obtain the proper timing.

**NOTE:** The reason that this timing is so essential is as follows:

Failure of lock release lock lever (18) to lock the ejector lock release lever (17) prior to the operation of the ejector slide (150), will cause the idler mandrel to maintain tension on the recording belt, when the ejector slide (150) is trying to eject the recording belt, thus causing jamming of the ejector mechanism, and damage to the recording belt.

This will only happen if the ejector control lever (15) is not pulled through its full travel, when this "out-of-timing" condition exists.

(5) Before reinstalling the idler mandrel, lubricate the cam surface on the injector fingers (148) with grease.

(6) Remove the idler mandrel shaft assembly and reinstall the idler mandrel on its shaft as explained in paragraph 95c.

(7) Reinstall the idler mandrel assembly as explained in paragraph 95d.

## **97. MACHINE COVERS (fig. 50).**

### **a. Removal.**

**CAUTION:** BEFORE ATTEMPTING TO REMOVE MACHINE COVERS (256), BE SURE THAT THE CARRIAGE CONTROL LEVERS (36) ARE IN THE "NEUTRAL" POSITION, AND THAT THE CARRIAGES ARE MOVED TO APPROXIMATELY THEIR CENTRAL POSITION, TO

**AVOID CATCHING THE COVERS (256) OR TIME INDICATOR PLATES (257) ON THE CARRIAGE CONTROL LEVERS (36) DURING REMOVAL.**

**ALWAYS REMOVE THE FRONT MACHINE COVER (256) FIRST.**

(1) To remove the front machine cover (256) remove screw (214) and loosen the two screws (230) about two turns.

(2) There is a detent on the lower left-hand edge of cover (256) in the center, which hooks the cover to the unit plate. In removing the cover (256), press in on the lower left-hand edge of the cover, to release this detent. Then lift cover (256) vertically off the machine.

(3) In removing the rear machine cover (256), follow the above procedure, with the exception that there is no screw (214) to remove. Simply loosen the one screw (230) about two turns.

### **b. Installation.**

**CAUTION:** WHEN INSTALLING THE MACHINE COVERS (256) ALWAYS INSTALL THE REAR MACHINE COVER FIRST, AND BE SURE TO REPLACE EACH COVER ON THE PARTICULAR MACHINE (FRONT OR REAR) FROM WHICH IT WAS REMOVED.

**BE CAREFUL NOT TO PINCH THE REPRODUCER CABLE BETWEEN THE MACHINE COVER AND THE UNIT PLATE.**

**USE A "HINGING MOTION" WHEN INSTALLING THE MACHINE COVERS, AS THOUGH THE COVERS WERE HINGED AT THE LOWER FRONT EDGE.**

(1) Installing the machine covers (256) by following the removal procedure in the reverse order.

(2) After the covers have been installed, move the recorder and reproducer carriages to their extreme right and left-hand positions to test for freedom of movement.

## **98. MOTOR ASSEMBLY (figs. 47, 60, and 62).**

### **a. Removal.**

**CAUTION:** DISCONNECT POWER SUPPLY FROM EQUIPMENT. WHEN PROCEEDING WITH THE

Reference No.	Description
20	Recorder anvil
23	Recorder stylus clamping screw
24	Recorder stylus
36	Carriage control lever
52	Recorder lift cam holding screw
87	Drive mandrel
94	Feed nut assembly mounting screw lockwasher
95	Recorder carriage control lever stop
206	Reproducer carriage guide prong (adjustable)
207	Reproducer carriage guide prong (adjustable) holding screw
208	Reproducer carriage guide rod
213	Reproducer carriage guide
216	Recorder and reproducer pivot screw locknut
217	Recorder and reproducer mount bracket mounting screw
222	Recorder and reproducer terminal block
228	Recorder and reproducer pressure arm adjusting screw
231	Recorder and reproducer carriage control lever connecting screw
232	Recorder cable (front and rear cables are different lengths)
233	Recorder lift cam
234	Recorder pressure spring
235	Recorder pressure adjusting arm
236	Recorder pivot screw
237	Recorder carriage guide
239	Recorder cable clamp and terminal block bracket screw
240	Recorder cable clamp
243	Recorder carriage assembly, complete
258	Recorder
259	Recorder mount bracket assembly, complete
264	Recorder lift cam roller pin
281	Recorder terminal block bracket

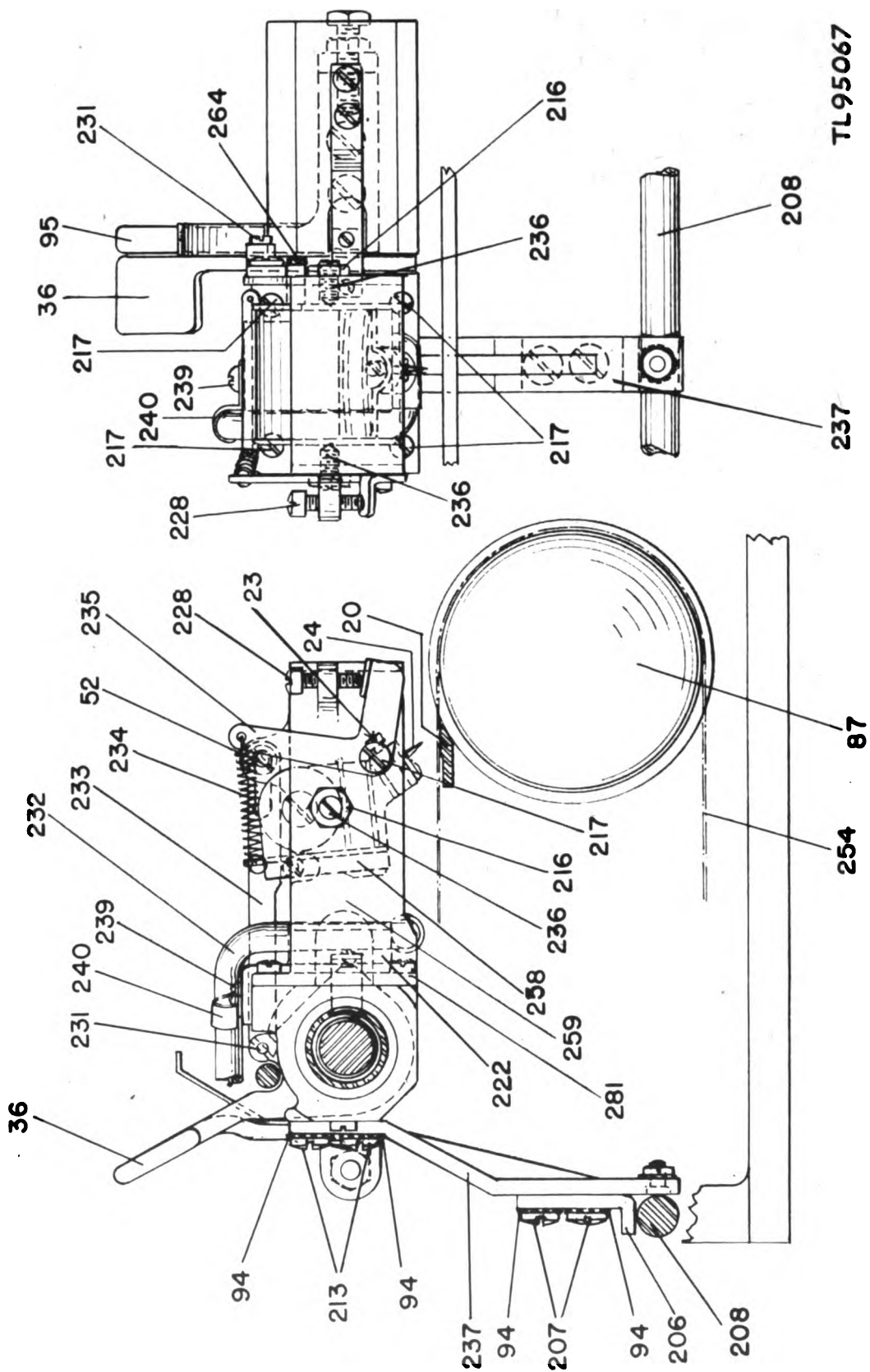


Figure 61. Recorder carriage assembly

FOLLOWING INSTRUCTIONS BE CAREFUL TO AVOID DROPPING THE MOTOR TO CAUSE IT TO HANG ON ANY ONE OF THE MOTOR SUSPENSION SPRINGS ((197) in fig. 60) THEREBY TENDING TO DEFORM THE SPRINGS OR STRETCH THEM OUT OF SHAPE.

- (1) Remove motor drive belt ((249) in fig. 60) from motor drive pulley (273).
- (2) Remove the five motor leads from terminal board ((TB-12) in fig. 47) in the case of the front machine and (TB-13) in the case of the rear machine.
- (3) Remove the two motor safety-mount mounting screws ((199) in fig. 60) and the two lock-washers (191).
- (4) To remove the motor (187) from the four suspension supports, remove suspension stud nut (193), being careful not to rotate stud (192) while doing so. This is accomplished by inserting a screwdriver in the screwdriver slot in stud (192), holding the screwdriver stationary in this position, while removing suspension stud nut (193), allowing the latter to slide down the screwdriver bit.
- (5) Remove insulating washers (194) and lift the motor assembly out of the machine.

**CAUTION: BE CAREFUL NOT TO LOSE ANY OF THE VARIOUS PARTS ASSEMBLED ON MOTOR SUSPENSION STUD (192).**

- b. Disassembly.** (1) Loosen the two motor pulley setscrews (43) and remove motor pulley (273) from the motor pulley shaft (fig. 62).
- (2) Remove the two motor mount brackets (204), one on either end of the motor, by removing the four motor torque-mount mounting screws (190), two for each bracket, and their associated lock-washers (191).
- (3) Remove the four motor torque-mounts, two on each end of the motor, by removing the two motor end cap screws (188) associated with each torque-mount.
- (4) Disassemble the motor by removing either of the end caps, which makes the armature and the spacers on the armature shaft accessible for removal.
- (5) Disassemble the motor suspension spring assembly (after insulating washers (194) have been

removed) by removing insulating sleeve (195) from stud (192).

- (6) Remove cup washer (196) and unscrew stud (192) from motor suspension spring (197).
- (7) Unscrew stud (198) from the machine.

**CAUTION: THIS IS A LEFT-HAND THREAD.**

**c. Reassembly.** (1) Reassemble the motor suspension spring assembly by following the disassembly procedure in the reverse order.

**CAUTION: ON REASSEMBLY BE CAREFUL TO REASSEMBLE EXACTLY AS SHOWN IN FIGURE 60.**

- (2) Reassemble the motor assembly by following the disassembly procedure in the reverse order.
- (3) Check to see that the motor armature rotates freely. If there is a bind in the motor armature, tap lightly with a screwdriver handle on the motor drive shaft, to relieve the bind. It should not require more than one or two light taps with a screwdriver handle to accomplish the desired result.
- (4) When the bearings are aligned, check the end play at four points, through one complete revolution of the armature, thus checking every 90°.
- (5) The motor drive shaft should rotate freely and should move endwise freely at any one of the four points checked.
- (6) Check to see that the two motor drive pulley setscrews (43) are tight, thus securing the motor drive pulley (273) tightly to the motor shaft.

**d. Installation.** (1) Reinstall the motor assembly by following the removal procedure in the reverse order.

- (2) Reinstall the motor drive belt (249).
- (3) If a new motor drive belt is to be installed, place the proper twist in the motor drive belt by suspending it in a normal manner on the fingers of the two hands with the fingers held in a vertical position. Twist the motor drive belt by rotating either hand in a clockwise direction, when facing the back of the hand. After making this twist, bring the two end loops of the motor drive belt together to form a double wrap belt, with a crossover and proceed with the motor drive belt installation, aligning the belt as shown in figure 62.

**e. Tests.** (1) Test the motor for proper operation by starting and stopping it by means of the

MOTOR "ON-OFF" switch on the control panel or the remote MOTOR CONTROL foot switch.

(2) Check to see that the motor pulley (273) is properly aligned with reduction pulley (166).

## 99. RECORDER (figs. 52 and 61).

**a. Removal.** (1) Remove screw (239) which holds recorder cable clamp (240) and the recorder terminal block bracket.

(2) Lift recorder terminal block bracket (281), with recorder terminal block (222) attached, far enough out of the machine to remove the terminal block cover.

(3) Remove the two recorder leads from the recorder terminal block (222); replace the recorder cable leads; replace the recorder terminal block cover, and lay the terminal block one side, attached to the recorder cable, until it is needed for reinstallation.

(4) Unhook recorder pressure spring (234) from recorder pressure adjusting arm (235).

(5) Unscrew lift cam roller pin (264).

**CAUTION: WHEN REMOVING ROLLER PIN (264), BE CAREFUL NOT TO ALLOW THE RECORDER STYLUS (24) TO HIT THE ANVIL (20) AND BE DAMAGED.**

**THERE ARE TWO ROLLERS ON ROLLER PIN ASSEMBLY (264), ONE BRASS AND ONE STEEL ROLLER. THE STEEL ROLLER SHOULD BE ADJACENT TO THE HEAD OF THE SCREW IN ROLLER PIN ASSEMBLY (264). SHOULD THERE BE ANY QUESTION REGARDING THEIR IDENTITY, CHECK BY BRINGING THEM NEAR THE PERMANENT MAGNET IN RECORDER (258). THE STEEL ROLLER WILL BE ATTRACTED BY THE MAGNET.**

(6) Rotate recorder assembly (258) in a counter-clockwise direction (when looking at the ejector side of the machine) and remove recorder stylus (24) by loosening clamping screw (23).

(7) Loosen lock nut (216) and pivot screw (236) ON ONE SIDE ONLY all the way out and remove recorder assembly (258) from the machine.

**NOTE:** Removing only one pivot screw (236) maintains the recorder "central" adjustment and eliminates the necessity

for readjusting recorder carriage assembly stop screw (98) for left-hand  $\frac{1}{8}$ " margin on the record, upon reinstallation.

**b. Installation.** Install recorder assembly (258) by following the removal procedure in the reverse order.

**c. Adjustment.** (1) Check to see that recorder assembly (258) is centrally located between the two sides of recorder mount bracket (259).

(2) Adjust pivot screw (236) so that recorder assembly (258) pivots freely under its own weight (with pressure spring (234) disconnected) and without end play.

(3) Check recorder stylus pressure by means of a pressure gauge, hooked to the guard at the stylus tip and observe the indication on the pressure gauge when the recorder stylus is lifted so that it just clears, by not more than the thickness of an ordinary sheet of paper, the recording belt, with the recorder carriage control lever (36) in the "operate" position.

**NOTE:** The recorder stylus pressure should be 4.75 ounces.

(4) Adjust the recorder stylus pressure by means of adjusting screw (228) which moves adjusting arm (235) to increase or decrease the tension on recorder pressure spring (234).

## 100. RECORDER CARRIAGE GUIDE (fig. 61).

**a. Removal.** Remove the two screws (213) and their associated lockwashers, which hold recorder carriage guide (237) to the recorder carriage assembly.

**CAUTION: BE CAREFUL NOT TO DAMAGE THE RECORDER STYLUS (24) WHEN PROCEEDING WITH THE FOLLOWING INSTRUCTIONS BECAUSE WHEN RECORDER CARRIAGE GUIDE (237) IS REMOVED, RECORDER STYLUS (24) IS FREE TO GO TO RECORDING ANVIL (20) AND IS NOT UNDER THE CONTROL OF CARRIAGE CONTROL LEVER (36).**

**b. Installation and Adjustment.** (1) When installing recorder carriage guide (237) by means of the two screws (213) and their associated lockwashers, have the two screws (207) loose, and, moving recorder carriage guide (237) to the right

and to the left, locate it at approximately the mid-point in this lateral travel, and tighten screws (213).

(2) Applying pressure (towards the rear of the machine) to the recorder carriage at the back of recorder carriage control lever stop (95), to make sure guide (237) is squarely against the back surface of recorder carriage guide rod (208), pull adjustable guide prong (206) down against the top surface of recorder carriage guide rod (208) and see that it seats squarely thereon. Tighten screws (207).

(3) With recorder carriage control lever (36) in the "neutral" position, move the recorder carriage to the right and to the left to check for freedom of movement and to see that there is no bind between recorder carriage guide (237) and recorder carriage guide rod (208).

(4) If there is a bind, slight tapping with a screw-driver handle at the elbow in recorder carriage guide (237) will aid in freeing the bind.

(5) Properly adjusted, recorder carriage guide (237) should move freely on recorder carriage guide rod (208) with practically no play.

#### **101. RECORDER MOUNT BRACKET ASSEMBLY (figs. 52 and 61).**

**a. Removal.** (1) Remove screw (239) which holds recorder cable clamp (240) and recorder terminal block bracket (281).

(2) Lift recorder terminal block bracket (281), with recorder terminal block (222) attached, far enough out of the machine to remove the terminal block cover.

(3) Remove the two recorder leads from recorder terminal block (241); replace the recorder cable leads; replace the recorder terminal block cover, and lay terminal block (241) to one side attached to the recorder cable, until it is needed for reinstallation.

(4) Unhook recorder pressure spring (234) from recorder pressure adjusting arm (235).

**NOTE:** This procedure is suggested by way of making ready to remove the recorder stylus (24) to avoid damage thereto, prior to removal of recorder mount bracket assembly (259).

(5) Unscrew lift cam roller pin (264).

**CAUTION:** WHEN REMOVING ROLLER PIN (264), BE CAREFUL NOT TO ALLOW RECORDER STYLUS (24)

TO HIT THE ANVIL (20) AND BE DAMAGED.

THERE ARE TWO ROLLERS ON ROLLER PIN ASSEMBLY (264), ONE BRASS AND ONE STEEL ROLLER. THE STEEL ROLLER SHOULD BE ADJACENT TO THE HEAD OF THE SCREW IN ROLLER PIN ASSEMBLY (264). SHOULD THERE BE ANY QUESTION REGARDING THEIR IDENTITY, CHECK BY BRINGING THEM NEAR THE PERMANENT MAGNET IN RECORDER (258). THE STEEL ROLLER WILL BE ATTRACTED BY THE MAGNET.

(6) Rotate recorder assembly (258) in a counter-clockwise direction (when looking at the ejector side of the machine) and remove recorder stylus (24) by loosening clamping screw (23).

(7) Remove screw (231) connecting recorder carriage control lever (36) and recorder lift cam (233).

(8) Remove the four recorder mount bracket mountings screws (217) and lift recorder mount bracket assembly (259) out of the machine.

**b. Disassembly.** For removal and replacement of recorder assembly (258) see paragraph 99.

**c. Installation.** Install recorder mount bracket assembly (259) by following the removal procedure in reverse order.

#### **102. RECORDER STYLUS (figs. 52 and 61).**

**a. Removal.** (1) Remove screw (239) which holds recorder cable clamp (240) and recorder terminal block bracket (281).

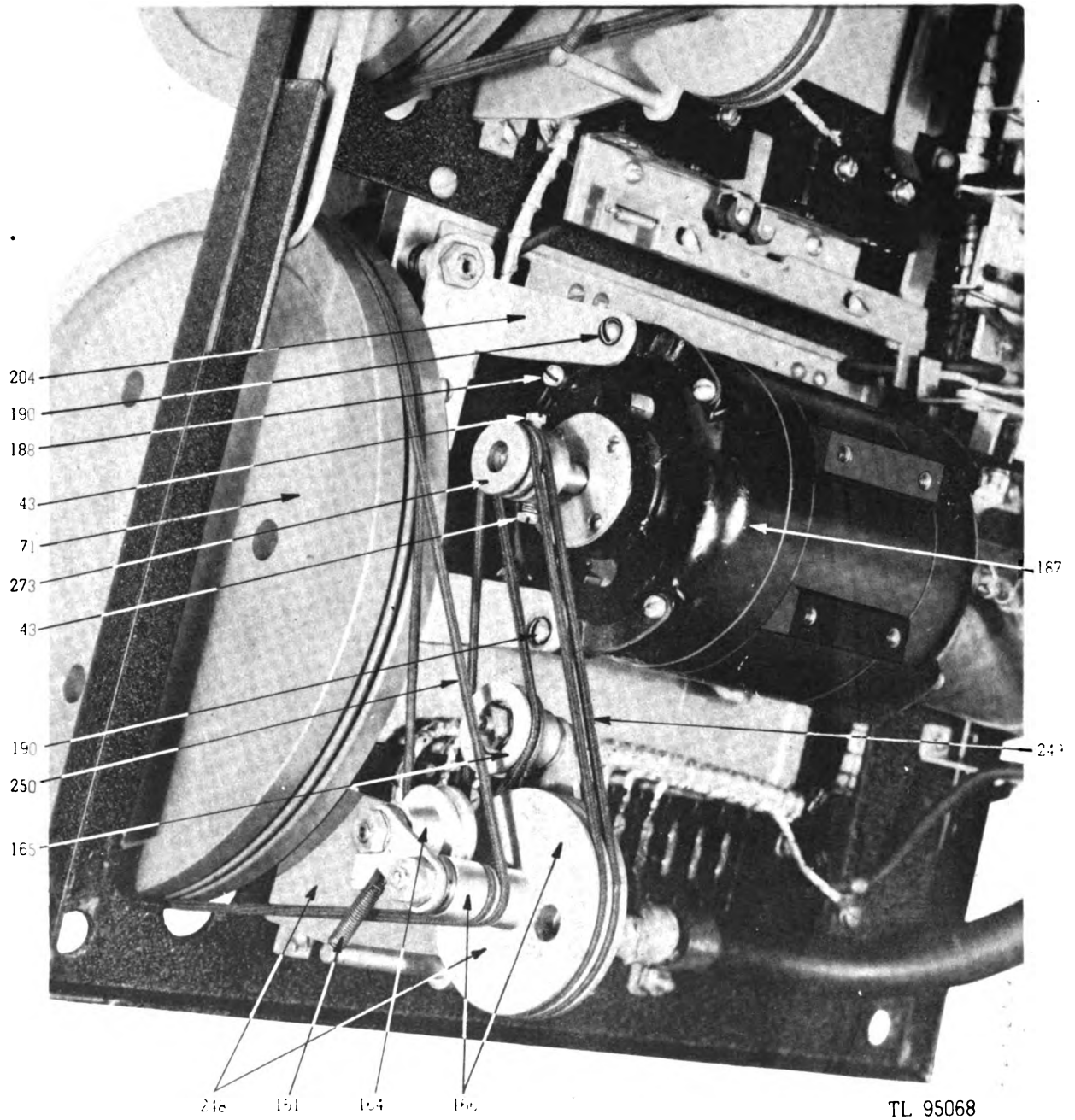
(2) Lift recorder terminal block bracket (281), with recorder terminal block (222) attached, out of the way to allow freedom of movement of recorder assembly (258) when lift cam roller pin (264) is removed.

(3) Unhook recorder pressure spring (234) from recorder pressure adjusting arm (235).

(4) Unscrew lift cam roller pin (264).

**CAUTION:** WHEN REMOVING ROLLER PIN (264), BE CAREFUL NOT TO ALLOW THE RECORDER STYLUS (24) TO HIT THE ANVIL (20) AND BE DAMAGED.

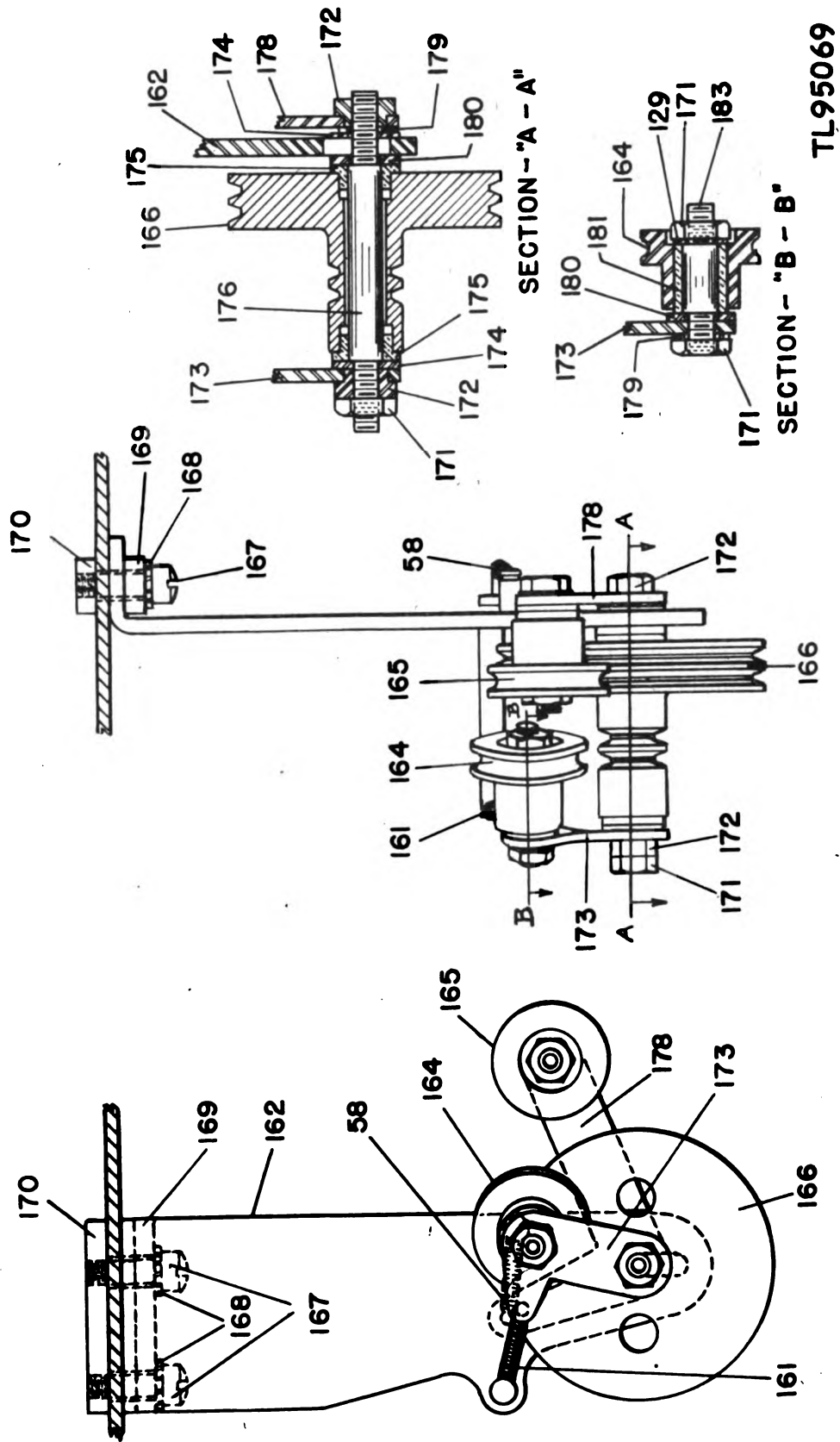
THERE ARE TWO ROLLERS ON ROLLER PIN ASSEMBLY (264), ONE BRASS AND ONE STEEL ROLLER.



**Figure 62. Reduction pulley assembly**



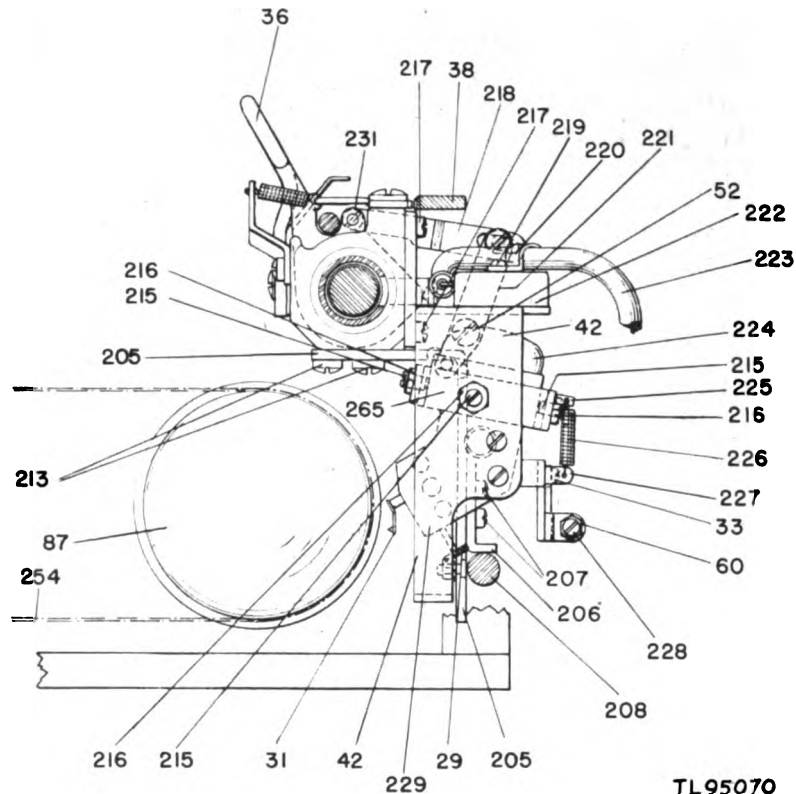
Reference No.	Description
58	Reduction pulley motor idler tension spring
129	Reduction pulley flywheel and motor idler pulley shaft washer
161	Reduction pulley flywheel idler tension spring
162	Reduction pulley bracket
164	Reduction pulley flywheel idler
165	Reduction pulley motor idler
166	Reduction pulley
167	Reduction pulley assembly holding screw
168	Reduction pulley assembly holding screw lockwasher
169	Reduction pulley assembly metal strip mounting washer
170	Reduction pulley assembly metal strip mounting nut
171	Reduction pulley shaft nut
	Reduction pulley flywheel idler shaft nut
	Reduction pulley motor idler shaft nut
172	Reduction pulley shaft shoulder nut
173	Reduction pulley flywheel idler bracket
174	Reduction pulley shaft washer
175	Reduction pulley shaft bearing
176	Reduction pulley shaft
178	Reduction pulley motor idler bracket
179	Reduction pulley shaft lockwasher
180	Reduction pulley shaft washer
	Reduction pulley flywheel idler shaft washer
	Reduction pulley motor idler shaft washer
181	Reduction pulley flywheel and motor idler pulley shaft bearing
183	Reduction pulley flywheel and motor idler pulley shaft
248	Reduction pulley assembly, complete



TL95069

Figure 63. Reduction pulley assembly (diagram)

<b>Reference No.</b>	<b>Description</b>
29	Reproducer stylus clamping screw
31	Reproducer stylus
33	Reproducer pressure arm pivot screw
36	Carriage control lever
38	Backspacer rack
42	Reproducer mount bracket assembly
60	Control interlock lock lever spring pin nut
87	Drive mandrel
205	Reproducer carriage guide
206	Reproducer carriage guide prong (adjustable)
207	Reproducer carriage guide prong (adjustable) holding screw
208	Reproducer carriage guide rod
213	Reproducer carriage guide
215	Reproducer pivot screw
216	Recorder and reproducer pivot screw locknut
217	Recorder and reproducer mount bracket mounting screw
218	Reproducer carriage control lever - reproducer lift lever connecting link
219	Reproducer cable clamp and terminal block cover screw
220	Reproducer cable clamp
221	Reproducer lift lever
222	Reproducer terminal block
223	Reproducer cable (front and rear cables are different length)
224	Reproducer lead counter balance
225	Reproducer pressure spring pin
226	Reproducer pressure spring
227	Reproducer pressure arm
228	Reproducer pressure arm adjusting screw
229	Reproducer
231	Reproducer carriage control lever    Reproducer link connecting screw
254	Recording belt
261	Reproducer carriage assembly, complete
265	Reproducer pivot bracket, lateral



TL95070

Figure 64. Reproducer carriage assembly

THE STEEL ROLLER SHOULD BE ADJACENT TO THE HEAD OF THE SCREW IN ROLLER PIN ASSEMBLY (264). SHOULD THERE BE ANY QUESTION REGARDING THEIR IDENTITY, CHECK BY BRINGING THEM NEAR THE PERMANENT MAGNET IN RECORDER (258). THE STEEL ROLLER WILL BE ATTRACTED BY THE MAGNET.

(5) Rotate recorder assembly (258) in a counter-clockwise direction (when looking at the ejector side of the machine) and remove recorder stylus (24) by loosening clamping screw (23).

**b. Installation.** Install recorder stylus (24) by following the removal procedure in reverse order.

### 103. REDUCTION PULLEY ASSEMBLY (figs. 62 and 63).

**a. Removal.** (1) Disconnect motor idler tension spring (58) and flywheel idler tension spring (161).

(2) Remove motor drive belt (249) and flywheel drive belt (250).

(3) Remove reduction pulley assembly (248) by removing the two screws (167), the two lockwashers (168), and washer (169). Nut (170) is a threaded strip which is welded onto the unit plate.

**b. Disassembly.** (1) Remove reduction pulley shaft nut (171) and shoulder nut (172) to remove flywheel idler bracket (173).

(2) Remove shoulder nut (172) to remove motor idler bracket (178).

(3) Remove lockwasher (179) and washer (174) to remove reduction pulley bracket (162).

(4) Remove reduction pulley (166) from reduction pulley shaft (176) removing remaining washers (174) and (180).

(5) Disassemble flywheel idler bracket assembly (173) by removing nut (171) and lockwasher (179) on the flywheel idler shaft (183).

(6) Disassemble the motor idler assembly the same as the flywheel idler assembly.

**c. Reassembly.** Reassemble the reduction pulley assembly (248) by following the disassembly procedure in the reverse order.

**CAUTION: ON REASSEMBLING FLYWHEEL IDLER (164) AND MO-**

**TOR IDLER (165) TO THEIR RESPECTIVE BRACKETS (173 and 178), BE SURE TO CLEAN THEM CAREFULLY WITH A CLOTH. DO NOT WASH WITH GASOLINE OR ANY OTHER SOLVENT AS THESE ARE OILITE BUSHINGS. APPLY ABOUT 2 DROPS OF OIL (SEE PARAGRAPH 115) TO EACH BUSHING BEFORE REINSTALLING. THIS CAUTION ALSO APPLIES WHEN INSTALLING REDUCTION PULLEY (166) IN ITS ASSEMBLY.**

**d. Installation.** Install the reduction pulley assembly (248) by following the removal procedure in the reverse order.

**e. Adjustment.** (1) To adjust the reduction pulley assembly (248), loosen screws (167) holding bracket (162) to the unit plate.

(2) Slide the entire reduction pulley assembly (248) in a direction away from the motor, until motor idler (165) is in such a position that it will not allow that portion of the belt operated on by motor idler (165) to touch any other portion of the belt, since motor idler (165) operates between two strands of the motor drive belt (249) at a point approximately mid-way between the two strands as shown in figure (62).

**CAUTION: BE SURE TO ALIGN THE REDUCTION PULLEY ASSEMBLY (248) BEFORE TIGHTENING THE SCREWS (167) HOLDING BRACKET (162) TO THE UNIT PLATE, SO THAT THE GROOVES IN FLYWHEEL IDLER (164) ARE IN LINE WITH THE GROOVES IN THE FLYWHEEL (71).**

(3) Tighten screws (167) holding bracket (162) to the unit plate.

**CAUTION: CHECK TO SEE THAT MOTOR IDLER PULLEY (165) IS IN LINE WITH MOTOR PULLEY (273).**

(4) Should motor idler pulley (165) and motor pulley (273) be out of line, loosen the two motor pulley setscrews (43) and slide motor pulley (273) to the proper position to bring the double wrap motor drive belt (249) in line, and to bring the motor pulley (273) and motor idler pulley (165) in line.

(5) Tighten motor pulley setscrews (43).

(6) A slot is provided in bracket (162) for vertical adjustment of reduction pulley (166).

(7) Reduction pulley (166) should be adjusted so that the front edge of flywheel idler (164) is flush with the front edge of flywheel drive belt (250) when facing the machine from the flywheel side.

(8) The front edge of flywheel idler (164) means that edge nearest the front of the machine, and the front edge of flywheel drive belt (250) means that edge of the flywheel drive belt (250) nearest the front of the machine on that portion of flywheel drive belt (250) which is not in contact with flywheel idler (164).

#### **104. REPRODUCER (figs. 7, 44 and 64).**

**a. Removal.** Remove the reproducer mount bracket assembly (42) as explained in paragraph 106a.

**b. Disassembly.** (1) Unhook reproducer pressure spring (226) from the pin on reproducer lateral pivot bracket (265).

**NOTE:** While still referring to figures 44 and 64, now refer to figure 7 also, which is a close-up view of the reproducer mount bracket assembly.

**NOTE:** Lateral pivot bracket (265) and lateral pivots (215) mounted therein, provide for lateral movement of the reproducing head. Vertical pivots (215) which are installed through the sides of reproducer mount bracket (42) provide for vertical movement of the reproducing head.

(2) Loosen vertical pivot locknut (216) and loosen vertical pivot (215) a number of turns, remembering the number of turns it was loosened to aid in relocating the reproducer quickly upon reinstallation.

(3) Loosen the other vertical pivot locknut (216) and unscrew the other vertical pivot (215) all the way out.

(4) Remove the reproducer, in its lateral pivot bracket (265), from reproducer mount bracket (42).

(5) Remove lateral pivot locknuts (216) and loosen lateral pivots (215) to remove the reproducer from the lateral pivot bracket (265).

**b. Reassembly and Adjustment.** (1) Reassemble the reproducer assembly by following the disassembly procedure in reverse order, observing the following instructions.

(2) Replace the reproducer in lateral pivot bracket (265) as shown in figure 7, with the reproducer pressure spring pin on reproducer lateral pivot bracket (265) aligned adjacent to reproducer pressure spring (226) when the reproducer stylus (31) is properly positioned.

(3) Install the reproducer in lateral pivot bracket (265) so that there is equal spacing on either side of the reproducer, between the reproducer and the lateral pivot bracket. Tighten the locknut (216) on one side of lateral pivot bracket (265).

(4) Screw the other lateral pivot screw (215) into place, then back off on pivot screw (215), screwing it in and out a few times until it stops without force, to indicate that it is tightly seated; then back off  $\frac{1}{8}$  turn and tighten its locknut (216) making sure that pivot screw (215) does not turn when locknut (216) is tightened.

(5) Replace the reproducer, in its lateral pivot bracket (265), in reproducer mount bracket assembly (42), and reset the vertical pivot screw (215) which was not removed to its original position, and tighten its locknut (216).

(6) Install the other vertical pivot screw (215), with locknut (216) attached, the latter backed off to the end of pivot screw (215), and tighten vertical pivot screw (215).

(7) Adjust this vertical pivot screw (215) by tightening the screw lightly until it stops; then back off pivot screw (215) not more than  $\frac{1}{16}$ th turn.

**CAUTION: THIS LAST ADJUSTMENT IS CRITICAL AND SHOULD BE MADE VERY CAREFULLY.**

(8) Tighten locknut (216) and be sure pivot screw (215) does not turn as locknut (216) is tightened.

(9) When properly adjusted, the reproducer should pivot freely but with no appreciable play.

(10) Replace reproducer pressure spring (226) on the pin on reproducer lateral pivot bracket (265).

**c. Installation.** Install the reproducer mount bracket assembly (42) by following paragraph 106a. in reverse order.

**d. Reproducer Stylus Pressure Adjustment.**

(1) Check the reproducer stylus pressure by means of a pressure gage hooked to the end of the stylus shank.

(2) Read the pressure gage indication when the reproducer stylus is lifted (with the carriage control lever in the "operate" position) so that the

stylus clears the recording belt by about the thickness of a sheet of paper.

**NOTE:** The reproducer stylus pressure should be 0.75 ounce.

(3) Adjust the reproducer stylus pressure by means of adjusting screw (228) which moves pressure arm (227) to increase or decrease the tension on pressure spring (226).

## **105. REPRODUCER CARRIAGE GUIDE (figs. 44 and 64).**

**a. Removal.** (1) Remove left-hand backspacer rack mounting screw (37) in fig. 44) and the two right-hand backspacer rack mounting screws (43), and remove backspacer rack (38) from the machine.

(2) Remove reproducer cable clamp (238) by removing its holding screw.

(3) Loosen screw (157) which holds reproducer carriage guide rod (208).

(4) Line up one of the two holes in flywheel (71) with the end of reproducer carriage guide rod (208) and slide the guide rod out through the flywheel so that it will be out of the way for rotating the reproducer carriage assembly on its bearing.

**CAUTION: BE CAREFUL NOT TO DAMAGE THE REPRODUCER STYLUS BECAUSE THE REMOVAL OF REPRODUCER CARRIAGE GUIDE ROD (208) ALLOWS REPRODUCER STYLUS (31) TO GO TO THE SURFACE OF THE DRIVE MANDREL (87).**

(8) Loosen the two screws (43) which secure feed screw assembly (252).

(9) With recorder carriage assembly (243) at the right-hand limit of its travel, (end of record position), and with reproducer carriage assembly (261) moved towards the flywheel so that the reproducer carriage guide rod (205) will clear reproducer safety switch (209), rotate reproducer carriage assembly (261) in a counterclockwise direction (when looking at the ejector side of the machine) until reproducer carriage guide rod mounting screws (213) are accessible for removal.

(10) Remove the two screws (213) and remove reproducer carriage guide (205) from the machine.

**b. Installation.** Install reproducer carriage guide (205) by following the removal procedure in reverse order.

**c. Adjustment.** (1) With the two holding screws (207) for adjustable reproducer carriage guide prong (206) loose, and with pressure on the reproducer carriage control lever stop (101) to bring reproducer carriage guide (205) squarely against the reproducer carriage guide rod (208), seat adjustable guide prong (206) squarely on the top of reproducer carriage guide rod (208) and tighten screws (207).

**NOTE:** The procedure outlined above can be accomplished by pressing on the reproducer carriage control lever stop with the little finger and at the same time using the thumb nail to push adjustable guide prong (206) down squarely on top of reproducer carriage guide rod (208).

(2) With the reproducer carriage control lever (36) in the "neutral" position, move the reproducer carriage assembly (261) back and forth on its bearing to test for freedom of movement. See that there is no bind between reproducer carriage guide (205) and reproducer carriage guide rod (208).

(3) If there is a slight bind, tap lightly downward on reproducer carriage guide prong (206) to remove the bind.

(4) When properly adjusted there should be no bind between reproducer carriage guide (205) and reproducer carriage guide rod (208) and there should be practically no play.

(5) Adjust feed screw assembly (252) as explained in paragraph 92e.

(6) Adjust backspacer rack (38) as explained in paragraph 85c.

## **106. REPRODUCER MOUNT BRACKET ASSEMBLY (figs. 44 and 64).**

**a. Removal.** (1) Remove left-hand backspacer rack mounting screw ((37) in fig. 44) and the two right-hand backspacer rack mounting screws (43), and lift backspacer rack (38) out of the machine.

(2) Remove reproducer cable clamp ((220) in fig. 64) by removing screw (219).

(3) Remove the cover of terminal block (222) and remove the two reproducer leads.

(4) Leave reproducer cable (223) connected to reproducer terminal block (222).

(5) Replace the cover on terminal block (222) and set to one side, with reproducer cable attached, until it is needed for reinstallation.

(6) Loosen screw ((157) in fig. 44) holding reproducer carriage guide rod (208).

(7) Line up one of the two holes in flywheel (71) with the end of reproducer carriage guide rod (208) and slide guide rod (208) out through the flywheel.

**CAUTION: BE CAREFUL NOT TO DAMAGE THE REPRODUCER STYLUS (31) BECAUSE WHEN REPRODUCER CARRIAGE GUIDE ROD (208) IS REMOVED, REPRODUCER STYLUS (31) IS FREE TO GO TO THE SURFACE OF DRIVE MANDREL (87).**

(8) Loosen screws (43) which secure feed screw assembly (252).

(9) Remove reproducer carriage control lever connecting screw (231). See figure 52.

(10) Remove lift lever pivot screw (52) and remove lift lever (221) and carriage control lever connecting link (218) in a unit

(11) Holding the reproducer carriage assembly firmly to safeguard reproducer stylus (31), and with recorder carriage assembly (243) at its right-hand limit of travel, (end-of-record position), move reproducer carriage assembly (261) towards the flywheel until reproducer carriage guide (205) clears reproducer safety switch (209), and rotate reproducer carriage assembly (261) in a counter-clockwise direction (when looking at the ejector side of the machine), until the four reproducer mount bracket assembly holding screws (217) are readily accessible for removal.

(12) Remove the four reproducer mount bracket assembly holding screws (217) and remove reproducer mount bracket assembly (42) from the machine.

**b. Disassembly, Reassembly, and Adjustment.** For disassembly, reassembly, and adjustment of the reproducer mount bracket assembly (42), see paragraph 104.

**c. Installation.** Install the reproducer mount bracket assembly by following the removal procedure in reverse order.

**d. Adjustment.** (1) Adjust feed screw assembly (252) as explained in paragraph 92e.

(2) Adjust backspacer rack (38) as explained in paragraph 85c.

## **107. REPRODUCER STYLUS (figs. 44 and 64).**

**a. Removal.** (1) Remove left-hand backspacer rack mounting screw ((37) in fig. 44) and

the two right-hand backspacer rack mounting screws (43), and lift backspacer rack (38) out of the machine.

(2) Remove reproducer cable clamp (238) by removing its holding screw.

(3) Loosen screw (157) which secures reproducer carriage guide rod (208).

(4) Line up one of the two holes in the flywheel (71) with the end of reproducer carriage guide rod (208) and slide the guide rod out through flywheel (71).

**CAUTION: BE CAREFUL NOT TO DAMAGE THE REPRODUCER STYLUS (31) BECAUSE WHEN REPRODUCER CARRIAGE GUIDE ROD (208) IS REMOVED, REPRODUCER STYLUS (31) IS FREE TO GO TO THE SURFACE OF DRIVE MANDREL (87).**

(5) Loosen the two screws (43) which secure feed screw assembly (108).

(6) With recorder carriage assembly (243) moved to its right-hand limit of travel, end of record position, and with reproducer carriage assembly (261) moved towards the flywheel (71) so that reproducer carriage guide (205) clears reproducer safety switch (209), rotate reproducer carriage assembly (261) in a counterclockwise direction, (when looking at the ejector side of the machine), until reproducer stylus (31) is accessible for removal.

(7) Remove reproducer stylus (31) by loosening clamping screw (29).

**b. Installation.** Install reproducer stylus (31) by following the removal procedure in reverse order.

**c. Adjustment.** (1) Adjust feed screw assembly (252) as explained in paragraph 92e.

(2) Adjust backspacer rack (38) as explained in paragraph 85c.

### **108. CHANGE RECORD SWITCH (figs. 19 and 47).**

**CAUTION: DISCONNECT POWER SUPPLY CABLE FROM MACHINE.**

**NOTE:** The front machine change record switch (3) is located at top right of the view of the bottom of the unit plate shown in figure 47, and the rear machine change record switch (3) is located at right center of the view in figure 47.

**a. Removal.** (1) Disconnect the wiring (two leads) to the change record switch.

(2) Remove the two **CHANGE RECORD** switch mounting screws (270) and their associated lock-washers and washers, and remove the **CHANGE RECORD** switch (3) from the machine.

**b. Installation.** Reinstall the **CHANGE RECORD** switch (3) by following the removal procedure in the reverse order.

**CAUTION: MAKE SURE THAT THE CHANGE-OVER ACTUATING LEVER ((1) IN figs. 44 and 47) OPERATES ON ITS PIVOT FREELY, BY DISCONNECTING SPRING ((272) IN fig. 47) AND CHECKING FOR FREEDOM OF OPERATION.**

**c. Adjustment.** (1) Place the recorder carriage in its extreme right-hand position so that full movement of the change-over actuating lever (1) is obtained.

(2) Adjust the **CHANGE RECORD** switch (3), toward the **CHANGE RECORD** switch actuating cam ((211) in fig. 19), so that the roller on the **CHANGE RECORD** switch (3) bears on the actuating cam (211).

(3) Adjust until the **CHANGE RECORD** switch (3) makes an audible click showing that the switch contacts are closed.

(4) Tighten the two **CHANGE RECORD** switch holding screws ((270) in fig. 47) to retain this adjustment.

(5) Move the recorder carriage from its extreme right-hand position, to the left, and see that change-over actuating lever spring (272) returns the actuating lever (1) to its normal position.

(6) Should this spring (272) fail to operate properly, it indicates that the **CHANGE RECORD** switch is adjusted too tightly against the actuating cam (211).

(7) Restore the recorder carriage to its extreme right-hand position and adjust the **CHANGE RECORD** switch (3), so that its actuating lever is moved away slightly from actuating cam (211) and test again for normal operation.

(8) If sufficient adjustment cannot be obtained through the medium of **CHANGE RECORD** switch holding screws (270), further adjustment can be achieved by bending the **CHANGE RECORD** switch actuating lever.

(9) When adjusted properly, the change-over actuating lever (1) can be moved to its extreme position when the recorder carriage is moved to its extreme



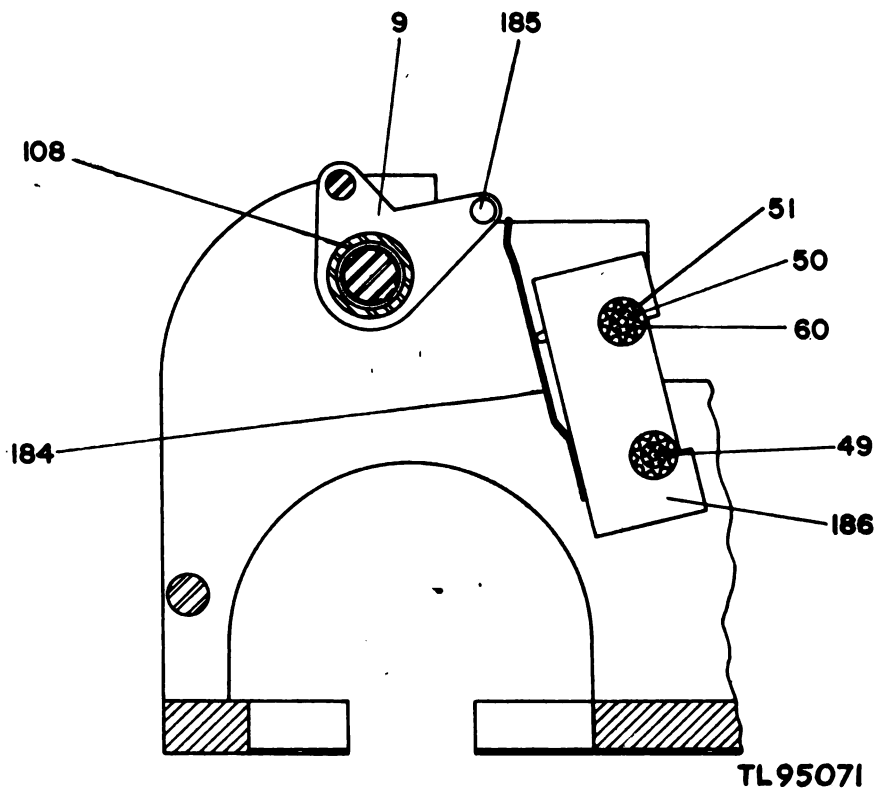


Figure 65. Ready switch assembly

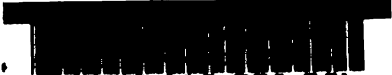
Reference No.	Description
9	Recorder carriage bail assembly, complete
49	READY switch mounting screw
50	READY switch mounting screw lockwasher
51	READY switch mounting screw washer
60	READY switch mounting screw nut
108	Feed screw cover
184	READY switch actuating lever
185	Recorder carriage bail READY switch actuating pin
186	READY switch











3 6105 113 778 356



