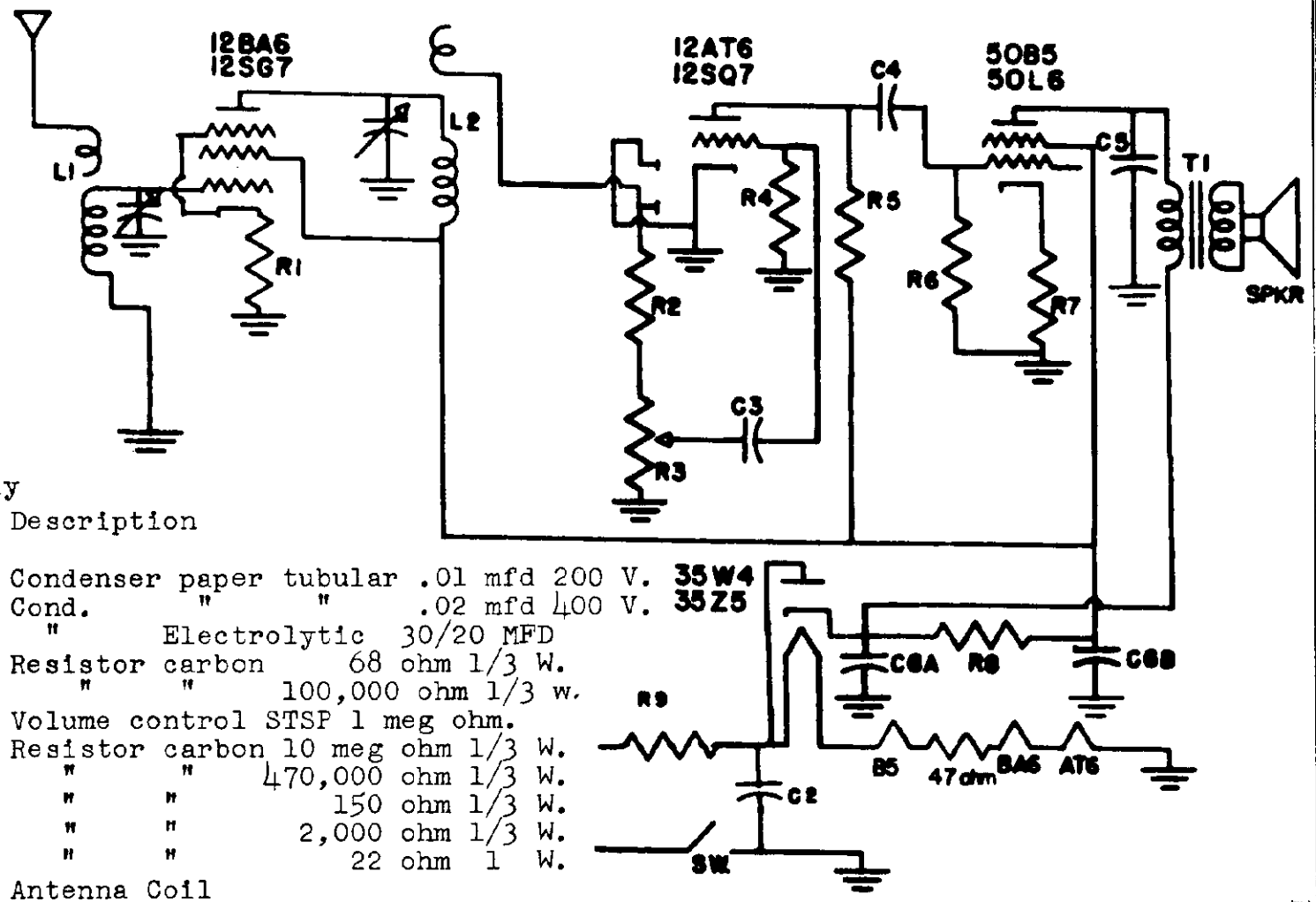
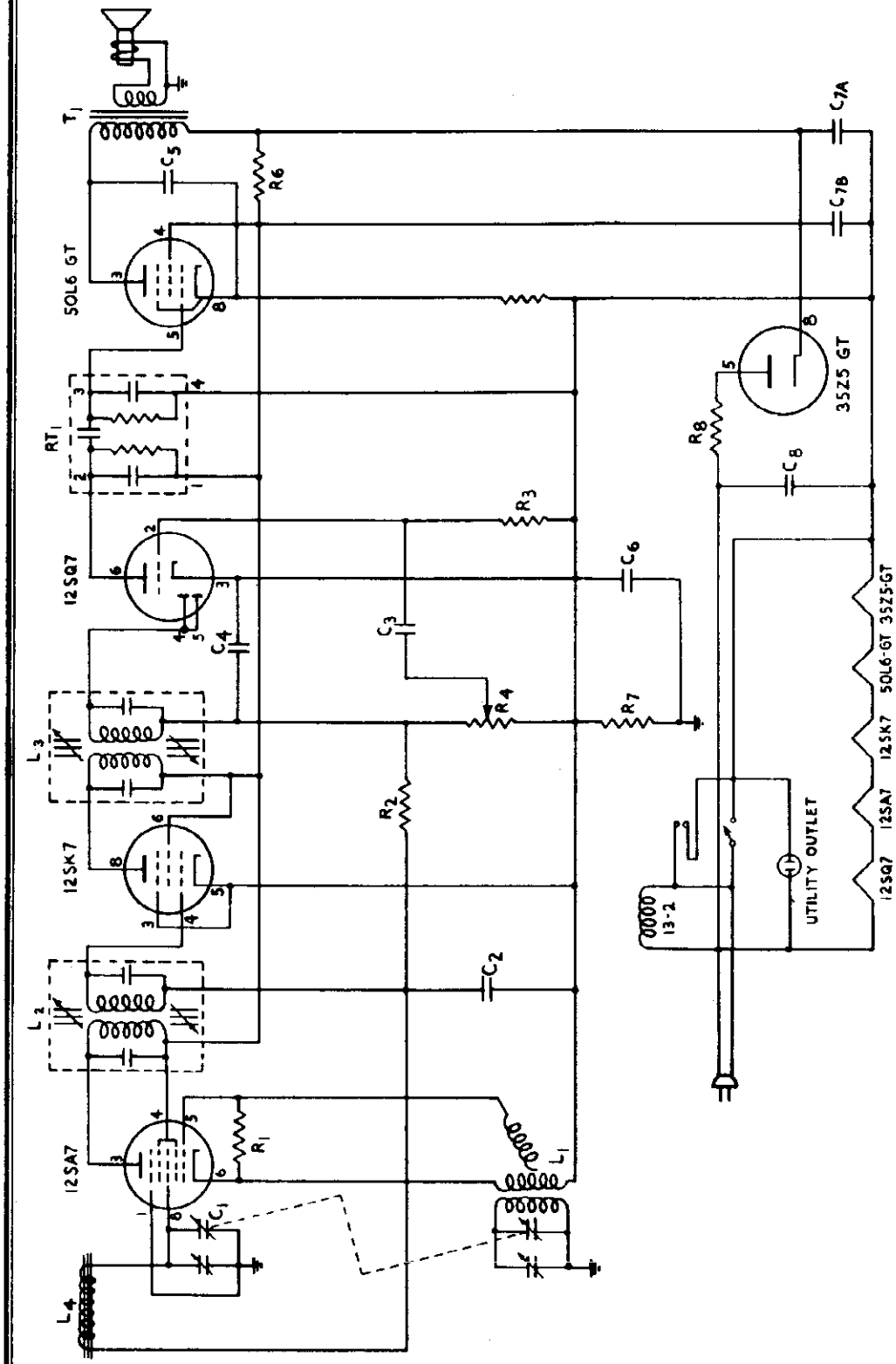


For CW-500 Assembly

Ck Sym.	Part No.	Description
C5	CP-12103	Condenser paper tubular .01 mfd 200 V.
C2	CP-14203	Cond. " " .02 mfd 400 V.
C6A,C6B	CL-10017	" Electrolytic 30/20 MFD
R1	RC-10680	Resistor carbon 68 ohm 1/3 W.
R2	RC-11003	" " 100,000 ohm 1/3 w.
R3	VC-12106	Volume control STSP 1 meg ohm.
R4	RC-11005	Resistor carbon 10 meg ohm 1/3 W.
R5, 6	RC-14703	" " 470,000 ohm 1/3 W.
R7	RC-11500	" " 150 ohm 1/3 W.
R8	RC-32001	" " 2,000 ohm 1/3 W.
R9	RC-40220	" " 22 ohm 1 W.
L1	TRF-10047-A	Antenna Coil
L2	TRF-10011-B	Interstage coil 15 uuf capacity turn
T1	TO-10000	Output Transformer
SPKR.	SR-10005	Round 3" speaker
C4	CP-12502	Condenser paper tubular .005 mfd 200V.
C3	CP-12202	" " " .002 mfd 200V.

MODELS 51C3,
51CU4



R1=22000 OHM ¼ W
R2=2.2 MEGOHM ¼ W
R3=10 MEGOHM ¼ W
R4=.5 MEGOHM VOLUME CONTROL
R5=150 OHM ¼ W
R6=1500 OHM 1W
R7=150000 OHM ¼W
R8=22 OHM ¼ W
C1=VARIABLE 290/105 MMFD.
C2=.05 MFD. 200V
C3=.005 MFD. 600 V
C4=100 MMFD.
C5=.02 MFD. 400 V
C6=2 MFD. 200V
C7A C7B=40 MFD. 150 V
C8=.05 MFD. 400V
RT1=COUPLING NETWORK-YA-400-001A
L1=OSC. COIL
L2 L3=455 KC. I.F.
L4=ANT.
T1=OUTPUT TRANSFORMER

DATE:- 4-27-51

Admiral 6C71-71A, Ch. 10A1; 7C62-62A, Ch. 6M1; 7C63-63A, Ch. 7C1

Model 6C71-71A is a console combination using radio chassis 10A1 and record changer RC200. Model 7C62A-62A, Ch. 6M1, and Model 7C63A-63A, Ch. 7C1, are console combinations and use either record changer RC170 or RC170A.

Admiral 6P32, Ch. 6E1; 7P35, Ch. 6H1

Model 6P32 uses chassis 6E1 and Model 7P35 uses chassis 5H1. These models are leatherette portables using an a-c—d-c battery.

Admiral 6RT41, 6RT42, 6RT43, Ch. 5B1-PH

Models 6RT41, 6RT42, and 6RT43 use radio chassis 5B1-PH. The 6RT41 is a plastic table combination using record changer RC160 or RC160A. The 6RT42 and the 6RT43 are wood table combinations using radio chassis 5B1-PH and record changers RC160 or RC160A. In addition to the RC160 and RC160A, the 6RT42 may use an RC150 record changer.

Admiral 6RT41A, 6RT42A, 6RT43A Ch. 5B1A

Model 6RT41A is a plastic table combination using radio chassis 5B1A and record changers RC160 or RC160A. Models 6RT42A and 6RT43A are wood table combinations using radio chassis 5B1A and record changer RC160 or RC160A.

Admiral 6T01, 6T05, Ch. 6A1

Model 6T01 is a plastic table model using chassis 6A1. Model 6T05 is a wood table model using chassis 6A1.

Admiral 6T02, 6T04, Ch. 5B1

Models 6T02 and 6T04 are table models using chassis 5B1. Model 6T02 has a plastic cabinet, while Model 6T04 has a wood cabinet.

Admiral 6T06, 6T07, Ch. 4A1

Models 6T06 and 6T07, Ch. 4A1, are wood table models using a farm battery.

Arvin 540T, Ch. RE-278

Model 540T is the same as model 440T, chassis RE-278, except for the part numbers listed below.

Ref. No.	*Part No.*	*Description*
R3	C23068	Resistor, Volume Control, 2 meg.
C2A,	C2BA20375	Condenser, I. F. Trans. Trimmers
T2	C22878-1	Output Transformer
T1	C22863-1	I. F. Transformer
L1	C22864-1	Antenna Coil
L2	C22865-1	Oscillator Coil
—	E24328-1	Cabinet with grille cloth, Ivory
—	C24096-1	Ivory cabinet, rear cover
—	E24328-1	Cabinet with grille cloth, citron
—	C24096-8	Citron cabinet, rear cover
—	E24328-7	Cabinet with grille cloth, flame
—	C24096-7	Flame cabinet, rear cover
—	E24328-9	Cabinet with grille cloth, cherry
—	C24096-9	Cherry cabinet, rear cover
—	E24328-10	Cabinet with grille cloth, Avocado, green
—	C24096-10	Cabinet rear cover, Avocado, green
—	E24328-11	Cabinet with grille cloth, Pebble
—	C24096-11	Cabinet, rear cover, Pebble
—	A24372-1	Arvin Name—on cabinet
—	A24084	Couplate
—	A24330-1	Knob, volume
—	C24331-1	Knob, dial
—	A18136	Antenna bank

Capehart-Farnsworth P-777

The rubber belt may run off the 78-rpm drive, due to the motor mounting frame being bent slightly, causing misalignment of the shafts. This should not be difficult to check and if bent, to correct. If, for some reason, it proves impossible to effect permanent correction, then the only solution would obviously be replacement of the motor assembly.

Also check for excessive friction in the 45-rpm bearing. This pulley may be removed, and, if there is any tendency to excess friction, ream it out slightly, apply lubricant, wipe off the excess lubricant and replace. This may also be the correction for one of those hard to locate sources of "wow" or speed variation, noticeable especially on 33- and 45-rpm records.

Farnsworth P71, P72, P73; Capehart-Farnsworth P77, P777

The failure of the changer to shut off after playing the last record may be caused by dust or foreign particles collecting between the inner tube (No. 11379) and the outer tube (No. 55334) or by corrosion on the two parts, making their movement sluggish. This may be checked easily. The weight of a 10" record on the single speed changer and a 7" record on the dual and triple speed changed should hold the spindle down. When the record is dropped to the turntable, the unloaded spindle should raise up approximately 1/16". If the spindle does not raise freely, it should be disassembled and cleaned. If corrosion is discovered after disassembly of the spindle, it may be removed from the compression rod (part of No. 13674) and from the outer surface of No. 11379 by polishing with crocus cloth. The best way to remove corrosion from the inner wall of part No. 11379 is to use a pipe cleaner, rouge and a rust solvent. After cleaning thoroughly in this manner, an unused pipe cleaner should be inserted in order to remove any remaining rouge and rust solvent before re-assembly of the parts. *Do not use any lubricant.* The same will apply to the inner wall of the outer tube No. 55334. When re-assemblying, be sure that the small washer, No. 55345, between the spring collets and the rubber is installed cup side down. If installed with the cup side up, two or more records will drop. As a final note on this point, spindle corrosion has nothing whatsoever to do with failure to drop records properly, unless, of course, the spindle parts are completely "frozen."

Failure of the changer to drop records properly may be caused by a spring collet, or by improper adjustments. In checking for proper adjustment, there are three dimensions which must be observed closely. Adjusting nut No. 37344 on the bottom of No. 13674 spindle must be set so that rubber washer, part No. 62152, when fully compressed does not exceed 0.337 inches in diameter. Original engineering specifications on this part were 0.312 to 0.325. In order to operate more satisfactorily on older records, this was later increased to 0.335 to 0.337, although the original specifications should be entirely satisfactory on new records which are in good condition. If necessary to change adjusting nut No. 37344, be sure locknut No. 2015-002 is tightened securely.

Chevrolet 986067

Model 986067 is designed expressly for 1947, '48, '49, and '50 Chevrolet trucks. In checking voltages of the 986067, it will be necessary to remove the rear cover of receiver and remove radio chassis from the case. Hook up radio on the service bench to a 6-volt power unit or a fully charged battery. The master selector switch of the volt-ohm-milliammeter should be set to the 12 position and the voltage selector switch to D.C. 1K/v position. Place test leads in jacks marked "test leads," ground the negative lead to the radio chassis for ground, with the red lead check all tube pins marked "H" which show a reading on voltage chart. Now set the Master selector switch to the 600 position and the voltage selector switch to A.C. 1K/v position. With red lead check the two terminals marked "P" on the OZ4 tube, both should read 270 to 280 volts a.c. each. If incorrect or no voltage check the following:

1. Check or replace capacitors (Illus. Nos. 31 and 32).
2. Check or replace resistor (Illus. No. 47).
3. Check or replace power transformer.
4. Check or replace vibrator.
5. Check or replace OZ4 tube socket.

Now change the Master selector switch to the 300 position and the voltage selector switch to D.C. 1K/v position. Pin "K" on OZ4 should read 245 to 255 volts d.c. If incorrect or no voltage, check or replace OZ4 tube.

Pin "P" on the 6V6GT tube should read 235 to 245 volts d.c. If incorrect or no voltage, check the following:

1. Check or replace electrolytic capacitor (Illus. No. 24B).
2. Check or replace resistors (Illus. Nos

Pin "S" on the 6V6GT tube should read 200 to 210 volts d.c. If incorrect or no voltage, check the following:

1. Check or replace electrolytic capacitor (Illus. No. 24C).
2. Check or replace resistors (Illus. Nos. 48 and 49).

Pin "K" on the 6V6GT tube should read 10 to 14 volts. If incorrect or no voltage check the following:

1. Check or replace electrolytic capacitor (Illus. No. 25A).
2. Check or replace resistor (Illus. No. 45).

Pin "P" on 6SQ7 tube should read 65 to 75 volts d.c. If incorrect or no voltage check the following:

1. Check or replace capacitors (Illus. Nos. 25, 26, and 32).
2. Check or replace resistor (Illus. No. 43).

Pin "P" on 6SK7 intermediate frequency amplifier tube should read 200 to 210 volts d.c. If incorrect or no voltage, check or replace the intermediate frequency transformer.

Pin "S" on 6SK7 i-f amplifier tube should read 60 to 70 volts d.c. If incorrect or no voltage, check the following:

1. Check or replace resistor (Illus. No. 38).
2. Check or replace capacitor (Illus. No. 17).

Pin "P" on the 6SA7 tube should read 200 to 210 volts d.c. If incorrect or no voltage, check or replace intermediate frequency transformer.

Pin "S" on the 6SA7 tube, should read 60 to 70 volts d.c. If incorrect or no voltage check the following:

1. Check or replace capacitor (Illus. No. 17).
2. Check or replace resistor (Illus. No. 38).

Pin "P" on the radio frequency amplifier 6SK7 tube should read 155 to 165 volts d.c. If incorrect or no voltage check the following:

1. Check or replace capacitor (Illus. No. 18).
2. Check or replace resistor (Illus. No. 39).

Pin "S" on r-f amplifier 6SK7 tube should read 60 to 70 volts d.c. If incorrect or no voltage check the following:

1. Check or replace resistor (Illus. No. 38).
2. Check or replace capacitor (Illus. No. 17).

If the tubes, vibrator, and voltages are correct and radio does not play the trouble will be in the grid circuit of the radio. To continue, it will be necessary to check the grid circuit by means of signal tracing.

Turn on signal generator on and off switch, place the modulation switch in the modulated position, set signal generator tone control to 0.5 and place shielded lead assembly in jack marked "audio." Ground the black lead to the radio chassis. Turn on radio receiver with volume to maximum position.

With red lead touch pin marked "P" on the 6V6GT tube. If you have no signal, check the following:

1. Check or replace speaker.
2. Check or replace audio transformer.

Touch pin "G" on 6V6GT tube. If no signal check or replace 6V6GT tube.

Touch pin "P" on the 6SQ7 tube. If no signal check the following:

1. Check or replace capacitors (Illus. Nos. 25, 26, 27, and 28).
2. Check or replace tone control.

Touch pin "G" on 6SQ7 tube. If no signal, check or replace 6SQ7 tube.

Touch the two pins marked "DP" on 6SQ7 tube. A signal should be heard on each one. If no signal check or replace 6SQ7 tube.

Change the signal generator shielded lead to the intermediate frequency "I.F." jack. Tune signal generator to exactly 262 and set band switch in "A" position. Turn the signal generator volume control about one-third open and touch pin "P" on intermediate frequency 6SK7 amplifier tube. If no signal, check the following:

1. Check or replace intermediate frequency transformer.
2. Check or replace volume control.
3. Check or replace capacitor (Illus. No. 23).
4. Check or replace resistor (Illus. No. 44).

Touch pin "G" on i-f 6SK7 amplifier tube. If no signal check or replace 6SK7 tube.

Touch pin "P" on 6SA7 tube. If no signal check the following:

1. Check or replace intermediate frequency transformer.
2. Check or replace sensitivity control.

Touch pin marked "G" on 6SA7 tube. If no signal check or replace 6SA7 tube.

Change the signal-generator shielded lead to the radio frequency "R.F." jack, tune signal generator to exactly 1000 kc and set band switch to "B" position. Tune radio to 1000 kc. Touch pin "P" on 6SK7 amplifier tube. If no signal check the following:

1. Check or replace radio frequency coil (Illus. No. 3).
2. Check or replace oscillator coil (Illus. No. 4).
3. Check or replace capacitors (Illus. Nos. 18, 19A, 19B, 20 and 21).

Touch pin "G" on r-f 6SK7 tube. If no signal check or replace 6SK7 tube.

Place a 0.000075-μf capacitor on the end of red lead and plug in antenna socket. If no signal check the following:

1. Check or replace antenna coil (Illus. No. 1).
2. Check or replace choke coils (Illus. No. 2).
3. Check or replace antenna trimmer (Illus. No. 16).
4. Check or replace resistors (Illus. Nos.

Crosley 11-100U, 11-101U, 11-102U, 11-103U, 11-104U, 11-105U, Ch. 330

Chassis 330 is similar to Chassis 301, which is also used with the above models, except that the 330 uses a 12SQ7GT (V3) in the detector—avc 1st a-f amplifier stage, whereas the 301 uses a 12AV6. The 12SQ7GT is connected in the following way: pin 1 goes to the shield; pin 2 goes to the junction of R5 and C8B; pin 3 goes to the junction of ground, pin 4, and C8A; pin 5 goes to tap 2 of the 2nd i-f transformer T2, pin 6 goes to the junction of R8, C8C, and C8D; pin 7 goes to pin 3 of V1, and pin 8 is grounded. The voltage readings are as follows: pins 1, 3, 4, and 8 are 0 volts; pin 2 is —0.8 volt; pin 5 is —0.6 volt; pin 6 is 52 volts; pin 7 is 12 volts a.c.

The following part should be added to the parts list: TS2, Part No. W-46447-1, Shield, tube (V3).

The following procedure should be used when installing an idler spring (part no. 151085) on the drive shaft:

1. Remove cotter from end of shaft under chassis.
2. Pull drive shaft straight out from chassis being careful to keep drive cord on shaft and pulley.
3. Remove spring washer from shaft.
4. Place idler spring on shaft and then hook one end of the spring under the chassis. The other end of the spring hooks around the portion of drive cord that is between the drive shaft and the tuning capacitor pulley.
5. Place spring washer on the drive shaft, insert drive shaft in chassis, and insert cotter on end of shaft.

Emerson 559, Ch. 120059A

The schematic diagram for Chassis 120059A shows two resistors marked R15. The one going to pin 6 of the 117Z3 should be marked R10.

Emerson 672B, Ch. 120097-B

The 672B is similar to Model 634B in that both models use a 120097-B chassis. The service data and Parts List for 672B, Ch. 120097-B, are the same as those for the 634B except for the cabinet parts listed below:

Part No.	Description
140396	Cabinet
470092	Lid support
620145	Chassis mounting board
580138	Shielded lead wire (25")
450099S	Knob
450099	Knob
587011	Spring insert
700053	Loop antenna
410807-1	Dial back plate
530002	Drive cord (37")
525022-1	Pointer.

Farnsworth P-63

Record changer P-63 is basically the same as the P-62 record changer—the difference lies in the type of trip mechanism. The P-62 changer employs a fixed position trip; the P-63, a velocity trip.

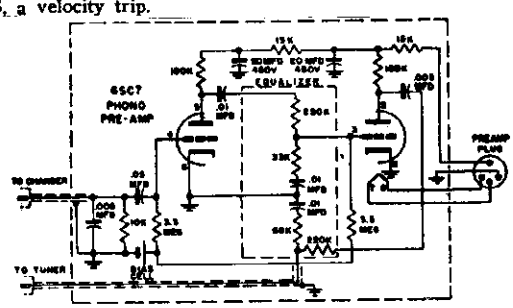


Fig. 1. Schematic for the 6SC7 phono-preamplifier stage used in the Farnsworth "N" Series, Capehart.

Farnsworth 36P10, Capehart

Model 36P10 employs the Farnsworth P-10 a-m—f-m radio chassis and the Farnsworth P-73 intermix record changer in a mahogany chairside cabinet with a 12-inch high-fidelity p-m speaker. For information on the radio chassis and record changer used in this instrument see Farnsworth Chassis P7, P9, and P-10 and the Farnsworth P-72 and P-73 Record Changers.

Following is a list of parts which pertain to the Model 36P10 only. Parts for the integral parts of the chassis and record changer are included under their respective chassis.

Part No.	Description
H-328	Cabinet (36P10)
750000A	Dial escutcheon
59373	Knob (2)
59316	Knob (2)
650011A-1	Speaker and output transformer
13908	Loop antenna assy.
750004A-1	A-m dial glass
750004A-2	F-m dial glass.

Farnsworth P-860

The alignment procedure and table, the chassis component layout, suggested batteries, and dial-cord stringing diagram for Model P-860 are the same as those for Farnsworth Model GP-350.

Farnsworth "N" Series, Capehart

In order to permit the use of the "Magnetic True Timbre" pickup in the N series instruments, a modification kit has been prepared, No. 41141.

A separate phono preamplifier (2-stage) using a 6SC7 twin triode tube, and mounted on a separate chassis, is used in place of the 6J7 preamplifier stage included on the tuner chassis. The schematic diagram for this stage is shown in Fig. 1. The 6J7 tube has been removed and the power cable to the preamp chassis is brought through the unused socket and connections made on the underside of the socket. The 6J7 stage is not used, so a shielded lead is connected directly from the phono input socket to the phono lug on the auxiliary bandswitch.

The noise eliminator, which is furnished with the record changer modification kit, is also included in these modified N series instruments. The circuit diagram of the noise eliminator is the same as that in the P4 series.

The voltage and resistance readings for the 6SC7 are given below:

Pin	Voltage (volts)	Resistance (ohms)
1	0	0
2	150	200 K
3	—0.3	inf
4	—0.3	inf
5	135	200 K
6	0	0
7	0	0
8	5.4ac	2.5

Farnsworth 1000-M, Capehart, Ch. P8

Model 1000-M is similar to Models 1002-F, 1003-M, and 1004-B, and uses a-m—f-m radio chassis P-8.

Gamble-Skogmo 43-7661, 43-7852

Model 43-7661 is the same as Model 43-7660 except that the 7661 uses a blond cabinet. Model 43-7852 is the same as Model 43-7851 except that it uses a blond cabinet.

Gamble-Skogmo 43-8101, 165, 197, 197U

Model 165 is the same as Model 94RA31-43-8115A. Model 197 is the same as Model 94RA31-43-8115B. Model 197U is the same as Model 94RA31-43-8116A. Model 43-8101 is electrically the same as Models 94RA31-43-8115A, -8115B, and -8116A.

Gamble-Skogmo 43-9841A

Model 43-9841A is the same as Model 94RA31-43-9841A.

Gamble-Skogmo 94RA4-43-8129A, 94RA4-43-8130A, 94RA4-43-8130B, 94RA4-43-8131A, 94RA4-43-8131B, 94RA4-43-8132A

Model 94RA4-43-8129A is the same as Model 43-8129A. Models 94RA4-43-8130A and 94RA4-43-8130B are the same as Models 43-8130A and 43-8130B, respectively. Model 94RA4-43-8131A is the same as Model 43-8131A. Model 94RA4-43-8131B is the same as Model 43-8131B. Model 94RA4-43-8132A is the same as Model 94RA4-43-8131A except that it employs a maroon cabinet.

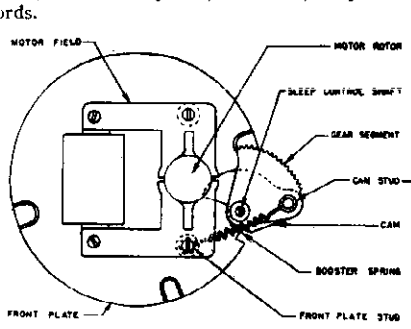
Gamble-Skogmo 94RA33-43-8135

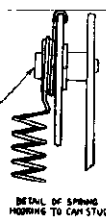
The 94RA33-43-8135 is the same as Models 94RA33-43-8130C and 94RA33-43-8131C except for the differences mentioned below. The physical difference is the cabinet, larger drum on the tuning gang, speaker bracket, dial glass, dial bracket and power-cord strain relief. The parts list for Model 94RA33-43-8135 is the same as that for the 8130C and 8131C except for the following parts.

Part No.	*Description*
E81650-2	Tuning gang
E81645-S2	Speaker
M1607-2	Dial bracket
P1602-2	Dial glass
SR-2P	Strain relief
P1601A-2	Cabinet, walnut
M1605-2	Chassis.

General Electric P15

To further clarify the identity of the three spindles for the record speeds for which they are to be used, the following descriptions have been added to the Parts List for record changer P15: RMU-060 Spindle, offset spindle for 7 inch, 33-1/3 rpm records; RMX-162 Spindle, for 10 or 12 inch, 33-1/3 or 78 rpm records; RMX-163 Spindle, for 7 inch, 45 rpm records.





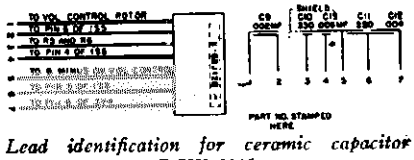
Rear view of clock mechanism in General Electric Models 64 and 65, showing position of booster spring.

General Electric 145

In late productions, resistors R13 and R14 have been combined into one tapped resistor, R25A and R25B. This new resistor is mounted in place of R14. The catalogue number for R25 is RRW-047. R25A is 1,000 ohms and should be wired in place of R14. R25B is 1,300 ohms and should be wired in place of R13.

Late production Models 145 have an automatic shutoff when the cabinet front is closed. New parts for these models are interchangeable and will be carried in replacement stock in place of the original early production items as shown below:

Part No.	*Description*
RDE-049	Escutcheon replaces RDE-034
RDK-166	Knob and knob clip replaces RDK-149
RAC-067	Cabinet front cover replaces RAC-055
RMC-036	Nameplate and catch, with 2 stud mount for maroon or white cabinets
RMC-038	Nameplate and catch, with 3 stud mount for maroon or white cabinets
RMC-039	Nameplate and catch, with 3 stud mount for brown cabinet.



Lead identification for ceramic capacitor RCW-3015.

The accompanying illustration of the four-section ceramic capacitor, catalogue number RCW-3015, is added to aid in capacitor-terminal identification of C9, C10, C11 and C12.

General Electric 64, 65

Late production receivers incorporate a helical spring in the clock mechanism which provides a more positive trip action to the switch contact assembly when operating the sleep control. Failure of switch contacts to open may be due to the incomplete travel of the sleep control gear segment and cam assembly after its release by the segment gear's drive pinion. Normally, the spring action of the switch contacts through the sleep control switch lever should be sufficient to allow sleep control cam and gear segment to spring outward completely after it becomes disengaged from its pinion drive gear. However, if binding or position of control parts results in failure of segment gear and cam to swing completely outward properly releasing switch control lever and contacts, the addition of the booster spring (catalogue no. RMS-203) will provide the additional tension to correct segment gear and cam operation.

To install the booster spring, remove the case and draw the clock mechanism forward from the front of the radio cabinet, just far enough to permit installation of the booster spring. The accompanying illustration shows the position of the booster spring as viewed from the rear of the clock mechanism. One end of the spring is fastened to the cam stud, the other end to the brass front plate stud.

General Electric 60, 62, 64, 65, 66, 67

The stock item RAB-054, Cabinet back and loop, is no longer available and Stock No. RAB-097, Cabinet back and loop, is substituted in its place. For those receivers produced, employing RAB-054 with connections made to the primary antenna winding, the black wire to chassis ground is removed when RAB-097 is substituted for replacement.

General Electric 123, 124, 125

A self-tapping screw, #4 x ¼ inch, Cat. No. RHS-044, Shakerproof type 25, has been added to the Parts List for the above models. Cabinets of later production receivers were tapped for these screws to mount the loudspeaker in lieu of the Tinnerman clip, RHM-061, used in earlier speaker mountings.

General Electric 140

The rectifier assembly, REX-004, is no longer stocked riveted to a mounting bracket. The new rectifier may be screw mounted to the original rectifier bracket as follows: remove wires at the connecting lugs of the old rectifier; using screwdriver blade between plates of rectifier to be removed, pry plates off from rectifier mounting bracket; assemble new rectifier to bracket, using a #6-32 x 1 inch long screw through rectifier and bracket hole and fasten using lock washer and nut; replace wire connections to new rectifier.

General Electric 143

In late production receivers, C5 was changed to 0.25 μf, 200 volts, Cat. No. UCC-050. This change was made to reduce regeneration which resulted in unstable operation.

General Electric 165

A tube shield has been added in late production receivers to the 1S5 tube, improving its stability. This item is carried in parts replacement stock at RHS-010.

General Electric 218, 218H

A 15,000-ohm, ½-watt resistor R33 has been added between the high side of the volume control and the arm of the band switch S1D. This improves receiver stability. The following changes should be made in the Parts Lists for these models:

Delete Stock No. RLI-084; Add RLI-088, Choke, f-m antenna (L2), used in 218 only; Add URD-077, Resistor, 15,000 ohms, ½ w. carbon.

Stock No. RLI-088 has been deleted from the Parts List and Stock No. RLI-084, Coil, f-m antenna choke, L2, added in its place.

General Electric 402

R2, shown connected to B+, should cross over the vertical B+ lead to pin 6 of V2, and a dot connection should be drawn at the vertical B— lead to pin 2.

General Electric 505, 506, 507, 508

Catalogue items RWL-009 and RWL-016 should be deleted from the Parts List and replaced by the following items: RWL-025, Cord, power cord and plug (brown, heavy duty type) for Models 505, 507, 508; RWL-026, Cord, power cord and plug (ivory, heavy duty type) for Model 506.

General Electric 505, 506, 507, 508, 509, 530

Change Step 1 (column 2) of the Alignment Chart to read "12BA6 grid pin (1)," and Step 2 (column 2) to read "12SA7 grid pin (8)." Change the tube type numbers of the I-F Stage Gains to read: 12SA7 grid to 12BA6 grid—50 at 455 kc; 12BA6 grid to 12SQ7 diode plate—50 at 455 kc.

General Electric 509, 530

Catalogue items RWL-009 and RWL-106 should be deleted from the Parts List and replaced by the following items: RWL-025, Cord, power cord and plug (brown, heavy duty type) for Model 530; RWL-024, Cord, power cord and plug (white, heavy duty type) for Model 509.

General Electric 515, 516, 517, 518

Catalogue items RWL-009 and RWL-016 should be deleted from the Parts List and replaced by the following items: RWL-025, Cord, power cord and plug (brown, heavy duty type) for Models 515, 517, 518; RWL-026, Cord, power cord and plug (ivory, heavy duty type) for Model 516.

General Electric 521, 522

Delete items RDK-217, RDS-090 and RWL-009 from the Parts List, and add the following items: RDK-237, Knob, tuning dial wheel with scale embossed; RWL-025, Cord, power cord and plug (brown, heavy duty, type).

General Electric 600, 601, 603, 604

The description "maroon for Models 600 and 601" should be added to Stock items RAB-096, RAU-308, RHY-010, and RHB-006. The following additional replacement parts have been added to the Parts List for Models 600, 601, 603, and 604.

Part No.	*Description*
RAB-125	Back, cabinet back, tan, less hinges (603)
RAB-126	Back, cabinet back, green, less hinges (604)
RAU-327	Cabinet, cabinet body, tan (less back, handle and hardware) (603)
RAU-328	Cabinet, cabinet body, green (less back, handle and hardware) (604)
RDK-204	Knob, volume or tuning, green (604)
RDK-205	Knob, volume or tuning, tan (603)
RHB-014	Button, plug button, tan, in cabinet over alignment trimmers (603)
RHB-015	Button, plug button, green, in cabinet over alignment trimmers (604)
RHM-052	Clip, for rim-mounting speaker
RHM-062	Clip, for hole-mounting speakers
RHW-024	Cup washer, retaining washer for item RMS-217, handle shock spring
RHY-016	Handle, cabinet handle, tan (603)
RHY-017	Handle, cabinet handle, green (604)
RJP-028	Plug, battery connecting plug P1
RMS-216	Guide spring, used with item RMC-040
RMS-217	Spring, shock spring for cabinet handle
UCG-022	Capacitor, 56 $\mu\mu$f, mica, C15.

General Electric 752

A 47-$\mu\mu$f, silver mica capacitor, C3, was added to the circuit of later receivers to prevent parasitic oscillation. C3 has been added from ground to the junction of R6 and the f-m terminal of S1E. In the Visual Alignment Chart, Step 5 of FM-IF Alignment, change adjustment "Core of T4" to read "Core of T9."

Hallicrafters S-41G, S-41W

In the Alignment Data Table for these models, under the column headed Adjust Trimmers, add C-4A to Step 1, C-4B to Step 2, and C-4C to Step 3. In some models the two capacitors marked C2 have been replaced by variable iron core T6.

Jewel 349, 949

Model 349 is the same as Model 949. The Alignment Procedure for these models is the same as that for Models 921, 935 and 936, except that "Reduce input as needed to keep output near 1.28 volts (0.5 watt)" should read "to keep output near 0.4 volt (0.5 watt)," and in the third column, 12BE6 grid (mentioned twice) should read 1R5 grid. The Parts List for Models 349 and 949 is given below:

Ref. No.	*Part No.*	*Description*
C1	30-17A	Variable capacitor, 2 gang, 420 & 162 $\mu\mu$f
C2, 3, 11	32-4	Tubular paper capacitor, 0.05 μf, 200 v
C4, 6	32-29	Tubular paper capacitor, 0.01 μf, 200 v
C5, 7	32-17	Tubular paper capacitor, 0.002 μf, 200 v
C8	32-20	Tubular paper capacitor, 0.005 μf, 200 v
C9	32-5	Tubular paper capacitor, 0.05 μf, 400 v
C10	32-32	Tubular paper capacitor, 0.2 μf, 200 v
C12, 13	35-4	Mica capacitor, 100 $\mu\mu$f, 500 v
C14	31-16A	Electrolytic capacitor, 50 x 30 μf, 150 v
C15	31-17	Electrolytic capacitor, 200 μf, 15 v
R1	20-49	100K, ¼ w, 20%
R2	20-46	3.3M, ½ w, 20%
R3	20-6	2.2M, ½ w, 20%
R4	20-42	8.2K, ½ w, 20%
R5	20-57	10M, ¼ w, 20%
R6	20-53	4.7M, ¼ w, 20%
R7	20-74	220K, ¼ w, 20%
R8	20-14	1M, ½ w, 20%
R9	20-31	47 ohms, 1 w, 10%
R10	20-143	2.5K, 8 w, 5% ww
R11	20-134	2.7K, 1 w, 10%
R12	20-109	1.5K, ½ w, 10%
R13, 14	20-67	1K, ½ w, 10%
R15	50-17	Volume control, 1 megohm, DPST switch (S2)
T1	61-12	Input i-f transformer
T2	61-13	Output i-f transformer
L1	62-16	Loop
L2	60-10	Oscillator coil
S1	65-4	Manual slide switch, DPDT
	73-3	Selenium rectifier, 65 ma
	80-15	4" p.m. speaker with output transformer
	120-28	Leatherette cabinet
	120-29	Front panel and baffle board
	W122-24	Volume knob
	W122-19	Selector knob
	123-9	Plastic dial.

Jewel 920A

The Alignment Procedure and Parts List for Model 920A is the same as that for Models 921, 935, 936.

Jewel 964

In later Model 964 receivers, pin 5 of the 12AT6 is connected to the junction of the i-f transformer and pin 6, instead of to the junction of the antenna coil and the 4.7-megohm resistor (going to the i-f transformer). The Alignment Procedure is the same as that given for Models 921, 935, and 936, except that 1500 kc, under Coupling Capacitor, should read 50 $\mu\mu$f; under Connections to Receiver should be Antenna (Disconnect antenna hank by unsoldering), and under Ground Connection should be B—. The seven markings on the dial represent 550 kc, 650 kc, 750 kc, 900 kc, 1100 kc, 1400 kc, and 1600 kc, respectively.

Jewel 955

The Alignment Procedure for Model 955 is the same as that given for Model 964. Model 955 also uses 12SA7, 12SQ7, 50L6, and 35Z5. The Parts List is as follows:

Ref. No.	*Part No.*	*Description*
C1,	32-17	Tubular paper capacitor, 0.002 μf, 200 v
C2	32-4	Tubular paper capacitor, 0.05 μf, 200 v
C4,	32-29	Tubular paper capacitor, 0.01 μf, 200 v
C6	32-5	Tubular paper capacitor, 0.05 μf, 400 v
C7	35-4	Mica capacitor, 100 μf, 500 v
C8	31-20	Electrolytic capacitor 50 x 30 μf 150 v
C9	30-18	Variable capacitor, 420 & 162 $\mu\mu$f
R1	20-3	22K, ½ w, 20%
R2	20-7	4.7M, ½ w, 20%
R3	20-8	10M, ½ w, 20%
R4	20-19	470K, ½ w, 20%
R5	20-14	330K, ½ w, 20%
R6	20-73	1.5K, 1 w, 20%
R7	20-93	22 ohms, ½ w, 20%
R8	20-96	22 ohms, 1 w, 20%
R9	50-11B	Volume control, 2 megohms, SPST switch
	60-12	Oscillator coil, with spring clip
61-5 or	61-14	I-f transformer, with solder tabs
	62-17	Antenna coil
	47-3	Antenna hank, 15'
	80-17	4" p.m. speaker with output transformer
	120-30A	Cabinet (specify color)
	122-15	Knob (2) (specify color)

Midwest KC-16

The mixer coil plate should be grounded to the front apron of the chassis with tinned copper braid to reduce f-m—r-f regeneration.

Montgomery Ward 94GSE-3011B

Model 94GSE-3011B differs from Model 84GSE-3011A only in type of cabinet covering and cabinet hardware as listed below:

Part Number	*Description*
MW7E179-3	Cabinet
MW20E449-2	Rear door with hinges, antenna post and line cord
MW20E461	Handle with mounting brackets

Motorola BKOA, CT8A, GM9TA, GMOT, HNO, ILOTC, KR9A, OEO, PCO, PC9A, SR9A, Ch. 10A

The above models all use Chassis 10A. Model BKOA is used in 1950 Buick Special, Super and Roadmaster cars. It will also accommodate 1949 Buick Super and Roadmaster; also the 50-70 Series 1948, '47, '46, and '42 Buick cars. Model CT8A is used in 1948 Chevrolet. It will also accommodate 1947, '46, '42, and '41 Chevrolet cars. Model GM9TA is used in 1949 and 1948 GMC and Chevrolet trucks. Model GMOT is used in 1950, '49, and '48 GMC and Chevrolet trucks. Model HNO is used in 1950 Hudson (Pacemaker, Super, and Commodore). Model ILOTC is used in International L-Line trucks. Model KR9A is used in 1949 Kaiser and Frazer. Model OEO is used in 1950 Series 76 and 88, all 1949 and 1948 Futuramic Oldsmobile cars. Model PCO is used in 1950 and 1949 Pontiac cars. Model PC9A is used in 1949 Pontiac cars. Model SR9A is used in 1949 Studebaker cars.

Philco 50-621

This model completed production without change and appears as Run #1 only. The following corrections and additions have been made to the Parts List:

Part No.	*Description*
34-8003-1	Selenium rectifier, 100 ma, CR1
10761-3	Cabinet, brown
10761-4	Cabinet, beige
10761-5	Cabinet, green
54-4712-3	Back, brown
54-4712-4	Back, beige
54-4712-5	Back, green
Delete	Front
Delete	Shield base.

National HRO-7

To eliminate oscillator drift occurring during stand-by periods, the following changes have been made. These changes allow the h-f oscillator, bfo oscillator and output tubes to remain on all the time whether the B+ switch is turned on or off.

1. Move the B+ end of R24 from the B+ tie-point to pin 6 of V9, 6J7.
2. Connect pin 6 of V9 to pin 5 of S1 using 8¾ inches of red wire.
3. Move red lead supplying pin 4 of S1 from the cold terminal of bsw to the hot terminal.
4. Move red lead running to tie-point located on chassis between C31 and C37 from pin 4 of S1 to the cold terminal of bsw.
5. Change the value of R21 to 3500 ohms, 5 watts.

National 686S, 686SB, SPU686S, 1286S

The 686SB power unit is the same as the 686S except that it is equipped with mounting brackets. The SPU686S is the same as the 686S except that it is designed for rack mounting. The 1286S is similar to the 686S except that it is designed to operate from 12 volts d.c. The voltages available at the output socket are 12 volts d.c. and 165 volts at 45 milliamperes d.c.

The following capacitors have been added to the 686S and 1286S power units:

1. C203, 0.01 μf, 300 vdcw, added from the junction of fuse F101 and switch S101 to ground.
2. C204, 0.0043 μf, 500 vdcw, from the B+ terminal to ground.
3. C205, 0.0001 μf, 500 vdcw, across output socket, from L201 to A+.

RCA A-82, Ch. RC-1094; A-91, Ch. RC-1095; A-108, Ch. RC-1096; 45-W-9, Ch. RC-1095A

The original carriage in all of the above models used a pull-out handle on the top front, the carriage now in use has a handle under the lower front edge. The same plastic frame may be used for all models. A plug button (supplied with each plastic frame) is used to cover a center hole which is unused on all models except A-108.

Frame—Stock No. 76161 is used as a replacement for frame Stock No. 75549 or 75571 (maroon).

Frame—Stock No. 76162 is used as a replacement for frame Stock No 75683 or 75684 (light brown).

The new type of pull-out handle (lower front) is available as Stock No. 76125. If the original pull-out handle (top front) is desired it will be necessary to drill two holes in the frame. The holes are .203" diameter and are located .625" each side of the center line and 13/64" down from the top.

In Models A-91 and A-108 the color of wire used in the connecting cable has been changed. A black-white wire has been used as a substitute for the black wire (pin 1 to speaker) and a brown-white wire has been used as a substitute for the brown wire (pin 8 to speaker). A brown wire goes from pin 2 to the jewel lamp and a black wire goes from pin 3 to the jewel lamp.

In Model A-82 a substitute speaker (stamped 92569-9B) has been used in some instruments. It requires a different speaker cone than the one listed in the A-82 Parts List. Speaker 92569-9B uses Stock No. 75875 cone, Speaker 92569-9W uses Stock No. 74901 cone.

RCA Q10-3, Q10 Series, Ch. RC-549C

Model Q10-3 is identical to other sets of the Q10 series with the exception of the cabinet which is black and uses ivory color knobs.

The output transformer mounting has been revised to minimize the possibility of breakdown, especially in tropical areas. The transformer in later production sets is mounted on insulation board which is, in turn, mounted on the dial back plate support.

RCA BX55, Ch. RC-1088; BX57, Ch. RC-1088A

Capacitor C11, 0.047 μf, must be dressed away from the metal chassis and in such position that inserting the chassis into the case will not change its position. The side of C11 which may short to chassis is the side which connects directly to the selenium rectifier. If this side contacts the chassis it will place the chassis at power line potential.

The 2600-ohm, 6-watt resistor R13 now being used in Model BX57 is of improved design. The original resistor was a ceramic type and the type now being used is a flat armored type. When the new type is used to replace the original type, it is necessary to drill a .120" diameter hole in the front apron of the chassis to accommodate a self-tapping screw for mounting purposes.

RCA Ch. RC-1065C, RC-1065D

The value of capacitor C3 in these chassis is 9.1-113.8 μμf. C3 is located across oscillator coil L2.

RCA Record Changers RP-176A, RP-176B

The record changers are the same as the RP-176 except for the following differences. The pickup and arm assembly for the RP-176A is: Stock No. 72716, Arm, Pickup arm complete, less pivot arm, crystal and cable. The motorboard sub-assemblies, complete with all welded and riveted parts, less detachable operating parts, are designated as stock numbers 72717 and 70844, for RP-178A and RP-178B, respectively.

RCA X551, Ch. RC-1089B; X552, Ch. RC-1089C

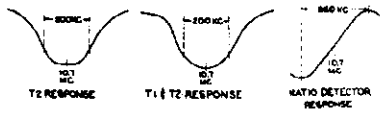
R4, the 3.3-megohm avc filter resistor previously connected to the junction of R12, 47,000 ohms, and the phono jack J1, is now connected to the junction of R12 and terminal 2 of the 2nd i-f transformer T2.

RCA 8V90, Ch. RC-618, RC-618A; 8V91, Ch. RC-616A, RC-616H

Under Alignment Procedure, Critical Lead Dress, the following additions should be made:

17. The f-m oscillator coil should be cemented to its support. Amphenol No. 912 cement is recommended for this purpose. If it is necessary to loosen the coil, use Amphenol No. 916 solvent.

18. Capacitor C41 should be waxed or cemented to the chassis apron. The f-m response curves are shown in the accompanying diagram.



F-m response curves for Models 8V90 and 8V91.

In Chassis RC-618 the value of R35 is 56(ohms; and R31, the 1-megohm resistor across C4, is used only on early chassis.

Chassis RC-618A is the same as Chassis RC-618 except for the following changes which have been made. A filament choke coil L6 has been added from pin 2 of V8 to pin 2 of the 6AV6 a-f amplifier V5. A 0.005-μμf ceramic capacitor has been added from pin 3 of the 6AU6 driver V3 to ground. A 0.005-μμf ceramic capacitor has been added from pin 5 of V7 to ground. A 100-ohm, ½-watt, fixed composition resistor R36 has been added from pin 4 of V8 to pin 4 of V6. Capacitor C11, 5 μμf, has been added in parallel with C12, and C13 across taps D and B of the oscillator coil L4

RCA 8R71, 8R74, 8R75, Ch. RC-1060; 8R72, 8R76, Ch. RC-1060A

A 15,000-ohm ½-watt resistor, R1, is sometimes used between pin 7 of S1 Rear and the phono outlet. R33, 1000 ohms, ½ watt, has been added from F to G of the a-m oscillator coil. A 0.005-μf capacitor, C10, has been added from pin 3 of the 6AU6 driver, V3, to ground. Filament choke coil L6 has been added from pin 3 of V5 to pin 2 of V6. A 5-μμf capacitor, C11, has been added in parallel across C12 and C13. A 0.005-μf capacitor, C44, has been added from pin 5 of tube V5 to ground.

RCA 8X541, Ch. RC-1065L; 8X542, 8X547, Ch. RC-1065M

These instruments are almost identical to the previous production of these instruments which used Chassis RC-1065J and RC-1065K

RCA 9EY3, Ch. RS13½

To aid in hum reduction in Record Changer 9EY3, resistor R8 and capacitor C4 have been changed in value. R8 has been changed from 470,000 ohms to 270,000 ohms. C4 has been changed from 0.002 μf to 0.0047μf, 60(volts, tubular.

Regal 7151

Model 7151 is electrically the same as Model 205.

Sparton 130, 132, 135, 139, Ch. 5A10

Inability to procure type 12AV6 tubes in production quantities for the above models using radio chassis type 5A10 made it necessary to make the following production substitution. In the future, these models will use a 12AT6 tube in the 2nd detector and av/ circuit in place of the original 12AV6 as shown in the schematic diagram. As these tubes are interchangeable, a change in other components of the circuit is not necessary.

Sears 220, Ch. 528.173

A quantity of model 220 portable radios was shipped on which a corner boss in the cabinet body became broken. Breakage of either or both bosses released the spring (Littlefuse) clip preventing the secure latching of the back in the closed position. When this condition is found a new case (cabinetless back) should be used. Follow instructions below to prevent repetition of the same trouble.

Remove the handle from the case. Save all parts. Discard the case with the broken bosses, the support brackets and the screws that held the Littlefuse clips in place. Retain the Littlefuse clips and screws, flat washers and grommets that secured the brackets at the bottom to the rear apron of the chassis.

Replace the items that were discarded with the following new items. Order from source number 528.

Part No.	Description	Amount Required
T42-467	Case	1
T97-147	Screw - No. 4-24 x ½ thread cutting	2
T11-420	Bracket - chassis support	2
T47-118	Grommet - 5/16 pure gum rubber	2
T86-74	Washer - flat ⅜" O.D.	2

The new support bracket has a larger diameter hole at the top for the new grommet. The mounting screw is longer and a flat washer has been added.

Sears 8260, Ch. 101.823 series

The loop antenna lead wires in the front cover of the above portable have continued to break despite careful assembly and inspection at the source. An analysis of a large number of these radios on life test showed that variations in the spring tension which takes up the slack in the leads is the greatest contributing factor in these failures.

It is recommended that this spring be disconnected on every model 8260 in store stock prior to sale and delivery to the customer. The only purpose of the spring is to hold the wires taut for better appearance. The slightly different appearance of slack wires is more desirable than the potential complaint due to broken leads.

Open the back cover and find the lug in the outer case (in line with the loop leads) to which the small spring is attached. With a small screwdriver or knife bend the lug out enough to slip off the spring loop. Use a paper clip bent to form a hook, if necessary. It is not essential to remove the spring, but merely to disconnect one end as described. When this spring is disconnected the possibility of broken loop leads is reduced to a minimum.

Sparton 1080A, 1081A, Ch. 8L10

Model 1080A in mahogany and Model 1081A in blond are radio-phonograph combinations using radio chassis type 8L10. All of the information on Chassis 8L10 is contained in the service notes for this chassis.

Sparton 141XX, 142XX, 1040XX, 1041XX, 1085, 1086, 1090, 1091, Ch. 8W10

Chassis 8W10 is similar to Chassis 8M10, and the service notes for the 8M10 apply also to the 8W10. The schematic diagram for the 8W10 is the same as that for the 8M10 except that a 68-ohm resistor, R38, has been added from the junction of C1B and C2B to pin 7 (a.m.) of switch S1-R. Models 141XX in mahogany and 142XX in blond are straight table model radio receivers. A new dial, front panel, and control knobs distinguish these models from Models 141X and 142X. Models 141XX and 142XX are equipped with a 6" x 9" p-m oval speaker.

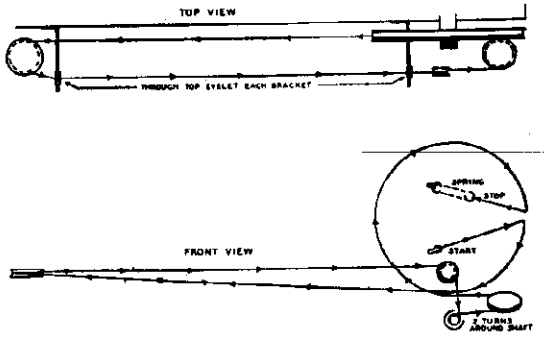
Models 1040XX in mahogany and 1041XX in blond are radio-phonograph combinations. The models also have new dials, front panels, and control knobs and are equipped with a three-speed record changer. The cabinet styling is the same as Models 1040X and 1041X. The receiver chassis is mounted to the tilting front panel in the right-hand cabinet compartment. A 10-inch p-m speaker is standard equipment.

Models 1085 in mahogany and 1086 in blond are radio-phonograph combinations. The receiver chassis is mounted in the top center compartment with the record changer directly below. A compartment either side of the units has been reserved for record album storage. The record changer is stationary mounted. These models employ a 10-inch p-m speaker.

The accompanying illustration shows the dial stringing for these models.

The Chassis Parts List for these models is the same as the Parts List for the 8M10 Chassis. The following parts apply to Chassis 8W10 and the models which use this chassis:

Part No.	Description
PA5654	Knob, maroon, 4 req'd (1085 only)
PA5625-1	Knob, black, 4 req'd (1086 only)
PA5654-1	Knob, volume (all other models)
PA5654-2	Knob, tone, on-off
PA5654-3	Knob, f-m, a-m, ph.
PA5654-4	Knob, tuning
PB30017	Dial scale
PB40150	Escutcheon, black (1086 only)
PB40150-1	Escutcheon, maroon (1085 only)
PD93012-1	Escutcheon, maroon and gold (141XX, 1040XX, 1090)
PD93012-2	Escutcheon, gold (142XX, 1041XX, 1091)
PC63000-12	Speaker, 10" round p-m (all consoles)
PC63000-19	Speaker, 6" x 9" oval p-m (table models)



Dial stringing for Sparton Chassis 8W10.

Stromberg-Carlson 1121, 1135

When f-m drift is encountered the following steps can be taken to assure better grounding and better receiver performance.

1. On the variable tuning capacitor, connect short lengths of wire braid from the shaft wiping contacts to the r-f tube shelf. Also at the four points, where the tie-bar of the variable capacitor is connected to the r-f tube shelf, use wire braid (heavy) and solder with a heavy duty soldering iron to insure a well soldered connection.

2. At the converter end of the r-f tube shelf, where it is mounted to the chassis mounting bracket, use a heavy duty iron and sweat in solder along the butting junction.

3. The f-m trimmers on the r-f shelf may be loose, permitting heat, vibration, etc., to cause them to change slightly. If they can be turned easily, unsolder the lock-nut, run it down a fourth or half turn, as necessary to get a smooth but secure hold on trimmer screw, and resolder. Pay particular attention to the oscillator section.

4. At the oscillator end of the range switch, check the contact of the metal spacers to the tie rods between wafer sections. If they are floating or only grounding intermittently, crimp them down tightly against the tie rods and tighten the tie bolts.

5. Substitute wire braid in grounding connections from r-f shelf to main chassis and solder well.

6. Check alignment of the f-m—i-f and discriminator and get proper bandwidth. At the same time be sure that the iron core slugs fit snug so that they will hold alignment. A Vistac compound can be obtained that acts as a non-hardening filler. Particular emphasis should be given on the discriminator transformer secondary where a slight movement gives the same effect as oscillator drift.

United Motors 980899, Buick

The value of the 7259128 (Illustration No. 35) electrolytic capacitor has been changed so that all sections are now 20 μf. Thus, the cathode bypass capacitance on the output tubes has been raised from 10 μf to 20, and the schematic should be altered to comply with this change.

The 470-ohm resistor (Illustration No. 63) in the cathode string of the 6R8 bucking diode circuit has been eliminated after Serial No. 94295.

United Motors 980980, Buick

The 1951 Buick Model 980980 is identical to the 1950 Model 980899 except that the antenna trimmer compensation is for antennas between 0.000061 and 0.000088 μf. The parts list is identical to that for the 980899 except for the following service parts. The service part numbers are the same as the production part numbers except where the service part number is shown in parenthesis.

Illus. No.	Production Part No.	Description
63	1219487	470 ohms, ½ w, insulated (removed)
85	1211118 (A104)	100,000 ohms, ½w, insulated (removed)
119	7260856	Transformer, output
128	7260454	Escutcheon assy
129	7260455	Dial
130	7260422	Dial backplate
133	7260456	Pointer backplate
134	1219847	Pointer tip pkg.
	1219846	Station selector bar pkg.
139	7260709	Station selector bar.

United Motors 980979, Buick

Model 980979 is used in all 1951 Buick cars, and is identical to the 1950 Model 980869 Buick except for the parts listed below. The antenna trimmer compensation is for antennas between 0.000061 and 0.000088 μf. In the Parts List given below, the service part number is identical to the production part number except where the service part number is given in parenthesis.

Illus. No.	Production No.	Description
4	7260499	Oscillator coil
13	7258221 (G390)	Capacitor 0.000039 μf molded
49	7234563	Resistor 360 ohms, 1w, ww
62	7259502	Speaker, 8", round p.m.
64	7260855	Transformer, output
81	7260421	Backplate pointer
90	7260420	Pointer assembly
	1219845	Pointer tip pkg.
92	7260416	Escutcheon Assy.
93	7260423	Dial
94	7260422	Dial backplate
98	1219840	Push button and slide assy "B"
99	1219841	Push button and slide assy "U"
101	1219842	Push button and slide assy "I"
102	1219843	Push button and slide assy "C"
103	1219844	Push button and slide assy "K"
104	7260414	Worm gear and bracket assy.

United Motors 982421, Oldsmobile

Capacitance drift of the 0.0012-μf mica capacitor used in the oscillator tank circuit (Illustration No. 20) sometimes occurs. This appears as intermittent oscillator frequency drift which seems to be the result of high temperature which may be caused by high input voltage or other extreme conditions. It may be necessary to cover the set or run at a high input voltage when bench testing in order to have the intermittent condition reappear. Since a fixed mica capacitor is usually considered a very stable unit, this condition is not a common occurrence. However, when oscillator frequency drift is encountered this capacitor should be considered as a possible source.

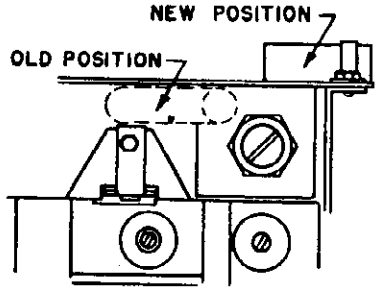
United Motors 982582, 982583, Oldsmobile

The tuner solenoid capacitor (Illustration No. 43) has been moved to a new position and is now secured by a circular mounting bracket. The new location is directly above the solenoid on the top of the tuner frame, as shown in the accompanying diagram, and eliminates any tendency for the rear cover to bind on this capacitor when located on the rear of the tuner.

The clamp fastens around the capacitor approximately ½-inch from the ground end and this lead is soldered to the clamp for grounding. A self-tapping screw secures the clamp to the liner frame. The hot lead to the capacitor is insulated by a heavy sleaving to the tuner return switch.

The value of the 7259128 electrolytic capacitor (Illustration No. 35) has been changed so that all sections are now 20 μf. Thus, the cathode bypass capacitance on the output tubes has been raised from 10 μf to 20 μf and the schematic should be altered to comply with this increase.

The oscillator coil is now the same as that which is used on both the Cadillac and Buick signal seeking tuner type radios. The part number for this coil is now 7259184.



New position of tuner solenoid capacitor on United Motors Models 982582, 982583.

United Motors 984570, Pontiac

A 7Q7 may be used as the oscillator modulator tube in place of the 6SA7. 7C5's may be used as output tubes in place of 6V6GT's. These substitutions do not require any circuit changes.

Westinghouse H-210, H-211, Ch. V-2144, V-2144-1

For convenience in later production, capacitor C11 that is connected between the common negative line and the chassis is changed to 0.15 μf, 200 volts, part no. V-6066-2154M.

Westinghouse H-305C8, H-306C8, Ch. V-2137-4

The first two items in the parts list for these models should be changed to read as follows

Part No.	Description
V-5982-2	Antenna assembly, a-m loop
V-598604	Antenna assembly, f-m loop.

Westinghouse H-312P4, H-312P4U, H-313P4, H-313P4U, H-314P4, H-314P4U, H-315P4, H-315P4U, Ch. V-2153-1

The following part should be added to the parts list for these models: R13 (Part No. RC30AE332K), 3300 ohms, 1 watt.

Westinghouse H-166C

The main chassis used in Model H-166C is the same as that used in Model H-166. A dual-speed record changer is used in Model H-166C. The changer employs a crystal pickup cartridge which has a higher output level than the variable reluctance cartridge used in the other models. For this reason, the phonograph pre-amplifier V-2138-1 in Model H-166C (see accompanying diagram) differs from those used in the other models. It functions mainly as a tone compensating device rather than an amplifier. Replacement parts for the V-2138-1 pre-amplifier are as follows:

Part No.	Description
V-4930	Cable, power
V-4931	Cable, output
V-5765	Capacitor, dry electrolytic, 20 μf, 300 v (C1)
RCP10W4103A	Capacitor, 0.01 μf, 400 v (C2, C3)
RCP10W6502A	Capacitor, 0.0005 μf, 600 v (C4, C5)
RCP10W6102A	Capacitor, 0.0001 μf, 600 v (C6)
V-3254S	Connector, phono
V-3345S-5	Grommet, power cord
V-3345S-10	Grommet, socket mtg
RC10AE333M	Resistor, 33,000 ohms (R1)
RC20AE564K	Resistor, 560,000 ohms (R2)
RC10AE104M	Resistor, 100,000 ohms (R3, R4)
RC20AE685M	Resistor, 6.8 megohms (R5)
V-4933	Socket, molded octal.

Westinghouse H-316C7, H-317C7, H-326C7, Ch. V-2136-1, V-2136-1A

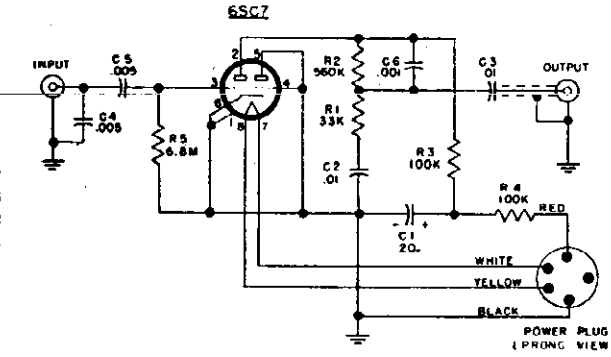
Model H-317C7 is the same as Models H-316C7 and H-326C7 except that an additional by-pass capacitor of 0.003 μf, 0.004 μf, or 0.007 μf, is connected across the output section of the filter capacitor C36 in some chassis. This additional capacitor is used in cases where the output section of C36 has excessively high impedance at radio frequencies. The chassis parts are listed in the H-316C7 service data. The cabinet and miscellaneous parts are the same as those for Model H-316C7 except for the parts listed below:

Part No.	Description
V-5982-4	Antenna assembly, a-m loop
V-6120	Background, dial
V-1223-2	Cabinet (blond)
V-9075-2	Clip, spring (ball head strike)
V-8568	Doors (matched pairs)
V-8569	Drawer, record changer (complete less hardware)
V-9832-2	Grille assembly, panel
V-9091-3	Hinge, L.H.
V-9091-4	Hinge, R.H.
V-10122-1	Pull, door
V-3246	Socket, octal wafer
V-9076-2	Strike, ball head.

In later production of the V-2136-1 chassis, the following changes were incorporated:

1. The oscillator injection capacitor (C24), which is connected between the top of the f-m oscillator coil and the top of the f-m—r-f coil, is changed in value to 0.68 μμf (Part No. V-5658-4). This change improves the mixer efficiency and increases the sensitivity.

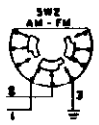
2. A 0.05-μf, 200-volt capacitor C44 (Part No. RCP10W2503M) is inserted in the line that extends between point "Y" on the schematic diagram and the selector switch SW2. In addition, R34 (Part No. RC20AE224M), a 220,000-ohm ½-watt resistor, is inserted between the selector switch side of C44 and ground. These changes improve the tuning characteristics of the f-m band.



Phonograph pre-amplifier used in Model H-166C.

Some chassis used in later production of the subject models are designated V-2136-1A. These chassis are the same as the V-2136-1 except for the differences mentioned in the following paragraphs. These chassis use a 19T8 tube in place of the 12AL5 and 12AV6 tubes used in the V-2136-1 chassis. Tap 1 of ratio detector transformer T3, that was connected to pin 1 of the 12AL5, is now connected to pin 3 of the 19T8; and tap 4 of T3 is connected to pin 1 of the 19T8. A 33,000-ohm resistor R35 (R5, 22,000 ohms which was in this position has been removed), is connected from pin 2 to pin 7 of the f-m detector 19T8. C30 is connected across R35, and the two 100,000-ohm resistors used for alignment purposes only are still connected to the junction of C30 and R35. R24, the 220,000-ohm resistor that was connected to C30 and the junction of R25 (4.7 megohms) and R2 (470,000 ohms), and the lead from R24 to SW2 have been deleted. Pin 6 of the 19T8 is connected to tap 1 of T6, the 2nd i-f—a-m transformer. Pin 7 is grounded; pin 9 goes to the junction of R31 and C19C and D; and pin 8 goes to the junction of R10 and C19A. R25, that was connected from R3 to the junction pin 6 of the 12AV6 and R24 and R2, has been deleted. R2, 470,000 ohms, is now connected from ground to the junction of R19 (the 2.2-megohm resistor going to tap 4 of 1st i-f—a-m transformer) and R6 (the 47,000-ohm resistor going to tap 2 of T6). C13, the 0.05-μf capacitor that went from terminal lug 4 of the antenna terminal board, is now located from tap 4 of T5 to ground, in place of C16, the 0.01-μf capacitor which has been removed. The positions of C31 and C19B have been reversed. Capacitor C31, 150-$\mu\mu$f, is now located from ground to tap 2 of T6, and capacitor C19B, 220 $\mu\mu$f, is now located from ground to the junction of R2, R6, and R19. A 470,000-ohm resistor R33 (Part No. RC20-AE484K) and a 100-$\mu\mu$f capacitor C43 (Part No. RCM20B101K) have been added in parallel from tap 3 of T2 to ground.

The accompanying diagram shows switch SW2. Only the middle wafer contains changes that have been made in the V-2136-1A chassis.



Switch SW2 used in Chassis V-2136-1A.

The first and last wafers are wired as shown in the schematic for V-2136-1. (The numbers in the illustration were added for reference only.) Contact 1 goes directly to B and A of C33, and thence to L10. Contact 2 goes directly to R20, 47 ohms, and thence to pin 7 of 12BE6. The 47,000-ohm resistor R26 and the 0.001-μf capacitor C2 connected to R20 have been deleted from the circuit, and contact 3 is grounded.

In the 50L6/GT output circuit capacitor C4, 0.005 μf, is connected to pin 8 rather than to pin 4. The 3.3-megohm resistor R27, that is connected from terminal lug 4 to SW2 in the V-2136-1 chassis, has been deleted in the V-2136-1A chassis.

Zenith H615, H615W, H615Y, Ch. 6G05

These models and chassis are the same as Model G615, Chassis 6G05, except for the differences in their cabinets. Model H615 has a plastic cabinet (part number 14-1274). Model H615W has a white plastic cabinet (part number 14-1275); and Model H615Y has a black plastic cabinet (part number 14-1276).

Zenith 6MF780, Ch. 6D80, Ford; 6MF780E, Ch. 6D80E, Ford; 6MM790, Ch. 6D90, Mercury; 6MM790E, Ch. 6D90E, Mercury

Model 6MM790, Mercury, is erroneously listed in the Indexes and in Volume XVIII as Model 6MN790.

Mercury Model 6MM790E is the export model of the 6MM790. Model 6MF780E, Ford, is the export model of the 6MF780. In these export models the circuit breaker capacitor 22-1148 should be installed as shown in Fig. 1.

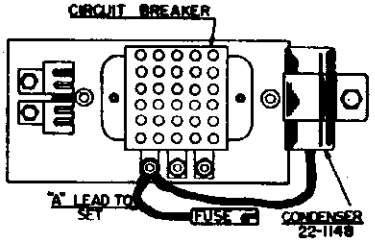


Fig. 1. Circuit breaker used on Mercury Model 6MM790E.

Top and bottom views for Chassis 6D80, 6D80E, 6D90, and 6D90E, are shown in Figs. 2 and 3. The i-f alignment procedure for these chassis is as follows:

1. Remove top and bottom covers from receiver.
2. Set signal generator to 265 kc.
3. Apply signal from generator through a 0.1-μf dummy to the 7B8 converter grid. (Pin 6 on the socket.)
4. Adjust the i-f trimmers, A, B, C, and D (shown in Fig. 2) in the order named for maximum output. Repeat the operation to assure accurate alignment.

The r-f and oscillator alignment is as follows:

1. Connect signal generator leads through dummy antenna lead in socket on receiver.
2. Set the signal generator to 535 kc.
3. Place set in manual tuning position and set dial to 535 kc.
4. Adjust oscillator trimmer C-9 (shown in Fig. 3) for maximum response.
5. Set signal generator to 1200 kc.
6. Tune set to 1200 kc.
7. Adjust converter trimmer C-7 and antenna trimmer C-2 for maximum response.
8. If dial calibration is off after making above adjustments, a correction can be made by loosening dial scale mounting screws and sliding scale to desired position.

When replacing the core or coil the following adjustments should be made:

1. Replace coil or core.
2. Set signal generator to 1700 kc.
3. Connect signal generator leads through dummy antenna to antenna receptacle on the receiver.
4. Set receiver dial to 1600 kc (maximum high-frequency end of dial).
5. Screw the core completely out of the antenna coil, the converter coil, and the oscillator coil.
6. Adjust oscillator trimmer C-9 at 1700 kc.
7. Adjust converter trimmer C-7, and antenna trimmer C-2 for maximum output reading.
8. Replace cores to their approximate original position.
9. Set signal generator dial and receiver dial to 1200 kc.
10. Adjust oscillator core L-5 to scale at 1200 kc.
11. Adjust the antenna core L-2 and converter core L-3 for maximum output reading.

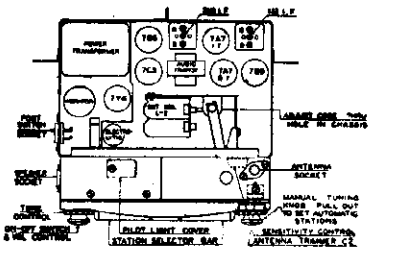


Fig. 2. Top view of Chassis 6D80, 6D80E, 6D90, and 6D90E.

12. Set signal generator to 600 kc.
13. "Rock in" shunt oscillator coil L-6 for maximum output reading. This should be done only as a last resort. This is the same as rocking in the padder capacitor on a ganged capacitor receiver.
14. Check receiver at 1200 kc for calibration and gain. If the receiver is off scale or weak, repeat operations 9, 10, and 11.

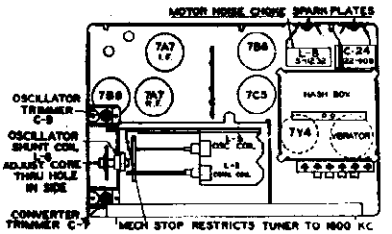
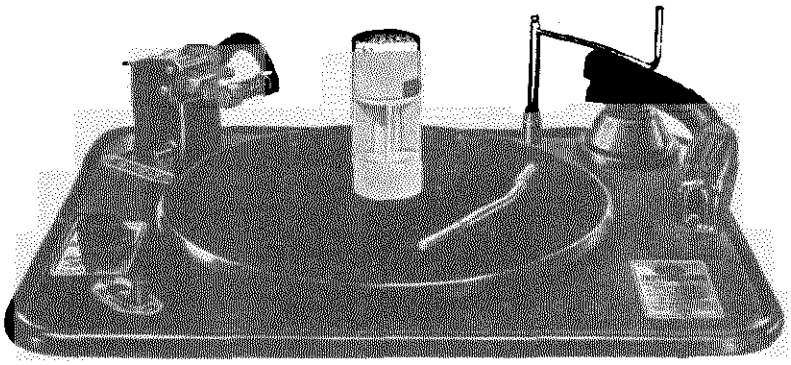


Fig. 2. Bottom view of Chassis 6D80, 6D80E, 6D90, and 6D90E.

15. After alignment is complete, the maximum high frequency tuning range should be checked. If the range is greater or less than 1605 kc, the mechanical stop for the tuner cross arm should be bent to limit the frequency coverage to 1605 kc. After all adjustments have been made, glue core screws with speaker cement.



The "Garrard" Model R.C.80 Record Changer

OPERATING INSTRUCTIONS

The "GARRARD" Model R.C.80 Automatic Record Changer will play any number of records up to 10, of any of the following types (not mixed):—

10″ or 12″	-	78 r.p.m.
7″, 10″ or 12″	-	33.1/3 r.p.m.
7″	-	45 r.p.m.

To operate the Record Changer proceed in the following order:—

1 See that the correct pick-up is in position for the type of record to be played, i.e., one having a standard .002″ to .003″ radius needle for 78 r.p.m. records, or .001″ radius needle for 33.1/3 and 45 r.p.m. records. The pick-up head is plugged into the arm and a slight pull is all that is necessary to remove it.

2 Place the correct record spindle in position, i.e., stepped sloping spindle for 78 or 33.1/3 r.p.m. records, or large spindle for 45 r.p.m. records. (See diagrams 12 and 14).

3 Set lever at side of platform to size of record it is desired to play, 7″, 10″ or 12″. Also turn subsidiary platform to forward position if it is desired to play 7″ records with small hole. (See diagram 2, 3, 4 and 5.)

4 Turn speed control knob to desired speed, 78, 45 or 33.1/3 r.p.m.

5 Place any number of records up to 10, (not mixed) on record spindle, lower overarm, and switch on by moving the front left hand knob to "Start"

Note: The overarm is not used when playing 7′ records.

To reject a record, move the left hand knob to the "Reject" position.

The changer can be switched off by moving the left hand knob to the "Stop" position. If this is done while a record is playing, when switching on again, that record will be automatically rejected and the next record commenced.

NOTE:

Should the record changer be stopped with the pick-up arm not on its rest, the pick-up should not be handled, but the left hand knob moved to "Start," when the pick-up will automatically lift and return to its rest position and stop if no records are on the record spindle.

The pick-up arm will not move from its rest unless one or more records are placed on the record spindle. This is a safety device designed to prevent the pick-up being damaged should the changer be switched on without being loaded with records.

RECORDS.

To obtain the best results from your records and record changer, care should be taken to see that the records are stored so that they keep reasonably flat and clean. Dust or dirt in the record grooves causes abrasive action and shortens the life of the record, whilst badly warped records will give trouble in dropping, poor reproduction, and even damage the pick-up stylus.

INSTALLATION

Dimensions.

The cabinet space required for fitting is 15½″ long, x 13¼″ wide, with 5.3/4″ clearance above and 3.1/2″ clearance below the plate. With a slight alteration to the motor board cut out, the "GARRARD" Model R.C. 80 is a direct replacement for the "GARRARD" Models R.C. 60, 65, 65A, 70 and 70A Record Changers.

FITTING TO CABINET.

First, the motor board should be cut out and drilled as shown on the template enclosed with each changer. If the changer is to replace one of the "GARRARD" Models mentioned above, only the piece marked on the left hand side of the template need be cut out. A small clearance should be left between the edges of the unit plate and the cabinet sides, to allow the record changer to float freely when mounted on its suspension springs.

Having opened the carton, remove the turntable found on the top liner and the box containing the record spindles, then, after disposing of the side liners, carefully lift out the changer by the string loops. A bag containing the fixing screws and spring mountings will be found in one corner of the carton. The spare pick-up head and accessories, if supplied, will be found in a box fixed to the bottom liner. Assemble the spring mountings to the motor board as shown on the template and diagram 1. Next, assemble the long fixing screws to the changer mounting plate, fitting the spring washer under the nut, then assemble a nut on each screw, leaving 3/8″ of thread below.

Before placing the changer in position, the final switch off arm at the rear of the changer, which on unpacking will be found in a downward position, should be turned to a vertical position as shown in the illustrations. To do this, loosen the round headed screw at the top of the auto switch spindle, turn the arm to a vertical position and re-tighten the screw.

The changer can now be placed in position on its suspension springs. Still using the string loops for lifting, the changer should be levelled by first fitting the turntable, then placing a spirit level on a record on the turntable, the changer can be adjusted by raising it and adjusting the lower nuts. When level, the nuts should be assembled under the springs and locked in position with the lock nuts. The string loops may now be removed and the changer connected to the power supply and pick-up to the reproducer.

It is essential to use the spring suspension assemblies on this model changer to prevent extraneous vibration from reaching the unit.

If two record spindles are used, a hole can be drilled in the wooden motor board to take the spindle not in use.

If two "GARRARD" pick-up heads are used, the plastic box in which one of the heads is supplied, can be screwed down into the cabinet to act as a dust free container for the pick-up head not in use.

If the plug-in feature is to be used to change pick-ups, the cheese headed screw under the pick-up arm at rear of pick-up should be removed. This screw should be replaced and tightened up for transit purposes only.

TRANSIT SCREWS.

Two plated wood screws are supplied for use in clamping the record changer rigid to the motor board for transit purposes. The small bakelite washers should be fitted under these screws to prevent marking the mounting plate. These screws should be removed before using the record changer. The position of the screws is shown on template and diagram 11.

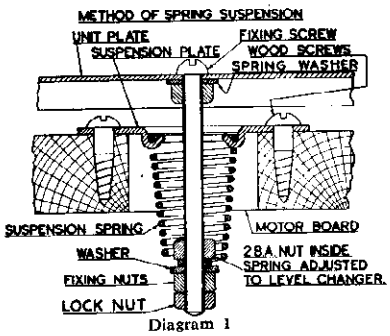
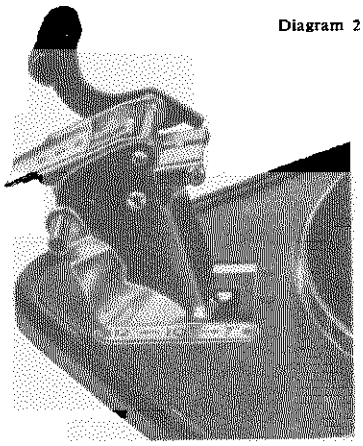


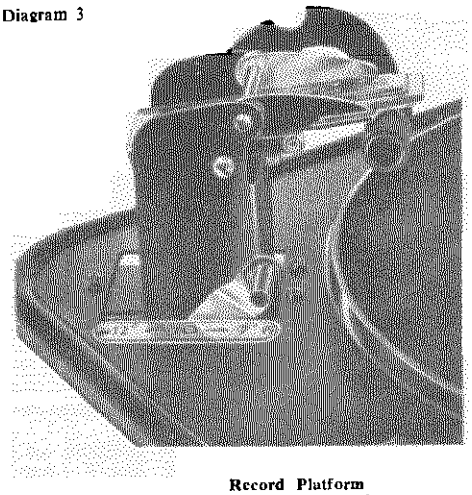
Diagram 1

Diagram 2



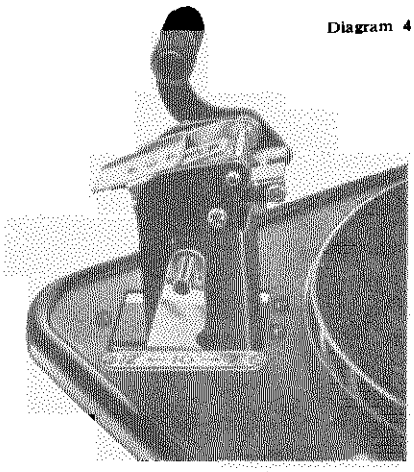
Record Platform
Set for 12" Records

Diagram 3



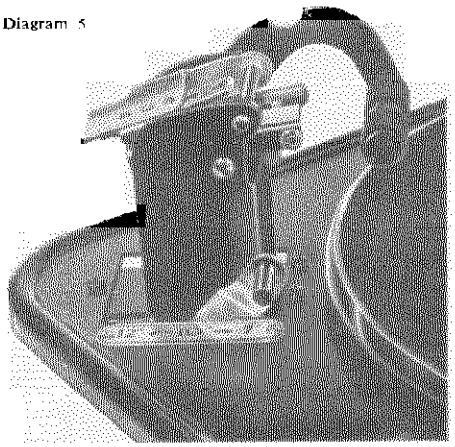
Record Platform
Set for 7" Records

Diagram 4



Record Platform
Set for 10" Records

Diagram 5



Record Platform set for 7"—45 r.p.m. Records using the large Record Spindle

MAINTENANCE.

The motor and intermediate wheel bearings, being of the oil retaining type, rarely need lubricating. When the need for oil is apparent, remove both the belts and while holding the intermediate wheel out of the way, lubricate the pulley and motor bearings with a medium grade of machine oil. Carefully remove every trace of surplus oil before replacing the belts.

The rubber rim on the intermediate wheel and the two belts must be kept free from oil.

VOLTAGE AND FREQUENCY.

The "GARRARD" Model R.C. 80/AC. Record Changer is suitable for use on 100/130 and 200/250 volts, at either 40, 50 or 60 cycles according to the motor pulley supplied, and the links on the terminal block should be set to the correct position to correspond with the voltage of the power supply as shown in diagrams 6 and 7.

A motor driving pulley can be supplied for 40, 50 or 60 cycle mains as required. The model R.C. 80/D.C. Record Changer is suitable for use on 100/130 and 200/250 volts direct current only and the links on the terminal block should be set to the correct position to correspond to the voltage of the power supply as shown in diagrams 8 and 9. The speed of the D.C. motor is governor controlled and information for adjusting the speed will be found under "Service Instructions."

The motor should be earthed by connecting a lead from the earthing tag, (located under one of the motor end cover screws) to a good earth connection.

When adapting an AC./DC. (Universal) Radio Receiver, Amplifier, or one using an AC./DC. Power Pack for the reproduction of gramophone records, a pick-up transformer, or condensers in series with the pick-up leads should be fitted, otherwise the pick-up circuit becomes alive. Also the leads from the radio set or amplifier to the pick-up should be screened and as short as possible.

LINK CONNECTIONS R.C.80/A.C.

This type is for A.C. only and has a brown cover on the terminal block.

CONNECT LINK THUS FOR 200/250 VOLTS.

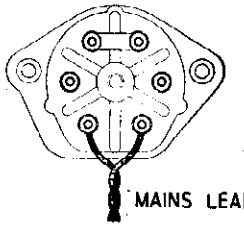


Diagram 6

CONNECT LINK THUS FOR 100/130 VOLTS.

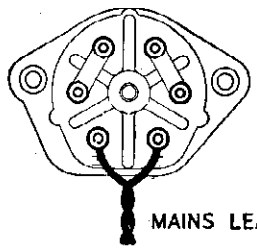


Diagram 7

LINK CONNECTIONS R.C.80/D.C.

This type is for D.C. only and has a blue Cover on the terminal block.

CONNECT LINKS THUS FOR 200/250 VOLTS.

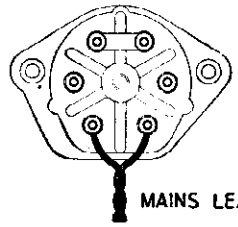


Diagram 8

CONNECT LINKS THUS FOR 100/130 VOLTS.

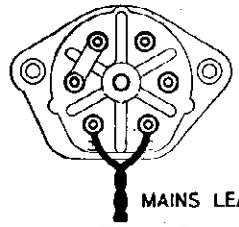
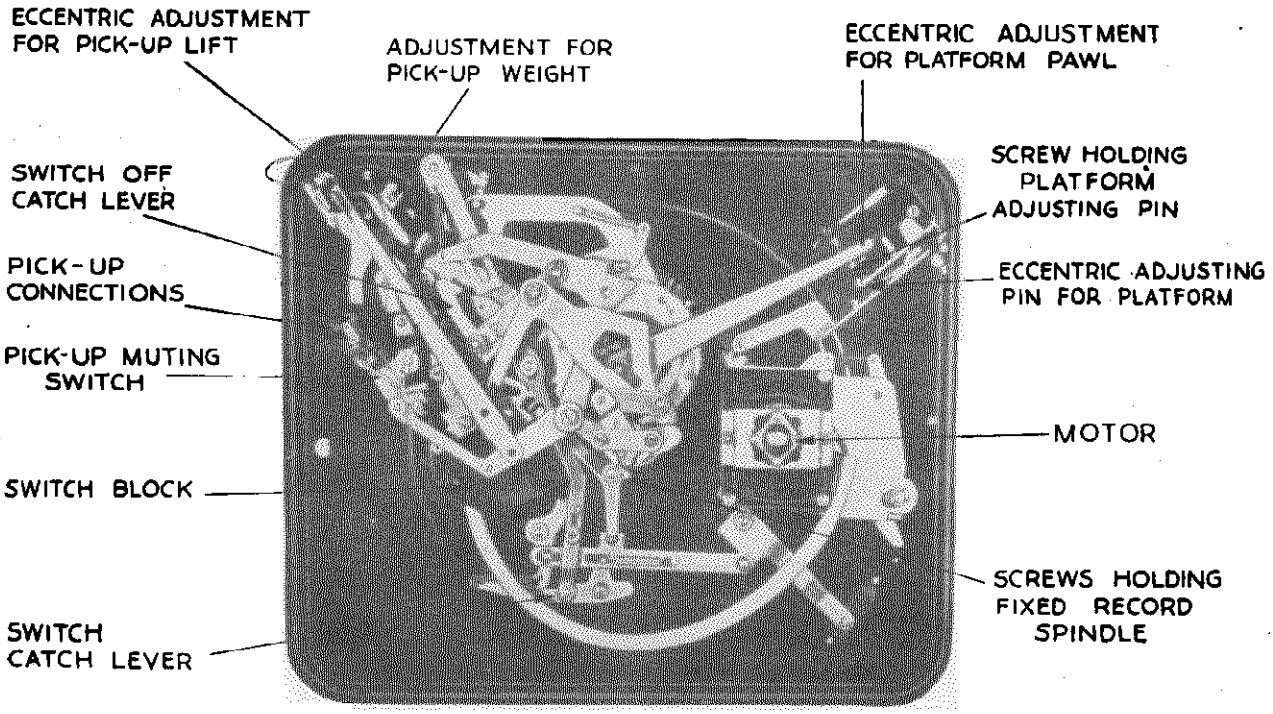


Diagram 9

Low voltage models have a green terminal block cover.



Underneath View

Diagram 10

SERVICE ADJUSTMENTS

SPEED.

The Model R.C. 80/AC. Motor is arranged to give the desired turntable speed within close tolerances. Should the turntable run excessively fast or slow then the motor pulley should be examined to see if it is the correct one to suit the frequency of the mains supply.

The various motor pulleys are colour finished as follows to distinguish the three types:—

Nickel	-	50 cycles.
Brass	-	60 cycles.
Copper	-	40 cycles.

For use on 25 cycles supply, a special motor and pulleys are required.

The speed of the R.C. 80/DC. and low voltage Models, is governor controlled, the governor being located at the lower end of the motor and is screwed on to the armature shaft and held in position by a screw through the governor collar. To adjust the speed, loosen the screw in the governor, and turn the governor a very small amount clockwise to increase the speed, or anti-clockwise to reduce it. Tighten the screw before running the motor to check the speed.

SPEED VARIATION.

It is essential that the driving surfaces of the three brass pulleys, the rubber tyred interwheel, and the belts, should be kept absolutely free from all oil or grease. This is the first point which must be checked if the turntable speed varies and the pulleys, belts and inter-

wheels should be cleaned with a dry cloth if contamination with oil is suspected. Another point to check is that the two belts run centrally on their pulleys; should they tend to run off the pulley, try removing the belt and turning it over. If this does not cure the trouble, a new belt should be fitted. Also see that the main spindle has a small amount of end play. To check this, remove the turntable and grip the main spindle firmly lifting it up and down. If no movement is felt, loosen the two screws (diagram 10) which holds the fixed portion of the main spindle, raise the main spindle a very small amount and re-tighten the screws.

NOISE.

Should the drive become noisy, first see that the screw holding the pulley to the motor shaft is not touching the intermediate wheel as it revolves. If it is, raise the pulley by loosening the screw holding it to the shaft. If the motor pulley is correct, then lubricate the pulleys as described under "Maintenance."

MOTORS.

If the motor fails to start when the control knob is turned to "Start," first check the power supply and ascertain if current is reaching the motor terminals. If correct, switch off the mains supply and examine the terminal block and see that the leads and screws are tight, also examine the switch contacts accessible underneath. Clean and adjust if necessary. On the R.C. 80/DC. and low voltage models, examine the motor brushes and make sure that they are clean and making good contact with the commutator. Also ensure that they are not sticking in the brush tubes.

The "Switch Catch Lever" (diagram 10) should also be checked to see that it is engaging when the knob is moved to "Start." If it fails to engage, adjustment is provided on the link which operates it to allow it to drop into engagement with the switch lever and hold it in position.

If a thick oil has been used to lubricate the motor bearings, the motor will appear weak or will not start. It will then be necessary to dismantle the motor and clean away all traces of the thick oil. It is, therefore, essential to lubricate the motor bearings with a good quality thin oil.

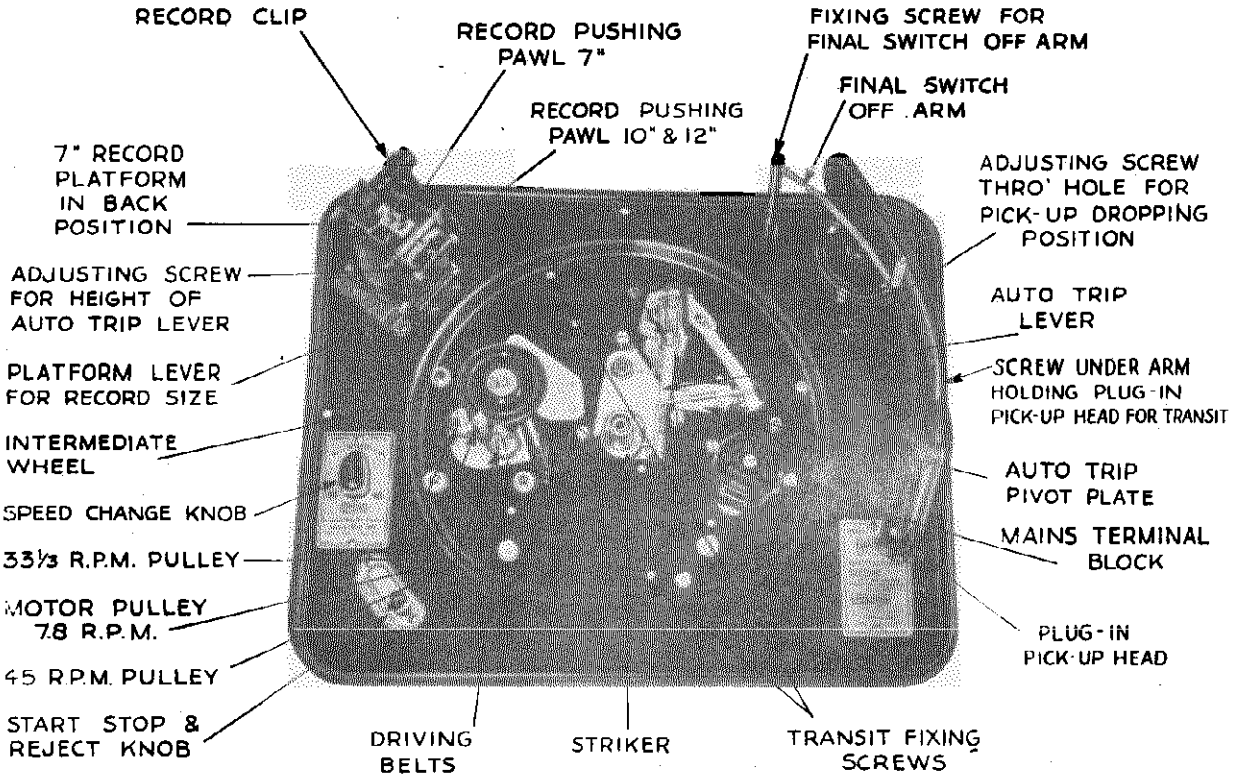
Should the motor get too hot, see that the voltage changeover links are set correctly to correspond with the voltage of the power supply. If correct, check the motor windings by inserting an AC. milli-ammeter in either motor lead.

The maximum current consumption of the R.C. 80/AC. should not exceed 0.26 amps. on 100/130 volts, 50/60 cycles, or 0.13 amps. on 200/250 volts 50/60 cycles. On the R.C. 80/D.C. the current should not exceed .26 amps. on 100/130 volts or .23 amps. on 200/250 volts. On the low voltage 12 volt model, the current should not exceed 1.2 amps. or the 6 volt model 2 amps.

If readings in excess of the above figures are obtained, the motor unit should be returned for examination.

To remove the motor, first make sure the electricity supply is disconnected, then remove the insulated plate on the underside of the terminal block and the two terminal block fixing screws will now be accessible, after removal the terminal block will be released and will be attached only to the motor leads. The speed indicator knob should also be removed.

Next, while supporting the motor underneath, unscrew the nuts on the three suspension screws which secure the motor to the unit plate. Before finally



View with Turntable Removed

Diagram 11

PICK-UP MUTING SWITCH.

A pick-up muting switch is connected across the pick-up to short circuit the pick-up except when the changer is in the playing position. It is important to note that no sound will be obtained from the pick-up by flicking the needle when the pick-up is on its rest. The muting switch contacts should be closed except when the changer is in its playing position. Should this switch fail to operate, clean the contact faces, and ensure that they make and break according to the position of the changer mechanism.

AUTO TRIP MECHANISM.

The auto trip mechanism is the velocity type and is of a special design to be very light and sensitive in operation. It is set to commence operation when the needle reaches a 2.7/8" radius. The trip operates by the auto trip lever being raised by a small cam attached to the main spindle when the pick-up arm runs in on the record run off groove. The auto trip lever, on being lifted, pushes a small cranked rod which engages the clutch.

If the auto trip fails to operate, it may be caused by the auto trip lever being too low and it should be raised by giving the auto trip lever adjusting screw (diagram 11) about half a turn in a clockwise direction).

RECORD PLATFORM ADJUSTMENT.

When despatched from our Works, the record platform is set to accommodate records of average dimensions. Occasionally, however, records may be found outside the normal limits. If necessary, therefore, the platform may be adjusted to take them. To adjust the platform position, loosen the screw in the platform pivot collar (diagram 10) accessible from underneath the changer, rotate the pin by means of the slot in the end, until the platform is in the required position, then re-tighten the screw. The end of this pin is eccentric, and it is this eccentric which adjusts the platform position. Before finally tightening the screw after adjusting this pin, see that a small clearance, about 1/64" is left between the eccentric shoulder and the side of the platform support.

Separate adjustment is provided for the platform pawl, and, to set the platform pawl, first set the platform lever in the 10" position and operate the changer until the pawl is in its forward position. It should then be flush with the edge of the record platform. If it is not, the nut locking the eccentric adjustment for platform (diagram 10) should be loosened and the eccentric adjustment turned until the setting is correct, then re-tighten the locking nut. The pawl position should now be correct for all sizes of record.

RECORD DROPPING.

If the changer fails to drop any records other than the 45 r.p.m. type having a large centre hole, first make sure that the records are not badly warped. If they are reasonably flat, the record platform setting should be checked and adjustments made if necessary. Also check the record spindle to see that it is not bent out of position by laying it on the template (diagram 15).

Should records fail to drop correctly when using the large diameter record spindle, replace this spindle with the sloping one and see that it leans towards the record platform and is exactly in line with it. If this spindle is out of position it should be set correctly by loosening the two screws (diagram 10) holding the fixed part of the main spindle in position, turning the record spindle until it leans towards the centre of the record platform and tightening up the screws. After tightening the screws, see that the main spindle has a small amount of end play by first removing the turntable and gripping the main spindle firmly, lift it up and down. If no end play is felt, adjust as described under "Speed variation" on page 7. On fitting the large spindle the records should then drop correctly.

AUTO SWITCH.

When the last record on the record spindle drops on to the turntable, it allows the final switch off arm to move inwards far enough to switch the changer off. When any records are on the spindle, the arm does not move in far enough to allow this to happen. Should the changer fail to stop automatically, check the following points:—

1 That the auto switch arm is in vertical position as shown in the illustrations and that its fixing screw is tight.

2 See that the split lever holding the spindle underneath the mounting plate is also tight—it is at this point that a slight adjustment may be made to the position of the knock-off lever should it for any reason be forced out of position.

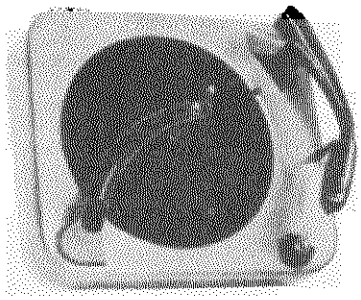
3 The auto switch catch lever (diagram 10) has a friction pivot and if this should become very free it may fail to hold the catch pin when it should engage. If this is so, remove the split pin at the catch lever pivot and stretch the friction spring a small amount, replacing the washer and split pin.

TEMPLATE FOR R.C. 80 RECORD SPINDLE.

Should the sloping record spindle be accidentally bent out of position through being dropped or other reasons, the record dropping will be affected. If trouble is experienced with erratic record dropping, lay the record spindle on the template and check that it conforms to the shape thereof.

Template for Record Spindle

Diagram 15



CONTENTS

SPECIFICATIONS

This single-pickup-arm, single-spindle record changer is designed for three-speed operation (33⅓, 45 or 78 revolutions per minute) from a power source of 110 volts at 60 cycles. It will play a single record manually, or a series of twelve 7-inch, twelve 10-inch, ten 12-inch, or ten 10-inch and 12-inch records intermixed.

Indexing of the tone arm for different sizes of records is automatically controlled by two feeler levers, making unnecessary the usual manipulation of the record shelf by the operator.

The pickup arm is designed to use a two-position knob-controlled dual stylus pickup. A special spring coupling system makes it impossible for the changer mechanism to be jammed or damaged by accidentally moving the pickup arm during the change cycle.

45 RPM records are adapted to the single spindle of this changer by inserting a bushing in the large center hole of each record.

Advantages of the spindle-type record shelf include: simplicity of changer mechanism, ease of operation, freedom from chipped records, and ability to change slightly warped records.

The changer shuts itself off after the last record is played.

OPERATING INSTRUCTIONS

LEVELING RECORD CHANGER

It is important to have the record changer absolutely level. Use a torpedo or similar type level on the record changer base plate. Use adequate shims under the radio combination cabinet to achieve perfect level.

LOADING RECORDS ON CHANGER

Pull straight up on the record balance arm until the arm clears the spindle. Swing the arm to the left until the pin in its shaft drops into the locating groove.

Gently lower records over the spindle until they rest on the off-set shelf. While holding the records level, lower the balance arm over the spindle to hold the records in place.

NOTE: Records requiring different speeds cannot be intermixed. When using 45 RPM records, each record must have a record adapter shim pressed into the large hole to permit their use on the small standard-sized spindle.

BEFORE PLAYING RECORDS make certain that the speed control knob is set at the proper speed for the records to be played, and that the small stylus selector knob on the pickup arm points to the same number as indicated on the speed control knob.

REJECTING: To reject a record at any time while the changer is operating, turn the changer control knob to "REJ" and release.

STOPPING: To turn the changer off before automatic shut-off, turn the changer control knob to "OFF." Lift the pickup arm and place on its rest.

UNLOADING: Lift the record balance arm and swing it to the lef until the small pin on the shaft drops into the locating groove Lift the stack of records straight up and off the spindle.

MANUAL OPERATION: To play single records or home recordings allow the changer to go through its complete shut-off cycle. Lif the record balance arm and move it to the left to its locatin groove. Place the record on the spindle and lower it to the spindl shelf. Tilt the record down toward the back end of the picku arm while gently pulling it toward the record balance arm shaft releasing the record support and allowing the record to be lowere to the turntable. Turn the changer control knob to the "ON position *only*. Raise the pickup arm and place the stylus in th 1st groove of the record. To stop, place the pickup arm on it rest and turn the changer control knob to "OFF."

TO REPEAT RECORDS: Swing the record balance arm clear of th spindle, place a record on the turntable and start the changer. Th record will be repeated until the control knob is turned off. If 12-inch record is to be repeated, provide some means such as rubber band to hold the 12-inch feeler lever against the picku arm support post, otherwise the pickup will index as for a 1(inch record.

OPERATING PRECAUTIONS

1. Do not, under any circumstances, connect the motor to source of direct current or to alternating current other than 11 volts at 60 cycles.

2. Do not allow oil or grease to come in contact with the rul ber drive wheels (or belts) of the motor assembly.

3. Do not intermix records of different speed requirements.

4. Do not attempt to play records with other than the prop stylus or turntable speed.

5. Do not allow records to remain unplayed on the chang spindle since they will be warped and ruined. Store records fla in a cool place. Dust on records spoils tone, and leads to sho record and stylus life.

6. Take extra care with micro-groove records—a sing scratch can cause the stylus to skip across a large portion of th record: a little dust under the stylus can cause groove jumpir and poor tone.

7. Keep a small eyebrow brush handy to remove dust fro the stylus after every stack of records for best volume and tone.

8. When not in use, leave the speed control knob betwe the "78" and "45" positions to relieve pressure on the mot wheel.

9. When playing records manually, do not allow the stylus be dragged across the record, or "ride" against the top or ed of the turntable. The stylus jeweled point may be broken.

10. Do not play fine records with a broken or badly wo stylus. If tone is poor even after the dust has been removed fro the stylus, the stylus may be defective. Further use may ru records.

PICKUP CARTRIDGE

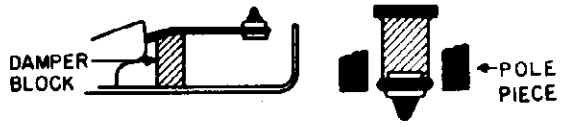
The Model P16 record changer is equipped with a dual styl variable reluctance cartridge (G.E. Cat. No. RPX-050). A sm knob control permits instant selection of either a .003" or .00 stylus for use on standard or micro-groove records. To chan styli, first depress the control knob, and then rotate half a turn either direction, until the pointer points to the number on t pickup arm corresponding to the speed of the records to be playe When the knob is released, the stylus assembly should spri back into its operating position.

MODEL P16

TO CHECK STYLUS

Dust on and around the stylus may cause easily corrected complaints. A soft bristled brush, such as G.E. Cat. No. RQB-001, should be used to clean these parts. A few of these brushes in the home service kit make friendly gifts, may save a service call, and enhance the customer's record enjoyment.

The small rubber-like damper block may become loose at one end, causing distortion. A tiny drop of thin nail polish may be used to re-cement the damper block. Do not allow the whole block to become coated with the cement.



Stylus should ride equidistant between the pole pieces, with only the stylus tip protruding down below the poles. Low pickup output is sometimes traced to a stylus lever bent down below the field of the poles. Normally, a slight extra pressure on the pickup arm causes the stylus to be forced up between the poles, which then support most of the pressure, protecting the stylus.

The tiny micro-groove stylus may be easily broken, causing distortion, groove-jumping, and *rapid record wear*. Such a defect is almost impossible to see with the naked eye, especially since the sharp outline of a break would be worn round by the time the serviceman was called. A jeweler's eyeglass, known as a loupe, is very useful when inspecting stylii and damper blocks.

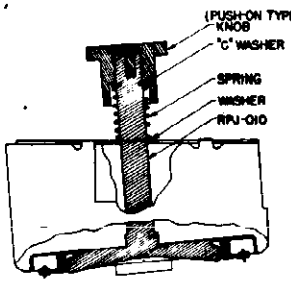
Early stylus wear, though distinguishable by the ear, is almost impossible to determine by sight, unless a high-powered microscope is used. For this reason the listening test for stylus wear is recommended: if a new stylus sounds better, the old one must be defective. Use almost new records with critical high frequency passages for listening tests.

It is suggested that whenever the changer is not in use the larger standard stylus be left in the playing position since the tiny micro-groove stylus is much more easily damaged in case of accidental shock.

TO REPLACE STYLI

To remove the styli assembly for replacement, first pull off the control knob; remove the two cartridge mounting screws; slip off the two wire connectors, and remove the cartridge from the pickup arm. Depress the small spring on the stylus control shaft to remove the "C" washer, followed by the spring and flat washer.

When reassembling, the two wires may be connected to either terminal of the pickup. Note that the knob is keyed to fit on the shaft only one way.



RKP-009 SERVICE KIT—Contains knob, "C" washer, spring, and flat washer

RPJ-010 REPLACEABLE STYLI ASSEMBLY—With .003 and .001 inch sapphire styli

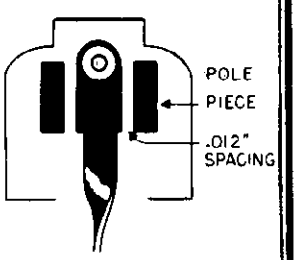
RPJ-011 REPLACEABLE STYLI ASSEMBLY—With .001 and .0025-inch diamond styli

SCRATCH, SURFACE NOISE

Scratch can be reduced by connecting a 15,000 ohm resistor across the pickup leads, either at the amplifier, or under the changer. Lower values of resistors will increase the effect. This procedure reduces the high frequency response of the phonograph, and may be noticed by a lack of "brilliance" in classical music if the resistor value is not carefully chosen to suit the customer.

TO CHECK PICKUP

The pickup coil should measure about 340 ohms. Output measured with a vacuum-tube voltmeter and a Columbia 10003M Standard Test Record should be about .01 volts at 1000 cycles. Distortion originating at the pickup other than by worn or broken styli is usually due to improper spacing of the pole pieces, or bits of dust, especially iron filings, accumulating between the stylus and the pole pieces. Pole pieces should be parallel to each other, and .012 inches from the stylus. Increasing this clearance lowers the voltage output, but tends to lessen distortion and scratch pickup. Though decreasing the clearance increases the output, the stylus becomes more easily clogged with dust, and there is danger that the stylus may actually touch the pole pieces causing unpardonable distortion.

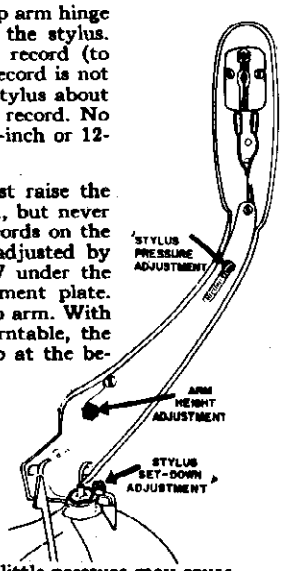


SERVICE ADJUSTMENTS

STYLUS SET-DOWN

A small screw on the top of the pickup arm hinge post adjusts the set-down position of the stylus. Make adjustment with a new 10-inch record (to make sure that the center hole in the record is not enlarged). The ideal setting drops the stylus about in the center of the lead-in area of the record. No other adjustment is necessary for the 7-inch or 12-inch records.

PICKUP ARM HEIGHT: The pickup arm must raise the pickup enough to clear the 12th record, but never so high that it strikes the unplayed records on the record spindle. The pickup height is adjusted by turning the hex-headed **LIFT SCREW** under the pickup arm at the end of the adjustment plate. Screwing it up and in lowers the pickup arm. With a 1⅛ inch stack of records on the turntable, the pickup should raise ¼ inch straight up at the beginning of the change cycle.



STYLUS PRESSURE

The stylus pressure should be between 6 and 8 grams. Adjustment may be made by loosening the small round-headed screw which moves in a slot on the adjustment plate under the pickup arm. Moving the screw toward the pickup reduces the stylus pressure. Too little pressure may cause groove-jumping or failure to trip; too much pressure causes excessive record and stylus wear.

NOTE: Before increasing stylus pressure to remedy groove-jumping check:

For dirt under stylus

For worn or broken stylus

Damaged micro-groove records

That mounting bolts have been removed allowing the changer to float on its mounting springs. This prevents room vibrations from jarring the stylus out of the record groove.

That the radio and changer are approximately level. Check with a spirit level.

TROUBLESHOOTING

Rather than attempt to itemize the numerous bent levers and stuck bearings and the resulting symptoms that may possibly occur during the life of a record changer, this manual intends to explain the operating principles and purpose of the special parts in the belief that a serviceman who understands *how* it is supposed to work can more easily figure out *why* it does not operate.

The following is a brief review of complaints common to many record changers, with suggested causes and remedies.

Many intermittent complaints are caused by irregular recor
Another cause is over-oiling: small levers requiring very lig
pressures become stiff with oil, and the dust accumulated by t
oil, and should never be oiled. Gasoline or kerosene should nev
be used for cleaning changer parts because of possible damage
rubber parts. Use carbon tetrachloride in a *well-ventilated roo*

SYMPTOM	CAUSE	REMEDY
Too slow, stalls	Dirt or oil on motor pulleys and turntable rim	Clean with carbon tetrachloride
	Speed pulley unsnapped from retaining ring	Snap back in place
	Large idler wheel mounting bent, idler tire not making firm contact with pulley	Straighten mounting
	Voltage too low	Check line voltage, should be at least 105
	Changer too cold	Test changer at room temperature, 70 deg.
	New oil or grease too heavy	Use only light oil and grease. MANY POIN *MUST HAVE NO OIL.* See page 2 for lubricat instructions
Noises: Wow	Oil on pulleys causing slippage	Clean with carbon tetrachloride
	Warped records	Use flat records for testing
Click	Trip lever friction assembly too stiff	Clean, adjust spring by bending for minimum fric required to move pawl lever
Rumble, roar	Changer not floating on mounting springs	Loosen mounting bolts under turntable
Thumping	Dent in rubber tire on idler wheel, caused by storing changer in 33-45 RPM position or allowing motor to run when changer is stalled.	May disappear after running the changer a *minutes; otherwise replace the idler wheel. To prev* reoccurrence, leave speed control knob between " and "45" when not in use
Dead motor or pickup	Open circuit	Both circuits are simple series type and can be ea checked with an ohmmeter. Pickup—340 oh Motor—15 ohms (approx.)
Poor tone, Jumps grooves	Broken or dirty stylus Stylus pressure too light	See page 2 for stylus and pickup information
	Pickup arm bearings stiff	Remove all grease, burrs
	Substandard records	Check for scratches, shallow grooves
	Changer not level or not floating on springs	Level changer; loosen mounting bolts
Doesn't drop records	Spindle *mechanism bent or dirty* Record holes too small	*Repair or replace spindle (see page 8)* Check records
Drops two records	Record holes too big Record guide in spindle may be stuck	Use other records *Record guide must drop freely by gravity*
Fails to cycle, or cycles too soon	Check trip link, trip lever, pawl lever and trip pawl for easy operation. Check spring friction coupling between trip lever and pawl lever	Straighten bent trip link; wash off main gear lev **DO NOT Oil.**
Pickup arm indexes O.K. for one size record only	Reset lever or 7 inch feeler lever dirty, or their springs interchanged when reassembled; 12 inch lever bent, or spring missing.	Spring under reset lever is lightest of all; 7 inch fe spring is same tension as auto. shutoff lever as See page 5.

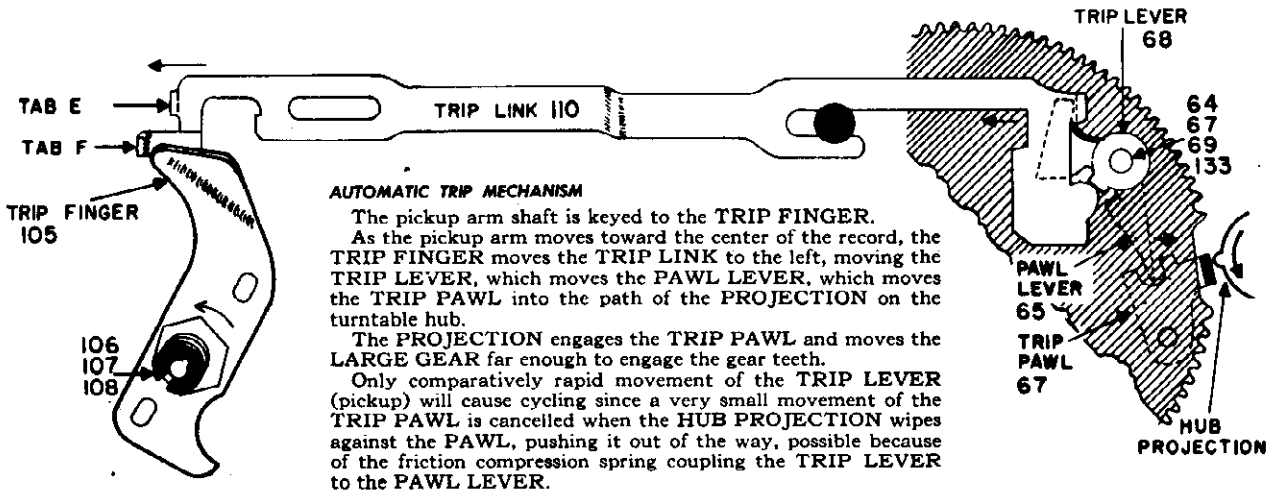
MODEL P16

THEORY OF OPERATION

STARTING CHANGER:

When the control knob is turned to the REJ position, the manual shut-off rod moves the switch operating lever, which engages TAB E of the TRIP LINK.

The TRIP LINK moves the TRIP LEVER, which moves the PAWL LEVER, which moves the TRIP PAWL into the path of the PROJECTION on the turntable hub. The PROJECTION engages the TRIP PAWL and moves the LARGE GEAR far enough to engage the gear teeth with the turntable hub gear.



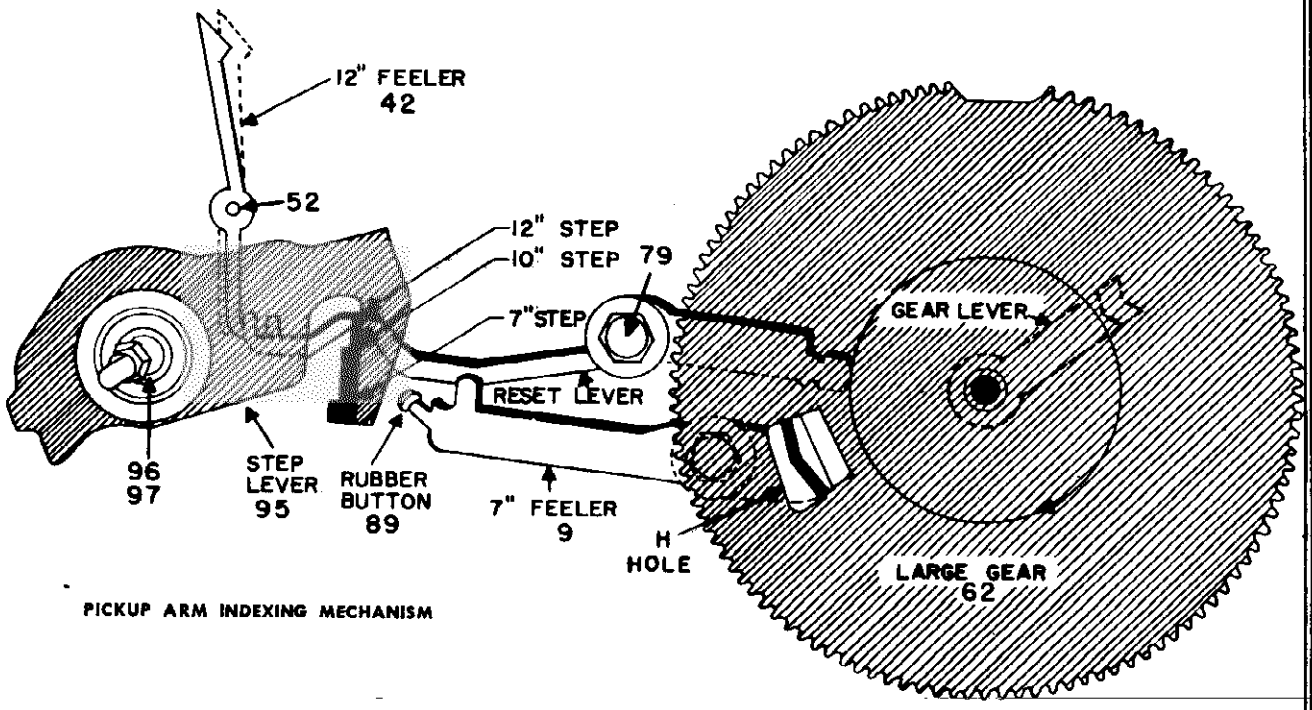
AUTOMATIC TRIP MECHANISM

The pickup arm shaft is keyed to the TRIP FINGER.

As the pickup arm moves toward the center of the record, the TRIP FINGER moves the TRIP LINK to the left, moving the TRIP LEVER, which moves the PAWL LEVER, which moves the TRIP PAWL into the path of the PROJECTION on the turntable hub.

The PROJECTION engages the TRIP PAWL and moves the LARGE GEAR far enough to engage the gear teeth.

Only comparatively rapid movement of the TRIP LEVER (pickup) will cause cycling since a very small movement of the TRIP PAWL is cancelled when the HUB PROJECTION wipes against the PAWL, pushing it out of the way, possible because of the friction compression spring coupling the TRIP LEVER to the PAWL LEVER.



PICKUP ARM INDEXING MECHANISM

PICKUP ARM INDEXING SEQUENCE

The RESET LEVER is a limit stop for the STEP LEVER, the position of which determines where the pickup arm sets down after a change cycle.

The GEAR LEVER depresses the RESET LEVER, cancelling all previous indexing information. (This is done mid-cycle, as soon as the pickup arm reaches the extreme right-hand position.)

As each 12-inch record falls it displaces the 12-inch FEELER, which unlatches the RESET LEVER, allowing a spring to move the RESET LEVER to its 12-inch position. The position of the RESET LEVER determines which step the STEP LEVER will stop against.

As LARGE GEAR continues to rotate, the 7-inch FEELER is allowed to drop into HOLE H, forcing the RUBBER BUTTON upward toward a record; if it touches a 10-inch or 12-inch record its movement is limited—and nothing happens. If a 7-inch record is on the turntable, RUBBER BUTTON cannot stop the 7-inch FEELER from depressing the RESET LEVER enough to engage the STEP LEVER at the 7-inch step.

Since neither the 12-inch FEELER nor the 7-inch FEELER operate when a 10-inch record falls to the turntable, the RESET LEVER remains in the neutral 10-inch step position.

PICKUP ARM MOVEMENT

As the forked lever begins to move, the inclined surface on the end near the switch pushes the lift pin upward, raising the pickup arm clear of the record. As soon as the pickup arm is fully raised, the tab on the side of the forked lever contacts the trip finger, swinging the pickup arm clear of the turntable. The tab also contacts the step lever moving it clear of the reset lever.

As the lift pin is pushed upward, the conical spring is compressed, overcoming the pressure of the spring washer separating the step lever and the trip finger, and forcing them together. The detents in the trip finger drop into the matching holes in the step lever locking the two together so that the step lever can control the pickup arm until the stylus is properly placed on the next record.

As soon as the stylus is placed in the lead-in groove of the record, the rapidly decreasing conical spring tension is overcome by the spring washer, which unlocks the trip finger from the step lever, thereby allowing the pickup arm to be guided by the stylus in the record groove.

CHANGING RECORDS

As the **LARGE GEAR** rotates, the **ROLLER** moves the **FORKED LEVER** toward the **ON-OFF** switch.

Near the end of its travel, the **FORKED LEVER** engages the **EJECTOR LINK**, which forces the **PUSH ROD** up inside of the record support spindle.

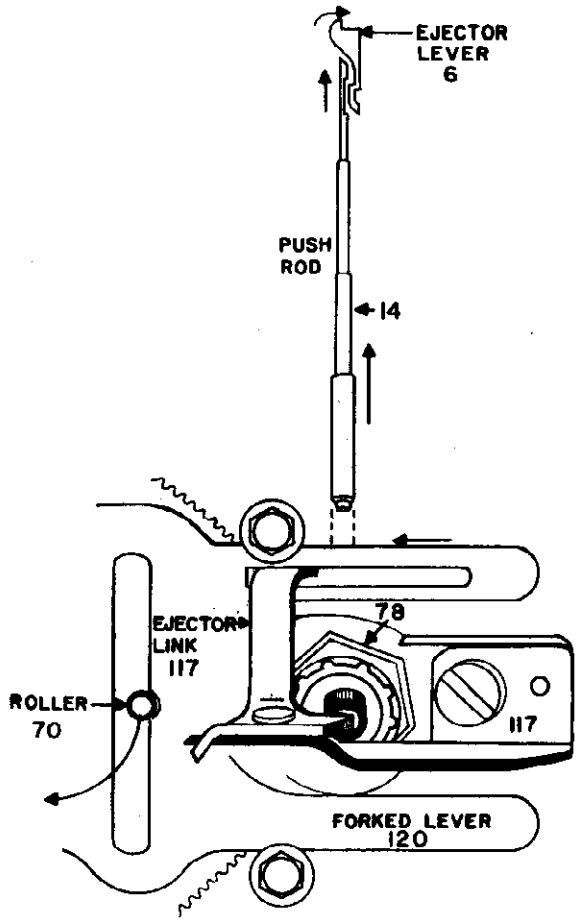
The **PUSH ROD** forces the record **EJECTOR LEVER** up and over, forcing the record off the record support ledge of the spindle.

AUTOMATIC SHUTOFF SEQUENCE

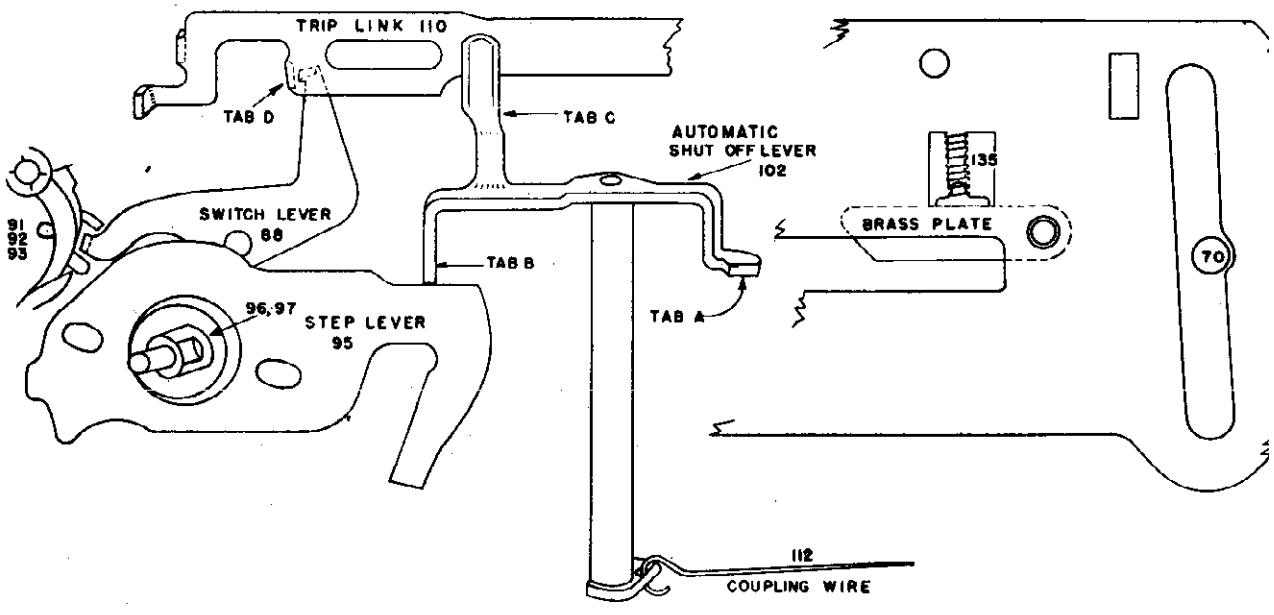
After the last record falls to the turntable, the record balance arm drops, operating a lever which pulls on the **COUPLING WIRE** which operates the **AUTOMATIC SHUTOFF LEVER**. At this instant the **STEP LEVER** and **TRIP LINK** are in a position to stop the changer . . . but are prevented from doing so by **TAB A** which strikes the **BRASS PLATE**, thereby limiting the movement of the **AUTOMATIC SHUTOFF LEVER** until after the record has been played and the next cycle completed.

On the shutoff cycle **TAB B** moves up to stop the **STEP LEVER**, which locates the tone arm in its rest position.

TAB C pushes up on the **TRIP LINK** allowing **TAB D** of the **TRIP LINK** to engage the **SWITCH LEVER** which operates the **ON-OFF** switch.



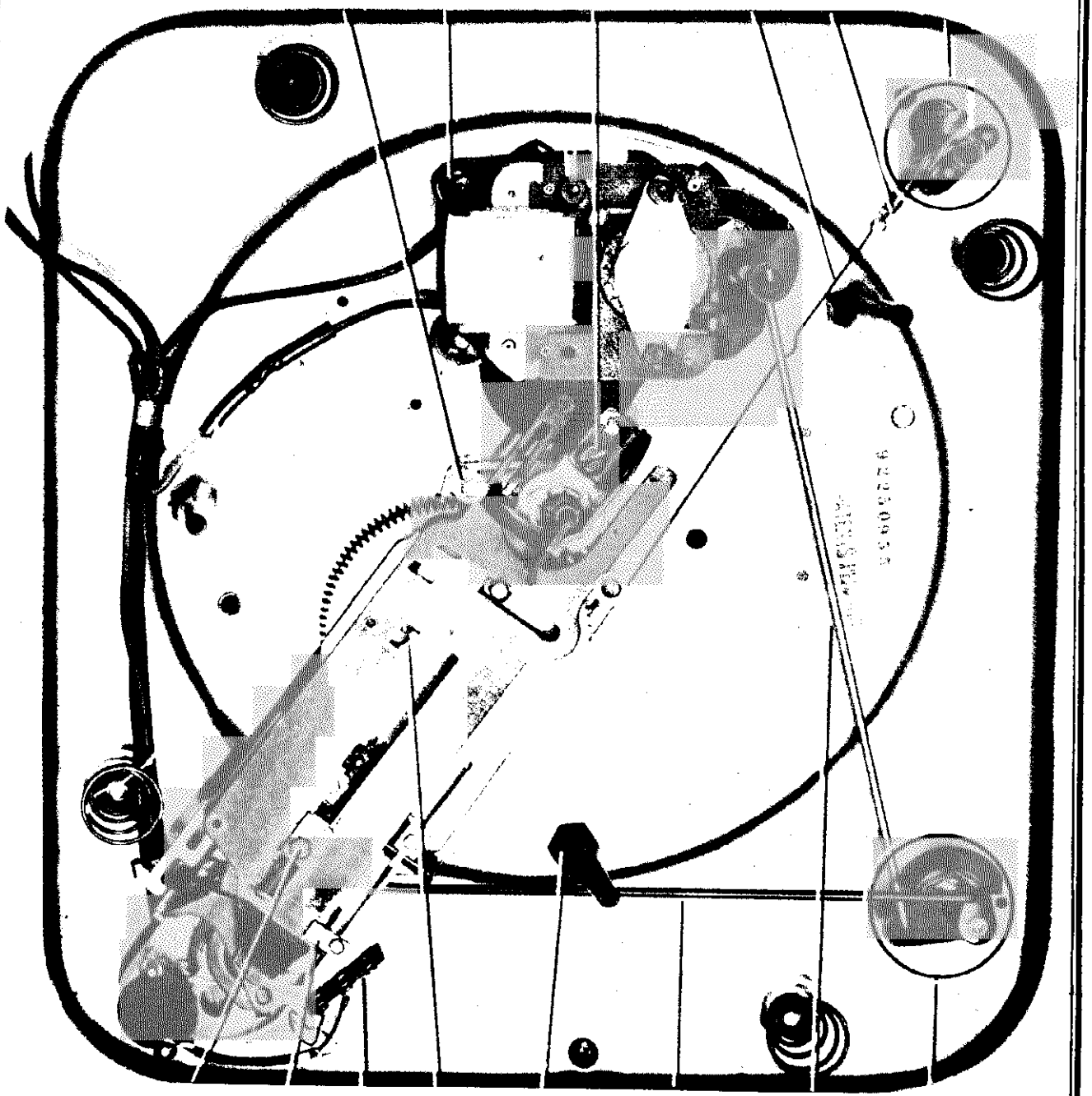
RECORD CHANGING MECHANISM



AUTOMATIC SHUTOFF MECHANISM

MODEL P16

ASSEMBLY INSTRUCTIONS—PARTS IDENTIFICATION



*Series of items listed in order assembled.

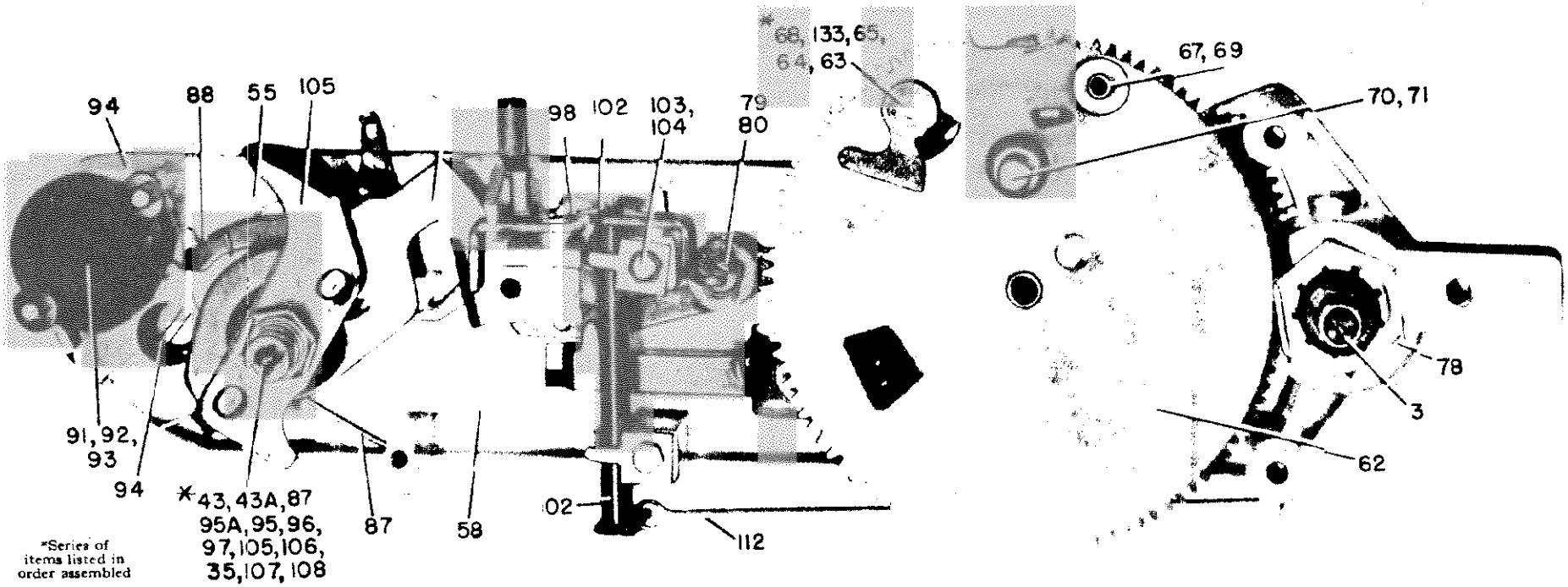
UNDER-CHASSIS VIEW COMPLETE

CONTROL KNOB SHAFT ASSEMBLY SEQUENCE

Control knob shaft bearing, PAL nut

Speed control shaft, rubber grommet, speed control rod, spring washer (dish away from bearing). Mount shaft through bearing, add C washer to hold shaft in place

Connect ON-OFF shaft to manual shut-off rod, mount compression spring on shaft, slip ON-OFF shaft thru speed control shaft, mount speed control knob, C washer and ON-OFF knob.



MAIN LEVER SUB-ASSEMBLY

MAIN LEVER ASSEMBLY SEQUENCE

Main casting.
12" feeler lever, C washer, wire spring, speed clip.
Switch lever, wire spring, C washer.
Hook ON-OFF control rod into hole in switch lever.
Mount casting on changer chassis.
Reset lever, spring, washer, screw.
7" feeler lever, spring, washer, screw.
Place fiber washer on pickup arm shaft, insert shaft through bushing, add step lever spring, fiber washer, step lever, retaining ring.
Spring washer (dish away from step lever), trip finger lever, nut.
Pickup arm push rod, conical spring, C washer.
Hook automatic shutoff wire to automatic shutoff lever.
Mount automatic shutoff lever, spring, two bearings, screws.
Mount large gear, thin fiber washer goes under C washer.
Forked lever assembly (slip trip lever under automatic shutoff tab C). 2 rectangular bearings (one holds detent spring), 2 round bearing washers and screws.
Turntable spindle, nut.
Ejector link, lockwasher, screw.
ON-OFF switch, fiber spacer strip, fiber cover disk, speed clips.

MODEL P16

LUBRICATION

Additional lubrication should not be required for the life of the changer, but in cases of unusual use, high temperature or very dusty conditions the changer should be lubricated as follows:

Old grease and dust should be removed with a small brush and plenty of cleaning fluid. Gasoline or kerosene should not be used because of possible damage to rubber parts.

Grease the following points, using Millicott 70K, Andok "B," or other high grade, light-bodied lubricant:

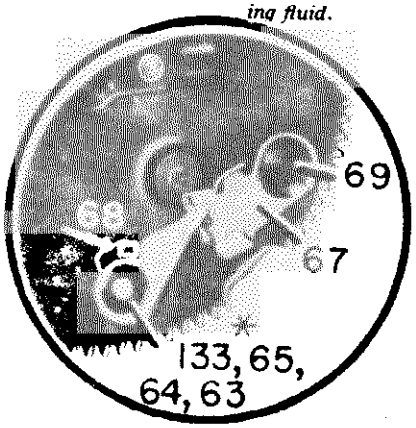
Head of lift screw under tone arm.
Edges of the 3 slots, other 4 support bearing surfaces, step lever cam, and the pickup arm push rod cam of the forked lever.
Lower surface of the step lever.
Base of record spindle push rod, turntable ball bearings, bushing and gear.

Apply a small quantity of light mineral oil to:

Tone arm hinge pivots, spindle, push rod.
Step Lever bearing
Ejector link
Large gear shaft, stud roller

Idler wheel and speed-change pulleys. (Remove pulleys to oil their spindles.) Motor can be partly disassembled to washer bearings; allow cleaning fluid to dry before applying a drop of light oil to each bearing.

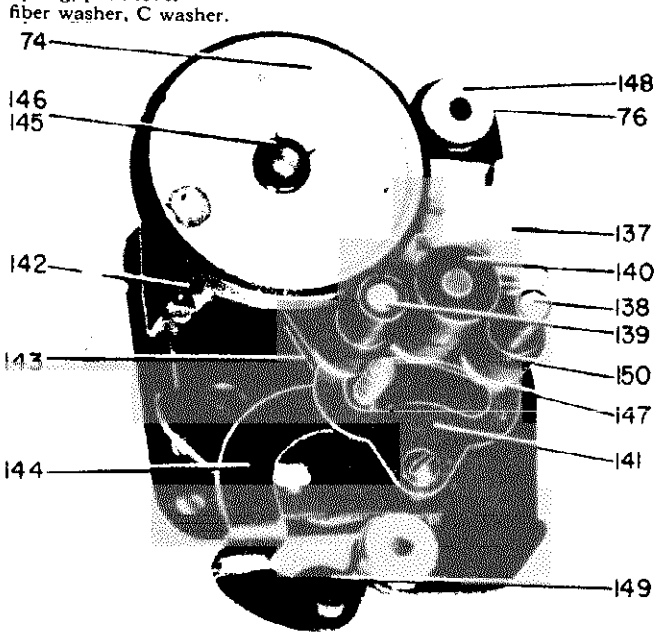
NOTE: Never allow any oil or grease to reach the rubber parts of the drive wheels. The rubber wheels should be cleaned with a cloth moistened with cleaning fluid.



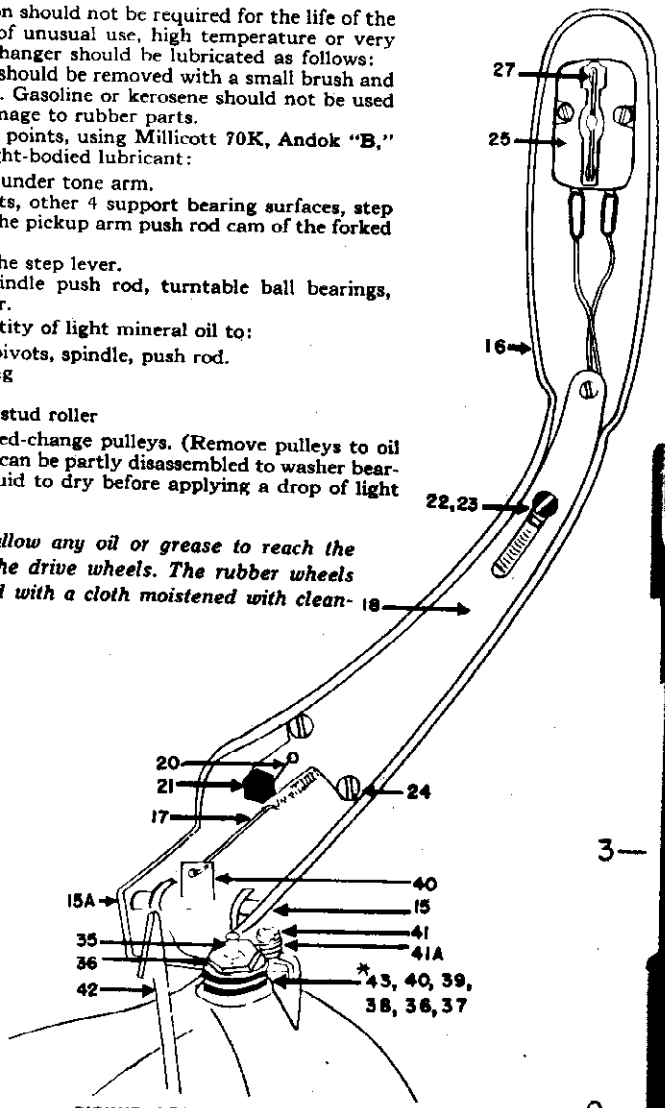
MAIN GEAR LEVERS

PAWL LEVER FRICTION ASSEMBLY SEQUENCE

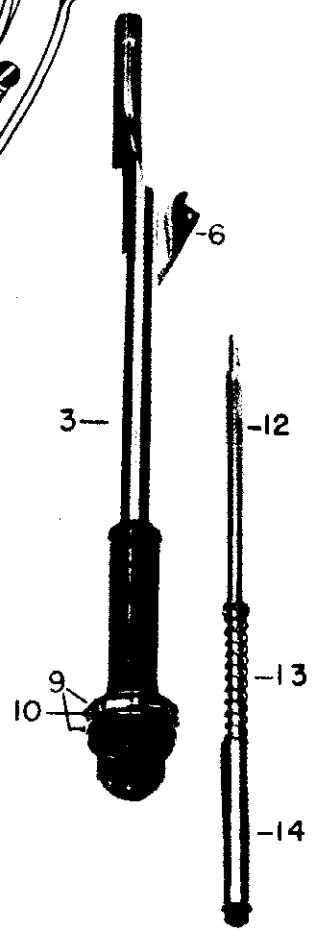
Mount the trip lever on the main gear
Spring, pawl lever
fiber washer, C washer.



MOTOR ASSEMBLY



PICKUP ARM ASSEMBLY



SPINDLE ASSEMBLY

* Series of items listed in order assembled.

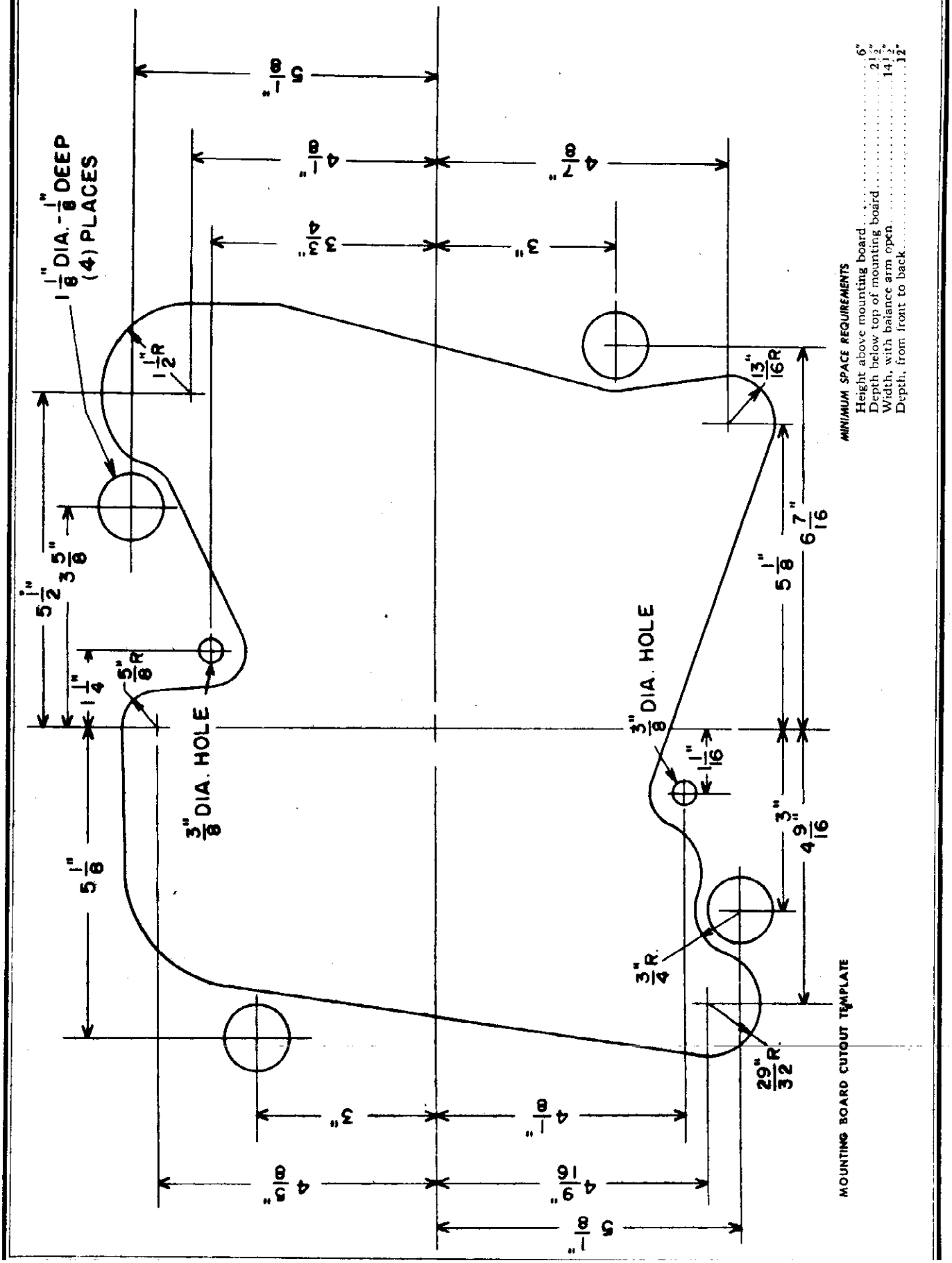
TO DISASSEMBLE SPINDLE PUSH-ROD ASSEMBLY

Holding the spindle vertically, press the base of the push rod against the bench until the ejector lever moves up into the spindle body. Press the lever on through with a thumbnail, and at the same time release the downward pressure on the spindle. When the ejector lever pops out, press downward on the spindle again and press the lever downward and out. The push rod and two springs may now be withdrawn from the base of the spindle.

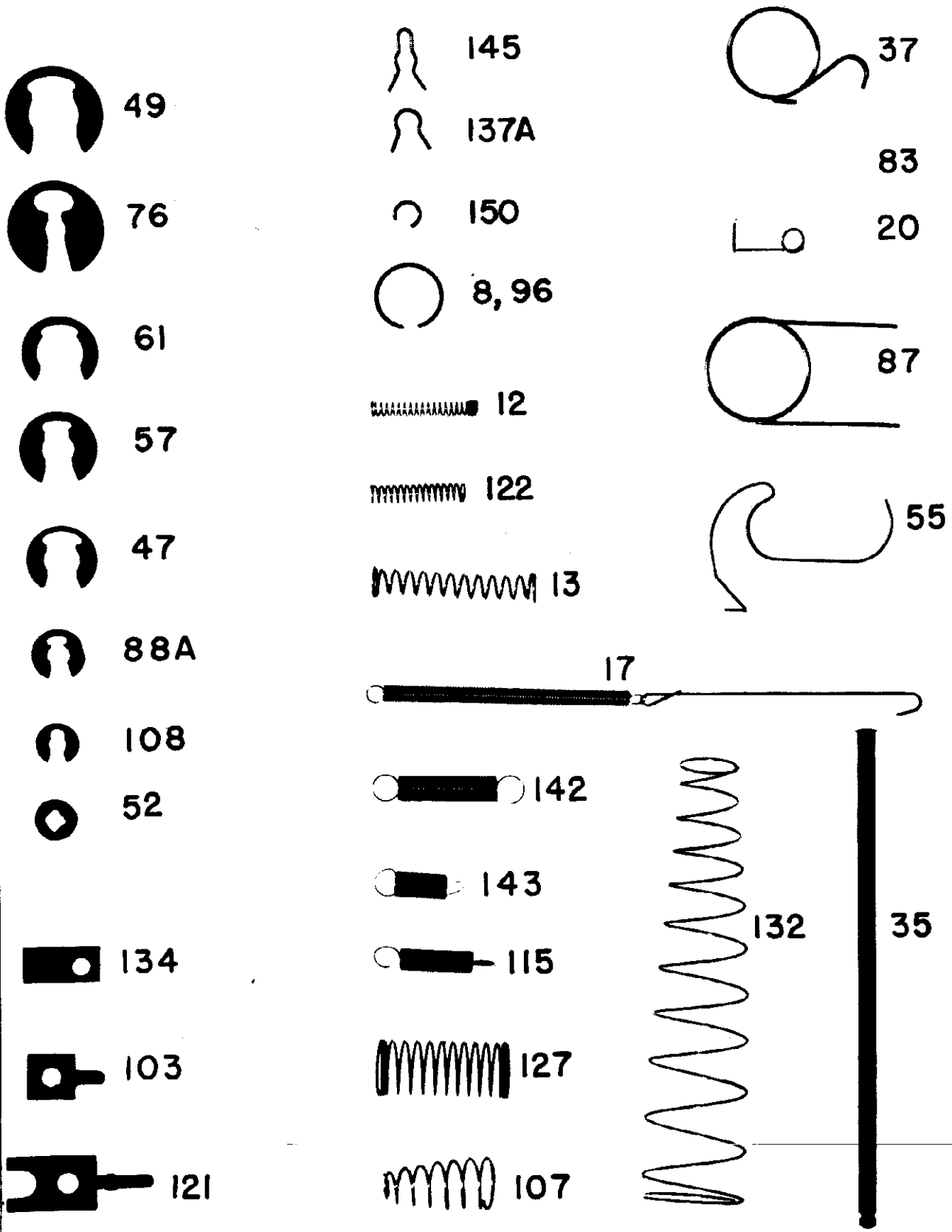
TO ASSEMBLE SPINDLE PUSH-ROD ASSEMBLY

Place both springs on push rod. Insert push rod into spindle with the flatted side of tip facing ejector lever retaining pin. Press spindle downward forcing the push rod in as far as possible. Place ejector lever in the slot resting the end against the top of the spring. Point the lever upward and release the pressure on the spindle, allowing the reject lever to be caught under its retaining pin. Press the spindle downward again pushing the ejector lever into the spindle, snapping it into place.

MODEL P16


1 1/8" DIA. - 1/8" DEEP (4) PLACES
3/8" DIA. HOLE
3/8" DIA. HOLE
3/4" R.
29/32" R.
1/2" R
13/16" R
5/8" R
MINIMUM SPACE REQUIREMENTS
Height above mounting board ..... 6"
Depth below top of mounting board ..... 2 1/2"
Width, with balance arm open ..... 14 1/2"
Depth, from front to back ..... 12"
MOUNTING BOARD CUTOUT TEMPLATE

MODEL P16



The following springs are critical, and their proper installation effects the indexing of the pickup arm. Their length, diameter and number of turns are very similar, making identification difficult. Their most distinguishing feature is their tension, a comparison of which is listed below.

Item			
82	for reset lever	very light tension	RMS-253
135	escape lever	light tension	RMS-262
99	7" feeler lever	medium tension	RMS-256

SPRING AND WASHER IDENTIFICATION

MODEL P16 RECORD CHANGER

REPLACEMENT PARTS LIST

Ref. No.	Cat. No.	Description
1	RMX-184	ARM—Record balance arm assembly, includes: plastic button, record balance arm and support rod
2	RMT-019	TURNTABLE
3	RMX-185	SPINDLE—Turntable spindle, less bearings. Includes pusher mechanism inside
6	RML-052	PUSHER—Record push-off lever in spindle
8	RMS-246	RING—Retaining ring for turntable bearing assembly
9	RHW-016	WASHER—Bearing washer, one needed on each side of turntable ball bearing assembly
10	RMB-020	BEARING—Ball bearing race
12	RMS-247	SPRING—Small spring inside spindle
13	RMS-248	SPRING—Large spring inside spindle
14	RMX-186	SHAFT—Pusher shaft inside spindle
15	*RHS-042	SCREW—Pickup arm hinge pivot adjustment screw
15A	RMB-024	BEARING—Pickup arm hinge pivot bearing
16	RPA-014	ARM—Plastic pickup arm only
17	RMS-249	SPRING—Pickup arm counterbalance spring
18	RAP-030	PLATE—Pickup arm adjustment plate (strengthener)
20	RMS-268	SPRING—Lift screw lock spring
21	RHS-090	SCREW—Hex head lift screw for pickup arm
†22		SCREW—6/32" x ⅛" screw for pickup arm counterbalance adjusting slide
23	RMM-196	SLIDE—Adjusting slide for pickup arm counterbalance
†24		SCREW—#4 x ¼" self threading screw for mounting adjustment plate
25	RPX-050	PICKUP—G. E. reluctance pickup, includes .001" and .003" sapphire styli
26	*RKP-009	KNOB KIT—Pickup knob kit
27	*RPJ-010	STYLI—.001"—.003" sapphire styli assembly
28	*RPJ-011	STYLI—.001"—.003" diamond styli assembly
29	*RQB-001	BRUSH—Small brush for cleaning stylus
35	RMU-075	LIFT PIN—Pickup arm lift pin
36	RHN-021	NUT—Holds hinge assembly on pickup arm shaft
37	RMS-250	SPRING—Pickup arm safety coupling spring
†38		WASHER—Lockwasher, ¼" I.D. x ½" O.D.
39	RAP-025	SAFETY PLATE—Washer-like member couples spring #37 to pickup arm shaft #43
40	RMX-187	HINGE—Pickup arm hinge and pin
41	RHS-086	SCREW—Eccentric setdown adjusting screw on pickup arm hinge
†41A		NUT—#720 Tinnerman speed nut for mounting eccentric screw
42	RML-053	LEVER—12 inch feeler lever
43	RMU-076	SHAFT—Pickup arm pivot shaft
†43A		WASHER—Fiber washer goes on top of pickup arm pivot sleeve under shaft shoulder ¼" I.D. x ½" O.D.
†44		SCREW—10-24 x ⅞" screw with lockwasher for mounting main casting and ejector link
45	RHX-018	POST—Plastic tone arm rest post
46	RDK-255	KNOB—Brown plastic OFF-ON-REJ. control knob
47	*RMC-046	WASHER—"C" washer under OFF-ON-REJ knob
48	RDK-256	KNOB—Brown plastic 33-78-45 speed control knob
49	RHC-050	WASHER—"C" washer under speed control knob
50	RMB-027	BEARING—Control knob shaft bearing
52	*RHC-033	WASHER—"C" washer for 12 inch feeler lever, pickup arm lift pin and trip link
53	RML-054	ROD—Manual shut-off rod
55	RMS-252	SPRING—Switch lever spring
†56		WASHER—Fiber washer, goes under main gear mounting "C" washer, ¼" I.D. x ½" O.D.
57	*RHC-027	WASHER—"C" washer holds main gear in frame
58	RAP-026	FRAME—Main lever assembly frame
60	RHF-013	FOOT—Plastic support foot
61	*RHC-028	WASHER—"C" washer holds spring under record balance rod
62	RMX-188	GEAR—Main gear assembly, complete
63	RHC-033	WASHER—"C" washer for trip lever on main gear
†64		WASHER—Fiber washer goes under trip lever "C" washer, ¼" I.D. x ½" O.D.
65	RML-055	LEVER—Pawl lever on main gear
67	RMM-186	PAWL—Trip pawl on main gear
68	RML-056	LEVER—Trip lever on main gear
69	RHR-016	RIVET—Trip pawl mounting rivet
70	RMB-025	ROLLER—Main gear detent roller
71	RHR-015	RIVET—Detent roller mounting rivet
74	*RMW-060	WHEEL—Motor idler wheel
75	*RBH-014	MOTOR—General Industries 3-speed turret motor, complete
76	*RHC-029	WASHER—"C" washer for mounting motor
77	RML-057	ROD—Motor speed control rod
78	RHN-022	NUT—Spindle mounting nut
79	RHS-087	SCREW—6/32 x ¼" self tapping screw to mount reset lever, terminal board and forked lever washer bearings
80		WASHER—Flat steel washer for mounting reset lever, 7" feeler lever and forked lever, ⅛" I.D. x ⅜" O.D.
81	RML-058	LEVER—Index reset lever
82	RMS-253	SPRING—Reset lever spring
83	RMS-254	SPRING—12-inch feeler lever spring
86	*UJB-001	TERMINAL STRIP—3 lug terminal strip
87	RMS-255	SPRING—Step lever return spring
88	RML-059	LEVER—Switch operating lever
88-A	RMC-042	WASHER—"C" washer for mounting switch operating lever
89	RMB-026	RUBBER—Tip of 7-inch feeler lever
90	RML-060	LEVER—7-inch feeler lever
91	RSW-089	SWITCH—ON-OFF switch
92	RII-063	INSULATOR—Fiber strip holds ON-OFF switch in place
93	RII-064	INSULATOR—Fiber disk holds ON-OFF switch in place
†94		NUT—(#720 Tinnerman speed nut) for mounting switch cover
95	RML-061	LEVER—Step lever, determines pickup arm indexing
†95A		WASHER—Fiber washer goes under step lever, ¼" I.D. x ½" O.D.
96	RMS-263	RING—Retaining ring for step lever
†97	RMS-269	WASHER—Spring washer between trip finger and step lever
98, 99	RMS-256	SPRING—Shut-off lever or 7-inch feeler lever spring
102	RML-062	LEVER—Automatic shut-off lever assembly
103	*RML-036	BEARING—Rectangular washer holds automatic shut-off lever
†104		SCREW—4-40 hex-head self tapping screw, for forked lever bearing
105	RML-063	LEVER—Trip finger lever
106	RHN-023	NUT—PAL nut holds trip finger lever to pickup arm shaft
107	RMS-264	SPRING—Conical lift pin spring
108, 109	*RHC-033	WASHER—"C" washer for 12-inch feeler lever, pickup arm lift pin and trip link
110	RML-064	LEVER—Trip link lever on forked lever
111	RHR-014	RIVET—Trip link mounting rivet
112	RML-065	WIRE—Automatic shut-off lever control link wire
113	RMX-189	BRACKET—Shut-off bracket
†114		SCREW—6 x 5/16" self tapping screw for mounting shut-off bracket
115	RMS-257	SPRING—Shut-off spring couples shut-off bracket to control wire
117	RMX-190	LINK—Ejector link operates spindle mechanism
†118		WASHER—Lockwasher, holds pickup arm hinge to spindle ¼" I.D. x ½" O.D.
†119		BRACE—Angle iron brace strengthens main frames ½" x ⅜" x 8" long
120	RAP-027	FORKED LEVER—(Slide and cam assembly) large forked sliding plate, less trip link
121	RAP-028	SLIDE BEARING—Rectangular washer with extension to hold detent spring, supports forked lever
122	RMS-258	SPRING—Forked lever detent spring
123	RHN-024	NUT—Knob shaft bearing mounting nut
124	RHW-031	WASHER—Spring washer goes under speed knob control shaft
125	RMX-191	SHAFT—33-78-45 knob shaft
126	*RHG-027	GROMMET—Rubber grommet for speed control rod
127	RMS-259	SPRING—Compression spring between control shafts
128	RMU-077	SHAFT—OFF-ON-REJ. knob shaft
†129		SCREW—6/32" x ½" screw holds forked lever detent spring "bearing"
†130		NUT—(#720 Tinnerman speed nut) for mounting shut-off lever bearings
132	RMS-260	SPRING—Record balance arm holddown spring
133	RMS-261	SPRING—Trip lever friction spring on main gear
134	RAP-029	BEARING—Rectangular washer supports forked lever
135	RMS-262	SPRING—Escape lever spring on forked lever
136	*RJP-003	PLUG—AC plug for motor
137	*RMA-008	ARM—Motor idler wheel arm
137-A	RHC-009	HAIRPIN CLIP—For idler arm
138	*RMW-061	PULLEY—Low speed pulley, 33 1/3 rpm
139	*RMW-062	PULLEY—Medium speed pulley, 45 rpm
140	*RMW-063	PULLEY—High speed pulley, 78 rpm
141	*RMA 009	ARM—Speed pulley mounting arm
142	*RMS-205	SPRING—Idler wheel tension spring
143	*RMS-211	SPRING—Pulley arm tension spring
144	*RMA-010	ARM—Motor speed control arm
145	*RHC-009	HAIRPIN CLIP—For idler wheel
†146		WASHER—Fiber washer for (¼" I.D. x ½" O.D.) idler wheel
†147		WASHER—Felt washer for (¼" I.D. x ½" O.D., 1/16") thick speed pulleys
148	*RHG-026	GROMMET—Motor mounting grommet
149	*RHG-027	GROMMET—Speed control arm grommet
150	*RMS-218	RING—Retaining ring for speed pulley

*Parts used on previous models. †Common hardware items not stocked by G.E.

TPO-1843

INTRODUCTION

This de luxe record changer is designed to automatically play 78, 45, or 33-1/3 r. p. m. records of 7", 10", or 12" size. The changer will play twelve 7", twelve 10", or ten 12" records at one loading. It operates from a 105-125 volt, 60-cycle a-c supply. If operation is desired on a 50-cycle supply, the 50-60 cycle motor, Part No. 35-1462, must be used, with the springs supplied in the conversion kit, Part No. 40-7848.

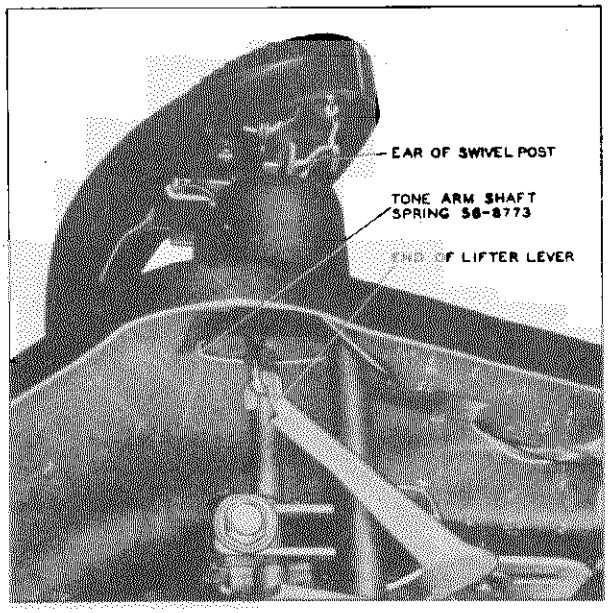
The time interval between the last note of one record and the first note of the next one is shortened by the use of a velocity trip. The possibility of damaging the changer by holding the tone arm during a change cycle is prevented by spring-loading all actuating levers.

The controls are conveniently grouped near the front of the changer. All knobs are concentrically mounted in the front right-hand corner. The tone-arm head is immediately behind the control knobs, and the record shelf is in the front left-hand corner.

The tone arm set-down indexing is simplified by eliminating feelers and establishing the set-down by means of the record-shelf position. The nodding spindle, rather than a complicated system of levers and blades, accomplishes the record dropping. Most of the working parts are mounted on a bridge subassembly, a feature which makes the parts easily accessible for servicing.

DESCRIPTION OF OPERATIONAL CYCLE

At the completion of a record, the changer trips, and allows the dog latch to engage the spur of the turntable hub gear. This rotates the cam gear, allowing the teeth of the cam gear and hub gear to engage. As the cam rotates, it forces the lifter lever down, raising the tone arm from the record. As the tone arm reaches maximum height, the tone-arm actuator, motivated by the cam gear, contacts the trip-arm stud and swings the tone arm against the rest post. After the tone arm reaches the rest post, the push-off lever rotates, nodding the spindle and dropping the next record onto the turntable. After the record has dropped, the return lever contacts the stud of the trip arm, and starts the tone arm inward. The tone arm is now controlled by the actuator and return levers, in contact with the stud of the trip arm. The return lever continues swinging the tone arm inward until it is stopped by the set-down lever, whose position is dependent upon the setting of the record shelf. This stoppage of the inward travel of the tone arm by the established position of the return lever accomplishes the set-down indexing. The tone arm is thus held above the set-down point. The lifter lever now moves upward, slowly dropping the tone arm to the record surface. As the cam gear continues to rotate, the actuator lever is moved outward and away from the trip-arm stud. The tone-arm return lever then moves away from the trip-arm stud, but the spring portion of the actuator momentarily remains in contact with the stud, eliminating a sudden release of control of the tone arm, and preventing the needle from jumping into the modulated grooves. The trip-plate supporting finger now engages the dog latch, and the index lever locks the cam gear in a neutral position. The tone arm is now free to play the record.



TPO-1831

Figure 1. Tone-Arm Height and Lift Adjustments and Vertical Timing Adjustment

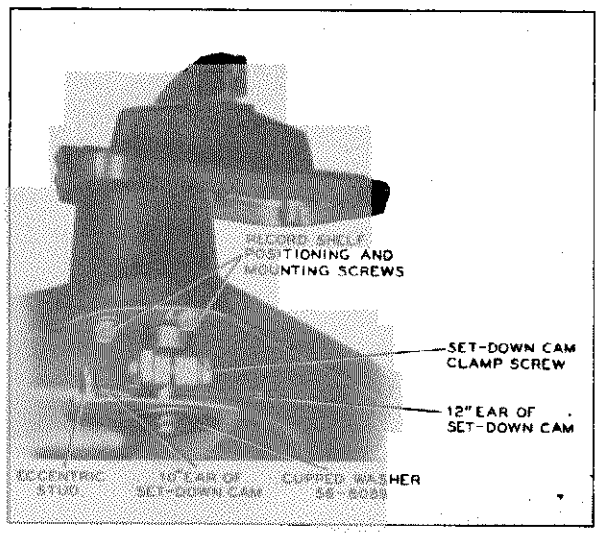
As the tone-arm advances toward the spindle, the friction-clutch trip finger engages the end of the trip plate. Through the applied pressure of the friction finger (approximately 2 grams) against the trip plate, the trip-plate finger supporting the dog latch begins to move, lessening the engagement of the trip-plate finger and dog latch, preparatory to releasing the latch. This engagement is slowly lessened while the needle is in the playing grooves, giving the reset cam an opportunity (once each revolution of the turn-

table) to reset the trip plate into full engagement and slip the friction finger in the friction clutch. As the needle rides in the lead-out or eccentric groove of the record, the velocity of the friction finger is increased. The speed of the disengagement of the trip-plate supporting finger and the dog latch is also increased sufficiently to allow complete disengagement of the dog latch before it has been restored by the reset cam.

ADJUSTMENTS

SPINDLE ADJUSTMENT

The spindle should be checked for perpendicularity (use square on turntable surface) when the changer is out of cycle. To adjust, bend the ear on the push-off-lever assembly; bending the lever toward the spindle spring throws the top of the spindle away from the record shelf. This is shown in figures 3 and 6.



TPO-1839

Figure 2. Record-Shelf Adjustment and 10", 12", and Fine Set-down

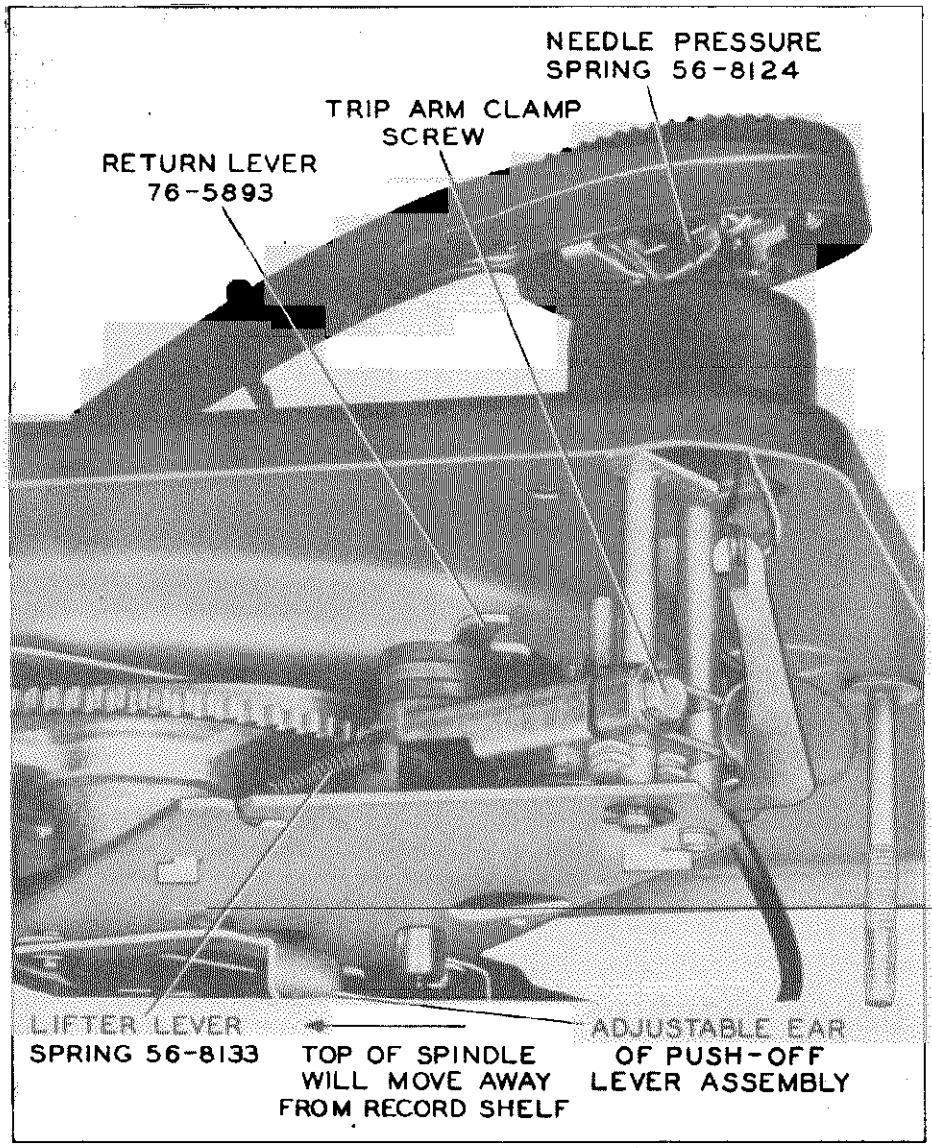


Figure 3. Adjustment of Trip Arm for 7" Set-down

TPO-1845

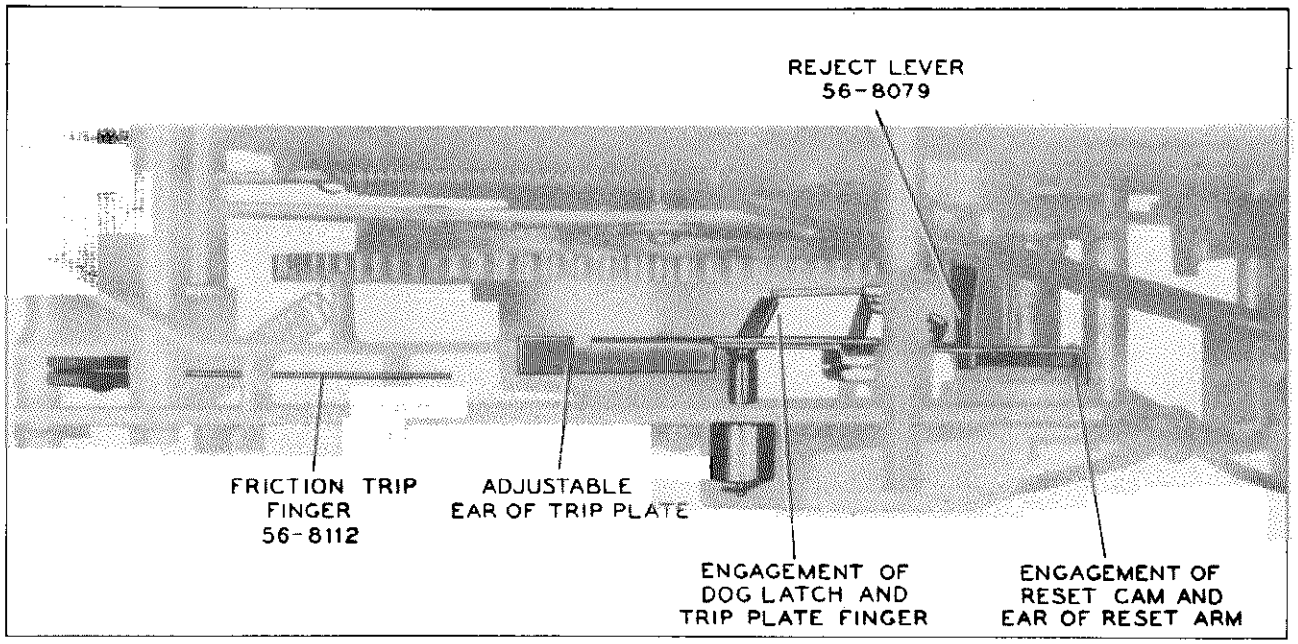


Figure 4. Trip Adjustment

RECORD SHELF

CAUTION: This adjustment must be made immediately after a change cycle is completed.

With the changer set for manual operation, place a record-shelf gauge, Part No. 45-6647, on the record shelf. The edge of the gauge should fit snugly against the edge of the raised portion of the shelf, without flexing the spindle.

If the gauge does not fit properly, loosen the two saddle mounting screws holding the record shelf to the base plate (figure 2), and adjust the position of the record shelf. Then tighten the screws.

TONE-ARM HEIGHT AND LIFT

With the changer out of cycle, and the tone arm over the base plate, the needle point should be 1/8" ± 1/16" above the base plate. To adjust the clearance, bend the protruding ear of the swivel post, at the rear of the tone-arm heel. See figure 1. Bending the ear upward decreases the clearance, downward increases the clearance. Raise the tone arm to its maximum height, and place it against the rest post. There should be approximately 3/32" clearance between the lower edge of the tone arm and the top of the rest-post hook. Bend the ear of the swivel to obtain the most satisfactory adjustment of both the rest-post clearance and the base-plate clearance.

VERTICAL TIMING

Adjust the vertical timing by bending the end of the lifter lever (shown in figure 1), which attaches to the pull-cord, so that there is 1/32" to 1/16" slack in the pull-cord for all tone-arm positions between the tone-arm rest post and the spindle when the changer is out of cycle. Check by cycling the changer and noting if the lifter lever and pull-cord will raise the tone arm to its maximum height.

SET-DOWN

Set the record shelf to the 12" position. Set the eccentric stud to its center position toward the corner of the base plate. This stud is accessible through a hole in the base plate near the tone-arm stanchion (see figure 5). Place a 7" record on the turntable, set the record shelf to the 7" position, and cycle the changer by hand until the tone arm is just above the record. Loosen the hex-head clamp screw on the trip arm (see figure 3), and swing the tone arm until the needle is 1/8" in from the edge of the record. Tighten the clamp screw, and check the adjustment by putting the changer through another cycle. If the set-down point is slightly incorrect, it may be corrected by means of the eccentric stud mentioned above. Recheck the needle set-down. The trip arm should be positioned vertically so that the friction finger is midway between the base plate and the lifter lever. Remove the 7" record. Set the record shelf to the 10" position, and place a 10" record on the turntable. Rotate the turntable until the needle is just above the record. If the needle is not 1/8" in from the edge of the record, an adjustment may be made by bending the ear of the set-down cam which is in contact with the eccentric stud. See figure 2. Bending the ear outward moves the set-down point away from the spindle; bending the ear in toward the shelf shaft moves the set-down point toward the spindle. Recheck the needle set-down. Using a 12" record, with the shelf set to the 12" position, repeat the adjustment, bending the corresponding ear of the set-down cam (figure 2).

The eccentric stud mentioned above (shown in figures 2 and 5) provides a fine adjustment of the set-down position. This adjustment varies the set-down position of ALL size records over a total range of 3/16". Do not use this adjustment unless it is desired to change all three set-down positions by an equal amount.

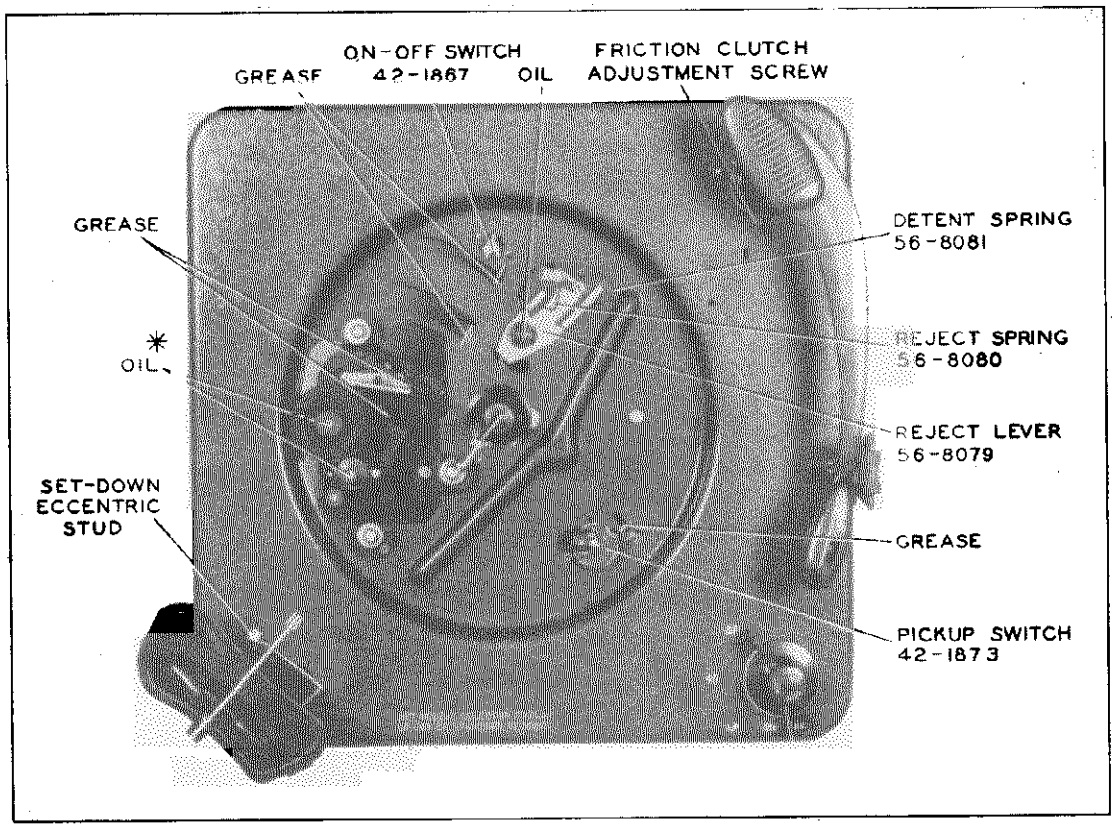


Figure 5. Top View, Showing Lubrication Points

TRIP

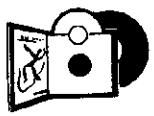
CAUTION: Do not adjust the friction clutch until the trip-plate engagement is properly set, as explained below.

The proper trip action is greatly dependent upon the proper engagement of the dog latch and the finger of the trip plate supporting it. The correct engagement is 5/64" (or approximately one-half the width of the supporting finger of the trip plate) when the ear of the reset arm is contacting the peak point of the reset cam. This is shown in figure 4. The extent of this engagement is adjustable by bending the ear of the trip plate, shown in figure 6. Bending the ear inward decreases the amount of engagement, and bending the ear outward increases the amount of engagement. This adjustable ear is accessible through the large hole in the bridge, and should be bent by using long-nose pliers.

NOTE: Too much engagement will prevent tripping, while too little engagement will cause pre-tripping. If the changer is Run 2, and if it still does not trip after the trip is properly adjusted, remove the tone-arm-shaft spring.

After the trip-latch engagement is set, check the changer for proper trip action. If the trip action is faulty, i.e., if the changer pre-trips or does not trip at all, recheck the trip-latch adjustment. If the changer still does not operate properly, check for tight tone-arm lead dress or excessive friction in the tone-arm-shaft bearing. If this does not clear the trouble, the friction clutch can be adjusted, although this should *not* normally be necessary. This is a screw adjustment and is accessible, when the tone arm is on the rest post, through a hole in the base plate near the tone-arm stanchion (see figure 5)

Turn the screw counterclockwise until the clutch is just snug (do not tighten), then loosen one turn. Check the adjustment by playing several records. If the changer pre-trips, loosen the screw (turn clockwise) a bit more. This trip arm and clutch assembly is shown in figure 16.



LUBRICATION

LUBRICANTS

Oil: S.A.E. 20.
Grease: Motor cup grease.
Contact lubricant: Dow Corning "DC-4."

PARTS NOT TO BE LUBRICATED

Motor drive shaft.
Motor pulley.
Drive belt.
Idler tire.
Dog latch (on cam gear).

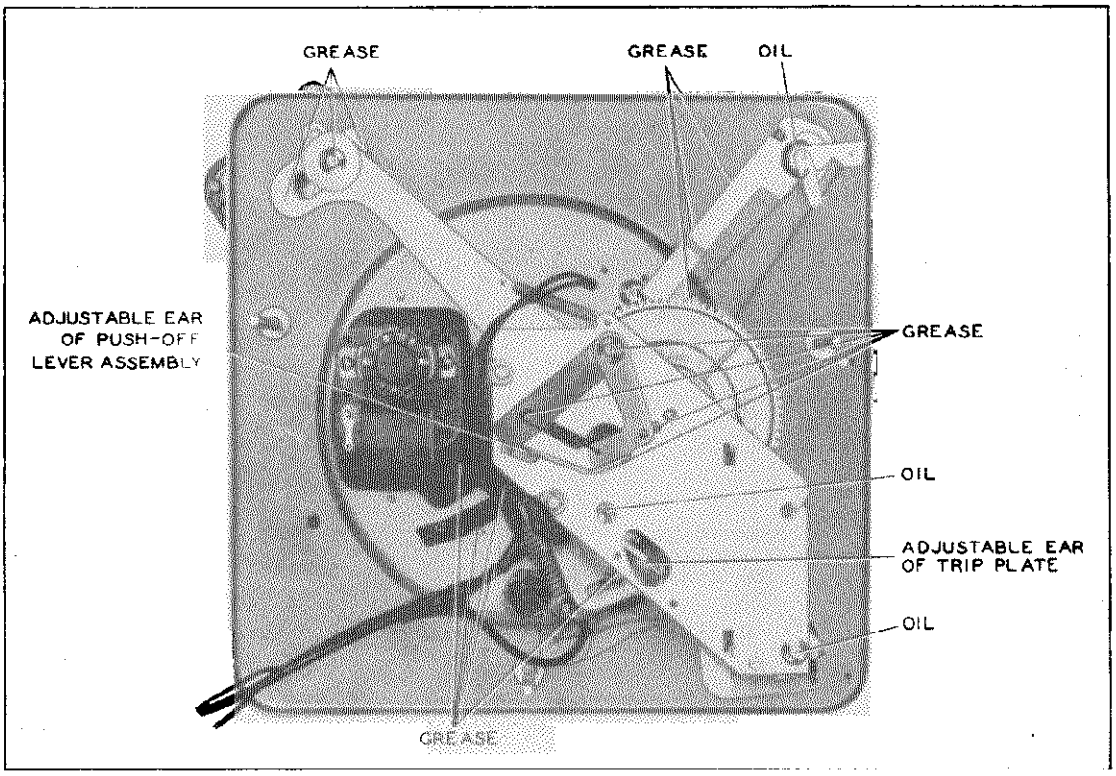


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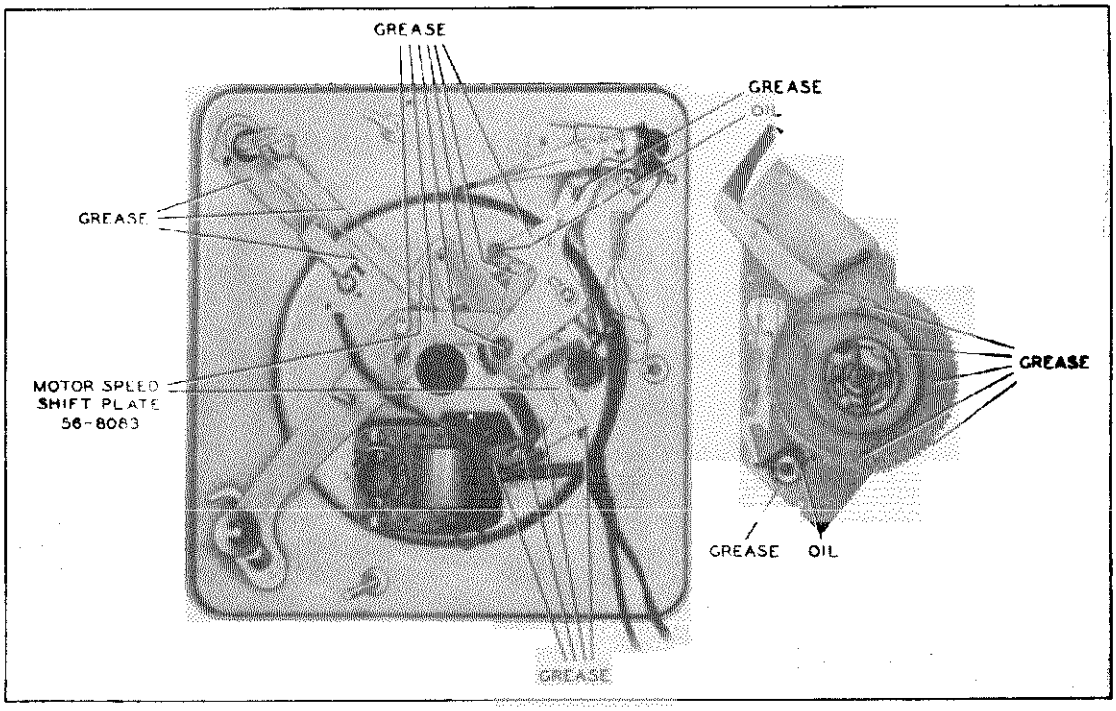
Figure 6. Bottom View, Showing Lubrication Points

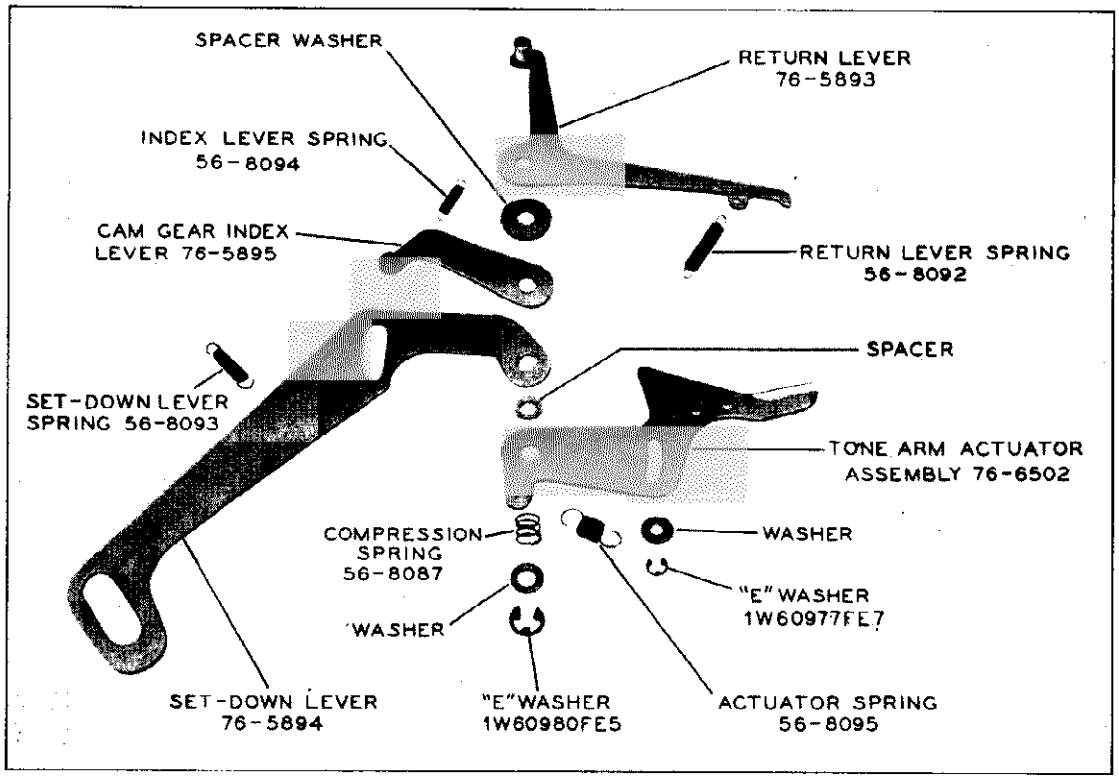
Lifting lever (where dog rides).
Trip-plate assembly.
Friction finger.
Friction washer.
Spindle latch (may be lubricated with powdered graphite or talcum powder).



TPO-1837

Figure 7. Bottom View, Bridge Removed, Showing Lubrication Points

MODEL M-22



TPO-1833A

Figure 8. Actuator Assembly

PARTS TO BE GREASED

Actuators

1. Lifting lever, where lever contacts cam gear.
2. Tone-arm-actuator lever where it contacts stud of friction-clutch assembly.

Base Plate

1. Switch lever where it slides on base plate, and slot where ear rides.
2. Motor-speed-shift plate, where it rides in guide slots, and slot that rides on cam-gear spindle; control links where they ride on base plate.

Bridge Assembly

Push-off lever where end slides on bridge, where stud rides in slot of bridge, and at pivot pin.

Cam Gear

All cam surfaces and gear teeth except dog latch.

Friction-Clutch Assembly

Stud of friction-clutch assembly where return lever and tone-arm actuator ride.

Motor

NOTE: When lubricating the motor, use grease or oil very sparingly. Excessive lubrication will cause erratic operation.

1. Cam surfaces of idler-wheel lifter.
2. Detent surfaces.
3. Guide slots of shifter plate.
4. Extension of idler shaft in contact with lower shifter plate.
5. Retaining ear of speed-shift lever.

Record Shelf

1. Record-shelf-shaft bearing.
2. Detents for record shelf.
3. Hold-down pin and detents.
4. Hold-down shaft.
5. Set-down cam, where eccentric stud rides.

PARTS TO BE OILED

1. Cam-gear spindle.
2. Control-knob shafts.
3. Index-lever roller.
4. Motor.
   a. Idler-assembly pivot shaft.
   b. Idler-wheel shaft.
   c. Slider bar, four points.
   d. Two shift roller pins.
   e. Pulley shaft (wipe dry and apply only one drop).
   f. Under pivot bushing of shifter plate.
5. Reject-lever pivot.
6. Tone-arm shaft where it rotates in bridge.
7. Tone-arm-pivot pin where it goes through holes in base plate.
8. Trip-plate-assembly pivot in bushing only.
9. Turntable bearings, top and bottom.
10. Actuator spindle.
11. Bearing surfaces between actuator lever, washer, set-down lever, index lever, washer, and return lever (grease end of return lever where it contacts stud of friction-clutch assembly).

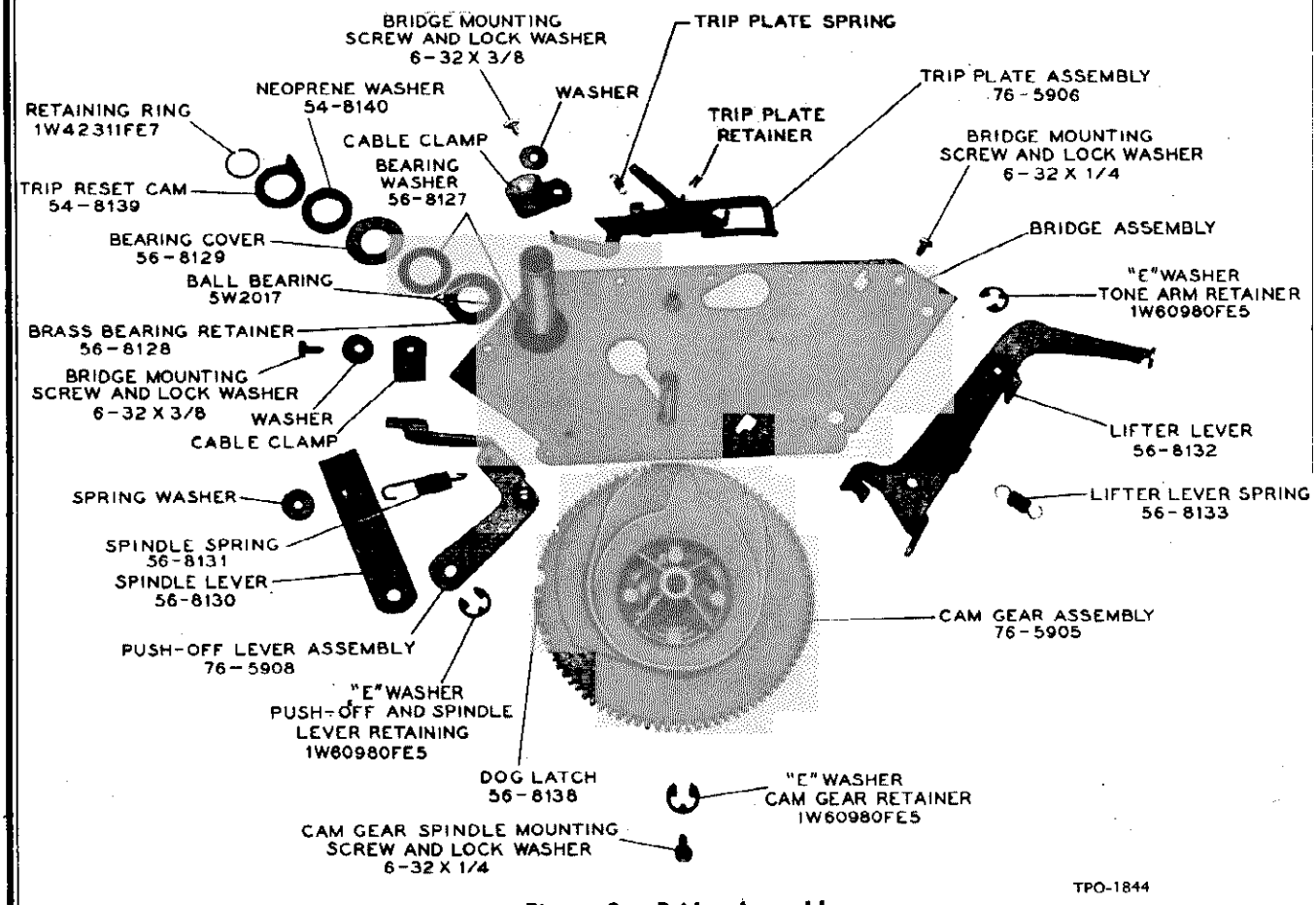


Figure 9. Bridge Assembly

CAUTION: When lubricating the motor, remove the rubber belt and idler wheel. When lubrication is completed, be sure the motor shaft and pulley are free from oil and grease. Failure to observe this precaution may result in slippage.

CONTACT LUBRICATION

Apply Dow Corning "DC-4" to the contacts of the cartridge contact plate, and to the dimple of the cartridge retaining spring.

UNEVEN TURNTABLE SPEED (WOWS)

Uneven turntable speed may be caused by any of the following conditions:

1. Dirt under and around the idler-wheel assembly.
2. Idler-wheel spring loose or missing.
3. Flat spot on idler-wheel tire or turntable.
4. Loose, worn, or distorted pulley belt.
5. Oil or grease on idler-wheel tire, pulley, pulley belt, or drive shaft.
6. Speed-control knob not in proper position.

REPLACEMENT OF PARTS AND ASSEMBLIES

The following procedures are recommended for the correct removal of parts and assemblies. The parts should be replaced by reversing the order of removal.

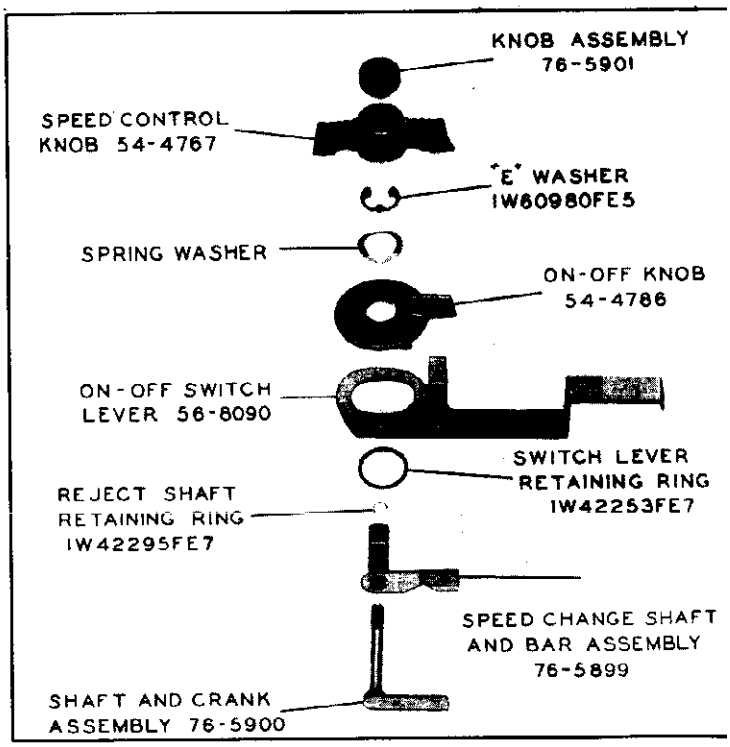


Figure 10. Control Assembly

MODEL M-22

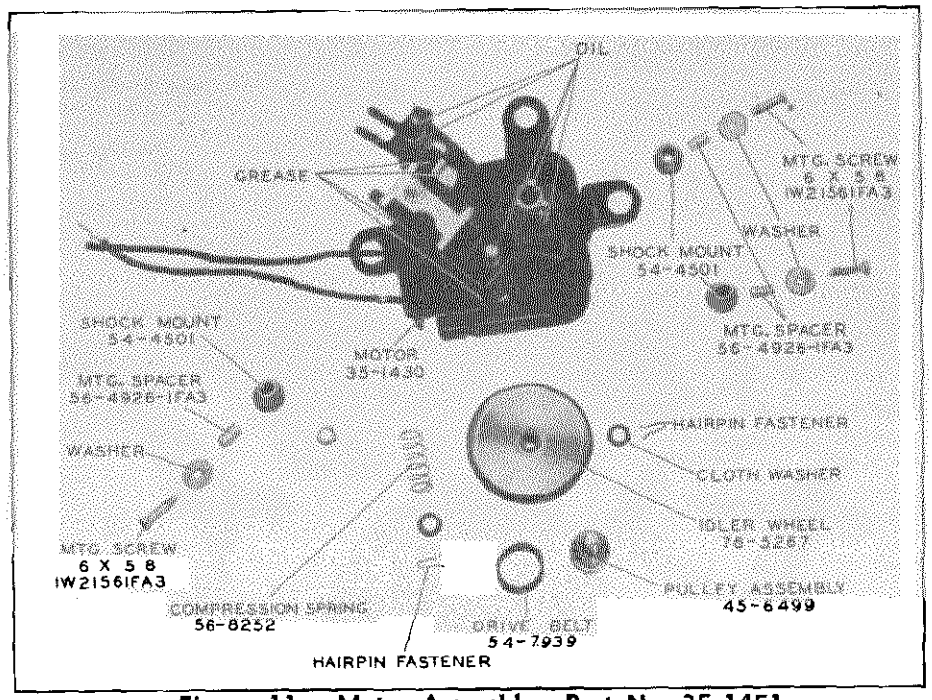


Figure 11. Motor Assembly—Part No. 35-1451 TP9-204

Adjustments should be made according to the directions given in the ADJUSTMENTS section of the manual.

1. Crystal Cartridge

Grasp crystal cartridge with fingernails. With the other hand, hold tone arm and apply slight pressure on switch lever. Pull cartridge down and to the outside. Replace cartridge by holding contacts toward spindle, and pushing upward until firmly seated.

2. Needle

Remove crystal cartridge (see paragraph 1). Lift needle out gently with prying motion, using fingernail or knife point. When replacing needle, align key of needle shaft with keyway in chuck of cartridge, then push needle into cartridge.

3. Turntable

Remove spring retainer and washer from top of spindle bushing. Lift turntable off.

NOTE: When replacing turntable, position speed-control knob midway between LP and 45 or 45 and SP. This holds the idler wheel in a retracted position. Then replace turntable. This method will prevent damage to the idler-wheel tire.

4. Spindle

Disengage spindle spring. Remove spindle. Do not lose spring washer under spindle lever.

5. Bridge (See figure 9)

a. Remove set-down-lever spring.
b. Remove lifter-lever spring.
c. Remove the three hex-head drive screws and the two plastic cable retainers.
d. Remove "E" washer from tone-arm spindle.
e. Remove hex-head drive screw from cam-gear spindle. This screw is located on the top.
f. Remove pull-cord and disconnect tone-arm wires.
g. Carefully lift off bridge, cam gear, spindle bushing, trip-plate assembly, lifter lever, spindle lever, and push-off lever.

6. Cam Gear

a. Remove bridge (see paragraph 5).
b. Remove "E" washer from cam-gear spindle.
c. Lift off cam gear.

7. Push-off-Lever Assembly and Spindle Lever

a. Remove cam gear (see paragraph 6).
b. Remove "E" washer from push-off fulcrum stud.
c. Rotate push-off lever so that stud is in large hole, and lift off both push-off lever and spindle lever.

8. Trip-Plate Assembly

a. Remove cam gear (see paragraph 6).
b. Remove clip from trip stud, and lift assembly from bushing.

9. Trip Reset Cam, Neoprene Washer, and Ball Bearing

a. Remove cam gear (see paragraph 6).
b. Remove spring retaining ring.
c. The trip reset cam, neoprene washer, ball cover, balls, and race may be removed in that order.

10. Trip-Arm Assembly

a. Remove "E" washer from end of tone-arm shaft.
b. Disengage pull-cord.
c. Loosen trip-arm-clamp screw.
d. Raise tone arm sufficiently to clear trip arm.
e. Remove trip-arm assembly.
Figure 16 shows trip-arm assembly.

11. Tone Arm

a. Place control in MAN. position.
b. Unsolder the four tone-arm leads.
c. Remove pull-cord from lifter lever.

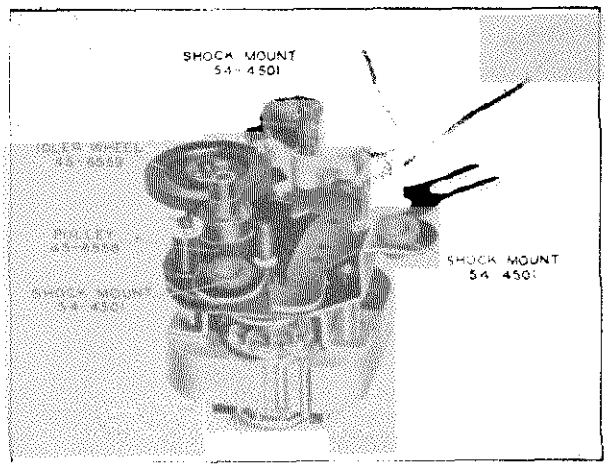
d. Remove "E" washer from end of tone-arm stud.

e. Loosen trip-arm-clamp screw.

f. Remove tone-arm-shaft spring, if present.

g. Lift out tone arm.

Figure 15 shows tone-arm assembly.



TP9-456

Figure 12. Motor Assembly—Part No. 35-1452

12. Motor Assembly

a. Remove turntable (see paragraph 3).

b. Unsolder motor lead from switch on base plate, and free other lead from tape and spaghetti.

c. Remove the three hex-head drive screws, washers, and spacers from motor frame.

d. Slide jaws of speed-shift lever free of rubber grommet and ear of motor-speed-shift plate.

e. Lift motor out.

Figures 11, 12, and 13 show motor assembly.

13. Control Shafts and Links

a. Pull off MAN.—AUT.—REJ. button.

b. Lift off speed-control knob.

c. Remove "E" washer and spring washer.

d. Lift off ON-OFF knob.

e. Remove retaining ring from reject shaft.

f. From underside, pull out speed-change shaft and bar assembly and MAN.—AUT.—REJ. shaft and crank assembly.

g. Disengage each of the above from its respective links.

h. Remove speed-change link.

i. Remove heavy spring ring from control bushing.

j. Remove ON-OFF switch lever by lifting over bushing, pulling toward corner of base plate, and lifting ear out of slot.

Figure 10 shows control assembly.

14. Record Shelf

a. Remove "E" washer from bottom of record-shelf shaft.

b. Remove cupped washer.

c. Loosen set-down clamp screw.

d. Remove set-down cam, record-shelf spring, and spacer (if used; Run 4 on). When reassembling, add spacer and new spring.

e. Lift record shelf from saddle.

Figure 14 shows record-shelf assembly.

15. Actuator Levers

a. Remove bridge (see paragraph 5).

b. Remove spring from tone-arm return lever.

c. Remove "E" washer, washer, and compression spring from actuator stud.

d. Remove "E" washer and washer from return-lever support stud.

e. Remove tone-arm-actuator lever.

f. Remove spacer washer.

g. Remove set-down lever.

h. Remove cam-gear index lever.

i. Remove motor-speed-shift plate by pulling speed-shift lever toward center of changer, freeing grommet from jaws of lever, and returning lever to an outward position. Lift and turn free end of speed-shift plate toward tone arm; this will free ear in large slot. With free end, carefully twist plate down between return-lever support stud and spring-anchor stud. Ear in small slot will come free.

j. Remove large washer.

k. From top of base plate, remove reject and detent springs, "E" washer, and spring washer. Free reject lever of stud, and remove reject link from lever.

l. Remove tone-arm-return lever.

Figure 8 shows actuator assembly.

NOTE: When replacing the index-lever spring, the tone-arm-actuator spring, and the return-lever spring, re-cement the ends to the spring mounting stud, using glyptol, as in production. This will prevent the springs from coming loose due to shock.

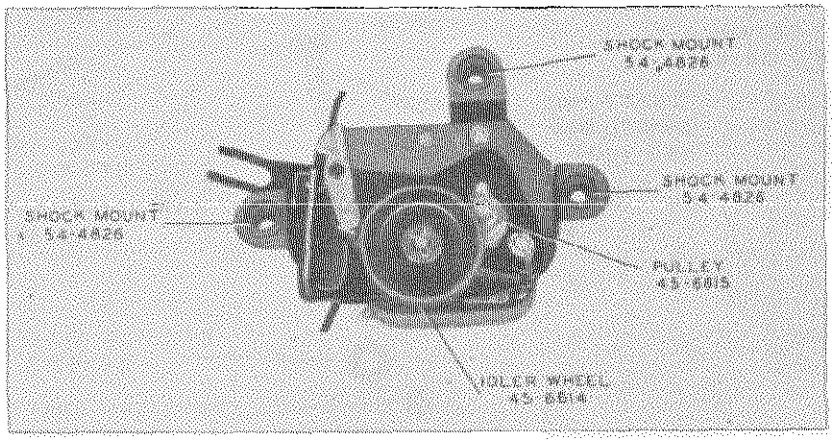


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Figure 13. Motor Assembly—Part No. 35-1455

MODEL M-22

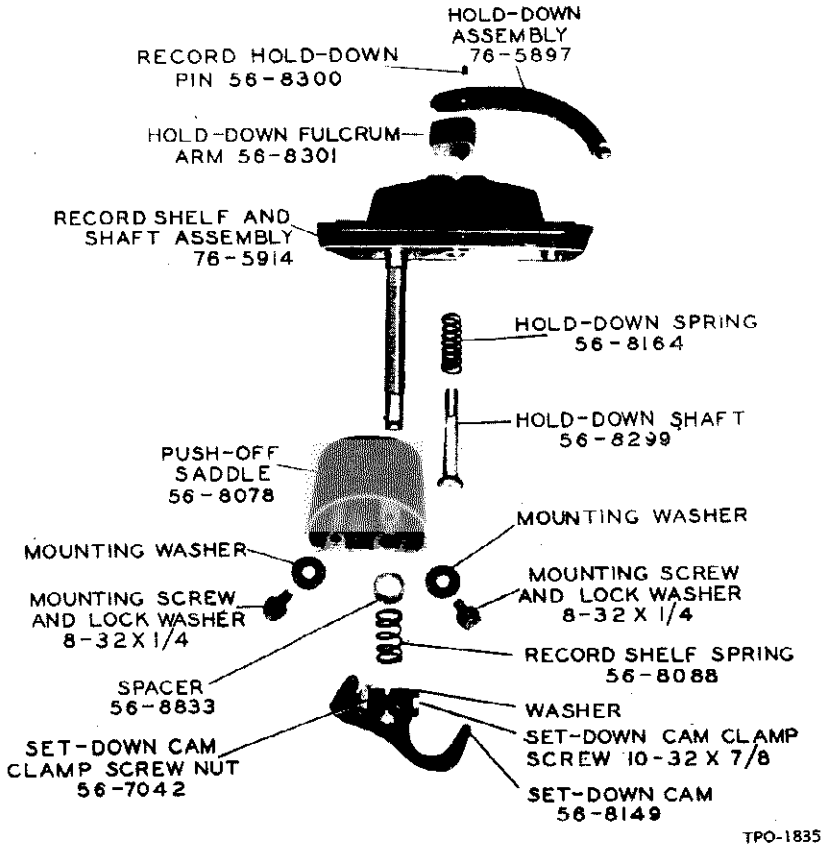


Figure 14. Record-Shelf Assembly

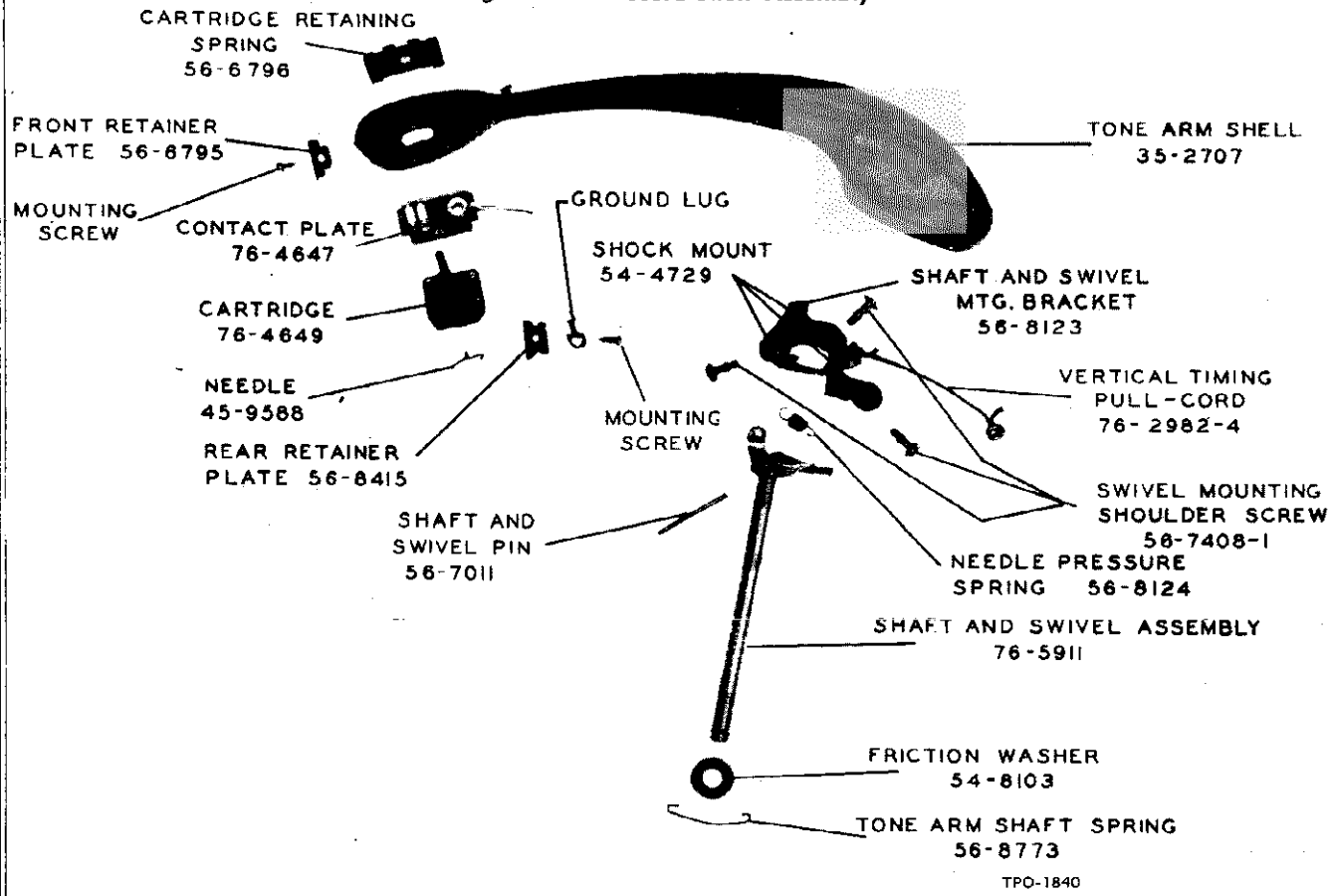
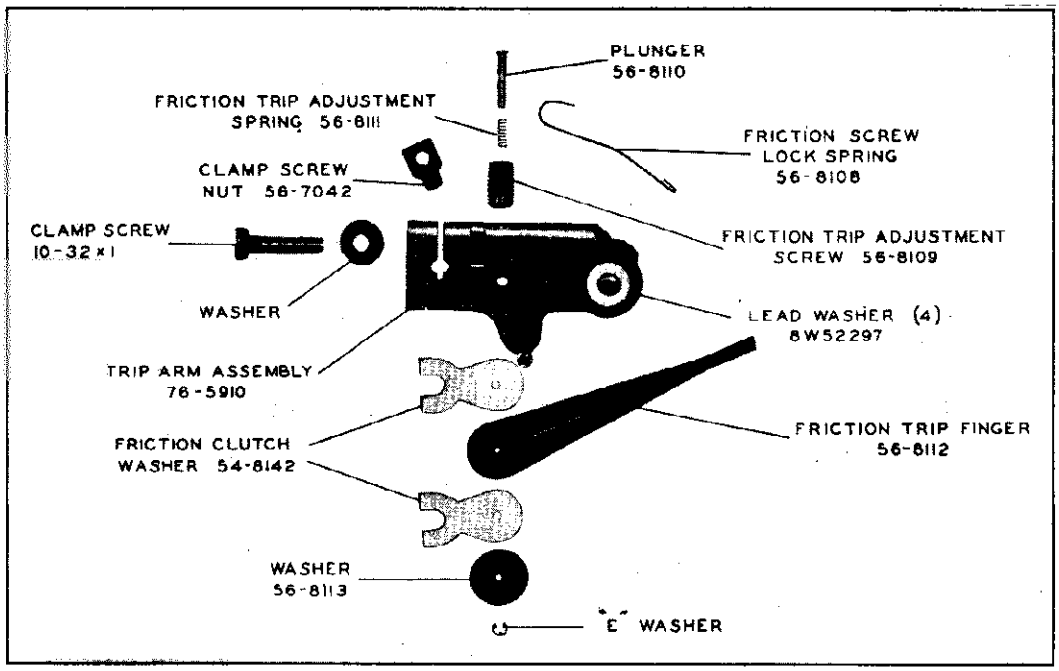


Figure 15. Tone-Arm Assembly



TPO-1842

Figure 16. Trip-Arm Assembly

PRODUCTION CHANGES

RUN 2

Tone-arm-shaft spring, Part No. 56-8773, was added, to stabilize tone-arm skip.

RUN 3

Tone-arm-shaft spring was removed, to eliminate mistracking. The inside of the tone-arm head was given an aquadage coating, to eliminate hum pick-up.

RUN 4

An extrusion was added to the tone-arm-shaft bearing of the tone-arm stanchion. Tone-arm-shaft spring, Part No. 56-8773, was added, to stabilize horizontal friction.

RUN 5

Record-shelf spacer, Part No. 56-8833, was added, to prevent jamming of shelf due to mishandling.

RUN 5Z

Changers built prior to Run 5, and converted to include all revisions up to and including Run 5, are identified as Run 5Z.

REPLACEMENT PARTS LIST

Description	Service Part No.
Actuator Assembly (figure 8)	
Cam-gear index lever	76-5895
Spring, index lever	56-8094
Compression spring	56-8087
Return lever	76-5893
Spring, return lever	56-8092
Set-down lever	76-5894
Spring, set-down lever	56-8093
Tone-arm-actuator assembly	76-6502
Spring, actuator	56-8095
Bridge Assembly	
Ball bearing, 1/8" dia. (3)	5W2017
Bearing cover	56-8129
Bearing retainer, brass	56-8128
Bearing washer (2)	56-8127
Cam-gear assembly	76-5905
Dog latch	56-8138
Pin, dog-latch mounting	56-8139
Lifter lever	56-8132
Spring, lifter lever	56-8133
Neoprene washer	54-8140
Push-off-lever assembly	76-5908
Retaining ring, reset cam and bearing	1W42311FE7
Spindle lever	56-8130
Spring, spindle	56-8131
Trip-plate assembly	76-5906
Trip-reset cam	54-8139
Changer base plate, tone-arm rest, and tone-arm stanchion	76-5892
Bumper, tone-arm rest, rubber	54-8136
Switch, motor power	42-1867
Switch, pickup	42-1873
Changer Mounting Hardware	
Sleeve, rubber (3)	54-7798
Spring, heavy, top (3)	56-7059FA9
Spring, light, bottom (3)	56-7059-1FCP
Speed nut (3)	W-2554FCP
Control Assembly	
Knob assembly, MAN.—AUT.—REJ.	76-5901
Knob, ON-OFF	54-4786

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Knob, speed control	54-4767
Lever, ON-OFF switch	56-8090
Link, reject	56-8084
Link, speed change	56-8091
Retaining ring, reject shaft	1W42295FE7
Retaining ring, switch lever	1W42253FE7
Shaft-and-bar assembly, speed change	76-5899
Shaft-and-crank assembly, reject	76-5900
Motor, 117 volts, 60 cycles	35-1451
Drive belt	54-7939
Grommet, rubber, speed-selector lever	27-4707
Idler wheel	76-5267
Plate, motor speed shift	56-8083
Pulley assembly	45-6499
Screw, motor mounting (3)	1W21561FA3
Shock mount (3)	54-4501
Spacer, mounting (3)	56-4926-1FA3
Spring, idler retractor	56-8252
***Motor, 117 volts, 60 cycles**	35-1452
Idler wheel	45-6559
Pulley assembly	45-6558
***Motor, 117 volts, 60 cycles**	35-1455
Idler wheel	45-6614
Pulley assembly	45-6615
Shock mount (3)	54-4826
Motor, 117 volts, 50-60 cycles	35-1462
Conversion kit, for 50-cycle operation	40-7848
Record-Shelf Assembly	
Hold-down assembly	76-5897
Hold-down fulcrum arm	56-8301
Hold-down pin	56-8300
Hold-down shaft	56-8299
Hold-down spring	56-8164
Push-off saddle	56-8078
Record-shelf and shaft assembly	76-5914
Set-down cam	56-8149
Nut, cam locking	56-7042
Spacer	56-8833
Spring, record shelf	56-8088
Washer, cupped	56-8089
Reject lever	56-8079
Spring, detent	56-8081
Spring, reject	56-8080
Spindle	76-5909
Tone-arm assembly (complete)	35-2710
Bracket, mounting for shaft and swivel	56-8123
Cartridge (includes needle)	76-4649
Contact plate	76-4647
Needle	45-9588
Needle, sapphire tips	45-9589
Pin, shaft and swivel	56-7011
Pull-cord, vertical timing	76-2982-4
Retainer plate, front	56-6795
Retainer plate, rear	56-8415
Screw, shoulder, bracket mounting (3)	56-7408-1
Shaft-and-swivel assembly	76-5911
Shock-mount, bracket mounting (3)	54-4729
Spring, cartridge retaining	56-6796
Spring, needle pressure	56-8124
Spring, tone-arm shaft	56-8773
Tone-arm shell	35-2707
Washer, horizontal friction (plastic)	54-8103
Trip-arm assembly	76-5910
Finger, friction trip	56-8112
Nut, clamp screw	56-7042
Plunger	56-8110
Screw, friction-trip adjustment	56-8109
Spring, friction screw lock	56-8108
Spring, friction-trip adjustment	56-8111
Washer	56-8113
Washer, friction clutch (plastic) (2)	54-8142
Washer, lead (4)	8W52297
Turntable	35-2711
Retainer, turntable	56-8097
Washer, turntable	56-8096

* This motor not carried in stock. Order motor Part No. 35-1451. If motor Part No. 35-1455 is replaced by motor Part No. 35-1451, order three shock mounts, Part No. 54-4501.

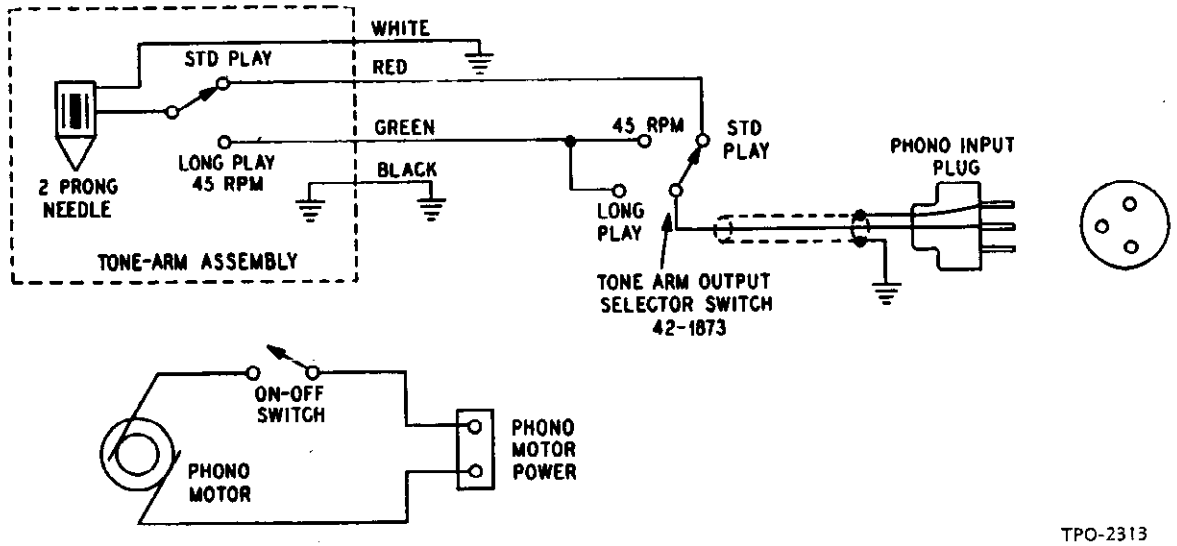
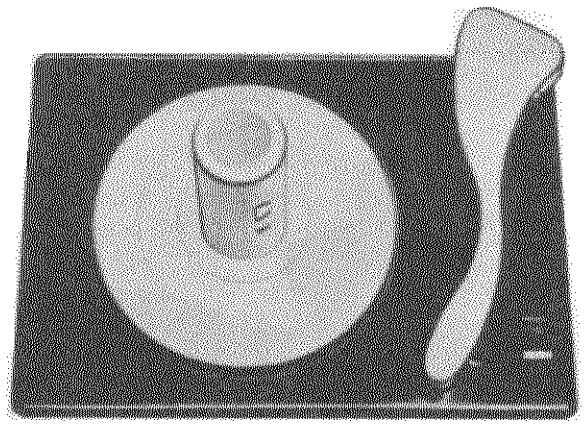


Figure 17. Wiring Diagram of Model M-22



PH489

The RP193-1 record changer is designed to play and change automatically twelve of the new RCA type seven inch fine groove 45 r.p.m. phonograph records.

SPECIFICATIONS

Turntable speed ..... **45 r.p.m.**
Records used ..... **RCA type seven-inch fine groove**
Record capacity ..... **12 records**
Pickup force ..... **Approx. 5 grams**
Stylus tip radius ..... **.001 inch**
Power supply ..... **105-125 volts, 60 cycle, a.c.**

LUBRICATION

A light machine oil (Singer Sewing Machine Oil) or equivalent, should be used to oil the bearings of the drive motor and the following:

Idler Carriage.
Pickup Arm Pivot Bearing.
Top & Bottom Turntable Shaft Bearings.

Houghton STA-PUT No. 512 or equivalent grease should be used on the following:

Ball bearing on bottom end of turntable shaft.
Cycling cam shaft.
Points of contact on reject slide assembly.
Cam tracks where the following parts contact.
Elevating rod, pickup arm lever and inclined edge where pinion gear rides.
All gear teeth.
Surfaces where pinion gear drive keys contact shelf and blade assemblies.

Houghton STA-PUT No. 320 can be used on the pinion gear shaft. (However, if available a graphite grease is highly recommended.)

(Do not oil or grease record separator shelves.)

It is important that the drive motor spindle and the rubber tire on the idler wheel be kept clean and free from oil and grease, dirt, or any foreign material at all times. Carbon tetrachloride or naphtha is satisfactory for cleaning those parts.

STA-PUT can be purchased from E. F. Houghton & Company, 303 W. Lehigh Avenue, Philadelphia, Pa.

CAUTION

1. Avoid handling the pickup arm when the mechanism is in cycle.
2. Do not use force to release a jam.
3. Do not try to remove the records on the turntable if the turntable is stopped in cycle with separator blades exposed.

AUTOMATIC OPERATION

1. Place a stack of records over the center post, with the desired selections upward, the last record to be played on top.
2. Push the "start-reject" knob toward the back of the cabinet and let go. The mechanism will automatically play in sequence one side of each record stacked on the separator shelves.
3. To reject a record being played, push the "start-reject" knob toward the back of the cabinet.
4. At conclusion of playing and as the last record is being repeated, lift the pickup arm and place on its rest. Turn off the power to the drive motor by pulling forward on control knob.
5. Remove the stack of records by lifting them straight up.

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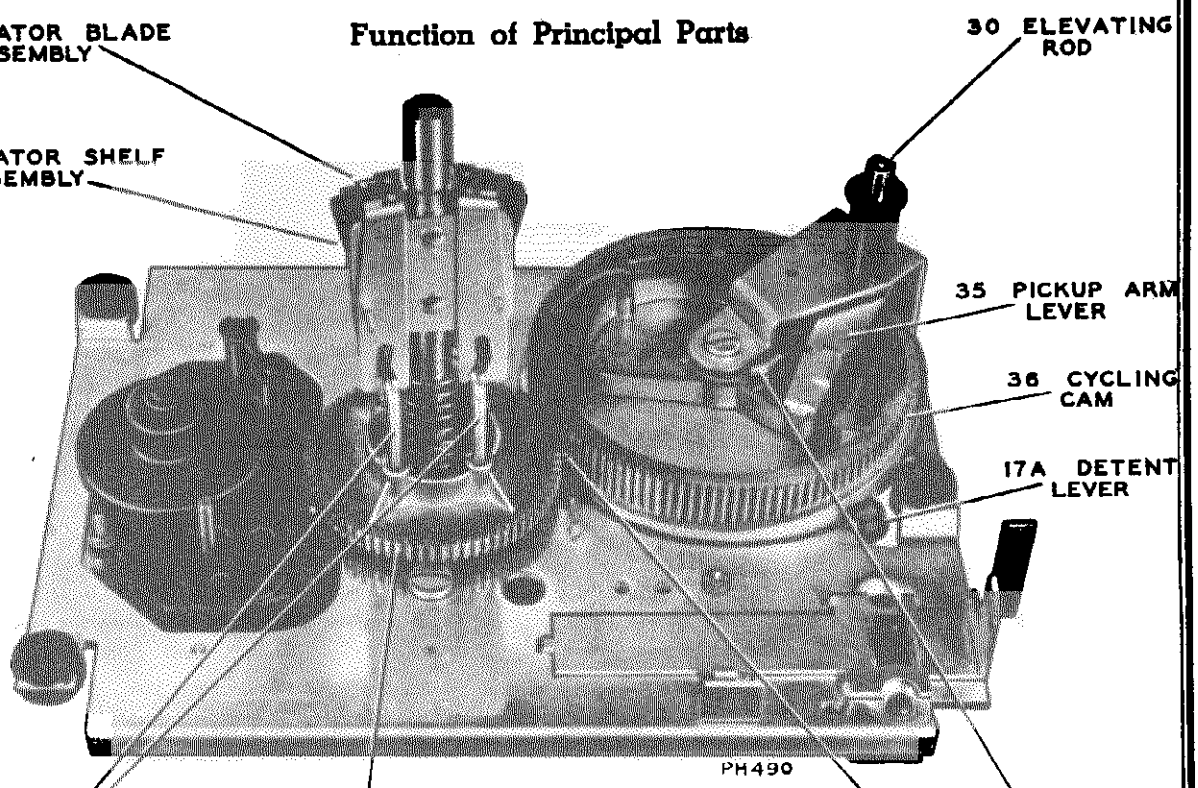
MODEL RP-193-1

Function of Principal Parts



Pickup Arm Lever (35)

The function of the pickup arm lever is to direct the horizontal movement of the pick-up arm during change cycle. This is accomplished as the end of the pickup arm lever rides in the channel molded in the cycling cam. Later, as the mechanism is playing, the pickup arm lever follows the movement of the pickup arm until the pick-up arm lever contacts and moves the segment engagement gear, thus tripping the mechanism.

Pinion Gear (13)

The function of the pinion gear is to mount the pinion gear drive keys and transfer the rotating motion of the turntable to the cycling cam during change cycle.

Pinion Gear Drive Keys (13A)

The function of the drive keys mounted on the pinion gear is to actuate the separator mechanism inside the centerpost as they raise and lower with the pinion gear.

Segment Engagement Gear and Lever Assembly (36A)

The segment engagement gear is mounted on the underside of the cycling cam. During the playing time the segment engagement gear is receded. As the mechanism is tripped the segment gear is extended, thereby making a momentary contact with the rotating pinion gear. This contact provides the movement to start the cycling cam rotating and carry the mechanism through change cycle.

Cycling Cam (36)

The function of the cycling cam and its molded channels is to direct the movement of the pickup arm and the separator mechanism during change cycle.

Detent Lever (17A)

The function of the detent lever is to engage the depression in the side of the cycling cam, and stabilize the cycling cam in the out of cycle position.

ADJUSTMENTS

PICKUP ARM HEIGHT

Loosen the screw marked ("A") on back of the pickup arm and adjust so the pickup will clear a stack of twelve records. Raising the screw in the elongated hole raises the pickup arm, lowering the screw lowers the pickup arm.

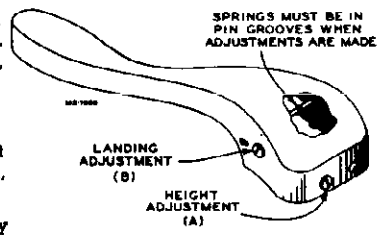
PICKUP-LANDING-ADJUSTMENT

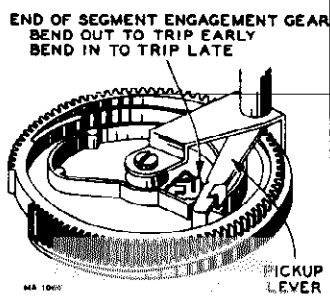
Loosen screw marked ("B") and slide the mounting bracket forward to move the landing point away from the centerpost, and back to move the landing point inward.

NOTE: Before making the adjustment, make certain the safety springs (26) are in the pin grooves.

TRIPPING ADJUSTMENT

If mechanism fails to trip when the stylus is approximately 1 9/32" from the side of the centerpost, bend the end of the segment engagement lever (indicated in drawing at right) out for early tripping and in for late tripping.





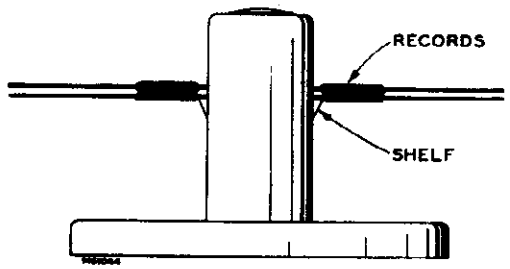
ADJUSTMENT RP-193

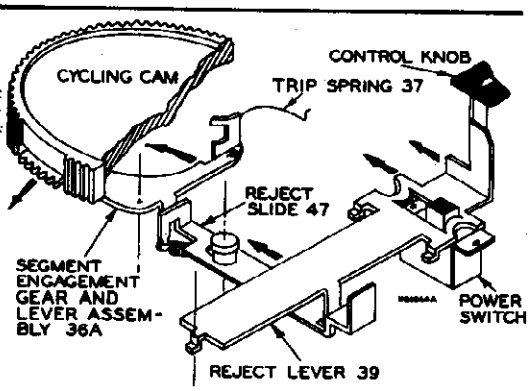
Note:

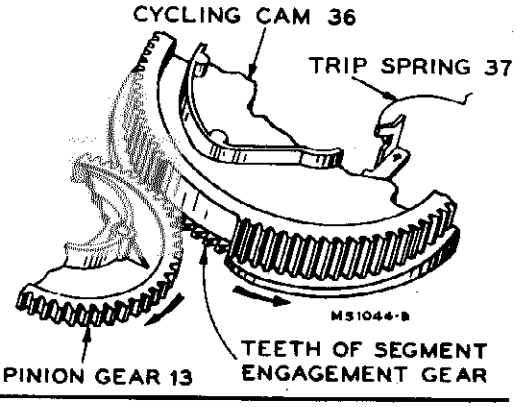
If spacing between separator blades and separator shelves do not fall between .040 to .048" bend blades accordingly.

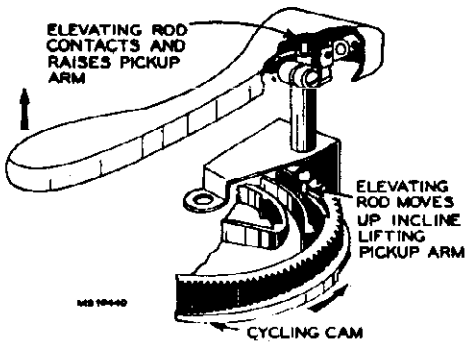
Cycle of Operation

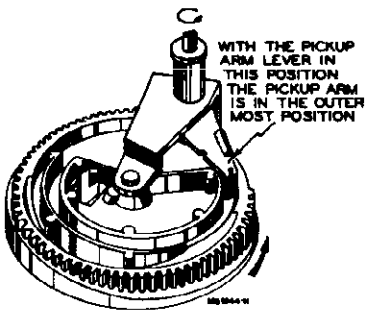
FUNCTION	EXPLANATION
Place a stack of records over the centerpost.	1. Records rest on separator shelves protruding from either side of the centerpost.
Push control knob to reject and release.	1. The control first actuates the power switch applying power to the drive motor. This action starts the turntable rotating. 2. Further movement of the control knob causes the reject lever (39) to move the reject slide (47) sufficiently, for engagement with the end of the segment engagement gear and lever assembly (36A). This movement through the train of levers trips the mechanism.
Cycling starts.	1. As the reject slide moves the segment engagement gear slightly, the segment gear snaps outward due to the action of trip spring (37). 2. After the segment engagement gear has snapped out, the rotating pinion gear (13) engages the teeth of the segment gear and gives a slight rotary motion to the cycling cam (36). This slight rotary motion causes the teeth of the pinion gear and the teeth of the cycling gear to engage, thus starting change cycle.
Pickup raises from the rest and moves out.	1. As the cycling gear starts rotating the pin on the muting switch moves off the boss on the gear permitting the switch to short out the pickup. 2. The elevating rod (30) rides up the incline surface of the track on the cycling cam, causing the pickup to raise from the rest. 3. As the cycling cam continues to rotate the turned down end of the pickup arm lever (35) follows the channel moulded in the cycling cam and swings the pickup arm out clear of the records.

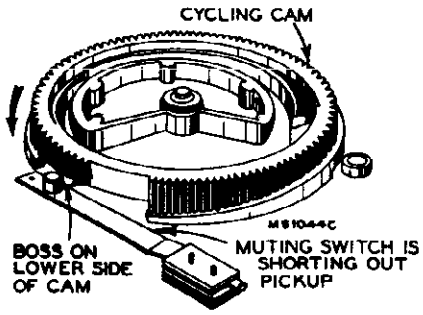






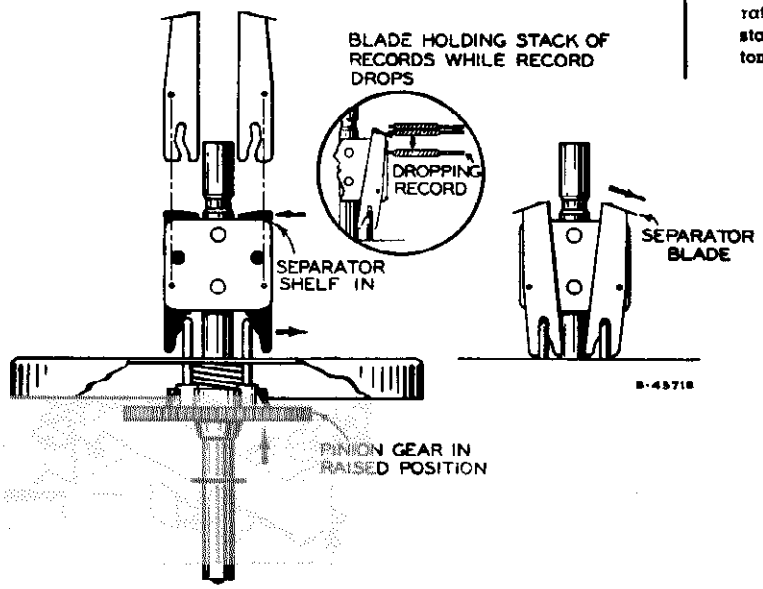


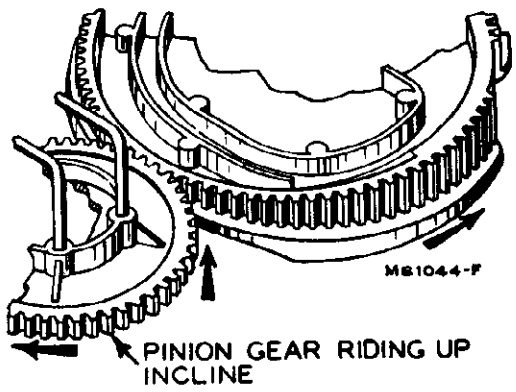




Separator blades separate the lower record from the stack and the lower record drops to the turntable.

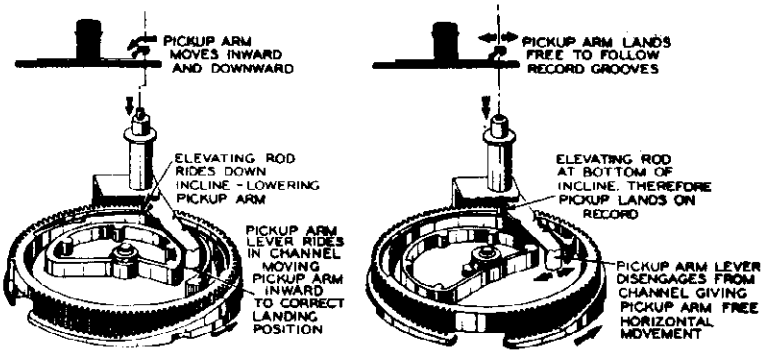
1. An instant after the pickup arm has started to raise the rotating pinion gear (13) starts to raise also. This is due to the lower edge of the gear riding up the spiral incline formed on the edge of the cycling cam.
2. The raising of the pinion gear and key assembly actuates the separating mechanism inside the centerpost. This action causes the support shelves to recede and the separator blades to move out to select the lower record of the stack and to support the remaining records while the bottom record drops to the turntable.



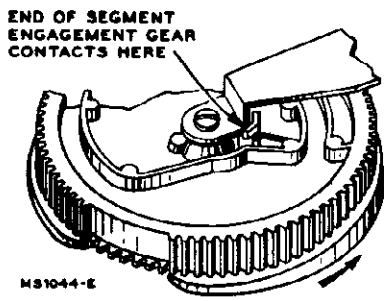


Pickup moves in for landing.

1. As the mechanism nears the end of the change cycle, the end of the segment engagement gear extending from the top of the rotating cycling gear comes against the mounting bracket. This contact resets the segment engagement gear preventing continuous cycling.
2. The end of the pickup arm lever riding in the channel in the cycling gear, moves the pickup arm in for landing.
3. The pickup lands on the start of the record as the elevating rod rides down the incline on the cycling gear.
4. At this very moment the end of the pickup arm lever moves into the open portion of the cycling cam track. This gives free movement to the pickup arm as it moves across the record.

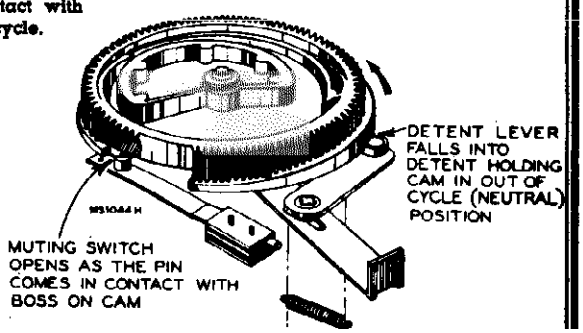


RP193 - CYCLE OF OPERATION — PICKUP LANDS

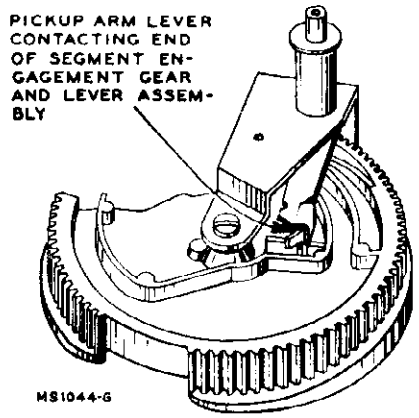


Cycling completed and the record plays.

1. The detent lever (17A) snaps the cycling cam into a neutral position as the muting switch pin comes in contact with the boss on the cam. This completes the change cycle.

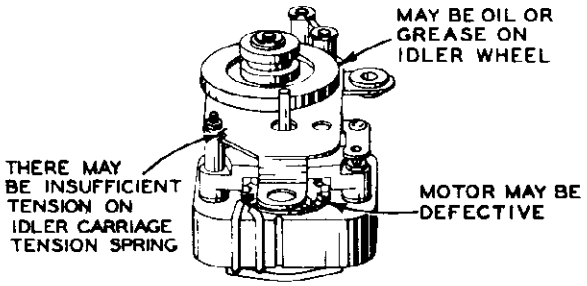


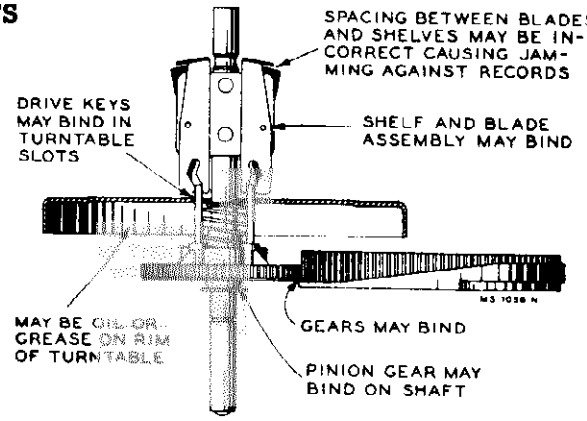
2. As the record plays, the pickup moves inward.
3. When the stylus reaches the end of the selection, the side of the pickup arm lever (35) contacts and trips the segment engagement gear and a new change cycle is started.
4. The mechanism repeats the preceding sequence of operations until the last record of the stack has dropped to the turntable and has been played.
5. The last record will be repeated until the pickup is lifted and placed on the rest.



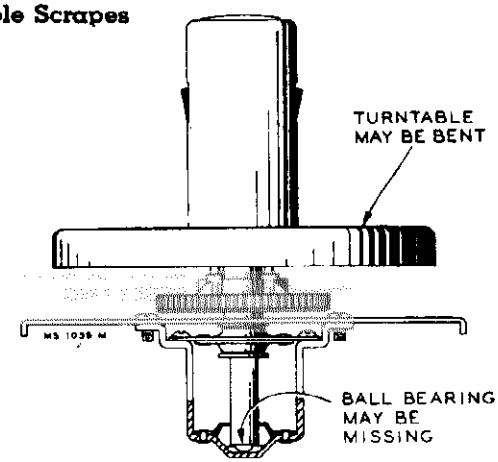
SERVICE HINTS

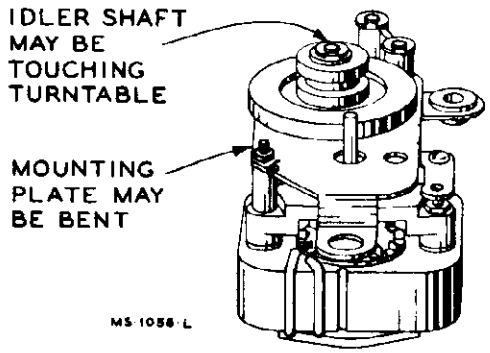
Stalling During Change Cycle



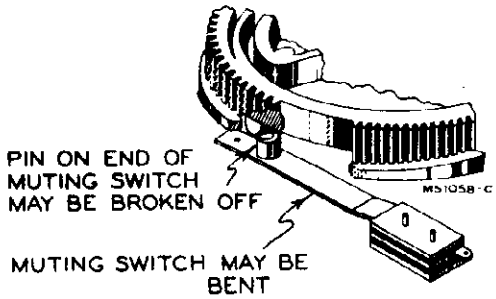


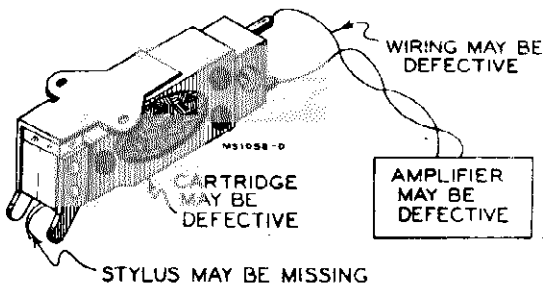
Turntable Scrapes





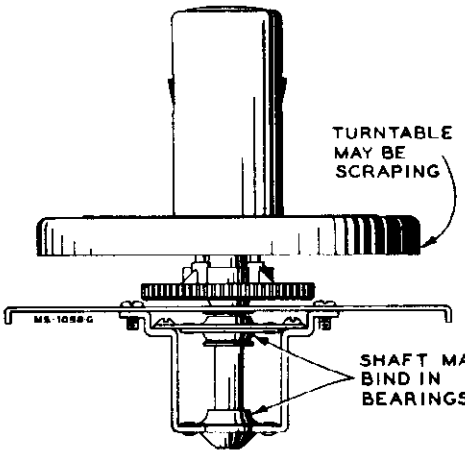
No Output From Instrument

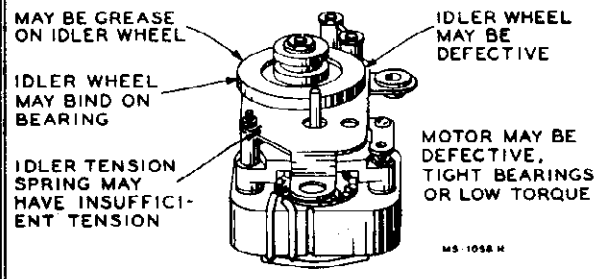




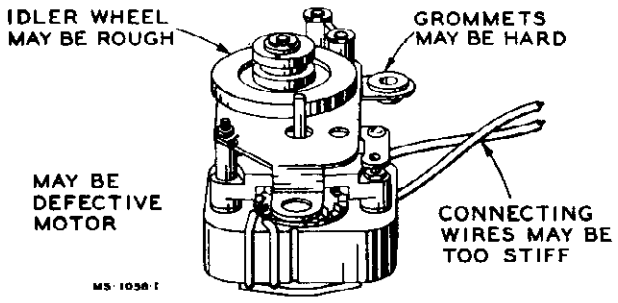
MODEL RP-193-1

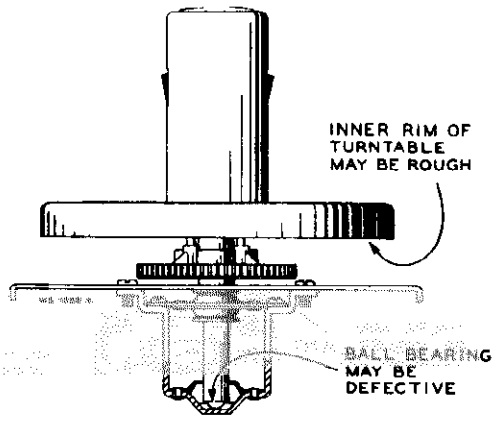
"WOW" OR SPEED VARIATION



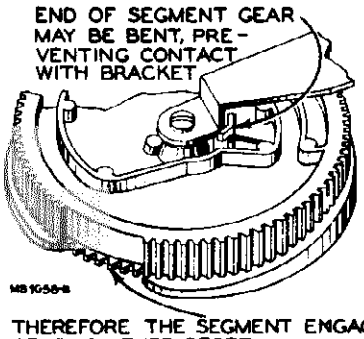


RUMBLE

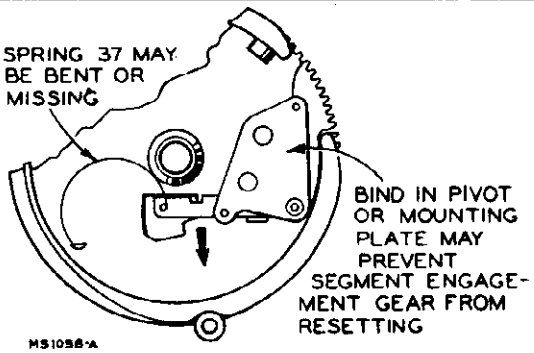


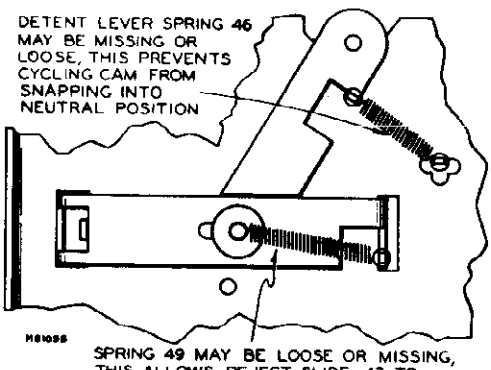


CONTINUOUS TRIPPING

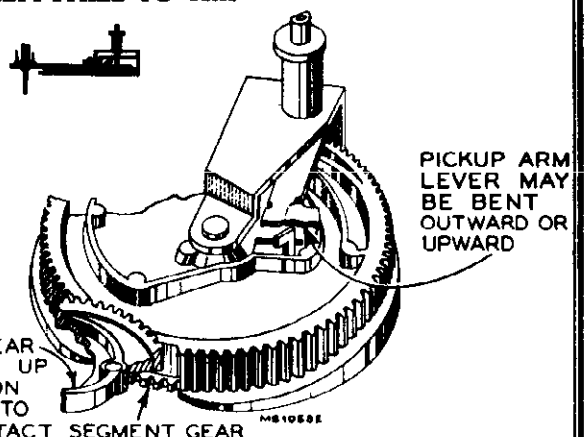


THEREFORE THE SEGMENT ENGAGEMENT GEAR IS NEVER RESET

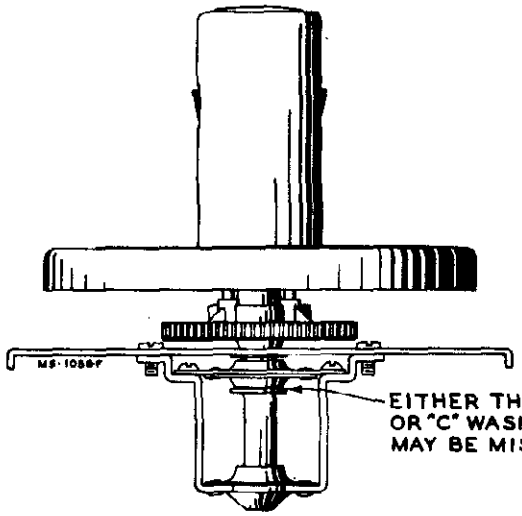




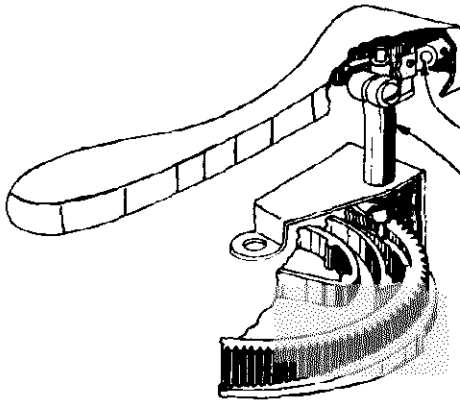
MECHANISM FAILS TO TRIP



TURNTABLE RAISES DURING CHANGE CYCLE

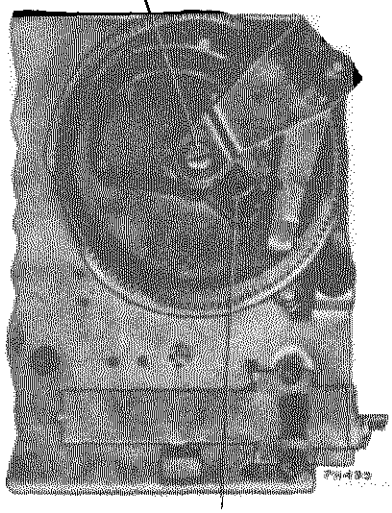


PICKUP SKIPS GROOVES



DO YOU KNOW?

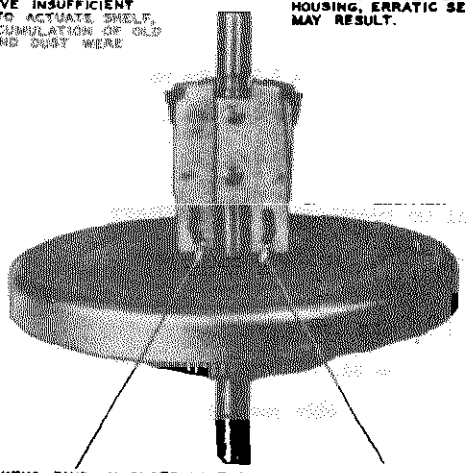
IF MOUNTING BRACKET IS NOT SEATED PROPERLY OVER SHOULDER OF SHAFT, MECHANISM MAY FAIL TO TRIP. ALSO MUTING SWITCH MAY NOT FUNCTION PROPERLY.



IF THE END OF THE SEGMENT ENGAGEMENT GEAR IS BENT IMPROPERLY, RESETTING THE GEAR WILL NOT BE ACCOMPLISHED AND CONTINUOUS TRIPPING WILL RESULT.

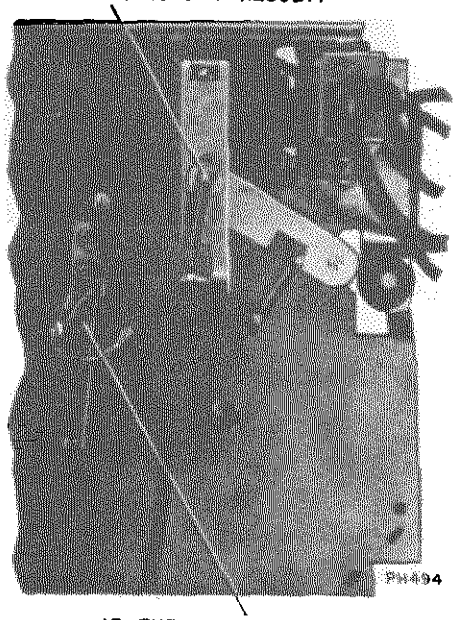
BLADE AND SHELF ASSEMBLY SHOULD NOT BE GREASED. THE SHELF RETURN SPRING WOULD HAVE INSUFFICIENT TENSION TO ACTUATE SHELF, IF AN ACCUMULATION OF OLD GREASE AND DUST WERE PRESENT.

IF BLADE AND SHELF ASSEMBLY IS NOT CENTERED PROPERLY IN SLOTS IN CENTER POST HOUSING, ERRATIC SEPARATION MAY RESULT.

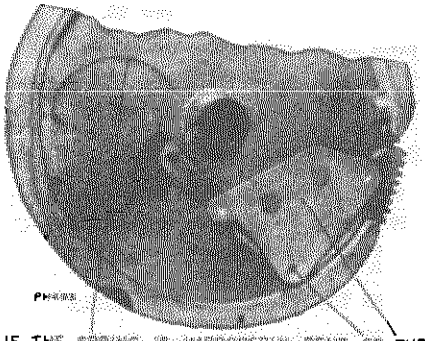


IF KEYS BIND IN SLOTS IN TURNTABLE, MECHANISM WILL NOT SEPARATE RECORDS. ALSO MECHANISM WILL NOT GO INTO CHANGE CYCLE IF THE PINION GEAR REMAINS IN THE UP

IF REJECT SLIDE BINDS, CONTINUOUS TRIPPING MAY RESULT.

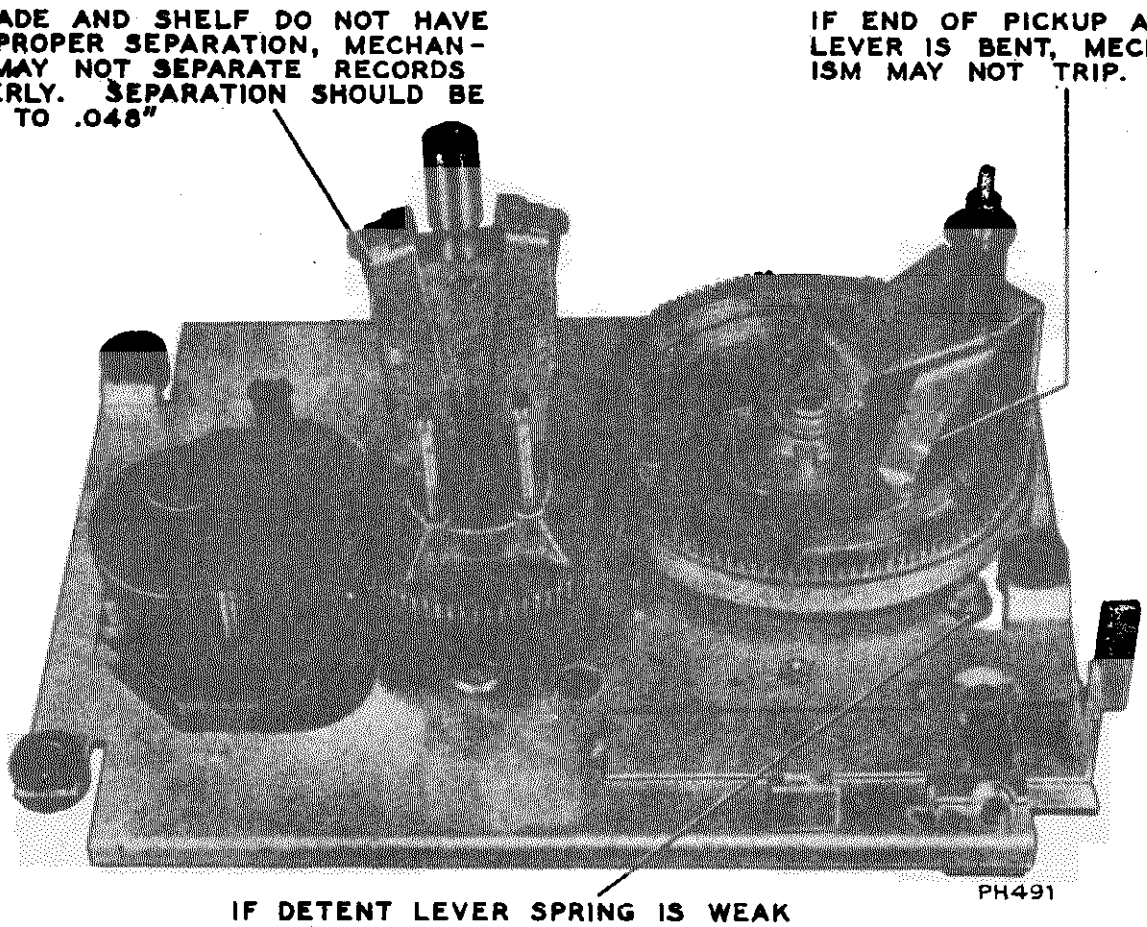


IF THE MUTING SWITCH IS BENT, MECHANICAL NOISES MAY BE AMPLIFIED DURING CHANGE CYCLE.



IF THE SPRING IS IMPROPERLY BENT, OR THE END OF THE SEGMENT GEAR BINDS IN THE HOUSING OR BEARING, TRIPPING WILL BE ERRATIC

DO YOU KNOW? (Continued)



DISMANTLING MECHANISM

(Refer to exploded view on opposite page)

REMOVAL OF PICKUP ARM

1. Disconnect pickup wires.
2. Loosen clamp screw 28.
3. Lift pickup arm straight up.

REMOVAL OF PICKUP ARM SWIVEL (BRACKET)

1. Remove landing adjustment screw 22.
2. Push pivot pin 25 away from the slotted side of the pickup arm shell, bend shell slightly to remove pin and entire swivel assembly will slide out.

REMOVAL OF TURNTABLE ASSEMBLY

1. The entire turntable and pinion gear assembly (Nos. 1 to 40 inclusive) can be lifted out by removing the "C" washer 40 located below the upper turntable bearing.

DISMANTLING THE TURNTABLE ASSEMBLY

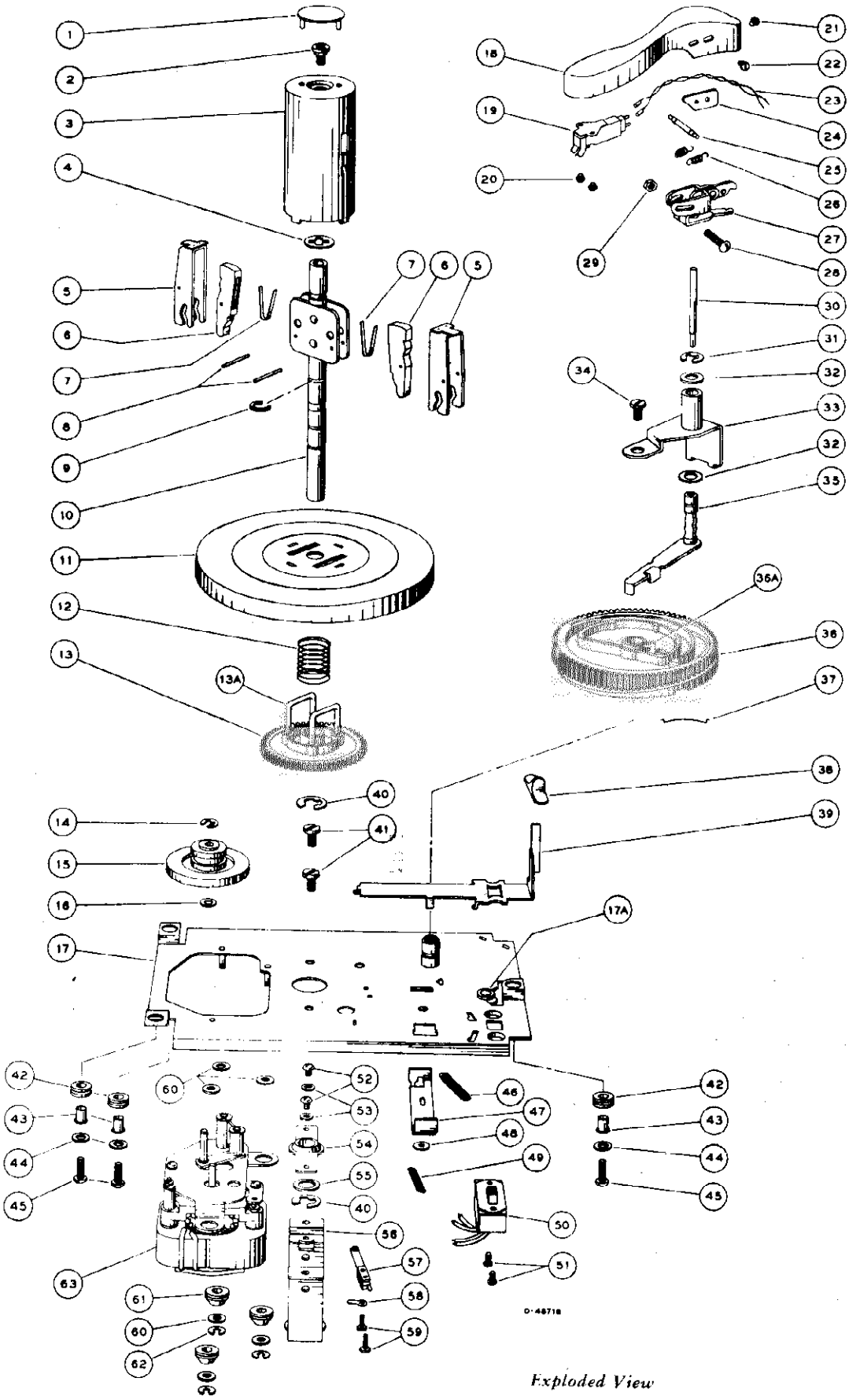
1. Remove "C" washer 40 located directly below the pinion gear.
2. Slide the pinion gear 13 and spring 12 off the spindle shaft 10.
3. Remove cap 1.
4. Remove screw 2.
5. Separate spindle cover 3 from the turntable.
6. Push pin 8 out to remove spring 7, shelf 6 and blade assembly 5.

REMOVAL OF TURNTABLE SPINDLE SHAFT

1. Remove "C" washer 9 and lift out spindle shaft 10.

REMOVAL OF CYCLING CAM

1. Remove screw 34.
2. Lift bracket assembly consisting parts Nos. 31 to 35 inclusive.
3. Remove cycling cam.



Exploded View

REPLACEMENT PARTS

ILL. NO.	STOCK NO.	DESCRIPTION
1	76245	Cap—Turntable centerpost housing cap—red
2	76242	Screw—#8-32 x ¾" cross-recessed shoulder screw
3	76241	Housing—Centerpost housing
4	76247	Washer—Spring washer for turntable centerpost and shoulder screw
5	76237	Separator—Record separator and knife
6	76238	Shelf—Record shelf
7	76239	Spring—Record shelf spring (formed)
8	76240	Pin—Record shelf and separator pin
9	76245	Washer—"C" washer for turntable centerpost
10	76236	Shaft—Turntable shaft
11	76248	Turntable—Turntable and mat
12	76244	Spring—Pinion gear return spring ($^{23}/_{32}$" O.D. 1⅛"—8 turns)
13	76243	Gear—Turntable pinion gear complete with two (2) drive keys
13A	——	Key—Drive key for turntable pinion gear—included in Ill. #13
14	76229	Washer—"C" washer to fasten idler wheel on Motor #9220-1.
15	76286	Wheel—Idler wheel for Motor 9220-1
16	76287	Washer—Dampening washer for idler wheel for Motor 9220-1
17	76231	Base—Sub-base complete with all staked and riveted parts including detent lever
17A	——	Lever—Detent lever—included in Ill. #17
18	76215	Arm—Pickup arm complete with counterweight less crystal and cable
19	76257	Crystal—Crystal cartridge complete with stylus
20	76216	Screw—#2-56 x ⅛" cross recessed fillister head machine screw to mount crystal
21	76210	Screw—#4-40 x ⅛" binder head machine screw for height adjustment
22	76210	Screw—#4-40 x ⅛" binder head machine screw for landing adjustment
23	——	Cable—Twisted pair cable and connectors
24	76211	Bracket—Landing adjustment bracket
25	76212	Pin—Pivot pin
26	76213	Spring—Pickup arm safety spring ($^{3}/_{16}$" O.D. x $^{35}/_{64}$"—9 turns)
27	76214	Bracket—Pickup arm mounting bracket
28	75726	Screw—#8-32 x ⅝" round head screw for mounting bracket
29	75725	Nut—#8-32 hex nut to fasten mounting bracket
30	76235	Rod—Elevating rod
31	76220	Washer—"C" washer to fasten pickup arm lever
32	57209	Washer—Spring washer for pickup arm lever and bearing bracket
33	76219	Bracket—Pickup arm bearing bracket
34	72409	Screw—#8-32 x ¼" binder head screw to fasten pickup arm bearing bracket
35	76222	Lever—Pickup arm shaft and lever
36	76217	Cam—Cycling cam and gear complete with segment engaging gear and trip spring
36A	——	Gear—Segment engaging gear—part of Ill. #36
37	76218	Spring—Trip spring
38	76251	Knob—Reject knob
39	76223	Lever—Reject lever
40	76221	Washer—"C" washer to fasten spindle and centerpost
41	76227	Screw—#10-32 x ¼" binder head machine screw to mount bearing assembly
42	76228	Grommet—Rubber grommet to mounting sub-base
43	76249	Spacer—Metal spacer to mount mechanism in plastic cabinet used in (45J3)
44	76250	Washer—Flat metal washer to mount mechanism in plastic cabinet used in (45J3)
45	——	Screw—#8-32 x ¾" binder head machine screw to mount mechanism in plastic cabinet used in (45J3)
46	76233	Spring—Detent lever return spring ($^{9}/_{64}$" O.D. x ¾"—34 turns)
47	76232	Link—Reject link
48	——	Washer—Flat washer for mounting reject slide
49	76230	Spring—Reject slide return spring ($^{9}/_{64}$" O.D. x ⅞"—42 turns)
50	32875	Switch—ON-OFF switch complete with cover
51	——	Screw—#4 x $^{3}/_{16}$" cross recessed round head self tapping screw to mount ON-OFF switch
52.		
53.		
54.		
56	76234	Bearing—Turntable bearing assembly
55	76226	Washer—Bakelite washer for bearing assembly
57	76224	Switch—Muting switch
58	——	Lug—Solder lug
59	76225	Screw—#5-40 x $^{5}/_{16}$" hex head tapping screw for mounting muting switch (2 req'd)
60	70490	Washer—Fibre washer for mounting motor
61	76288	Grommet—Rubber grommet for motor mounting plate for Motor 9220-1
62	76229	Washer—"C" washer to mount motor
63	76291	Motor—115 volt, 60 cycle motor less mounting plate and idler wheel (stamped 9220-1)
—	76289	Plate—Motor mounting plate for Motor 9220-1
—	76290	Spring—Idler wheel spring ($^{3}/_{16}$" O.D. x $^{5}/_{16}$") for Motor 9220-1

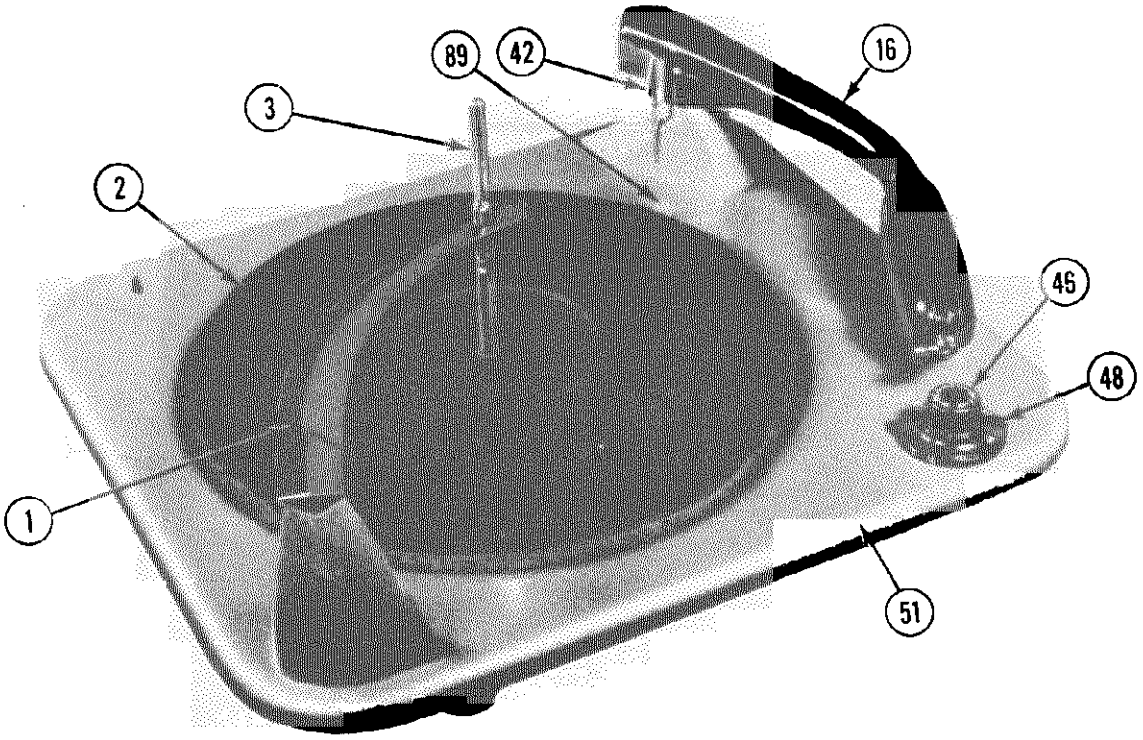


Figure 2

SPECIFICATIONS

The V-M 950 Tri-o-matic Record Changer Intermix Model is designed to play standard 78 RPM, fine-groove 45 RPM, or long-play 33-1/3 RPM records of standard commercial dimensions. Records up to 12 inches in diameter can be played manually.

Features of this changer include playing and automatically changing as many as ten - 12", twelve - 10", or any assortment of 10" and 12" of the same type (78 RPM or 33-1/3 RPM).

A full stack of twelve - 7", 33-1/3 RPM records or a full stack of twelve - 7", 45 RPM records (with the adapter inserted in the record) will also play on this changer.

The changer shuts off after the last record has been played.

Connect this changer only to an outlet supplying 117 volts, 60-cycle ac unless otherwise specified. Power consumption 25 watts.

PREPARING FOR OPERATION

SHIPPING BOLTS: Before placing in operation, the machine must be floated freely on the mounting springs. During shipment, the mechanism is secured by means of two shipping bolts. To float the changer, remove the turntable by lifting it straight up the spindle. Turn the two shipping bolts in a clockwise direction as far as they will go and replace the turntable. Before the turntable can be fully seated, the idler wheel must be gently pushed back out of the way to prevent damage to the rubber tire.

OPERATION

Loading -

1. Pull straight up on record support kno until record support clears spindle. Swing recor support to the left until pin in shaft drops into locat ing groove.

2. Changer will automatically play ten - 12' either standard or long-play records, twelve - 10' either standard or long-play records, any assortmen of ten - 12" and 10" records intermixed, or twelv - 7" long-play or fine-groove records.

NOTE: Standard, fine-groove, and long-play record cannot be intermixed. Motor speed control knob mus be reset for each type of recording.

3. Place records on spindle and lower to off set shelf. Hold records level and replace recor support over spindle.

To Play Standard Recordings -

1. Motor speed control knob must be in th "78" position.

2. To start, turn changer control knob t "Rej." and release. Changer will operate automat ically until the last record has been played. Picku arm returns to rest and the changer control knob t the "Off" position. Changer automatically stops.

LEVELING RECORD CHANGER: It is essential t have the record changer absolutely level. Use a tor pedo or similar type level on the record changer baseplate. Use adequate shims to level the recor changer pan or radio combination cabinet to achiev perfect level.

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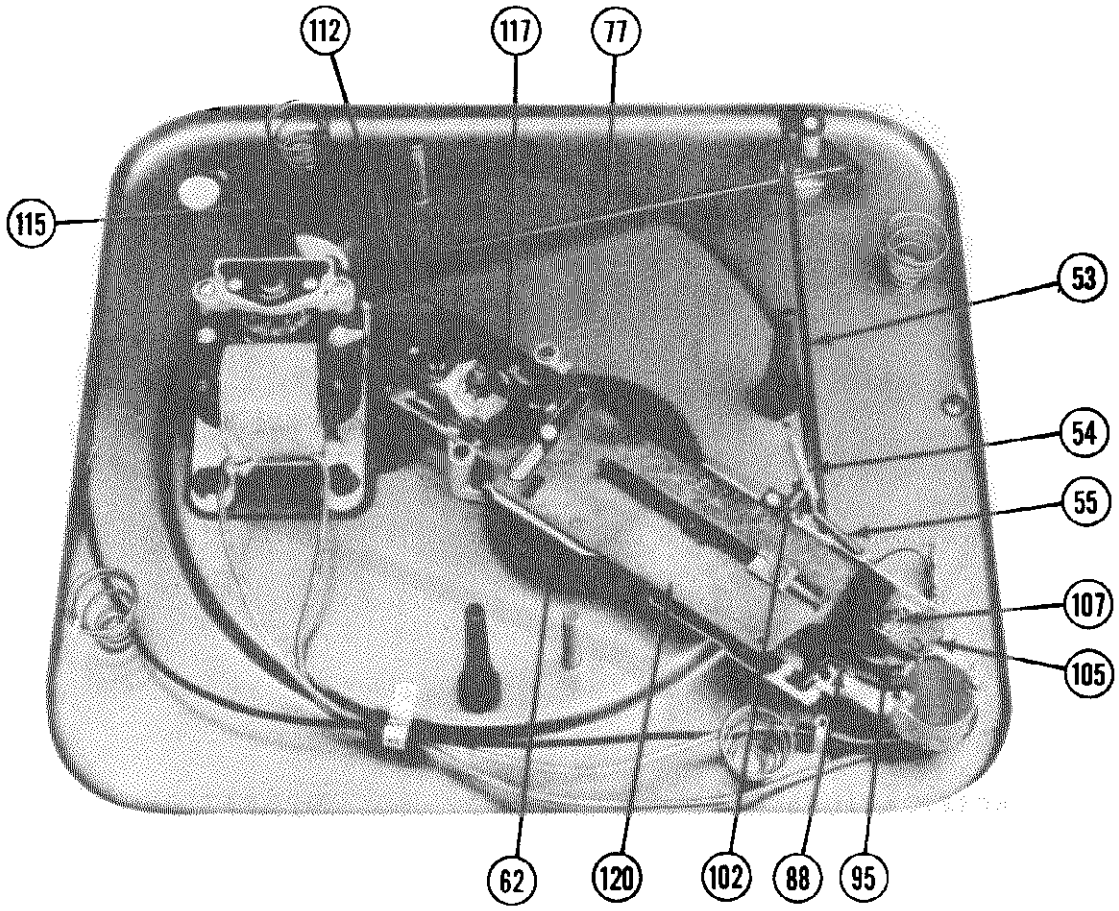

Figure 3

To Play Long-Play (33-1/3 RPM) Records -

1. Motor speed control knob must be in the "33" position.

To Play Fine-Groove (45 RPM) Records -

1. Motor speed control knob must be in the "45" position.

2. These records are manufactured with a 1-1/2" spindle hole. It is essential that a record adapter be inserted into each 45 RPM record to be played. This is necessary to reduce the spindle hole to conventional size.

REJECTING: To reject a record at any time while changer is operating, turn changer control knob to "Rej." and release.

STOPPING: To turn off changer before automatic shut-off, turn changer control knob to "Off." Lift pickup arm and place on rest.

UNLOADING: Lift the record support and swing to the left until pin on shaft drops into locating groove. Lift stack of records straight up and off spindle.

MANUAL OPERATION: To play single records or home recordings, allow the changer to go through its complete shut-off cycle. Lift the record support arm and move it to the left clear of the turntable. Place record on spindle and lower to spindle shelf. Tilt record down toward the rear of pickup arm and lower record to turntable. Turn changer control knob to "On" position only. Raise pickup arm and place in lead-in groove of record.

REPEATING OF 7", 10", OR 12" RECORDS: To repeat records, swing record support clear of spindle, place record on the turntable, and start changer. Record repeats until control is turned "Off." If a 12" record is repeated, wait for the changer to finish cycling and reposition the pickup arm manually to the 12" position.

SUGGESTIONS: When loading and unloading the changer, use care to prevent bending of the spindle. Records should not be left on the spindle except during operation of changer. Records will warp. When machine is not in use, it is suggested that the speed control knob be left in the "78" position. For best reproduction, keep needle and records clean. Store records flat, in folders or in albums. Do not lay record on record.

CHANGE CYCLE

This changer is provided with what is known as a velocity trip mechanism. The change cycle is started by the faster inward motion of the pickup arm when the needle enters the trip grooves at the end of the record. Only records having fast-finishing grooves before the eccentric cycling groove will operate this velocity trip.

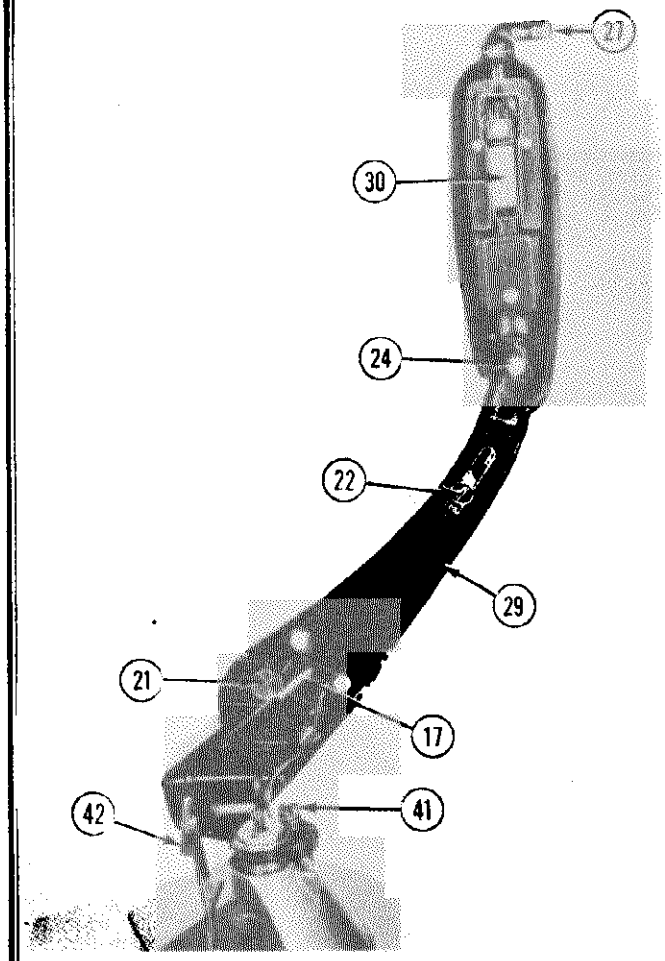

Figure 4

The pickup arm and hinge assembly and trip finger cam (105) are secured at opposite ends of the pickup arm shaft and sleeve (43) so that they move in unison. As the pickup arm nears the end of the record, the trip finger cam (105) pushes the trip link (110), which, in turn, engages the trip lever (68) rotating the pawl lever (65) to move the trip pawl (69) toward the hub on the turntable. While a record is playing, the small motions of the trip pawl (67) are not sufficient to cycle the mechanism because on each revolution of turntable the wiping contact by the hub projection moves the trip pawl (67) back to clear the projection.

In the first revolution of the turntable during which the pickup arm advances rapidly, the trip pawl (67) is moved far enough to definitely engage the projection on the turntable hub. The gear on the turntable hub will now engage the main gear (62) and start its rotation. This, in turn, starts the lateral motion of the slide and cam assembly (120). The slide and cam assembly (120) moves to the rear through the action of an eccentric pin (71) on the main gear (62) moving in the cross slot on the slide and cam assembly (120).

As the slide and cam assembly (120) begins to move, the cam surface at the rear pushes the lift pin (35) upward, raising the pickup arm clear of the record. At the same time, the tab on the rear of the slide and cam assembly (120) contacts the trip finger cam (105) swinging the pickup arm clear of the turntable.

The front edge of the ejector link slot in the slid and cam assembly (120) then contacts the ejector lin on the ejector link assembly (117). The ejector lin moves the pusher shaft and housing assembly (1 upward actuating the spindle assembly (3), causin the record pusher (6) to move straight up so as t enter the center hole of the record, and then to b pivoted forward, dropping a record to the turntable

The spindle guide (4) inside the spindle (3) prevent more than one record at a time from being ejected When records are removed from the turntable, th guide slides straight up allowing free movement u the spindle, then slides back into position by gravity

Simultaneously, the tab on the rear of the slide an cam assembly (120) contacts the pickup arm retur locator (95), moving it clear of the reset lever (81) at the same time, the pickup arm return locator (95 is locked in position with the trip finger cam (105) b means of matching holes in the pickup arm retur locator (95) and detents in the trip finger cam (105) This is accomplished by the pressure of the com pressed conical lift pin spring (107) overcoming th pressure of the lift pin compression spring washe (97).

At the same time, the cam surface of the bracket o the main gear assembly (62) moves the reset leve (81) to mid-position (10" set-down) where it is hel by the 12" record selector (42). The slide and can assembly (120) continues to the rear and then start forward. If 7" records are being changed, th rubber bumper (89) of the 7" set-down lever (90) i free to move upward permitting the other end to dro into the hole in the main gear (62) as this gear ro tates. This action of the 7" set-down lever (90 raises the reset lever (81) to the upper position (7" set-down).

If 10" records are being changed, the 7" set-dow lever (90) will not operate as the rubber bumper (89 will contact the edge of the record and the reset leve (81) will remain in the mid-position (10" set-dow as originally placed by the caming action of th bracket on the main gear (62).

If a 12" record is being changed, the edge of the re cord strikes the 12" record selector (42) releasin the reset lever (81) which drops to the bottom pos ition (12" set-down).

As the slide and cam assembly (120) continues for ward, the tab on the rear of the slide will move clea of the pickup arm return locator (95) and trip finge cam (105), which are still locked together. Thes rotate under the action of the pickup arm retur spring (87) until one of the three set-down steps i the pickup arm return locator (95) strikes the res lever (81), which has been positioned by the reco being changed (see above). This stops the inwar movement of the pickup arm return locator (95), tri finger cam (105) and pickup arm. The pickup arm i then lowered to the lead-in grooves of the record this point as the lift pin (35) rides down the rear ca surface of the slide and cam assembly (120). As th pressure is released from the conical lift pin sprin (107), the lift pin compression spring washer (9

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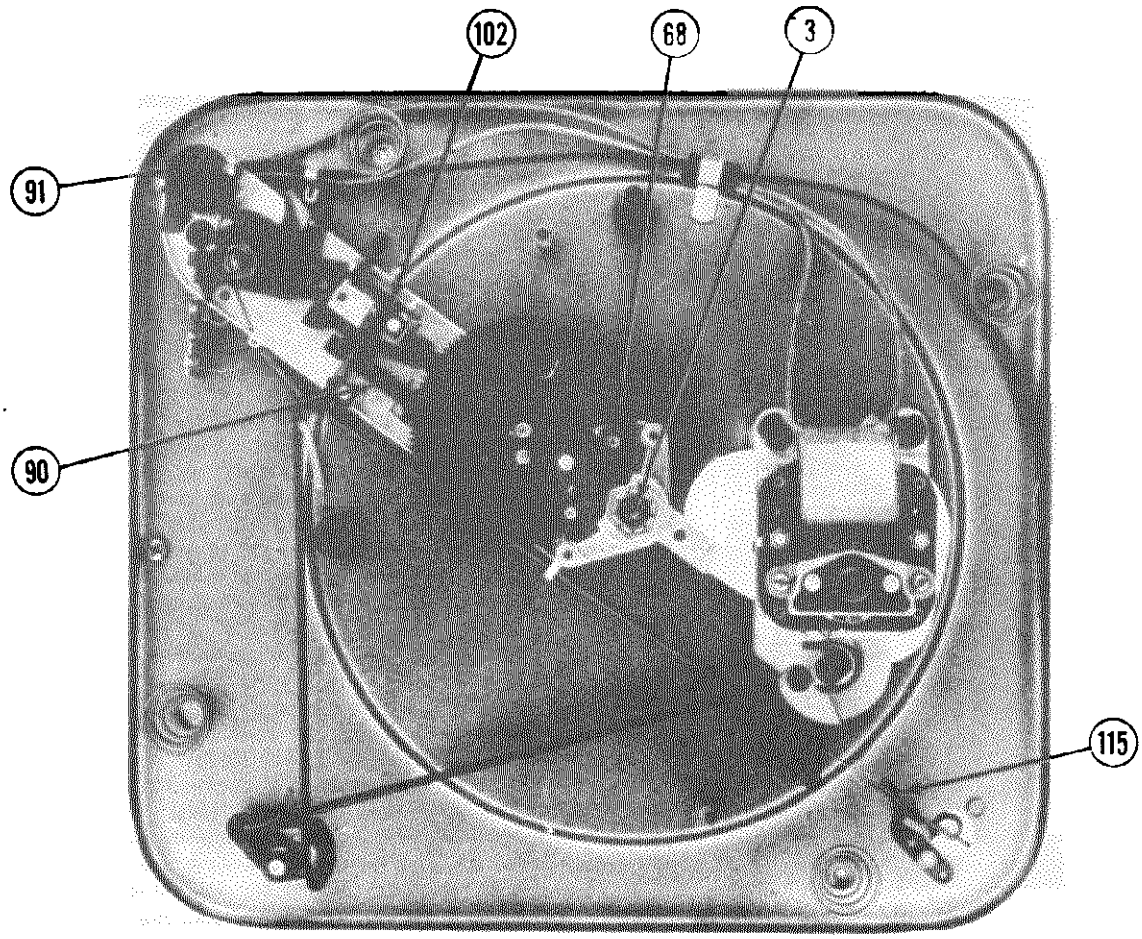


Figure 5

separates the pickup arm return locator (95) and trip finger cam (105), permitting the pickup arm to ride freely across the record.

As soon as the last record has been dropped, the record support assembly (1) drops below the shelf on the spindle assembly (3) and the lower end of the record support post contacts the arm of the shut-off lever on the shut-off lever bracket assembly (117). This pulls the control link (112), which, in turn, rotates the crank of the lever assembly (102). This forces the tab on the lever assembly (102) against the slide and cam assembly (120). At the end of the change cycle, which drops the last record, this tab on the lever assembly (102) drops into the cut-out in the main slot on the slide and cam assembly (120), and the other end of the lever assembly (102) is pushed against the pickup arm return locator (95).

When the last record has been played, the change cycle starts again; however, this time, as the pickup arm return locator (95) is pivoted clear of the reset lever (81) by the tab on the slide and cam assembly (120), the lever assembly (102) rises to the shut-off position. A tab on the lever assembly (102) raises the trip link (110) to the upper position. As the pickup arm return locator (95) starts to return the pickup arm to the record, it is stopped by the lever assembly (102) with the pickup arm positioned over the pickup arm rest post (45). The main gear continues to rotate pulling the trip link (110) forward to reset it. A tab on the upper surface of the trip link (110) contacts a lever on the control shaft assembly (88) rotating the control shaft assembly to turn off the motor and return the control knob to the "Off" position.

As the slide and cam assembly (120) moves forward, the lift pin (35) rides down the rear cam surface lowering the pickup arm to the pickup arm rest post (45).

LUBRICATION

Additional lubrication should not be required for the life of the changer, but in cases of unusual use or high-operating temperature, the changer should be lubricated as follows:

Apply Andok "B" to:

1. Edges of all slots in slide and cam assembly (120).

2. Outer edges of tines on forked end of slide and cam assembly (120).

3. Lift pin cam surface on slide and cam assembly (120).

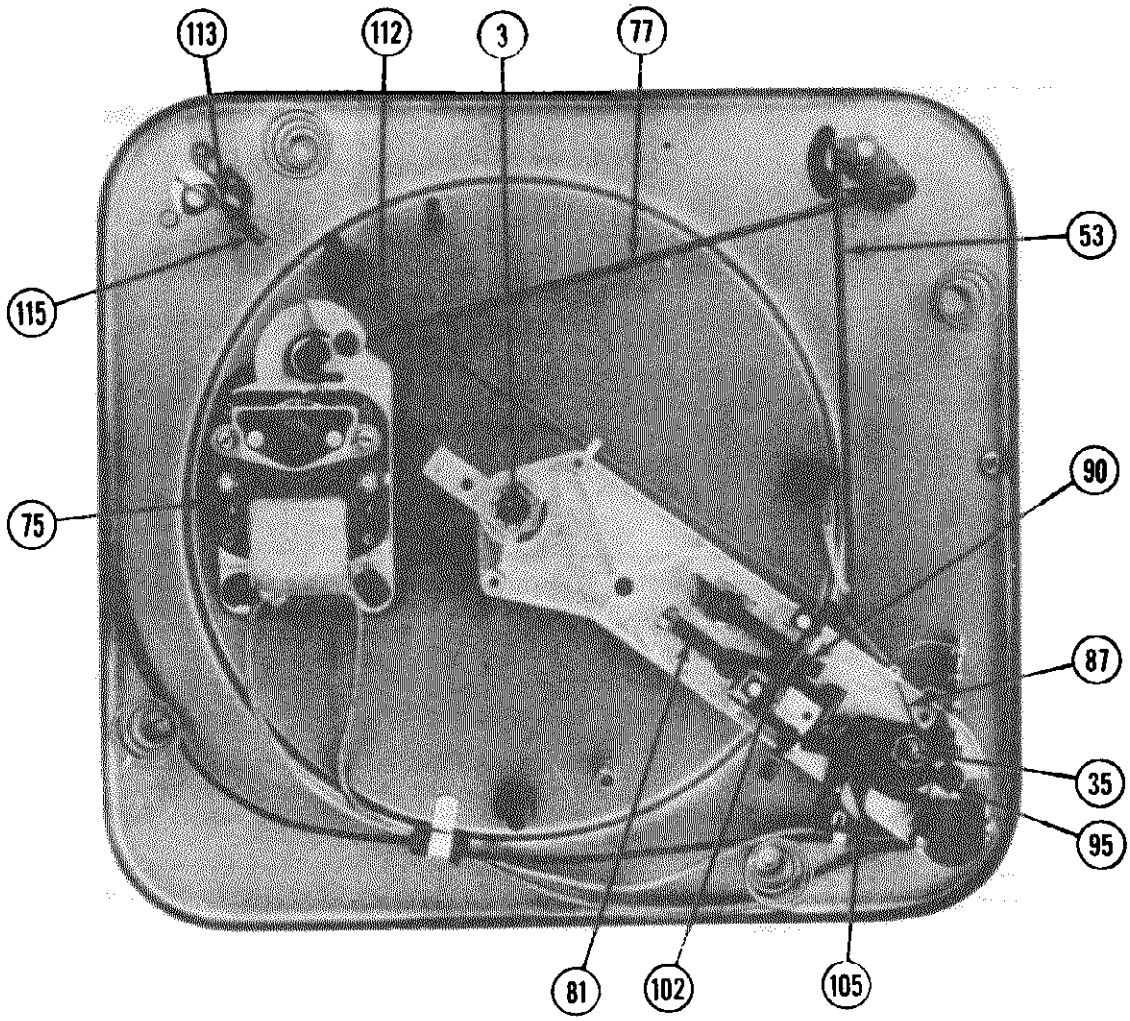


Figure 6

4. Lower surface of pickup arm return locator (95).

5. Inner surface of tab on rear of slide and cam assembly (120).

6. Turntable ball bearing (10).

7. Eccentric pin on main gear assembly (70).

Apply a small quantity of light mineral oil to:

1. Pickup arm shaft and sleeve bearing (43).

2. Turntable and spindle bearing.

ADJUSTMENTS

NEEDLE SET-DOWN (Refer to Figure 4); The set-down position of the needle is adjusted by means of the set-down adjustment screw (41) mounted on the hinge arm assembly (40). Turn this screw adjusting pickup arm for correct set-down on 10" record. When the correct set-down is obtained for the 10" position, the 12" and the 7" needle set-down will also be correct.

PICKUP ARM HEIGHT (Refer to Figure 4): The pickup arm height is adjusted by the lift screw (21) located at the rear of the strengthener. To raise the height of the pickup arm, turn this screw counter-clockwise. To lower the pickup arm, turn clockwise. The pickup arm height should be adjusted so that with a 1-1/8" stack of records the pickup arm lifts 1/4" straight up as the change cycle starts.

NEEDLE PRESSURE: The needle pressure should be between 10 and 12 grams. Adjustment may be made by loosening the screw (22) on the slide which moves in a slot in the tone arm strengthener (see Figure 4). Move the slide back and forth until the correct needle pressure is obtained.

MODEL 950

TROUBLE CHART

SYMPTOM	CAUSE	REMEDY
Turntable does not revolve when control is turned to "On."	1. No current at motor.	(a) Check that current is reaching ac leads of changer. (b) Check that switch is closing. (c) Check wiring and soldered terminals in the changer.
	2. Motor defective.	(a) Remove turntable to allow motor to operate without load. If current is reaching motor and drive spindle does not rotate, the motor is defective. Repair or replace.
	3. Motor idler wheel (74) not engaging turntable rim.	If drive spindle is turning but turntable is not: (a) Check motor idler assembly to determine if it is free to contact the drive spindle and turntable rim. (b) Wipe off inside rim of the turntable (2) to remove flock, or if oily, clean the turntable rim and rubber tire of the idler wheel (74) with naphtha.
Changer does not cycle when the control knob is turned to the "Rej."	1. The manual reject not actuating the trip.	(a) Turn the control knob (46) to the reject position, hold and see that the control shaft assembly (88) has moved the trip link (110) to the rear. This should actuate the trip pawl (67) on the main gear (62), which will bring the spur on the trip pawl (67) in contact with the hub gear on the turntable hub. (b) Check for binding of the pawl lever (65), the trip lever assembly (68) and the trip pawl (67). If binding occurs, clean out all foreign matter and check for freedom.
Control knob cannot be turned to "On" position.	1. Machine shut off during cycle.	Turn the turntable clockwise, by hand, until the control knob (46) is free.
Pickup arm strikes records on spindle when it raises, or pickup arm rest when it moves out.	1. Pickup arm height not adjusted properly.	(See instructions for adjusting pickup arm height under "Adjustments.")
Turntable speed too slow	1. Binding in turntable bearing.	Check the turntable bearing for freedom. Hold the motor idler wheel (74) out of engagement with the turntable and spin the turntable, by hand, to see if it turns readily and coasts for a long time. If binding occurs, remove turntable, clean off foreign matter, and lubricate with light mineral oil.
	2. Motor pulley too small in diameter.	Replace the motor pulley with one having a greater diameter.
	3. Line voltage too low.	The line voltage should not be less than 105 volts or the turntable may be too slow.
	4. Operating temperature too low.	If the machine has been stored in a cold place or operated in surroundings at a temperature of less than 60° F., the turntable speed may be too slow.
Turntable speed too fast.	1. Motor pulley too large in diameter.	Replace the pulley with one having a smaller diameter, or grind one or two thousandths off the pulley.
Turntable stalls or slows down during cycle	1. Motor idler not engaging turntable.	(See "Turntable Does Not Revolve When Control Knob Is Turned to 'On' Position.")

TROUBLE CHART - Cont.

SYMPTOM	CAUSE	REMEDY
	2. Turntable bearing tight.	(See "Turntable Does Not Revolve When Control Knob Is Turned to 'On' Position.")
	3. Operating temperature too low.	The line voltage should not be less than 105 volts.
	4. Binding in drive mechanism.	Hold idler (74) away from turntable, or remove idler wheel. Cycle machine by turning turntable slowly by hand. The main gear should turn freely for the complete revolution without binding at any point: (a) If binding occurs, check for foreign matter in the gear teeth, a bent gear bearing, or bent spindle bushing. Straighten or replace. Clean and lubricate.
	5. Binding between pickup arm lift pin (35) and lift pin cam surface on slide and cam assembly (120).	Lift pin should ride freely on cam surface without binding.
	6. Spindle pusher spring compressing too far.	Cycle the changer and watch the relationship between the bottom of the pusher housing and the lower button of the pusher housing. Just before the slide and cam (120) has completed its backward motion, the pusher housing should stop its upward motion and the lower button should continue up .005 to .047" more, slightly compressing the pusher spring. If the spring compresses too much, the changer may stall on the shut-off cycle.
	7. Motor weak.	When everything checks all right, but the changer still stalls in cycle, the motor may be weak.
	8. Grease on idler wheel.	1. Wipe off idler wheel rubber tire; inner rim of turntable and rubber belts with naphtha.
	9. Idler wheel bent and not making positive engagement with drive pulley.	1. Straighten idler, or replace, as necessary.
	10. Turrets unseated from lock ring on turret shaft.	Remove turret and center lock ring. (If lock ring is distorted, replace with new lock ring.) Replace turret and press down to assure turret of being locked to the turret shaft. (Turret will snap into position when properly locked.)
	11. Idler wheel tension spring weak.	Replace spring or bend motor tension spring anchor bracket to give desired tension.
Changer continues to cycle.	Reject mechanism binding.	(a) Make certain the trip link (110) is not frozen in the reject position. (b) Make certain the changer control lever (88) is not binding and that it actuates the trip link (110) when the changer control knob (46) is turned to reject. (c) Check for binding of trip pawl (67), trip lever (68) and pawl lever (65); these must be free to turn easily. (d) Check the changer control linkage (23), (53) and (88).

MODEL 950

TROUBLE CHART - Cont.

SYMPTOM	CAUSE	REMEDY
Noise during playing of record.	1. Motor rumble.	If a low-pitched rumbling sound comes from the loud speaker while a record is being played, check motor grommets to be sure the motor is freely suspended on them. The motor lead wires should have slack to allow the motor to float. Motor rumble may also come from an unbalanced motor rotor; in this case, replace the motor.
	2. Defective turntable bearings (10).	Defective turntable bearings can cause rumble. Check for foreign matter in the bearing, defective balls, binding between balls and ball retainer; rough surface on washers. Clean ball bearing, sleeve bearing, and washers; lubricate with Andok "B" and light mineral oil.
	3. Defective motor idler wheel.	A rapid thumping sound while the motor is running may indicate a flat spot on the motor idler wheel (74). If this condition does not clear up after ten minutes of running time, remove the turntable and check the rubber tire on the idler. If the surface of the rubber tire is not smooth and even, replace the idler. Should the bearing of the idler wheel show signs of excessive wear or be extremely wobbly, the idler wheel should be replaced.
	4. Defective record.	Worn or defective records cause needle scratch and distortion of the recorded sound. If the record is warped, it may slip on the other records causing "Wow" (a waver in the recorded sound). An enlarged hole in the record can also cause "Wow."
	5. Turntable scrapes.	If a scraping sound occurs as the turntable revolves, check: (a) Turntable warped, causing outer rim to rise and fall. (b) Motor idler or mounting plate bent.
	6. Squeaks.	Squeaking sound as changer operates indicates lack of oil. Lubricate points indicated under "Lubrication."
	7. Pulleys on motor not properly seated.	Check that pulleys are properly seated.
	8. 7" lever (81) loose.	Check 7" lever washer (100) and screw (101) to see if they are tight.
Distortion of Recorded Sound.	1. Defective record.	(See "Noise During Playing of Record.")
	2. Defective amplifier.	Check phonograph amplifier and speaker.
	3. Bad cartridge.	Replace. (See "Defective Cartridges.")
No Sound During Playing.	1. Defective cartridge.	Replace. (See "Defective Cartridges.")
	2. Defective wiring.	Check pickup leads for a shorted or open lead.
	3. Defective amplifier.	Check phonograph amplifier and speaker.
	4. Loose cartridge terminal clips.	Remove, squeeze together slightly, and replace.
Excessive Record Wear	1. Binding on pickup arm.	(See "Needle Does Not Track Across Record Properly."
Changer does not shut off after last record has been played	1. Record support binding (1).	The record support must drop below the off-set shoulder of the spindle or the changer will not shut off. (See "Two Records Drop at Once." - 3)

TROUBLE CHART - Cont.

SYMPTOM	CAUSE	REMEDY
	2. Lever assembly binding (100).	Clean out dirt and make sure this operates smoothly.
	3. Control link broken (112).	Replace.
	4. Spring (115) loose or broken.	Replace.
	5. Shut-off lever binding.	Check lever and if bent, straighten.
Rough pickup arm motion.	1. Horizontal defects.	(a) Check pickup arm return locator (95) for tightness. (b) Check that pickup arm return spring (87) is not weak and is hooked up properly. (c) Check that fiber washer (95A) is installed under pickup arm return locator.
	2. Vertical defects.	(a) Lift pin (35) binding; clean out dirt and lubricate. (b) Slide and cam (120) binds; check bearing points - - clean and lubricate. (c) Burrs in main slot in slide and cam (120) - - remove with fine file. (d) Ejector lever on ejector bracket assembly (117) binding in slide and cam slot: straighten, remove burrs, and lubricate. (e) Pickup arm shaft and sleeve binding: clean and lubricate.
Noise during change cycle.	1. Tines on the forked end of the slide and cam assembly (120) bent.	Replace.
	2. Control lever bent.	Straighten or replace. Check that "C" washer (95) holds.
	3. Lack of lubrication Grinding noise.	Lubricate ejector lever (117) where it contacts lower end of spindle (3).
Control knob does not detent on "33," "45," or "78" positions.	1. Bent parts.	(a) Insure that forked shaped stamping under idler is not catching in detent notch. Straighten or replace motor. (b) Insure that speed control arm (126) and speed control rod (77) are not bent.
Cartridge drags on record.	1. Needle bent.	Replace.
	2. Cartridge mounting screws loose.	Tighten.
Shuts off when last record drops.	1. Shut-off spring (115 and link (112) too short.	Check length of shut-off spring (115) and shut-off link (112) by comparing with another set - - may be too short. Replace.
	2. Shut-off bracket (113) bent.	Straighten or replace.
	3. Shut-off link (112) bent.	Straighten or replace.
	4. Shut-off lever assembly (102) binding.	(a) Check for burrs: remove with fine file. (b) Check for tight bearings: clean and lubricate.

MODEL 950

TROUBLE CHART - Cont.

SYMPTOM	CAUSE	REMEDY
Will not play manually.	1. Trip link (110) bent.	Straighten or replace.
	2. Trip finger cam (105) bent.	Straighten or replace.
Impossible to adjust set-down.	1. Pickup arm shaft and sleeve assembly (43) defective.	Shift the safety plate (39) toward the eccentric set-down adjusting screw (41), and tighten pickup arm shaft and sleeve nut (36). Hold pickup arm against rear stop and push on trip finger cam (105). The safety plate (39) should move away from the set-down adjusting screw (41) and snap back when the trip finger cam (105) is released: if it does not, replace the pickup arm shaft and sleeve assembly (43). Hinge pivot screws may be adjusted favoring one side or the other.
Record does not drop when changer cycles.	1. Spindle pusher shaft and housing assembly (14) broken.	If the pusher shaft (inside the spindle) is broken, the lower end (housing) will drop out of the spindle (7) (see Figure 5). Loosen spindle nut (78) and remove spindle (3). Replace with new spindle unit.
	2. Record pusher (6) in spindle not moving far enough forward to reject a record.	The record pusher should move up inside the spindle body (7), then move forward until it has reached a point flush with, or a maximum of, .010" beyond the spindle body(7). To insure that the record pusher (6) is all the way forward, the lower button on the shaft and housing assembly (14) should be raised high enough by the ejector lever to slightly compress the pusher spring inside the pusher shaft and housing assembly (14). (See "Turntable Stalls During Cycle.") If the spring is compressed and the record pusher (6) does not move far enough forward to eject a record, the spindle (3) should be replaced. If a record is not pushed completely off the ledge, it may hang on the spindle momentarily, then drop on the pickup arm when it moves in over the turntable.
	3. Record pusher (6) raises outside the spindle body (7).	When changer cycles, the record pusher (6) should rise up just inside the spindle body, then move forward inside the center hole in the record. If the record pusher (6) rises outside the spindle body (7), it will raise the record instead of pushing it off the spindle ledge. Remove the spindle (3) and replace with a complete new spindle assembly.
Two records drop at once	1. Hole in record too large.	Check the diameter of the hole in the record. An oversize hole will cause two records to drop at once.
	2. Spindle guide (4) not fully down.	If the spindle guide is not all the way down, more than one record may be dropped at a time. (a) Check the guide to be sure it is free and does not bind at any point. Clean out foreign matter or straighten if necessary. Do not oil. (b) When records are placed on the spindle, be sure the guide is all the way down. The guide will normally raise as a record is being dropped, but it should return to place immediately, by gravity.
	3. Record support (1) binding on spindle, or bent out of square with shaft.	The record support (1) must be able to slide freely, by gravity, down the spindle. If the support does not follow the records down as they are being ejected, two or more records may be ejected at once. If binding occurs: (a) Check the spindle (3) to determine if it is straight. Bend carefully with the fingers, if necessary.

TROUBLE CHART - Cont.

SYMPTOM	CAUSE	REMEDY
		(b) Straighten the record support (1) if it is not square with the record support shaft. (c) When the pin in the record support shaft has just entered the slot in the record support shaft post on the baseplate, the play in the record support (1), as it is swung from side to side, should be equal on both sides of the spindle. To correct bent condition, hold the support shaft and carefully force the record support into proper position. If the support is loose on the shaft, remove the knob and restake with hammer and punch.
	4. Record pusher (6) defective.	The record pusher (6) may be deformed, etc. This may cause two records to drop at once. Replace with new pusher or replace spindle assembly.
	5. Slide play in spindle (3).	Tighten spindle nut (78). If stripped, replace.
Record hits pickup arm	1. Record pusher (6) not moving far enough forward to eject record.	(See "Record Does Not Drop When Changer Cycles" -2.)
	2. Record pusher (6) extending beyond outside diameter of spindle.	Cycle changer, by hand, until pusher shaft and housing assembly (14) is at the top of its travel. Using new record as a gauge, pass it over the spindle to see if it binds at any point. File off high points on record pusher (6), with a fine file, until record will pass freely over spindle.
	3. Pickup arm not adjusted properly.	(See "Adjustments")
Needle does not set down on 10" record in proper position	1. Pickup arm not adjusted properly.	(See "Adjustments") (a) Loose nut (36) on pickup arm shaft and sleeve (43).
	2. Pickup arm shaft and sleeve (43) binding.	File off burrs and rough surfaces. Polish and lubricate shaft.
	3. 7" set-down lever (90) and 12" record selector (42) not operating properly.	Insure that the proper operation and reset of the 7" set-down lever (90) and 12" record selector (42) is not being interfered with.
	4. Needle bent.	Replace with new needle.
	5. Wire spring (83) broken.	12" record selector (42) does not cock: check for broken 12" record selector spring (83).
	6. Bent pickup arm return locator (95).	Straighten or replace.
	7. Bent trip finger cam (105).	Straighten or replace.
Needle does not set down on 12" record in proper position	1. Diameter of 12" record undersize.	The set-down position of the needle for 12" records is determined by the edge of the record striking the 12" record selector (42). If a 12" record has a diameter of less than the standard size of 11-7/8". plus or minus 1/32", it may fail to depress the 12" record selector far enough.
	2. Enlarged center hole in record.	An enlarged center hole might fail to set the 12" record selector because it could produce the same effect as a small record.

MODEL 950

TROUBLE CHART - Cont.

SYMPTOM	CAUSE	REMEDY
	3. Pickup arm not adjusted properly	(See "Adjustments") (a) Loose nut (36) on the pickup arm shaft and sleeve (43). Tighten.
	4. Binding of pickup arm shaft and sleeve (43).	Clean and polish shaft (43), and lubricate with light oil.
	5. Reset lever spring (82) broken.	Replace spring (82).
	6. 12" record selector spring (83) broken.	Replace spring (83).
	7. 12" record selector (42) binding.	The 12" record selector must be free to operate smoothly. Clean out dirt and straighten if bent, or replace.
	8. Bent pickup arm return locator (95).	Straighten or replace.
	9. Bent trip finger cam (105).	Straighten or replace.
Needle does not set down on 7" record properly.	1. 7" set-down lever spring(99) broken or weak.	Replace.
	2. Pickup arm not adjusted properly.	(See "Adjustments") (a) Loose nut (36) on pickup arm shaft on sleeve: tighten.
	3. 7" set-down lever screw (101) loose.	Tighten.
	4. 7" set-down lever (90) hitting frame or baseplate when it goes through hole in frame.	Straighten, or replace.
	5. Reset lever (81) bent.	Replace.
	6. 7" set-down lever (90) does not fall into opening in main gear.	Replace.
	7. Bent pickup arm return locator (95).	Straighten, or replace.
	8. Bent trip finger cam (105).	Straighten, or replace.
Changer does not cycle when record has been played.	1. No finishing trip groove on record.	Check record for eccentric trip groove in center of record. Some old records and home recordings do not have this eccentric trip groove.
	2. Needle jumps out of grooves in record.	(a) Check trip pressure: the lateral pressure should not exceed 3 grams. (If pressure is excessive, see "Changer Trips Before Needle Reaches End of Record.") (b) The record may be defective: the finishing groove is often too shallow. Check with a record that is known to be good.

TROUBLE CHART - Cont.

SYMPTOM	CAUSE	REMEDY
		(c) The needle point may be damaged or affected by an excessive accumulation of dust, lint, etc.: check needle pressure as described under "Adjustments."
		(d) There may be binding in the pickup arm shaft and sleeve assembly (43) or between the pickup arm return locator (95) and the trip finger cam (105): see "Needle Does Not Track Properly Across Record.")
	3. Trip pawl (67) binding on gear face.	The trip pawl must be free to move forward and engage the boss on the turntable hub when the trip lever releases it. Check for burrs or foreign matter lodged between the trip pawl (67) and main gear (62). Do not oil as this might collect dirt and gum up the pawl.
	4. Trip finger cam (105) bent.	Straighten, or replace.
	5. Trip link (110) bent.	Straighten, or replace.
Changer trips before needle reaches end of record.	1. Hole in record too large.	If the hole in the record is too large, the groove may turn eccentric with the spindle and cause premature tripping.
	2. Binding of trip link (110).	With the trip link released, check the trip link for freedom of motion. It should be free to move without binding.
Needle does not track across record properly.	1. Needle may be clogged by accumulation of lint, dirt, etc., or worn.	(a) Clean foreign material from around needle (105).
		(b) Check needle to see if the tip is bent or broken. Replace, if necessary. (Refer to paragraph on "Damaged Needle.")
	2. Trip finger cam (105) does not disengage from the pickup arm return locator (95) when cycle is completed.	There should be a 1/32" gap between the trip finger cam (105) and the pickup arm return locator (95) when the machine is not in cycle. If the gap is small enough to allow the parts to touch and bind as the needle moves across the record, the compression spring washer (97) may be weak or broken. Replace.
	3. Check the bearing in the pickup arm post for binding.	(a) Check pickup arm return locator (76) and trip finger cam (80) for binding. (See 2 above.)
	4. Changer not level.	(See "Leveling Record Changer During Long Play" under "Preparation for Operation.")
	5. Pickup leads too tight.	Give the pickup leads enough slack to allow the tone arm to move freely across a record.

CARTRIDGES

1. Damaged Cartridge (Astatic LQD)

To remove the cartridge, proceed as follows:

(a) Rotate the cartridge so the cartridge mounting screw (28) is facing downward.

(b) Loosen the set screw (26) and remove the cartridge control knob (27).

(c) Carefully pull the cartridge lead up from the rear section of the arm until adequate slack is obtained.

(d) Remove the cartridge mounting screw (28).

(e) Disconnect the pickup leads and remove cartridge.

(f) Replace cartridge and connect pickup leads.

(g) Secure pickup cartridge to mounting bracket (18).

(h) Replace the cartridge control knob (27) and tighten set screw (26).

(i) Push excess pickup lead into rear section of pickup arm.

Damaged Needle (Astatfc LQD)

(a) Rotate cartridge control knob to correspond with needle to be removed.

(b) The needle may now be removed by pulling it straight out of its mounting.

(c) In replacing the new needle, make sure that the colored needle is used on the side of the pickup cartridge having the corresponding color spot.

2. Damaged Cartridge (Shure P-81)

(a) Disconnect the pickup leads.

(b) Loosen the two cartridge mounting screws and remove cartridge.

(c) Replace cartridge and connect leads.

Damaged Needle (Shure P-81)

(a) Loosen knurled thumb nut that secures needle to the cartridge.

(b) Carefully remove needle and replace with a new needle of the same part number.

CAUTION: The replacement needle will have to be adjusted, before it is tightened in the pickup cartridge, to assure that the needle shank is securely held by the knurled thumb nut. Do not use pliers on knurled thumb nut. Tighten with fingers only.

3. Damaged Cartridge (Shure P-77)

(a) Rotate the cartridge so the cartridge mounting screws may be loosened.

(b) Remove the cartridge control knob (27).

(c) Carefully pull the cartridge lead up from the rear section of the arm until adequate slack is obtained.

(d) Disconnect the leads and remove the cartridge.

(e) Replace the cartridge and connect the pickup leads.

(f) Secure the cartridge to the mounting bracket (strengthener) (29).

(g) Push excess pickup lead into rear section of pickup arm and re-install plastic cartridge control lever.

Damaged Needle (Shure P-77)

(a) Rotate the cartridge control knob to the position corresponding to the type needle to be replaced.

(b) Loosen the knurled thumb nut that secures needle to the cartridge.

(c) Carefully remove needle and replace with a new needle of the same part number.

CAUTION: Make sure that the colored needle is used on the side of the pickup cartridge having the corresponding color spot. The replacement needle will have to be adjusted, before it is tightened in the pickup cartridge, to assure that the needle shank is securely held by the knurled thumb nut. Do not use pliers on knurled thumb nut. Tighten with fingers only.

ASTATIC CARTRIDGES

2753	Cartridge, Astatic LQD-1M complete	
	2754	Osmium one mil needle
	2755	Osmium three mil needle
3137	Cartridge, Astatic LQD-1JM complete	
	2755	Osmium three mil needle
	3135	Sapphire one mil needle
3168	Cartridge, Astatic LQD-1J complete	
	3135	Sapphire one mil needle
	3136	Sapphire three mil needle
2816	Cartridge, Astatic LQD-1M not grounded complete	
	2754	Osmium one mil needle
	2755	Osmium three mil needle
2876	Cartridge, Astatic CQ complete	
	3521	Sapphire one mil needle
2500	Cartridge, Astatic CQ ungrounded complete	
	3709	Sapphire one and one-half mil needle
3560	Cartridge, Astatic GCAG complete	
	3561	Osmium truncated needle
3547	Cartridge, Astatic GCAG complete	
	3559	Sapphire truncated needle

SHURE BROTHERS CARTRIDGES

2606	Cartridge, Shure Brothers, P-77 complete	
	2628	Osmium one mil needle
	2629	Osmium three mil needle
3063	Cartridge, Shure Bros., 79-V complete	
	2629	Osmium three mil needle
	3120	Sapphire one mil needle
3182	Cartridge, Shure Bros., P-76-A complete	
	3119	Sapphire three mil needle
	3120	Sapphire one mil needle
3366	Cartridge, Shure Bros., P-71-A complete	
	3367	Sapphire Unipoint needle
3368	Cartridge, Shure Bros., P-37-C complete	
	3369	Osmium Unipoint Needle
3373	Cartridge, Shure Bros., P-81 complete	
	3374	Osmium Unipoint needle

3411 Cartridge, Shure Bros., P-81 complete
- 3412 Sapphire Unipoint needle

3415 Cartridge, Shure Bros., P-81-C complete
- 3369 Osmium two mil needle

3455 Cartridge, Shure Bros., P-76-AF complete
- 3120 Sapphire one mil needle
- 2629 Osmium three mil needle

3442 Cartridge, Shure Bros., P-72-V complete
- 2628 Osmium one mil needle
- 2629 Osmium three mil needle

3553 Cartridge, Shure Bros., P-37-D complete
- 3567 Osmium Unipoint needle

3579 Cartridge, Shure Bros., P-37-A complete
- 3412 Sapphire Unipoint needle

3691 Cartridge, Shure Bros., P-76-A complete
- 2628 Osmium one mil needle
- 2629 Osmium three mil needle

3719 Cartridge, Shure Bros., P-81-A complete
- 3720 Osmium 2.3 mil needle

WEBSTER CARTRIDGES

2197 Cartridge, Webster F-14-2 complete
- 2630 Duo Needle, Osmium tip

3239 Cartridge, Webster A-1 complete
- 3292 Sapphire one mil needle
- 3293 Sapphire three mil needle

3399 Cartridge, Webster A-1M complete
- 3400 Osmium one mil needle
- 3401 Osmium three mil needle

3555 Cartridge, Webster A-1M-Z complete
- 3292 Sapphire one mil needle
- 3401 Osmium three mil needle

PARTS LIST

Ref. No.	Part No.	Description
1	2908-A	Record Support Assembly - Consists of
1A		3286-P Plastic Button
1B		2902-J Record Support Arm
1C		2530 Record Support Rod
2	2528-A	Turntable and Hub Assembly
3	2576	Spindle and Bearing Assembly - Consists of
		2536 Spindle Assembly less Ball Race and Washers
4		2128 Spindle Guide
5		1535 Pin for Spindle Guide
6		1529 Record Pusher
7		2537 Spindle Body and Base Assembly
8		2078 Retaining Ring
9		2639 Bearing Washer
10		2624 Bearing (Ball Race)
11		2639 Bearing Washer
12		1527 Pusher Spring
13		2552 Pusher Shaft Spring
14		2539 Pusher Shaft and Housing Assembly
15	2310	Hinge Pivot Screw
16	2503-B	Plastic Tone Arm
17	2508	Hinge Spring
18	2945	Strengthener and Bracket Assembly
19	2275	Strengthener Screw #4 x 1/4" Thread Cutting
20	2255	Lock Spring
21	2912	Lift Screw
22	2449	Screw for Slide 6-32 x 1/8"
23	2934	Adjusting Slide
24	2275	Strengthener Screw #4 x 1/4" Thread Cutting
25	2753	Cartridge "Astatic LQD" (Also see Cartridge Breakdown)
26	2370	Cartridge Control Knob Screw
27	2860-G	Cartridge Control Knob
28	2817	Lockwasher and Screw-Cartridge Mounting
29	2509	Strengthener and Bracket Assembly
30	3691	Cartridge "Shure P-76V" (Also see Breakdown on Cartridges)
31	2542-B	Plastic Tone Arm Assembly Only
32	2917	Strengthener and Bracket Assembly
33	3373	Cartridge "Shure P-81" (Also see Cartridge Breakdown)
34	2904	Cartridge Mounting Screw
35	2220	Lift Pin
36	1975	Pal Nut
37	2247	Safety Spring

Ref. No.	Part No.	Description
38	2937	Washer 1/4 I.D. x 1/2 O. D. x 1/16"
39	2249	Safety Plate
40	2294	Hinge Assembly
	2933	Hinge Pin
	2505	Hinge Bracket Only
41	2269	Eccentric Set-Down Adjustment Screw (Part of Item 40)
41-A	2926	Speed Nut
42	2957	12" Record Selector
43	2921	Tone Arm Shaft and Sleeve
43-A	2952	Fiber Washer
44	409	Screw 10-24x5/16" - Casting Hold-down and Lockwasher
45	2558-G	Tone-Arm Rest Post
46	2907	Reject Knob
47	1651	"C" Washer - Switch Control
48	2906-G	Speed Control Knob
49	2594	"C" Washer - Switch Control
50	2593	Control Shaft Bearing
51	2523	Base Plate
52	1588	"C" Washer - 12" Record Selector
53	2600	Shut-off Rod
54	2442	Trip Spring - Control Link
55	1721	Reject Spring - Shut-off Rod
56	2221	Fiber Washer - Main Gear Assembly
57	1719	"C" Washer - Main Gear Assembly
58	2525	Die-Cast Frame
59	2077	Shipping Bolt
60	2918	Plastic Support Leg
61	2110	"C" Washer - Record Support Assembly
62	2575	Main Gear Assembly - Consists of:
		2512 Gear Only
63		1588 "C" Washer - Trip Lever Assembly
64		2829 Fiber Washer - Trip Lever Assembly
65		2940 Pawl Lever
66		2516 Spring Washer - Trip Lever Assembly
67		2939 Trip Pawl
68		2569 Trip Lever Assembly
69		2943 Rivet for Pawl Lever
70		2977 Roller
71		2227 Rivet for Roller
72	3361	Hairpin Clip - Idler Wheel
73	2583	Fiber Washer - Idler Wheel
74	3353	Idler Wheel
75	2727	Gen. Ind. 2-belt Motor 110 Volt 60 Cycle

MODEL 950

PARTS LIST - Cont.

Ref. No.	Part No.	Description
	2772	Idler Wheel
	2773	Mounting Grommet
	2765	Lever Grommet
	2797	Belt
	3088	Idler Spring
	3089	Pulley 45 RPM
	3090	Pulley 33-1/3 RPM
	3294	Hairpin Clip-Idler
	3295	Fibre Washer-Idler
	3355	Felt Washer-Pulley
		Note: Above parts may also be used to service:
	3321	Motor (110 Volt 50 Cycle)
	3322	Motor (220 Volt 50 Cycle)
	3129	General Industries Turret Motor 110 Volt 60 Cycles
	3139	Pulley 78 RPM
	3140	Pulley 45 RPM
	3141	Pulley 33-1/3 RPM
	2772	Idler Wheel
	2773	Mounting Grommet
	2765	Lever Grommet
	3088	Idler Spring
	3294	Hairpin Clip-Idler
	3295	Fibre Washer-Idler
	3355	Felt Washer-Pulley
		Note: Above parts may also be used to service:
	3395	Motor (110 Volt 50 Cycle)
	3396	Motor (220 Volt 50 Cycle)
	3211	Russel Turret Motor 110 Volt 60 Cycle
	3353	Idler Wheel
	3354	Pulley 33-1/3 RPM
	3356	Pulley 45 RPM
	3357	Pulley 78 RPM
	3358	Idler Arm & Pivot Assembly
	3359	Idler Arm Link
	3360	Idler Spring
	3361	Hairpin Clip Idler
	2638	Mounting Grommet
	3362	Felt Washer-Pulley
	3363	Fibre Washer-Idler
	2765	Lever Grommet
		Note: Above parts may also be used to service:
	3393	Motor (110 Volt 50 Cycle)
	3394	Motor (220 Volt 50 Cycle)
	3338	Alliance Turret Motor 110 Volt 60 Cycle
	3481	Idler Wheel
	3489	Mounting Grommet
	3487	Idler Spring
	3484	Pulley 78 RPM
	3483	Pulley 45 RPM
	3482	Pulley 33-1/3 RPM
	3488	"C" Washer for Idler Wheel
	3493	Fibre Washer for Idler Wheel
	3492	Fibre Washer for Pulleys
	3490	Felt Washer for Pulley
	3491	Felt Washer for Idler Wheel
		Note: Above Parts may also be used to service:
	3478	Alliance Turret Motor 110 Volt 50 Cycle
	3498	Alliance Turret Motor 220 Volt 50 Cycle
76	1685	Motor Fastener
77	2942	Motor Speed Control Rod
78	2208	Pal Nut for Spindle
79	2087	Screw 6/32 x 1/4" Reset Lever
80	492	Washer - Flat Steel-Reset Lever
81	2560	Reset Lever
82	2925	Spring - Reset Lever
83	2563	Spring - 12" Record Selector
83-A	1720	Speed Nut - Spring - 12" Record Selector
84	409	Screw 1-/24 x 5/16 and Lockwasher
85	2951	Terminal Strip
86	2087	Screw 6/32 x 1/4
87	2574	Return Spring-Pickup Arm
88	2284	Control Shaft Assembly
88-A	1652	"C" Washer for Item 88
89	2560	Rubber Bumper
90	2581	7" Set-down Lever
91	467	Switch
92	2931	Fiber Insulating Strip
93	2573	Switch Cover
94	1720	Speed Nut - Switch Cover Hold-down
95	2561	Locator Plate - Tone-Arm Return
95-A	2266	Fiber Washer
96	2271	Retaining Ring - Locator Plate
97	2953	Spring Washer
98	2585	Spring Shut-Off Lever
99	2579	Spring - 7" Set-down Lever
100	492	Washer - Flat Steel - 7" Set-down Lever
101	2087	Screw 6/32 x 1/4" - 7" Set-down Lever
102	2591	Lever Assembly - Shut-off
103	1587	Lever Assembly Bearing
104	2932	Screw 4/40 Hex Head
105	2520	Trip Finger Cam
106	1975	Pal Nut
107	2262	Conical Lift Pin Spring
108	1588	"C" Washer - Lift Pin Spring
109	1588	"C" Washer - Slide Retainer
110	2958	Trip Link
111	2245	Rivet-Trip Link
112	2935	Control Link
113	2586	Shut-off Bracket Assembly
114	2053	Screw 6 x 5/16
115	2978	Shut-off Spring
116	409	Screw 10/24 x 5/16 and Lockwasher
117	2571	Ejector Link Assembly
118	2274	Flat Washer
119	2087	Screw 6/32 x 1/4 Slide and Cam Assembly
120	2288	Slide and Cam Assembly
121	2211	Slide Bearing
122	2246	Spring - Slide Bearing
123	2208	Pal Nut
124	2909	Washer
125	2597	Control Shaft Assembly - Motor
126	2765	Rubber Grommet
127	2910	Compression Spring
128	2599	Switch Control Lever Assembly
129	2087	Screw 6/32 x 1/2"

GENERAL INFORMATION

THE MODEL 950 SERVICE MANUAL (V-M FORM 2544) MAY BE USED IN THE SERVICING OF ALL MODEL 950 TRI-O-MATIC® RECORD CHANGERS, EVEN THOSE PRODUCED AFTER OCTOBER 15th, 1950 AT WHICH TIME MANY PRODUCTION CHANGES WENT INTO EFFECT. These changes are outlined in the following paragraphs and should be noted, as it is of the utmost importance when ordering replacement parts.

You will find that most of the new items are interchangeable with those used in earlier models with the exception of the shut-off lever (item 126) V-M part 2591. Should it become necessary to replace this item, the slide and cam assembly (item 120) V-M part 2288 should also be replaced and vice versa with the later design. (Refer to parts list in this supplementary manual).

The last record shut off mechanism has been altered slightly and functions as follows: When the last record is dropped to the turntable the record support arm also slides downward contacting the shut off bracket assembly. This, in turn, pivots the shut off lever (126) through the media of spring (131) and connecting shut off wire. However, the full pivot of the shut off lever (126) is blocked by the escape lever (130A) of the slide on cam assembly (130), which has moved in under the shut off lever. This prevents the changer from shutting off. As the changer completes the change cycle, the shut off lever (126) slides off the escape lever (130A) and drops into the slot of the cam and slide assembly (130). When the last record has been played, the change cycle starts again, however, this time, as the pickup arm moves outward, the way is clear for the shut off lever (126) to raise to the shut off position, thus causing the mechanism to shut off upon completing the change cycle (see "Change Cycle" in the V-M 950 Manual, Form No. 2544, for complete description of the shut off mech.).

MODEL 950

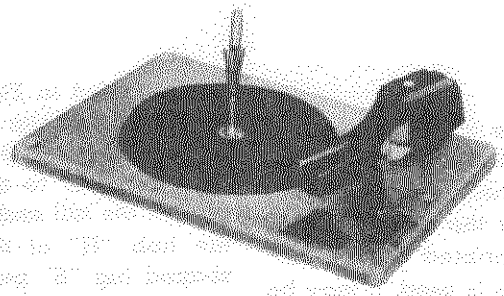
REASONS FOR ADDITIONS AND CHANGES To The Record Changer Mechanism

REF. NO.	PART NO.	DESCRIPTION	REASON
115	3602	Hinge Button Bearing	This hinge button bearing replaces the 2310 pivot screw in order to maintain better control over the vertical friction of the tone arm.
116	3887	Jam Nut	This jam nut replaces the 1975 palnut inasmuch as the palnut had tendancy to strip the threads of the brass housing in which the tone arm lift pin rides.
117	3888	Lock Washer	This lockwasher replaces the 2937 flat washer inasmuch as a locking device was needed to secure the 2887 jam nut into position. No lockwasher was needed with the 1975 palnut as the palnut was self-locking.
118	4088	Brace for Base Plate	This brace was added to the baseplate in order to straighten the well in which the turntable rides to prevent turntable scraping and also to prevent bending of the baseplate while in transit.
119	2546	Record Support Hold-down Spring	This spring was added shortly after the beginning of the 950 production in order to facilitate the shut off after the last record had been played.
120	2110	"C" Washer for Record Support	This "C" Washer was omitted from the original exploded view of the Model 950 and it was felt necessary to show it on this drawing.
121	4172	Spring for Trip Lever Assembly	This spring replaces the 2516 spring washer in order to maintain a more uniform friction within the trip lever assembly.
122	1736	Motor Mtg. "C" Washer	This "C" Washer was adapted for motor mounting purposes inasmuch as the original snap fastener proved to be unsatisfactory.
123	3915	Slide Support	This support was added to the mechanism to stabalize the slide and cam assembly during the change cycle.
124	2932	4-40 Hex Hd. Screw	This screw is used to secure the #3915 slide support in position.
125	3901	Reject Spring	This spring replaces the 1721 reject spring and tends to give better return action on the reject rod assembly.
126	4013	Shut Off Lever Assembly	This replaces the 2591 shut off lever assembly which consisted of two separate items and will also serve to simplify and improve upon the last record shut off.
127	2579	Shut Off Lever Spring	This replaces the 2585 shut off lever spring inasmuch as the 2585 spring did not have the proper tension for the new shut off lever.
128	3916	Tinnerman Nut	This Tinnerman nut replaces the 2932 self tapping screw on some models due to a change in the die cast subframe.
129	2585	Escape Lever Spring	This spring was necessary to help actuate item 130A which is an escape lever located on the main slide and cam assembly.
130	4014	Slide and Cam Assembly	This replaces the 2288 slide and cam assembly inasmuch as the earlier assembly did not carry the escape lever and spring for the shut off mechanism.
131	4016	Shut off Spring	This spring replaces the 2978 shut off spring inasmuch as the 2978 spring did not have the proper tension when used with the new shut off mechanism.

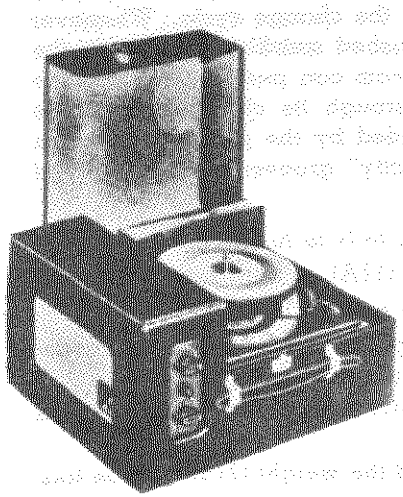
Most of the changes which have taken place on the Model 950 Tri-O-Matic record changer were so done to improve upon the product and from time to time we will incorporate more changes either to simplify or improve upon the mechanism.

PARTS LIST V-M 950

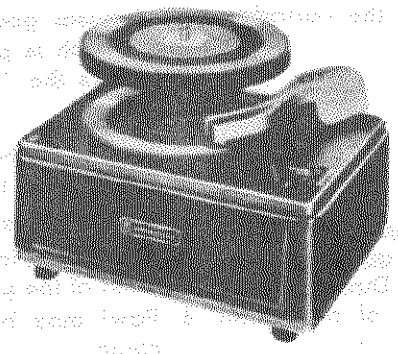
REF. NO.	PART NO.	DESCRIPTION	REPLACES
115	3602	Hinge Button Bearing	2310 Pivot Screw
116	3887	Jam Nut	1975 Palnut
117	3888	Lock Washer	2937 Flat Washer
118	4088	Brace for Base Plate	Addition to Mech.
119	2546	Record Support Holddown Spring	Addition to Mech.
120	2110	"C" Washer for Record Support	Addition to Mech.
121	4172	Spring for Trip Lever Assembly	2516 Spring Washer
122	1736	"C" Washer-Motor Mounting	Addition to Mech.
123	3915	Slide Support	Addition to Mech.
124	2932	Screw 4-40 Hex Hd.	Addition to Mech.
125	3901	Reject Spring	1721 Reject Spring
126	4013	Shut-Off Lever Assembly	2591 Shut Off Lever Assembly
127	2579	Shut Off Lever Spring	2585 Shut Off Lever Spring
128	3916	Tinnerman Nut	2932 Screw
129	2585	Escape Lever Spring	Addition to Mech.
130	4014	Slide and Cam Assembly	2288 Slide and Cam Assembly
130A	4005	Escape Lever (Part of item 130)	Addition to Mech.
131	4016	Shut Off Spring	2978 Shut Off Spring



MODEL 77



MODEL 762



MODEL 755

MODEL 760

DESCRIPTION

The Webster-Chicago Model 77 basic mechanism is a two speed, automatic record changer. Simple in design and operation, it will automatically play up to eight 7" records of either 33⅓ or 45 rpm.

The 1½" center hole records are played on the Model 77 by inserting an RS-46 center hole adapter in the record. An important feature of the RS-46 adapter is its weight. The adapters are metal and the added weight is just enough to prevent the records from slipping.

Model 77 repeats the last record of a stack until the Speed Selector wheel is turned to the center or OFF position. The idler wheel is pulled away from the motor shaft when the control is at OFF, preventing flat spots on the rubber idler which would cause wow and rumble.

Model 77 features the Webster-Chicago Velocity Trip which guarantees fast record change regardless of the position of the trip grooves or the speed with which they move the pickup arm toward the center of the record. The Velocity Trip also eliminates lateral pressure against the delicate sides of the record grooves that would be present if "lead in" springs were used. This lack of lateral pressure is considered to be as important as extra-light vertical pressure or needle weight.

Model 760 is a Model 77 mechanism combined with an amplifier and speaker in a beautiful plastic case to form a complete table model automatic phonograph.

Model 755 is a Model 77 mechanism mounted on an attractive, convenient, metal base. Model 755 is usually connected to the phono input of a radio receiver. A switch is provided to conveniently play either the 10-inch and 12-inch changer in the radio-phono combination or the Model 755.

Model 762 is a Model 77 mounted in an attractive burgundy leatherette carrying case, together with an amplifier and speaker, to make a fine portable phonograph.

These service instructions apply to the changer mechanism of all models. The circuit diagrams for the phonograph models are included in the operating instructions included with each unit.

MODELS 77,
755, 760, 762

PICKUP CARTRIDGE

The pickup cartridge may be of the crystal or ceramic type. Replacement cartridges and needles are available from most radio parts distributors and should be ordered by the manufacturerers name and part number printed on the cartridge. If a substitute cartridge is used, it may be necessary to use a different needle pressure adjusting weight to maintain the correct needle pressure of approximately 5 grams. When ordering the removable weight, specify the cartridge to be used.

A. C. CONNECTIONS

Connect the motor cord to a source of 105-115 volt 60 cycle current only. Do not under any circumstances connect the motor to a Direct Current plug (DC) or alternating current of any other frequency.

To Play Records — See Operating Instructions supplied with the changer or phonograph.

SERVICE NOTES

All units are accurately adjusted, lubricated and tested at the factory. However, service repairs and adjustments sometimes become necessary. This bulletin should be studied carefully before making any adjustments or replacing parts.

Service parts are available from your Webster-Chicago distributor. All parts must be ordered by piece part number and also record changer model and production number, stamped on the under side of the main plate.

The functions and most probable misadjustments of the main assemblies are as follows (reference numbers refer to the photographs on page 7).

THE AUTOMATIC TRIP FAILS TO FUNCTION

Model 77 uses a Velocity trip mechanism in order to reduce "non play" time to a minimum, in other words to secure a fast change cycle.

As indicated in Fig. 1 when the pickup arm (4) moves toward the center of the record the weight (7) and the felt washer (7B) cause the Velocity trip arm (7A) to move with it. The arm in turn pushes the tail end (11A) of pawl (11). Each time the hub "H" of the turntable rotates, the cam shaped lug "S" pushes the pawl (11) to the "restore" position. This prevents the pawl engaging the lug "L" to start the change cycle. Whenever the pawl (11) is pushed quickly, it engages the lug "L" before the cam can push it back and the mechanism goes through its change cycle. The quick push is provided by the pickup arm when it follows the "velocity" grooves in the center of the record.

If the automatic trip fails to function, check for:

1. Bent "pawl tail" (11A) or bent arm (7A).
2. No trip groove on records.
3. Arm (7A) binding and not following the movement of the pickup arm.
4. Pawl may be dirty and sticky. Remove and clean.
5. The Arm (7A) and the weight (7) should be free

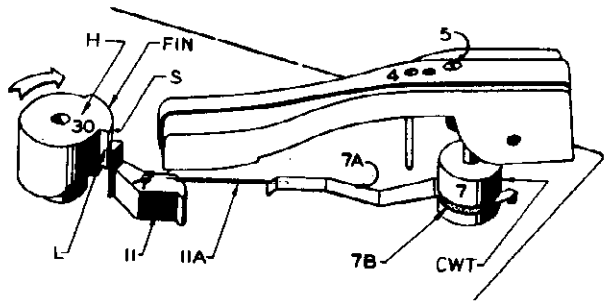


Fig. 1

to move back slightly each time the cam "S" resets the pawl (11), as explained in the discussion of the Velocity Trip above. Clean the felt and arm with Carbon Tetrachloride or similar cleaning agent.

PICKUP ARM LIFT TOO HIGH OR TOO LOW

The vertical movement of the pickup arm is controlled by the motion of the lever (10) Fig. 2 as the cam follower pin "P" follows the up and down contour of the cam in the bottom of the turntable. Adjustment of the vertical lift of the pickup arm can be made by means of the pickup arm post (6A) Fig. 2.

NEEDLE SET DOWN POINT INCORRECT

The pickup arm should set the needle down just inside the "lead in groove" of the record.

The horizontal movement of the pickup arm, like its vertical movement, is controlled by the motion

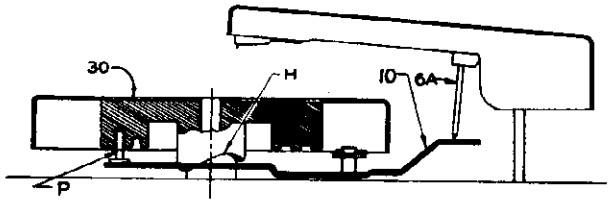


Fig. 2

of the lever (10) Fig. 2. As the cam follower pin "P" follows the eccentric grooves on the under side of the turntable, the pickup arm post (6A) is moved forward and back to permit the next record of the stack to drop.

Any final adjustment of the movement of the arm is made by means of the eccentric screw driver slot "E" Fig. 3.

1. Loosen the pickup arm mounting screw (5) slightly. This screw is the anchor post for the eccentric adjustment lever.
2. Insert a screw driver in the slot "E" and move the arm in or out, slightly, as required.
3. Tighten the mounting screw (5), being careful to not change the set down adjustment setting.

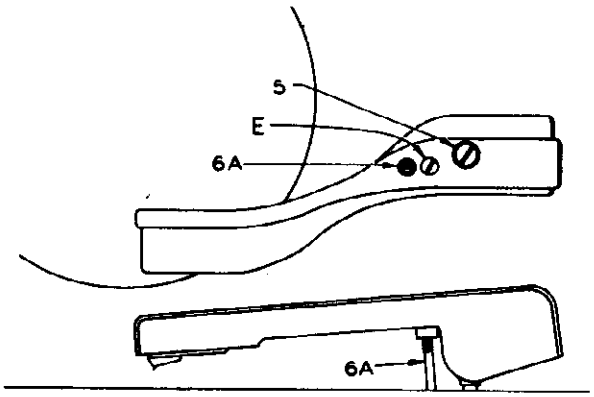
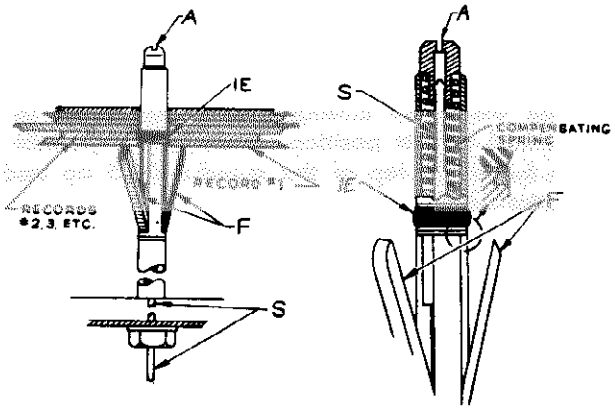


Fig. 3

MORE THAN ONE RECORD IS DROPPED DURING A CHANGE CYCLE

The three fingers of the center post support the unplayed stack of records and drops them one at a time, onto the turntable.

In operation the sequence of functions consists of the following. Referring to Fig. 4, the actuating wire "S" is pulled downward part way at the start of the change cycle. This expands the rubber



Figs. 4 and 5

collar (1E) which suspends the second and remaining records, while the bottom record No. 1, lowers slightly to provide air separation between Nos. 1 and 2 records, breaking the partial vacuum between the two records. The 3 fingers "F" meanwhile have closed slightly, although remaining in the expanded position. As the change cycle proceeds to the point where the tone arm is swung to one side ready for the dropping of the next record, a further downward pull on wire "S" retracts the fingers "F", permitting the record to drop, as shown in Fig. 6.

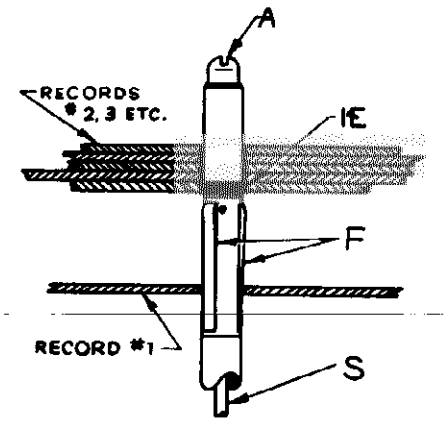


Fig. 6

If the expansion rubber does not hold the stack of records up, adjust the bulge by means of the screwdriver adjustment "A". To do this:

MODELS 77,
755, 760, 762

1. Do not turn the power on.
2. Trip the reject button and turn the turntable clockwise by hand until the three fingers are fully closed.
3. With a screwdriver turn the adjusting screw "A" until the rubber expansion ring (1E) expands sufficiently to support a stack of records.
4. Turn the turntable on through the change cycle and see if the expansion rubber is entirely free when the change mechanism is in the neutral or rest position. It should be possible to move the top of the spindle shaft up and down slightly.
5. Put a stack of records on the spindle and make certain that the expansion rubber is correctly adjusted.

Important Note: Any grease or oil on the expansion rubber will make it slick and the records will not be held up. Remove any grease or oil with Carbon Tetrachloride.

WILL NOT DROP RECORDS

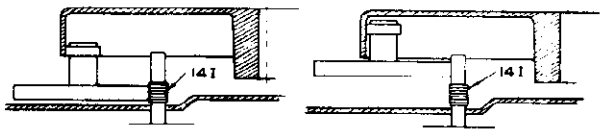
Check for:

1. Foreign matter, dust, etc. inside the spindle to prevent the fingers from closing fully and at the same time.
2. Bent or broken spindle finger.
3. Insufficient pull on wire "S" inside spindle. To adjust, be certain the set screw holding the nut (27), Fig. 14, is tight. Loosen the set screw in nut (28). Trip the mechanism and turn the turntable until the fingers close as much as possible. Back off nut (28) until the fingers are loose, then retighten until the fingers are just closed into the shaft. Notice the position of any one of the flat sides of nut (28) and tighten the nut 3 or more "flats". Tighten the set screw.

   If the mechanism stalls in cycle and all other adjustments are correct, loosen the set screw and back off the nut one or two "flats"

STALLS IN CYCLE

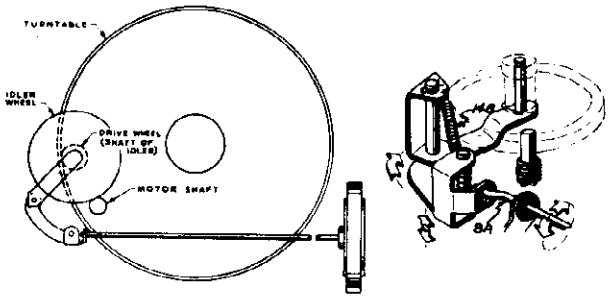
1. Tap the motor to seat the self aligning bearings more perfectly.
2. On early models the sleeve (14I) was placed at the top of the motor shaft, not as Figs. 7 and 8. If the bushing is at the top of the shaft, force it on down to the position indicated. The speed selector wheel will then be calibrated wrong so it would be well to replace it.



Figs. 7 and 8

TURNTABLE TURNS AT 45 R.P.M. AT EITHER SPEED SETTING

The power from the motor is transmitted to the turntable by means of a compound diameter idler as illustrated in Fig. 9. The turntable speed is changed by shifting the idler up or down to contact the motor shaft or the shaft sleeve as shown in Fig. 10.



Figs. 9 and 10

If the motor shaft sleeve (14I) is too high on the shaft, the idler will contact it in either speed control position. Gently force the sleeve down on the shaft until the idler just clears it when in the 45 rpm position.

TO REMOVE TOP COVER FROM MODEL 760

Fig. 12 shows a Model 77 basic mechanism with the top cover removed for easy access to the mechanism. Fig. 12 also shows how the mechanism will look after the Model 760 has been removed from its cabinet. The top cover or the cabinet must be removed in order to make some of the adjustments or repairs mentioned in the Service Notes. To do this:

1. Remove pickup arm mounting screw (5), remove the pickup cord terminal clips from the pickup cartridge, remove the anchor spring (through which the leads are threaded) from the pickup arm, note the routing of the pickup leads as you pull them out of the arm through the hinges.

2. Use a #6 Bristol wrench to loosen the pickup arm mounting assembly screws (6F) and remove the mounting assembly (6). Lift off the Reject button (19) and felt washer.
3. Remove the 6 mounting screws "A" indicated in Fig. 12. (Caution: Remove only these screws — No others at this point.)

   Lift the cabinet off the mechanism and amplifier.

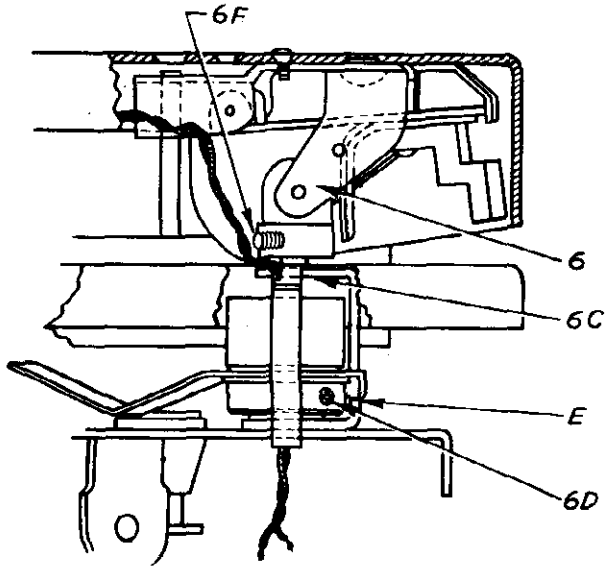


Fig. 11

TO REMOVE THE AMPLIFIER

1. Remove the dial knobs by pulling them straight out, remove the mounting nuts holding the volume and tone controls in place, remove the 4 mounting screws "B" Fig. 12. Save the heavy cardboard spacers.

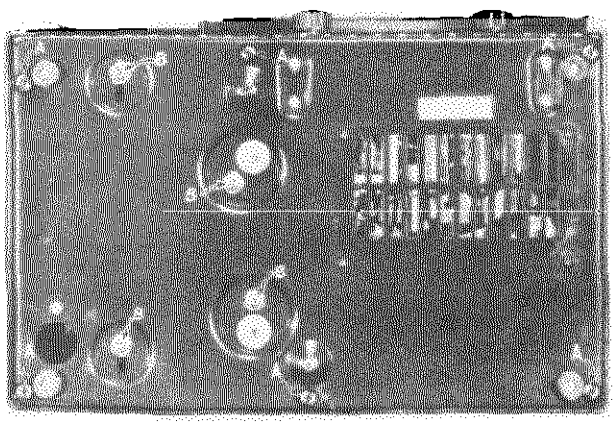


Fig. 12

2. Unplug the leads connecting the amplifier and changer mechanism. Lift the amplifier out of the chassis.

To reassemble Amplifier to Phonograph, put together in reverse order to the above disassembly instructions. Be certain to place the heavy cardboard spacer in position.

TO REASSEMBLE TOP COVER TO MECHANISM AND PICKUP ARM TO MECHANISM

It is imperative that the following steps be followed in the order listed. Failure to do so may result in difficulty in making the necessary final adjustments for needle set down point positioning.

1. Place the cabinet over the mechanism, etc. and fasten in place with the 6 mounting screws. (Fig. 12.)
2. Trip the mechanism and turn the turntable by hand until the pickup arm raising lever (10) is at the extreme limit of its outward movement (the fingers of the spindle will be fully closed into the spindle at this point). Force the mounting post (6C) Fig. 11 to turn until the extended set screw (6D) is firmly against the bracket at point "E". The ear of the velocity trip arm will of course be carried with the set screw.

   Hold the mounting post in this position by means of the pickup leads while the pickup arm mounting assembly (6) is placed in position and tightened. BEFORE TIGHTENING the set screws, position the mechanism (6) carefully so the pickup arm height adjusting pin (6A) is exactly in the shallow groove on the pickup arm actuating assembly (10). Failure to adjust this properly will result in an incorrect needle set down point on the record. It may be advisable to just lightly tighten the set screw (6F) and check the needle set down adjustment. Tighten them securely if the adjustment is correct.

   Be very careful to not tighten the set screws too firmly in the wrong place, forming dents in the mounting post that will prevent a correct adjustment.
3. Attach the pickup arm (4) to the hinge and mounting assembly (6) by means of set screw (5).

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4. Make any final needle set down adjustment by means of the screw driver slot (E) as explained on page 3.

   If you should get a false needle set down point, remove the mounting screw (5) and the pickup arm, then bend the bottom ear of the bracket holding the pickup arm height adjusting pin (6A) until the point of the pin (6A) fits exactly in the groove of the actuating assembly (10). Be careful not to bend the rest of the pickup arm mounting assembly. Remount the pickup arm and recheck the adjustment of the screw driver adjustment "E".

TO REMOVE TOP COVER FROM MODELS 77, 755 AND 762

1. Remove the mechanism from the cabinet or base pan.
2. Remove pickup arm mounting screw (5), remove the pickup cord terminal clips from the pickup cartridge, remove the anchor spring (through which the leads are threaded) from the pickup arm, note the routing of the pickup leads as you pull them out of the arm through the hinge.
3. Use a #6 Bristol wrench to loosen the pickup arm mounting assembly screws (6F) and remove the mounting assembly (6) from the mounting post (6C). Lift off the Reject button (19) and felt washer.
4. Remove the 3 nuts from the mounting studs and lift the top cover from the mechanism.

TO REASSEMBLE THE TOP COVER TO THE MODELS 77, 755 AND 762

1. Place the top cover in position and replace the lockwashers and nuts on the 3 mounting studs.
2. Follow steps 2, 3 and 4 for reassembly of Model 760 cover.

MODEL No. 77—REPLACEMENT PARTS LIST

Figure Number	*Part Number*	*Description*
1	11X529	Spindle Cap and Wire Assembly
2	11X528	Main Spindle Assembly
3	25P432	Fibre Washer
4	42P209	Tone Arm
5	26P912	Tone Arm Mounting Screw
6	21X304	Tone Arm Mounting Assembly
6A	41P713	Height Adjusting Pin
7	11X496	Automatic Trip Assembly — Complete
7A	45P871	Trip Lever
7B	25P420	Felt Washer
8	11X501	Speed Control Knob, Lever Bracket Assembly
9	45P838	Switch Slide
10	11X498	Tone Arm Actuating Lever Assembly
10A	46P206	Spring for 11X498
10B	25P439	Retainer for 11X498
11	11X499	Pawl and Wire Assembly
11A	50P225	Retainer Pin
12	46P145	Tension Spring for Actuating Lever
13	24P043	Rubber Sleeve Bumper
14	15X103	Motor
14A	11X507	Idler Wheel
14B	25P429	Washer — Fibre
14C	50P034	Retaining Clip
14D	50P125	Retaining Clip
14E	46P130	Tension Spring
14F	46P212	Tension Spring
14G	24P043	Rubber Sleeve Bumper
14H	25P074	Rubber Grommet
14I	46P188	Speed Bushing
15	26P046	Nut — Motor Mount
16	25P211	Lock Washer — Motor Mount
17	25P367	Washer — Motor Mount
18	25P363	Shock Mount — Motor
19	49P132	Reject Control
20	11X493	Manual Trip Lever Assembly
21	46P223	Tension Spring — Trip Lever
22	46P196	Tension Spring
23	46P209	Tension Spring
24	11X495	Spindle Actuating Assembly
25	27P212	Retaining Pin for 11X495
26	45P891	Pull Down Spring
27	41P688	Hold Down Anchor
28	41P687	Lock Nut
29	32P044	A.C. Switch
30	11X489	Turntable
31	49P130	Tone Arm Res

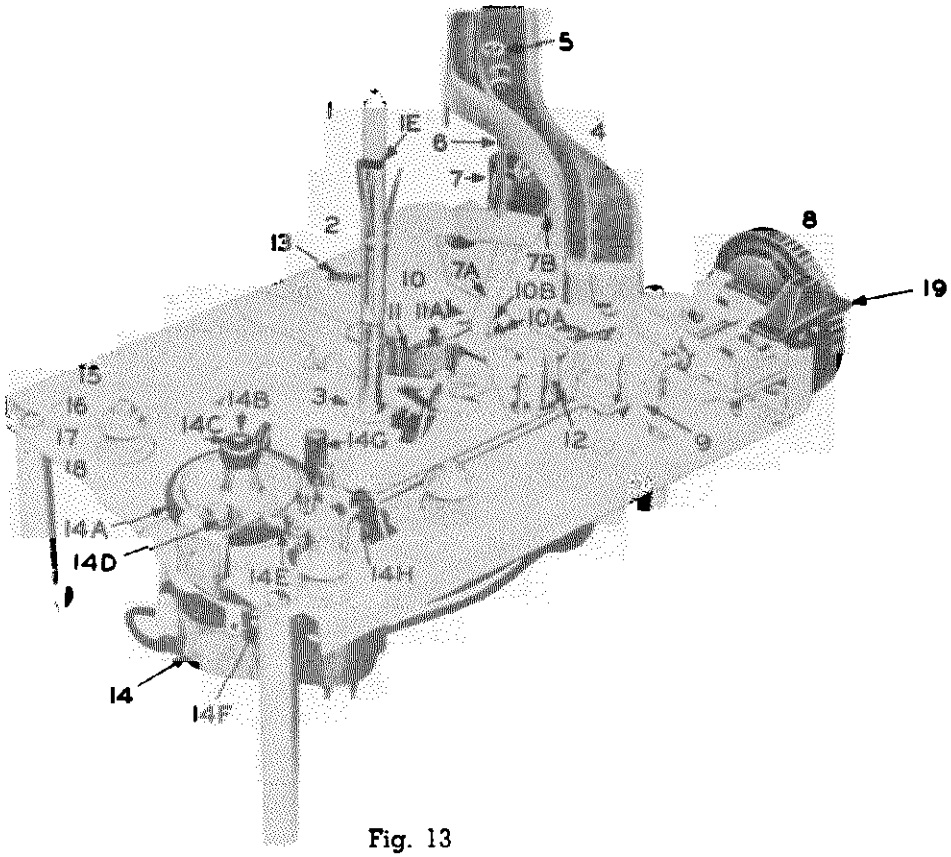

5
1E
6
4
7
8
2
13
10
7A
7B
19
11
11A
10B
10A
15
16
14B
3
14C
17
14C
12
9
18
14A
14D
14E
14H
14
14F

Fig. 13

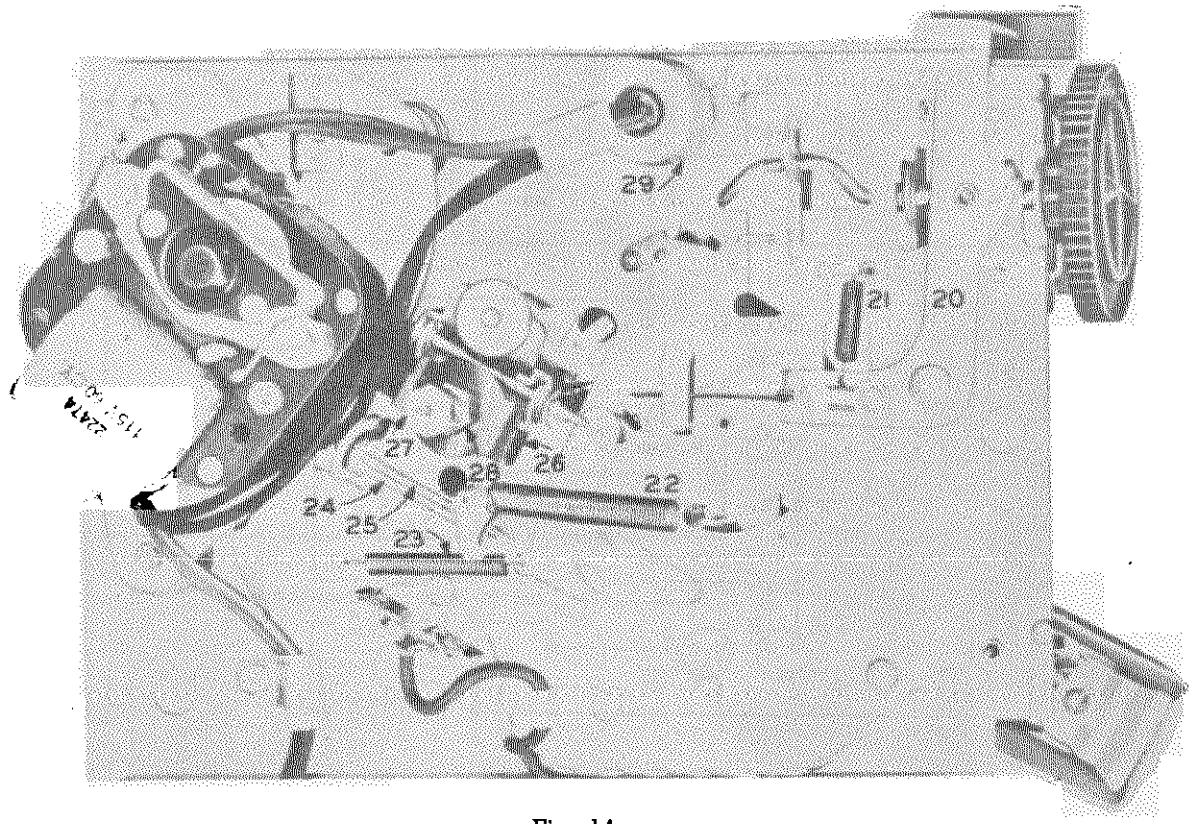
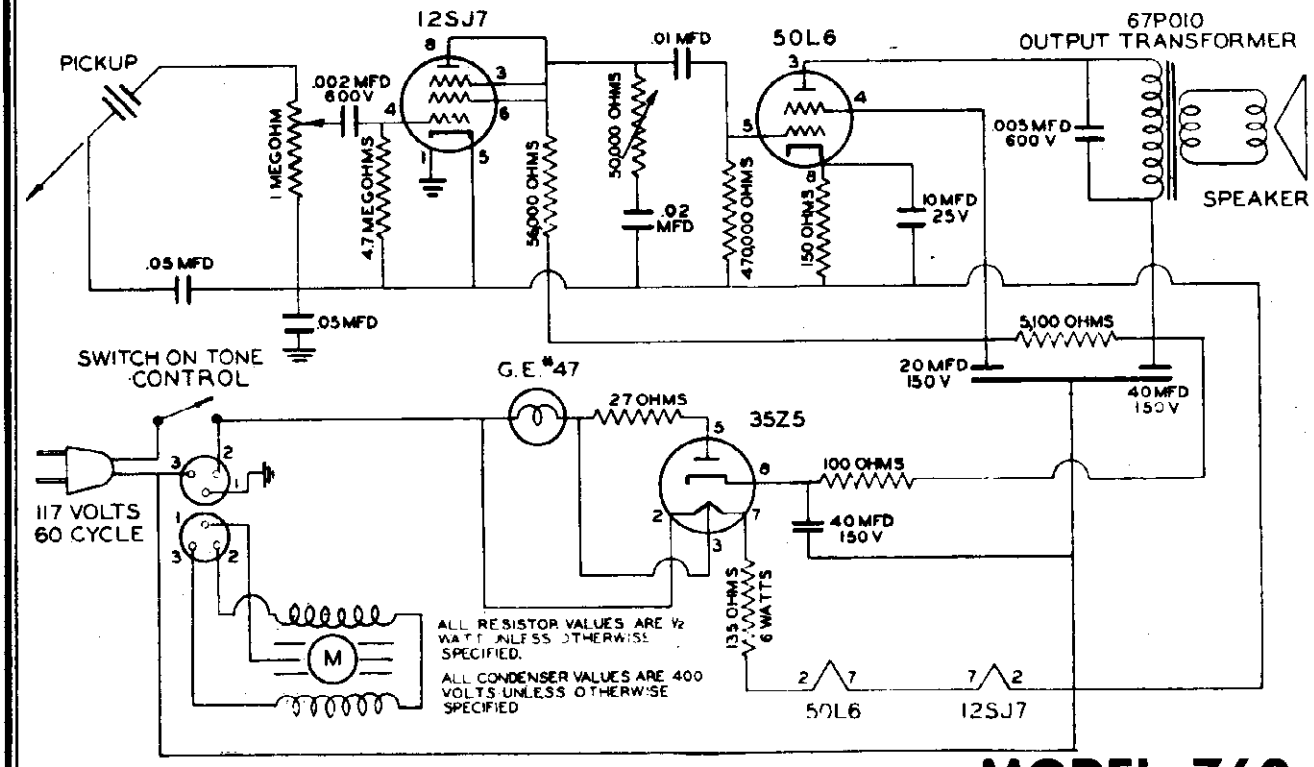

29
21
20
27
28
26
22
24
25
23

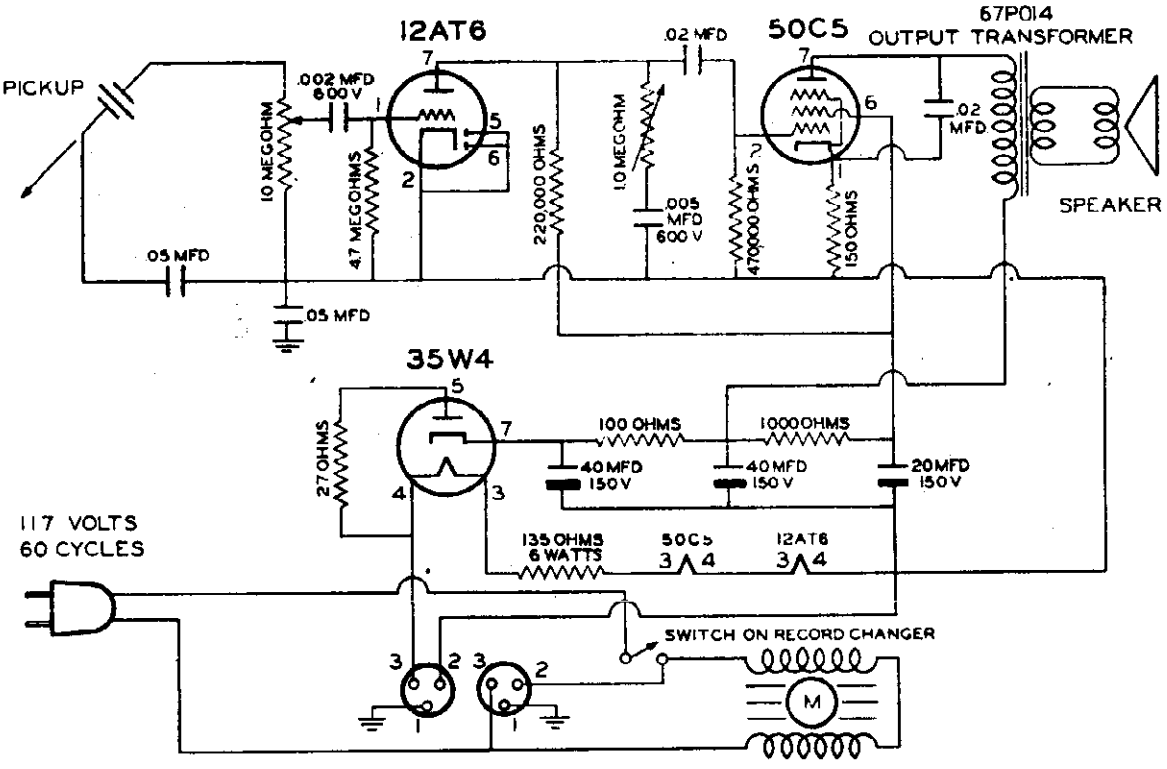
Fig. 14

MODELS 760, 762

MODEL 762



MODEL 760



ALL RESISTOR VALUES ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED.
ALL CONDENSER VALUES ARE 400 VOLTS UNLESS OTHERWISE SPECIFIED

GENERAL

The Record Changer will automatically play up to twelve 10 inch or ten 12 inch records at one loading. The Record Stack rests on the Spindle and the Record Shelf. The Selector Sprocket drives the Ejector Plate which pushes the records off the Shelf and Spindle allowing them to drop on the Turntable. To load for automatic operation, set the Record Size Selector Knob to 10 or 12, raise the Pressure Bar, place the stack of records on the Spindle, lower the Pressure Bar until it rests on the Record Stack. Set the AUTO-MAN-OFF switch to AUTO and press the Record Change Button. The Changer will play the entire selection of records and will repeat the last record until it is turned off. For manual operation set the AUTO-MAN-OFF switch to MAN and play the records singly as on a non-automatic record player.

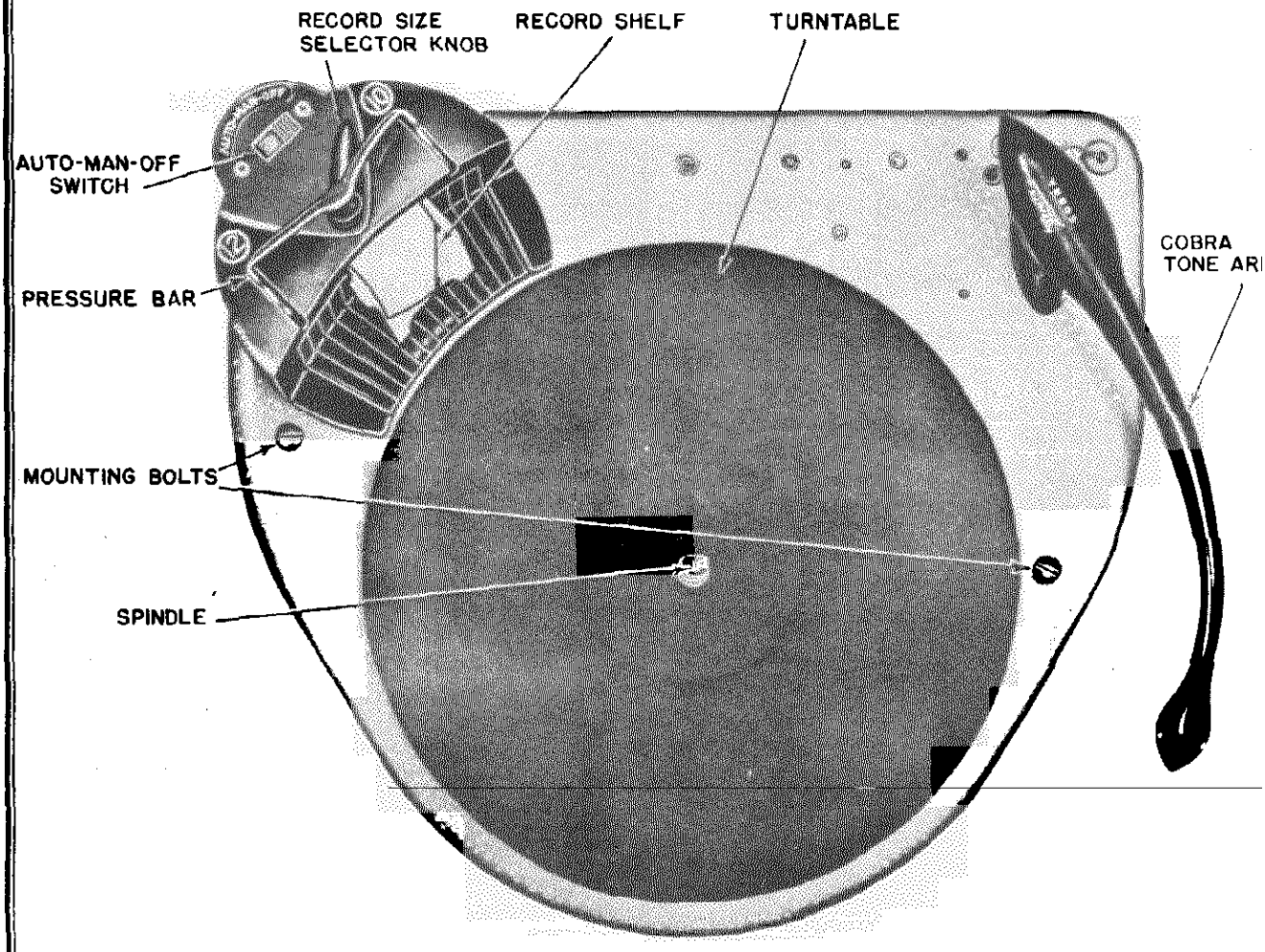


Fig. 1. Top View of Record Changer.

MODEL S-14001

DESCRIPTION OF CYCLING

The phono motor friction drives the idler wheel. The idler wheel rim drives the turntable, and the turntable shaft. To the turntable shaft is attached the segmented clutch drive plate. The pawl on the clutch drive sprocket assembly engages the drive plate causing the sprocket to rotate. The pawl pusher lever on the clutch release arm assembly causes the clutch to engage or disengage.

Closing either the trip switch or the record change switch energizes the solenoid. The magnetic flux of the solenoid attracts the clutch release lever causing the mechanism to trip and move the pawl pusher arm away from the clutch pawl. This action allows the clutch pawl spring to pull the pawl into position for the drive plate segment to engage and start the clutch sprocket rotating. The clutch sprocket is meshed with the chain drive sprocket and the chain drives the selector and timing sprockets.

The timing sprocket completes 7 functions through 360° rotation. These functions are as follows: 1. Applies the tone arm brake. The brake lever is actuated by the brake stud on the timing sprocket. The brake prevents coasting and erratic landing of the needle. 2. The inclined groove pushes the lift pin upward. The lift pin raises and lowers the tone arm. 3. The locating pin laterally swings the tone arm off the record stack. 4. The locating pin or bushing swings the tone arm over the starting groove of the record. With 12" records, the locating pin swings the tone arm in while the locating bushing swings the tone arm with 10" records. The locating bushing is pushed upward by the record selector lever. 5. The reset stud resets the clutch trip mechanism. Moves the pawl pusher arm in the path of the clutch pawl. 6. The lift pin lowers the tone arm over the starting groove of the record. 7. The brake stud releases the brake. When the clutch pawl hits the pawl pusher arm, the clutch selector disengages.

The selector sprocket actuates the record ejector plate and must be timed with the timing sprocket to drop the records on the turntable when the tone arm is at its greatest outward swing. This occurs immediately after the No. 3 function of the timing sprocket.

As the record is played, the tone arm gradually moves toward the center. The ratchet on the tone arm control lever moves toward pawl on the trip switch lever. As the ratchet comes in contact with the pawl, the oscillating action produced by the eccentric groove on the record causes the trip switch to close, complete the solenoid circuit and repeat the cycle. If the record does not have an eccentric groove, the position trip will close the trip switch and start the next cycle.

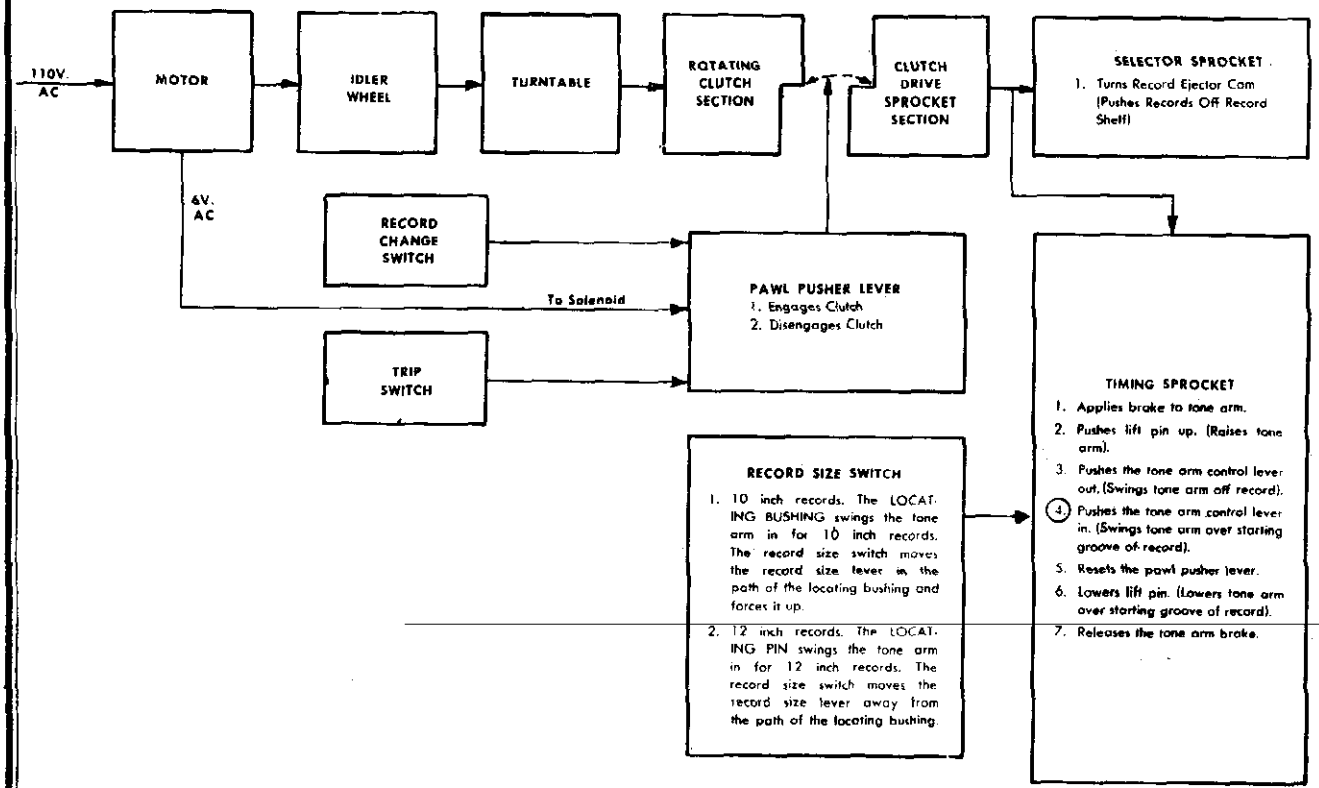
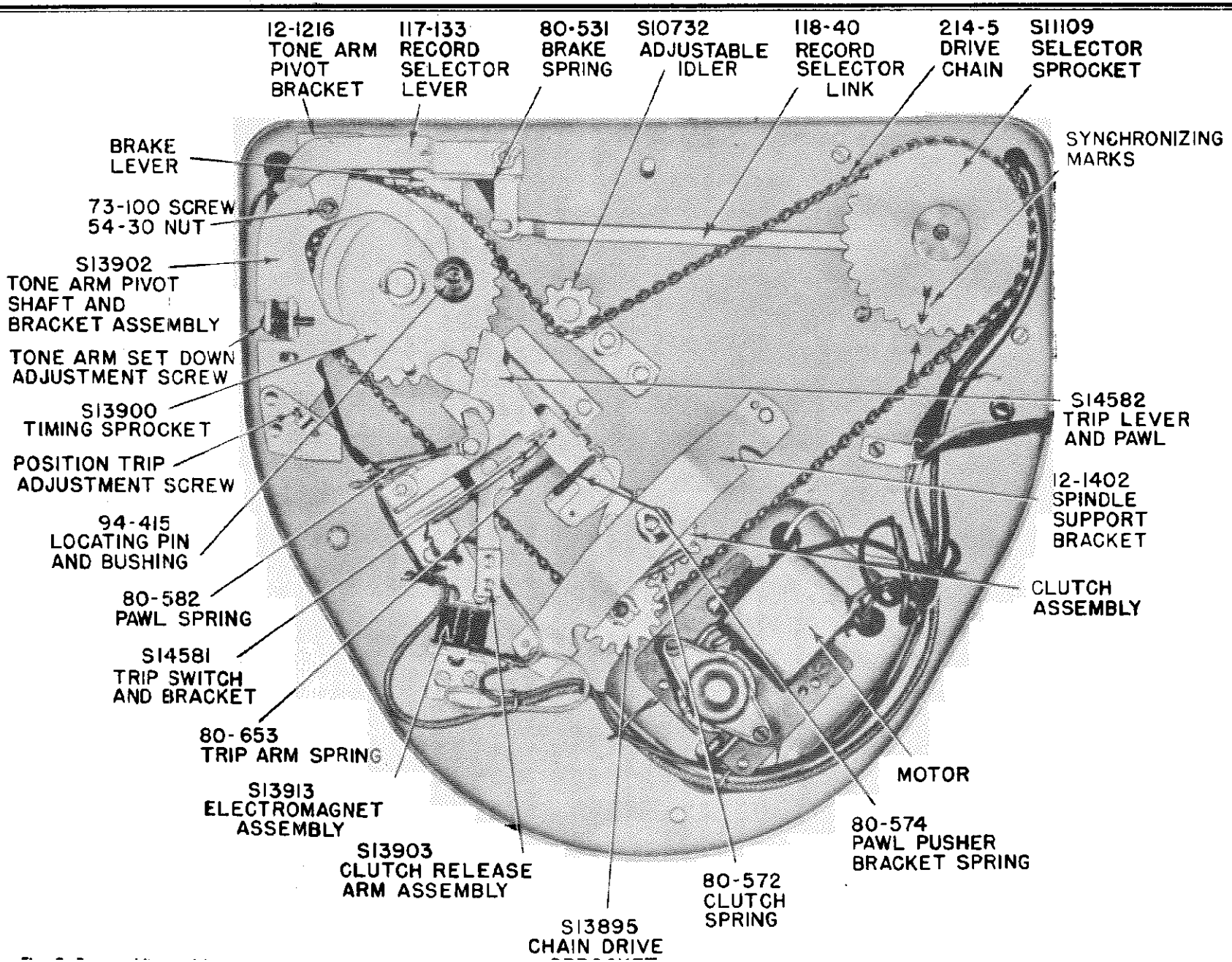


Fig. 2. Sequence of Operation—Zenith Record Changers.


12-1216
TONE ARM
PIVOT
BRACKET
117-133
RECORD
SELECTOR
LEVER
80-531
BRAKE
SPRING
S10732
ADJUSTABLE
IDLER
118-40
RECORD
SELECTOR
LINK
214-5
DRIVE
CHAIN
S11109
SELECTOR
SPROCKET
BRAKE
LEVER
SYNCHRONIZING
MARKS
73-100 SCREW
54-30 NUT
S13902
TONE ARM PIVOT
SHAFT AND
BRACKET ASSEMBLY
TONE ARM SET DOWN
ADJUSTMENT SCREW
S13900
TIMING SPROCKET
POSITION TRIP
ADJUSTMENT SCREW
94-415
LOCATING PIN
AND BUSHING
80-582
PAWL SPRING
S14581
TRIP SWITCH
AND BRACKET
80-653
TRIP ARM SPRING
S13913
ELECTROMAGNET
ASSEMBLY
S13903
CLUTCH RELEASE
ARM ASSEMBLY
S13895
CHAIN DRIVE
S14582
TRIP LEVER
AND PAWL
12-1402
SPINDLE
SUPPORT
BRACKET
CLUTCH
ASSEMBLY
MOTOR
80-574
PAWL PUSHER
BRACKET SPRING
80-572
CLUTCH
SPRING

MODEL S-14001

THEORY OF THE COBRA RADIONIC PICKUP

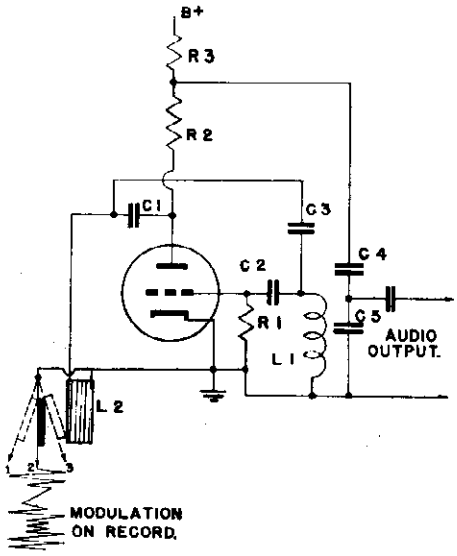


Fig. 4. Simplified Circuit of Oscillator.

The operation of the Cobra pickup is considerably different from Crystal and Dynamic pickups. These pickups generate audio power, while the Cobra controls power generated by a radio frequency oscillator. The triode tube is a modulated oscillator, detector and audio amplifier. The oscillator operates at a frequency of 2.5 Mc. Modulation is accomplished by changing the energy losses in a tuned circuit. These losses may be represented by an equivalent resistance in series with the reactance of the coil. The ratio of the resistance to the reactance determines the efficiency or Q of the coil. The amplitude of the RF voltage developed across this coil by the oscillator will vary with changes in Q.

The grid coil L_1 and other components of the oscillator are mounted in the receiver chassis, while the plate coil L_2 is in the Needle Cartridge with the vane and needle assembly. The coil is fixed and has 40 turns of No. 40 wire (approximate DC resistance 2½ ohms). The stainless steel vane, which is in the field of the coil, is spot welded to the osmium-iridium tipped stylus.

Any movement of the stylus will cause a corresponding movement of the vane. As the stylus and vane follow the modulations in the record, changes in the mutual inductance between the vane and coil occur (see Fig. 4). In position 2 the vane is at rest; and a constant RF voltage appears across the plate coil. As the vane is set in motion and reaches position 1, it is at its greatest outward swing from the coil, resulting in low mutual inductance, low reflected resistance, higher Q, and a higher RF voltage across the coil. In position 3 it is at its greatest inward swing; resulting in a high mutual inductance, high reflected resistance, lower Q and a lower RF voltage. It can be seen that the amplitude of the RF voltage which appears across the coil will vary with changes in Q, satisfying the condition for amplitude modulation. The position of the vane changes both the Q and L of the coil. Changes in L shift the frequency slightly, and a certain amount of frequency modulation is present, but since there is no frequency discrimination it remains undetected.

Since the grid and plate coils are part of a single tuned circuit, any variations of amplitude of the RF voltage brought about by the changes in Q across the plate coil will also appear across the grid Coil L_1 causing a shift in the average plate current through the plate load resistor across which the audio output voltage is developed. Plate bend detection takes place since only the positive half of the grid swing causes an increase in the average plate current. These changes in the average plate current appear as audio voltage across the plate load resistor.

The 2.5 Mc. RF voltage and the audio voltage both appear at the plate of the oscillator triode. R_2, C_4 and C_5 filter out the RF voltage allowing only the audio component to the grid of the phono amplifier where it is amplified and reproduced by the loud-speaker.

LUBRICATION

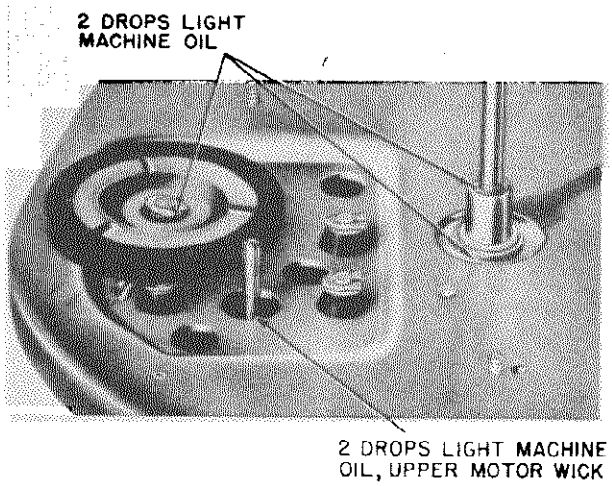


Fig. 5. Lubrication Top of Record Changer.

Sta-Put grease No. 512 (light grease of the vaseline type) and light machine oil of No. 10 consistency are used for lubrication throughout.

Figures 5 and 6 indicate the points to be lubricated and the type of lubricant to use. The Motor has two oil wicks which should be saturated with oil. The Record Spindle Guide Bearing, Idler Wheel Bearing, Lower Drive Shaft Bearing, Drive Shaft Thrust Bearing and the Motor Bearings are of the OILITE type and require very little attention. If squeaks develop, be certain that they are not caused by friction between the Spindle and records on the Turntable. A thin coat of wax on the Spindle will remedy this condition.

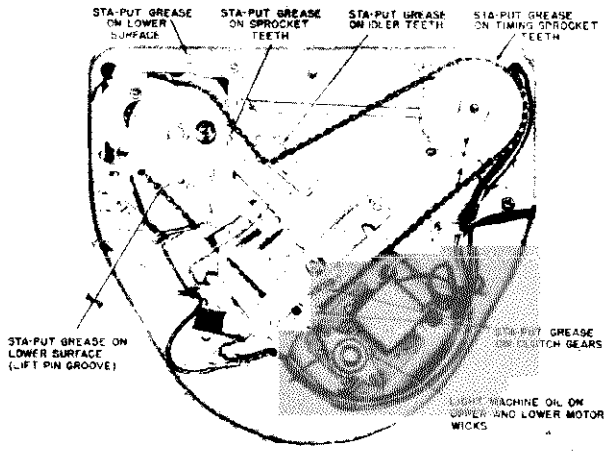


Fig. 6. Lubrication Bottom of Record Changer.

ADJUSTMENTS

1. Tone Arm Set Down Adjustment.

The Tone Arm Set Down Adjustment determines the landing position of the needle on the starting groove of the record. The adjustment screw can be reached with a screwdriver (Fig. 7). The tone arm must be held in the rest position while the adjustment is made. Clockwise rotation of the screw moves the tone arm in, while counter-clockwise rotation moves it out.

2. Position Trip Adjustment.

The Position Trip does not depend on an eccentric groove in the record to start the record change cycle, but will trip the mechanism whenever the needle comes within a pre-determined distance from the Spindle. Older type records that do not have an eccentric groove can in most cases be played automatically by the proper adjustment of the Position Trip. Under normal conditions with the needle approximately 1⅞" from the center of the Spindle, adjust the Position Trip Adjustment Screw (Fig. 7) until the trip switch contacts close. This distance is generally satisfactory since no modern record will be cut off before it has completed its play, and none will fail to trip the mechanism at the end. In special cases, screw the Position Trip Adjustment Screw clockwise for earlier tripping and counter-clockwise for later tripping as the individual case may be.

It may be impossible to find an adjustment that will always trip the mechanism and never cut off on all type records, and in these special cases the record must be played manually.

3. Trip Switch Adjustment.

As the record is played, the ratchet on the tone arm pivot shaft engages the trip pawl. The oscillating action developed by the eccentric groove on the record closes the trip switch contacts and allows the solenoid to become energized. The magnetic flux attracts the trip lever which moves the pawl pusher lever from the path of the clutch pawl. This allows the clutch to engage and start the next cycle.

The gap between the trip switch contacts should be approximately 1/16 inch. If the spacing is incorrect, bend the contact spring. To adjust the contact spring tension, insert a screwdriver between the contact and guide springs and bend the contact spring so that an approximate pressure of one ounce is necessary to move the contact spring from the guide spring. Be certain that the contact spring exerts some pressure on the guide spring after adjustment.

The spacing between the trip magnet solenoid and trip lever should be approximately 3/32". (See Fig. 7.)

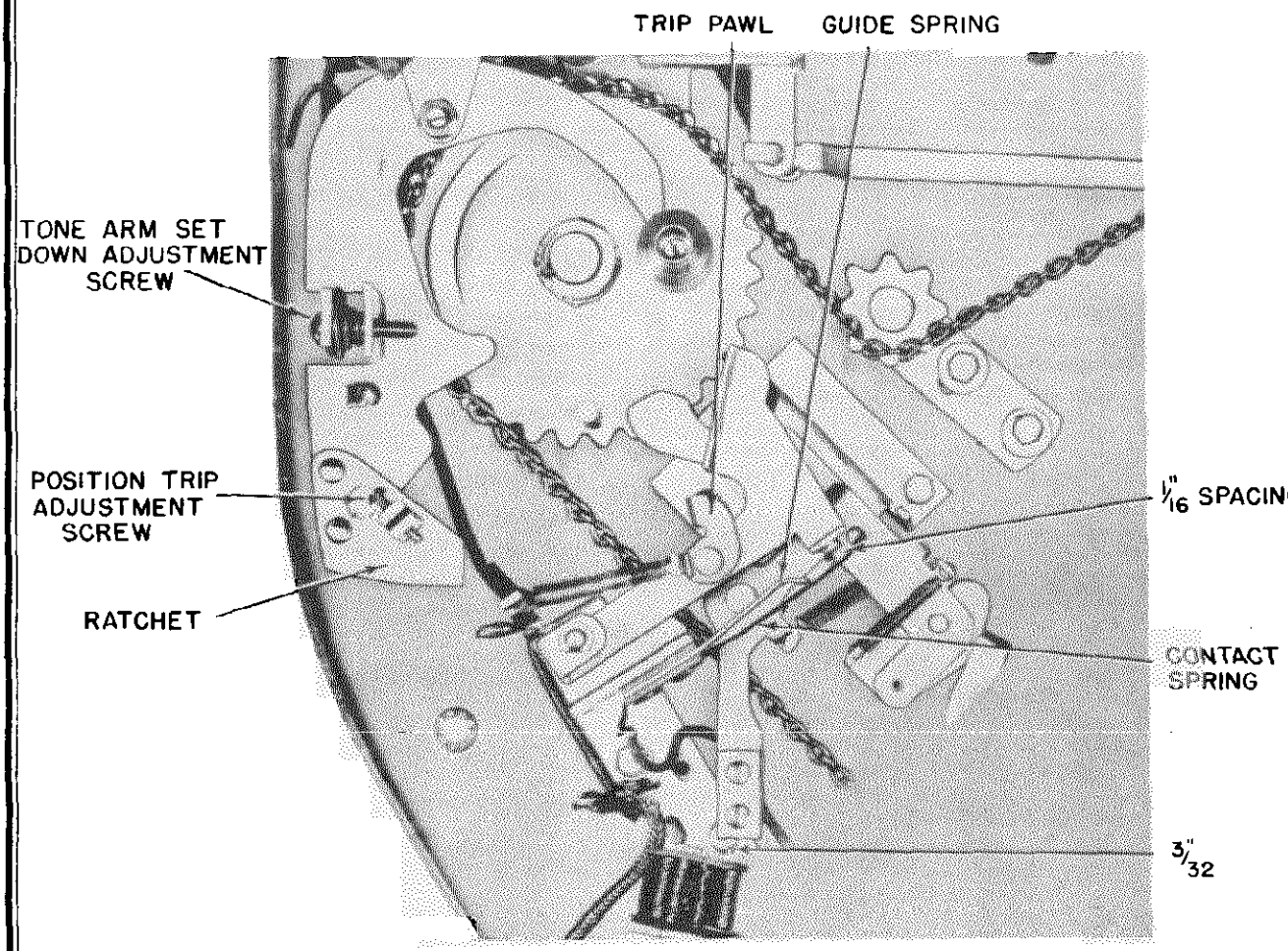


Fig. 7. Tone Arm Set Down, Position Trip and Trip Switch Adjustments.

MODEL S-14001

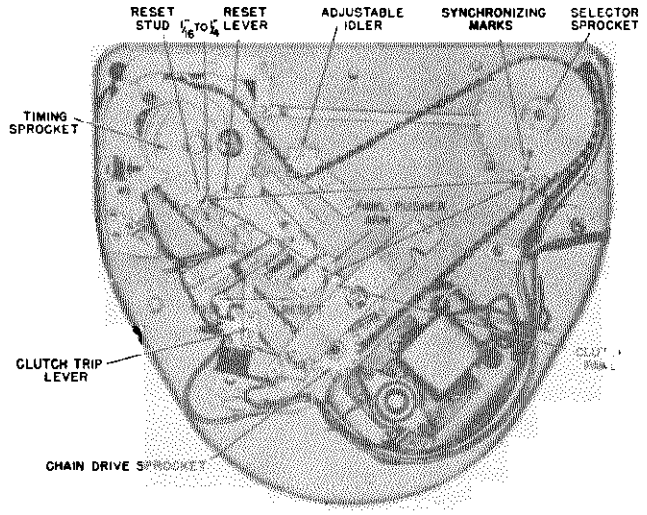


Fig. 8. Synchronization.

4. Synchronization.

A properly timed changer drops records on the turntable when the tone arm is at its greatest outward swing. Improper timing results in the records hitting the tone arm. The record changer is kept in time by the drive chain. If the chain is removed, the changer must be synchronized.

Fig. 8 indicates the correct position of the timing sprocket, selector sprocket and the clutch. To synchronize, study Fig. 8 and proceed as follows:

1. Reset the clutch trip lever.

2. Turn the timing sprocket until the reset stud is approximately 1/16" from the reset lever (1). Turn the selector sprocket until the synchronizing mark lines up with the mark on the base plate (2). THESE POSITIONS MUST BE MAINTAINED DURING THE NEXT OPERATION.

3. Thread the chain over the timing sprocket, chain drive sprocket, adjustable idler, selector sprocket and set the adjustable idler for medium tension of the chain. Check the position of the synchronizing marks and the reset stud.

4. Remove the retaining washer and lift the chain drive sprocket until the gears disengage.

5. Turn the clutch until the clutch pawl touches the pawl pusher arm (3).

6. Lower the chain drive sprocket until it engages the clutch gears and reinsert the retaining washer.

5. Tone Arm Height Adjustment.

The Tone Arm vertical rise is governed by the Lift Pin. The Lift Pin is adjustable (see Fig. 9). Too long a Lift Pin will cause the Tone Arm to hit the underside of the records on the Spindle. If the Lift Pin is short the needle will not clear twelve records on the Turntable. To make the proper adjustment, trip the Clutch by hand and rotate the Turntable clockwise until the Tone Arm starts to swing toward the Spindle. Gently push the Tone Arm as close to the Spindle as it will go, place a record over the Spindle and observe the spacing between it and the Tone Arm. The spacing "A" (Fig. 10), should be approximately the thickness of a record. If the spacing is incorrect, lift the Tone Arm, remove the Lift Pin, and adjust the Lift Pin to the proper length.

Fig. 9. Lift Pin.

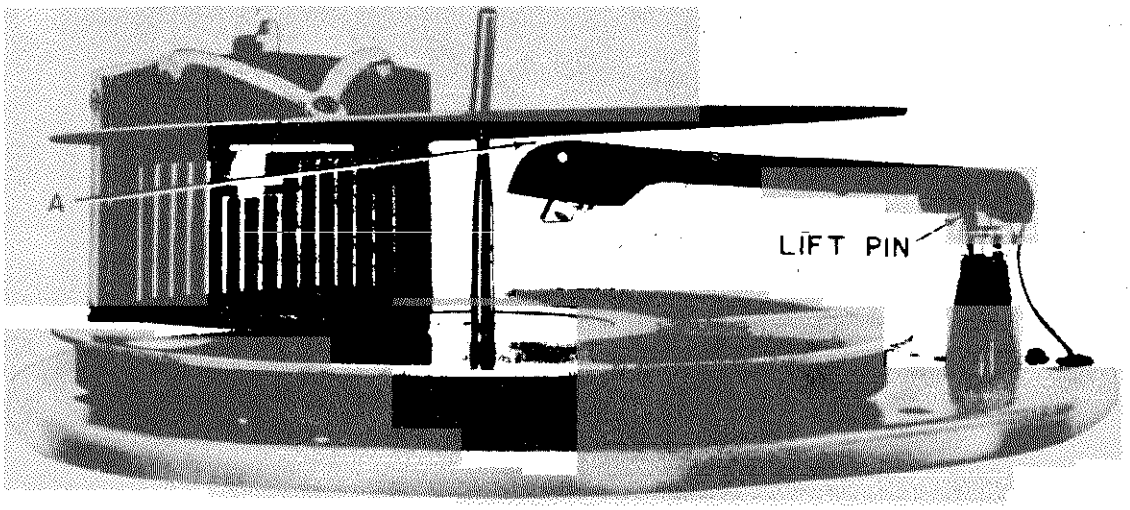


Fig. 10. Tone Arm Height Adjustment.

REMOVING THE TURNTABLE

Hold the clutch by inserting a wide blade screwdriver against the spindle bracket and a segment of the drive plate. Apply a twisting, pulling force to the turntable.

Before seating the turntable, be certain that the idler wheel is pushed inside the turntable rim.

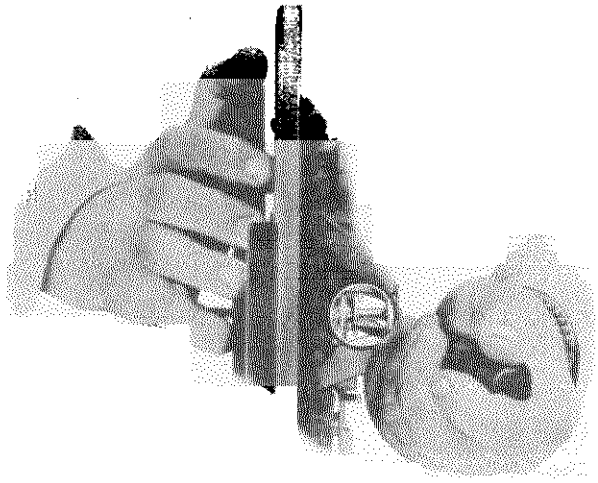


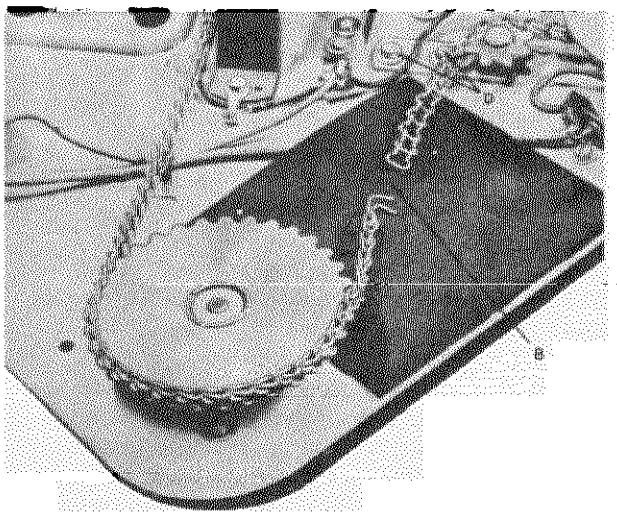
Fig. 11. Removing the Turntable.

REPLACING THE MOTOR

When a replacement Motor is ordered, be certain that the line voltage and frequency of the receiver are given.

To replace the Motor, unsolder the connecting leads, remove the Turntable, the three retaining washers and allow the Motor to drop out. When the Motor is installed do not draw the connecting leads tight as this will prevent the Motor from "floating" on its mounts. Be certain that the retaining washers are crimped and the leads securely soldered and taped.

REPLACING THE CHAIN



The chain may be removed by loosening the adjustable idler (Screws "D", Fig. 12), and opening one of the links (B) It will be noted that on some models the open ends of the links face inward while on others outward as in Fig. 12. The reason for this is to get the quietest operation. Normally the open ends of the links will face outward with all replacement chains.

After the chain is threaded in place, carefully close the open link and be certain that there is no stiffness in its action. Read the paragraph on Synchronization before the chain is permanently installed.

TROUBLE SHOOTING

SQUEAKS OR NOISES DURING PLAYING OF RECORDS

a. Friction between the records on the turntable and the spindle will occasionally cause squeaks. A thin coat of wax applied to the spindle will remedy this condition.

b. Check lubrication.

MECHANISM STARTS SLOWLY AND MOTOR GETS HOT.

a. Check line voltage and frequency.
b. Check lubrication.
c. Motor windings damaged.
d. Room temperature abnormally low.

PRESSING RECORD CHANGE BUTTON ON RECEIVER PANEL DOES NOT START RECORD CHANGE CYCLE

a. See that the AUTO-MAN-OFF switch is set to AUTO
b. Check Record Change Switch.
c. Check electrical continuity of solenoid circuit.
d. Check the solenoid energizing voltage.

MOTOR FAILS TO RUN EVEN WHEN IT IS DISCONNECTED FROM CHANGER AND PROPER VOLTAGE AND FREQUENCY APPLIED DIRECTLY TO THE TWO INPUT LEADS OF THE WINDING.

a. Open windings.

b. Damaged or frozen bearings.

c. Lower Bearing Support Bracket bent. Remove and straighten bracket—Re-center armature.

RUMBLE AND MICROPHONICS DURING REPRODUCTION.

a. Changer not "floated" properly. Remove packing strip. Loosen mounting bolts.

b. Motor retaining rings rubbing on the idler wheel.

c. Motor leads pulled too tight preventing motor from "floating" freely.

d. Noisy phono oscillator tube.

e. Impression on Idler Wheel.

NEEDLE SETS DOWN PROPERLY ON RECORD BUT SLIDES OVER THE RECORD GROOVES.

a. Cabinet tilted.

b. Badly worn or broken needle cartridge.

NEEDLE FAILS TO CLEAR MAXIMUM LOAD OF RECORDS ON THE TURNTABLE.

a. Check Tone Arm height adjustment. (Adjustment 5.)

CHANGER CYCLES WITH AUTO-MAN-OFF SWITCH ON MAN.

a. Check AUTO-MAN-OFF switch.

MODEL S-14001

TONE ARM FALLS OFF RECORD.

a. Check Tone Arm set down adjustment. (Adjustment 1.)
b. Check Tone Arm Pivot Bracket.
c. Changer not level.

TONE ARM SET-DOWN POSITION VARIES.

a. Check Tone Arm Brake and Spring.
b. Loose Tone Arm mounting screw.

RECORD IS NOT HEARD ALTHOUGH CHANGER OPERATES.

a. See that the Phono Radio switch is on Phono.
b. Check receiver audio by listening to radio.
c. Check the phono oscillator tube.
d. Check Needle Cartridge.
e. Check Tone Arm Housing for broken leads.

TONE ARM SETS DOWN TOO FAR IN OR OUT ON RECORD.

a. Check Tone Arm set down adjustment. (Adjustment 1.)

CHANGER CONTINUES TO CYCLE.

a. Check the trip switch adjustment. (Adjustment 3.)
b. Check Record Change switch.
c. Clutch release mechanism sticks.

CHANGER WILL NOT CYCLE UPON COMPLETION OF RECORD.

a. See that the AUTO-MAN-OFF switch is set to AUTO.
b. Be certain that the record has an eccentric center groove.
c. Check the Trip Switch.
d. Check the solenoid energizing voltage.

SQUEAKS WHEN CHANGER IS IN CYCLE.

a. Friction between Lift Pin and Timing Sprocket. Apply a thin coat of Sta-Put.

MOTOR RUNS BUT TURNTABLE SLIPS OR STOPS.

a. Turntable not fully seated. Tap gently.

NUMERICAL PARTS LIST

S-10732	Idler Assembly
S-11105	Record Ejector Plate and Pin Assembly
S-11106	Record Support Plate—Shaft and Pin Assembly
S-11107	Record Support and Ejector Bracket Assembly
S-11109	Selector Sprocket and Bushing Assembly
S-11111	Turntable Shaft and Bearing Assembly
S-11118	Idler Wheel Assembly
S-11441	Record Change Lever and Stud Assembly
S-11473	Cobra Needle Cartridge
S-11657	Idler Stud and Washer Assembly
S-12633	Needle Cartridge Socket and Cable Assembly
S-13060	Cobra Tone Arm Hinge Plate and Swivel Bracket Assembly
S-13062	Cobra Tone Arm Hinge Plate, Swivel Bracket, Needle Cartridge Socket and Cable Assembly
S-13466	Cobra Tone Arm Assembly
S-13894	Clutch Pawl Assembly
S-13895	Drive Sprocket and Bushing Assembly
S-13896	Turntable Drive Shaft Bearing Assembly
S-13900	Timing Sprocket Assembly
S-13901	Trip Switch Assembly
S-13902	Tone Arm Pivot Shaft and Bracket Assembly
S-13903	Clutch Release Arm Assembly
S-13913	Magnet Coil Assembly
S-13931	Turntable Assembly
S-13933	Main Base Plate Assembly
S-14140	Record Spindle Assembly
S-14172	Cable Assembly
S-14581	Trip Lever Mounting Bracket Assembly
S-14582	Trip Lever and Pawl Assembly
12-1216	Tone Arm Pivot Bracket
12-1390	Magnet Mounting Bracket
12-1402	Record Spindle Support Bracket
17-81	Cable Clamp
23-22	AC Wire Connector
24-445	Record Ejector Housing Cover
43-152	Record Ejector Housing
43-157	Tone Arm Support Housing
54-30	No. 8-32 x 5/16" Hex Nut—Steel N.P.
54-66	No. 10-32 x 5/16" x 1/8" Hex Nut—Steel N.P.
56-128	Groove Pin (Sprocket Bushing)
56-226	Tone Arm Lift Pin—Lower
56-227	Tone Arm Lift Pin—Upper
57-1323	Turntable Shaft Plate
58-158	Five Prong Plug (for S-14172)
63-1744	100 Ohm Carbon Resistor 1/2 W. Insulated
69-38	No. 8-32 x 3/4" R.H.M.S.—Steel N.P.
69-43	No. 8-32 x 3/8" R.H.M.S.—Steel N.P.
73-90	No. 8-32 x 5/16" Hex Head Slotted Set Screw—Conepoint
73-99	No. 8-32 x 1/4" Slab Head Set Screw—Steel Conepoint
73-102	No. 8-32 x 7/16" Slab Head Set Screw—Steel—Conepoint
76-409	Record Ejector Cam Shaft
80-367	Toggle Spring (S-11106)
80-368	Idler Wheel Tension Spring
80-448	Pressure Arm Spring
80-531	Brake Spring
80-538	Landing Adjustment Spring (S-13902)
80-572	Clutch Spring (S-13894)
80-574	Pawl Pusher Bracket Spring (S-13903)
80-582	Pawl Spring (S-13901)
80-584	Tone Arm Lift Pin Spring
80-605	Cobra Cartridge Socket Tension Spring
80-653	Trip Arm Spring (S-13903)
83-1349	Tone Arm Shipping Strip
83-1453	Two Lug Terminal Strip
85-371	3 Position Slide Switch
93-10	.025 x .260 x 5/8" Steel Washer—Cadmium
93-216	.015 x .255 x 7/16" Steel Washer—Cadmium
93-125	No. 6 Int. Shakeproof Lockwasher No. 1206
93-126	No. 8 Int. Shakeproof Lockwasher No. 1208
93-617	Sprocket Shaft Retaining Washer
93-673	Idler Wheel Stud Washer

93-678	Idler Wheel Stud Fishpaper Washer (Small)
93-679	Idler Wheel Stud Felt Washer (Large)
93-764	Spring Washer—Shakeproof
93-900	Fibre Washer (Motor Mtg.)
93-901	Spring Washer Shakeproof
93-903	Steel Washer—Copper Flash (Motor Mtg.)
93-905	Spring Washer—Shakeproof No. 3502-16-01
94-415	Tone Arm Locating Bushing
112-450	No. 4-40 x 1/8" Phillips Binding Hd. M.S. Steel Cad. Pl.
112-451	No. 8 x 5/16" B.H. Self Tapping Screw—Stan-Tap—Cad.
112-581	No. 6 x 3/8 R.H. Self Tapping Screw
112-619	Cobra Tone Arm Housing Mtg. Screws
112-687	Pivot Screw
112-688	No. 8 x 3/8" Flat Hd. Screw—Shakeproof Type 25—Cad. Pl.
112-689	No. 8 x 3/8" R.H. Screw—Shakeproof Type 25—Cad. Pl.
112-706	No. 4-40 x 3/16" lg. R.H.M.S. (Sems)—Steel N.P.
112-719	No. 6 x 3/8" Flat Head Screw—Self Tapping.
114-88	No. 8-32 x 1/2" Hex Acorn Hd. M.S.—Steel N.P.
114-201	No. 8-32 x 5/16" Hex Head Slotted—STAN-TAP—Thread Forming Screw—Cad. Pl.
114-248	No. 6-20 x 5/16" Hex Head Slotted—Self Tapping Screw
117-133	Record Selector Lever
118-40	Record Selector Link
125-45	Rubber Grommet
125-60	Pressure Arm Grommet
125-61	Rubber Grommet
128-20	Record Ejector Cam
128-40	Record Selector Cam
141-108	A.C. Motor—60 Cycles
148-83	Cobra Tone Arm Housing
148-87	Record Pressure Arm
166-41	Rubber Bumper
188-27	Record Spindle Retaining Washer
188-32	Retaining Ring
188-52	Retaining Ring
214-5	Sprocket Drive Chain

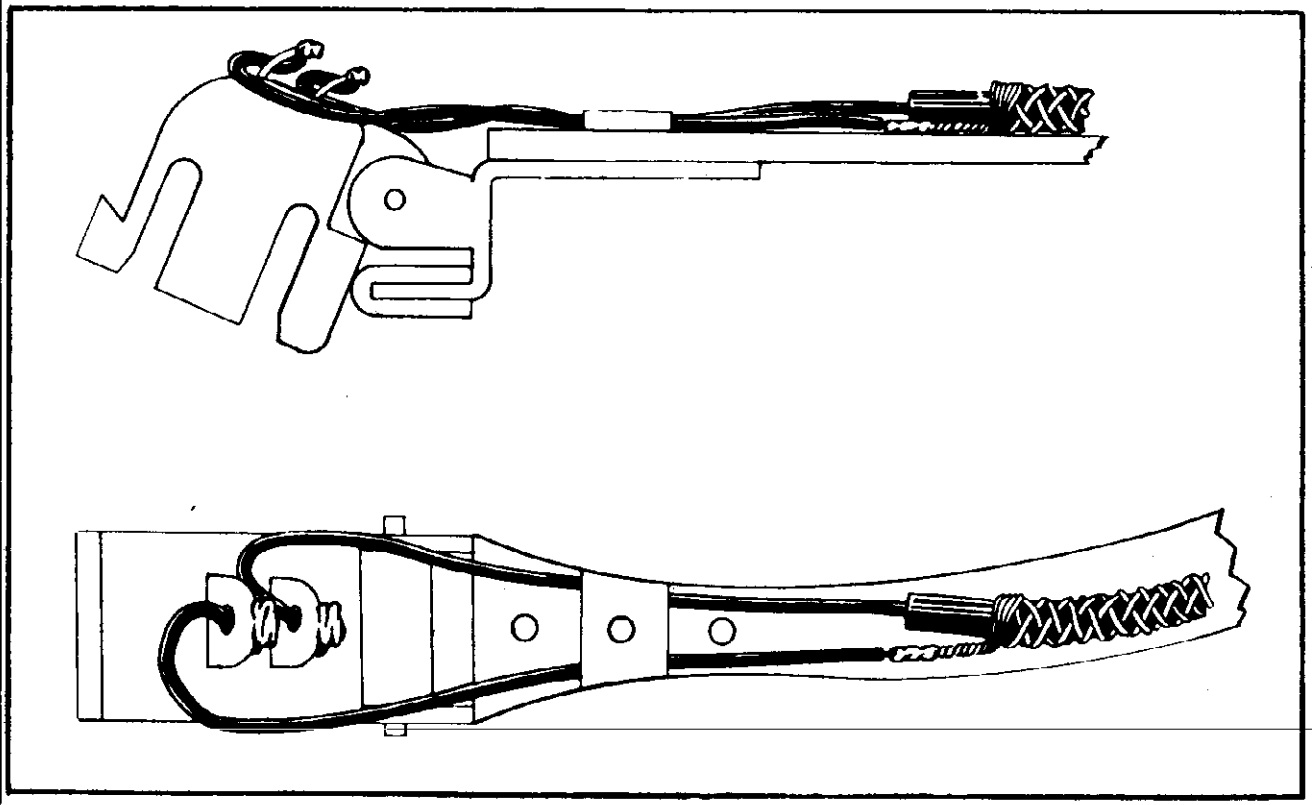


Fig. 13. Needle Cartridge Socket Connections.

Fig. 13 shows how the leads are connected to the Needle Cartridge Socket. The lead and insulation are run through the hole in the contact and the lead is soldered with a light soldering iron. Great care must be exercised, and very little heat applied as the socket is made of lucite and will burn easily. The complete lead, socket and bracket are supplied as S13062.

MODEL S-14001

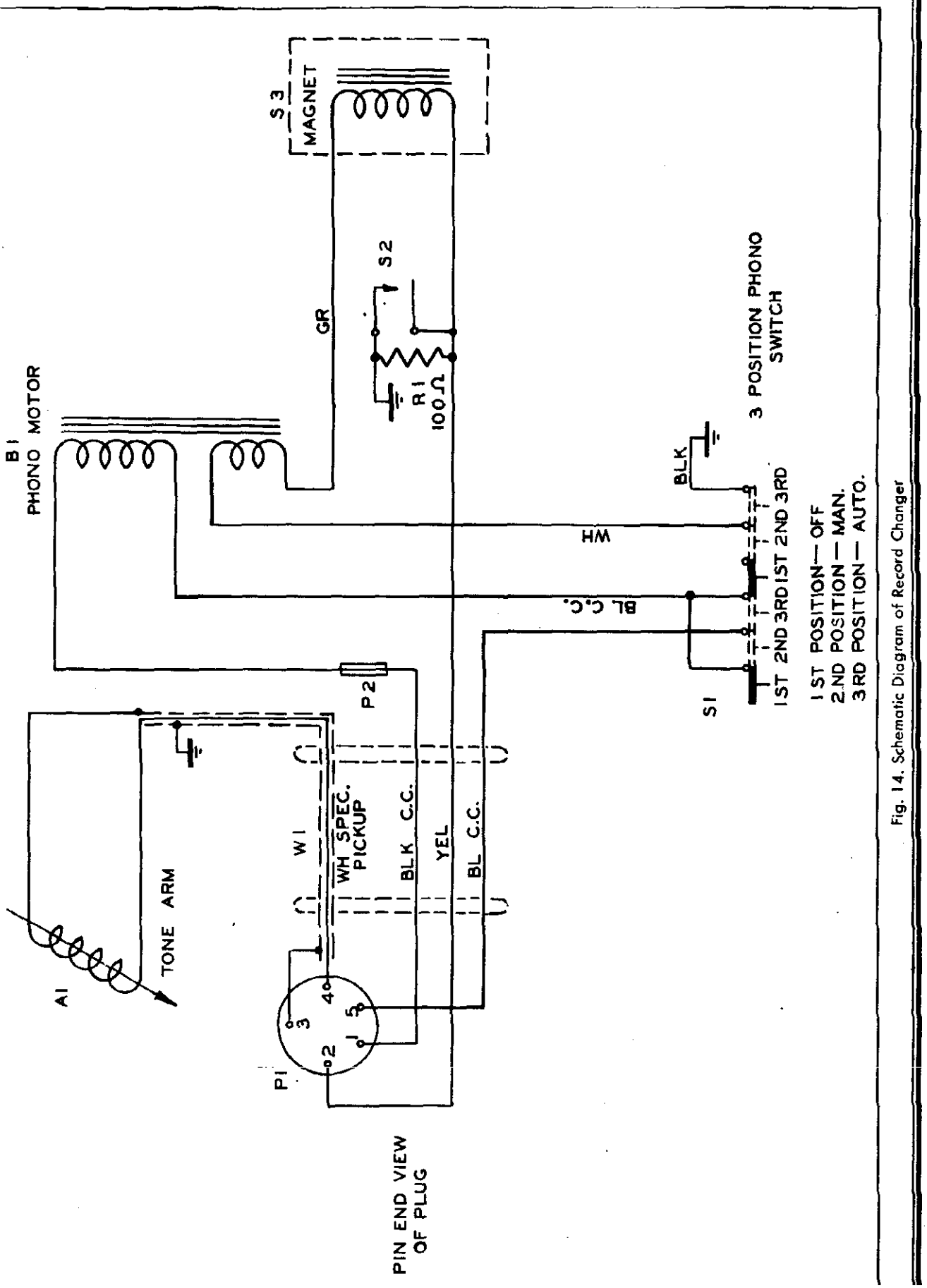


Fig. 14. Schematic Diagram of Record Changer

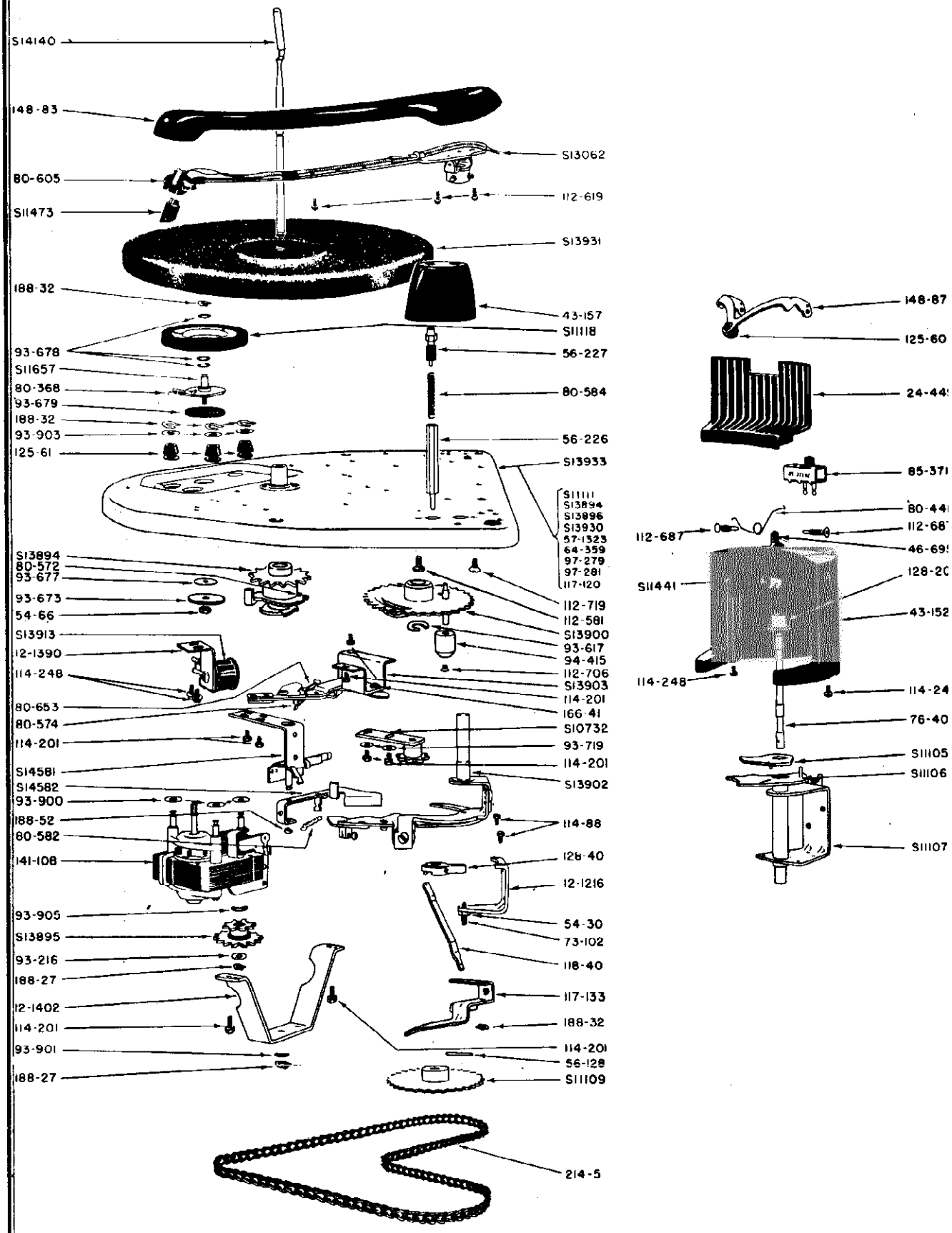


Fig. 16. Exploded View of Record Changer.

MODELS S14012, S14014, S14019, S14021

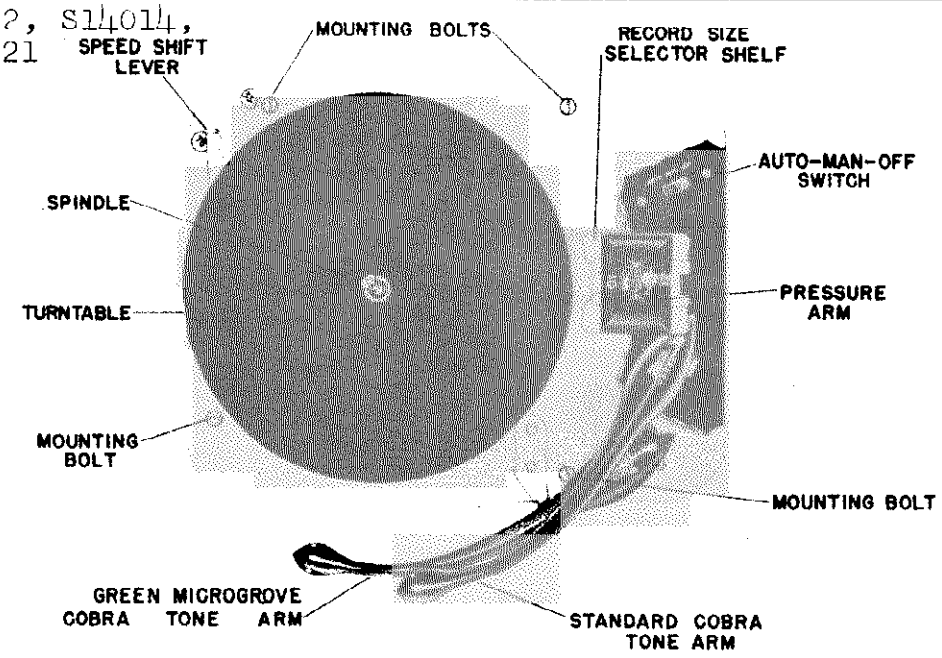


Fig. 1. S14012 and S14014 Record Changers.

GENERAL

The Models S14012 and S14014 record changers are used in Zenith Models 9H995RLP and 6R980LP respectively. These changers are designed to play 12 ten inch or 10 twelve inch 78 RPM records automatically. They will play 33-1/3 RPM records manually. Odd size and warped records must be played manually. Mechanically the changers are alike. There are slight electrical differences. Model S14012 receives the solenoid energizing voltage from the receiver proper while the S14014 supplies its own energizing voltage from a separate winding on the motor. When servicing these changers, check the schematic diagrams for electrical differences. The mechanical operation and adjustments of both changers are identical. To load for automatic 78 RPM operation, set the record size selector shelf to either ten or twelve, depending on the size of the records to be played. Lift the pressure arm and place a stack of records over the spindle. Lower the pressure arm until it rests on the record stack. Set the AUTO-MAN-OFF switch to AUTO. Move the speed shift lever to 78 RPM and press the record change button on the receiver panel. The record changer will play the complete selection of records, and will repeat the last record until turned off. For manual operation set the AUTO-MAN-OFF switch to MAN, place a record on the turntable and set the needle on the starting groove of the record. For 78 RPM records use the standard tone arm and place the speed shift lever to 78 RPM. For 33-1/3 RPM records use the green tone arm and place the speed shift lever to 33-1/3 RPM. To turn the changer off, set the AUTO-MAN-OFF switch to OFF, and place the tone arm in the rest position.

DESCRIPTION OF CYCLING

The motor drives the turntable thru the media of shafts and idler wheels. Closing the contacts of the trip switch or the record change switch allows current to flow through the solenoid. The magnetic field of the energized solenoid attracts the trip pawl lever which releases the gear pawl tooth and allows it to engage the rotating turntable gear. This action starts the clutch gear to turn. A stud on the clutch gear engages the tone arm lift lever which engages the tone arm stud and raises the tone arm. The tone arm lift lever also applies the tone arm brake which prevents coasting and erratic landing of the needle. The clutch gear moves the tone arm actuating lever and laterally swings the tone arm off the turntable. During the lateral swing of the tone arm, the record ejector link and arm assembly operates the record push plate and when the tone arm moves to its maximum outward position, the record push plate ejects the record and allows it to drop on the turntable. The clutch gear then moves the tone arm actuating lever which swings the tone arm over the starting groove of the record. The tone arm swings 1 inch nearer the spindle with 10 inch records than it does with 12 inch. This difference in inward swing is controlled by the discriminator lever assembly. When the record size selector shelf is turned to the 10 or 12 inch position, its shaft moves the discriminator cam and sets the discriminator lever assembly for the correct inward swing of the tone arm. After the tone arm swings over the starting groove of the record, the tone arm lift lever lowers it and releases the brake. As the clutch gear completes the revolution, the gear pawl tooth bracket hits the trip pawl and the action removes the gear pawl tooth from the path of the turntable gear, causing the clutch gear to stop thus completing the cycle.

The velocity trip depends on the ratio of oscillations of the trip switch contact to the rate of movement of the tone arm. As the record is played, the tone arm lever moves slowly inward. The oscillating lever comes in contact with the ratchet on the tone arm lever and then moves out before the ratchet can drag the oscillating lever and close the trip switch contacts. When the record is completed and the needle enters the oscillating groove, the inward speed of the tone arm increases. This makes it impossible for the oscillating lever to move out of the ratchet in time and as a result is dragged inward, closing the trip switch contacts and starting the next cycle.

MODELS S14012
S14014, S1401
S14021

The S14012 and S14014 record changers use the famous Cobra pickup. On S14012, S14014 and S14019, use only a red cartridge in the red tone arm and only a green cartridge in the green tone arm. On S14021 which has a red tone arm use only a red-green cartridge. Previously published service manuals Z800 and Z801 explain in detail the theory and operation of the Cobra pickup. If these manuals are not available, they may be obtained from your Zenith distributor.

RECORD CHANGER MOUNTING CLIPS

Clamp on pivot clips are used to mount the record changer in the cabinet. The changer is released by applying an upward pressure to the slotted ends of the clips (see Fig. 3) until the clips pivot to a vertical position. When the changer is installed, the clips are pivoted back to the horizontal or holding position.

LUBRICATION

Sta-Put grease No. 512 (light grease of the vaseline type) is used for lubrication throughout. Fig. 7 indicates the various lubrication points. Do not apply grease to the top surface or teeth of the clutch gear.

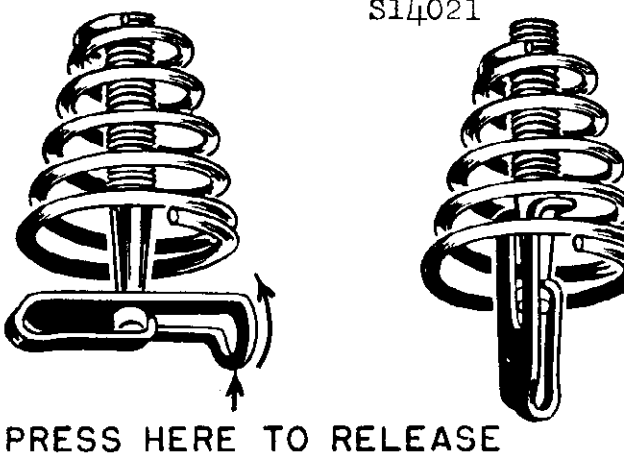


Fig. 3. Record Changer Mounting Clip.

ADJUSTMENTS

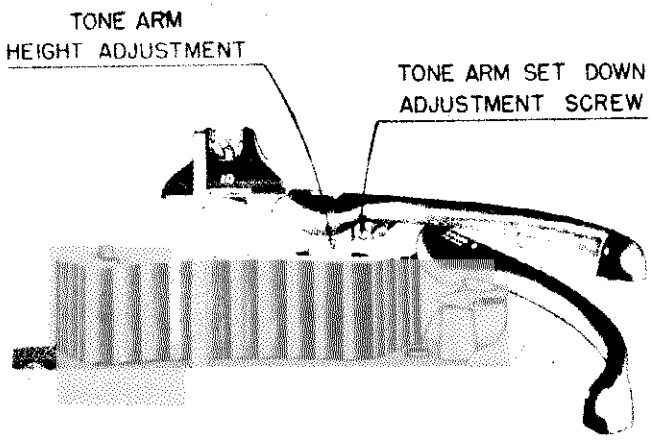


Fig. 2. Tone Arm Set Down and Height Adjustment.

TONE ARM SET DOWN ADJUSTMENT

The landing position of the needle on the record is determined by the setting of the tone arm set down adjustment screw (see Fig. 2). Clockwise rotation of the screw moves the tone arm in, while counter-clockwise rotation moves it out.

TRIP SWITCH ADJUSTMENT

The tone arm lever must be moved so that its ratchet does not engage the oscillating switch lever. With a pair of long nose pliers simultaneously bend the stationary contact and guide spring until the spacing between the trip switch contacts is 1/16 inch to 3/32 inch. The contact spring must always rest against the heavier guide spring after adjustment.

TONE ARM HEIGHT ADJUSTMENT

The tone arm height adjustment determines the vertical r
of the tone arm. If the tone arm does not rise sufficiently, t
record changer will not play a full load of 12 ten inch recor
If, on the other hand, the tone arm is raised too high, it may
the records on the record shelf. Set the adjustment screw
that the needle clears 12 unwarped ten inch records on the tu
table. The tone arm housing must not hit the underside of
records on the record shelf when the changer is cycled af
adjustment.

SLAB HEAD SET SCREWS

For maximum rigidity, the spindle, discriminator cam a
tone arm lever are locked in position with slab head screv
A sl b head set screw wrench is available as Zenith part N
68-8

REMOVING THE 78 RPM TONE ARM ASSEMBLY

The complete tone arm assembly can be removed by loosen
the two slab head holding screws and pulling the unit out. Wh
the tone arm assembly is installed, the cone points of the s
head screws must enter the indentations previously made.
new assembly does not have these indentations, and must
assembled as follows:

1. See that the changer mechanism is out of cycle.
2. Turn the tone arm set down adjustment screw (see Fig.
   as far as it will go in the clockwise direction.

MODELS S14012, S14014,
S14019, S14021

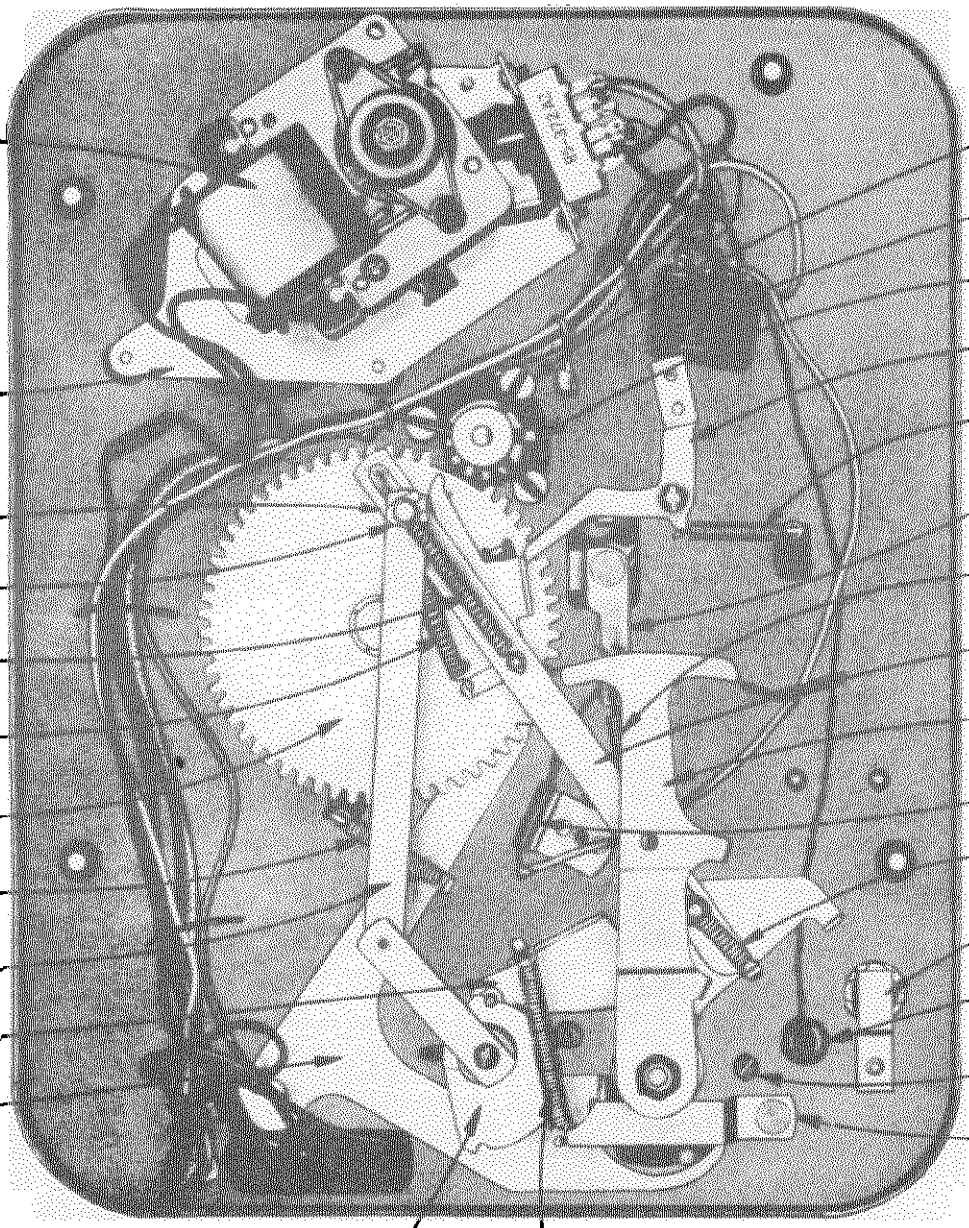


Fig. 4. Bottom View.

3. Insert the tone arm support shaft through its mounting hole.
4. Place a 12 inch record on the turntable and hold the Cobra tone arm housing against the edge of the record. Move the tone arm lever (Part No. S14495) to its maximum outward position. These two positions must be maintained during the next operation.
5. See that the tone arm lever bushing has approximately .005" inch play and tighten the slab head screws.
6. Adjust the tone arm set down adjustment screw (see Fig. 2) for proper landing of the needle.

REMOVING THE RECORD SHELF

The record shelf is removed by unscrewing the slab head screw at the bottom of its shaft and the machine screw which holds the record ejector link. When the unit is assembled, see that the changer is out of cycle and turn the slotted shaft until the record push off plate is retracted into its housing before attaching the record ejector link.

MODELS S14012, S14014, S14019 S14021

OPERATION OF DUAL SPEED MECHANISM

Figs. 5. & 6. illustrate the items involved in the two speed drive mechanism.

On 78 RPM operation the motor drive shaft comes in contact with idler wheel S15383 and in turn this idler wheel drives the turntable.

On 33 1/3 operation the motor drive shaft drives the idler wheel S15383. A flange on the lower portion of this idler wheel drives a second idler wheel S15382. This second idler wheel drives the slow speed drive plate on the turntable. See Fig. 6.

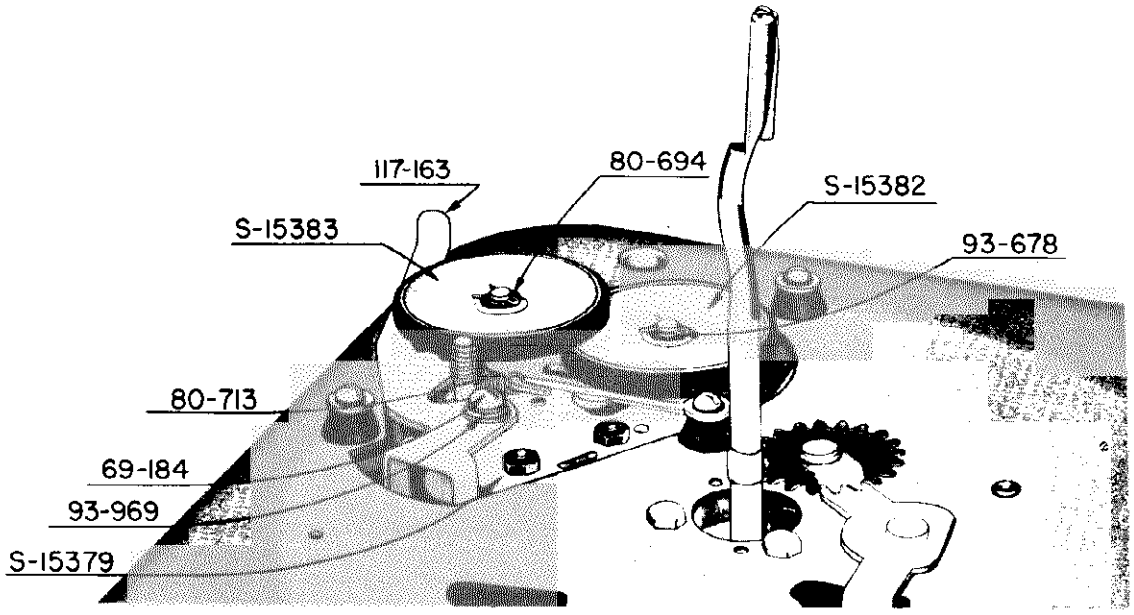


Fig. 5. Speed Changing Mechanism.

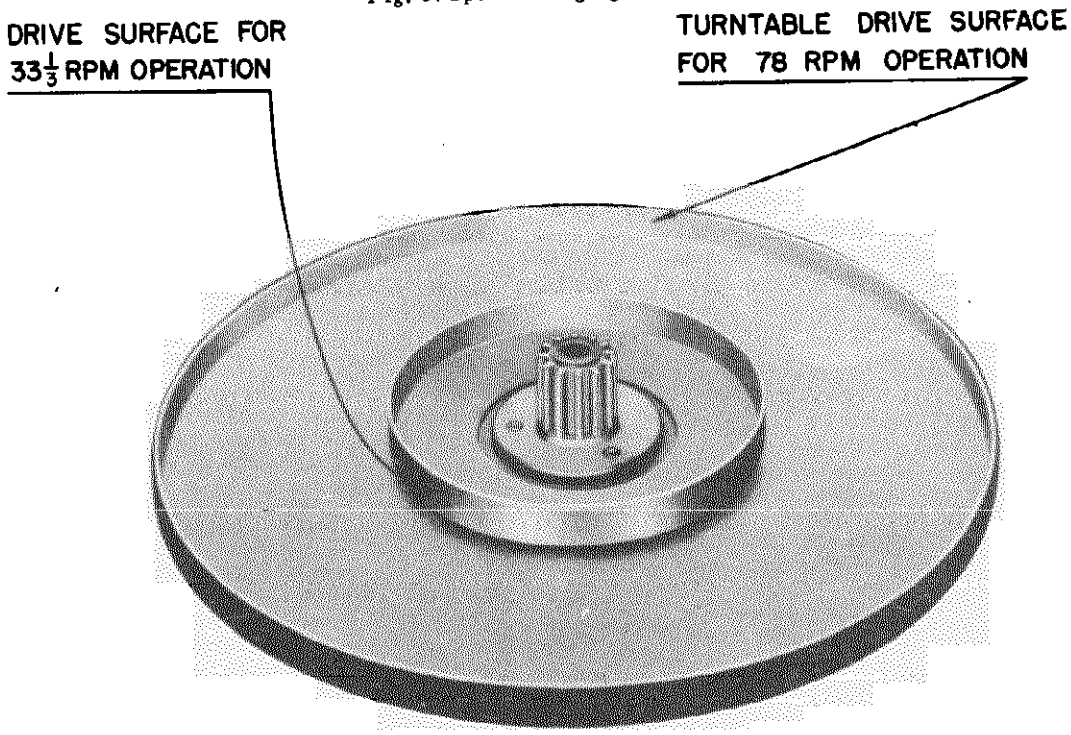


Fig. 6. Turntable Assembly S15411.

MODELS S14012, S14014, S14019, S14021

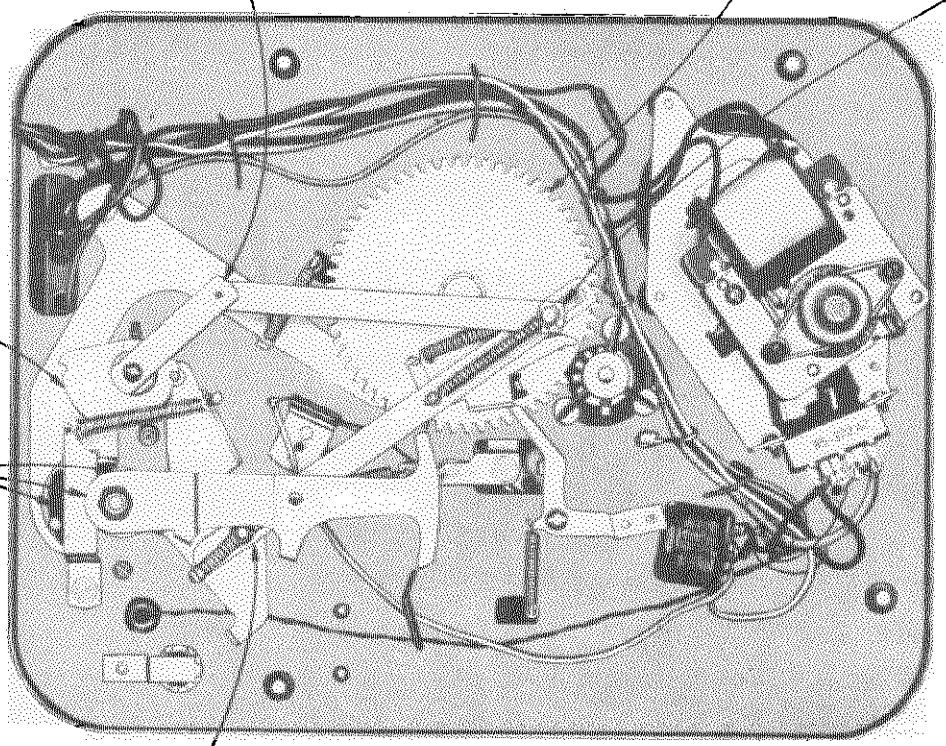


Fig. 7. Lubrication.

TROUBLE SHOOTING

SQUEAKS OR NOISES DURING PLAYING OF RECORDS.

a. Friction between the records on the turntable and the spindle will occasionally cause squeaks. A thin coat of wax applied to the spindle will remedy this condition.

b. Check lubrication.

RECORD IS NOT HEARD ALTHOUGH CHANGER OPERATES.

a. See that the Phono Radio switch is on Phono.
b. Check receiver audio by listening to radio.
c. Check the phono oscillator tube.
d. Check Needle Cartridge.
e. Check Tone Arm Housing for broken leads.

PRESSING RECORD CHANGE BUTTON ON RECEIVER PANEL DOES NOT START RECORD CHANGE CYCLE.

a. See that the AUTO-MAN-OFF switch is set to AUTO.
b. Check Record Change Switch.
c. Check electrical continuity of solenoid circuit.
d. Check the solenoid energizing voltage.

RUMBLE AND MICROPHONICS DURING REPRODUCTION.

a. Changer not "floated" properly. Remove packing strip. Loosen mounting bolts.

b. Motor retaining rings rubbing on the idler wheel.

c. Motor leads pulled too tight preventing motor from "floating" freely.

d. Noisy phono oscillator tube.

e. Impression on Idler Wheel.

NEEDLE FAILS TO CLEAR MAXIMUM LOAD OF RECORDS ON THE TURNTABLE.

a. Check Tone Arm height adjustment.

TONE ARM SETS DOWN TOO FAR IN OR OUT ON RECORD.

a. Check Tone Arm set down adjustment.

TONE ARM SET-DOWN POSITION VARIES.

a. Check Tone Arm Brake and Spring.
b. Tone Arm pivots loosely.

CHANGER CONTINUES TO CYCLE.

a. Check the trip switch adjustment.
b. Check Record Change switch.
c. Trip Pawl sticks.

CHANGER WILL NOT CYCLE UPON COMPLETION OF RECORD.

a. See that the AUTO-MAN-OFF switch is set to AUTO.
b. Be certain that the record has an eccentric center groove.
c. Check the Trip Switch.
d. Check the solenoid energizing voltage.

SOLENOID FAILS TO TRIP MECHANISM.

a. Check the pawl lever positioning stud. The tip of the pawl must be in approximately the same position in relation to the gear pawl tooth lever as indicated at "A" in Fig. 4. If the position is not the same as indicated, the positioning stud can be bent slightly.

b. Tension on the trip pawl actuating spring too high.

MECHANISM JAMS.

a. Burr or sharp point on the gear pawl tooth. Smooth out with a small file.

MODELS S14012, S14014, S14019, S14021

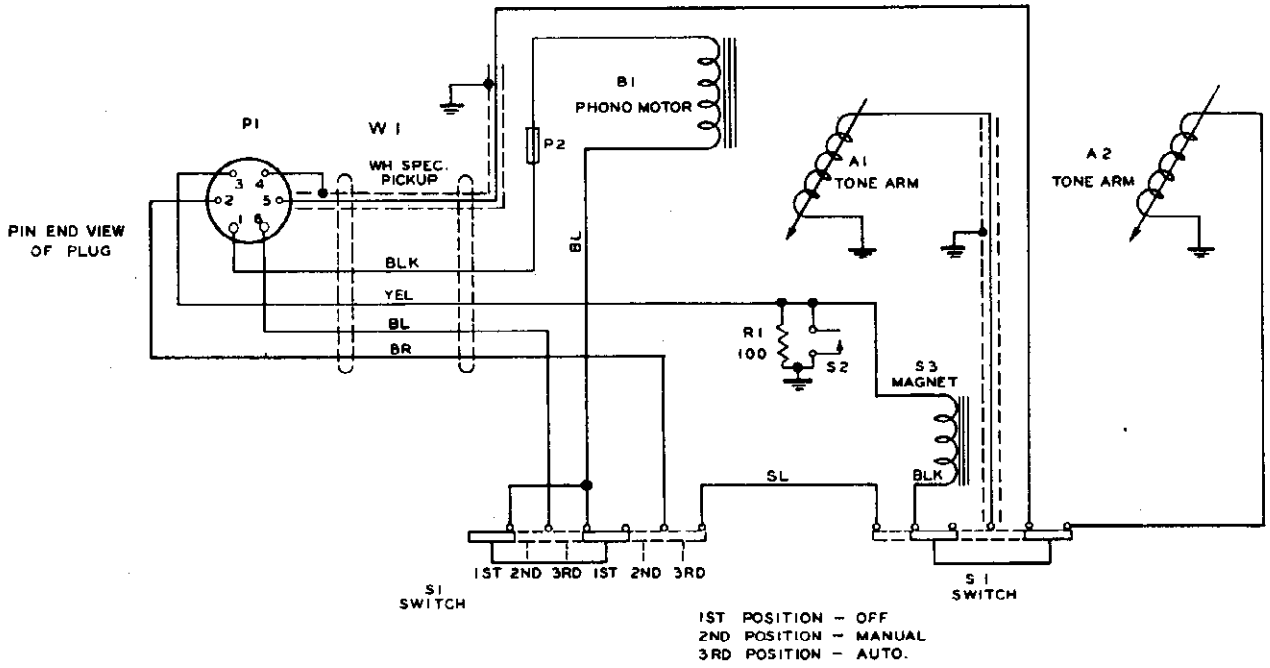


Fig. 8. Schematic Diagram S14012 Record Changer.

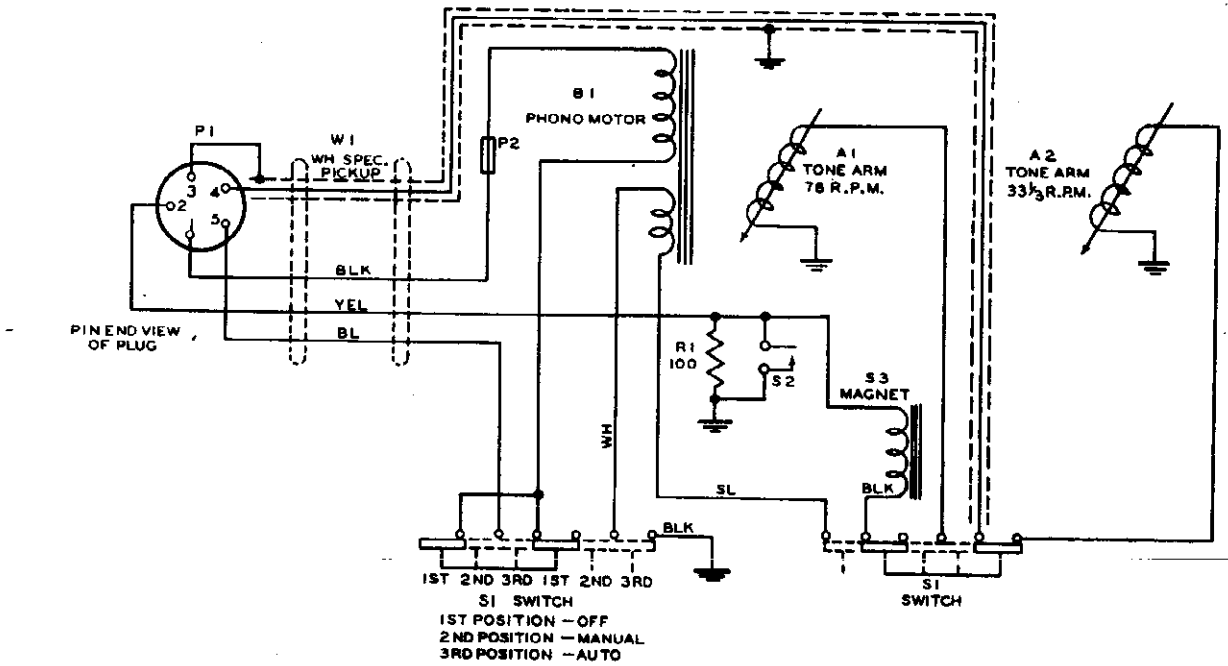


Fig. 9. Schematic Diagram S14014 Record Changer.

MODELS S14012, S14014,
S14019, S14021

PARTS LIST FOR S-14012-14-19 and 21.

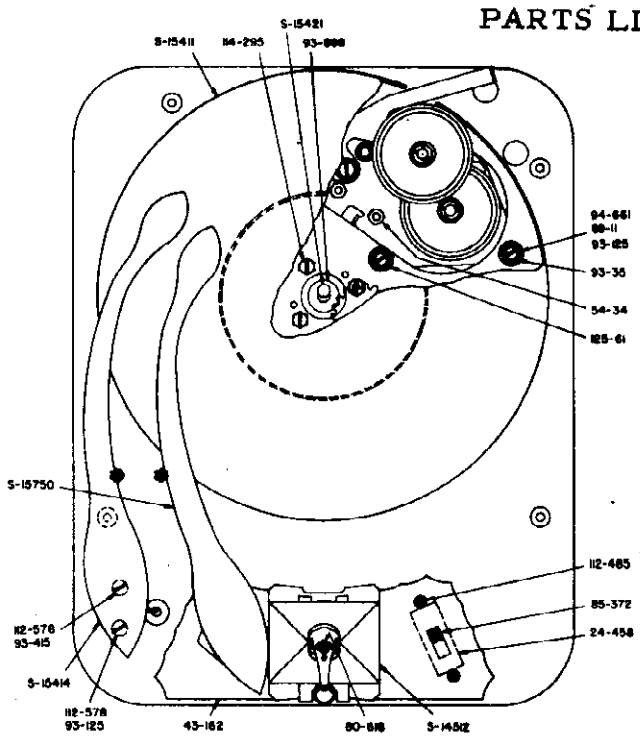


Fig. 10. Parts Identification, Top View.

17-81	Cable Clamp
*17-88	Cable Clamp
23-22	A.C. Wire Connector
24-458	Switch Cover
43-160	Turntable Gear Assembly
43-162	Record Ejector Housing
56-144	Socket Retaining Pin
*56-240	Groove Pin (2 used on S-14521)
57-1375	Record Push Plate
57-1577	Record Post Adj. Plate
*58-158	Five Prong Plug (Used on S-15466)
*58-166	Six Prong Plug (Used on S-15443)
63-1744	100 Ohm Ins. 1/2W. Res.
*64-430	Shoulder Rivet (6 used)
*64-431	Shoulder Rivet (2 used)
69-11	#6-32 X 3/4" R.H.M.S. Steel N.P.
69-43	#8-32 X 3/8" R.H.M.S. Steel N.P.
69-141	#5-40 X 1/4" R.H.M.S. Steel N.P.
69-184	#8-32 X 1/4" R.H.M.S. Steel Cad.
69-262	#8-32 X 1/2" Phillip R.H.M.S. Steel Stat. Bronze
73-99	#8-32 X 1/4" Slab. Hd. Set Screw Cone Pt (2 used)
73-112	#8-32 X 1/2" Slab. Hd. Set Screw Cuppoint
73-121	Special Set Screw
x73-123	Allen Hd. Set Screw - cone point
76-538	Tone Arm Shaft (33 1/3 R.P.M.)
78-561	Cartridge socket
*78-844	Socket (45 R.P.M. Adaptor)
80-582	Pawl Spring
80-605	Socket Tension Spring
80-609	Landing Adj. Spring
80-610	Switch Contact Spring
80-613	Lift Pin Lever Spring
80-614	Brake Spring
80-615	Tone Arm Link Spring (Long)
80-616	Tone Arm Link Spring (Short)
80-618	Pressure Arm Spring
80-619	Tone Arm Swivel Spring
80-631	Pawl Spring
80-645	Tone Arm Height Adj. Spring
80-650	Lever Spring (Fast Speed)
80-692	Detent Lever Spring
80-694	Idler Wheel Retaining Spring
*80-698	Pawl Spring
80-700	Oscillating Lever Spring
x80-737	Oscillating Lever Tension Spring
x80-738	Oscillating Lever Spring
x80-739	Trip Pawl Spring
83-1121	Felt Strip
85-372	Three Position Slide Switch
93-35	.032 X .144 X 3/8" Steel Washer N.P. (3 used)
93-53	1/32" X 11/64" X 3/8" Steel Washer N.P.
93-125	#6 Int. Shakeproof Lockwasher (5 used)
93-381	1/32" X 7/32" X 3/8" Steel Washer - Cad.
93-415	#6 Ext. Shakeproof Lockwasher
93-781	#8 Split Lockwasher Steel N.P.
93-876	Fibre Washer
93-898	Steel Washer
93-899	Steel Washer N.P. .025 X .129 X 5/16"
93-969	Spring Washer, Shakeproof
94-620	Stop Bushing
94-659	Tone Arm Shaft Bushing
94-661	Motor Mounting Bushing (3 used)
97-298	Trip Pawl Stud
97-301	Clutch Gear Retaining Stud
97-329	Change Lever Spring Stud
97-333	Change Lever Mounting Stud
112-485	#4-40 X 1/4" B.H.M.S. Steel Black Zinc Plate (4 used)
112-619	#2 X 5/16 R.H.S.T. Screw Cad. Plate Shakeproof Type #25 (3 used)
114-248	#6-20 X 5/16" Hex. Hd. Slotted S.T. Screw Steel Cad. (4 used)
114-295	#8-32 X 5/16" Hex. Hd. Slotted S.T. Screw Steel Cad. (4 used)
117-144	Brake Lever
117-145	Tone Arm Lift Lever
117-163	Speed Control Lever
117-164	Detent Lever
125-61	Rubber Grommet (3 used)
125-65	Rubber Grommet Pressure Arm
135-13	Counterweight
x135-14	Counterweight
128-45	Discriminator Cam
141-122	Phono Motor A.C. 110V 60 Cycle
*141-123	Phono Motor A.C. 110V 60 Cycle
148-83	Tone Arm Housing
148-96	Record Ejector Arm
148-97	Record Pressure Arm
148-109	Plastic Tone Arm Only
149-60	Magnet Core
x159-32	Plug Button
x159-73	Plug Button
x159-74	Plug Button
188-32	Retaining Ring
199-85	Tone Arm Sleeve
S-13913	Magnet Coil Assembly
S-14487	Clutch Gear Assembly
S-14490	Tone Arm Actuating Lever Assembly
S-14491	Discriminator Lever Assembly
S-14493	Trip Switch Assembly
S-14494	Record Ejector Link & Arm Assembly
S-14495	Tone Arm Lever Assembly
S-14499	Ejector Cam Shaft Assembly
S-14510	Record Support Plate & Post Assembly
S-14512	Pressure Arm & Mounting Assembly
S-14513	Tone Arm Shaft Assembly
S-14514	Tone Arm Bracket & Lift Pin Assembly
S-14516	Tone Arm Assembly (78 R.P.M.) or S-15428
S-14673	Hinge Plate Socket & Stop Assembly
S-15379	Motor Mounting Plate Assembly
S-15380	Speed Change Lever & Stud Assembly
S-15381	Detent Lever & Stud Assembly
S-15382	Idler Wheel Lever & Stud Assembly (Slow Speed)
S-15383	Idler Wheel Lever & Stud Assembly (Fast Speed)
S-15384	Idler Wheel Lever & Swivel Plate Assembly
S-15407	Dual Speed Mechanism Final Assembly - Complete
S-15411	Turntable Assembly
S-15414	Cobra Tone Arm Assembly (33 1/3 R.P.M.)
S-15421	Spindle Assembly (or S-14496 with 147-157)
S-15428	Cobra Tone Arm Assembly (78 R.P.M.)
S-15443	Cable & Plug Assembly
*S-15466	Cable & Plug Assembly
S-15444	Oscillating Lever & Gear Assembly
S-15451	Hinge Plate Assembly - Complete
S-15453	Hinge Plate & Socket Assembly
S-15454	Hinge Plate Assembly - Complete
S-15505	Trip Pawl Assembly
xS-15780	Red-Green Cobra Cartridge Assembly
12-1444	Socket Mounting Bracket
12-1447	Tone Arm Mounting Bracket (Upper)
12-1548	Tone Arm Shaft Pivot Bracket

* Denotes Parts Used On S-14014 Only

x Denotes Parts Used On S-14021 Only

Those that are blank denote parts used on S-14012, S-14014, S-14019 & S-14021

S14019 & S14021

MODELS S14012, S14014, S14019, S14021

The S14019 is identical to the S14012 except it uses a 50/60 cycle phono motor #141-124 motor and a 85-445 phono reject switch mounted on the record changer base plate. For 50 cycle operation the 60 cycle spring on the phono motor drive shaft must be replaced with a 50 cycle spring #80-732. See fig. 13 for electrical circuit.

The S14021 is identical to the S14012 except the S14021 has only one Cobra Tone Arm which contains a red-green cartridge. This cartridge allows both 33-1/3 and 78 R.P.M. 10" and 12" records to be played. 10" and 12" records can be played automatically but are not to be intermixed. The electrical circuit is shown in fig. 14.

To adjust the velocity trip switch assembly proceed in the following manner. Adjust trip pawl spring 80-739 so that the end of the spring is in line with an imaginary center line through the center of the shoulder rivet and the coil spring 80-738. (See fig. 12).

Rotate the turntable until the oscillating lever has moved as far to the right as possible. Spring 80-739 should just touch the ratchet on the tone arm lever assembly at a point that is 3/8" from the end of the lever (See fig. 12). The spring should be adjusted by bending it until it will conform to the prescribed limits. Only when the velocity trip switch assembly is adjusted in this manner will the changer trip properly.

When the tone arm fails to track, and jumps grooves, the pivot bearing pressure is too great, this inhibits the movement of the arm. This can be corrected by loosening the lock nut (See fig. 11) and with the use of an Allen wrench adjust the pivot bearing so it will be free enough to allow the tone arm to track properly. Holding the pivot bearing in this position, tighten the lock nut.

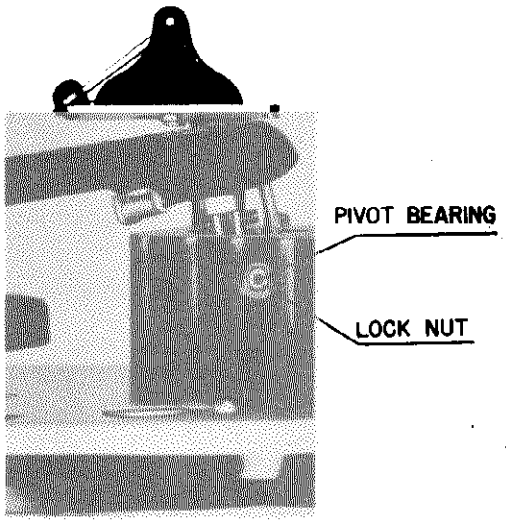


Fig. 11. Pivot Pressure Adjustment.

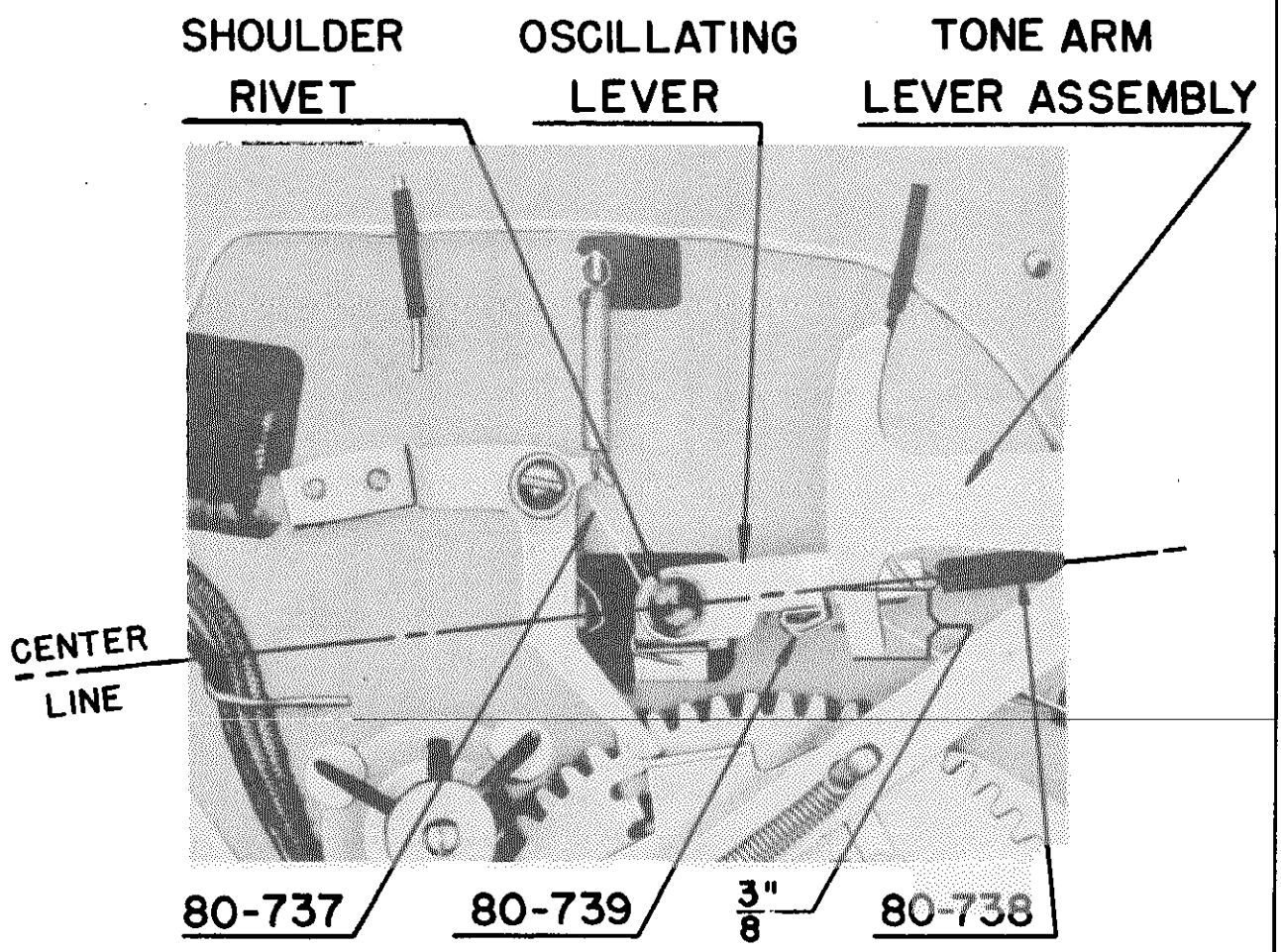


Fig. 12. Velocity Trip Adjustment.

MODELS S14012, S14014, S14019, S14021

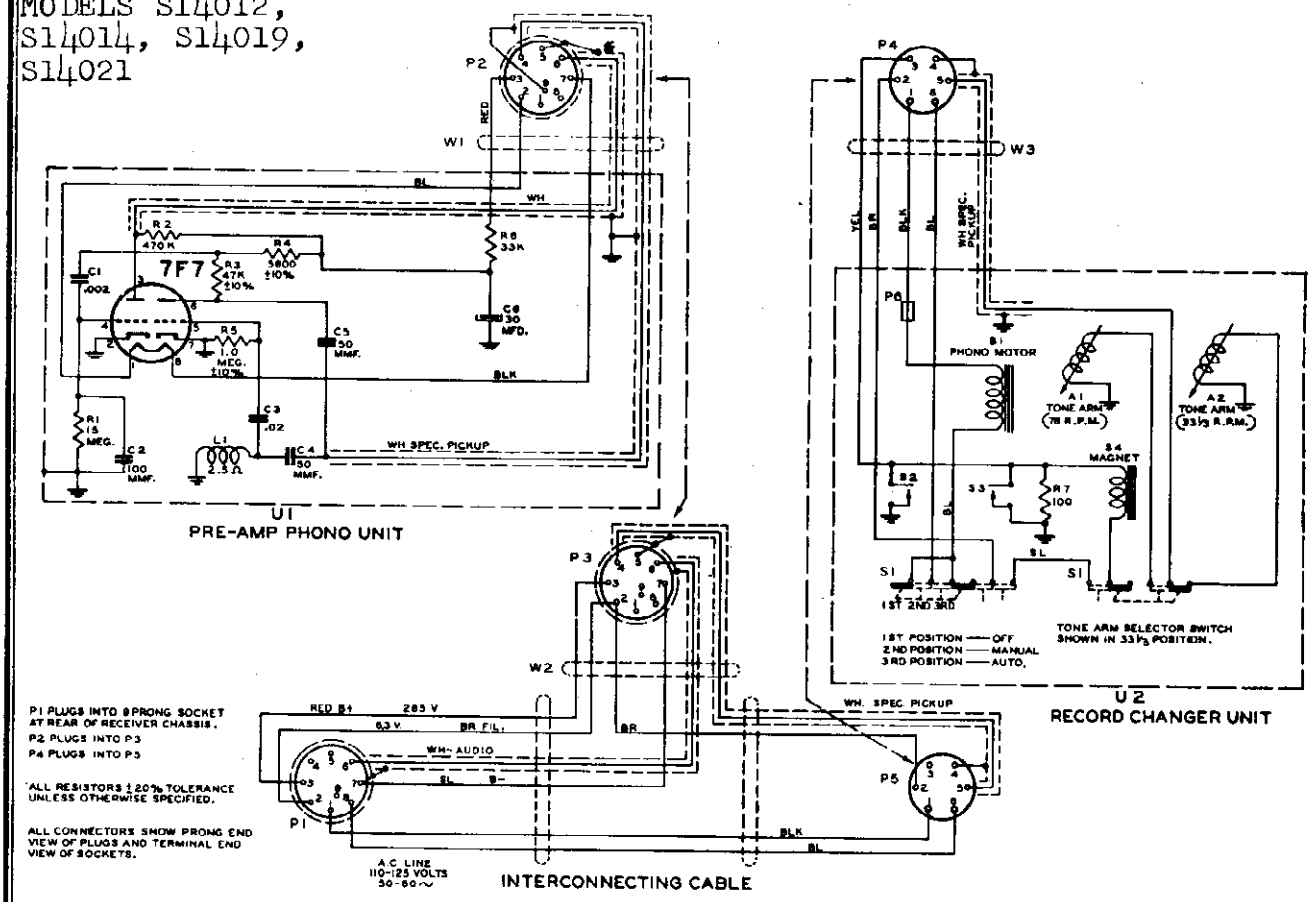


Fig. 13. Schematic For S14019.

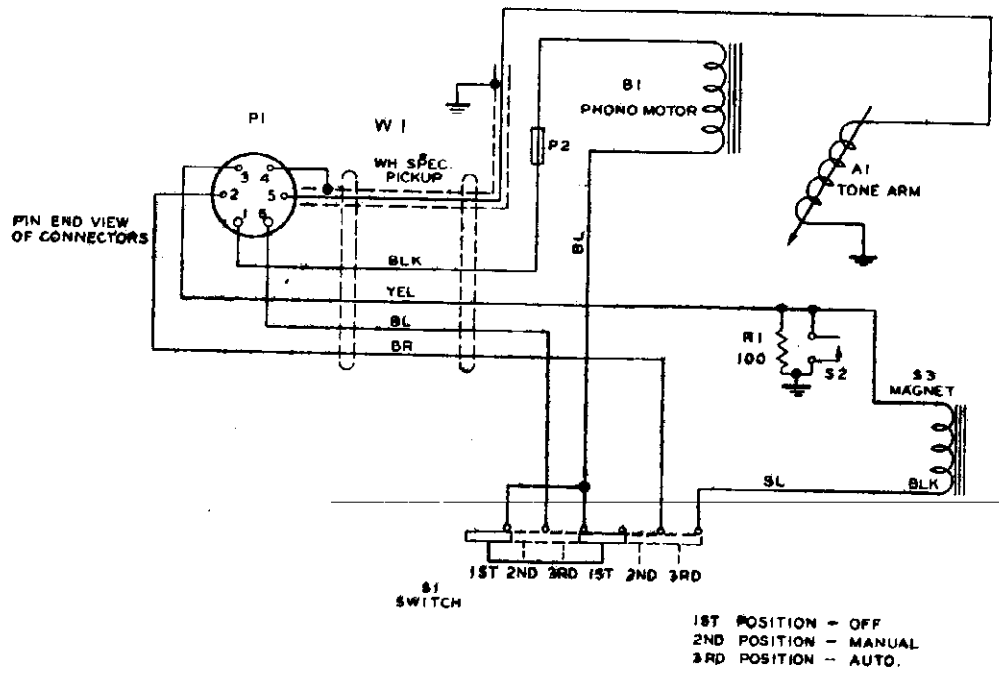
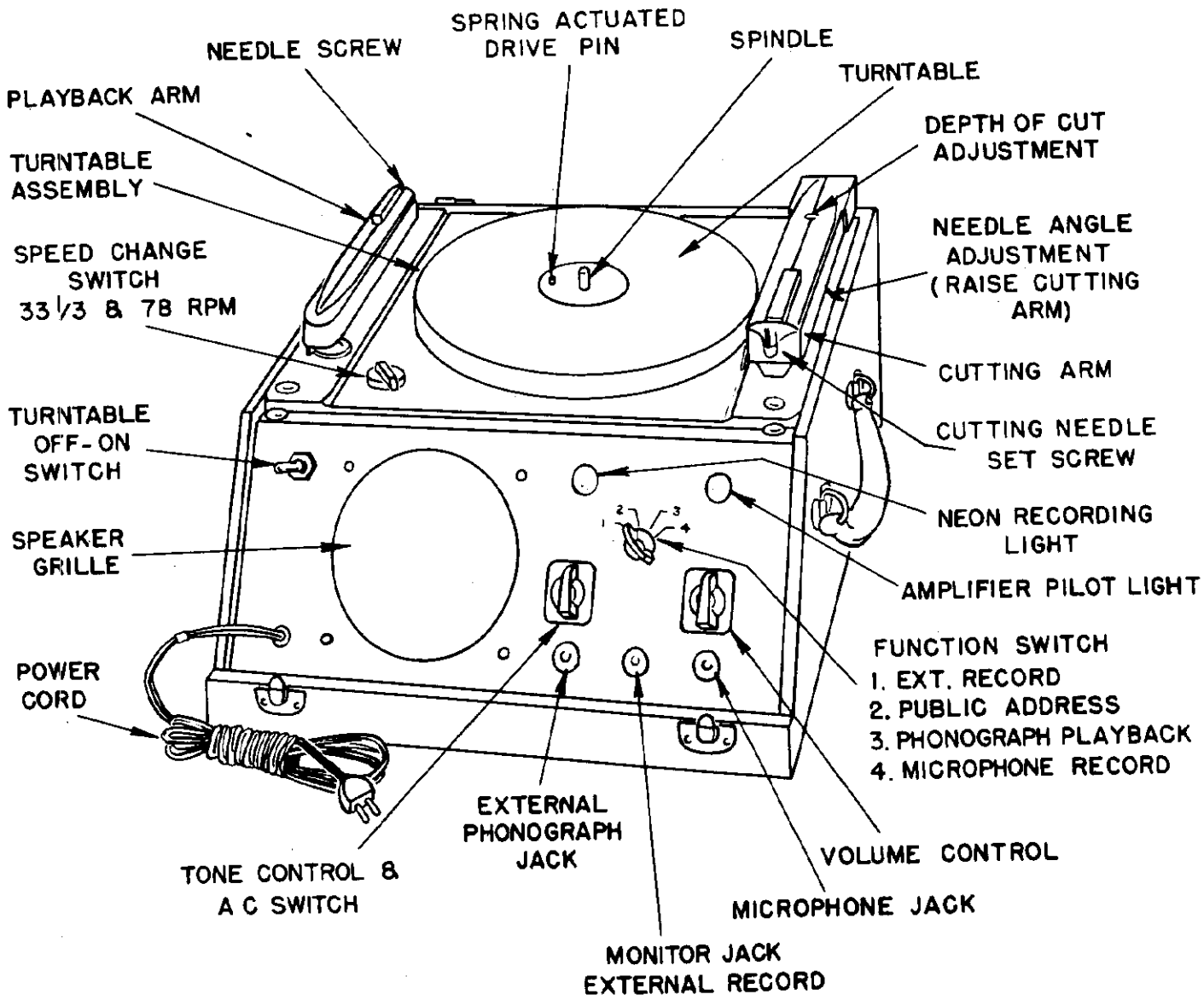


Fig. 14, Schematic For S14021.


NEEDLE SCREW
SPRING ACTUATED DRIVE PIN
SPINDLE
TURNTABLE
PLAYBACK ARM
DEPTH OF CUT ADJUSTMENT
TURNTABLE ASSEMBLY
NEEDLE ANGLE ADJUSTMENT (RAISE CUTTING ARM)
SPEED CHANGE SWITCH 33 1/3 & 78 RPM
CUTTING ARM
CUTTING NEEDLE SET SCREW
TURNTABLE OFF-ON SWITCH
NEON RECORDING LIGHT
SPEAKER GRILLE
AMPLIFIER PILOT LIGHT
FUNCTION SWITCH
1. EXT. RECORD
2. PUBLIC ADDRESS
3. PHONOGRAPH PLAYBACK
4. MICROPHONE RECORD
POWER CORD
EXTERNAL PHONOGRAPH JACK
VOLUME CONTROL
TONE CONTROL & A C SWITCH
MICROPHONE JACK
MONITOR JACK EXTERNAL RECORD

MODEL RC-47

General Description - (See Outline Illustration)

The Model RC-47 Bell Re-Cord-O-Fone is a compact, completely portable three-tube disc recorder and playback unit capable of many uses. Complete with crystal microphone and stand; it is ready to record any sound and provide immediate playback. The slanting panel allows easy access to all controls. Phone jacks permit quick and easy connection of additional devices. Adequate tone and volume control provide exceptional, natural reproduction in any recording situation.

Receiving Inspection

Immediately upon receiving your Re-Cord-O-Fone, please check to see that no damage has occurred in shipment. Mount turntable on spindle with idler pulley properly seated. For carrying, place microphone base on post over spindle to prevent turntable coming off.

Connect AC plug to source of power (115V 60 cycles). Turn on phono switch. Turntable should run smoothly on both speeds as selected by rotating green plastic knob on motor board. Microphone should be plugged in and various functions checked. Check cutter by touching needle with fingertip.

If unit fails to operate, remove top and bottom screws holding front panel and chassis. Lift up and outward. See that tubes are plugged in securely. Be sure turntable cable is plugged in tightly to rear of chassis. Reassemble.

SETTING UP RECORDER

Place recorder on solid level surface. An accidental jar during recording might cause the cutting arm to shift, thereby spoiling an otherwise good recording. Set microphone at level of speaker's face, at least 15" away. Do not attempt to make recordings in large hard-walled rooms. Good results will be had in average living room. For best results rehearse material to be recorded so that proper settings and procedure may be ascertained.

NOTE: Be sure to read "Operating Instructions and Auxiliary Information" sections before using this Recorder.

OPERATING INSTRUCTIONS

Recording with Microphone

Turn amplifier on by rotating "tone control" knob clockwise. Set volume control knob at zero. Insert mike plug in "microphone" jack. Set function switch at "microphone re-cord" and place mike in position for pickup. While subject is test performing, adjust "volume control" while watching neon light. Place recording blank on turntable being sure spring-actuated pin fits in one of the off-center holes in blank. Install new cutting needle. Be sure needle screw bears against flat side of needle. Turn on "turntable" switch and select proper speed, 33 1/3 or 78 r.p.m. Lower cutting arm on record and make test cut. Thread should throw toward center of record where rubber finger will cause it to wrap around spindle out of the way. Record may be played back at once.

NOTE: Care must be exercised at all times that this thread never gets under the turntable where it can be caught in the mechanism. This will cause irregular operation or complete stoppage.

External Record - (From Radio or External Amplifier)

Note: - Three methods are possible. Use one most suitable.

METHOD 1

To record from an external amplifier or radio, proceed as follows: Secure a two-wire cable to the voice coil of the radio (3-6 ohms impedance) or to low impedance output of amplifier. Connect a phone plug to free end, being sure grounded side of radio is connected through wire to sleeve or plug. Recorder amplifier is not used for this purpose but may be left turned on if desired. Insert plug in "external Re-Cord" jack and set function switch to "external re-cord". Adjust volume and tone controls of radio or amplifier for satisfactory results. Best results will usually be obtained with tone control on radio turned up for maximum "high" response. Re-cord as above.

NOTE:- Radio or amplifier must be capable of supplying 5 to 6 watts undistorted, in order to produce good recording. At this power level, considerable sound is produced by the loudspeaker.

METHOD II
(Preferred)

Connect as in Method 1 except insert plug in "external phonograph". Set function switch to "external re-cord" with recorder volume off. Adjust radio (or amplifier) volume to slightly above normal listening level and tone control for good treble response. Advance recorder volume control to proper level. Readjust controls if necessary. NOTE:- It may be necessary to reverse one or both AC plugs to secure lowest hum level.

METHOD III

Set up as for "mike record". Place mike 15" to 24" in front of, and to one side of speaker. Re-cord as usual. This method is the simplest to use but care must be used to prevent pickup of room noises.

External Re-cord from external Phone unit

Any record may be copies or re-corded on another blank. Proceed as follows: Insert plug from phono unit in "external phonograph" jack. Set function switch to "external record". Place record to be copies on other turntable and blank on recorder. Place external playback arm on record and adjust volume control on recorder. Start recorder turntable and re-cord as usual.

DUBBING

If desired, vocal comments may be added to (dubbed in) recordings by setting function switch to "mike re-cord" and speaking comments into the microphone. This procedure should be monitored by headphones in order to get good balance. Neither should be much louder than the other if good results are to be obtained. The external phone unit must have a separate volume control for this purpose. Adjust the microphone volume control first, then set the external volume control of phone or radio for proper.

PLAYBACK

Always use new needles on instantaneous recordings to prolong their useful life. Turn "turntable" switch on. Be sure turntable speed is correct for record being played. Turn function switch to "phonograph" position. Lower playback arm to record surface--do not drop. Adjust volume and tone for most pleasing results. Mike cable may be left plugged in. Any record up to 12" may be played back. (See Auxiliary Speaker paragraph)

MODEL RC-47

Public Address Usage

To use as a Public Address System, turn on amplifier by rotating "tone control" knob clockwise. Set function switch at "Public Address" position. Insert mike plug into "microphone" jack. Extend mike cable to full length or use extension cable to allow turning up volume control. In some applications it may be desirable to use external speaker and locate it at one side for better results. Adjust volume and tone controls for proper level. (See speaker on auxiliary speaker)

The speaker will howl if volume control is turned up to high and the microphone is too close to speaker. Separation of the two or turning down volume control is only cure.

External Phonograph

To use an external phono unit such as Bell Sound Models 10T, 10R or "C" with this recorder, proceed as follows: Terminate the shielded cable from the phono unit with a phone plug and insert into the "external" phonograph jack. Turn function switch to "phonograph" position. Adjust volume and tone controls for best results. (See paragraph on auxiliary speaker.)

AUXILIARY INFORMATION

Adjustment of Cutting Arm

There are two adjustments of the cutting arm; one to vary the needle pressure, and another to adjust the needle angle. These are necessary because needle length and blank material and thickness vary. They are interlocking to a slight extent and it may be necessary to recheck one after varying the other. Do not attempt to change these adjustments until the following is thoroughly understood.

Refer to the outline drawing. The needle pressure adjustment is made by turning the screw in the top of the cutting arm. Turning clockwise increases needle pressure and vice versa. The needle pressure should be such that a thread approximately the size of human hair is produced. It should be straight, not curly or fuzzy. The latter condition may also denote a damaged cutting needle.

The other adjustment is found when the cutting arm is raised to a vertical position. The bolt with locknut may be turned so that the end of the cutting arm is raised or lowered. This varies the angle which the needle makes with the vertical to the blank. The cutting surface of the needle should be at a 90° angle to the blank. This may be checked by setting the cutting needle on an uncut blank and raising or lowering the arm until the face of the needle and its reflection form a straight line.

If the needle pressure is too much or the angle wrong, the needle may be forced through the coating with damage to tip. It may also slow down the turntable and cause "wows". If the pressure is too little, the groove will be too shallow to hold the playback arm, causing it to slide across the record.

Recording Level

It is quite important that the recording level be carefully adjusted, otherwise results will be discouraging. Three factors govern the strength of the signal delivered to the recording head:

(1) Setting of volume control; (2) loudness of sound; and (3) distance from microphone. If the voltage to the cutting crystal is too great the crystal

may be damaged and the record groove walls broken down. If this voltage is too small the playback will be weak and noisy. Also, needle scratch and motor rumble may interfere with the recorded sounds.

To help the operator correctly adjust this voltage a neon light is provided. This begins to flash when the volume control is set right. Proper adjustment is made when the lamp flashed on the louder parts and goes out on the softer. Too much volume will light the bulb continuously and even cause it to have a bluish glow.

NOTE:- Riding the level or continuously adjusting the volume during the recording is not recommended. Adjustment should be made so that the loudest passage will be recorded satisfactorily.

An AC voltmeter may be plugged into the monitor jack and the average volume set at approximately 1.5 volts. Loudest sounds should not cause the meter to read more than 2.0 volts.

Crystal headphones may be plugged into this monitor jack and the quality and balance of the recording judged.

Needles

Sapphire cutting needles should be used for best results. Stellite and steel needles may be used with poorer results and shorter useful life. Sapphire, precious metal tipped or steel needles may be used for playback. Personal preference should be guide in selection. Useful life will usually be in proportion to cost. Never use worn or damaged playback needles on instantaneous recordings. Never use thorn, cacti, or fibre needles on acetate recordings.

Cutting Blanks

Best results are had with metal or glass base blanks. Paper base blanks are adequate for test purposes or where not much importance is given the finished product. They are also cheaper while learning. As the operator becomes expert he will find that the more expensive blanks are necessary for best results.

On good blanks, the coating is thick enough that a deep cut will not allow the needle to catch in the base or be dulled or broken. Bubbles, surface irregularities or warping are enough to reject any record.

It may be necessary to adjust both depth of cut and angle on blanks of different manufacturers, even when using the better makes of recording discs. (See section on adjustment of cutting arm.)

Auxiliary Speaker

If desired, an external speaker in suitable housing may be connected in place of the built-in speaker. Terminate cable with phone plug and insert in monitor jack. Better volume and tone as well as a more advantageous speaker location will result. It should have an impedance of 3.4 ohms to properly match output of amplifier.

Speed - 78 or 33 1/3 R.P.M.

Best results will be had when recording music at 78 r.p.m. However, where material to be recorded is long or where highest fidelity is not necessary the lower speed will allow more recording on a given blank. Recording should not be started too near the outer edge because of irregularity of coating; nor, carried too close to label because of loss of tone quality.

MODEL RC-47

Consult table below for specific date.

Blank Size	Speed (r.p.m.)	Outer Margin	Recording Time	Width
10"	78	1/4"	4 1/2 Min.	3
10"	33	1/4"	11 "	3
12"	78	5/8"	5 1/2 "	3 1/2
12"	33	5/8"	12 1/2 "	3 1/2

Routine Care

While these units are quite sturdy, they should not be subjected to unnecessary rough treatment. Playback and cutting arms should be handled carefully. Neither should be dropped on turntable, nor should the needles be struck against any part. Such treatment may damage either the needle or cartridge or both.

Periodically, the turntable should be raised and any dust and cutting threads removed. Oil motor and idler pulleys with a few drops of light oil, being extremely careful not to apply oil on rubber pulley tire. Microphone cords should be checked for loose connections. Tubes should be checked and doubtful ones replaced.

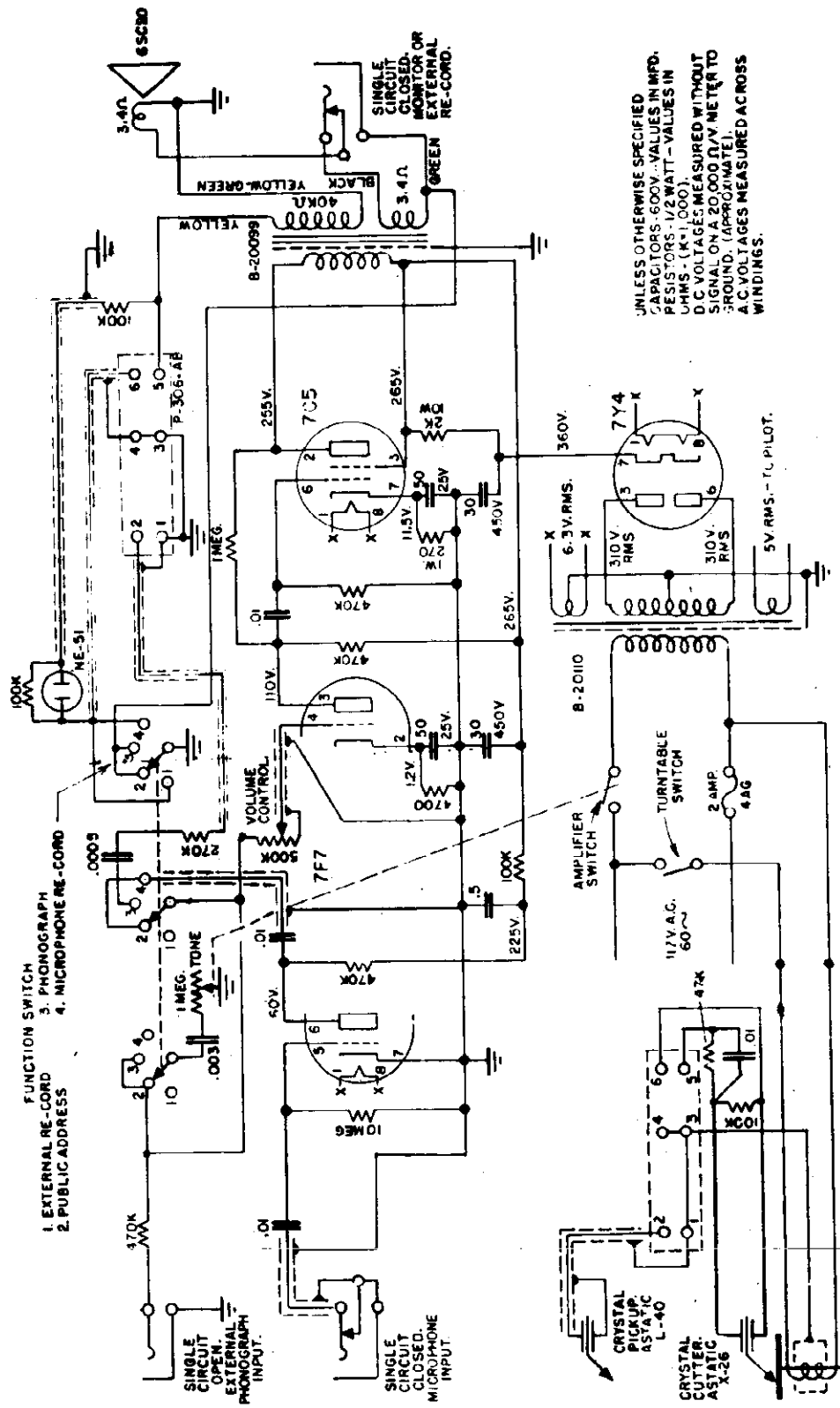
Playback and cutting crystals and the microphone are sensitive to heat and should never be subjected to temperatures greater than 120° F. Continued exposure to direct sunlight should be avoided.

Repair - General

1 - Inspect visually.
2.- Check tubes - replace bad or doubtful ones.
3 - Mike voltage and continuity tests with aid of schematic.
4 - Check all electrolytic condensers on reliable bridge. Check coupling condensers, especially to output tube grid. Replace those bad or doubtful.

Phono Unit

5 - If phono is suspected, check motor speed using stroboscope disc under neon or fluorescent lights. Speeds should be 78 or 33 1/3 r.p.m. and steady. Motor should run quietly. Remove dirt or threads and oil.
6 - To check for defective playback cartridge; While playing record, place finger near end of pickup, press lightly downward and across grooves. If crystal is O.K., volume will change only slightly; if broken, volume will change considerably. If no volume, check input to amplifier. Hum will be heard if finger is touched to ungrounded amplifier lead after disconnecting cartridge. Replace cartridge.
7 - To check cutting crystal; If neon light indicates voltage present, cutting needle in the chuck will be felt vibrating. If voltage from amplifier is not available, the leads may be connected to the 115 volt AC supply where again the needle will vibrate. For quality tests, substitute a new cartridge and compare.



DRAWING No. B-12002

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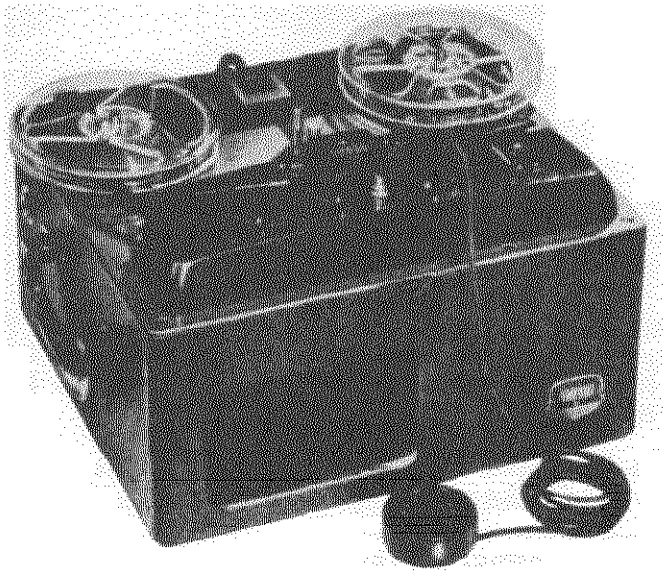

INTRODUCTION

Tape Recorders will be delivered to you for servicing for one of three reasons: one, unsatisfactory performance due to operational errors on the part of the user, two, periodic inspection and maintenance, and three, unsatisfactory performance due to wear or failure of components.

Proper operating procedures are described in detail in the operator's instruction book and need not be repeated in this manual. The first section of this manual deals with the routine inspection and protective maintenance of the device. The second section deals with trouble shooting and refers to the applicable material describing the correction of trouble, which constitutes the third section. The fourth section describes the procedures for inspecting and adjusting the device after the repair work has been completed. The final section contains a parts list and information relative to the procurement of parts.

SECTION I

Periodic Inspection and Protective Maintenance

A. CLEANING

Dirt is the cause of many irregularities in performance. Therefore, it is advisable to clean all parts in the path of the tape before attempting to inspect or test the equipment.

1. Remove the control panel using the procedure described in Section III Par. A.

2. Wipe the tape guide stud (95), guides on tape erase lever (98), erase head (67) (surface which contacts the tape), sound head (81), capstan (52), and the pressure roller (74) with a cloth dampened with carbon tetrachloride.

> WARNING: DO NOT USE FIRE EXTINGUISHER FLUID OR OTHER SOLVENTS; SUCH MATERIALS MAY EITHER LEAVE A COATING ON THE PARTS, DAMAGE THE PARTS OR LOOSEN ADHESIVES USED IN ASSEMBLING PARTS.

3. Wipe the pressure pads (78) with a cloth dampened with carbon

tetrachloride. Wipe in the direction of tape travel and be careful not to catch the cloth on the pressure springs or bend the springs.

4. Blow any dust or dirt out of the exposed mechanism. DO NOT DIRECT A STREAM OF AIR AGAINST THE PRESSURE PADS.

B. INSPECTION AND TESTING

1. Check the exposed mechanism for loose screws. Tighten any loose screws EXCEPT DO NOT DISTURB SCREWS ON THE ERASE HEAD ASSEMBLY OR THE SCREW OR NUT WHICH HOLD THE SOUND HEAD IN PLACE.

2. Thread the recorder with tape and make a test recording using procedure described in the operating instructions.

> NOTE: The owner's previously recorded tape may be used to determine what he is complaining about. However, you should make a separate recording in order to make an actual test of the recorder under controlled conditions and assure yourself that his complaint is not traceable to operational errors. Play back the recording which you made and note any irregularities on tape movement, quality of reproduced sound and unusual background noises if present. Also check operation of the controls. If any irregularities in performance are noted, refer to Section II for probable cause and remedy.

C. LUBRICATION

The operator has been instructed not to lubricate this device and has been referred to the service technician for this service which should be on an annual or 500 operating hour basis.

> WARNING: Do not use lubricants other than those specified or in excess of the amounts specified. Excessive lubrication will cause slippage in the drive system. USE A WATCHMAKER'S OIL APPLICATOR OR A BROOMSTRAW - NEVER USE AN OIL CAN.

1. CAPSTAN SHAFT (52) - Apply one drop of Amproil or pure mineral instrument oil to outer end of each bearing. Allow mechanism to run until oil works into the bearing. Then WIPE EXPOSED PORTIONS OF SHAFT TO REMOVE ANY OIL FROM THEM AND CLEAN FLYWHEEL TIRE AND CAPSTAN WITH CARBON TETRACHLORIDE.

2. MOTOR BEARINGS - Apply two drops of Amproil or pure mineral instrument oil to each motor bearing.

> WARNING: The bearings are equipped with wicks, oil the bearings, not the shaft - oil on the shaft will cause slippage. AFTER OILING, WIPE MOTOR SHAFT AND THE FLYWHEEL TIRE WITH A CLOTH DAMPENED WITH CARBON TETRACHLORIDE.

3. TAKEUP SPINDLE (36) - Apply one drop of Amproil or pure mineral instrument oil to the shaft at the end of the bearing adjacent to the pulley—allow mechanism to run and wipe all oil off of pulley and belt.

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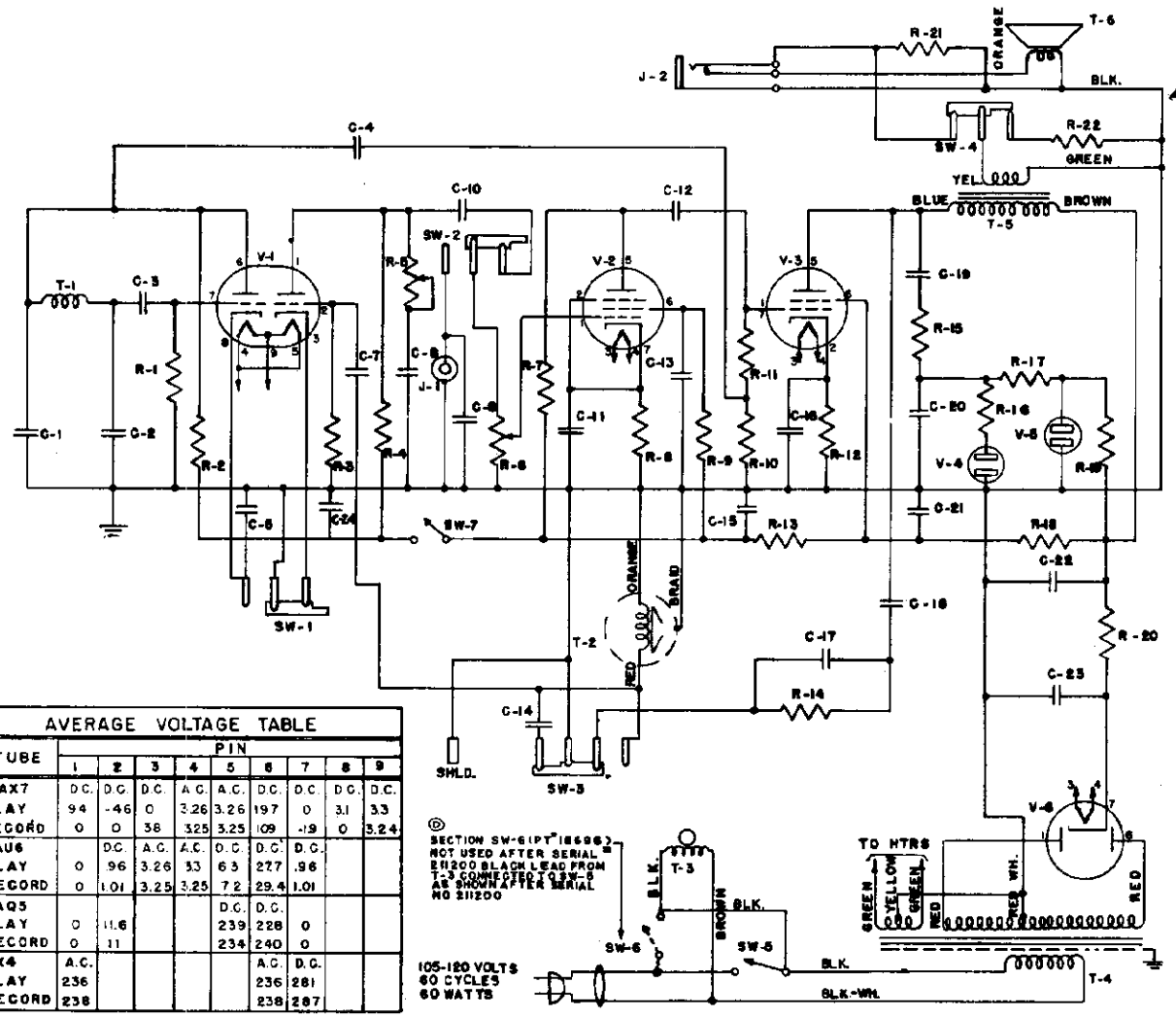

Ⓓ SECTION SW-6 (PT #18696) NOT USED AFTER SERIAL # 211200 BLACK LEAD FROM T-3 CONNECTED TO SW-6 AS SHOWN AFTER SERIAL NO 211200

AVERAGE VOLTAGE TABLE

TUBE	PIN 1	2	3	4	5	6	7	8	9
12AX7	D.C.	D.C.	D.C.	A.C.	A.C.	D.C.	D.C.	D.C.	D.C.
PLAY	94	-46	0	3.26	3.26	197	0	3.1	3.3
RECORD	0	0	38	3.25	3.25	109	-19	0	3.24
6AU6		D.C.	A.C.	A.C.	D.C.	D.C.	D.C.		
PLAY	0	.96	3.26	3.3	63	227	.96		
RECORD	0	1.01	3.25	3.25	72	29.4	1.01		
6AQ5					D.C.	D.C.			
PLAY	0	11.6			239	228	0		
RECORD	0	11			234	240	0		
6X4	A.C.					A.C.	D.C.		
PLAY	236					236	281		
RECORD	238					238	287		

VOLTAGE AT JUNCTION OF R-20 & C-22:
PLAY: 259
RECORD: 260

NOTE: LINE VOLTAGE 115 VOLTS 60 CY. MEASUREMENT OF ABOVE VOLTAGES MADE WITH 20,000 OHMS PER VOLT METER.

MARK	PART No	DESCRIPTION
C-1	18733	CAPACITOR-.0027MFD. 400V. CERAMIC
C-2	18731	" .02 MFD. 400V. PAPER
C-3,4,9	18489	" .0005MFD. 500V CERAMIC
C-5,13,	18732	" .03MFD. 400V PAPER
C-7	18739	" .007MFD. 200V. PAPER
C-8	17782	" .01 MFD. 400V. PAPER
C-10,12	18487	" .01 MFD. 400V. CERAMIC
C-11,16	18716	" 80MFD. 15V ELECT. BNK. I
C-14	18091	" .001MFD. 600V. PAPER
C-15,21	18716	" 4MFD. 350V. ELECT. BNK. I
C-17	18773	" .0003MFD. 600V. PAPER
C-19	18488	" .005MFD. 400V. CERAMIC
C-20,24	18485	" .001MFD. 400V. CERAMIC
C-22	18715	" 30MFD. 350 V. ELECT. BNK II
C-23	18715	" 10 MFD. 350 V ELECT. BNK II
C 18	18492	" .033 MFD 600V. PAPER
R-1, 17	18474	RESISTOR- 470K. 1/2 WATT CARBON
R- 10,2	18471	" 100 K. " "
R-3	17554	" 10 MEG. " "
R-4,7,8	17959	" 220K. " "
R-5	18777	CONTROL-TONE 50 K. CARBON
R-6	18709	" -VOLUME 500K. CARBON
R-7	18467	RESISTOR- 560 K. 1/2 WATT CARBON
R-8	18582	" 2700 OHM " "
R-9	18436	" 18 MEG. " "
R-11,19	18729	" 390K. " "
R-12	18770	" 270 OHM 1 WATT CARBON
R-13	18583	" 22 K. 1/2 WATT CARBON
R-18	18653	" 2700 OHM 1WATT CARBON
R-20	18772	" 390 OHM 2WATT CARBON
R-21	18771	" 33 OHM 1 WATT CARBON
R-22	18718	" 3 OHM 5WATT WIRE WOUND
V-1	18497-5	TUBE- 12AX7 (SELECTED)
V-2	18699	TUBE- 6AU6
V-3	18701	TUBE- 6AQ5
V-4,5	16915-1	LAMP-INDICATOR NE-51 (SEASONED)
V-6	18700	TUBE- 6X4
SW-1	18786	SWITCH, RECORD-LISTEN (PART OF BNK. I)
SW-2	18786	" " " "
SW-3	18786	" " " "
SW-4	18786	" " " "
SW-5		SWITCH, AMPLIFIER (PART OF R-6)
SW-6	18696	SWITCH, MOTOR
SW-7	18696	" "
T-1	18784	COIL, OSCILLATOR
T-2	18737	HEAD, TAPE RECORDER
T-3	18787	MOTOR
T-4	18728	TRANSFORMER, POWER
T-5	18782	TRANSFORMER, OUTPUT
T-6	18775	SPEAKER, TAPE RECORDER
J-1	18708	JACK-PHONO.-MIC.
J-2	18769	JACK-EXT SPEAKER

4. PRESSURE ROLLER SHAFT (pt. of assem. #74) - Wash with carbon tetrachloride then dry thoroughly and apply one drop of Amproil and rotate roller to work into the bearing. Wipe surplus oil off of roller and bracket.

5. ACTUATING COLLARS (16 & 63) - Use a toothpick to apply a thin film of " Lubriplate" or light graphite grease to those surfaces where sliding action occurs.

6. CONTACT SURFACE BETWEEN PRESSURE PAD BRACKET (78) AND PRESSURE ROLLER BRACKET (74) - Use a toothpick to apply a thin film of " Lubriplate" or light graphite grease to the working surfaces.

SECTION II

Trouble Shooting

In this recorder, like any other electro-mechanical device, many things could happen which would affect performance. The purpose of the following table is to group the troubles which may be encountered in as few groups as possible and indicate the probable cause and corrective action to be taken.

TROUBLE AND REMEDY TABLE

Trouble	Probable Cause	Remedy
1. Low pitch	Tape speed is below 3 3/4" sec.	Check Drive (Sec III C-4) Check pressure pads (Sec III C-3) Check Capstan Follower Check Feed Spindle
2. No high frequencies and distortion	Tape not in contact with sound head. Improper Azmuth adjustment Amplifier trouble Improper Guiding Pressure roller actuator has slipped	Damaged head Worn Pressure pad See Sec. IV A Check Amp. (Sec III C-1)

Trouble	Probable Cause	Remedy
3. Varying pitch (Wows)	Feed reel jerks Worn or loose feed guide Worn Capstan bearings Worn or improperly adjusted pressure pads Bent or worn erase lever Eccentric Capstan or Flywheel Tire Bent motor shaft Sound head loose in shield Dirty or worn takeup mechanism Improper guiding Worn takeup drive belt Rewind lever engaged Worn guide surfaces in soundhead	Check felt feed spindle disc Rotate or replace, or tighten (Sec. III C-4) Replace Replace (Sec. III C-3) Replace or repair Replace or exchange (Sec. III C-4) Replace motor (Sec. III C-4) Tighten Clean or replace (Sec. III C-4) Check tape for weaving Replace (Sec. III C-4) See operating instructions Replace
4. Takeup doesn't operate	Dirty or worn friction washer Takeup drive belt off pulleys Takeup drive belt broken or worn out	Clean or replace spindle (Sec. III C-4) Replace Replace
5. Can't thread recorder	Loose pressure roller actuator collar Bent pressure pad springs	Adjust or tighten (Sec. III C-3) Adjust
6. No sound on playback	Loose erase lever actuator collar Amplifier trouble	Adjust and tighten (Sec. III C-3) Plug in mike, switch to "Record" position, turn on motor switch if feedback occurs, check T-2 and input section of V-1. If no feedback, check SW-4, "B" supply & SW-2.
7. Playback OK-won't record	Damaged mike, cable or receptacle Failure of SW-1, 2, 3, or 7 Oscillator section of V-1 not functioning C-4, 17 or 18 open V-4 damaged	Repair Repair or replace (Sec. III C-1) Check and repair Check Replace BOTH V-4 and 5 (Matched set)

Trouble	Probable Cause	Remedy
8. Excessively noisey recordings	C-18 leaking Worn erase pad Recording level too low Weak oscillator or C-4 off value Loose connections in amplifier Damaged mike or mike receptacles Noisey switches Erase head not properly adjusted	Replace Replace (Sec. III C-3) Check V-4 (Replace V-4 & 5 Matched set) Check Check all connections Check Check switch contacts Adjust (Sec. III C-2)
9. Excessive 120 cycle hum	Open filter capacitor Hum shield not bearing on sound head	Check C-15, 21, 22, 23 Check spring
10. Excessive 60 cycle hum	Damaged tube Hum shield not bearing on sound head	Check tubes for heater to cathode leakage Check springs
11. Low gain and distortion	C-18 leaking Damaged 6AQ5 Damaged coupling or decoupling capacitors Poor contact in switches Incorrect recording bias Open cathode bypass capacitor Damaged output transformer Erase head requires adjustment	Replace Check tubes Check Clean or replace Check recording bias Check capacitors Replace Adjust (Sec. III C-2)
12. Microphonics	Sustained (defective 12AX7 or 6AU6)	Replace with selected tube
13. Oscillation	Damaged 12AX7 C-11 or C-16 open	Replace Replace

SECTION III

Service Procedures

A. EXPOSURE OF WORKING COMPONENTS

1. Removal of control panel - loosen the setscrews and lift off the four control knobs (9), then take out the three panel retaining screws (11) and lift off the control panel (10).

2. Removal of recorder from case.

   a. Take out the six screws which hold the tape reel panel (7) in place.

   b. Take out the six retaining screws (8).

   c. Lift recorder assembly out of case.

   d. Remove hex nut, "External Speaker" nameplate, and speaker jack (24).

   e. Remove the four hex nuts, lockwashers and burr washers and lift out the speaker (2).

3. Removal of Amplifier Cover.

   a. Take out the seven cover screws (13) and remove the amplifier cover (12).

B. REMOVAL OF THE MAJOR UNITS

1. Removal of Amplifier Assembly

   a. Complete procedure A.

   b. Loosen setscrew (17) and remove erase lever actuator collar assembly (16) and spring (18).

   c. Place recorder on its side (controls down).

   d. Unsolder recording head cable from the two terminals on the "Play - Record" switch. Mark the terminals.

   e. Remove the three nuts and washers from the amplifier stop screws.

   f. Remove the four screws (26) and grommets (25) which hold the amplifier to the mechanism plate.

   g. Pull the amplifier back away from the mechanism plate and disconnect the amplifier leads from the terminals of the motor control switch.

   h. Disconnect the two motor leads from the amplifier (one was connected to SW-6 in the initial run).

   i. Disconnect the ground wire from the upper flywheel bracket.

2. REMOVAL OF TAPE RECORDER DRIVE ASSEMBLY

   a. Complete procedures A-1, A-2, and A-3.

   b. Remove the motor lock shaft stud (5), lock key (4) and spring.

   c. Remove hex nut (31) and washer (30) then remove the motor plate actuator assembly (27).

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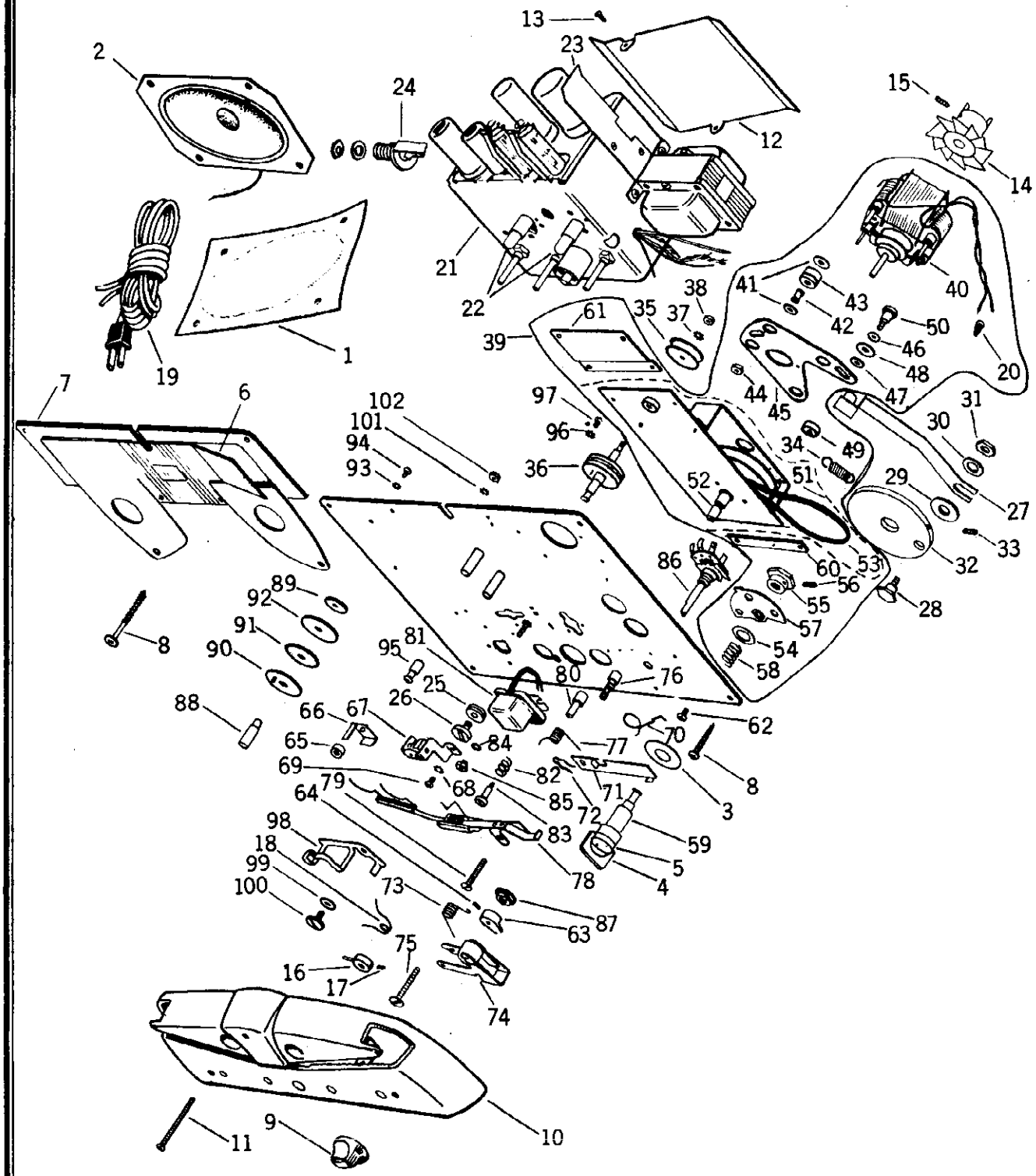

d. Disconnect the motor leads from the amplifier (one lead was connected to SW-6 in the initial run).

e. Disconnect the ground lead from the upper flywheel bracket.

f. Remove the three screws (62) which hold the drive assembly (39) to the mechanism plate.

g. Lift off the drive unit.

C. SERVICING THE MAJOR UNITS

WARNING: NEVER APPLY DIRECT CURRENT TO THE RECORDING HEAD.

1. Servicing the Amplifier and Recording Head.

a. D.C. Voltage Checks - Check all socket voltages—if voltages vary by more than 10% from those indicated on schematic diagram, check tubes (preferably by substitution) and check associated capacitors and resistors. Bear in mind that a leaking filter capacitor may upset voltages on several stages and that a leaking coupling capacitor will upset voltages on the following stage.

b. Bias Current Check - Disconnect the grounded lead from the recording head at the "Play - Record" switch, switch to "Record" position. Insert a D.C. microameter and check for current, if current exceeds 1 microampere, replace C-18. Measure the bias current by inserting a 20 ohm non-inductive (or carbon) resistor between the recording head lead and the switch terminal from which it was disconnected and connect a VT voltmeter across the resistor. The bias current will produce .015 volts ± 10%. Voltages are also subject to the same tolerance as the specific resistor being used in the test circuit. If the current is not within the limits specified, check the oscillator and associated resistors and capacitors. If component values are correct, then push plate and grid leads of 6AQ5 together to reduce current or separate them to increase current.

c. Recording Current Check - Disconnect either lead from the oscillator coil, thereby stopping the oscillator. Connect an audio oscillator to the input jack. Place the "Play-Record" switch in the "Mic" position and turn the "Volume-Control" to the maximum clockwise position. Set the audio oscillator for 400 cycles/sec and adjust the output so that V-4 flashes faintly (NOT A SUSTAINED GLOW). A VT voltmeter and a 20 ohm resistor (when connected as described in Par. b.) will indicate .001-.002 volts (plus or minus tolerance on resistor). The wave form (when viewed on an oscillascope connected across R-22) will be free from distortion. If the current is not correct, change V-4 and V-5 (supplied as a matched and aged set) and recheck. If current is low, increase oscillator level to produce proper curreht and check wave form. If wave is free from distortion, check all resistors and condensers in the neon lamp circuits. If wave is distorted, in-

dicator lamp circuit can be assumed to be correct and recording head or associated supply network is at fault

d. Gain and Distortion Check - Restore recording head circuit to normal—leave oscillator circuit open. Load the output of an audio oscillator with a non-inductive resistor of the proper value and connect the ground terminal of the oscillator output to the amplifier chassis. Connect a 20,000 ohm carbon resistor between the "hot" terminal on the oscillator output and the ungrounded lead from the recording head (resistor and connecting lead should be shielded and shield should be grounded). Turn "Volume" control to maximum clockwise position, and "Play-Record" control to "Play" position. Turn "Motor" switch "ON". Adjust oscillator to 400 cycles/sec and .01 volts (measured across oscillator load resistor). An output meter connected across the speaker terminals should read 2. to 3.5 volts and the output wave form should be free from visible distortion. If distortion is present or output is low, first check the tubes (substituting one at a time) then starting at the output stage, check the wave form at each plate and grid in order to locate the stage in which the distortion is occuring. When the bad stage is located, check all associated resistors, condensers, and connections. If switches are a part of the circuit be sure to check them.

e. Noise Check - Tap each tube with a pencil or other small object and check for microphonics. Any tubes which produce a sustained ringing or crashing noise should be replaced. Operate all switches and check for crashing noises which continue after switch movement has stopped (caused by dirty or worn contacts).

2. Servicing the Erase Mechanism

The erase head consists of a permanent magnet and magnet shield held in place on the mounting bracket by a socket head setscrew and a binder head screw. The proper adjustment of the magnet and shield requires special equipment which is not usually available in a service shop. Therefore, we do not recommend disturbing the two screws referred to. If positioning of the head and erase lever as described herein does not produce satisfactory erasure, or if recordings are noisy and distorted and the cause of the trouble is not traceable to other sources, then a fair adjustment can be made by using the procedures described in paragraph c. The factory service department and certain Authorized Service Stations are equipped to make precision adjustments.

a. Positioning Erase Head - Turn "Play - Record" control to either "Record" or "Mic" position, thereby moving tape erase lever (98) away from the erase pad. Loosen the two screws (69) which hold the erase head to the panel. Rotate the "Motor Control" knob slowly and check to be sure that the erase pad bears evenly on the face of the head. If it does not, rotate the head slightly to correct the condition. Tighten the two screws. Make sure that the tape is pressed firmly against both the magnet and the guard.

b. Positioning the Erase Lever - Turn the "Play - Record" control to the "Play" position. Loosen the setscrew (17) which holds the erase lever actuator collar assembly (16) to the control shaft. Turn the collar clockwise until a straight-edge placed across the erase lever fingers is 1/8" to 3/16" in front of the magnet poles. Move the collar up or down as required so that the actuating arm bears fully upon the ear on the erase lever, then tighten the setscrew. Be sure that the erase lever spring (18) is not pinched between the collar and control bushing. Drop the control panel in place and make sure that the ends of the erase lever fingers are covered by the panel when the control is in the "Play" position and the threading track is clear.

c. Adjusting the Erase Head - The erase head must perform two functions, one, completely remove all previously recorded material, and two, leave the tape in a demagnetized state. Erasure is accomplished by passing the tape thru a strong magnetic field (note that the tape from the supply reel actually is in contact with the leading pole of the permanent magnet). Demagnetization is accomplished by passing the tape through a weaker field of reversed polarity (note that the tape is separated from the trailing pole of the magnet by means of an adjustable non-magnetic guard). If the guard is moved in against the pole of the magnet, the tape passes through a very strong magnetic field which will neutralize the charge placed upon the magnetic coating by the leading pole of the magnet and probably will set up a charge of opposite polarity (this charge will produce excessive tape noise in the recording and also introduce even order harmonic distortion). If the guard is moved as far as possible away from the pole, then the charge placed upon the tape by the erase pole will not be completely neutralized and the remaining charge will again cause excessive tape noise and even order harmonic distortion. Therefore, the placement of the erase guard governs the degree of demagnetization of the tape and proper adjustment will result in the tape leaving the erase head in the desired condition.

1. Adjustment by noise level method (Emergency procedure) - Connect an output meter across the voicecoil of the speaker. Run the recorder and adjust the volume control to produce a low reading on the meter (this will be the system noise for the particular setting of the control). Thread the recorder with a loop of new brown oxide tape which has neither been used for recording or erased. Switch to the "Play" position. Loosen the setscrew (17) and release the erase lever actuator collar (16). Run the recorder and note the output meter reading and listen to the noise.
Loosen the screw which holds the magnet guard in place and move the guard about .005" in either direction. Note the meter reading and apparent increase or decrease in noise. If the latest reading is less than the previous reading, repeat the process after moving the guard a little farther in the same direction. If the reading is more than

the previous reading, move the guard in the opposite direction. When the position is found at which the output meter gives the lowest reading and the listening test indicates the lowest level, this will be the best adjustment attainable by this procedure. Due to the changing nature of the noise, a trained ear may note a more definite minimum noise level than is indicated by the output meter.

2. Adjustment by Harmonic Distortion Method (Preferred Procedure) - This procedure requires the following test equipment:

   Audio frequency oscillator producing 400 C.P.S. free from second harmonic distortion or equipped with filter to attentuate 800 C.P.S. harmonic by at least 75 D. B.

   Matching transformer or network to couple oscillator to input of recorder.

   Distortion meter (harmonic)

   Check the audio oscillator with the distortion meter to be sure that the 400 C.P.S. tone is free from harmonic distortion. Use a filter if necessary. Match the oscillator to the input of the recorder. Connect the distortion meter to the output of the recorder using the procedure recommended by the manufacturer for connecting to a 3.75 ohm source.

   Turn on the recorder, switch to "Phono - Radio" position and adjust the volume control to produce a faint flash from the recording lamp. Check the output of the recorder to be sure that the level being used produces negligible harmonic distortion. If the output is distorted, service the amplifier before attempting to adjust the erase head.

   Thread the recorder with brown oxide tape and record about 5' of tape. Rewind the tape, switch to "Play" position and measure the harmonic distortion.

   Loosen the screw which holds the magnet guard in place and move the guard about .005" in either direction. Repeat the recording and playback operation and again measure the distortion. If the distortion has decreased, continue moving the guard in the same direction and repeating the test until a position which produces minimum distortion has been located. As the point of minimum distortion is approached, move the guard approximately .001" per step (this can be accomplished by only loosening the retaining screw slightly and tapping the guard with a light tool).

   If a considerable number of recorders are to be serviced, the process can be speeded up by placing a second recorder (known to be in good condition) along side of the one being adjusted and using it as a continuous playback unit to monitor a loop of tape upon which a recording is

being made continuously by the unit being adjusted. Slack should be left in the tape as it passes between the two recorders. This produces an additional lag in the record-reproduce process but prevents spurious readings which might be caused if the tape was under abnormal tension in the monitor unit.

Special test equipment can be built for this specific purpose, however, the volume of work to be done will seldom justify the cost of assembling a test device which can only be used for one type of operation.

3. SERVICING THE PRESSURE PADS, PRESSURE ROLLER AND ACTUATING MECHANISM

a. Pressure Pads - If the pressure pads are worn down to a thickness of less than 1/16", lift the end of the pressure pad spring (77) over the end of the "Motor Control" shaft. Take out the screw (79) which holds the pressure pad bracket assembly (78) in place and lift off the assembly and the pressure pad bracket stud (80). Use Petroleum Naptha (140-210F.) as a solvent to remove the old pad. Use Minnesota Mining & Mfg. Co. Cement #EC-104 to cement the new pad in place (Be sure that the edges of the pads are parallel to the edges of the springs and that the ends of the pads are flush with the ends of the springs). Reassemble and install the pressure pad bracket assembly, place the end of the pressure pad spring below the pressure roller actuator (63) and turn the motor control knob slowly. Check to be sure that the pressure pads enter the slots in the sound and erase heads and bear firmly on the proper surfaces of the heads. Turn the "Motor Control" to the "On" position. Loosen the setscrews (64) which hold the pressure roller actuator (63) in place. Turn the "Motor Control" switch to "Off", then turn the actuator collar in a counter clockwise direction until the sound head pressure pad clears the sound head by at least 1/8". Tighten the setscrews and place a speck of "Lubriplate" on the side of the actuator which comes in contact with the end of the pressure pad bracket.

b. Pressure Roller Assembly (74) - Rotate the capstan pressure roller and check for binding. If the roller does not revolve freely, immerse it in carbon tetrachloride and rotate the roller until free. Dry the parts and apply 1 drop of Amproil to the edge of the roller and work it into the bearing. Wipe off any surplus oil.

Check the clearance between the heel of the pressure roller bracket and the body of the pressure pad bracket when the "Motor Control" is "ON". If the clearance is less than .005" file the surfaces to increase the clearance.

4. SERVICING THE RECORDER DRIVE ASSEMBLY

a. Concentricity of Capstan and Flywheel Tire - Use an indicator to check these parts for runout. If the runout exceeds 0.0002" full indicator reading, or the bearings are loose, an

objectionable wow will be produced. If the runout exceeds 0.0002", remove the motor (40) as per sub-paragraph b of this paragraph and replace the flywheel and capstan (52) and the bearings if required (See sub-paragraph d). Organizations not equipped to work to close tolerances may find it to their advantage to send the drive sub-assembly (51) to the factory for replacement with a factory rebuilt unit.

b. Separation of Motor Unit from the Capstan and Takeup As-

1. Remove drive assembly from mechanism plate as per procedure B-2.

2. Loosen setscrew and remove fan.

3. Unhook motor pressure spring (34).

4. Remove the three motor mounting shoulder screws (50), felt washer (48), plain washers (46 & 47) and spacers (49).

5. Lift off the motor unit.

WARNING! When placing the motor on the bench, do not allow the shaft to strike the bench (this might spring the shaft).

c. Servicing the Motor

1. If the motor does not drive the capstan at the proper speed, take off the three nuts (44), and plain washers (41) and remove the motor from the mounting plate (45). Disassemble the motor and clean and relubricate the bearings. Use 3 speaker cone shims as spacers to center the rotor when re-assembling.

2. Concentricity of motor shaft. Use an indicator to check the part of the motor shaft which drives the flywheel. If the runout exceeds 0.0005" full indicator reading, replace the motor.

d. Servicing Capstan and Takeup Assembly

1. Replacing the takeup drive belt (53).

(a) Remove the four screws and lockwashers, the reinforcing strip (60) and plate (61).

(b) Pull off the flywheel lower bracket assembly.

(c) Install the new belt and reassemble the unit. If the Capstan shaft does not revolve freely, tap the two frame members lightly with a screw driver handle in order to line up the bearings.

2. Repair of Flywheel and Capstan

If the runout of either the capstan or flywheel tire exceeds

the tolerance indicated in paragraph 4 a, the flywheel assembly will require replacement. Disassemble as per sub-paragraph 1 and install a new flywheel and bearings if required. Warning! When removing the rivets which hold the bearing retainers in place, be careful not to distort the aluminum frame members.

3. Servicing the takeup spindle assembly

   If takeup jerks or fails to operate, proceed in the following manner:

   (a) Remove drive belt (53) from the takeup pulley (35).

   (b) Remove hex nut (38), lockwasher (37) and spindle pulley (35).

   (c) Remove takeup spindle (36) from the bearing.

   (d) Immerse spindle in carbon tetrachloride and spin reel drive disc to wash dirt out of felt washer.

   (e) Allow carbon tetrachloride to evaporate, then soak the felt washer with Amproil. Gently press the drive disc against the washer to squeeze out the surplus oil. Place the spindle on a blotter and allow it to stand for 20-30 minutes, then wipe excess oil off of shaft and reassemble.

4. Servicing the motor lock - It will seldem be necessary to remove these parts. Should it be necessary to remove them, proceed in the following manner:

   (a) Loosen the setscrew (56) and slide the cam (55) and detent (57) off of the end of the shaft.

   (b) Remove the lock shaft (59), spring (58), and washer (54).

   (c) When reassembling the parts, make the final timing adjustment after the motor assembly and the drive are installed in the recorder. Turn on the motor switch and turn the lock to "Run". Loosen the setscrew (56) and rotate the cam so that the motor shaft is in contact with the flywheel tire and the working side of the cam is not bearing against the motor mounting plate. Tighten the setscrew and turn to "Lock" and check to be sure that the motor shaft is lifted off of the flywheel tire.

SECTION IV

Final Adjustments and Testing

A. MECHANICAL

1. Check operation of felt pressure pads and be sure that they are clean.

2. Check operation of the erase lever and actuating mechanism.

3. Check the feed tension.—Tension should be just great enough to cause tape to follow groove in tape guide at start of 7" reel. If excessive tension is noted, clean or replace friction disc.

4. Check takeup tension — Tension should be great enough to wind tape evenly on the takeup reel, (Watch out for warped reels.) but not great enough to pull tape through the capstan.

5. Check rewind time — 5" reel of tape should rewind in 3 minutes.

6. Check tape velocity—Unwind about 10' of tape from start of reel, place a mark on the light or glossy side of the tape, then measure 36 3/4" and place another mark on the tape. Measure an additional $1\frac{1}{2}$" and place a third mark on the tape. Thread the tape in the recorder. Hold a watch (type with sweep second hand preferred) near the tape guide with the face of the watch vertical. Start the recorder and note the position of the second hand on the watch, when the first mark passes over the guide. If the second mark on the tape reaches the guide within 10 seconds and the third mark does not pass the guide, the speed of the recorder is acceptable. If the speed is low the drive is slipping, pressure on pressure pads is too great, or feed tension is too high. If the speed is high, the flywheel tire is worn.

7. Check the tape passage — Look for weaving of the tape or creeping on the capstan (caused by worn or misaligned pads, tape not guiding properly in head, drive unit loose on mechanism plate, or worn pressure roller).

8. Azmuth adjustment — Thread the recorder with Azmuth adjustment tape, connect an output meter across the speaker voicecoil and rotate the hex nut (85) until maximum output is obtained. Two peaks may be encountered. Adjust for the stronger one.

B. AMPLIFIER

1. Gain Test - Disconnect bias oscillator, connect an audio oscillator to the input jack and adjust the oscillator output to .06 volts at 400 cycles/sec. Connect an output meter and oscillascope across the speaker voice coil. Place the "Play - Record" control in the "Record" position and advance the "Volume" control to a point just below where the wave appears to distort. The output voltage should be at least 2 volts. Restore bias oscillator circuit.

C. FREQUENCY RESPONSE

1. Connections - Connect an audio oscillator to the input jack of the recorder. Connect a VT Voltmeter across the oscillator output. Connect a 3 ohm 5 watt resistor in place of the speaker and connect an output meter across the resistor. Turn tone control to "Treble" position.

2. Tests - Set oscillator to 1000 C.P.S. and set recorder volume control at normal recording position. Adjust oscillator output so that recording indicator flashes very faintly. Record about 10' of tape. Change oscillator frequency to 200 C.P.S. and adjust oscillator output to the same level used at 1000 C.P.S. Record about 10' of tape. Change oscillator frequency to 3000 C.P.S. and adjust oscillator output to 1000 cycle level. Record about 10' of tape. Switch recorder to "Play" position and rewind tape. Start the recorder and adjust volume control to suitable level (not in excess of 2 volts). The output at 200 C.P.S. will usually be within 3DB of the level (maximum permissable variation 7DB), the 3000 cycle will normally be within 3DB of the 1000 cycle level (maximum permissable variation $8\frac{1}{2}$DB).

SECTION V

Assembly Parts List

Ampro Magnetic Tape Recorder

Model 731

Item	Part Number	Quantity Required	NOMENCLATURE 1 2 3 4 5 6 7 8 9
	16929	1	Carton, Recorder Shipping
	A-731	1	Book, Instruction
	20444	1	Recorder Assembly, Magnetic Tape
	111	1	Reel, Tape Recorder
	14112	1	Nut, Wing #10-24
	102	1	Microphone Assembly
	106	1	Cable Assembly, Radio Speaker
1	18779	1	Grille, Speaker
2	18775	1	Speaker, Tape Recorder (T-6)
	1462	4	Washer, Burr
	1679	4	Washer, Lock #8 Ext.
	14975	4	Screw, Rosette Hd. #8-32 x 1" Stl. F-110
	1453	4	Nut, Hex #8-32 Stl. N. P.
	18785	1	Button, Plug
	18698	1	Nameplate, Recorder Case
	14140	2	Screwnail, #15 x 3/8
	18788	1	Nameplate, External Speaker
	18778	1	Case Assembly, Tape Recorder
8	14102	6	Screw, Wood Phillips Oval Hd. #6 x 1-1/4
3	18842	1	Nameplate, Motor Lock
	13465	1	Spring, Motor Lock Key
4	13464	1	Key, Motor Lock
5	12888	1	Stud, Motor Lock Shaft
6	16952	1	Cover, Compartment
	13876	1	Spring, Compartment Cover Retaining
	14141	2	Nut, Speed
	18776	1	Nameplate, Tape Recorder (available only upon certification of loss and serial # of unit)
	14106	2	Rivet, Tub. Oval Hd. .051 x 9/64
7	16951	1	Panel, Tape Reel
8	14102	2	Screw, Wood Phillips Oval Hd. #6 x 1-1/4
	14109	1	Washer, Plain
	14991	4	Screw, Phillips Bd. Hd. #6-32 x 1/4
	13462	1	Bracket, Tape Reel Panel
	14199	1	Screw, Wood Phillips Rd. Hd. #6 x 3/8
9	16926	4	Knob, Control
10	16950	1	Panel, Control
	14107	1	Screw, Phillips Oval Hd. #6-32 x 1-1/2
11	14136	2	Screw, Phillips Oval Hd. #6-32 x 1-3/8
12	13839	1	Cover, Recorder Amplifier
13	14996	6	Screw, Sheet Metal Phillips Bd. Hd. #4 x 1/4 Type Z
14	20446	1	Fan Assembly, Recorder
15	14780	1	Screw, Hdlss. Socket Set #6-32 x 1/8 Cup Pt.

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Item	Part Number	Quantity Required	NOMENCLATURE 1 2 3 4 5 6 7 8 9
16	20414	1	Collar Assembly Erase Lever Actuator
17	14999	1	Screw, Hdlss. Socket Set #4-40 x 3/16
18	15032	1	Spring, Tape Erase Lever
19	18774	1	Cord, Recorder Line, 8 Ft. long
20	18671	2	Connector, Wire
	18697	1	Shield, Motor Switch
21	20445	1	Amplifier Assembly, Tape Recorder
22	16915-1	2	Lamp, Neon (seasoned) (V-4,5)
	18714	1	Shield, Tube Cover
	18497-S	1	Tube, 12AX7 (selected) (V-1)
	18699	1	Tube, 6AU6 (V-2)
	18700	1	Tube, 6X4 (V-6)
	18701	1	Tube, 6AQ5 (V-3)
23	13873	1	Shield, Motor
	14658	1	Screw, Sheet Metal Phillips Rd. Hd. #8 x 3/8 Type Z
	16984	1	Clamp, Cable
	14972	1	Washer, Lock #6 Ext.
	14100	1	Screw, Phillips Bd. Hd. #6-32 x 5/16
	1452	1	Nut, Hex #6-32
	17782	1	Capacitor, .01 mfd. 400 V Paper (C-8)
	18091	1	Capacitor, .001 mfd. 600 V Paper (C-14)
	18485	2	Capacitor, .001 mfd. 400 V Ceramic (C-20, 24)
	18487	2	Capacitor, .01 mfd. 400 V Ceramic (C-10, 12)
	18488	1	Capacitor, .005 mfd. 400 V Ceramic (C-19)
	18489	3	Capacitor, .0005 mfd. 500 V Ceramic (C-3, 4, 9)
	18492	1	Capacitor, .003 mfd. 600 V Paper (C-18)
	18715	1	Capacitor, 10-30 mfd. Elect. (C-22, 23)
	18716	1	Capacitor, 4-4-80-80 mfd. Elect. (C-15, 21, 11, 16)
	18731	1	Capacitor, .02 mfd. 400 V Paper (C-2)
	18732	2	Capacitor, .03 mfd. 400 V Paper (C-5, 13)
	18733	1	Capacitor, .0027 mfd. 400 V Ceramic (C-1)
	18739	1	Capacitor, .007 mfd. 200 V Paper (C-7)
	18773	1	Capacitor, .0003 mfd. 600 V Paper (C-17)
	17554	1	Resistor, 10 megohms, 1/2 watt carbon (R-3)
	17959	4	Resistor, 220 K ohms, 1/2 watt carbon (R-4, 14, 16, 2)
	18436	1	Resistor, 1.8 megohms, 1/2 watt carbon (R-9)
	18467	1	Resistor, 560 K ohms, 1/2 watt carbon (R-7)
	18471	2	Resistor, 100 K ohms, 1/2 watt carbon (R-10, 15)
	18474	2	Resistor, 470 K ohms, 1/2 watt carbon (R-1, 17)

Item	Part Number	Quantity Required	1 2 3 4 5 6 7 8 9
	18582	1	Resistor, 2700 ohms, 1/2 watt carbon (R-8)
	18583	1	Resistor, 22 K ohms, 1/2 watt carbon (R-13)
	18653	1	Resistor, 2700 ohms, 1 watt carbon (R-18)
	18718	1	Resistor, 3 ohms, 5 watt wire wound (R-22)
	18729	2	Resistor, 390 K ohms, 1/2 watt carbon (R-11, 19)
	18770	1	Resistor, 270 ohm, 1 watt carbon (R-12)
	18771	1	Resistor, 33 ohm, 2 watt carbon (R-21)
	18772	1	Resistor, 390 ohm, 2 watt carbon (R-20)
24	18769	1	Jack - External Speaker (J-2)
	18707	1	Board, Terminal
	18773	2	Screw, Sheet Metal Phillips Bd. Hd. #6 x 1/4 Type Z
	18722	1	Socket, Miniature Tube (9-pin)
	18706	1	Base, Miniature Socket Shield
	1466	2	Rivet, Tub. Oval Hd. .085 x 7/32
	18525	1	Clamp, Tube
	18721	1	Socket, Miniature Tube (7-pin)
	14871	1	Rivet, Tub. Oval Hd. .085 x 3/16
	14908	1	Rivet, Tub. Oval Hd. .088 x 1/4
	18720	2	Socket, Miniature Tube (7-pin)
	18524	2	Clamp, Tube
	14871	2	Rivet, Tub. Oval Hd. .085 x 3/16
	14908	2	Rivet, Tub. Oval Hd. .088 x 1/4
	13845	2	Bracket, Resistor Board Mtg.
	14773	2	Screw, Sheet Metal Ph. Bd. Hd. #6 x 1/4 Type Z
	18702	1	Terminal, Locking #4 Double
	1474	1	Rivet, Tub. Oval Hd. 1/8 x 1/8
	13840	1	Platform, Recorder Amplifier Tube
	12540	3	Spacer (Tube Plateform)
	14729	3	Washer, Plain
	14992	3	Screw, Phillips Bd. Hd. #4-40 x 3/8
	18708	1	Connector, Female (J-1)
	12832	1	Base, Microphone Jack
	14993	2	Screw, Phillips Fil. Hd. #4-40 x 1-1/8
	18728	1	Transformer, Power (T-4)
	14994	4	Screw, Phillips Bd. Hd. #8-32 x 1/4 (Sems Unit)
	18782	1	Transformer, Output (T-5)
	14117	2	Nut, Speed #6-32 Type U
	14991	2	Screw, Phillips Bd. Hd. #6-32 1/4
	18784	1	Coil, Oscillator (self-fastening) (T-1)
	18709	1	Control, Volume (R-6)
	14854	1	Nut, Hex. 3/8-32 Washer Type
	18777	1	Control, Tone (R-5)
	16523	1	Washer, Lock 3/8 Int.
	14854	1	Nut, Hex. 3/8-32 Washer Type
	18786	1	Switch, Record-Listen (SW-1, 2, 3, 4)
	14773	2	Screw, Sheet Metal Phillips Bd. Hd. #6 x 1/4 Type Z
	17593	3	Grommet, Rubber
	16910	2	Socket, Neon Lamp
	1474	4	Rivet, Tub. Oval Hd. 1/8 x 1/8
	12886	3	Spacer, Amp. Shock Control
	1698	3	Washer, Plain

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Item	Part Number	Quantity Required	1 2 3 4 5 6 7 8 9
	14972	3	Washer, Lock #6 Ext.
	14153	3	Screw, Phillips Bd. Hd. #6-32 x 1/2
	18702	1	Terminal Locking, #4 Double
	1474	1	Rivet, Tub. Oval Hd. 1/8 x 1/8
	1767	1	Eyelet, Brass
	16824	1	Eyelet, Brass
	1475	11	Rivet, Tub. Truss Hd. .085 x 1/8
25	18794	2	Shock-Mount, Rubber (orange)
	18795	2	Shock-Mount, Rubber (blue)
26	12783	4	Screw, Shoulder, Amplifier Mtg.
	13825	3	Washer, Plain
	14972	3	Washer, Lock #6 Ext.
	1452	3	Nut, Hex #6-32
27	20436	1	Actuator Assembly, Motor Plate
28	12859	1	Screw, Shoulder, Motor Plate Actuator
29	1693	1	Washer, Plain
30	13020	1	Washer, Plain
31	14916	1	Nut, Hex #6-32
32	12858	1	Collar, Motor Plate Actuator
33	14135	1	Screw, Hdlss. Socket Set #8-32 x 7/16 Cup Pt.
	14171	1	Screw, Hdlss. Set Hex Socket #8-32 x 3/8 Cone Pt.
34	15036	1	Spring, Motor Pressure
35	12824	1	Pulley, Takeup
36	20409	1	Spindle Assembly, Takeup
	13827	1	Lever, Tape Rewind
	14130	1	Washer, Plain
37	14972	1	Washer, Lock #6 Ext.
38	1452	1	Nut, Hex. #6-32
39	20447-1	1	Drive Assembly, Tape Recorder
40	18787	1	Motor Assembly, Tape Recorder (T-3)
41	14131	5	Washer, Plain
	1693	1	Washer, Plain
42	12834	3	Sleeve, Motor Mtg.
43	16904	3	Grommet, Rubber
44	14916	3	Nut, Hex #6-32 Brass, N. P.
45	13872	1	Plate, Motor Mtg.
46	1313-10	3	Washer, Plain
47	13940	3	Washer, Plain
48	16923	3	Washer, Felt
49	12838	3	Washer, Motor Mtg. Spacing
50	12837	3	Screw, Shoulder, Motor Mtg.
51	6002	1	Drive Sub Assembly, Tape Recorder
	20406-1	1	Bracket Assembly, Flywheel Upper
	16905-1	1	Bearing, Flywheel
	16906	1	Washer, Felt, Flywheel Brg. Oil
	13846	1	Retainer, Flywheel Bearing
	14105	3	Rivet, Tub. Truss Hd. .098 x 7/64
	20416-1	1	Bracket Sub Assembly, Flywheel Upper
52	20434	1	Shaft & Flywheel Assembly Recorder
53	16912	1	Belt, Takeup Drive
	20407	1	Bracket Assembly, Flywheel Lower
	16905-1	1	Bearing, Flywheel
	16906	1	Washer, Felt, Flywheel Brg. Oil
	13846	1	Retainer, Flywheel Bearing
	14108	3	Rivet, Tub. Truss Hd. .098 x 9/64
	18593	1	Lug, Solder
	14972	3	Washer, Lock #6 Ext.
	14100	4	Screw, Phillips Bd. Hd. #6-32 x 5/16

Item	Part Number	Quantity Required	1 2 3 4 5 6 7 8 9
54	14104	2	Washer, Plain
55	12887	1	Cam, Motor Lock
56	14935	2	Screw, Hdlss Set Hex Socket #8-32 x 1/4 Cup Pt.
57	13463	1	Detent, Motor Lock
	14838	1	Washer, Plain
58	15097	1	Spring, Motor Lock Shaft
59	12889	1	Shaft, Motor Lock
60	13897	1	Strip, Drive Assembly Reinforcing
61	13898	1	Plate, Drive Assembly Reinforcing
	14972	3	Washer, Lock #6 Ext.
62	14153	3	Screw, Phillips Bd. Hd. #6-32 x 1/2
63	12847	1	Actuator, Pressure Roller
64	14780	2	Screw, Hdlss. Socket Set #6-32 x 1/8
65	16871	1	Damper, Tape Erase Pressure Spring
66	13891	1	Stop, Tape Erase Lever
67	20401	1	Magnet Assembly, Tape Erase (adjust after installation)
68	14972	2	Washer, Lock #6 Ext.
69	14991	2	Screw, Phillips Bd. Hd. #6-32 x 1/4
70	15068	1	Spring, Foot Control Lever
71	13877	1	Lever, Pressure Roller Retractor
72	15043	1	Retainer, Pressure Roller Retractor
73	15034	1	Spring, Pressure Roller
74	20404	1	Bracket Assembly, Pressure Roller
75	14101	1	Screw, Phillips Truss Hd. #6-32 x 1"
76	12830	1	Stud, Pressure Roller Bracket
77	15033	1	Spring, Pressure Pad Assembly
78	20439	1	Bracket Assembly Pressure Pad
	16903	1	Pad, Sound Head Pressure
	16920	1	Pad, Tape Erase Pressure
79	14101	1	Screw, Phillips Truss Hd. #6-32 x 1"
80	12823	1	Stud, Pressure Pad Bracket
81	20424	1	Head Assembly, Tape Recorder
82	15035	1	Spring, Recording Head Adjustment
83	12842	1	Screw, Shoulder, Recording Head
84	13208	1	Washer, Plain
85	14103	1	Nut, Lock #6-40
	14109	1	Washer, Plain
86	18696	1	Switch, Rotary (SW-6, 7)
87	14854	1	Nut, Hex 3/8-32 Washer Type
88	12820	1	Stud, Feed Reel
89	13822	1	Spacer, Feed Reel
90	13821	1	Disc, Reel Drive
91	16909	1	Washer, Felt, Reel Spindle
92	13820	1	Disc, Tape Feed Reel Friction
93	14972	1	Washer, Lock #7 Ext.
94	14991	1	Screw, Phillips Bd. Hd. #6-32 x 1/4
95	12821	1	Stud, Tape Guide
96	14972	1	Washer, Lock #6 Ext.
97	14100	1	Screw, Phillips Bd. Hd. #6-32 x 5/16
98	13823	1	Lever, Tape Erase
99	13825	1	Washer, Plain
100	12822	1	Screw, Shoulder, Tape Erase Lever
101	14972	1	Washer, Lock #6 Ext.
102	1452	1	Nut, Hex #6-32
	14313	1	Pin, Grooved, 3/32 x 5/16
	12851	2	Stud, Tape Rewind Guide
	12836	1	Stud, Recording Head Adjustment
	13871	1	Plate, Tape Recorder Mechanism

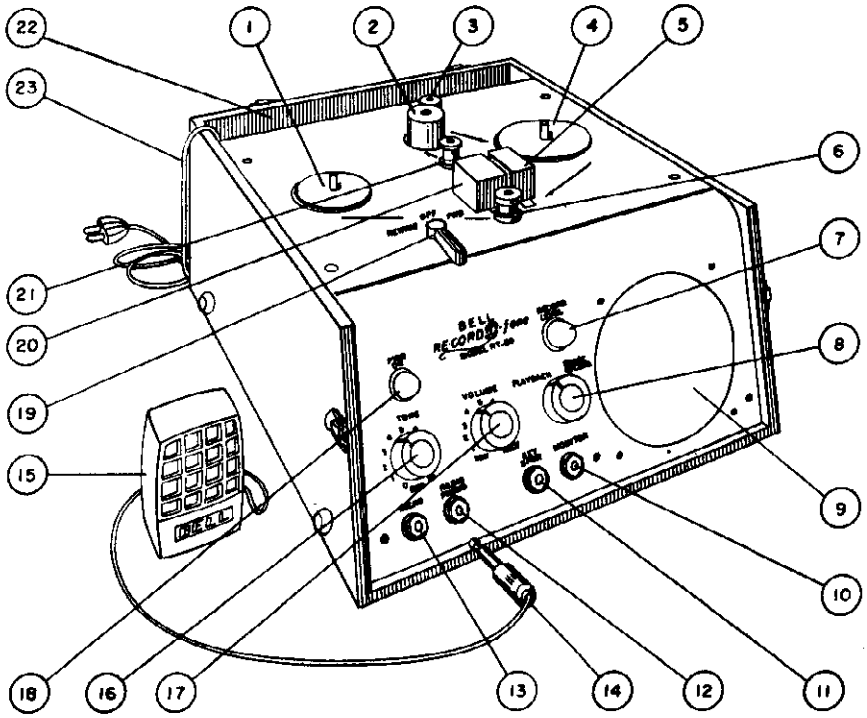


DIAGRAM SHOWING NAME AND LOCATION OF PARTS.

1. Supply Reel Platform
2. Capstan
3. Pressure Roller
4. Take-up Reel Platform
5. Pressure Pads
6. Idler Roller & Tape Guide
7. Recording Level Indicator
8. Erase Record-Playback Control
9. Speaker
10. Headphone Monitoring Jack
11. External Speaker Jack
12. Radio or Phono Jack
13. Microphone Jack
14. Microphone Plug
15. Microphone
16. Tone Control & Master Power Switch
17. Volume Control
18. Pilot Light
19. Direction Control - 3 Position Rewind-Off-Forward
20. Erase-Record-Playback Head
21. Tape Guide Post
22. Storage Compartment for Power Cord, Reels and Microphone
23. Power Cord

SPECIFICATIONS

POWER SUPPLY:	115 Volts 60 Cycles A. C.
POWER COMSUMPTION:	90 Watts maximum - 1.1 Amp.
TAPE SPEED:	7 1/2 inches per second
RECORDING TRACK WIDTH:	3/32 inch - dual track

MODEL RT-65

RECORDING MEDIUM:	Plastic or Paper tape - Red or black oxide, (Plastic red oxide preferred.)
RECORDING TIME:	5 inch reel; 15 minutes each track, 30 minutes total. 7 inch reel; 30 minutes each track, one hour total.
FREQUENCY RESPONSE:	70 to 8,000 c.p.s.
REWIND SPEED:	6 to 1 ratio, 5" reel 2 1/2 minutes; 7" reel 4 minutes
TYPE OF ERASE AND BIAS:	High Frequency A. C. 48 K.C.
RECORDING LEVEL INDICATOR:	Neon Lamp NE-51
POWER OUTPUT:	3.5 Watts - 6V6GT output tube.
AMPLIFIER:	4 stages with inverse feedback - volume and tone controls - high and low frequency compensation in record and playback.
SPEAKER:	6 inch heavy duty, 8 watt capacity
INPUTS:	Microphone 75 db gain - Phono or Radio 40 db gain. Play back gain 85 db.
OUTPUTS:	External speaker 3.2 ohm - Monitor for headphones or meter 500 ohm source with voltage divider.

NOTE: (1) Internal speaker disconnects when external speaker jack is used.
(2) 500 ohm output is available by shorting out 10,000 ohm resistor inside amplifier.
(3) A power amplifier may be driven from either external speaker or monitor jack. If external speaker jack is used a 3 ohm 5 watt resistor should be shunted across the connecting plug or amplifier input, to provide load on recorder amplifier.

FUSE: 2 Amp solder-in type GJV located underneath chassis.

HOW TO REMOVE TOP PLATE MECHANICAL ASSEMBLY FROM CABINET

This is necessary to gain access to tubes, controls, etc.

CAUTION - - USE EXTREME CARE IN REMOVING THIS ASSEMBLY TO PREVENT DAMAGE TO FAN.

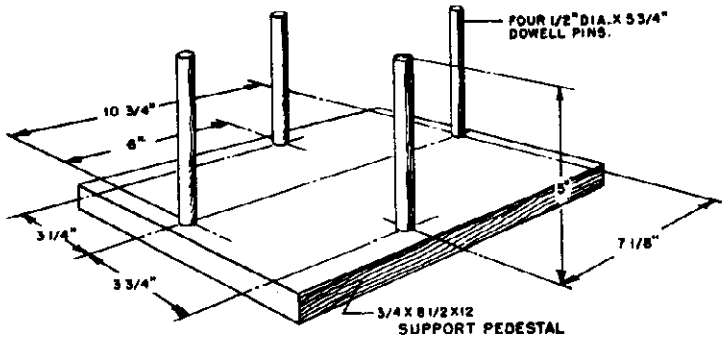
1. Remove four 10-32 large truss head screws along right and left edges of panel.
2. Lift plate up at right side by grasping take-up reel with left hand. Now, grasp right front corner of plate with right hand and left rear corner with left hand. Pull plate to the right enough for the casting to clear brackets on left side of cabinet and lift up. Top plate is now free except for head wires and 5 prong plug.
3. Push plate to extreme rear of cabinet and rest back of plate on vent grille. Prop front up with piece of wood or carboard box while unsoldering four head leads. Remove 5 prong plug and mechanical assembly is now free.

NOTE: A. In some earlier models of recorders using a shorter motor, lift top plate up at front and pull forward until casting clears cabinet bracket on right side. Now move plate to right to clear left hand cabinet bracket, lift up and assembly is free except for head wires and plugs. See paragraph 3 above.

B. If in some models there is difficulty in removing top plate without striking fan, remove chassis and front panel by taking out 3 Phillips oval head screws from bottom of case and 2 on each side (7 total).

CAUTION: DO NOT SET THIS ASSEMBLY DOWN ON FAN BLADE.

4. See sketch below for details of a pedestal for supporting top plate assembly while making examination or repairs.



HOW TO REMOVE AMPLIFIER FROM CABINET

1. First it is advisable to remove top plate assembly (see above).
2. Remove 3 Phillips oval head screws and finish washers from bottom of case, remove 4 same type screws and washers from cabinet sides.
3. Push chassis toward front of cabinet while supporting front panel.
4. Unwind power cord if coiled up and push under cabinet vent partition. Remove cable clamp.
5. Unsolder 4 head connections located on slide switch, if not already detached, remove 5 prong plug. Amplifier is now free.

REMOVING TOP PLATE FROM MECHANICAL ASSEMBLY

1. If possible, rest unit on pedestal as described earlier - if this is not available remove fan blade and rest unit on motor shaft.
2. Remove pointer knob from control shaft. Remove four Phillips oval head 10-32 machine screws recessed in panel.
3. Top panel will now lift off of mechanical assembly. It is best to disconnect two wires to blade switch otherwise top panel must be placed to one side while working on either mechanical unit or top plate mechanism.

TOP PLATE MECHANICAL INSPECTION
(See Drawing Fig. 2)

1. With top plate removed from mechanical assembly check the parts located on underneath side of top plate as follows:
Push bell crank (14) toward front edge of top plate, as far as possible, release slowly and note sliding parts. These should not bind or stick in any position. If they do, remove and check for burrs or rough places. Parts should be well lubricated with Sta-Put #18-H grease. See paragraph describing lubrication of recorder. To check roller slide assembly (10) alone, push bell crank forward and while holding against spring, move roller slide assembly and check for sticking friction. To check pressure pad slide assembly (7) alone, push roller slide assembly (10) toward rear of top plate and move bell crank in both directions. Check bell crank (14) to see that it works free and does not strike rubber grommet (17). Bend away slightly if necessary.
2. Install top plate to mechanical assembly and check the following:
Rotate control knob to forward position. The pressure pad slide assembly (7) must be against its full travel stops when control is in the forward position and indexed. Check as follows:
(a) If pad slide assembly moves still further (is not against the stop) when control knob is pushed beyond the index point, the bell crank flange should be bent toward the cam which acuates the bell crank.
(b) If pad slide assembly hits its stops before the control is forward in the index position it is necessary to bend the bell crank flange slightly away from the cam.
3. Check the blade switch (18), which is operated by the cam and bell crank (14), and make sure that it is closed in the forward position only. If the switch closes in off or rewind position, bend the angle bracket which mounts switch, by lessening the 90 degree angle.

MODEL RT-65

MECHANICAL ASSEMBLY INSPECTION AND TESTS

(See Drawing Fig. 3)

1. Driving Surfaces:

All driving surfaces and surfaces which touch the tape must be free of oil or grease. These includes:

(a) Motor Shaft (53).
(b) Idler wheel, rubber surface (34).
(c) Supply or rewind drum, tapered driven surface (44).
(d) Capstan drum, driven surface (8).
(e) Take-up drum, driven surface (1D).
(f) Belt (13).
(g) Capstan rubber drive (8).
(h) Capstan pressure roller (10C-Fig. 2)
(i) Tape guide rollers (2) (12-Fig. 2)
(j) Recording head surface (2- Fig. 2)
(k) Felt pressure pads (2) (7D - Fig. 2)
(l) Motor pulley groove (28 - Fig. 3)
(m) Belt pulley groove (17)

Wipe off any oil or grease with a clean dry cloth. Carbon tetrachloride may be used but must be wiped off any rubber surface immediately or unit will not have good drive for several hours after application. Use sparingly.

2. Drive Tests:

With motor power off:

(a) With control knob in forward position, manually turn capstan clockwise. The idler should cause motor shaft to rotate, which will in turn rotate take-up drum. Oil or grease on idler, motor shaft, belt, belt pulleys, or take-up drum driven surface will cause a failure of this test. In off position, clearance between idler rubber surface and motor shaft should not be more than .031 inches. This clearance can be reduced by taking up clearance in 4 motor mounting bolts and 3 motor mounting plate screws, in the direction toward the idler. The idler cam part #2043 can cause too much clearance also. Replace cam or bend small stop (1/16" high) toward center hole.

(b) 1. AFTER MACHINE HAS BEEN RUNNING IN THE CABINET FOR FIVE MINUTES OR MORE AND CLUTCHES HAVE BEEN SLIPPING (Normal forward operation), CHECK AS FOLLOWS:

Place a full 5" plastic reel of tape on the take-up drum - hook a gram or ounce scale to end of tape and throw control to forward position. The pull should be 1-1/2 to 2 ounces (40-55 grams). Wipe oil off clutch if above this amount. Add a few drops of STA-PUT #360 if below this amount.

2. Place a full 5" plastic reel of tape on the rewind drum and hook scale to tape end as before. Motor control should be in off position. Measure pull necessary to unwind tape from reel, this should be 1/2 to 3/4 ounce (15 to 20 grams). Remove or apply lubricant as described in preceeding paragraph. NOTE: - Addition of oil increases tension and pull of either clutch.

Clearances:

(a) Idler roller to motor shaft 1/32" maximum, 1/64" minimum, control in "off" position.
(b) Brake (24 Fig. 3) to take-up drum (1D) 1/32" minimum, control "rewind" position.
(c) Idler roller edge to motor frame 1/32" minimum, control "off" position. "Forward" position same, 1/32" minimum. There must be a minimum of end play in idler shaft, idler lever assembly and idler pulley, so that idler does not rub motor, idler lever or motor pulley.
(d) Belt to take-up drum, control "off" position, 1/32" minimum with motor running.
(e) End play - take-up, capstan and rewind drums must have some end play but not to exceed 3/64". Motor shaft should also have slight end play.

4. Timing Tests:

(a) Motor running, turn control knob slowly toward "forward" position. Capstan should start to rotate before take-up drum.
(b) Motor running, turn control knob slowly from "rewind" to "off" At same time spin take-up drum manually. Brake should stop take-up drum before rewind drum stops rotating.
(c) The speed of the tape thru the recorder can be checked with Minnesota Mining #43 Leader and Timing Tape. An 18.75 foot length of tape should run 30 seconds plus or minus .5 second. Unit should be tested after it has warmed up.

5. Miscellaneous Tests:

(a) Motor running, control in off position, check belt position in large pulley groove. The belt should not climb or rotate about the center of a cross section. To remedy change pulley #2081 or take up all excess play in lever assembly #2080. Replace belt.

INSTRUCTIONS FOR LUBRICATION

DO NOT LUBRICATE THIS INSTRUMENT UNTIL YOU READ THESE INSTRUCTIONS AND OBTAIN THE CORRECT LUBRICANTS.

(1) All the wiping surfaces of mechanical linkages should be free of dirt and foreign material and be lubricated lightly with STA-PUT #18-H grease. This lubricant should be at point of friction only and wiped clean from other surfaces.
(2) The felt clutch washers on TAKE-UP AND REWIND drums should be lubricated ONLY after tests indicate the necessity. Use a small amount of STA-PUT oil #360 and make tension tests as outlined under "Mechanical Assembly Inspection and Tests." Wipe off excess oil from all surfaces including felts.
NOTE: IF tension tests cannot be met with addition of small amount of oil, the felts are worn and should be replaced.
(3) For all other bearings and shafts, use a light spindle oil such as Kensington #9. Clean surface to be lubricated first, then apply only two to three drops.
NOTE: The above lubricants can be obtained from the E.F.Houghton & Co. Pipe cleaners are excellent for applying either oil or grease.

AMPLIFIER TESTS AND REPAIRS

See paragraph on "How To Remove Amplifier From Cabinet."

1. See schematic wiring diagram (Fig.4) for all voltages.

2. Check all tubes, inspect wiring and slide switch for poor or open connections.

3. If indicated, test volume control for open or poor connections.

4. Always check head surface for dirt and clean thoroughly. Test for continuity if suspected of being open. Erase winding 11 ohms playback-record winding 170 ohms. Demagnetize head by operating in record position for short time.

5. Test jacks for open or shorted circuits. Microphone jack must be insulated from front panel.

6. Test bias oscillator as follows: Throw switch to record position. Connect A.C. vacuum tube voltmeter capable of measuring 50 K.C. across erase winding at slide switch. Close blade switch (18, Fig. 2) on top panel by hand. Voltage should be 40 volts or more. Check frequency with signal generator and scope. This should be 48 K.C. plus or minus 3 K.C.

7. Hum test in record position - this can be measured across monitor jack. Turn volume and tone control full on, insert dummy shielded open-circuited plug in microphone jack. Amplifier must have bottom shield plate in place and line cord in proper polarity. Voltage should be less than 3 volts. Be sure bias is off. For playback test it will be necessary to listen to the hum in the speaker as the minimum audible hum and minimum voltage reading are not the same.

The power transformer is mounted so that it can be rotated on its axis to cancel hum picked up by the head. THIS HAS BEEN ADJUSTED AT THE FACTORY FOR MINIMUM HUM AND SHOULD NOT HAVE TO BE READJUSTED UNLESS MAJOR REPAIRS ARE MADE SUCH AS REPLACEMENT OF POWER TRANSFORMER, ETC.

To do this it is necessary to remove both the top plate and chassis from the cabinet. The chassis must rest on a sheet of metal similar to the bottom plate in cabinet to be shielded properly. The top plate must be placed in exactly the same position as when installed in cabinet, i. e., the top plate must be level with top of front panel of chassis. It must also have about 1/8" space between flange of top plate and flange of front panel. It may be rested on cardboard boxes or pieces of wood. Loosen four transformer mounting screws, rotate transformer for minimum audible hum (volume control turned on full). Tighten screws. NOTE: There are two null points 180 degrees apart. One will have much lower audible hum than the other. Do not rotate transformer too far or leads may be broken underneath chassis.

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INSPECTION AND TEST OF COMPLETE RECORDER

The testing of the complete recorder can be accomplished by making recordings with microphone, record player, radio, etc., but if instruments are available a more accurate test can be made.

(1) VISUAL TESTS

First, visually inspect the recorder for mechanical defects which can be detected by eye. Check for dirt pile up on record-playback and erase poles of head, clean with cloth slightly dampened in carbon tetrachloride. Check tape guide rollers for easy turning, the outside surfaces should be free of oil and dirt. Check capstan and pressure roller surfaces, clean if necessary with carbon tetrachloride but wipe off immediately so that roller will not soften.

Turn control to rewind and forward positions. Control should index in both positions smoothly. In forward position, both felts should be against head, and roller against capstan.

In off position roller should move away from capstan and allow enough room for feeding tape between roller and capstan. This should be a gap of 1/16" or more. Also, felt pads should move away from head to allow threading of tape between pads and head. The gap should be 1/8" or more. CAUTION: Do not bend springs to meet this dimension. See (2) below.

Check controls on front panel, tone control and power switch and Erase-Record-Playback Switch. These should operate smoothly without binding. If Erase-Record-Playback knob does not operate properly, remove top plate and check slide switch mechanism and shaft rear bearing. Be sure slide switch throws to full extent each position. It may be necessary to position rear bearing on a slight angle to cause this action. Check the position of the shaft arm located on the bearing shaft. To change position of this shaft arm it will be necessary to remove amplifier unit and loosen set screw with screwdriver inserted from underneath chassis thru hole provided. NOTE: - When checking switch, chassis must either be bolted in cabinet or on flat surface.

(2) HEAD TESTS AND ADJUSTMENT

To properly check head alignment it is necessary to have a roll of pre-recorded head alignment tape of one mil wave length, or 7500 cycles (3M head alignment tape #119). Play this back through recorder with A.C. vacuum tube voltmeter connected to monitor jack. Volume control full on. CAUTION: Be sure switch is in PLAYBACK position so as not to erase tape. The meter should read 15 volts or higher. Three things can cause low meter readings, (provided amplifier and tubes are okay). (1) wrong head alignment angle, (2) dirty head or (3) improper pressure of felts. Remove right hand cover which protects the felts and springs. Check head and be sure there is no dirt on poles or bakelite. Dirt holds the tape away from the poles and lowers output. If dirty, clean with carbon tetrachloride and allow to dry. Start the recorder and turn volume full on. With one finger push the felt (farthest from front) toward head. This will increase pressure and indicate whether there was sufficient pressure. If the voltage increases more than one or two db (2 or 3 volts) check the pressure of the felts with a gram or ounce scale gauge. This may be two ounces (55 grams) but NO MORE.

To do this, turn off power switch but throw control to forward. Connect the gauge to the top of the felt and spring. Pull at right angles enough to just lift the felt off the head. Read gauge. If pressure is under 2 ounces, the springs can be bent forward by carefully applying pressure at bottom or by tightening set screws. The set screw adjustment is very critical, so caution must be used if screws are tightened.

NOTE: - Too much pressure will wear the head unnecessarily, cause dirt to accumulate too fast, cause tape to slow down and possibly cause wow. It may also cause tape to squeak and vibrate as it enters head.

(3) HEAD ALIGNMENT

If head is clean and felts have proper tension check the tightening of screws on both sides of head cover. If both are tight, loosen first one slightly, then tighten and loosen other slightly while watching meter. If meter reading goes up when either screw is loosened, make sure other screw is tight and adjust this one for a maximum of voltage, using 7500 cycle head alignment tape.

(4) FREQUENCY TESTS

To make overall frequency response and gain test, proceed as follows:

Connect a signal generator to phono input and adjust and hold the input voltage to .03 volts. Install a reel of 3M plastic tape (red oxide) and record the following frequencies: 70, 125, 250, 500, 1000, 2000, 4000 and 8000. Rewind and playback measuring the voltage

in the monitor jack with a 3.2 ohm (5 to 10 watt) load plugged in the external speaker jack. The output voltage should be approximately 5-7 volts at 1000 cycles. The various frequencies should be within a total of plus or minus 3 to 4 db. Use a good A.C. V.T.V.M. for all voltage readings at all frequencies.

If the unit does not record and play back within these limits it will be necessary to check the complete amplifier unit and make tests as outlined under "Head Tests." NOTE: Before condemning either amplifier or head adjustments be sure tests were made exactly as outlined above. Be sure V.T.V.M. has flat frequency response.

(5) ELECTRICAL TESTS

Amplifier Unit only:

(a) Distortion Test - Connect signal generator to phono input and load resistor of exactly 3.2 ohms (5 watts or more) to external speaker output. At 1000 cycles it should be possible to obtain at least 3.35 volts at less than 8% distortion across load as measured on a "total distortion" type analyzer. This is 3.5 watts of power.

(b) Gain Test - The voltage at the phono input should be within 2 db. of .145 volt to obtain 3.5 watts output at 1000 c.p.s. as outlined in (a).

(c) Frequency Response - Connect signal generator to phono input and use 50, 100, 1000 and 10,000 cycles for test. Use .03 R.M.S. volts input (hold constant). Using 1000 c.p.s. reference 100 cycles should be plus 7 db when measured at monitor jack with 3.2 ohm plugged in internal speaker jack. 50 c.p.s. up 4.25 db, 10,000 c.p.s. up 5 db. These should be within plus or minus 1 db.

(d) Tone control should drop response 27 db plus or minus 2 db at 10,000 c.p.s. when turned to minimum position and 10 db plus or minus 1 db at 1000 c.p.s.

(e) See schematic wiring diagram (Fig. 4) for voltages of various parts of circuit both A.C. and D.C.

SOME COMMON FAILURES AND THEIR REMEDIES

The most common causes of failure are dirt on head (which should be cleaned regularly), defective tubes and oil on driving surfaces (see "Mechanical Assembly Inspection and Tests").

1. Will Not Record: (Neon Lamp Flickers)	A. Open record-playback head winding or leads. B. Output transformer open or shorted 500 ohm winding. C. Open 150 K resistor (R-19) in series with head. D. Open or short section of slide switch.
2. Will Not Play Back:	A. Amplifier inoperative. See "Amplifier Tests and Repairs." B. Open or short section of slide switch. C. Open or shorted speaker coil or external speaker jack.
3. Tubes Will Not Light Up: (Inoperative)	A. Fuse open. Replace with 2 Amp Littelfuse Type GJV. B. Defect in line cord or attachment cap. C. Open power transformer winding. D. Open A.C. switch on volume control.
4. Will Not Erase:	A. Open erase winding in head. Replace head. B. Open or short in slide switch. C. Bias Oscillator not working properly. See "Amp tests and repairs."
5. Does Not Record or Play Back Properly: (Distorts)	A. Dirt covering either or both poles of head. Clean head. B. Bias oscillator weak or wrong frequency. C. Amplifier defective. See "Amplifier Tests and Repair." D. Check contact closure of bias switch under control lever in forward position.
6. Piano and Sustained Notes Have Flutter or Wow.	A. Wow or waver. Check idler, capstan, belt, take-up drum and felt pressure disc for wow. These parts should not have flat spots or be oily or greasy with the exception of the felt disc. To find which part is at fault make a mark with chalk or crayon which can be seen while unit is running. Record a constant note of 400 to 1000 c.p.s. Play

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back the recording and listen to wow while watching mark as it rotates. Correlate the rate of any severe fluctuation with the rotating speed of the mark. If the wow and mark are exactly synchronized, replace the part which is marked. NOTE: Slight fluctuations may be found on any recorder but these will not interfere with music as the constant note test is a severe one.

B. Flutter. The cause of flutter, which is a very rapid wow, is more difficult to locate. (1) If the roller nearest front panel is bakelite, replace with an aluminum type, available from the factory, for a trial recording. (2) Check pressure pad tension against the tape. This must not exceed 55 grams (2 ounces) to start pulling pad away from tape. (3) Check motor for undue amount of vibration. Check for slightly bent shaft. Check shock mounts of motor mounting plate, these should be free vertically but must be firm against rubber sideways. Check spacing of idler wheel, check belt for abnormal vibration due to uneveness. Check fan blades and straighten if necessary.

AMPLIFIER PARTS LIST

Major Items

Resistors

R3	470,000	½W 10%
R4	270,000	" "
R13	"	" "
R14	"	" "
R23	"	" "
R6	3300	" "
R7	130,000	" 5%
R12	"	" "
R8	22,000	" "
R9	2700	" 10%
R10	100,000	" "
R16	"	" "
R26	"	" "
R35	"	" "
R11	39,000	" "
R15	360	1W 5%
R17	10,000	½W 10%
R18	"	" "
R19	150,000	" "
R20	6800	1W "
R21	4700	1W "
R24	3	5W
R25	27,000	½W
R28	500,000	Control Audio Taper
R29	500,000	" w/sw. Audio Taper
R31	150	½W. 10%
R32	"	" "
R33	10 Meg.	" "
R34	10,000	2W "
R35	100,000	½W "
R36	82,000	½W "

Capacitors

C1	.02 mfd.	600 Volt Tubular
C2	.01 "	450 " Ceramic
C4	" "	" " "
C3	.05 "	200 " Tubular
C5	.05 "	600 " "
C10	" "	" " "
C11	" "	" " "
C21	" "	" " "
C6	200mmfd.	500 " Mica 5%
C7	.01 mfd.	300 " " "
C8	" "	" " " "
C9	.015 "	600 " Tubular 5%
C12	.005 "	500 " Mica 5%
C13	.001 "	600 " Tubular
C14	.002 "	" " "
C16	200 mfd.	500 " Mica
C17	20-20-20 mfd. 450-450-25 Volt Electrolytic	
C18	20-20-20-mfd. 450-450-25 Volt Electrolytic	
C19	40 mfd. 450 Volt Electrolytic	
C20	470 mmfd. 500 Volt Mica	

Miscellaneous	Bell Part No.
Power Transformer	B-20203
Output Transformer	B-20204
Oscillator Transformer (High frequency erase and bias)	B-13793
Slide Switch	B-13053P4
Blade Switch (on top panel)	A-13055
Fuse - 2 Amp. Solder in Type GJV - Littelfuse	
Pilot Lamp Socket	B-20045P18
Level Indicator Socket	B-20045P19
Loudspeaker - 6" P.M.	B-20111P17
Recording-Erase-Playback Head-Shure TR-5	B-13828

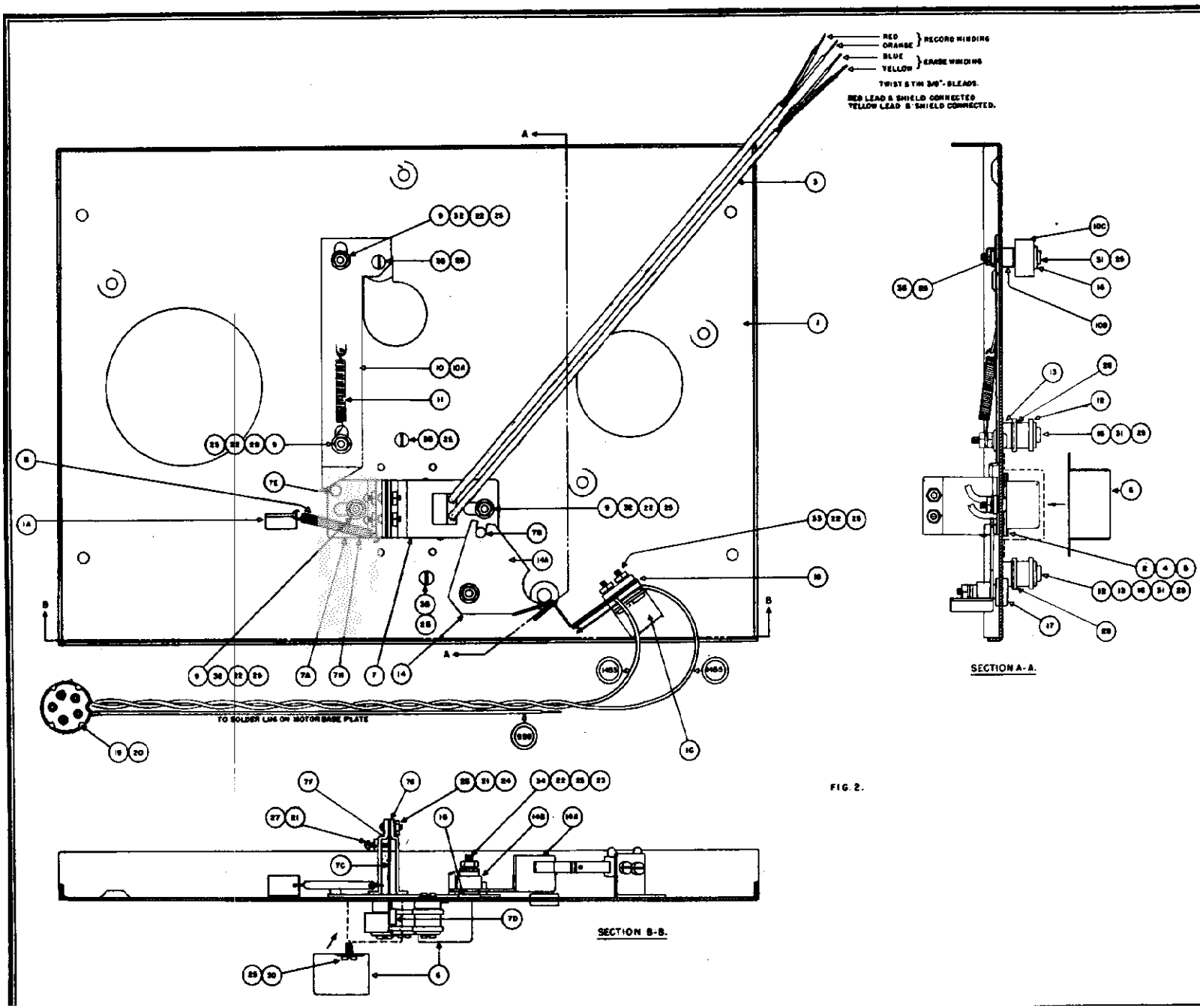


FIG. 2.

39		3	6-32 X 5/16 BHMS-STL.-Z.P.
34		1	6-32 X 7/8 BHMS-STL.-N.P.
33		2	6-32 X 3/8 BHMS-STL.-Z.P.
32		3	6-32 X 7/16 BHMS-STL.-N.P.
31		3	6-32 X 5/16 BHMS-STL.-N.P.
30		6	6-32 X 1/4 BHMS-STL.-N.P.
29		1	6-32 X 5/8 FHMS-STL.-N.P.
28	2012	2	FELT WASHER
27		2	4-40 X 3/8 RHMS-STL.-Z.P.
26		2	4-40 X 5/16 RHMS-STL.-Z.P.
25		17	#206 LOCKWASHER-STL.-Z.P.
24		2	#804 LOCKWASHER-STL.-Z.P.
23	2008MP17	1	FLAT WASHER-STL. CD.P.
22		7	6-32 ST. HEX. NUT-STL. Z.P.
21		4	4-40 ST. HEX. NUT-STL. Z.P.
20		1	SHELL (# 7008)
19		1	PLUG (M-51)
18	A-13055	1	SWITCH
17	8-2008SP25	1	RUBBER GROMMET
16	A-13817	3	IDLER CAP
15	A-13824	1	BELLCRANK SHAFT
14B	A-13825	1	BEARING
14A	A-13848	1	BELLCRANK
14	A-13849	1	BELLCRANK ASSEMBLY
13	B-13839	2	IDLER ROLLER SHAFT
12	B-13838	2	TAPE IDLER ROLLER
11	B-2015MP6	1	TENSION SPRING
10C			ROLLER (# 25158)
10B	A-13820		ROLLER SHAFT
10A	B-13811		ROLLER SLIDE
10	A-13846	1	ROLLER SLIDE ASSEMBLY
9	A-13819	4	SLIDE BEARING
8	B-2015MP8	1	TENSION SPRING
7D	B-2016SP6		2-FELT PAD
7C	A-13813		2-PAD SPRING
7B	A-13810		ACTUATING PIN
7A	A-13811P2		1 BRACKET
7F	A-13811P1		1 BRACKET
7H	A-13809		1 SLIDE
7A	A-13844		1 PAD SLIDE WELD ASSEM.
7	B-13840	1	PAD SLIDE ASSEMBLY
6	B-13829	2	HEAD COVER
5	A-13828	2	.043 GRS SHIM
4	A-13830	2	HEAD LOCATING PIN
3		2	VINYLITE SLEEVE (CUT TO LENGTH)
2	B-13822	1	SHURE RECORDING HEAD
1C	A-13783		SW. MTG. BRACKET
1A	A-13790		SPRING SUPPORT BRACKET
1	C-13788	1	TOP PLATE WELD ASSEMBLY

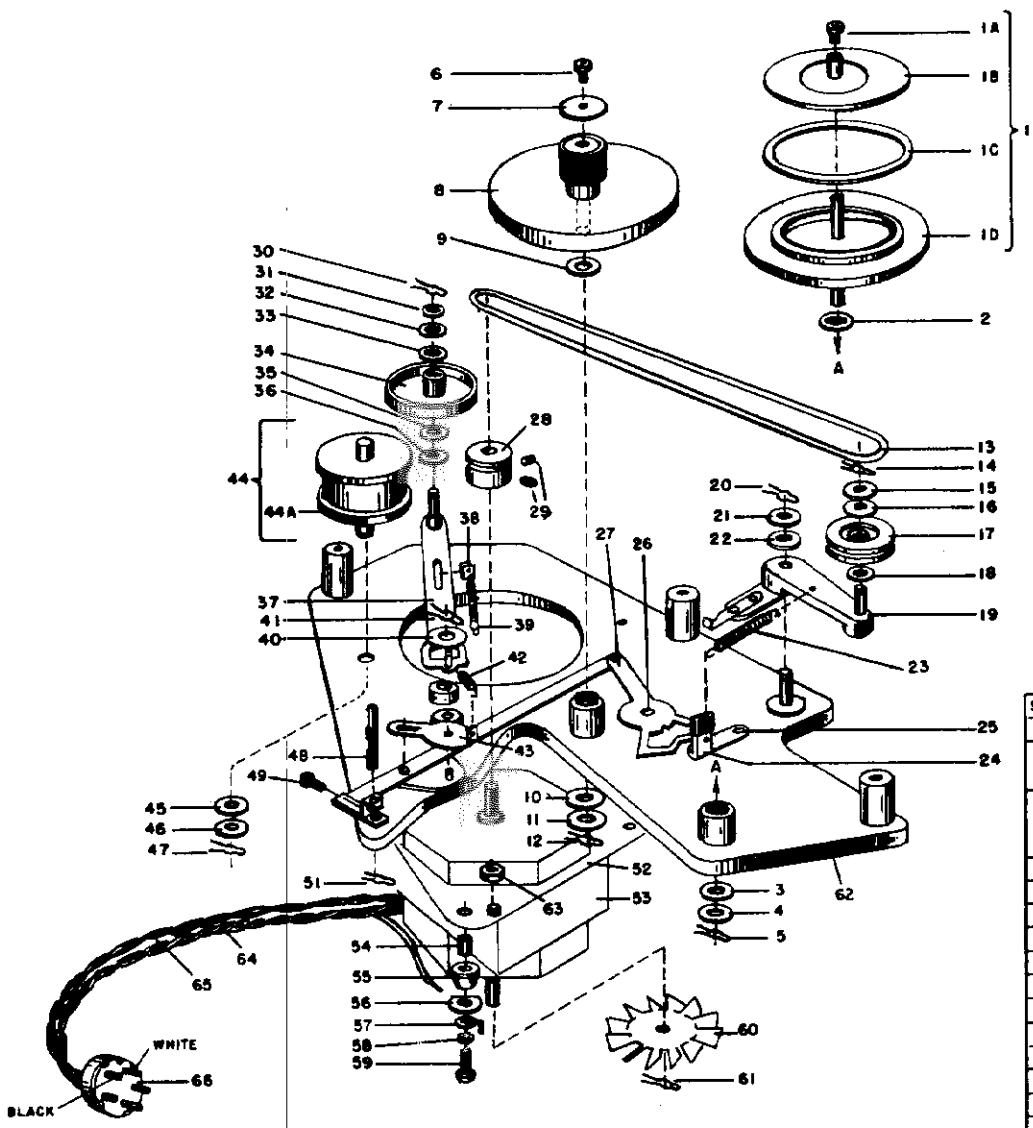
SYMBOL	PART NO.	QTY.	DESCRIPTION

TOP PLATE MECHANICAL ASSEMBLY

MODEL RT-65 RECORDER

SHEET 1 OF 1 SHEETS

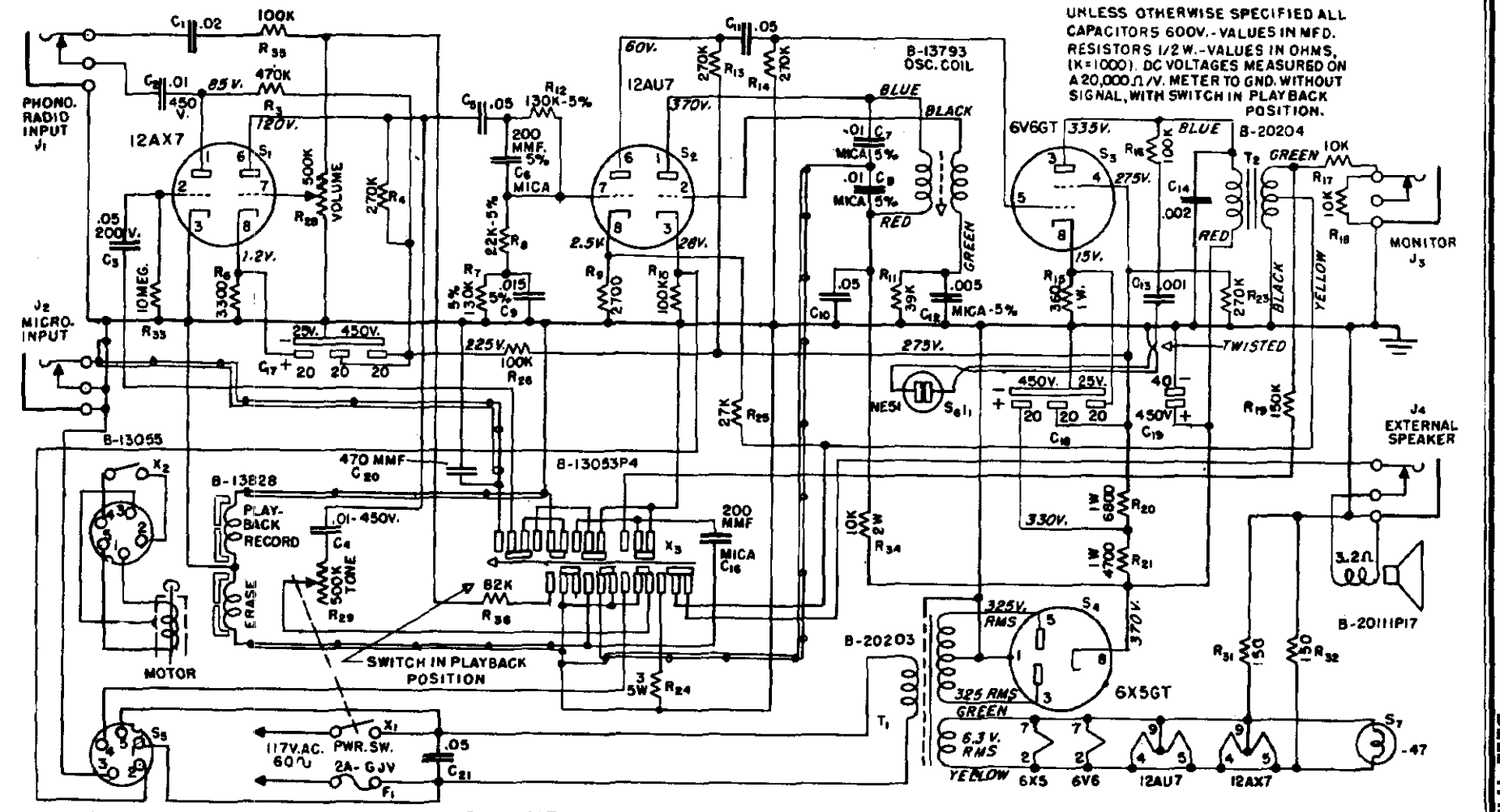
DRAWING NO. D-13807



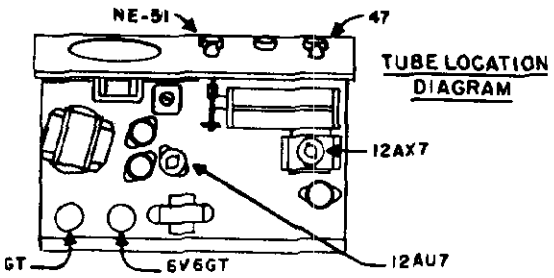
MODEL RT-65 TAPE RECORDER FIG. 3. MECHANICAL ASSEMBLY.

SYMB	DWG. NO	QTY.	DESCRIPTION.
66	M-91	1	PLUG W/SHELL
65		1	16" FLEX. WIRE
		1	16" FLEX. WIRE
64		1	13" FLEX. WIRE - WHITE
		1	13" FLEX. WIRE - BLACK
		1	11" FLEX. WIRE
63		4	10-32 STAN. HEX. NUT.
62	2090	1	BASE & BUSHING ASSEMBLY
61	2073	1	SPRING RETAINER
60	2098	1	FAN
59		3	10-32 RHMS - STL.
58		3	NO. 10 SPLIT LOCKWASHER
57	LUG-175	1	LUG
56	2089	3	SPECIAL WASHER
55	2001	3	GROMMET
54	2006	3	BUSHING
53	2000	1	MOTOR
52	2088	1	MOTOR MTG. PLATE
51	2073	1	SPRING RETAINER

49		1	8-32 RHMS - STL.
48	A-13804	1	CONTROL SHAFT
47	2073	1	SPRING RETAINER
46	2011	1	BAKELITE WASHER
45	2070	1	FELT WASHER
44A	2080	1	FELT WASHER
44	2082	1	REWIND DRUM ASSEMBLY.
43	2043	1	IDLER CAM
42	2039	1	IDLER CAM SPRING
41	2071	1	SPRING RETAINER
40	2031	1	RETAINING WASHER
39	2038	1	IDLER LEVER SPRING
38	2042	1	IDLER LEVER SPRING CLIP
37	2089	1	IDLER LEVER ASSEMBLY
36	2044	1	BAKELITE WASHER
35	2085	1	FISHPAPER WASHER
34	2003	1	IDLER WHEEL
33	2065	1	FISHPAPER WASHER
32	2044	1	BAKELITE WASHER
31	2030	1	FELT WASHER
30	2073	1	SPRING RETAINER
29		2	6-32 ALLEN SET SCREW
28	2033	1	MOTOR BELT PULLEY
27	2091	1	CONTROL LINK ASSEMBLY
26	2021	1	RIVET
25	2021	1	RIVET
24	2094	1	BRAKE ASSEMBLY
23	B20191P4	1	BRAKE SPRING
22	2012	1	FELT WASHER
21	WAS-496	1	BAKELITE WASHER
20	2073	1	SPRING RETAINER
19	2080	1	BELT PULLEY LEVER ASSEM.
18	WAS-496	1	BAKELITE WASHER
17	2081	1	BELT PULLEY ASSEMBLY
16	2012	1	FELT WASHER
15	WAS-496	1	BAKELITE WASHER
14	2072	1	SPRING RETAINER.
13	2002	1	"O"-RING BELT
12	2073	1	SPRING RETAINER
11	2011	1	BAKELITE WASHER
10	2070	1	FELT WASHER
9	2011	1	BAKELITE WASHER
8	2083	1	CAPSTAN ASSEMBLY
7	A-13832	1	CAPSTAN TOP PLATE
6		1	4-40 RHMS-STL-NP
5	2073	1	SPRING RETAINER
4	2011	1	BAKELITE WASHER
3	2070	1	FELT WASHER
2	2011	1	BAKELITE WASHER
1D	2087	1	TAKE-UP DRUM ASSEMBLY
1C	2061	1	FELT WASHER
1B	2079	1	TAPE DISC ASSEMBLY
1A		1	4-40 PH. RHMS-STL-NP.
1	2077	1	TAPE DISC & TAKE-UP ASSEMBLY

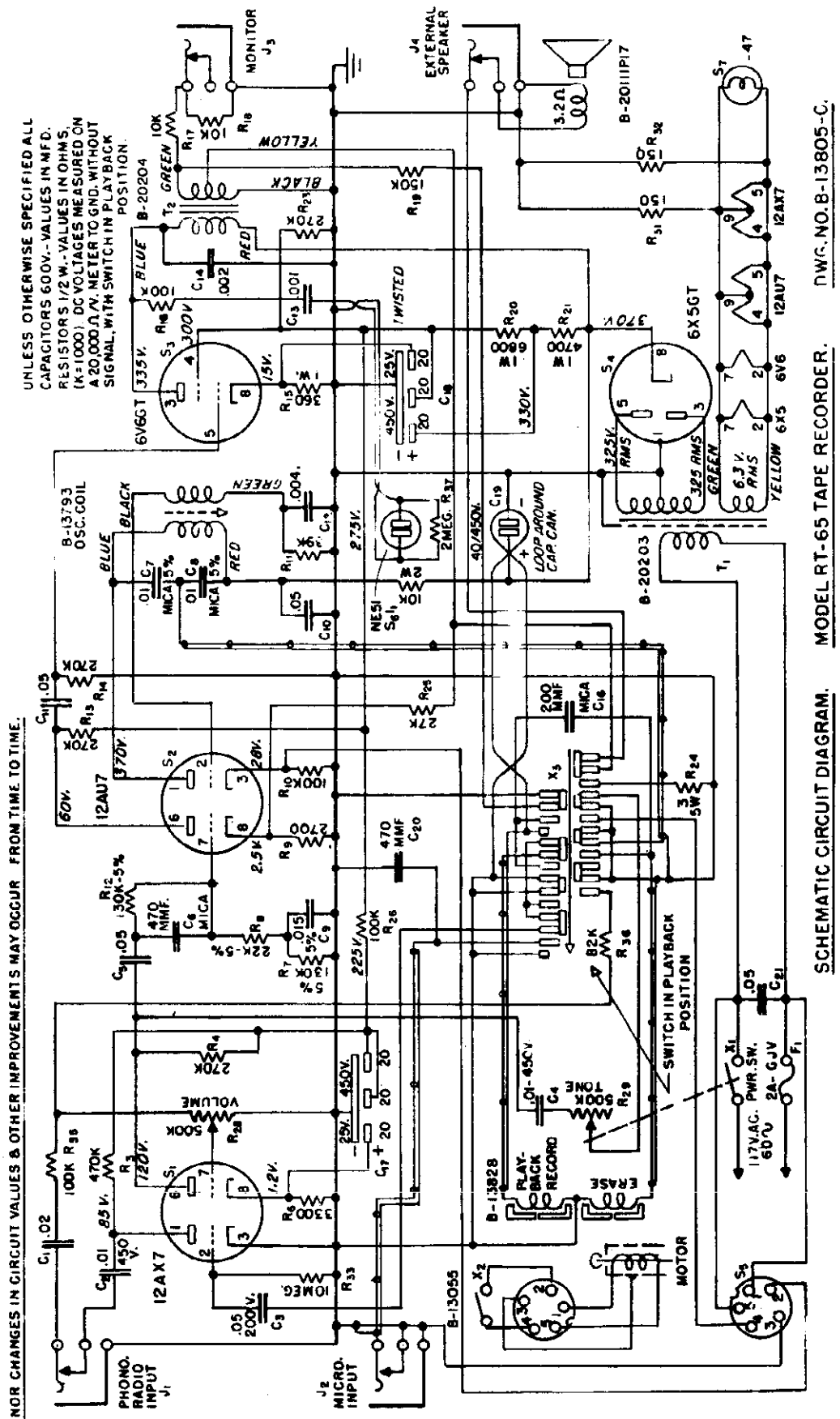


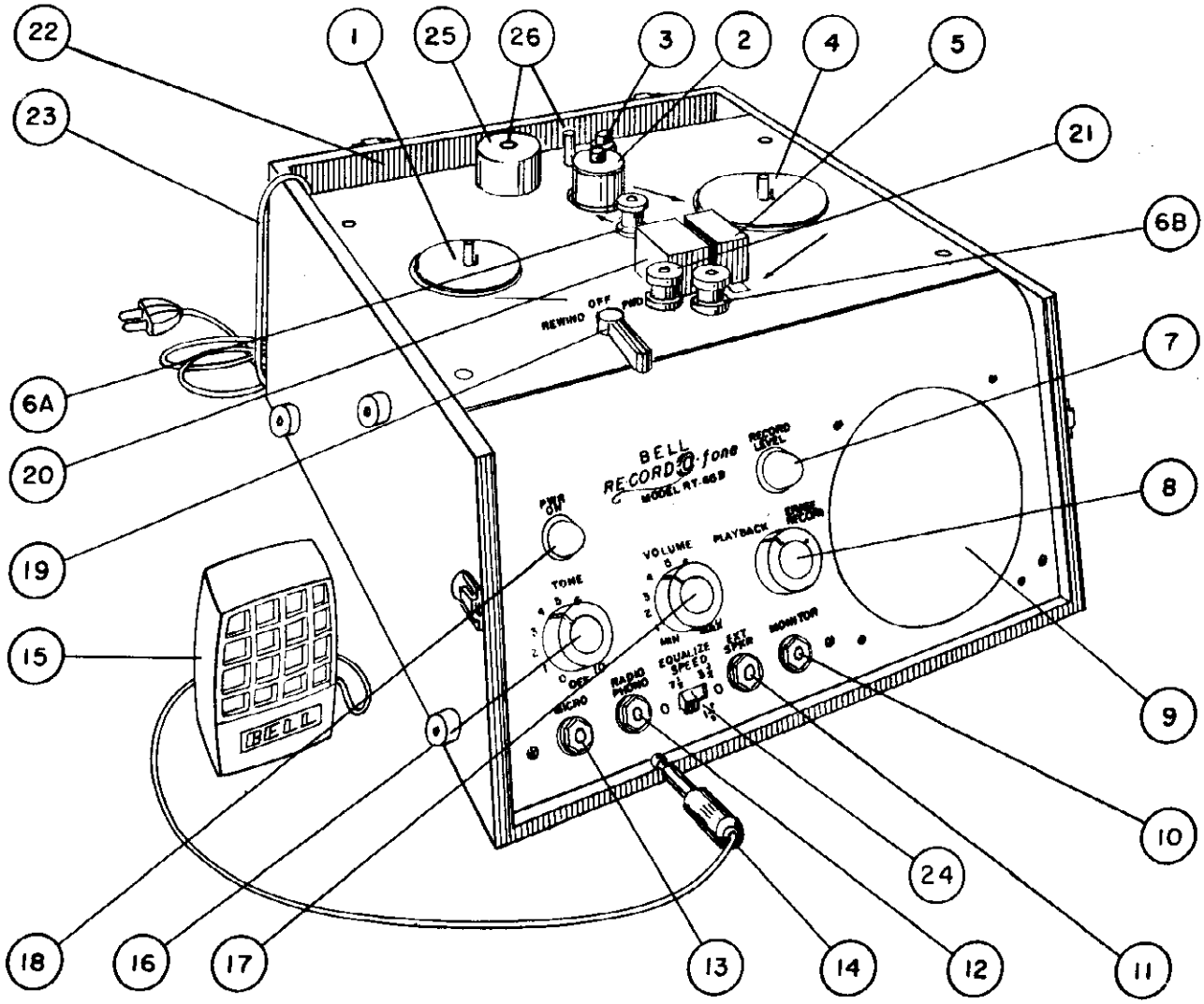
SCHEMATIC CIRCUIT DIAGRAM. MODEL RT-65 TAPE RECORDER. DWG. NO. B-13805. FIG. 4



TUBE LOCATION DIAGRAM

MODEL RT-65


UNLESS OTHERWISE SPECIFIED ALL CAPACITORS 600V.- VALUES IN MFD. RESISTORS 1/2 W.- VALUES IN OHMS. (K=1000) DC VOLTAGES MEASURED ON A 20,000 Ω/V. METER TO GND. WITHOUT SIGNAL, WITH SWITCH IN PLAYBACK POSITION.
MINOR CHANGES IN CIRCUIT VALUES & OTHER IMPROVEMENTS MAY OCCUR FROM TIME TO TIME.
SCHEMATIC CIRCUIT DIAGRAM. MODEL RT-65 TAPE RECORDER. DWG. NO. B-13805-C.
MONITOR J3
EXTERNAL SPEAKER J4
PHONO. RADIO INPUT J1
MICRO. INPUT J2
B-20204
B-13793 OSC. COIL
B-20203
B-20111P17
B-13828
B-13055
6V6GT
12AU7
12AX7
6X5GT
SWITCH IN PLAYBACK POSITION
PLAY-BACK RECORD
ERASE
MOTOR
117V. AC. PWR. SW.
LOOP AROUND CAP. CAN.
YELLOW
GREEN
BLACK
BLUE
RED
TWISTED



1. Supply Reel Platform
2. Capstan
3. Pressure Roller
4. Take-Up Reel Platform
5. Pressure Pads
6. A Rear Tape Guide Roller
   B Front Tape Guide Roller
7. Recording Level Indicator
8. Erase Record-Playback Control
9. Speaker
10. Headphone Monitoring Jack
11. External Speaker Jack
12. Radio or Phono Jakc
13. Microphone Jack
14. Microphone Plug
15. Microphone
16. Tone Control & Master Power Switch
17. Volume Control
18. Pilot Light
19. Direction Control - 3 Position
    Rewind - Off - Forward
20. Erase-Record-Playback Head
21. Tape Idler Roller
22. Storage Compartment for Power Cord, Reels and Microphone
23. Power Cord
24. Switch to Equalize Tape Speeds
25. Spare Pressure Roller for 1-7/8" Speed
26. Spare Pressure Roller Posts for Storing Rollers

MODEL RT-65-B

THREE SPEED DUAL TRACK TAPE RECORDER

7-1/2", 3-3/4" and 1-7/8" per second

INTRODUCTION

This recorder is precision built and with reasonable care it will provide many hours of dependable service and enjoyment. At 7-1/2" tape speed it will give good quality reproduction to 8000 cycles and higher. At 1-7/8" tape speed it will provide two hours recording on a single track, or a total of four hours on a 7" reel. The 1-7/8" speed is recommended for voice and music where the quality of music need not be as good as at 7-1/2". The intermediate speed of 3-3/4" provides twice the recording time of 7-1/2" with some reduction in high frequency response.

These three speeds enable the user to choose between the response he wants versus playing time, all in one recorder. The 7-1/2" speed should be used to obtain the best quality recordings.

When unpacking the recorder carefully examine it for visible damage. If unit is damaged, notify your dealer at once so that claim may be filed with the transportation agency.

NOTE - RECORDERS ARE SHIPPED WITH CAPSTAN AND PRESSURE ROLLERS IN 7-1/2" SPEED POSITION.

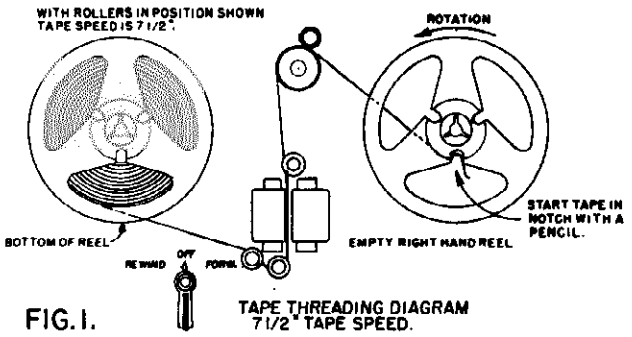


FIG. 1. TAPE THREADING DIAGRAM 7 1/2" TAPE SPEED.

OPERATING INSTRUCTIONS

Place the recorder on a flat surface close to a convenient 110 volt AC outlet. Next, remove the cover and take out power cord and after first checking to see that direction control (#19) is in "Off" position, plug into outlet. Now turn on unit by rotating tone control (#16) to the right until you hear a click and the pilot light is illuminated. Place a full reel of Type "A" tape on supply reel platform (#1). Rotate reel until small pin near center post engages one of the small notches in reel. Grasp end of tape and unwind about two feet, notice that the tape has a dull coating on side nearest center of reel. Recordings are made on this (coated) side. Place empty reel on tape take-up reel platform (#4). Thread tape around idler pulleys (#21) and (#6B), then in slot between Erase-Record-Playback head (#20) and the pressure pads (#5); next, past tape guide roller (#6A) around capstan (#2) and between pressure roller (#3) to empty take-up reel. Now thread free end of tape up into empty reel. Push the tape into one of the notches with a pencil. Holding the tape in the notch, rotate the reel for a few turns in a counter-clockwise direction. Be sure small drive pin is engaged and take up all extess slack in tape. See Figure #1.

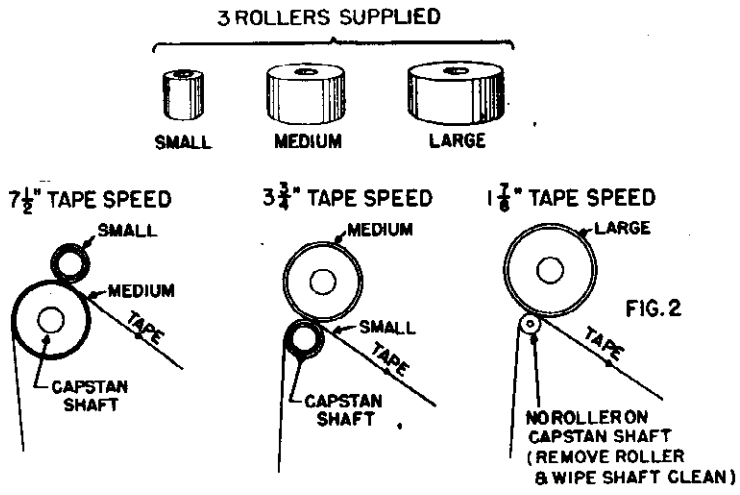


FIG. 2

Method of Changing Tape Speed - The speed at which the tape runs through the recorder depends on the size of the capstan, therefore, to change speed it is necessary to change the diameter of the capstan and the pressure roller. See Fig. 2.

For 7-1/2" per second tape speed, use the medium and the small rollers, as shown.

For 3-3/4" per second tape speed, interchange the small and medium size rollers. (Just reverse of 7-1/2").

For 1-7/8" per second tape speed, remove roller and screws from the capstan shaft, wipe off any oil on the shaft and use the large size roller only. Do not use washer or thumb nut on capstan shaft.

NOTE - When changing capstans and rollers, turn power switch (located on tone control) #16 to "Off" position. Turn direction control #19 to "Forward". This prevents the rollers from turning while loosening and tightening thumb screws. Store spare rollers, washer and thumb nut on posts #26.

Equalize Tape Speed Switch - When using 7-1/2" speed, the equalize switch #24 should be in 7-1/2 position for correct response. For 3-3/4" or 1-7/8" speed the switch should be in the 3-3/4-1-7/8 position. This position has extra high boost with some bass droop.

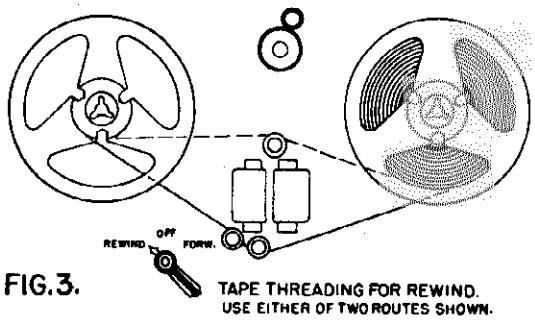


FIG.3. TAPE THREADING FOR REWIND. USE EITHER OF TWO ROUTES SHOWN.

Keep your tape recorder in good condition. The erase head and capstan of the recorder should be cleaned periodically with a soft cloth and carbon tetrachloride to insure maximum performance. Wipe dry before using again. For best results use plastic tape, Type "A" wind.

Recording

Microphone: Insert microphone plug (#14) into microphone jack (#13). Turn Erase-Record Playback control (#8) to Erase-Record position. Now turn volume control (#17) to position #5 and speak into the microphone, holding the microphone about ten inches from your lips. The Record-level indicator (#7) should flicker. If it does not, turn up the volume control until the lamp just flickers occasionally when you speak. Remember, this lamp indicates the instantaneous peaks of volume, it should, therefore, flash only when a loud sound is made. If it flashes too much or lights continuously it means that the peaks are too loud and serious distortion will result. Excellent recordings can be made with volume reduced just below the flash point where lamp does not flash at all. Use the same method of adjustment when using microphone to record music or any type of pickup.

To set the tape in motion, turn Direction control (#19) to "Forward" position. The recorder is now recording all sounds entering the microphone. Watch the recording level indicator (#7) during recording to avoid overloads but do not continually adjust the volume as this destroys the naturalness of the recording. Keep a uniform distance from microphone for best results.

Stop the tape by turning direction control (#19) to "OFF".

Rewinding

To rewind a full reel or a major portion thereof, turn Record-Playback switch (#8) to playback position. Next, remove tape from around capstan (#2) and from the recording slot (this is the slot between #20 and #5) and run tape straight across from reel to reel. See Fig. 3 above. Now turn Direction Control (#19) to "Rewind" position. For rewinding a small portion of the tape, while desirable, it is not necessary to remove tape from capstan and recording slot. First, turn Record-Playback switch to Playback, then CARE MUST BE EXERCISED TO TURN CONTROL VERY SLOWLY TO REWIND TO PREVENT BREAKING TAPE.

If tape is rewound past head, the volume control (#17) should be turned down to avoid unpleasant high-pitched chatter, However, with a little practice this chatter may be recognized and various sections of recorded speech or music identified during rewind.

The numbered lines to be seen under the left hand or supply reel indicate approximate time elapsed during recording or playback. Each line is approximately three minutes playing time, at 7-1/2" speed, six minutes at 3-3/4" speed and 12 minutes at 1-7/8" speed.

Playback

Thread the recorded tape into the machine the same as for recording and simply turn Direction Control (#19) to forward position, making certain that the Record-Playback Control (#8) is in playback position. To playback a partially recorded tape it is first necessary to rewind your tape to where your recording began. After the tape has been rewound, proceed as described above. Adjust the volume and tone controls for best listening.

CAUTION: Be certain that the Record-Playback Control (#8) is in playback position before starting the tape in motion, at all times, except when recordings are actually being made. This will prevent accidently erasing a tape when PLAYBACK was intended.

MODEL RT-05-B

Erasing

Any previously recorded tape may be erased by running the tape through the machine in the manner as described for "recording" except that the volume control (#17) is turned to zero so that no signal will be recorded. The erase feature is automatic, since when a recording is being made, the tape is erased just ahead of the recording. In this way, any previously recorded material is always removed before the new material is recorded on the tape.

How To Obtain Dual Track

This recorder will record two "tracks" on a single tape, in other words, only one half of the width of the tape is recorded at a time. After recording through an entire reel in one direction, the full reel is inverted and placed on the Supply Reel Platform (#1), the empty reel on the Take-Up Reel Platform (#4), and the entire tape length may be recorded again on the other half of the tape. To facilitate reel change-over, stop tape motion just before the tape unthreads, leaving five or ten turns on the reel. This avoids need for re-threading. With a little practice, change-over can be done in less than fifteen seconds.

Recording Direct from External Radio, Phonograph or Record Player

To record direct from an external radio or phonograph, a single conductor microphone type cord should be equipped with a shielded plug similar to the one on the microphone cable, and plugged into the radio or phono jack (#12). Shield should be connected to sleeve of plug. The other end of this cable should be connected directly to the speaker voice coil terminals of the radio or phono making certain that the shielding connects to the grounded side of the circuit. (Determine by trial and error test.) A radio service man may be called in to make this simple connection and to supply the cable and plug. You may, of course record radio or phonograph programs by simply placing your microphone approximately one to two feet in front of the loudspeaker and following the procedure as outlined under microphone recording. You may also connect a crystal pickup direct to the recorder by connecting the pickup leads to the phono input. Observe polarity as described above.

Use With Radio Tuner

By connecting the output of one of the commercially available FM, or combination AM-FM tuners, direct into the recorder, a complete high quality radio is obtained with both listening and recording features. One word of caution, in recording direct from a radio or phonograph having "Bass boost" type of tone control, it is recommended that no bass boost be used during recording since bass distortion may result when played back.

CAUTION: Recorder will not playback with plug in radio-phono jack. Also microphone cannot be used to record with plug in radio-phono jack.

Use of Monitoring Headphones

For those who desire to make the best recordings of singers, speakers, musical groups, plays, weddings and similar types requiring varied microphone pick-up, investment in a pair of crystal headphones for monitoring purposes is recommended. The headphones should be equipped with a shielded plug and are inserted into the headphone monitoring jack (#10). You will then be able to hear the sounds just as they are being recorded and keep a constant check on the quality of the recorded material.

500 Ohm Output

The output transformer has a 500 Ohm winding and is connected to the monitor jack through a 10,000 Ohm resistor. To obtain 500 Ohm output, short circuit this series resistor. Connect to monitor jack. Observe ground polarity.

Use of an External Speaker for Better Playback Listening

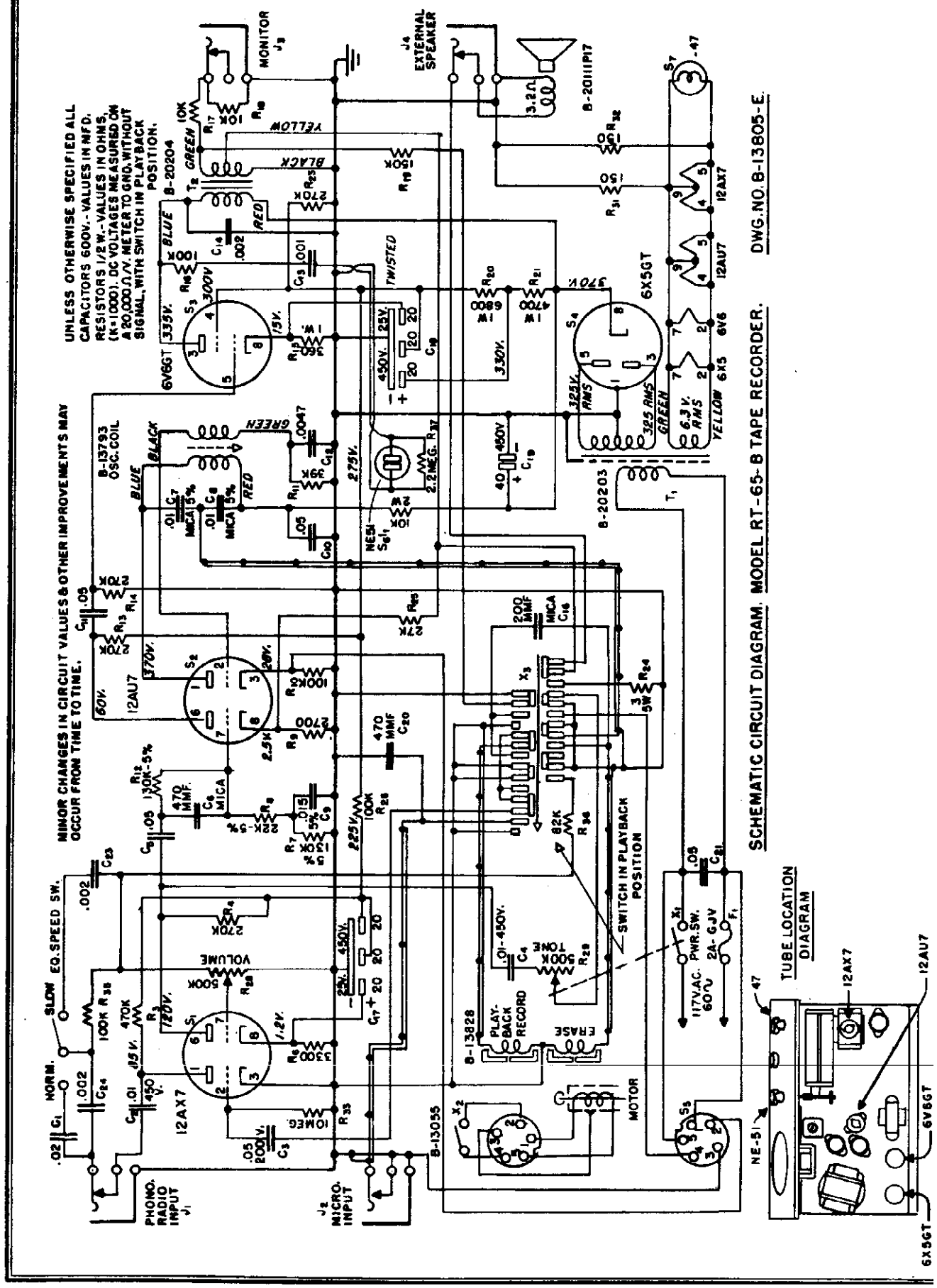
Although the built-in speaker is especially designed to give the best possible sound quality for portable use, it is sometimes desirable to playback to a large audience through a larger, separate loudspeaker, or to use a separate high-fidelity speaker in the home. Leads from the external speaker should be connected to a shielded plug and inserted into the external speaker jack (#11). This output jack has an impedance of 4-6 ohms. Also, when a speaker is plugged into this jack, it automatically disconnects the internal speaker in the unit.

Use of Recorder with an External Amplifier for Recording or Playback

Playback - The output from this recorder may be fed directly into any high impedance phono input of a sound system or amplifier. This is accomplished by connecting the headphone monitoring jack (#10) to the phono input of the amplifier. Connect sleeve of plug to ground connection of amplifier. This permits use of the internal speaker of the recorder to monitor programs being fed to the external amplifier.

You may also feed an external amplifier by connecting the external speaker jack (#11) of the recorder to the phono input of an amplifier. If this is done, it is necessary to add a 3 ohm 5 watt load resistor across your cable between the recorder and amplifier. By this method, the internal speaker of the recorder is silenced and you may monitor your out-going program by use of headphones.

Recording - The output of any sound system or amplifier, if properly terminated by a loudspeaker or equivalent load resistor, may be connected into the Radio-Phono input of the recorder and recordings made. Insert a phone plug into the phono jack of the recorder. Connect the two leads to the speaker or proper resistor load of the amplifier. Observe ground polarity, ground side of amplifier to sleeve of plug.


UNLESS OTHERWISE SPECIFIED ALL CAPACITORS 600V.- VALUES IN MFD. RESISTORS 1/2 W.- VALUES IN OHMS, (K=1000). DC VOLTAGES MEASURED ON A 20,000 Ω/V. METER TO GND. WITHOUT SIGNAL, WITH SWITCH IN PLAYBACK POSITION.
MINOR CHANGES IN CIRCUIT VALUES & OTHER IMPROVEMENTS MAY OCCUR FROM TIME TO TIME.
SCHEMATIC CIRCUIT DIAGRAM. MODEL RT-65-B TAPE RECORDER.
DWG. NO. B-13805-E
TUBE LOCATION DIAGRAM
SWITCH IN PLAYBACK POSITION
MONITOR J3
EXTERNAL SPEAKER J4
PHONO. RADIO INPUT J1
MICRO. INPUT J2
EQ. SPEED SW.
SLOW
NORM.
PLAY-BACK
RECORD
ERASE
MOTOR
VOLUME
TONE
PWR. SW.
117 V. AC. 60 ~
2A-GJV
NE-51
B-20204
B-13793 OSC. COIL
B-13828
B-13055
B-20111 P17
B-20203
6V6GT
12AU7
12AX7
6X5GT
6X5GT

MODELS BK-411
BK-414

EQUIPMENT DATA FOR MODELS BK-411 and BK-414 SOUNDMIRROR

1. WEIGHT — BK-411 — 32 lbs. 40 lbs. packed BK-414 — 38 lbs. 48 lbs. packed
2. DIMENSIONS — BK-411 — unpacked, 17½" wide x 12½" deep x 11¼" high (less feet), feet made of cork ⅜" x 1¼" diameter.
   BK-414 — (unpacked in operating position, lid closed) 17" wide x 20½" deep x 10" high (less feet and catches).
3. POWER REQUIREMENTS — 105-120 volts, 60 cycles, A. C., single phase.
4. WATTS CONSUMED — 85 total.
5. RECORDING MEDIUM — "Magic Ribbon" (magnetically coated paper ribbon).
6. RECORDING TIME — Approximately 30 minutes per 7" reel.
7. CONSTANT RECORDING SPEED — 7.5 inches per second, nominal.
8. DYNAMIC RANGE — Approximately 40 db.
9. FREQUENCY RESPONSE (overall) — Essentially flat from 100 to 5000 cycles. (See Fig. 29)

10. INPUT CONNECTIONS

Input	Impedance	Source	Voltage Limits
Microphone	1 megohm	Crystal microphone	.003 to .2 volts.
Radio	1 megohm	any	0.2 to 100 volts

11. OUTPUT CONNECTIONS

Output Circuit	Impedance	Power Output	Output Voltage
Internal Speaker	3.2 ohms	1 watt undistorted	1.8
External Speaker (terminal strip E-3 on BK-411 and output jack J-7 on BK-414 permits its use)	3.2 ohms (secondary of output transformer T-2)	1 watt undistorted (when terminated with 3.2 ohm load)	1.8

12. TUBE COMPLEMENT

V-1 — 6J7 or 1620†
V-2 — 6SJ7
V-3 — 6E5
V-4 — 6J5
V-5 — 6SN7 or 6SL7*
V-6 — 6SN7
V-7 — 5Y3

† recommended in cases of extreme microphonics.
* recommended for higher output.

MODELS BK-411,
BK-414

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MODEL BK-414

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LIST OF ILLUSTRATIONS

MODELS BK-411,
BK-414

Fig. 1—*Model BK-411 Soundmirror*

SECTION I

Introduction

This publication is issued as the basic Instruction and Service Manual for the Model BK-411 Soundmirror-Magnetic Ribbon Record-Reproducer, and contains the necessary descriptive data, pictures and necessary drawings, coded and identified for its operation, maintenance, and overhaul.

The Model BK-411 Soundmirror (Fig. 1) is a complete unit designed to record and reproduce audio signals magnetically. The recording medium is a ferromagnetic powder coated paper ribbon, *"Magic Ribbon," wound on reels of appropriate size to supply approximately thirty minutes each of recording or playing time.

The Model BK-411 is a compact unit comparable in size to the average table model combination radio and weighs approximately thirty pounds.

The accessories included with the Model BK-411 Soundmirror are as follows: Microphone complete with cord and phono plug, connected, through a hole in the microphone compartment, to the recorder-amplifier; a removable microphone base to which the microphone may be attached for stationary operation or detached for hand operation; one empty reel and one full reel of *"Magic Ribbon" packed separately alongside the cabinet in the packing carton.

The Model BK-411 Soundmirror operates from a power source of 105 to

SECTION II

Detailed Description

POWER REQUIREMENT

The power requirement for the Model BK-411 Soundmirror is 85 watts at 105 to 120 volts 60 cycles, single phase, alternating current. Caution: DO NOT CONNECT TO DIRECT CURRENT.

If direct current is the only source of power available, an inverter must be used to supply 85 watts at 105 to 120 volts 60 cycles A. C. to the Model BK-411 Soundmirror.

Note: When used with other than power source specified above, the inverter, generator, or power source must be well grounded and filtered to eliminate line noise or hum.

REELS AND RIBBON

Two reels 7" in diameter x 7/16" thick are furnished with the BK-411 Soundmirror; one empty and one filled with "Magic Ribbon" (approximately 1225') to supply approximately thirty minutes of recording or playing time. (See Fig. 2).

The reels are made of light weight material and are subject to shape distortion if care is not exercised in handling.

When extra reels of "Magic Ribbon" are not in use they should be stored by standing them on edge (in the carton) in a dry place. If reels are stored in stacked manner they are apt to become bent.

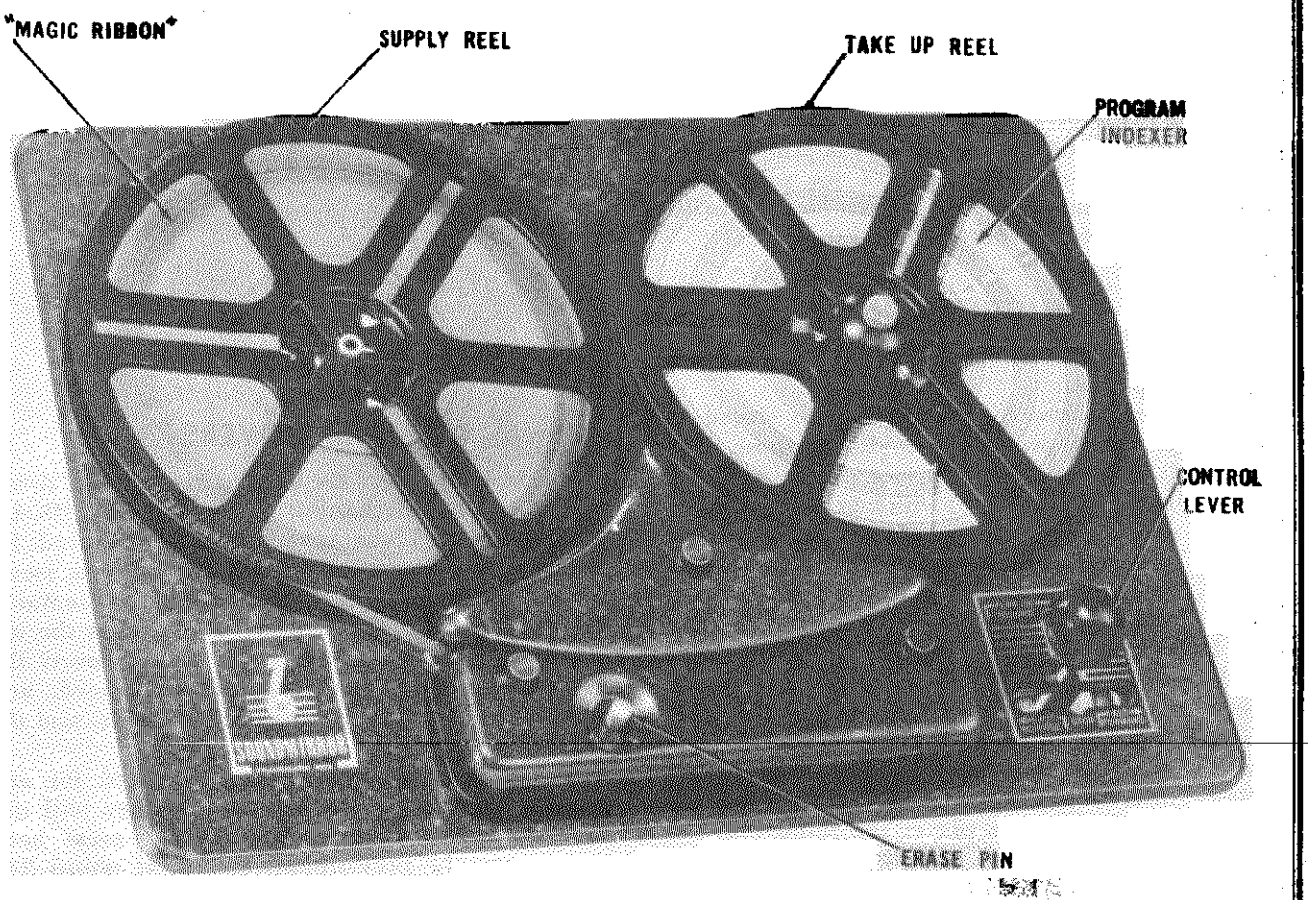

Fig. 2—*Top Panel*

MODELS BK-411,
BK-414

The "Magic Ribbon" furnished with the Model BK-411 is a paper ribbon coated with a magnetic material (black iron-oxide) and has a breaking load of 6 lbs. With proper care in handling, "Magic Ribbon" should last indefinitely.

CABINET

The cabinet for the Model BK-411 Soundmirror is made of solid Mahogany and Mahogany veneer.

With the doors and lid closed, the cabinet measures 17½ inches wide, 12½ inches deep, and 11¼ inches high, less feet. The feet are made of cork ⅜" high and 1¼" in diameter.

To preserve the finish of the cabinet, a suitable furniture wax such as Simonize or Johnsons Wax may be used. After applying wax, rub the finish with a polishing cloth to return luster finish.

Scratches may be removed (before waxing) by applying a thin coat of Mahogany stain to the scratch, allowing it to set a moment, then wiping with a polishing cloth.

PILOT LIGHT JEWEL

The pilot light jewel located at the bottom, center-front of the cabinet is an amber translucent rod made of Lucite material. Light is transmitted through the rod from the pilot lamp located inside the cabinet. Alignment of the pilot lamp with the rear end of the rod determines the brilliancy of the light at the front of cabinet.

MICROPHONE

Furnished with the Model BK-411 is a crystal type microphone.

When not in use the microphone is stored in the compartment provided for this purpose. (See Fig. 3). It mounts on one surface of the compartment by a spring clip (H16) which grips the handle of the microphone. During shipment, a rubber band is wrapped around the handle of the Microphone and around the clip to prevent it from dropping and becoming damaged during shipment.

A base (A-3) is furnished with the Microphone for the purpose of using the microphone for stand operation. The base is also mounted in the compartment during shipment and storage, and when used is assembled to the microphone handle as follows: insert lower end of stand into the hole of the base, fitting the key pin of the stand into the key slot of the base and turn the stand clockwise until it locks. Fig. 1 shows the microphone stand and base assembled. To disassemble, turn the stand counter-clockwise until key pin lines up with the key slot, then pull apart.

The microphone head can also be removed from the stand (by unscrewing it counter-clockwise) for the purpose of replacement.

The microphone plugs into a pin jack (J-1, Fig. 16) connected to the amplifier and may be detached for the purpose of servicing the unit.

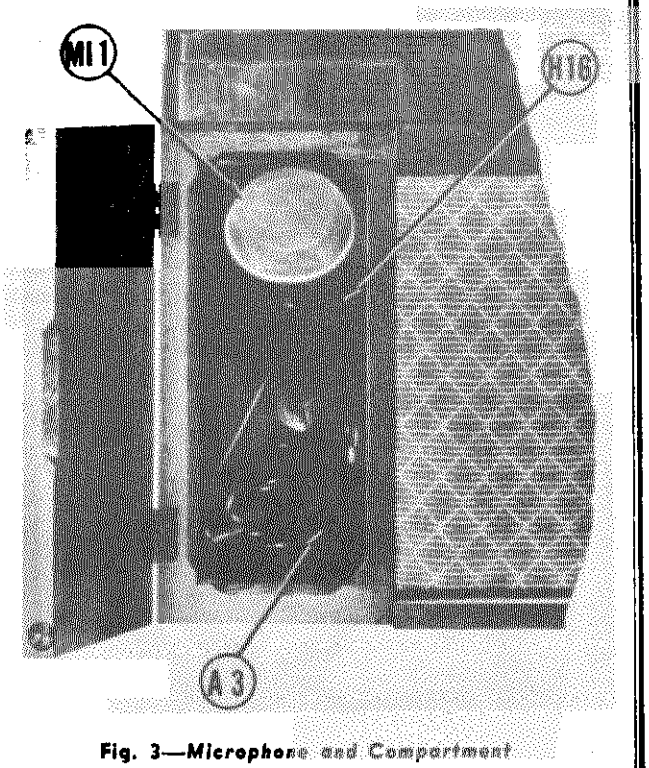

Fig. 3—Microphone and Compartment

TRIM COVERS

Three trim covers are used to give a final "dress" finish to the mechanical section of the BK-411 Soundmirror. These covers may be removed for access to various components located on the mechanism chassis. Fig. 4 shows two covers removed from the chassis. Trim cover (A-14) covers the top mechanism chassis. Trim cover (A-10) covers the record-reproduce head and the erase-head, and trim cover (A-12) covers the pressure wheel and the bracket assembly.

When these trim covers are removed for any reason, they should be replaced so they will not interfere with the operation of the erase head bracket or the pressure wheel link at points "A" and "B" respectively of Fig. 4.

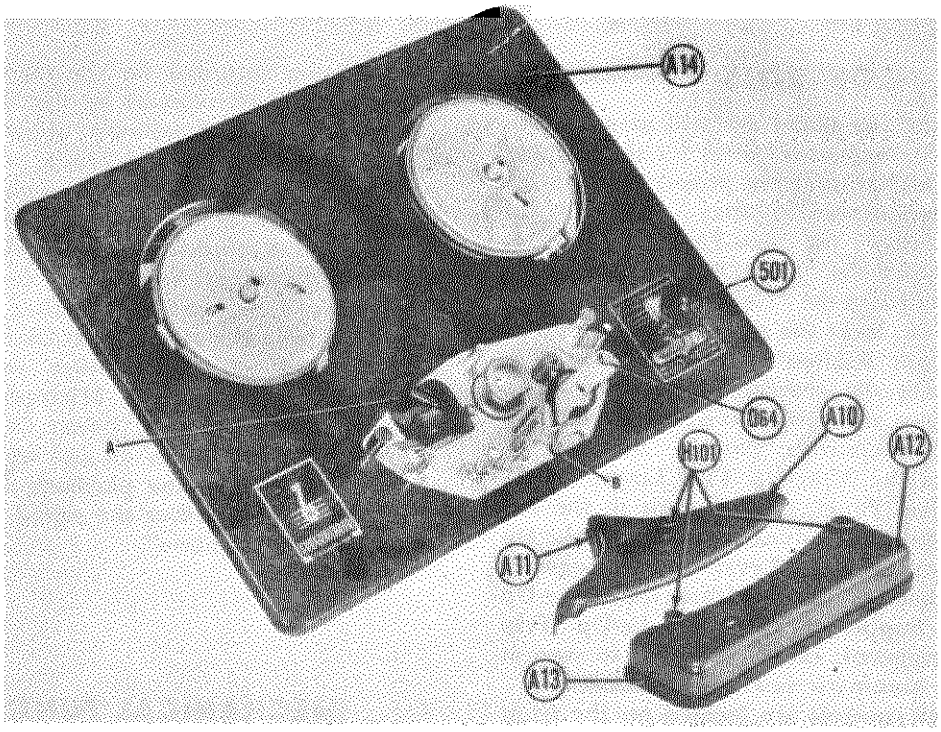

Fig. 4—*Top Panel Trim Covers*

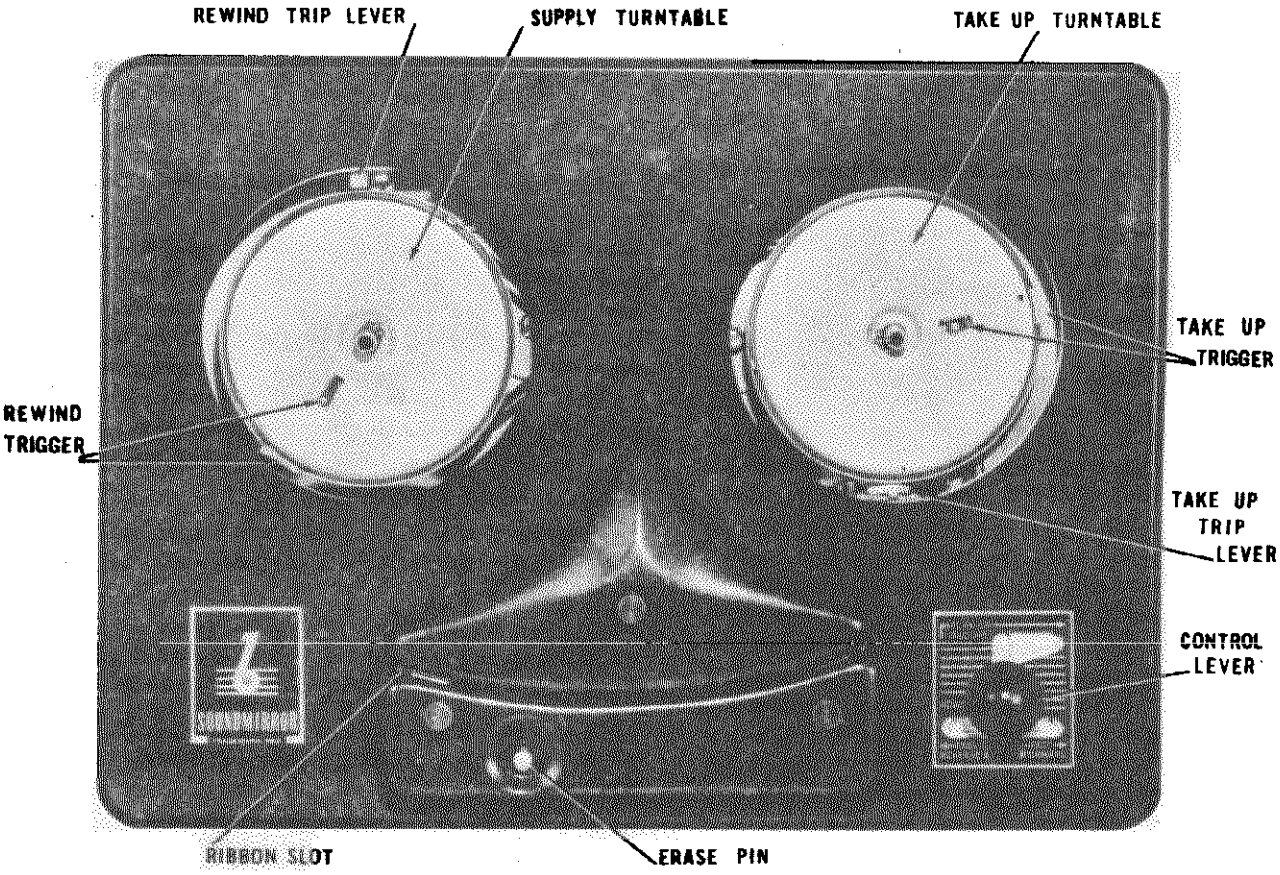

Fig. 5—*Top Panel Controls*

MODELS BK-411,
BK-414

CONTROLS

Located on the top panel are two manual controls; (See Fig. 5) one control lever for the purpose of shifting the mechanism to its proper position for the following operations: (a) "Play or Record", (b) "Rewind", (c) "Stop", (d) "Fast-Forward", and (e) "Fast-Reverse"; and the "Erase Pin", which, when pressed while shifting the "Control Lever" to the "Record" position, locks the erase head in position against the "Magic Ribbon". The latter control is used only during the recording operation or to erase any previous recording from the ribbon.

Two automatic controls, namely; the Rewind Trip Lever and the Take-Up Trip Lever, are located on the Top Panel; one adjacent to the Rewind clutch and one adjacent to the Take-Up clutch. The Rewind Trip Lever, when triggered, causes the ribbon to rewind from the Take-Up reel onto the Supply reel. The Take-Up Trip Lever, when triggered, causes the reels to stop at the end of the automatic rewind operation.

The amplifier controls are located on the front panel which is concealed by a door on the right front side of the cabinet (See Fig. 6). The controls are as follows, from top to bottom; (a) "Volume Control Play or Record"—This controls the level of sound being recorded on the ribbon during the recording process (viewed by the "Record-Volume Indicator" (VI) immediately above this control). It also controls the play-back volume to the speaker. (b) A Selector Switch—which connects the various sections of the amplifier for the following operations; "Record-Radio," "Play", and "Record-Mic." (c) "Speaker Volume (Recording Only)"—This controls the speaker (monitor) volume while recording from the radio input circuit. To prevent acoustic feedback the Monitor signal is muted while recording from the Microphone input circuit. (d) 'Tone Control" "Power Off—This control is for turning the power on and off as well as controlling the tone of the playback and monitoring signal. It does not effect the signal being recorded on the "Magic Ribbon".

MECHANICAL FUNCTION

Drive Mechanism

The Drive Mechanism includes the following:

1. A single motor (B-1 Fig. 7) which drives both the capstan and the reeling mechanism. It is an induction type motor and is resiliantly mounted on a bracket which can be shifted in its position for the purpose of adjusting the tension of the rubber drive belts. A fan is attached to the drive motor shaft to cool the motor.

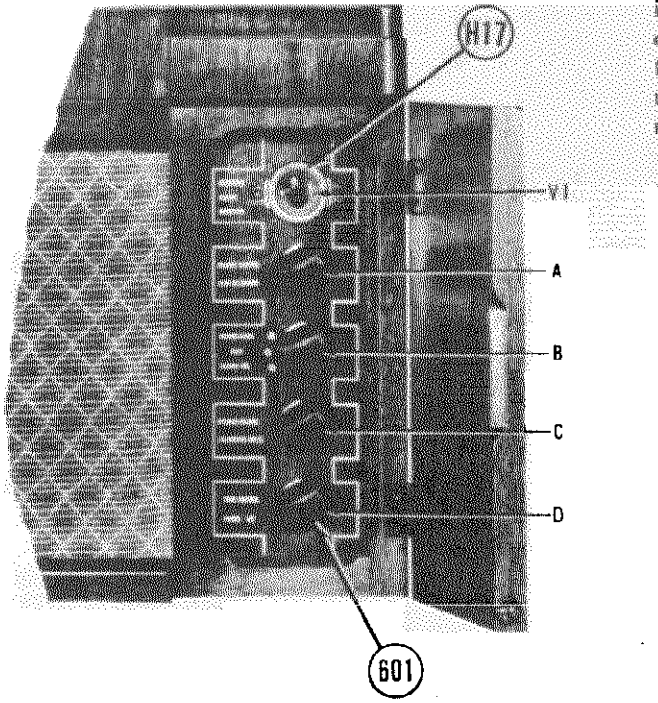

Fig. 6—*Front Panel Controls*

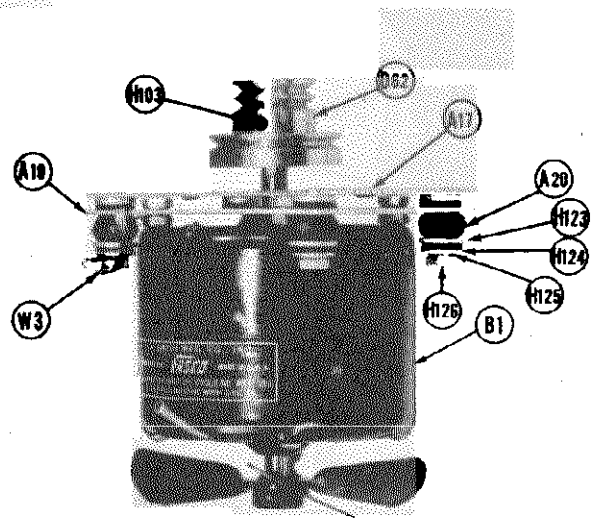

Fig. 7—*Drive Motor*

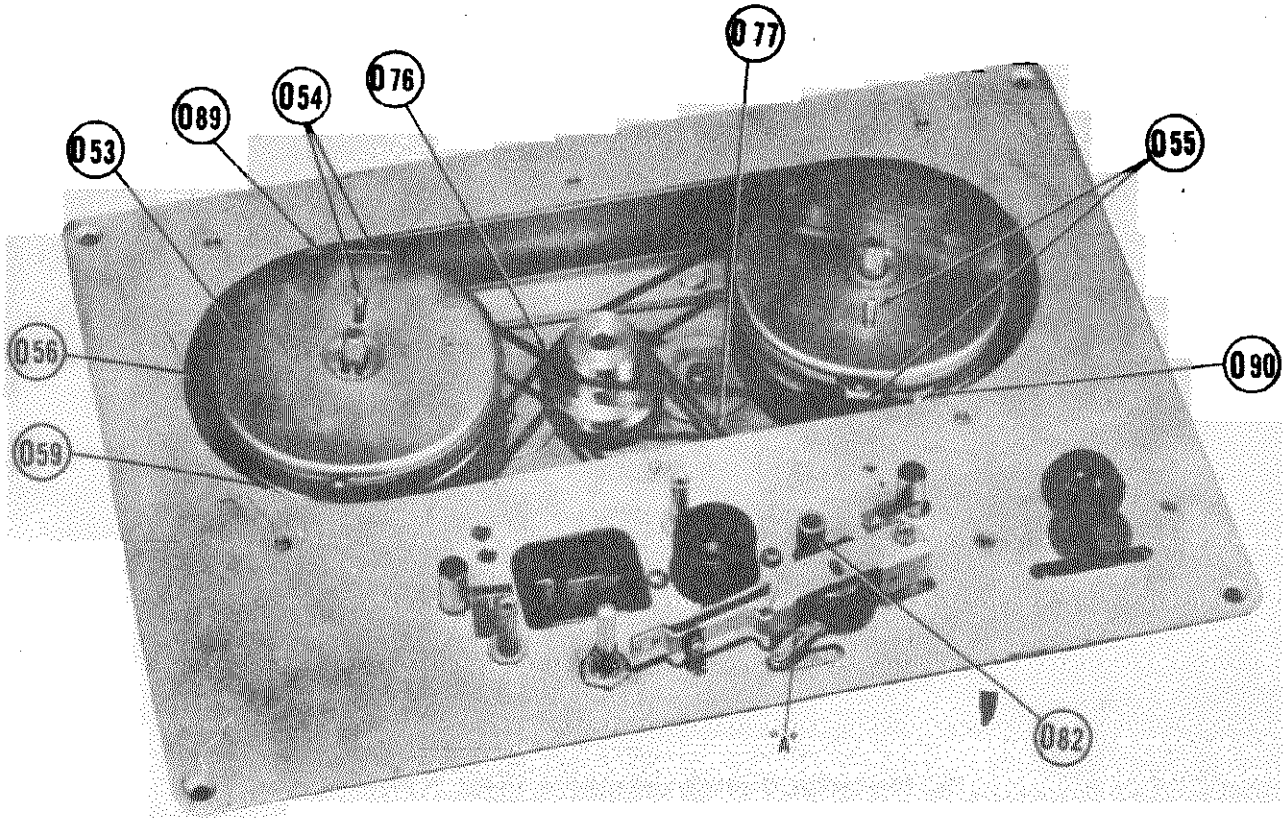

Fig. 8—Reeling Mechanism—Reels Displaced

2. Rubber belts (O-76 & O-77 Fig. 8) couple the drive pulley to the capstan assembly and the reeling mechanism. The smaller belt (O-77) drives the capstan and the larger belt (O-76) drives the reels.

3. A small diameter capstan (O-82 Fig. 8) attached to a pulley and a balanced flywheel provide a constant drive speed for the "Magic Ribbon". The capstan revolves in two bearings which are of the "Oilite" type and require very little additional lubrication. The bottom bearing is of the self-aligning type.

4. A pressure wheel (O-84 Fig. 9) and a pressure pad (MS-2) are assembled on a bracket (A-16) (Also see Fig. 10) which is engaged by the control lever (501) to press the ribbon against the capstan (O-82) and the record-play head (E-1) respectively during the record or play operation. The rubber tire pressure wheel has an "Oilite" bearing requiring very little additional lubrication.

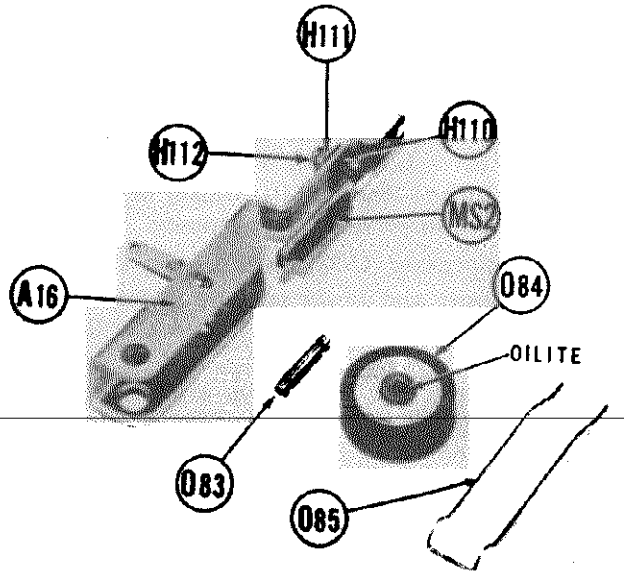

Fig. 9—Pressure Wheel Assembly

MODELS BK-411,
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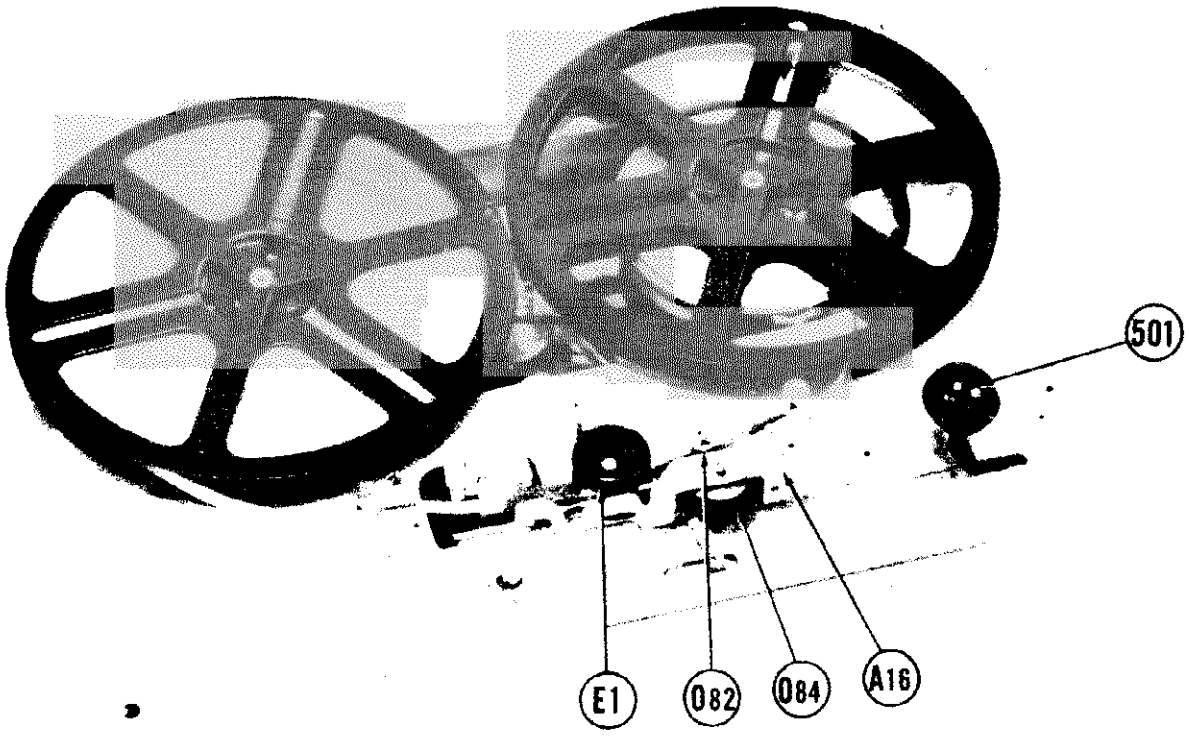

Fig. 10—*Reeling Mechanism—Reels and Ribbon in position*

Reeling Mechanism

(See Fig. 38)

The reeling mechanism consists of two turntables (O-53) and two clutch assemblies (O-56 and O-58) mounted on the two reel shafts (O-57), and two pulleys (O-59) mounted on bearings (O-63), all of which are driven by the motor (B-1) through the rubber drive belt (O-76, Fig 8).

The two turntable assemblies consist of two cups fitted together to serve three purposes:

1. The upper cup (O-53) which supports the reel.
2. The upper and lower cups fitted together to house the rewind trigger (O-54) and the take-up trigger (O-55).
3. The lower cup (O-56) to form the clutch facing which contacts the felt disc (O-58 mounted on the pulley (O-59) when the turntable assembly is lowered.

The clutch assembly, actuated by the clutch raising lever (O-86, Fig. 11) and pin (H-115, Fig. 38) is considered to be engaged when the felt disc contacts the facing of the cup (O-56). While engaged the rewind clutch turns clockwise and the take-up clutch turns counter-clockwise.

The two triggers (O-54 and O-55) are for the purpose of tripping the automatic control levers (O-89 and O-90 Fig. 8) respectively.

The rewind trigger (O-54) which is held in a cocked position by the ribbon on the reel is released when only 20 to 40 turns of ribbon remain on the reel. When released the trigger trips the rewind trip lever (O-89) which actuates the control mechanism to rewind the ribbon automatically.

The take-up trigger (O-55) is held in a cocked position by the first turn of ribbon on the take-up reel, and when the automatic rewinding is completed the ribbon leaves the reel and releases the trigger (O-55). When the trigger is released the centrifugal force causes the trigger to protrude through the opening in the outer edge of the take-up turntable and strike the trip lever (O-90) which actuates the control mechanism to stop the motor.

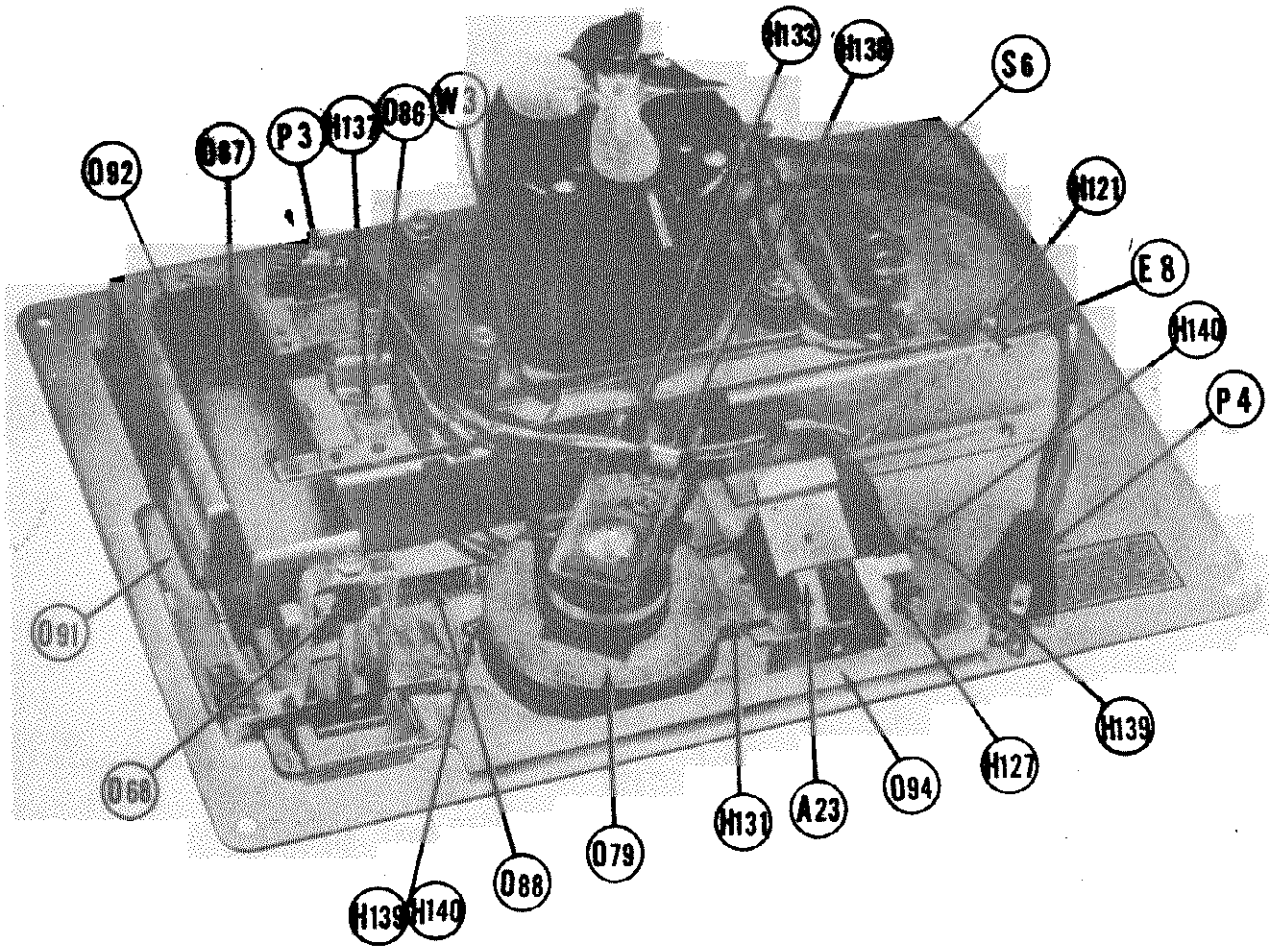

Fig. 11—*Control Mechanism—Bottom View*

Control Mechanism

The control mechanism is actuated by two control levers which are operated manually and two trip levers which are operated automatically by the reeling mechanism triggers. The manual controls are: The "Control Lever" and the "Erase Pin" (See Fig. 5). The control lever moves the corresponding engaging levers to the following positions:

1. "Play or Record" Position

Placing the control lever in this position causes:

(a) The latch cam slide (O-91, Fig. 11) which actuates the trip lever latch (H-141, Fig. 13) and the trip bar (O-99, Fig. 12) to engage and set the take-up trip lever (O-90, Fig. 13) and the rewind trip lever (O-89, Fig. 12).

(b) The head locking slide (O-94, Fig. 11) to lock the erase head in position against the ribbon (when the erase pin is pressed), the pressure wheel (O-84, Fig. 12) to bear against the capstan (O-82, Fig. 12), and the pressure pad (MS-2, Fig. 12) to bear against the record head (E-1, Fig. 12).

(c) The clutch lever (O-92, Fig. 11 & 14) which couples to the raising lever assembly (O-86, Fig. 14) to engage the take-up clutch, disengage the rewind clutch, and close the motor switch contacts (S-6 Fig. 11).

(d) The latching gate (O-93, Fig. 14) to lock the control mechanism in "Play or Record" position until released either manually (by placing control lever in "Rewind" or "Stop" position) or automatically (by action of the rewind trip lever). The latching gate is moved to the locking position by a spring (O-97, Fig. 14). This gate should be lubricated periodically with light oil (SAE-10) to prevent binding.

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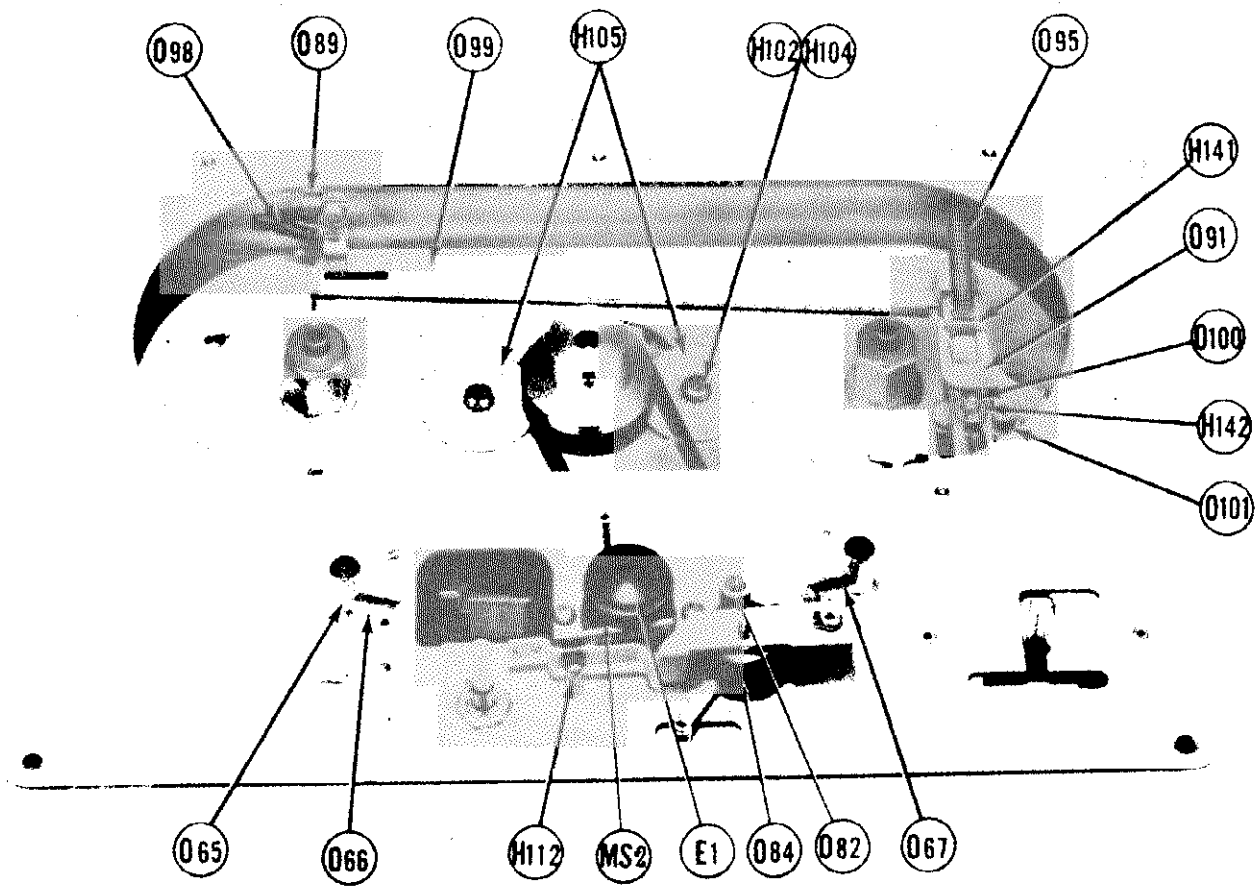

Fig. 12—*Control Mechanism—Rewind Trip Lever View*

2. "Rewind" Position

Placing the control lever (Fig. 2) in the "Rewind" position initiates the following actions:

(a) The latching gate (O-93, Fig. 14) is moved half-way out of its locked position.

(b) The spring (O-87, Fig. 11) then moves the raising lever assembly (O-86, Fig. 11) to its extreme opposite position to disengage the take-up clutch and engage the rewind clutch to cause the reels to turn in the reverse direction and rewind the ribbon from the take-up reel onto the supply reel.

(c) The pressure wheel (O-84, Fig. 10) is moved away from the capstan (O-82) to allow free movement of the ribbon during the rewind operation.

(d) The head locking slide (O-94, Fig. 11) is moved to release and drop the erase head from its engaged position after completion of a recording.

3. "Stop" Position

Placing the control lever in the "Stop" position releases all levers remaining engaged, and opens the motor switch contacts. The raising lever assembly (O-86, Fig. 11) is moved to a position which allows both clutches to engage and produce a friction brake to stop the reels quickly.

4. "Fast-Forward" Position

Placing the control lever in the "Fast-Forward" position causes the take-up clutch to engage, the rewind clutch to disengage, and the motor switch contacts to close and cause the ribbon to wind forward rapidly.

5. "Fast-Reverse" Position

Placing the control lever in the "Fast-Reverse" position causes the rewind clutch to engage, take-up clutch to disengage, and the motor switch contacts to close and cause the ribbon to rewind rapidly.

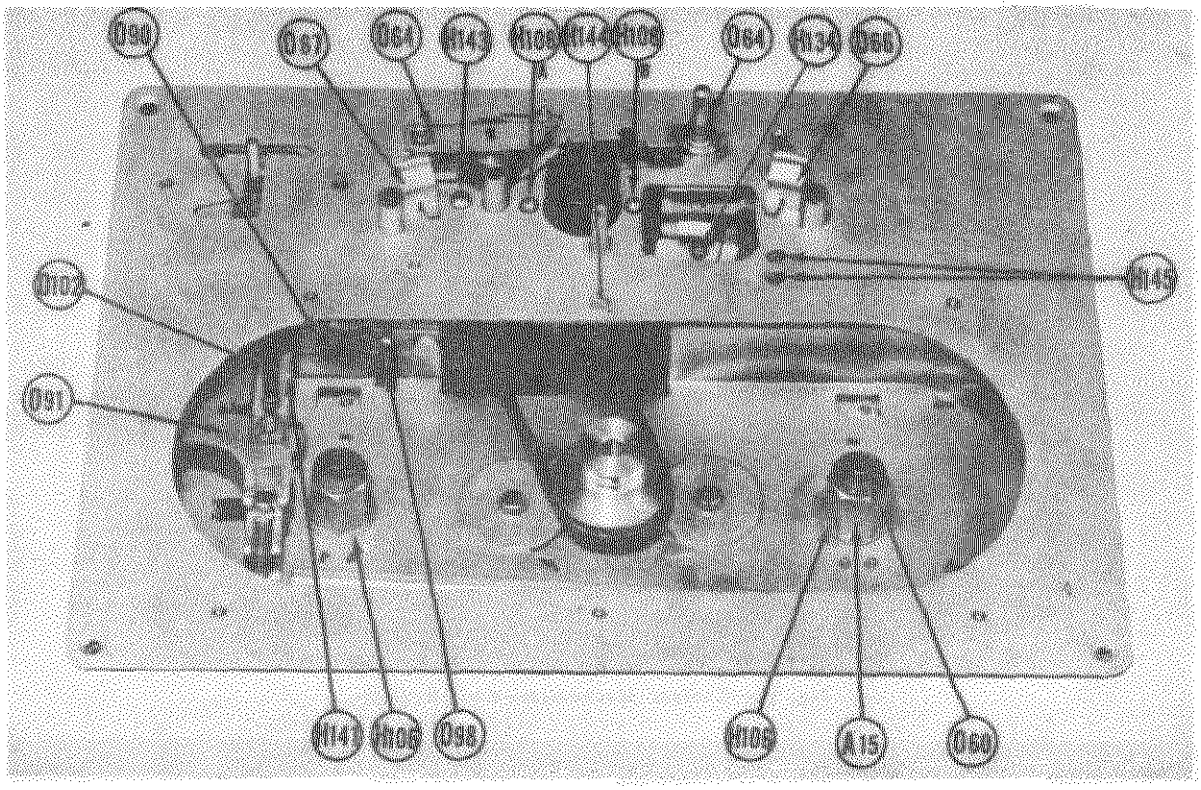

Fig. 13—*Control Mechanism—Take-up Trip Lever View*

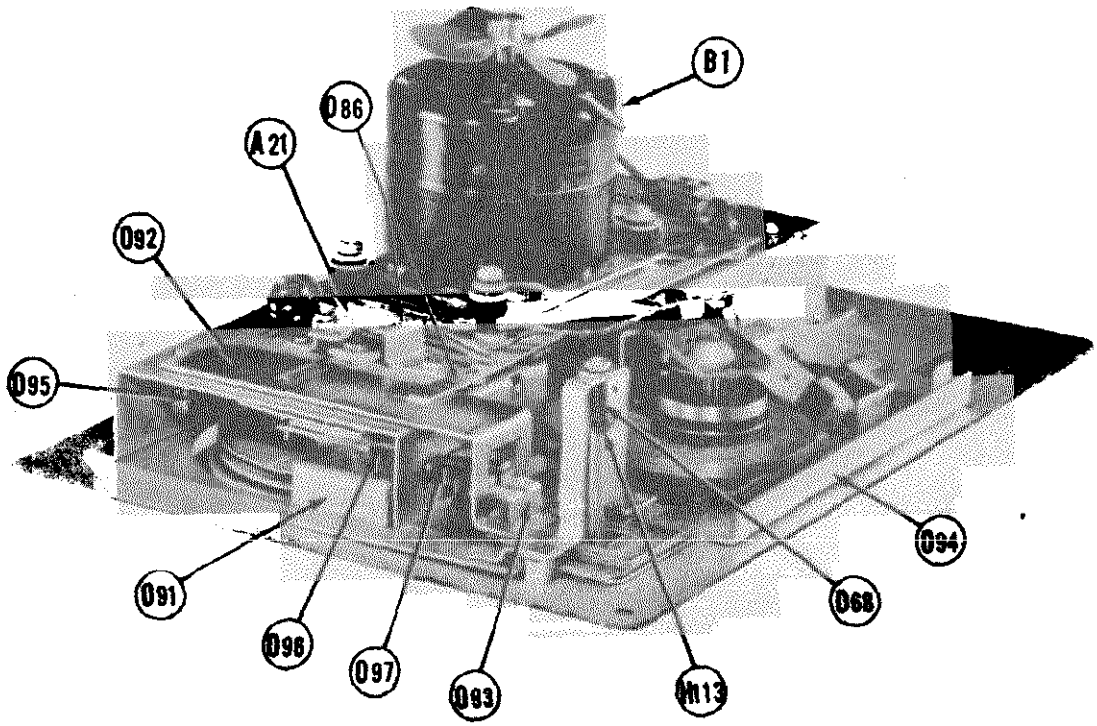

Fig. 14—*Control Mechanism—Spring View*

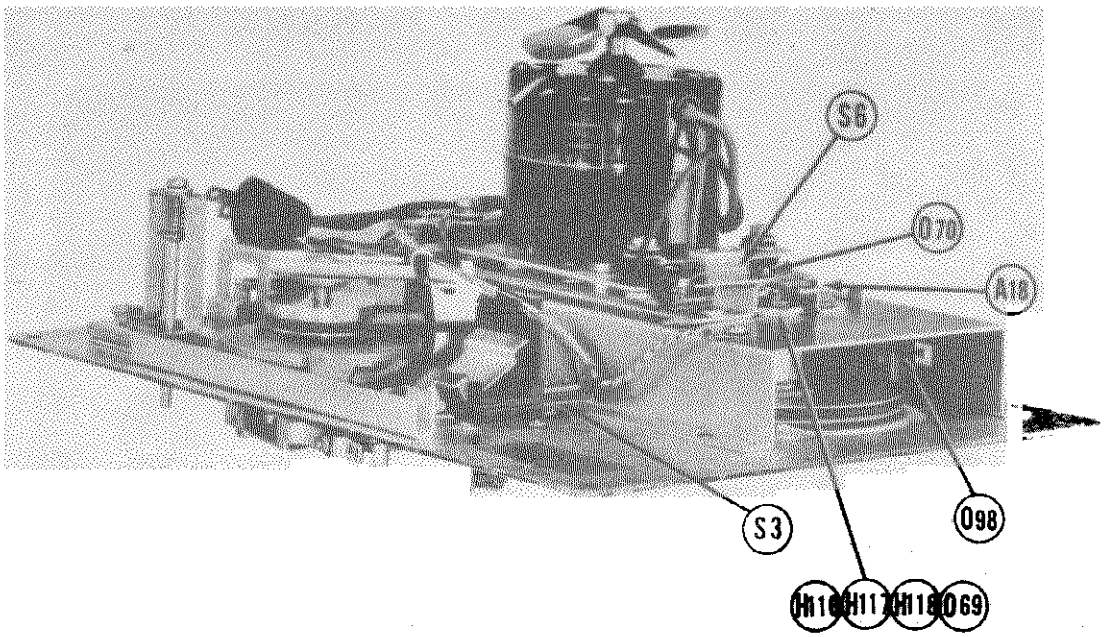

Fig. 15—*Control Mechanism—Switch View*

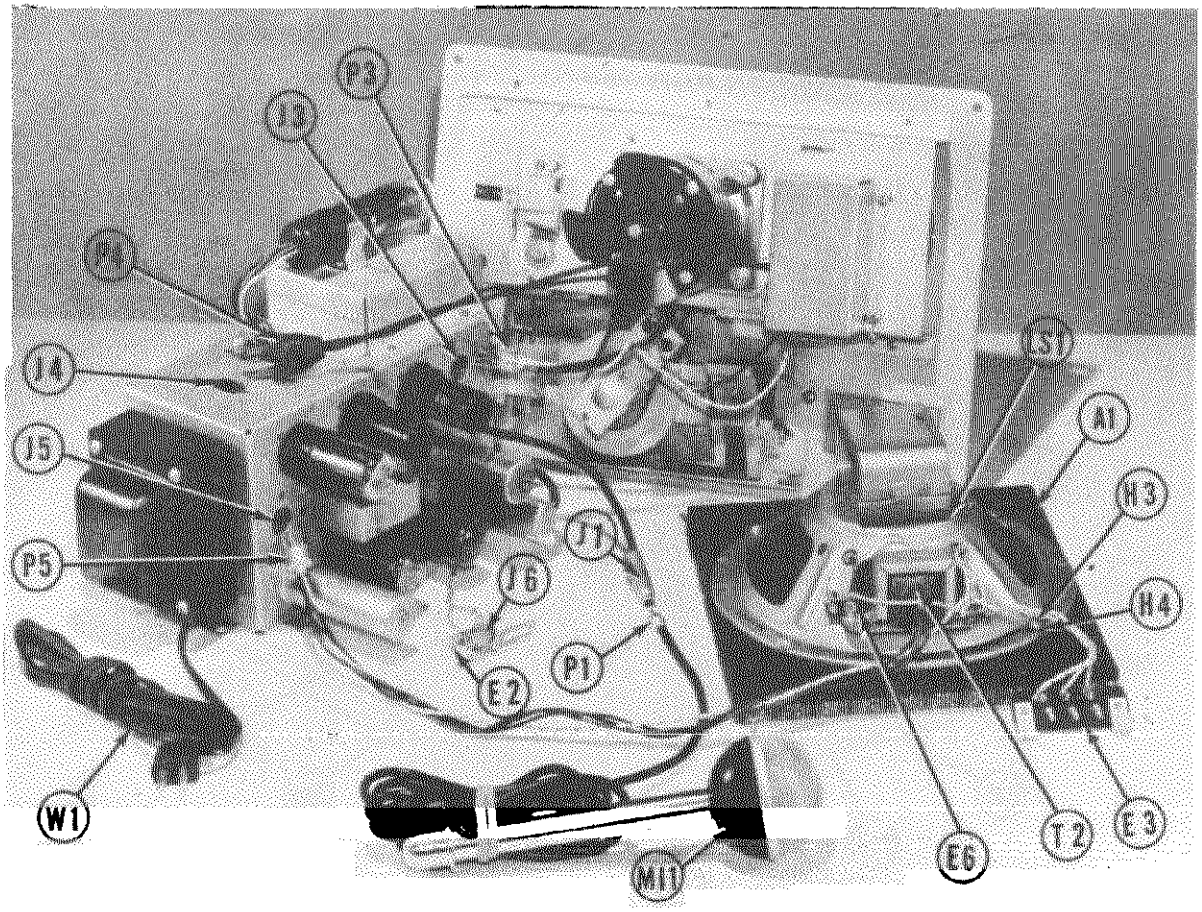

Fig. 16—*Model BK-411—Removed from Cabinet*

MODEL BK-411

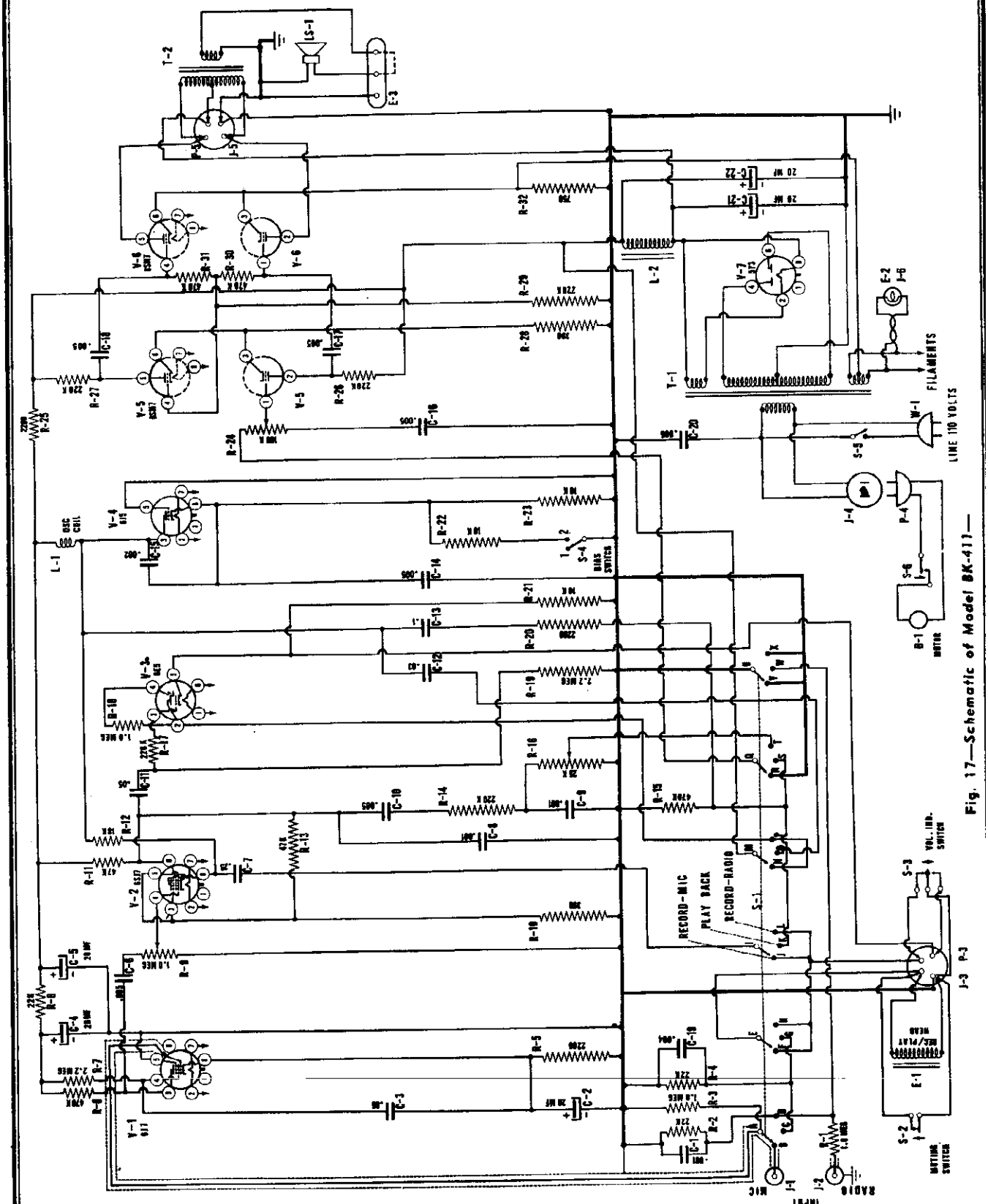

Fig. 17—Schematic of Model BK-411—

VOLTAGE

(D.C. unless otherwise specified)

Tube	Pin No. 1	Pin No. 2	Pin No. 3	Pin No. 4	Pin No. 5	Pin No. 6	Pin No. 7	Pin No. 8	Cap	Notes
V-1	0	12	80	30	0	N. C.	12	1.4	0	
V-2	0	12	3	0	3	115	12	230 A.C. 65		A.C. voltage at 28 K.C.
V-3	12	Rec. 32	—0.75	365	0	12				Pin No. 5 Grounded for measurement to allow 6E5 to be in operating condition.
V-4	0	12	325 A.C. 80	Rec. 26 Play 0	0	Rec. 0 Play —.6	12	Rec. 55 Play 15 A.C. 20		Pin No. 4 .6 volts on long amplifiers. Pin No. 6 .2 volts on long amplifiers.
V-5	0	35	1.1	0	33	1.1	12	12		
V-6	0	370	12	0	370	12	12	12		
V-7	0	370	365	A.C. 300	335	A.C. 300	0	370		Long Amplifiers have 45 V.D.C. on Pin No 1. N.C. Pin No. 3 and 7.

Tests made with 20K ohms per volt meter. All controls turned counter-clockwise. Bias Switch closed. Line voltage 115V A.C.

RESISTANCE

Tube	Pin No. 1	Pin No. 2	Pin No. 3	Pin No. 4	Pin No. 5	Pin No. 6	Pin No. 7	Pin No. 8	Cap	Notes
V-1	0	750	550K	2.2 Meg.	0	N.C.	750	2200	See note	Cap 1 Meg.-Rec. Mike Position 22K Play Position 22K Rec. Radio Position
V-2	0	750	390	1 Meg.	390	35K	750	58K		
V-3	750	Rec. 45K Play Inf.	2.4 Meg.	Rec. 1 Meg Play Inf.	10K	750	. . .	. . .		
V-4	0	750	45K	10K	0	2.4 Meg.	750	See note		Pin No. 4 2.4 meg. on long amplifiers. Pin No. 6 2.2 meg. Pin No. 8 10K with S-4 open. 5K with S-4 closed.
V-5	See note	260K	390	220K	260K	390	750	750		Pin No. 1 0 ohms in Rec. Mike position. 470K ohms in Play. 25K ohms in Rec. Radio Position.
V-6	690K	Inf.	750	690K	Inf.	750	750	750		
V-7	0	45K	45K	85	45K	85	2.2 Meg.	45K		Pin No. 1 10K on long amplifiers. No. 3 N.C. No. 5 0. No. 7 N.C.

Measurements made to chassis ground. Head and speaker unplugged. All controls turned clockwise. Tubes in sockets.

Voltage-Resistance Chart

ELECTRICAL SECTION

(See Schematic Fig. 17)

Operating Power

The line power (105 to 120 volts 60 cycles A.C.) is supplied to the amplifier through the line cord and plug assembly (W-1). The power is turned on by the switch S-5 which is attached to the "Tone" control. The power is then supplied to the drive motor through the inter-connecting plug P-4 and jack J-4 located on the amplifier chassis. (See Fig. 16).

The motor is controlled by a switch (S-6, Fig. 15) which is actuated when a ball (O-70, Fig. 15) is forced against a bakelite bushing mounted on the moving contact of the switch.

During operating positions of the Control Lever the rewind clutch raising lever forces the ball against the bushing to close the contacts of the switch. During the "Stop" position the ball recesses into an indentation in the raising lever and allows the switch contacts to open.

Pilot Lamp

The pilot lamp (E-2, Fig. 16) is of the 6-8 volt, .25 amp. Bayonet Base type—Mazda No. 44. See Pilot Lamp Replacement Page 34.

ELECTRONIC SECTION

The electronic circuit of the BK-411 is shown in the schematic (Fig. 17) and the block diagram (Fig. 18) and is, for discussion purposes, divided into the following circuits, namely: Input Circuits, Record Amplifier Circuit, Record Bias Circuit, Record Volume Indicator Circuit, Monitor Amplifier Circuit, Reproduce Amplifier Circuit, Output Circuit, and Power Supply Circuit. Location of the electronic components is found in Figs. 20 through 26.

Input Circuits

Microphone Input

The microphone input circuit consists of a shielded cable from the Microphone plug (P1 and jack J-1) to the grid of the input tube V-1 through connections "A" and "B" of the selector switch (S-1) (for reference to contacts of S-1 see Fig. 19).

The input impedance of this circuit is approximately one megohm due to the resistance of R-3.

Radio Input

The Radio input connections are made through the plug (P-2) and jack (J-2), through the one

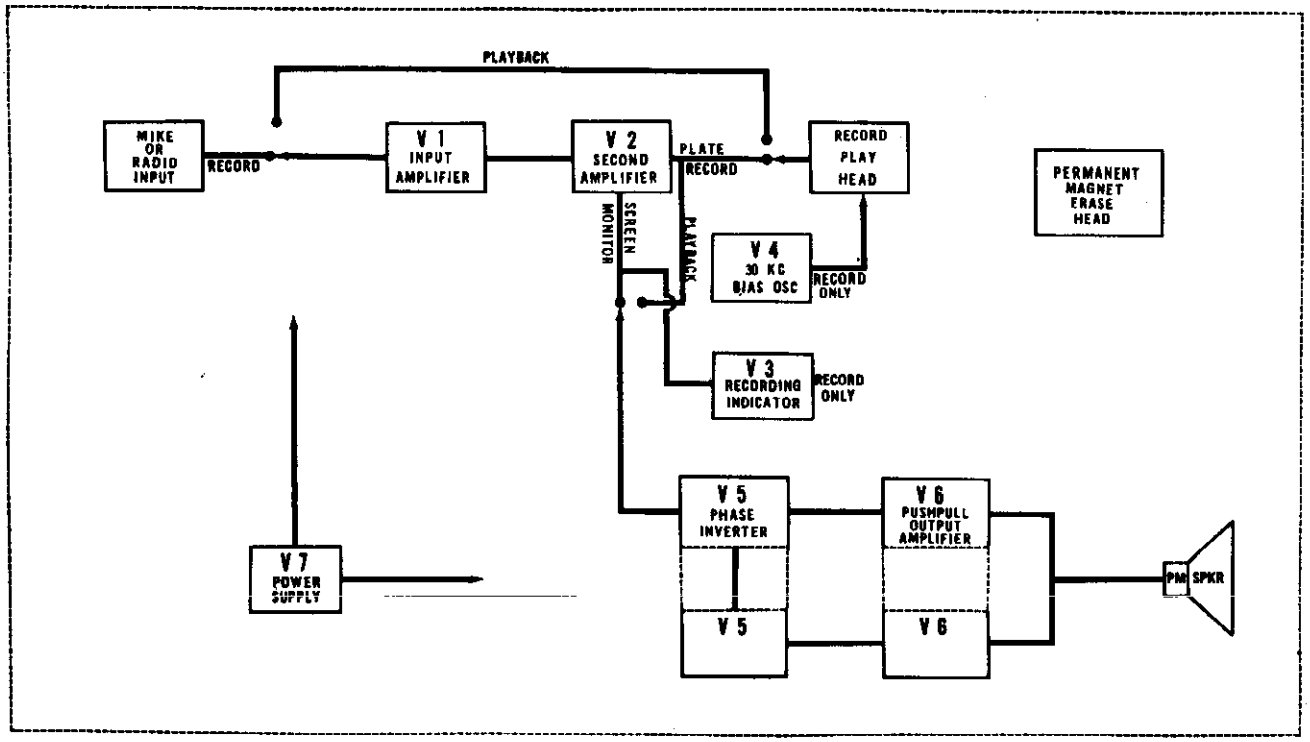

Fig. 18—*Block Diagram of Model BK-411*

megohm resistor R-1, and through contacts "D" and "A" of the selector switch (S-1), at which point a voltage dropping resistor (R-2) is connected with R-1 to drop the radio input voltage (at a ratio of 46 to 1) before applying it to the grid of V-1. No more than 10 volts can be applied at the radio input plug to avoid overloading of the input stage.

The capacitor C-1 bypasses to ground frequencies of approximately 30KC and above. This reduces the feedback in the amplifier caused by the 30KC bias oscillator.

During the Playback process the Radio input circuit is connected to ground through contacts "U" and "W" of the selector switch S-1. This prevents the signal from being amplified (by way of interwiring capacities, etc.) and interfering with the playback signal from the "Magic Ribbon."

Record Amplifier Circuit

First Record Amplifier Stage (V-1)

The first record amplifier stage is a 6J7 tube and has a gain of approximately 120. The grid is connected to contact "A" of the selector switch (S-1) and is switched to contact "B" while recording from the Microphone and to contact "D" while recording from the Radio Input Circuit.

The filter network in the B+ supply circuit to this stage is composed of capacitors C-4 and C-5 and resistor R-8 and is for the purpose of preventing the stage from motor-boating as well as removing any slight hum from the power supply.

The screen and cathode are by-passed to ground in the conventional manner.

The output of this stage provides a flat frequency response at the grid of V-2 (through capacitor C-6 and volume control R-9).

Record Current Converter Stage (V-2)

The 6SJ7 tube (V-2) is a converter tube and functions to convert the voltage from V-1 into a current which flows through the coupling capacitor C-8, through the contacts "I" and "J" or "I" and "L" of the selector switch (S-1) and into the Record Head (E-1).

The proper amont of signal recording current through the record head is 0.8 ma.

During the recording process a 30 KC signal is present at the plate of V-2. It joins the audio signal and is fed to the recording head. It is in amplitude about three times greater than the audio signal, thus in order to operate the Record Volume Indicator (V-3) and the monitor amplifier from this stage the signal is taken from the screen. The

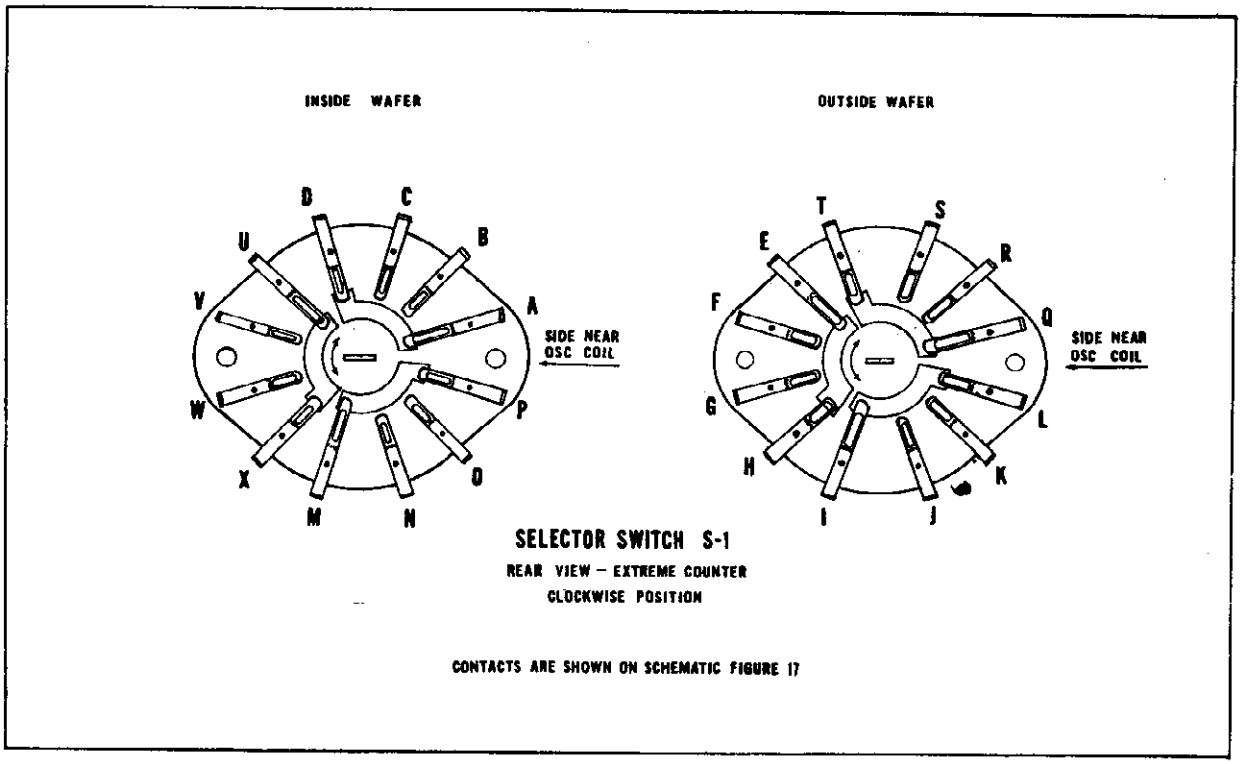

Fig. 19—Selector Switch S-1 Contacts

screen is by-passed to ground with a small capacity of C-8 and C-9 (.001 MFD each) to prevent any trace of the 30 KC signal from being applied to the recording indicator.

A resistor (R-13) is connected from the screen to the cathode to reduce the screen degeneration.

The signal from the screen to the monitor amplifier is coupled by means of the network C-10, R-14 and Volume Control R-16.

The signal from the screen to the Record Volume Indicator (V-3) is coupled through the capacitor C-11 and the resistor R-17. The resistor R-17 is for the purpose of preventing the grid current of V-3 from distorting the recording.

Record Volume Indicator (V-3)

The Record Volume Indicator is a 6E5 tube and functions to visually indicate the level of sound being recorded on the 'Magic Ribbon".

It receives a signal from the screen of V-2 through the coupling capacitor C-11 and the resistor R-17.

When the Selector Switch S-1 is in the "Record" position, the Volume Indicator remains closed until the Erase Pin is pressed to close the contacts of switch S-3 (see Fig. 15) which connects the cathode of V-3 to ground.

The resultant action of switch S-3, when the erase pin has not been pressed, is a reminder to the operator to press the erase pin to make a recording, otherwise the signal is shorted to ground by the other half of the switch (S-3) to prevent a recording from being made over a previous recording and ruining either the first, the latter, or both recordings.

The B+ voltage to the plate of V-3 is used only during the recording process and is connected through contacts "M" and "N" of selector switch S-1 while recording from the microphone and through contacts "M" and "P" while recording from the radio input circuit.

Record Bias Circuit

The record bias oscillator tube (V-4) is a 6J5. It supplies the necessary bias current for recording on the "Magic Ribbon".

Various types of recording ribbon are available. Some types require more bias current than others for better quality recordings. For this reason, a switch (S-4) is provided in the cathode circuit of V-4 to change the amount of recording bias current according to the type of ribbon to be used.

Two positions are indicated on this switch as "1" and "2". Number 1 position opens the switch and number 2 position closes the switch. When the switch is open only Resistor R-23 is in the cathode circuit and the output of V-4 supplies a bias current of 2.0 ma. to the record head, and when closed connects R-22 in parallel with R-23 which increases the current to 4.5 ma. in the head.

The bias oscillator frequency is approximately 30KC and is produced by the inductance of L-1 and the capacitance of C-15, which constitute a Colpitts Oscillator circuit.

Monitor Amplifier Circuit

The monitor amplifier circuit consists of the same input circuit as the recording amplifier circuit with the exception that the signal is taken from the screen of the second stage (V-2) and fed to the phase inverter stage (V-5), which is a 6SN7 twin triode tube. A 6SL7 tube may be used in this position to obtain more output volume during the monitor or playback process.

The output of the phase inverter is coupled to the pushpull output stage (V-6) through capacitors C-17 and C-18. The output of V-6 is then fed to the output transformer (T-2) through the interconnecting plug P-5 and jack J-5 and thence to the speaker (LS-1).

The volume of the monitor amplifier is controlled by the potentiometer R-16, and the tone is controlled by the potentiometer R-24.

The Monitor Amplifier is purposely muted while recording from the microphone to prevent acoustic feedback.

Reproduce Amplifier Circuit

The reproduce (Playback) amplifier circuit operates as follows: the signal is picked up from the "Magic Ribbon" by the reproduce head (E-1) and is applied to the grid of V-1, amplified and fed to the next stage (V-2) through the capacitor C-6 and volume control R-9. It is then taken from the plate of V-2 through capacitor C-7 and contacts "I"/"K" and "Q"/"S" of the selector switch S-1 and coupled to the grid of V-5 through the tone control R-24. Tube V-5 is a phaseinverter which supplies the signal to a pushpull output amplifier stage V-6, where it is converted into a power output signal of approximately one watt (undistorted) in the loudspeaker (LS-1). A 6SN7 tube is used in the Phase inverter stage V-5 and may be interchanged with a 6SL7 tube if more output volume is desired. This may increase any microphonics occurring in the first stage (V-1), but this in turn may be improved by the use of a selected 6J7 tube that does not have a tendency to be microphonic, or in cases where microphonics become a problem the 67J tube may be replaced with a type No. 1620 tube which is more expensive but less microphonic.

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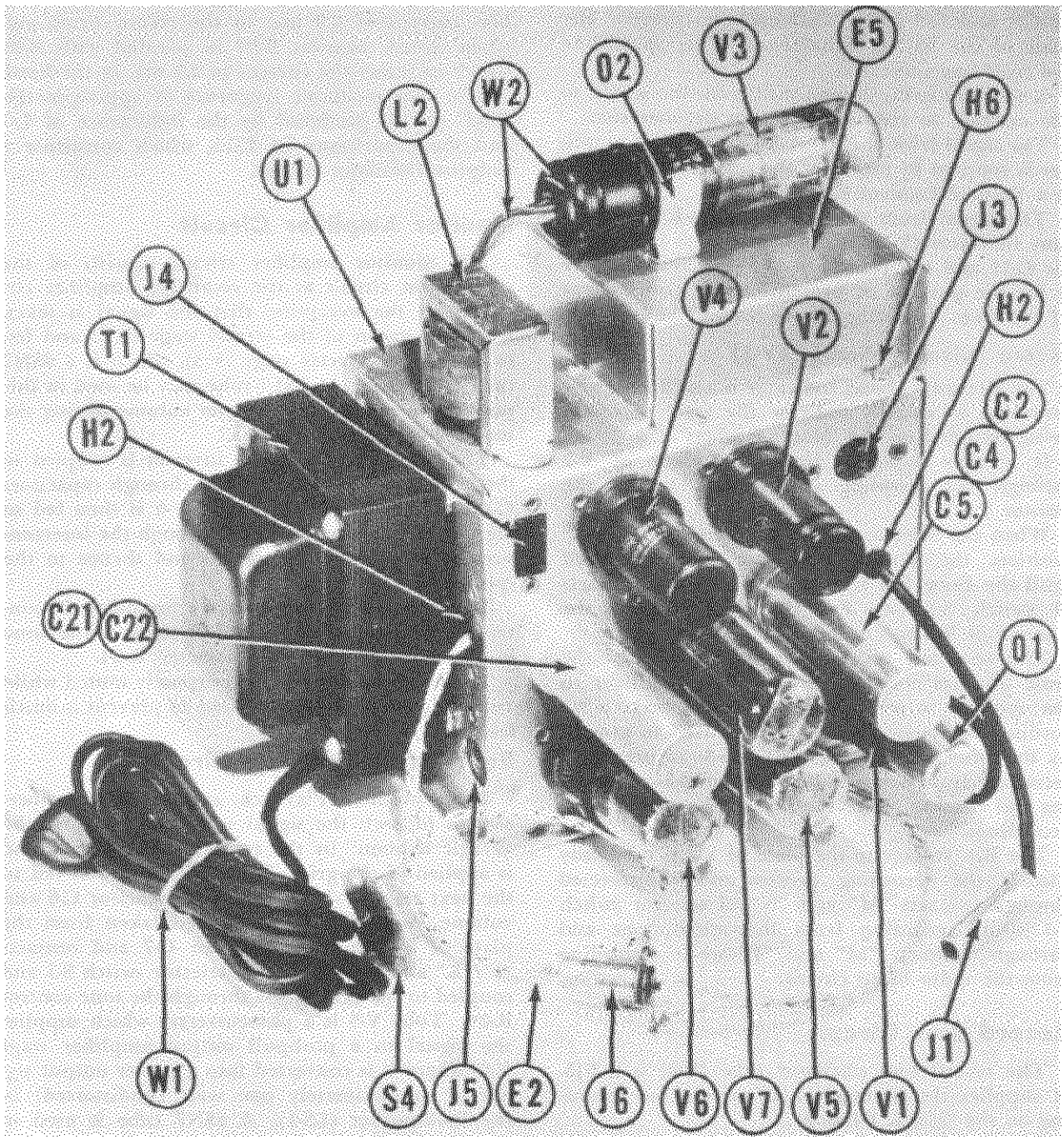

Fig. 20—*Small Amplifier Chassis—Tube View*

During the playback process the 30 KC oscillator circuit becomes inoperative when the oscillator coil L-1 is shunted by a .03 mfd. capacitor (C-12). This shunting takes place when the selector switch S-1 connects the capacitor C-12 to the power supply and thence to ground through the capacitor C-22. The oscillator coil L-1 is grounded through the capacitor C-5, thus a common connection from L-1 to C-12 is made through the ground circuit. The shunting of the inductance coil L-1 with the capacitor C-12 is used in conjunction with the combination of the resistor R-20 and capacitor C-13 to form a frequency compensating network in the output circuit of V-2.

This compensating network provides an overall frequency response necessary to equalize the natural frequency characteristic of the 'Magic Ribbon".

The inductance of L-1 and the capacitance of

C-12 when paralleled form a circuit resonating at 5000 cycles. This boosts the high frequency response, while at middle frequencies (around 1000 cycles) the impedance of this network becomes quite low, and in series with capacitor C-13 and resistor R-20 attenuates these frequencies. At lower frequencies, down to about 100 cycles, the impedance of capacitor C-13 becomes higher causing the network to appear open and permit these lower frequencies to be passed on to the next stage V-5 through capacitor C-7.

A capacitor C-19 is connected across the reproduce head during the playback process to tune the head to the higher frequencies, around 5000 cycles.

The frequency response curve shown in Fig. 29 gives the average overall response of the complete recorder and reproducer amplifier with "Magic Ribbon".

A muting switch S-2 is included in later units to short-circuit the reproduce-head during the automatic rewind process. This prevents the signal from being heard as the ribbon passes the reproduce head in the reverse direction.

This switch S-2 is mounted on the control lever bracket and is actuated by the latching gate (O-93, see Fig. 45) while the unit is in the automatic rewind position.

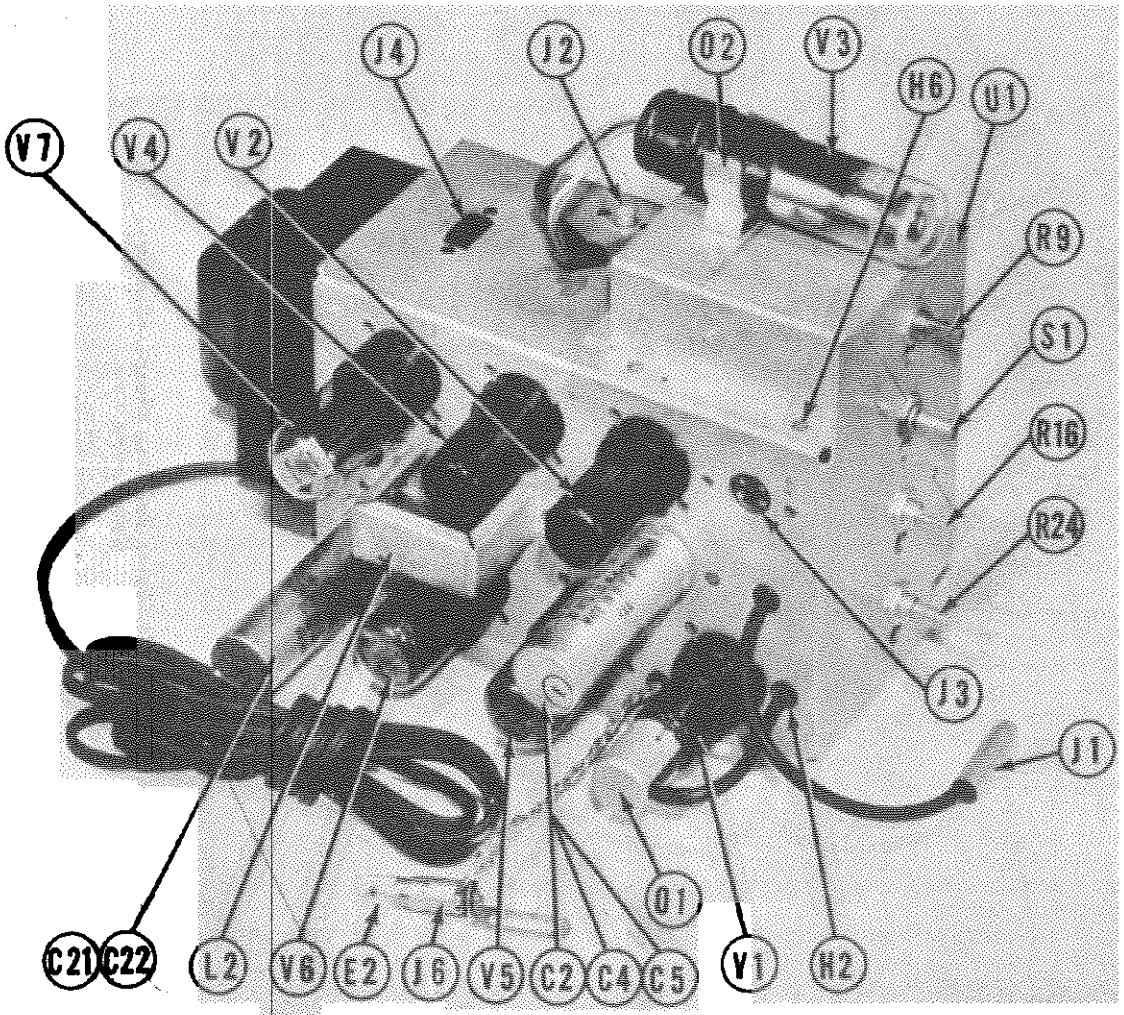

Fig. 21—*Large Amplifier Chassis—Tube View*

Output Circuit

The output circuit consists of the output transformer (T-2), the loudspeaker (LS-1), and a terminal strip (E-3). These components are mounted on the speaker, except the terminal strip, which is mounted on the cabinet near the back.

The purpose of the terminal strip is for connecting the output of the recorder to other speakers, amplifiers, etc.

The secondary impedance of the output transformer is 3.2 ohms when its part number is No. 200923 and 8.0 ohms when its part number is No. 206792. The corresponding speaker in each case is 3.2 ohms when its part number is No. 305975 and 8.0 ohms when its part number is No. 306795. These part numbers are stamped on the individual components.

Power Supply Circuit

The power supply circuit is conventional and uses a 5Y3 tube (V-7) as the rectifier for the high voltage. The rectified voltage is filtered by a capacitor C-21, choke L-2, and capacitor C-22.

The filament center tap is returned to ground through the cathode resistor R-32 of the pushpull output stage (V-6) for the purpose of biasing the filament with a positive potential. This tends to reduce any hum from the first stage V-1, due to heater/cathode leakage.

A receptacle (J-4) is provided in the power supply circuit for the purpose of connecting the top panel motor circuit to the power source (105 to 120 volts 60 cycles a-c).

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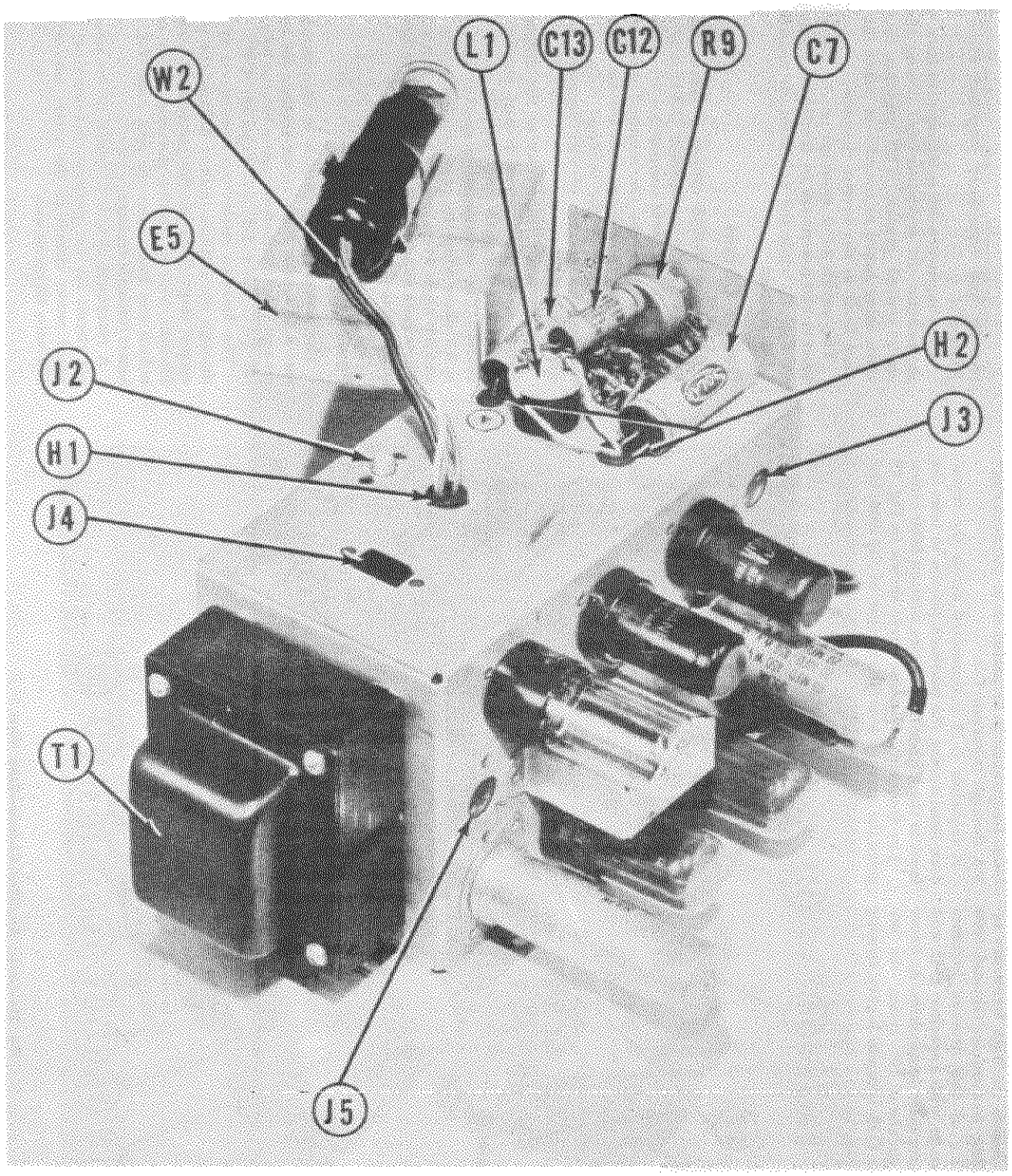

Fig. 22—*Large Amplifier Chassis—Oscillator Components View*

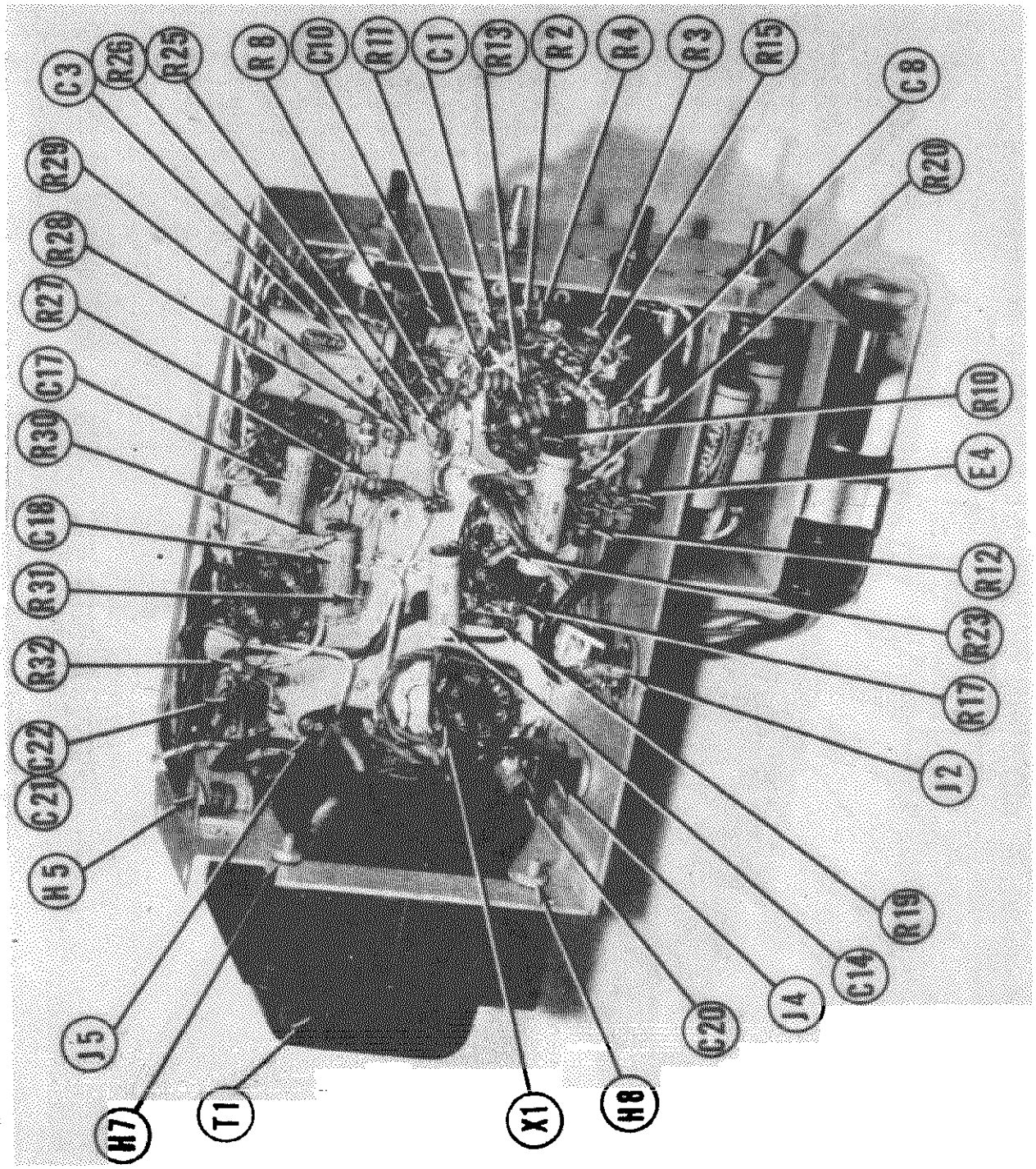

Fig. 23—Large Amplifier Chassis—Bottom View—A

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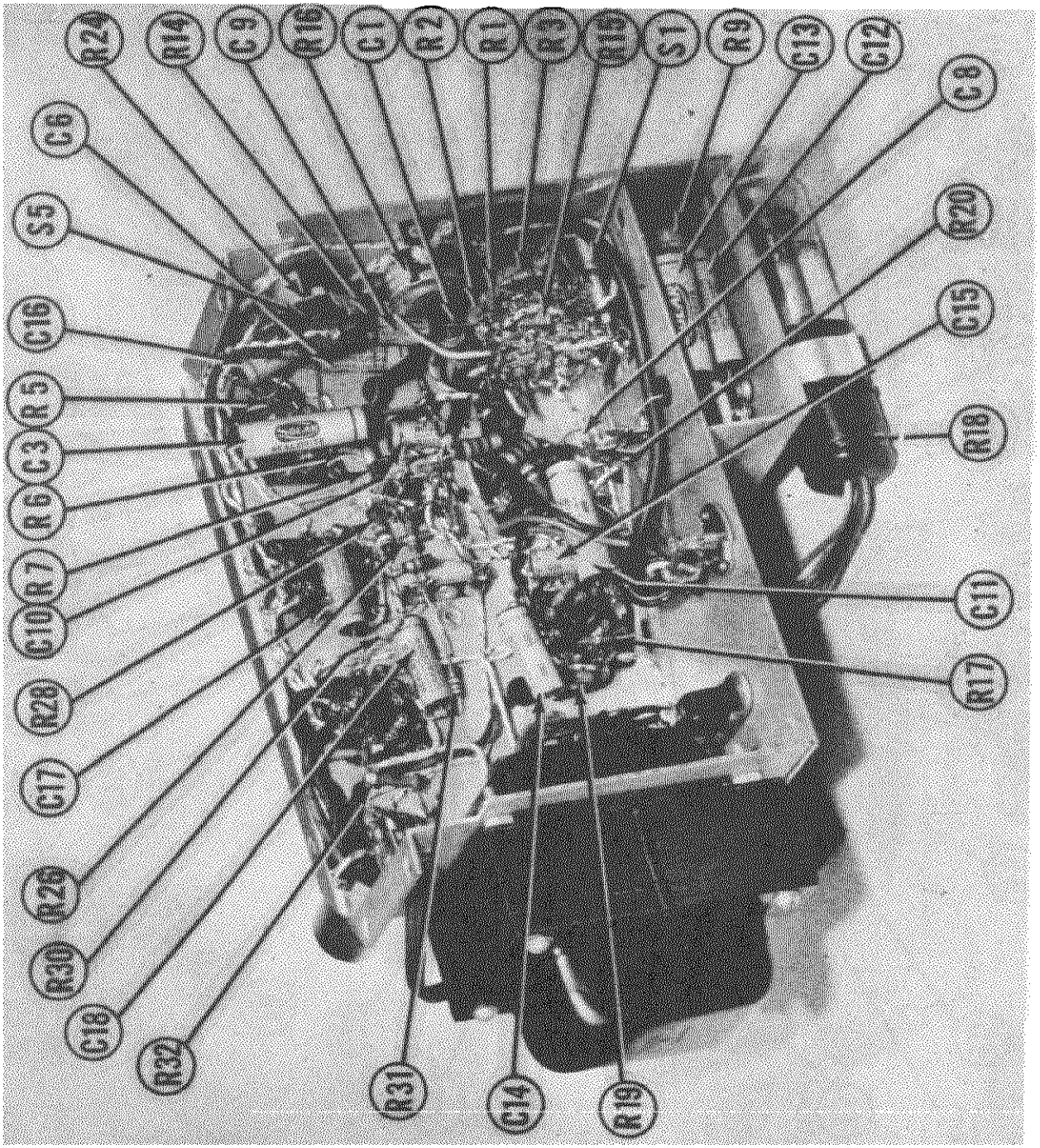

Fig. 24—Large Amplifier Chassis—Bottom View—B

SECTION III
Principles of Operation
INTRODUCTION

Fundamentally the art of magnetic recording is old, dating back from the last century.

Although a detailed explanation of the theory of magnetic recording is probably not in order in this type of instruction book, it nevertheless appears desirable to include a sufficiently extensive investigation of the principles to make clear the relationships between, and the need for, the various elements in the present magnetic recorder.

A magntic recording can be made in any type of material which permits a varying degree of permanent magnetization and which is mechanically stable and physically formed in a fashion permitting it to be handled in a reeling and scanning mechanism. The process of making a magnetic recording is basically one of moving the recording material at a fixed rate of speed through a station which functions to impress upon the material the desired magnetic state. In the reproducing process, the requirement is to move the material at the same rate of speed as in the recording process through the reproducing station, whose function is to derive from the magnetic state of the material a signal voltage which can be amplified in the electronic section of the recorder to produce a usable audio power.

Magnetic recording also lends itself to a further basic operation which gives to magnetic recording a unique advantage over almost any other type of recording. This principle is the erasing principle. Since a magnetic recording consists of a varying degree of magnetization in some form of carrier, it is possible to conceive of the idea of erasing a magnetic recording by subjecting the material to some operation which will demagnetize the material. In the conventional magnetic recorder this process of erasing is automatically and simultaneously effected when a recording is being made, since it is obvious that if a new recording is being made on a piece of material, it is desirable to erase from that material any old recording.

We shall now consider under the three heads of Recording, Erasing, and Play-Back, how these basic operations in magnetic recording are accomplished.

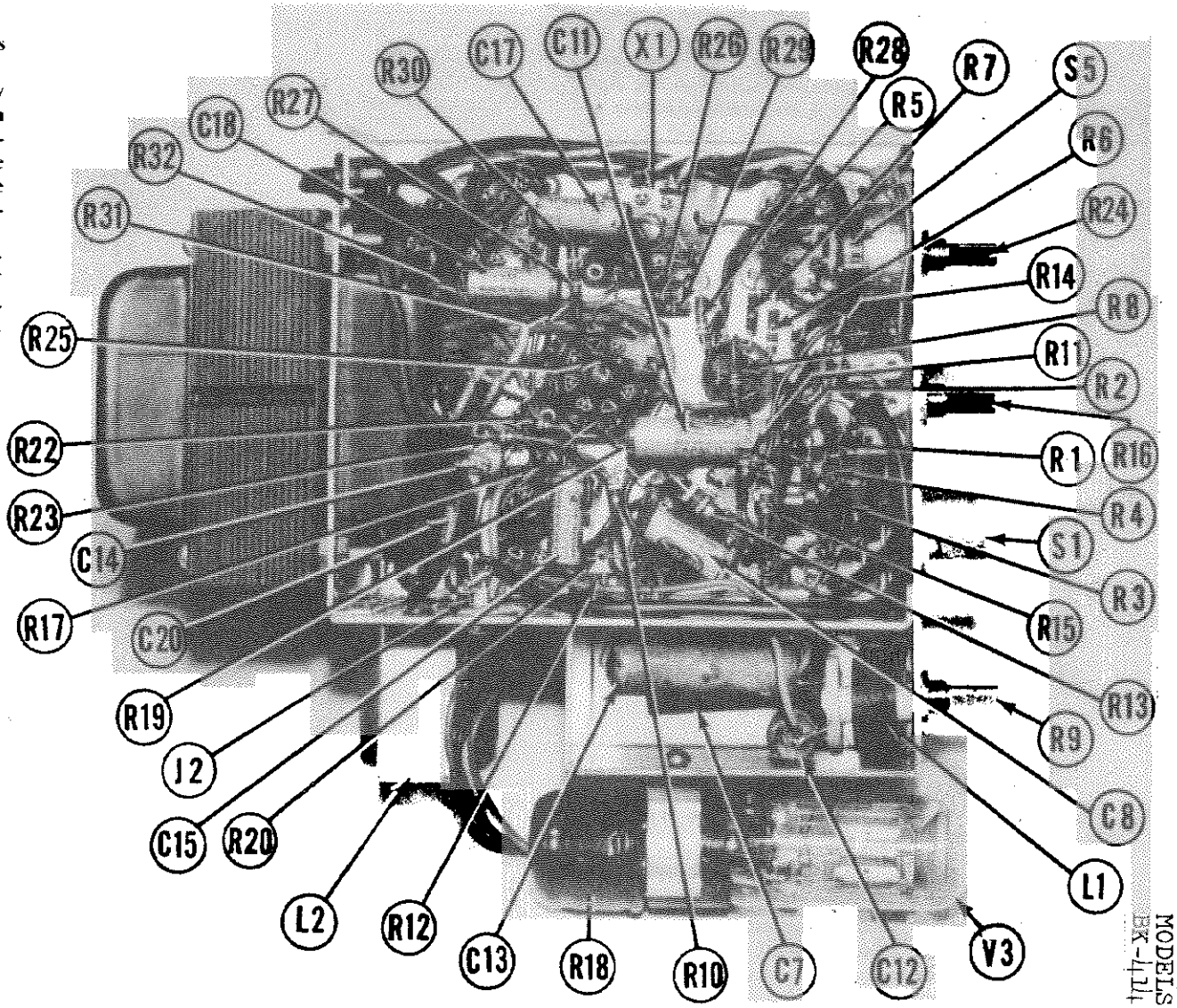

Fig. 25—Small Amplifier Chassis—Bottom View—A

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RECORDING

Fig. 27 shows an electromagnet in contact with a section of magnetic ribbon. The dashes in the ribbon and the arrows in the magnet indicate by their direction and concentration the magnetic condition of any particular part of the system. Note that to the left of the magnet and in the unrecorded portion the particles in the ribbon are completely unoriented, having no net force. This case of disorientation is one which exists in a demagnetized magnetic material and represents, in magnetic recording an erased or unrecorded section of ribbon. Note that the force lines in the electromagnet set up across the air gap, where the ribbon makes contact with this electromagnet, a relatively intense field as indicated by the bunching of the arrows. This intense field penetrates the ribbon causing the unoriented condition of the magnetic particles in the ribbon to be changed to a more or less oriented condition. The amount of orientation is controlled, of course, by the amount of current flowing instantaneously in the recording magnet. It is well to understand that it requires more energy to produce complete orientation of the magnetic particles than it does to obtain partial orientation. In this way, if the current through the recording head increases slowly, for example, more and more orientation is established in the material until finally all of the particles are completely oriented and this represents the maximum energy which can be stored in the material. The condition of completely unoriented particles corresponds to the noise level of the material, and the condition of saturation, when all of the particles are oriented, corresponds to the maximum signal which can be recorded on the material. The ratio between these two figures is the maximum dynamic range of the material.

This simple picture of the mechanics of making a magnetic recording is unfortunately obscured by the fact that the remaining magnetization of the recording material is not quite proportional to the recording magnetic field, particularly at small recording currents, and this results in a distorted magnetic pattern after the ribbon leaves the recording pole-pieces. To guard against this happen-

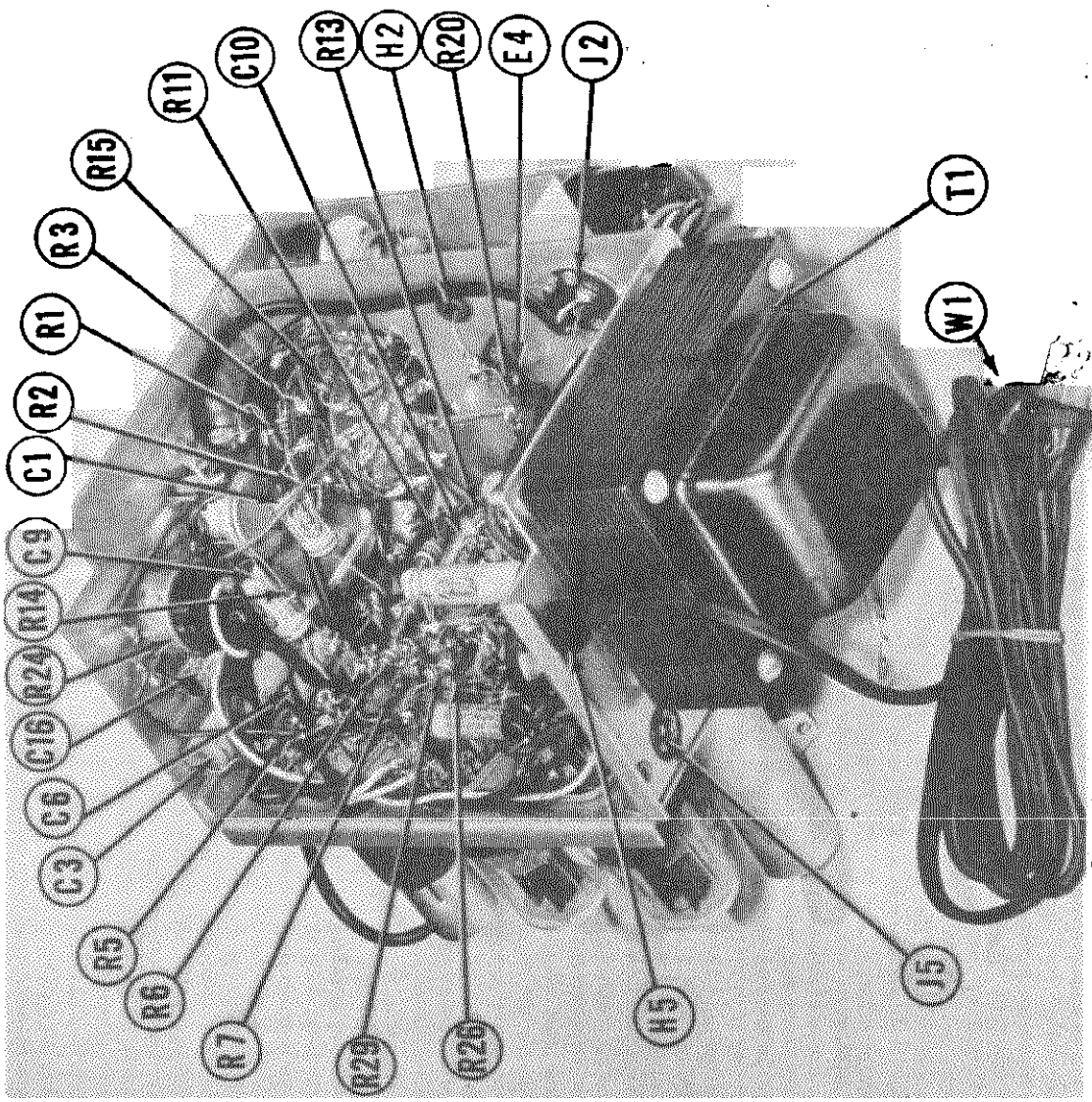

Fig. 26—*Small Amplifier Chassis—Bottom View—S*

ing, a very simple trick is used. This trick consists of superimposing upon the current in the coil corresponding to the signal a second current of relatively high amplitude but of such a high frequency that it cannot be heard in the reproducing process. The function of this high frequency, current, which will hereafter be termed "bias current", can be understood very simply if one considers that it is to add to the relatively weak signal current sufficient energy to leave in the ribbon permanent magnetic orientation proportional to the signal currents. By the use of this bias current superimposed on the signal current any intensity of recording signal from the very lowest to complete saturation will leave a corresponding degree of magnetization in the magnetic material, and this magnetization will be as permanent as the material itself until the material is again subjected to some form of magnetic process.

ERASING

Magnetic Erasing can be defined as the process of removing from a magnetic medium any net orientation in its magnetic state.

There are two basically different methods of erasing a magnetic recording; one method, which is the earliest and most simple, utilizes a powerful Direct Current field, such as that produced by a permanent magnet (See Fig. 28 A). As the recording medium passes this magnet the field magnetizes the material to saturation leaving the magnetic state of the material oriented in such a manner as to completely wipe out the modulations which had represented the recorded signal.

This simple method, however, does not leave the magnetic recording medium in the best state for a subsequent noise-free recording when A. C. bias is employed. Therefore, the second basic method of erasing is used almost exclusively. This preferred method utilizes an alternating current magnetic field for erasing. (See Fig. 28 B). As the magnetically recorded material approaches the alternating field type erase head, each incremental section of material is magnetized first one way and then the other, as the direction of field reverses, and when the material is in the center of such an erasing head, these magnetic cycles are of sufficient magnitude to saturate the material, which effectively erases the previously recorded signal. As the

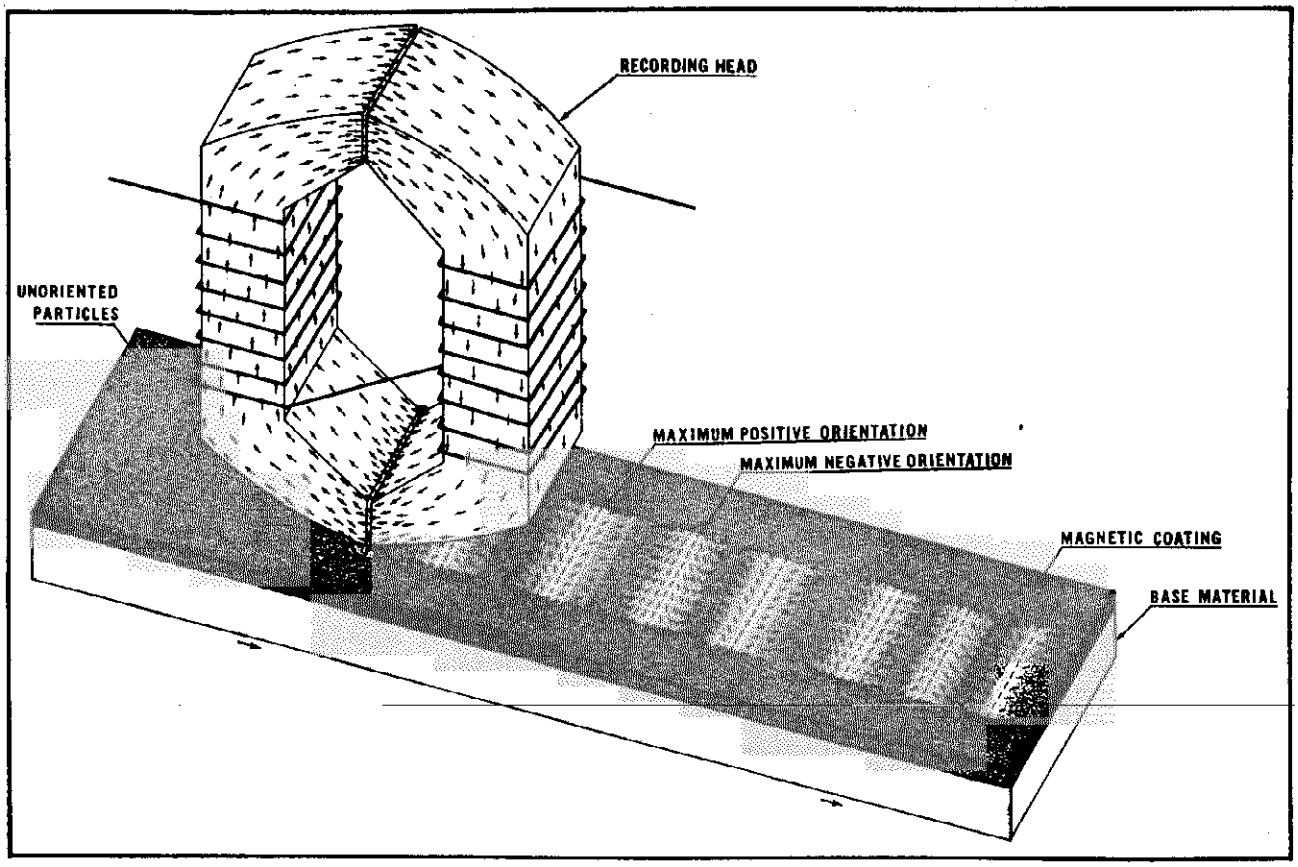

Fig. 27—*Principles of Magnetic Recording*

Fig. 27 is not quantitative as to flux distribution as it is only intended to schematically illustrate the principle of operation of a magnetic recorder head.

material leaves the erasing head, it is still subjected to the reversing field directions, but each succeeding cycle is weaker than the last, due to the increasing distance between a given section of material and the erase head. The final result is such that the recording medium is left completely demagnetized, ready for a new recording.

In the Model BK-411, this type of erase is accomplished by the use of permanent magnets arranged in such a manner to produce a reversing field in the recording medium as the medium passes each pole of the magnets (See Fig. 28 c and 28 d).

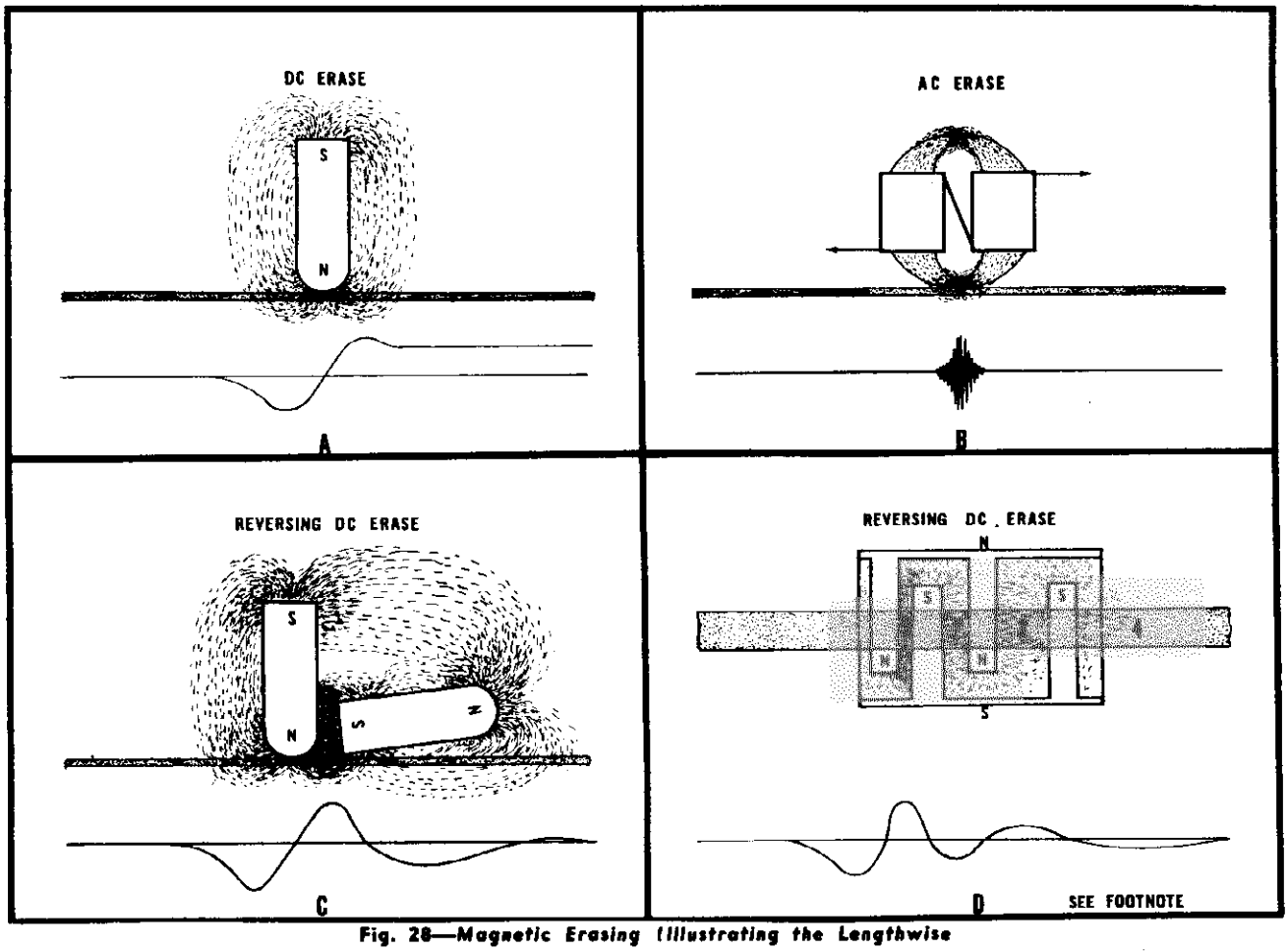

Fig. 28—*Magnetic Erasing (Illustrating the Lengthwise Magnetization Component of the Recording Medium)*

As the ribbon passes this type erase head it should contact the first pole and gap (1) to become completely magnetized, pass through the magnetic field of the second gap (2) at a small distance from the second pole to become partially magnetized in the opposit direction, pass through the third gap (3) at a greater distance from the third pole to become magnetized again in an opposit direction but to a lesser degree than before, and finally pass through the fourth magnetic field (4) at a greater distance from the last pole. This results in a demagnetized state of the ribbon.

PLAYBACK

The playback process is possibly the easiest to understand of the three processes in magnetic recording. Here it can quite easily be appreciated that any degree of net orientation of the magnetic particles of a given section of recording medium will produce a net external magnetic field. If we move a conductor across such a field a voltage will be established in the conductor. This is the basic theory of the dynamo and was discovered by Faraday in 1831. In magnetic recording these net fields are very weak and therefore special efforts have to be made to produce from these fields as much voltage as is possible; practically speaking, these efforts result in a pickup structure which may be identical to the recording structure. Instead of having a single turn of wire close to the magnetic medium, a set of polepieces are in contact with the medium and any difference in the field from one section of medium to another sets up a magnetic field across these polepieces. Many turns of extremely fine wire are wound on these polepieces and as the magnetized medium moves by the polepieces the magnetic force exerted thereby thread through the polepieces and induce a voltage in the many turns of fine wire. This voltage is then fed to an amplifier wherein it produces sufficient power to operate a speaker.

EQUALIZATION

It might be expected in such a complicated series of processes as have been described that the frequency response of such an over-all system would not be exactly the same to a high frequency audio signal as it would be to a low frequency audio signal. Such is the case, unfortunately, and since a recorder should do equal justice to any frequency to be recorded, it requires that the amplifiers associated with the magnetic recorder must have characteristics which are the inverse of those of the recording medium, thus producing a net over-all effect which is reasonably independent of frequency.

To illustrate this problem of equalization, Fig. 29 Curve A shows the frequency response obtained using flat amplifiers in recording and reproducing on the BK-411 Recorder using the head and the speed of that particular recorder. It will be seen that such a system would be deficient in both low frequencies and very high frequencies. Curve B shows the frequency characteristics of the amplifier actually used with the BK-411 when that amplifier is in recording position. Curve C shows the characteristics of the playback amplifier and Curve D is the result of superimposing Curve C upon Curve A and B and shows the actual measured over-all frequency response of the recorder.

In addition to these fixed characteristics of the recording process and of the recording amplifier and playback amplifier, the BK-411 Recorder has a variable frequency network, the "Tone" control, which operates to suppress as much as desired the high frequencies in the playback process. The "Tone" control has no effect on a recorded signal although it might appear that it was doing so because it does affect the sound through the speaker while a recording is being made from the radio input circuit.

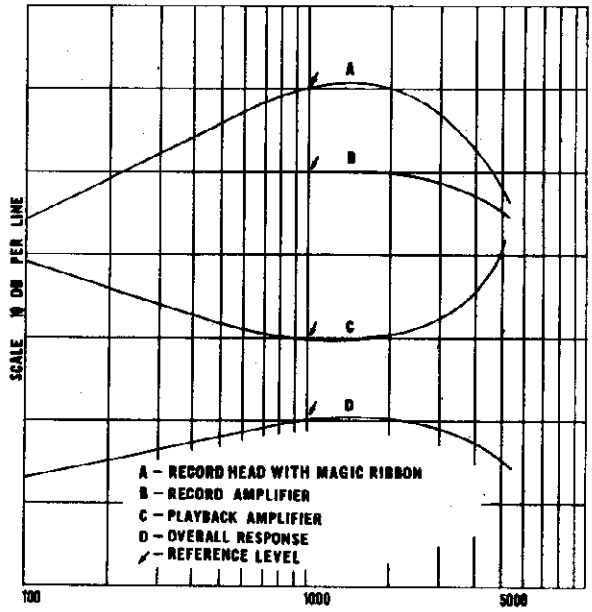

Fig. 29—*Frequency Characteristics*

SECTION IV
Operating Instructions

INTRODUCTION

Best results are obtained when proper care is given the Model BK-411 Soundmirror.

IMPORTANT—Before connecting the Soundmirror to a power source be sure that it is 105 to 120 Volts 60 cycles alternating current. DO NOT connect the unit to a Direct Current Source. The warranty is void if the Soundmirror is connected to a power source other than 105 to 120 Volts 60 cycles a.c.

If other than the voltage or frequency specified above is the only available power source a 150 watt transformer, inverter, or converter must be installed in the line.

PREPARATION

Power—Plug the line cord into a power line receptacle of 105 to 120 volts, 60 cycles a.c. and turn the "Tone Control" clockwise to turn "power on". The power switch is attached to the Tone Control.

Operate the control lever through the "Stop" position to cause all control mechanisms to be in neutral position before threading. Allow the unit to warm up a few moments before using.

Reels—Place the reel with "Magic Ribbon" on the left hand turntable so that the ribbon comes off the left side of the reel. Be sure the magnetic coating on the ribbon faces the center of the reel. (In the Brush "Magic Ribbon" this coating is the black side).

Place the empty reel on the right hand turntable.

Be certain that the key pin (A) of each turntable fits into the key slot (B) of each reel. (See Fig. 30). Correct positioning allows proper action of each automatic trip lever (C).

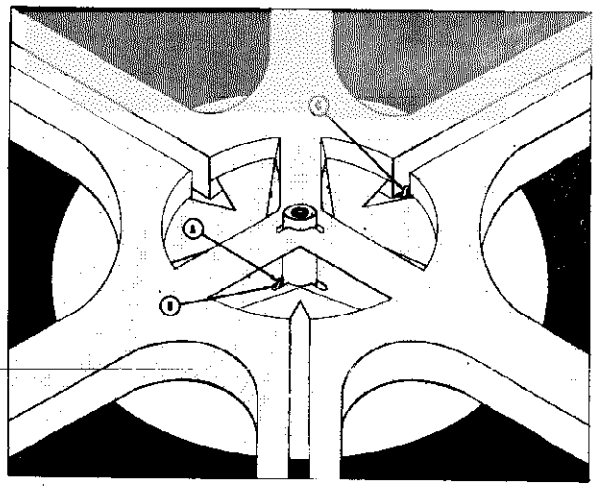

Fig. 30—*Reel Keying of Turntable*

THREADING

1. After placing reels on turntables, as instructed in paragraph above, grasp the free end of the ribbon in the right hand, and with the left hand

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guide the ribbon into the "Recording Slot", from the left side to the right side keeping the slack adjusted until the ribbon rides smoothly when pulled through the slot (see illustration Fig. 31).

2. Thread the free end of the ribbon into the hub of the take-up reel. Give the reel one or two complete turns by hand to allow the ribbon to grip around the hub of the reel and take up the slack. (See illustration Fig. 32).

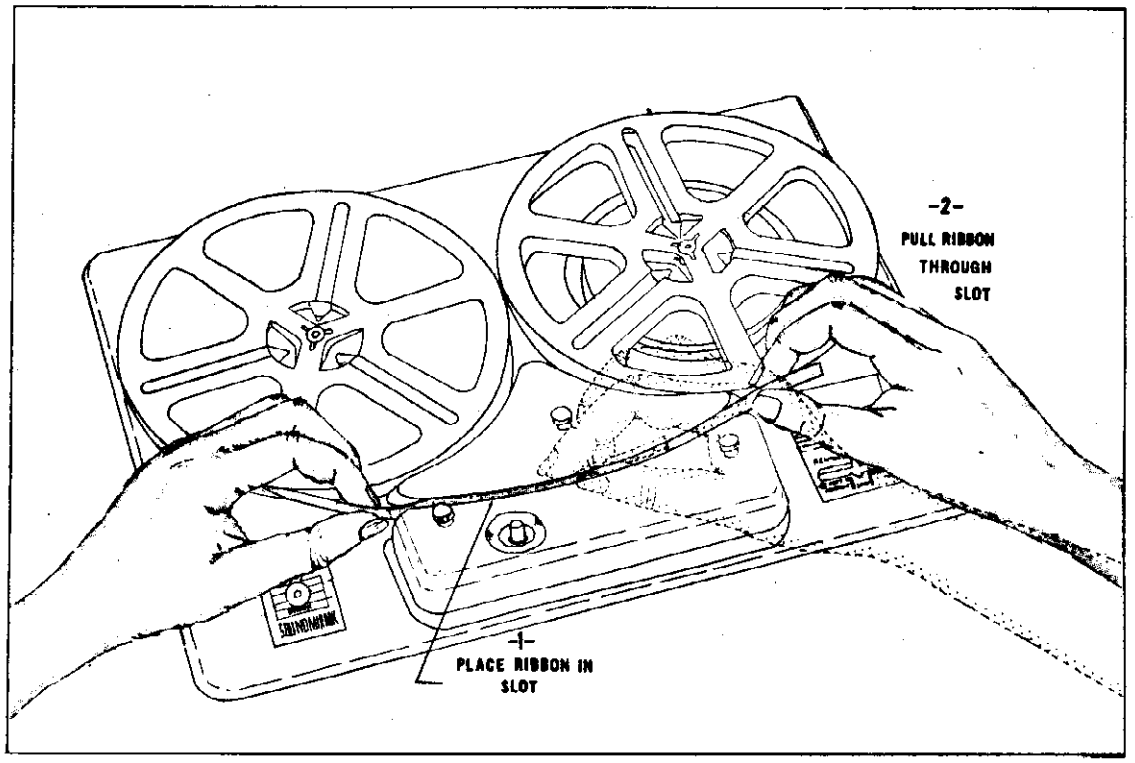


Fig. 31—*Threading Ribbon In Slot*

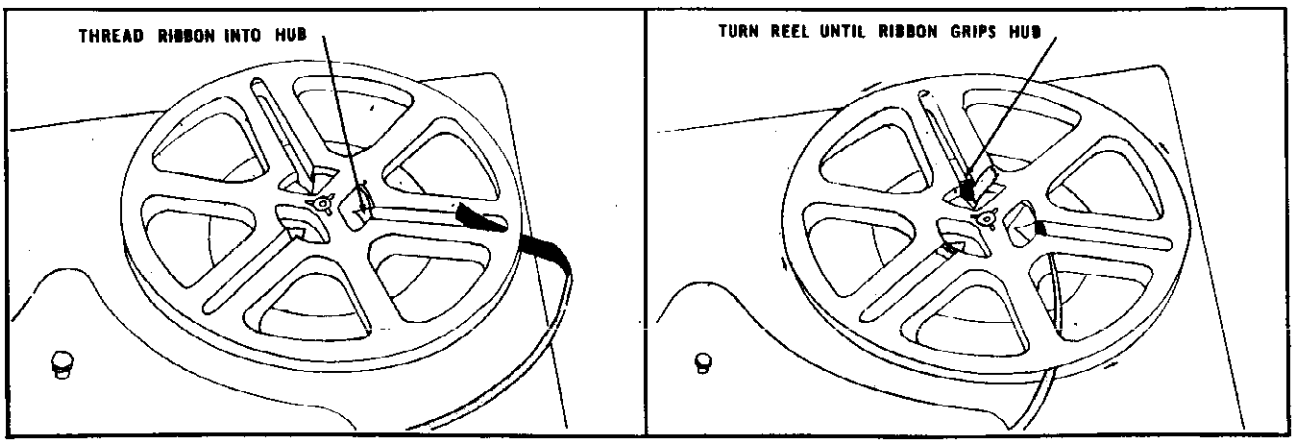


Fig. 32—*Threading Ribbon In Take-up Reel*

RECORDING FROM MICROPHONE

Set the controls as follows: (See Fig. 33 for controls).

1. Turn the Selector Switch (3) to the "Record-Mic." position.

2. The "Speaker Volume" control (4) is used only when recording from the radio input circuit.

3. The "Tone Control" (5) does not affect the recording process, but can be used during monitoring or playback operation.

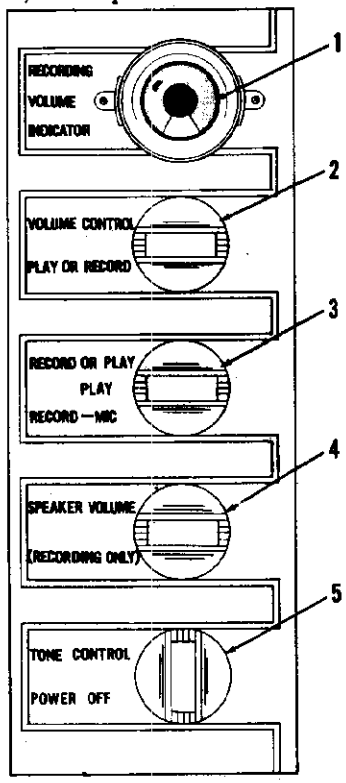


Fig. 33—*Amplifier Controls*

4. Shift the Control Lever (Fig. 34) up, and to the right, as far as possible to the "Record" position while pressing on the Erase Pin which locks the erase head against the ribbon. This operates a switch which causes the Volume Indicator motion. Note: The control Lever, when released, will automatically return to its neutral position.

5. Turn the "Volume Control" (2) clockwise gradually to set the recording level, which is indicated by the "Recording Volume Indicator". (1)

Correct recording level is obtained when the Indicator shadow just closes with the loudest sounds being recorded.

6. At the end of each recording turn the recording volume control (2) completely counter-clockwise, gradually, before stopping the ribbon to prevent sudden breaks of sound during playback.

RECORDING FROM RADIO

The Soundmirror should preferably be wired to the Radio. For wiring instructions see Page 42.

Set the controls as follows:

1. Turn the Selector Switch (3 Fig. 33) to the "Record-Radio" position.

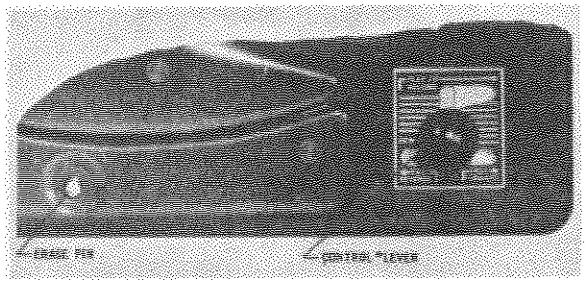
2. Adjust the "Speaker-Volume" control (4) for the desired listening volume from the Soundmirror speaker.

3. Adjust the "Tone Control" (5) for the desired listening tone.

4. Follow steps 4, 5, and 6 in "Recording from Microphone."

STOP

The "Magic Ribbon" may be stopped at any point by shifting the control lever to the position marked "Stop". (See Fig. 34).



REWIND

If the recording is allowed to continue to the end, the ribbon will automatically rewind. When desiring to rewind the ribbon before reaching the end, the control lever may be moved to the position marked "Rewind," being careful not to shift the lever on past to the "Stop" position.

This sets the machine for rewind and the lever can then be released. The lever must be moved to the "Stop" position before returning it to the "Record" or "Play" position.

FAST FORWARD OR FAST REVERSE

The ribbon may be run rapidly in either direction by moving the control lever to the proper position; "Fast Forward" at the bottom right or "Fast Reverse" at the bottom left (Fig. 34). The lever must be held in position during either operation. If it is desired to stop the ribbon at any point after it has attained a fairly high speed in either direction, the lever should be held in the opposite direction for a moment to cause a braking action and to prevent "slacking" of the ribbon. As the reels come to rest, the lever should then be moved to the "Stop" position to prevent winding in the opposite direction.

PLAYBACK

To play a recording after the ribbon has been rewound, and if necessary rethreaded, set the controls as follows:

1. Turn the selector switch (3 Fig. 33) to the "Play" position.

2. The "Speaker Volume" control (4) is not used during the playback operation.

3. Shift the control lever to "Play" position. This sets the ribbon in motion.

4. Adjust the "Volume Control" (2) for the desired listening volume.

5. Adjust the "Tone Control" (5) for the desired listening tone.

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OPERATIONAL CARE

The model BK-411 Soundmirror is designed to give long service with a minimum of maintenance. It is recommended, however, that care be exercised in handling and operating the Soundmirror to assure high quality performance. The following should be kept in mind at all times:

1. Keep the pole-pieces of the Record-head clean and free from accumulated dust, dirt, or ribbon residue.

Whenever the ribbon residue becomes collected and "piled" on the pole pieces it may be removed by the "flick" of a toothpick or similar non-metallic implement. In stubborn cases the use of a small swab dampened with acetone may be required.

CAUTION: Use acetone sparingly and avoid getting it on the felt pad which presses the ribbon against the head.

Care should be exercised with the use of any implement to prevent marring the surface of the pole pieces.

Loss of high frequencies is evidence of a dirty head. The front trim cover (A-12, Fig. 4) must be removed to clean the head.

When the trim covers are removed for any purpose, be sure to replace them so they do not interfere with the action of the erase head bracket (18), the roller bracket (44), or the reels. (See points A and B of Fig. 4).

2. Dust from the surface of the ribbon gradually accumulates on the capstan bearing block. (O-82, Fig. 8). Large accumulations of this material can cause trouble. This material should be brushed away with a small dry brush (toothbrush or similar implement). Do not use anything hard which will mar the surface of the capstan. The front trim cover (A-12 Fig. 4) must be removed for this operation.

3. An attempt to operate the recorder in a warm room immediately after prolonged exposure to low temperatures may produce a poor recording because of moisture condensation on friction drive surfaces.

4. Any deformation in the rubber pressure wheel (O-84, Fig. 9) which presses the ribbon against the capstan spindle, will be kneaded-out by the normal operation of the recorder. However, should the Control Lever have inadvertently been left in the "Play or Record" position and the pressure wheel left in contact with the spindle for an extended length of time, there will temporarily be a speed variation in the movement of the ribbon until this rubber has been kneaded into a uniform state. Therefore, to obtain highest quality recordings, it is desirable to run the recorder for a few minutes before actually attempting to make a recording. Upon completion of recording or playing be sure to shift the control lever to the "Stop" position. This position disengages the pressure wheel from the capstan spindle.

5. Sufficient ventilation should be provided for best results in the operation of the Soundmirror. Do not set the recorder on a radiator. Allow at least three inches space between the rear of the cabinet and the adjacent wall for air circulation.

SECTION V
Maintenance

INTRODUCTION

Servicing the Model BK-411 Soundmirror is as simple as servicing any popular combination radio and record changer.

The following information will aid the serviceman in a quick and thorough analysis and overhaul of the subject equipment.

A Symptom – Cause – Remedy – chart will be found on pages — to — to provide a quick reference to possible troubles and their remedy.

Photographs and drawings of the complete and sub-assemblies as well as descriptive methods for disassembly and re-assembly of various parts are included throughout the book.

The reference numbers located on the photographs, schematic and exploded view drawings are a reference to items in the list of Material.

DISASSEMBLY OF UNIT

To Remove Amplifier From Cabinet

1. Disconnect the Soundmirror from the power source.

2. Remove reels and ribbon.

3. Remove the cardboard back from the cabinet. (Provided on later units.)

4. Disconnect the interconnecting plugs P-3 and P-4 (Fig. 16) which connect the top panel to the amplifier. Be careful when removing plugs to not damage the sockets. DO NOT PRY PLUGS FROM SOCKETS.

5. Disconnect the speaker plug P-5 from jack J-5.

6. Disconnect the microphone plug P-1 from the jack J-1.

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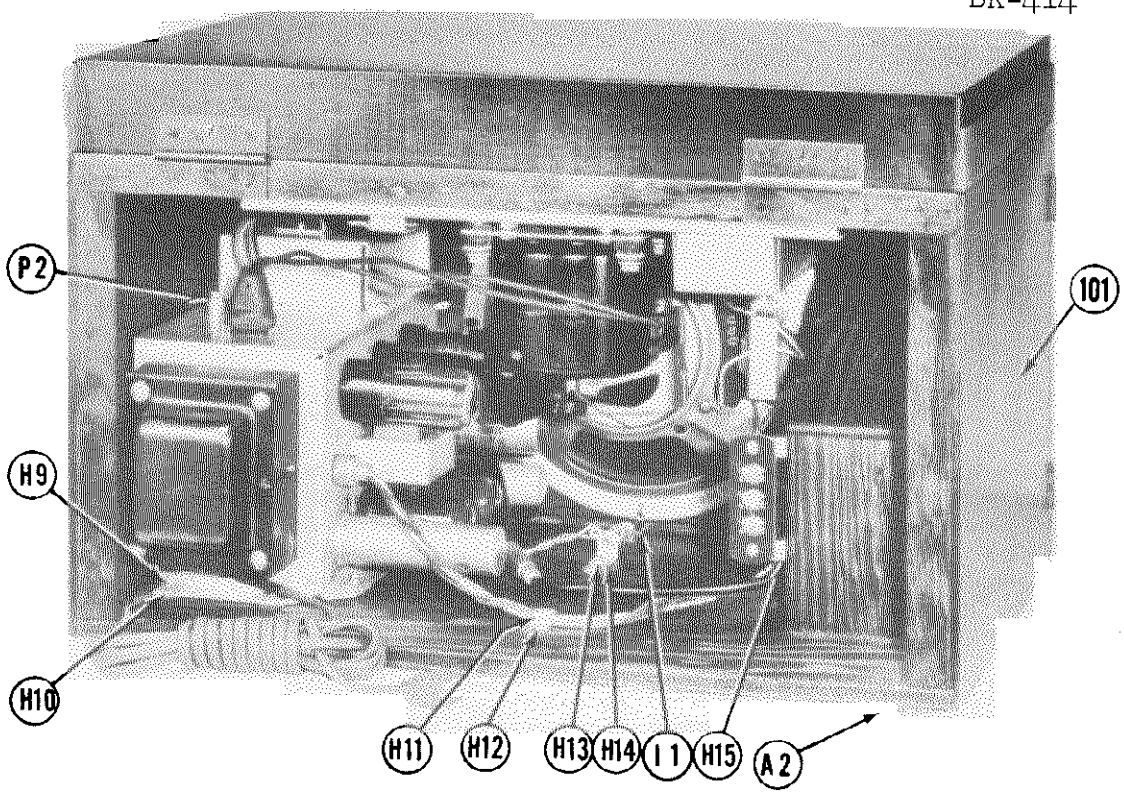

Fig. 35—*Model BK-411—Rear View*

7. Remove the pilot lamp holder from its mounting.

8. Remove the four control knobs A, B, C, and D located on the front panel (Fig. 6).

9. Remove the screws (H9 Fig. 35) which hold the amplifier chassis to the bottom of the cabinet.

10. Carefully slide the amplifier out the rear of the cabinet.

To Remove Top Panel From Cabinet

11. Follow steps 1 through 4.

12. Remove the two small trim covers A-10 and A-12 held in place by three knurled thumb screws H-101. (See Fig. 4).

13. Remove the control lever knob (501) by screwing it counter-clockwise while holding the lever with a pair of pliers.

14. Remove the large trim cover A-14.

15. Remove the four screws which mount the top panel to the cabinet and lift the panel from the cabinet.

To Remove The Speaker

16. Follow steps 1 through 15.

17. Remove the screws which mount the speaker terminal strip to the side of the microphone compartment. (H-15, Fig. 35).

18. Remove the screw (H-12) which mounts the speaker cable clamp (H-11) to the bottom of the cabinet.

19. Remove the four screws which mount the speaker to the grille board and lift the speaker out of the cabinet.

To Remove The Speaker Grille

20. Follow steps 1 through 19.

21. Remove the four screws which mount the grille board to the cabinet.

22. Remove the tacks or staples holding the grille cloth to the edge of the grille board.

23. Remove the staples holding the grille to the face of the grille board.

To Remove Pilot Light Rod

24. Follow steps 1 through 19.

25. Remove the staples holding the rod in place.

26. Drive the rod through the hole (from outside to inside) with a small mallet and pin drift or similar implement.

When replacing the rod, drive it in from the outside, keeping the beveled portion of the rod facing upward so that the light from the pilot lamp will be directed toward it when in the final position.

TUBE REPLACEMENT

Tubes are made accessible by removing the back cover from the cabinet.

CAUTION: TO AVOID BURNS AND CUTS caused by heated tubes and moving fan blades, TURN THE POWER OFF, and allow the tubes to cool and the fan to stop before attempting tube replacement.

The tubes are located as shown in Figs. 20 and 21.

NOTE: When replacement of the 6J7 tube becomes necessary be sure to place the shield cap (O-1) on the grid, otherwise hum may occur. The

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shielded lead to the grid cap should be carefully placed for minimum hum. The best position will usually be with this lead as close to the bottom of the cabinet as possible.

It is also recommended that this tube be selected for a minimum of microphonics.

PILOT LAMP REPLACEMENT

To replace the Pilot lamp the back cover of the cabinet must be removed.

The lamp is of the bayonet base type and may be removed from its socket by pressing the lamp into the socket slightly and twisting it until the guide pins allow the lamp to come out of the socket.

Early units have a lamp socket mounted on a bracket which in turn is mounted on the floor of the cabinet immediately behind the pilot light rod. Later units have a lamp holder which clips onto the flange of the speaker frame. In either case the lamp should be positioned to align with the pilot light rod so that the rod will transfer the most light.

RECORD-PLAY HEAD REPLACEMENT

Remove the Record-Play Head as follows:

1. Remove the top panel from the cabinet. (See steps 11 through 14 above).

2. Remove the record-play head mounting screws. (H-108, Fig. 13).

3. Remove the capstan drive assembly mounting screws (H-143 and H-144) and carefully lower the assembly away from the panel enough to slip the record-play head out of the hole.

Replace head as follows:

4. Assemble the capstan drive assembly and the Record-Play head (E-1) by placing the head and the mounting clamp (H-131) between the flywheel and the bracket.

5. Hold the assembly in the left hand and position it onto the panel while tightening the flat head screw (H-144, Fig. 13) enough to hold the drive assembly until the other mounting screws are placed in position in the following sequence:

a. The screw between the head and the capstan spindle (H-108-A, Fig. 13).

b. The screw nearest the erase head (H-108-B).

c. The screw between the capstan spindle and the right hand ribbon guide (H-143).

6. Adjust the head for hum cancellation as outlined on page 40.

7. Alternately tighten (a) and (b) until the head is aligned vertically when the screws are completely tightened.

8. Tighten screws (H-143 and H-144) completely.

ERASE HEAD REPLACEMENT

Replacement of the erase head will only become necessary when the magnets are too weak to thoroughly erase any signal from the ribbon, or if any part becomes damaged. If such is the case replacement procedure is as follows:

1. Remove the small Trim Covers A-10 and A-12 (Fig. 4).

2. Set the mechanism control as for recording (the control lever being moved to the "Record" position while pressing the erase pin to lock the erase head in an accessible position).

3. Remove the screw (H-134, Fig. 13, or H-22, which holds the erase head to its bracket. At this point the parts held together by the clamp (H-136, will tend to fall apart, therefore it is desirable to hold the parts with the left hand while removing the above mentioned screw.

In the case of the multipolepiece type erase head, the parts are held together by the two screws H-21.

4. Assemble new and/or old parts in order Be sure that the orientation of the magnets (E-7a and b) permits them to attract each other and that the rounded end of the magnets (E-7a) faces the ribbon.

In the case of the multi-polepiece erase head, the mounting hole is relocated on the bracket A-23 to accommodate the change in overall dimensions of the head. When desiring to install the multi-polepiece erase head on previous units the bracket A-23 must be replaced by bracket A-23a (part number 107272-501) or, a hole must be drilled in the bracket A-23, and tapped for a No. 4-40 screw.

Note: Brass screws are used in this assembly to prevent a partial short-circuit of the magnetic field.

5. Place the assembly on the mounting bracket and replace the screw which holds the head in position.

6. Adjust the head for minimum noise as outlined on page 38, then tighten screw to hold the head in the proper position.

7. Replace the trim covers. Be sure they do not interfere with the action of the erase head bracket moving up and down, the pressure wheel bracket, and the takeup reel when tightened in position.

REPLACEMENT OF CAPSTAN DRIVE ASSEMBLY

To replace the capstan drive assembly follow procedure outlined in "Record-Play Head Replacement" page 34. Some units contain a type of capstan drive assembly which can be disassembled from the lower end of its mounting bracket by the following procedure:

1. Remove the top panel from the cabinet as outlined in steps 11 through 15 on page

2. Remove the drive belt (O-77, Fig. 8).

3. Remove the two allen-head screws (H-133,

4. Carefully pull the capstan spindle and flywheel assembly out of the upper bearing (O-78, . This allows replacement of only the spindle and flywheel assembly and the lower bearing assembly. To replace the upper bearing and bracket assembly, follow procedure as outlined in "Record-Play Head Replacement" page 34.

5. Replace parts and/or assemblies in reverse order as outlined above.

Before and after replacement of spindle and flywheel assembly, check for binding in the bearings. Spin the flywheel with the finger to be sure the

assembly rotates freely. The drive belt must be displaced for this check. If binding occurs in the lower bearing, realign the bearing by tapping lightly on all its sides. This should jar the bearing just enough to cause it to align itself with the spindle (O-82). If the binding occurs in the upper bearing (O-78, reposition the lower bearing bracket (A-26) to center the spindle (O-82) in the upper bearing (O-78). To reposition the bracket, loosen the two allen head screws (H-133) just enough to move the bracket to a point which allows the spindle to turn freely in the upper bearing (O-78) when the set screws are again tightened.

If correct alignment of bearings, etc. does not eliminate the binding, check for a bent capstan spindle, and replace if bent.

NOTE: Any binding or excessive friction in any part of the drive assembly will result in a speed variation of the ribbon and thus produce a pitch variation known as "Flutter".

The capstan flywheel is made of three identical discs which rotate on the same axis. Each disc contains an indexing notch on its circumference. These notches are spaced 120° apart to provide a balance in the flywheel and produce a minimum of "Flutter" during recording or reproduction.

REPLACEMENT OF PRESSURE WHEEL ASSEMBLY

The pressure wheel assembly (Fig. 9) consists of a bracket (A-16), a spring (O-85), a shaft (O-83), a wheel (O-84), and a pressure pad (MS-2) which is attached to the bracket. To replace the complete assembly:

1. Remove the small trim cover (A-12) and the "Tru-Arc" retaining ring (O-64), see Fig 4.

2. Lift the assembly off the post, being careful not to damage the spring (O-85).

3. Slide the spring out the end of the bracket. The wheel and shaft should then come out easily.

4. Replace parts in reverse sequence of steps 1, 2, and 3.

The link which couples the control lever system to the pressure wheel bracket is coined on one edge to increase the width and thus prevent a locking effect which occurs if the center line of the link intersects the pressure wheel bracket pivot point. (See point "A" of Fig. 8). Should the link become worn to the extent that the mechanism locks, replacement of the complete pressure wheel bracket assembly is required.

REPLACEMENT OF PRESSURE PAD

The friction between the pressure pad and the ribbon will in time wear the felt pad. When it becomes necessary to replace this pad it is recommended that a good cement such as Bakelite Corporation No. BC-6052 be used. Care should be taken to prevent any cement from getting on the face of the felt which contacts the ribbon. After replacement is made the pressure should be adjusted as outlined on page 42.

REPLACEMENT OF BELTS

If the unit fails to start with a full reel of ribbon on the take-up turntable, due to slippage of the clutch belt (O-76, Fig. 8), this belt should be replaced.

When replacing either belt, install it as shown in Fig. 8. Be sure that the clutch belt does not rub against itself at the crossover point. This may be adjusted by raising or lowering the drive pulley on the motor shaft. Under normal operation, rubber dust from the clutch belt will accumulate. This dust should be removed thoroughly from the mechanism.

DISASSEMBLY AND REPLACEMENT OF TURNTABLE ASSEMBLY

1. Remove the "Tru-Arc" retaining ring (O-52, Use a number 22 "Tru-Arc" pliers.

2. Lift the turntable assembly from the reel post (O-57). The assembly may be divided into the upper cup (O-53), the lower cup (O-56), and the tripping trigger (O-54 or O-55).

3. Replace either trigger if damaged.

4. Reassemble parts in order

Be sure cups fit together with insides facing each other and indexed according to the notches and slots in their edges.

NOTE: If the reel guide pin is broken off, the cup must be replaced. DO NOT ATTEMPT TO BEND THE PIN into position because it is likely to break off.

5. Install the assembly on the reel post and replace the "Tru-Arc" retaining ring making sure it fits into the groove on the reel post. A slight downward pressure on the cup near the post will reveal the groove.

DISASSEMBLY AND REPLACEMENT OF CLUTCH ASSEMBLY

1. Remove top panel from cabinet (see steps 11 through 15, page 34).

2. Remove the turntable assembly as in steps 1 and 2 of "Disassembly of Turntable", above.

3. Remove the clutch belt (O-76, Fig. 8).

4. Remove the two screws which mount the clutch lifter bracket assembly (A-18 or A-21,

Slide the assembly out at one side being careful not to distort the clutch lifter spring attached to the bracket. Remove the switch cover A-22 for access to the rewind bracket. NOTE: Be careful not to lose the ball actuator (O-70) from the rewind bracket (A-18).

5. While holding the clutch raising lever in an extreme position carefully remove the small "Tru-Arc" retaining ring (O-69) located at the lower end

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of the reel post (O-57). This requires the use of the No. 0018 "Tru-Arc" pliers.

6. Lift out the reel post assembly being careful not to lose the clutch lifter pin (H-115). This allows the clutch and pulley to be lifted from the clutch bearing assembly (A-15).

7. The felt clutch (O-58) is cemented to the upper face of the pulley and under normal conditions need not be removed, however if damaged it may be replaced in the following manner:

a. Peel off the old felt from the pulley.
b. Remove the old cement by washing the pulley thoroughly with benzol or similar solvent.
c. Apply a coat of cement (such as No. BC-6052 made by the Bakelite Corporation) to the upper face of the pulley. Apply only to the area to be covered by the felt. Allow it to dry. Apply a second coat to the pulley and allow it to become tacky.
d. Place the felt on the pulley and center it on item O-59 and allow it to become completely set. Note: The use of a small weight to press the felt to the pulley while it is setting will assure a firm adhesion.
e. After the cement is thoroughly set and dry, apply a few drops of light oil to the felt and allow it to soak in.

8. If necessary, remove the clutch-pulley bearing assembly by removing the hex nut (H-117) on lower side of chassis. Replace any damaged or worn out parts.

In some early units, trouble may be encountered with the recording ribbon continually dragging on the lower edge of the take-up reel during the recording or playing process, even though the clutches are adjusted properly. This may be corrected by removing the appropiate spacer washer (H-106, Fig. 13) from beneath the clutch bearing housing (A-15). To do this the spring (O-102) must be lowered slightly to prevent the dragging on it of the clutch pulley (O-59, To lower the spring, a hole (approximately 1/16" diameter) should be drilled in the chassis immediately above the trip lever latch (H-141, Fig. 13) and below the spring post. The end of the spring should then be placed through the hole and one leg of the spring anchor slot in a manner which provides the lowest positioning of the spring.

9. Reassemble the clutch pulley, the reel post, and the lifter pin and install onto the clutch bearing.

10. Install the "Tru-Arc" retaining ring on the lower end of the reel post.

Install the clutch lifter bracket assembly. Note: If installing the rewind bracket—be sure to replace the ball (O-70) which actuates the contact arms of the motor switch.

11. Install the turntable assembly. (See step 5 of "Disassembly of Turntable",

12. Install the clutch belt (O-76) as shown in Fig. 8.

13. Position the clutch lifter brackets and adjust the clutches as outlined in "Clutch Adjustment",

14. Plug the motor leads into a power source.

15. Wear in the clutch felts for about 15 to 30 minutes each in the following manner:

a. Place a full reel on the take-up turntable and anchor it in a stalled position by applying a piece of Scotch Tape from the reel to the panel.
b. Shift the control lever into the "Record or Play" position and allow the unit to operate.
c. After the takeup clutch is worn in, place the full reel on the rewind turntable and anchor as in "a" above.
d. Shift the control lever to the "Rewind Position" and allow unit to operate.

16. After the clutch felts are worn in, readjust the clutches to be sure conditions listed under "Clutch Adjustment", page 41, are still satisfied.

REPLACEMENT OF MOTOR

1. Remove the top panel from the cabinet. (See steps 11 through 15,

2. Remove the shield (A-22) from the rewind clutch lifter bracket and disconnect the motor wire from the switch (S-6).

3. Disconnect the other wire from the interconnecting power plug P-4.

4. Remove the rubber belts (O-76 and O-77 Fig. 8).

5. Remove the two binding head screws (H-102 Fig. 38) which mount the motor to the chassis.

6. Loosen the 8-32 allen head set screws (H-103) and remove the drive pulley (O-62) from the motor shaft.

7. Remove the 4 hex nuts which mount the motor to the plate assembly (A-19).

8. To replace the rubber shocks; remove the 4 hex nuts (H-126) holding the shocks in place, remove the motor mounting plate (A-19) from the plate assembly (A-17), remove the rubber shocks from the plate and install new ones, install onto plate assembly and replace screws. Note: It is best to replace all four rubber shocks to assure proper balance of motor.

Be sure to replace ground wire (W-3, Fig. 11) to prevent electrical hum from motor.

9. Install new motor and reassemble onto chassis in reverse order of steps 3 through 8.

10. After installation of rubber belts adjust the height of the drive pulley on the motor shaft to a position which prevents rubbing at the crossover point of the clutch belt (O-76).

11. Adjust the position of the motor on the chassis to a point which causes least vibration of the drive belt (O-77), and which gives the greatest tension to the clutch belt (O-76).

REPLACEMENT OF CONTROL SPRINGS

The control mechanism requires nine springs

of various sizes. Do not interchange springs of different sizes, as the tension of each spring is critical.

Identification of springs is found in Figs. 11 through 15.

ADJUSTMENT OF ERASE HEAD FOR MINIMUM NOISE

The erase head of the early BK-411 consists of two rectangular permanent magnets which are located in a position against the ribbon (when engaged) so that any previous recording becomes erased as the ribbon passes it.

The erasing process should disarrange the minute particles of the magnetic material on the ribbon so that no signal is reproduced from the playback head. However, if the two magnets do not approach the ribbon at the proper angle, the erasing effect is changed and results in an arrangement of the particles so that they produce a noise signal in the playback head.

It is desirable to find a position which will result in a minimum of noise being produced. This may be done by the following method.

1. Thread the Soundmirror with ribbon containing a recorded portion which may be erased during this adjustment.

2. Remove the two small trim covers A-10 and A-12.

3. Turn the power switch (on the tone control) clockwise to the "on" position and allow the tubes to warm.

4. Set the Amplifier controls for "Playback" operation and the top panel controls for "Record" operation. (This puts the erase head in contact with the ribbon, thus erasing the ribbon before it enters the play-back head.

5. Adjust the playback volume control for maximum volume and the tone control for maximum high frequency response.

6. Loosen the screw (H-134, Fig. 13) that holds the erase head to its mounting bracket and rotate the head first one way and then the other until a point of minimum noise is found. (Do not rotate the head too far in either direction, or erasure will be incomplete.)

7. Tighten the screw to lock the head in this position.

8. Shift the control lever to the "STOP" position to allow the erase head to drop away from the ribbon.

9. Replace the trim covers.

In later production of the model BK-411 the multi-polepiece erase head is used. This head, contains only one magnet. However, due to the arrangement of the polepieces assembled with the magnet, the resultant effect of its use is that of many magnets, thus increasing the number of magnetic flux reversals in the recording ribbon as it passes the head, and producing more effectively an a.c. type of erase. (See Fig. 28d footnote).

The adjustment for minimum noise from the multi-polepiece erase head is the same as the adjustment for the two-magnet type erase head listed in steps 1 to 9 above.

Note: Any remaining noise produced by the erase head will be even further reduced by the action of the 30 K. C. bias current present in the record head during the normal recording process.

ADJUSTMENT OF RECORD-PLAY HEAD FOR MINIMUM HUM AND/OR MAXIMUM HIGH FREQUENCY RESPONSE

Excessive hum during any pause in the recording while the unit is in the play-back position may be caused by magnetic lines of force being radiated from sources such as the motor, power transformer, filter choke, etc., inductively creating an unbalanced voltage in the play-back head.

This condition may be corrected by reestablishing the balance by properly directing the magnetic lines of force through the two windings of the head, and is accomplished by slightly rotating the head either clockwise or counter-clockwise as the case may require.

To find the correct position:

1. Turn the power on and allow the tubes to warm.

2. Set the Amplifier Controls for playback operation at full volume.

3. Remove the small trim covers (A-10 and A-12 Fig. 4).

4. Loosen the mounting screws (H-108, Fig. 13) on either side of the record-play head enough to allow the head to be rotated slightly.

5. Place the ribbon around the back side of the record-play head and the capstan drive spindle.

6. Shift the control lever to the "Play" position.

7. Rotate the record-play head in either direction until a point of minimum hum is found.

8. Tighten the screws to hold the head in this position.

9. Shift the control lever to the "Stop" position to stop the reels. Fig. 39, Section 1, shows the head in the normal position. The cut-a-way of the head shows how the polepieces should contact the ribbon.

It is important to check this position after rotating the head to prevent the results shown in section 2 of Fig. 39. If the head is rotated too far in either direction the gap will not contact the ribbon and will result in a lack of high frequencies or no signal at all being recorded or reproduced.

To check this condition:

10. Place a mark on the panel at point "B" of Fig. 39 to identify the "minimum hum" position of step 7 above. The mark should be made in line with the end edge of the opening in the record head.

11. Place a recorded portion of the ribbon through the record-play head and the capstan drive spindle.

12. Shift the control lever again to the "Play" position.

13. Loosen the record-play head mounting screws enough to rotate the head toward "A" or "C" (Fig. 39) while listening to the signal being reproduced from the ribbon. When the position is found which allows the higher frequencies to be reproduced, place a second mark on the panel to identify this position.

If this position does not coincide with the position of least hum, then a choice or a compromise position must be made.

14. Alternately tighten the screws to lock the head in the position chosen.

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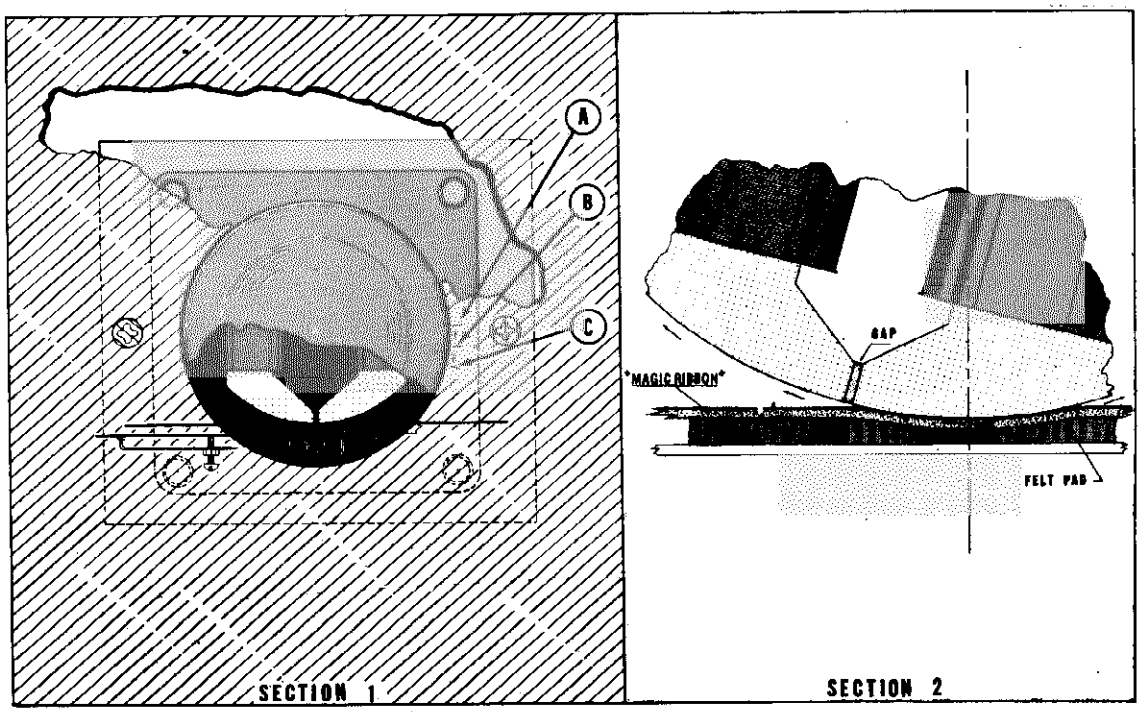


Fig. 39—Record-Play Head Adjustment

ADJUSTMENT OF CLUTCHES

The clutches are adjusted and set at the factory and under normal conditions should not require readjustment. In early BK-411 units the set screws for this adjustment were first dipped in glyptal then put into the reel posts and adjusted. As the glyptal dried the adjustment became set.

In later production of the model BK-411, longer set screws were installed, including a locking nut to secure their position after the clutch adjustments were made. items H-19 and H-20). This was done to facilitate adjustments as well as accommodate the reel hold-down nut which fits on the upper portion of the setscrews. (See item H-18,

No glyptal is required with this arrangement, therefore the following step No. 2 and the latter part of steps No. 1 and No. 10 shall be ignored in the adjustment of the above set screws H-20.

If it becomes necessary to replace any part of the clutch assembly, readjustment becomes necessary and proper procedure is as follows:

1. Remove the set screws located in the top end of the reel posts with a number 8 allen wrench. If the old glyptal is set too hard for the screws to turn readily, apply a few drops of solvent such as G. E. No. 1500 Glyptal thinner to dissolve the glyptal.

2. Re-dip the set screws in the G E. No. 1201 glyptal and replace into reel posts.

3. Place the control lever in the "Fast Forward" position and adjust the set screws so that the rewind clutch turns freely and the take-up clutch is engaged.

Note: Turning the screws clockwise disengages and counter-clockwise engages the clutch.

4. Place the control lever in the "Fast Reverse" position and adjust set screws so that the take-up clutch turns freely and the rewind clutch is engaged.

Note: Some units may contain a small friction brake placed between each turntable and its corresponding clutch-cup face. This will apply a small amount of drag on each turntable, preventing complete freedom of its rotation when not engaged with the clutch.

5. Recheck to be sure condition 5 is satisfied.

6. Place the lever in the "Play or Record" position and be sure condition 3 is still satisfied.

7. Trip the automatic rewind trip lever (Fig. 5) and be sure condition 4 is satisfied. This should be checked with the erase head up and again with the erase head down.

8. Correct adjustment satisfies all conditions listed above.

9. Check adjustments also to be sure retainer

ring (O-69) does not bind on the adjacent washer and bearing housing (H-118 and A-15) when the clutch raises. (The mechanism must be removed from the cabinet to see these parts.)

10. Both clutches should engage in the "Stop" position to produce complete braking action. When the clutch adjustments are completed, the machine should be allowed to set without operating for approximately four hours to allow the glyptal to harden.

ADJUSTMENT OF RIBBON TENSION

The pressure of the ribbon against the record head can be adjusted by turning the screw (H-112, Fig. 12) mounted on the pressure wheel bracket assembly. (Be sure to first loosen the hex nut before making adjustment.)

This pressure is measured in terms of tension by attaching a scale to the end of a piece of ribbon which is drawn through the ribbon guides, record head, pressure pad, and behind the capstan assembly at approximately 7½ inches per second to produce a scale reading of 1½ to 2½ ounces. This adjustment is made accessible by removing both trim covers (A-10 and A-12).

ADJUSTMENT OF RIBBON GUIDES

The ribbon guides (O-66 and O-67) are located beneath the head trim cover (A-10) and are mounted on the panel with the guide posts (O-65) by mounting screws (H-140, Fig. 11).

Approximate positioning of guides on panel is shown in Fig. 4. Final adjustment of guides is made by slightly rotating the guide clockwise or counter-clockwise around the guide post to increase or decrease the friction of the ribbon through the guides during the "Fast-Reverse" or "Fast-Forward" process. Proper adjustment allows the ribbon to wind tightly onto the reel within a reasonably short length of time. The guides should be shaped in a vertical plane with respect to the posts to facilitate the ease of threading.

Note: Units containing the small friction brakes attached to the clutch-cup face do not require the ribbon guides since the proper friction or drag on the turntables is obtained by their use.

ADJUSTMENT OF ROLLER PRESSURE

The pressure of the rubber wheel (O-84, Fig. 9) against the ribbon and capstan spindle (O-82, Fig. 10) is adjusted at the factory and it is not recommended that any adjustment be attempted in the service field but rather that any component found to be defective be replaced with a new part.

If the ribbon tends to crawl up or down on the capstan spindle, it indicates that the spring (O-85) may not be seating properly in the grooves of the wheel shaft (O-83). If this condition is not the case, then the spring may have inadvertently been bent in a manner causing one arm to press more than the other. Since the adjustment is critical, it is recommended the spring be replaced rather than adjusted.

Another possible cause for this trouble is insufficient ribbon tension at the record-play head. For adjustment see "Adjustment of Ribbon Tension" above.

LUBRICATION

Caution: Do Not Over Oil

MOTOR—The motor should be oiled once every three months with No. SAE 20 oil.

MECHANISM — All moving or sliding parts should be cleaned thoroughly of any dirt, dust, or rubber dust that may have accumulated. After cleaning apply a thin coat of light oil to all sliding surfaces. Wipe off any excess amount of oil. Do not allow oil to get onto the belts or the driving surfaces of the pulleys.

OILITE BEARINGS—The following are of this type and need very little lubrication.

1. Clutch Pulley Bearings.
2. Capstan Spindle Bearing.
3. Pressure Wheel Bearing.

CONNECTING SOUNDMIRROR TO RADIO

To Record From Radio:

Fig. 40 illustrates a preferred method of connecting the Model BK-411 Soundmirror to most radios. The connection, as illustrated, is made at the last detector stage preceding the audio ampli

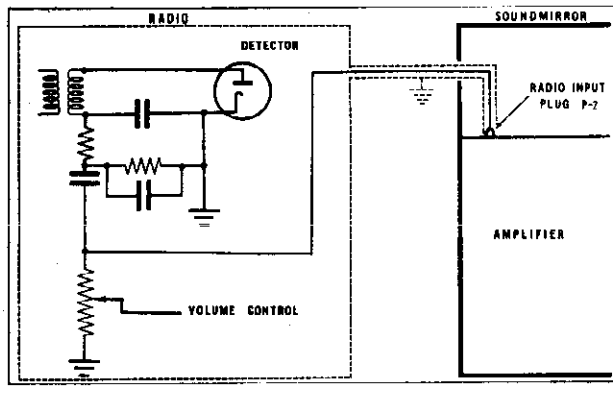


Fig. 40—Radio Connections to Soundmirror

fier stage, usually at the input of the radio volume control. Connection at this point allows the operator to have full control of the recording volume at the Soundmirror.

Radio circuits having a d. c. potential on the volume control will require a blocking capacitor between the radio and the Soundmirror connection. The value of the capacitor should not be less than .002 mfd.

To eliminate hum pick-up while recording from the radio, a low capacity coaxial type cable should be used to make the connection.

To prevent loss of high frequencies it is suggested that this cable be as short as possible. More than five feet will result in appreciable loss of high frequencies.

To Playback Through Radio:

Radios of the console type usually contain a high fidelity audio amplifier system which makes it desirable to play the Soundmirror recording through that system. A connection for this purpose is illustrated in Fig. 41.

The double pole double throw toggle switch shown may be installed on the back of the Soundmirror.

The lead from the radio to the Soundmirror Amplifier should be shielded to prevent hum pick-up from being fed into the radio amplifier.

To make the connection to the Soundmirror Amplifier:

1. Disconnect the wire which leads from the tone control (R-24) to contact "Q" of the Selector Switch (S-1).

2. Connect the D. P. D. T. Switch, as instructed in Fig. 41, to the contacts remaining vacant as a result of step 1 above.

3. The shield of the switch leads should be connected to the nearest ground tie point in the Soundmirror amplifier.

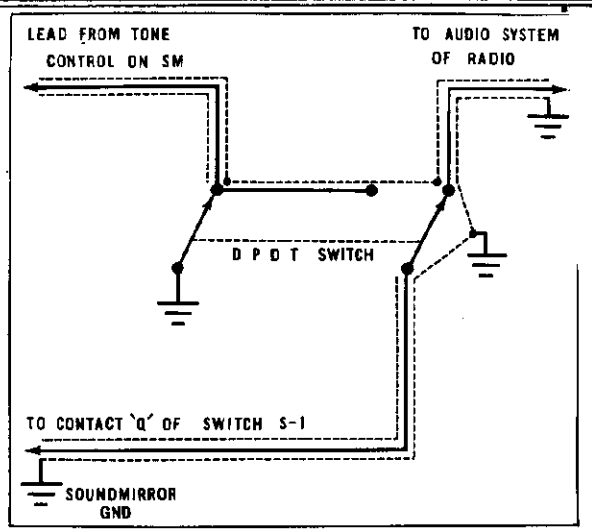


Fig. 41—*Soundmirror Connection to Radio*

SYMPTOM	CAUSE	REMEDY
INSUFFICIENT OR NO ERASE	1. Weak Magnets (E-7).	1. Replace (See instructions, page 35).
	2. Misaligned Magnets.	2. Readjust as instructed on page 38.
	3. Misplaced Magnets.	3. Place as shown
DOES NOT RECORD	1. Shorted or open head circuit.	1. Check connections and leads to switch S-2 and S-3.
	2. Grid shield cap shorted to grid lead on V-1.	2. Line inside of Shield Cap with insulating material.
	3. Open Coupling Capacitors C-6 or C-7.	3. Replace capacitor.
	4. Defective V-1, V-2, or V-7.	4. Replace.
	5. Open L-1.	5. Replace.
	6. Defective S-1.	6. Replace.
	7. Defective J-1, or J-2 (Radio input only.)	7. Replace.
	8. Defective associated resistors.	8. Replace.
	9. Defective wiring.	9. Rewire.
DISTORTION **Record Channel**	1. Insufficient 30 KC Bias Current through record head.	1. Proper current is 2.0 MA with S-4 in No. 1 position and 4.5 MA in No. 2 position.
	2. Defective components in Osc. circuit V-4.	2. Replace defective component (Check L-1).
	3. Leaky or shorted coupling capacitors C-6 or C-7.	3. Replace defective component.
	4. Defective components in associated circuits of V-1 and V-2.	4. Replace defective component.

SYMPTOM	CAUSE	REMEDY
Monitor Channel ("Record-Radio" position only)	1. Check for shorted coupling capacitors C-6, C-10, C-17, or C-18.	1. Replace defective component.
	2. Defective associated components of V-1, V-2, V-5, and V-6.	2. Replace defective component.
	3. Overloading of Input Stage V-1 by signal from Radio.	3. Reduce radio signal voltage to Soundmirror.
	4. Defective Output transformer or Speaker.	4. Replace.
Playback Channel	1. Check for shorted coupling capacitors C-6, C-7, C-17, C-18.	1. Replace defective components.
	2. Defective V-1, V-2, V-5, or V-6 or any associated circuit component.	2. Replace defective components.
	3. Open grid of one half of V-6.	3. Check tube socket contacts and squeeze together enough to grip tube prongs.
	4. Defective output transformer or speaker.	4. Replace.
	5. Insufficient erasure of previous recording causing undesired or unintelligible signal.	5. See "Insufficient or No. Erase" of Symptoms.
	6. Flutter.	6. See "Wow and Flutter" of Symptoms.
HIGH HUM	1. Defective tubes or ground connections.	1. Replace or rewire accordingly.
	2. One side of filament shorted to ground.	2. Check Pilot lamp holder and associated wiring.
	3. Open grid circuit.	3. Rewire.
	4. Microphonic tube.	4. Replace defective tube.
MICROPHONICS (Howling or Whistling when unit is jarred)	1. Microphonic 6J7 tube V-1.	1. Select non-microphonic tube and replace.
WEAK OR NO OUTPUT	1. Broken jumper wire on output terminal strip (E-3).	1. Replace wire.
	2. Defective power cord or plug.	2. Replace.
	3. Defective tubes.	3. Replace defective tube.
	4. Shorted capacitors—check C-4, C-5, C-8, C-9, C-19, C-21, or C-22.	4. Replace defective part.
	5. Open capacitors—check C-6, C-7, or C-10.	5. Replace defective capacitor.
	6. Open Osc. Coil L-1 (No B + to V-2).	6. Replace coil.
	7. Defective Output transformer or Speaker.	7. Replace defective part.
	8. Defective contacts or wiring of selector switch S-1.	8. Replace or rewire.
	9. Defective Power Transformer.	9. Replace.
	10. Open playback head.	10. Replace.

SYMPTOM	CAUSE	REMEDY
	11. Dirty polepieces of head (produces weak output).	11. Clean heads.
	12. Defective contacts from head to amplifier.	12. Rewire or replace defective plug or socket.
POOR FREQUENCY RESPONSE	1. Accumulation of dirt and ribbon residue on record/play head.	1. Clean head.
Insufficient Highs	2. Insufficient recording bias current.	2. See "Insufficient Record Bias" of Symptoms.
	3. Defective component in compensating network.	3. Replace defective part.
Insufficient Lows	1. Insufficient recording bias current.	1. See "Insufficient Record Bias" of Symptoms.
	2. Defective component in compensating network.	2. Replace defective part.
CONTINUAL TRIPPING OF RE-WIND TRIP LEVER	1. Reels improperly placed on turntable.	1. Place the reel on turntable so that the ribbon nearest the center of the reel holds the trigger above the trip lever until approximately 20-40 turns of ribbon remain on the reel, at which time the trigger should drop down and trip the lever to cause the ribbon to rewind. (See Fig. 5).
	2. Rewind trigger (Fig. 5) bent.	2. Reshape item O-54.
RIBBON SPEED TOO SLOW (Correct speed 7.2 to 7.9 inches per second.) Nominal: 7.5 inches per second.	1. Pressure pad—pressure too great.	1. Readjust according to procedure outlined in "Adjustment of Ribbon Tension", page 42.
	2. Rewind clutch misadjusted causing it to be engaged.	2. Readjust – see "Adjustment of Clutches", page 41.
	3. Capstan flywheel shaft binding in lower bearing.	3. Replace capstan drive assembly. See "Replacement of Capstan Drive Assembly", page 35.
	4. Motor shaft binding in motor bearings.	4. Replace motor.
"REWIND", "FAST-REWIND" OR "FAST-FORWARD" STICKS (Will not return to neutral upon actuating control lever.)	1. Control lever mechanism binding at some point.	1. Clean dirt, burrs, or cause of binding. After cleaning, lubricate parts with (SAE-10) light oil.
	2. Motor switch mounting bracket not positioned properly.	2. Reposition bracket slightly to satisfy condition. Check conditions to be sure ball (O-70, Fig. 15) does not fall out when control mechanism is actuated.
WOW AND FLUTTER	1. Pressure wheel defective, binding, or rubbing on capstan bearing housing.	1. Replace defective wheel. Remove source of binding (check wheel shaft for possible source), also check alignment of pressure spring against shaft. See "Adjustment of Roller Pressure", page 42.
	2. Excessive pressure of pressure pad against record/play head.	2. Readjust—See "Adjustment of Ribbon Tension", page 42.
	3. Binding motor shaft bearing.	3. Replace motor.
	4. Binding capstan lower bearing.	4. Replace capstan drive assembly.

SYMPTOM	CAUSE	REMEDY
	5. Binding reel-post bearing.	5. Clean or replace bearing or reel post.
	6. Damaged capstan drive belt.	6. Replace belt.
	7. Bent capstan.	7. Replace capstan drive assembly.
RIBBON BREAKS AT CAPSTAN SPINDLE	1. Pressure wheel shaft improperly seated on pivot.	1. See "Adjustment of Roller Pressure", page 42.
FAILURE TO OPERATE WITH POWER ON	1. Line voltage too low.	1. Proper line voltage is 105-120 volts, 60 cycles a.c.
	2. Control lever inadvertently left in "Rewind" position.	2. Shift control lever to "Stop" position then to "Record" or "Play".
	3. Clutches misadjusted.	3. See "Adjustment of Clutches", page 41.
	4. Controls fail to lock in "Record" position, or jammed due to excessive dirt in mechanism.	4. Clean mechanism thoroughly and lubricate.
	5. Dislocated ball actuator on motor switch mechanism (Item O-70, Fig. 15).	5. Replace ball and readjust mounting of switch bracket to prevent ball from being dislocated when clutch raising lever is actuated.
	6. Capstan drive belt worn out.	6. Replace belt.
	7. Defective motor switch.	7. Replace switch.
	8. Defective motor.	8. Replace motor.
FAILURE OF CAPSTAN TO PULL RIBBON	1. Capstan spindle-shaft binding in lower bearing.	1. Replace capstan drive assembly.
	2. Broken or weak capstan drive belt.	2. Replace belt.
	3. Capstan spindle jammed with accumulated ribbon residue on bearing.	3. Clean thoroughly.
	4. Roller pressure insufficient.	4. See "Adjustment of Roller Pressure", page 42.
FAILURE TO TAKE-UP RIBBON OR WINDS TOO LOOSELY ON TAKE-UP REEL	1. Clutches misadjusted.	1. Readjust—See "Adjustment of Clutches", page 41.
	2. Ribbon guides misadjusted.	2. Readjust—See "Adjustment of Ribbon Guides", page 42.
	3. Clutch belt slipping.	3. Clean motor drive pulley with carbontetrachloride. Reposition motor to tighten belt. If unsatisfactory, replace belt.
FAILURE TO REWIND RIBBON PROPERLY	1. Clutches misadjusted.	1. Readjust—See "Adjustment of Clutches", page 41
	2. Ribbon guides misadjusted.	2. Readjust—See "Adjustment of Ribbon Guides" page 42.
	3. Failure of automatic trip, due to reel binding against edge of trigger.	3. Readjust angle of reel key pin to prevent reel from binding trigger. (See Fig. 30).
	4. Binding of slide assembly (O-94, Fig. 11).	4. Clean mechanism thoroughly and lubricate.

MODEL BK-414
PORTABLE SOUNDMIRROR

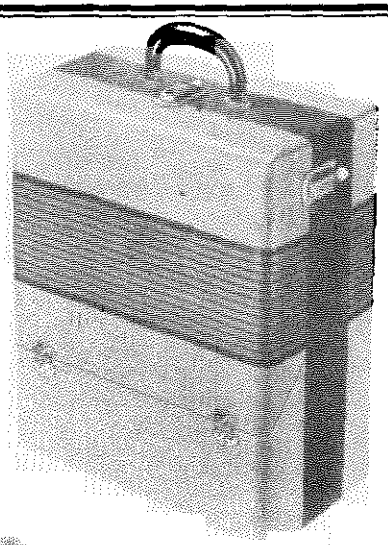


Fig. 42—Model BK-414 Portable Soundmirror

INTRODUCTION

The operation and function of the Model BK-414 *Portable Soundmirror* is basically the same as that of the Model BK-411 Soundmirror.

The construction features in the carrying case and the cabinet for these two models are different however, and require different procedures for their disassembly and reassembly.

The following information in addition to the preceding information, in general, will be sufficient to service and overhaul the Model BK-414.

The parts listed on pages 56 to 63 is a combined parts list for the Models BK-411 and BK-414.

DISASSEMBLY OF MODEL BK-414

To remove unit from case:

1. Remove the control knob (501) and the trim covers (A-10, A-12, and A-14). (See Fig. 43).

Note: On later units the trim cover (A-14) is held in position by two additional screws located at each corner of the cover near the control panel.

2. Remove the two screws (H-146) located at the front of mechanism panel. (See Fig. 44).

3. Lift up the mechanism at the front, allowing it to fold back on the hinge far enough to facilitate the disconnecting of the record head inter-

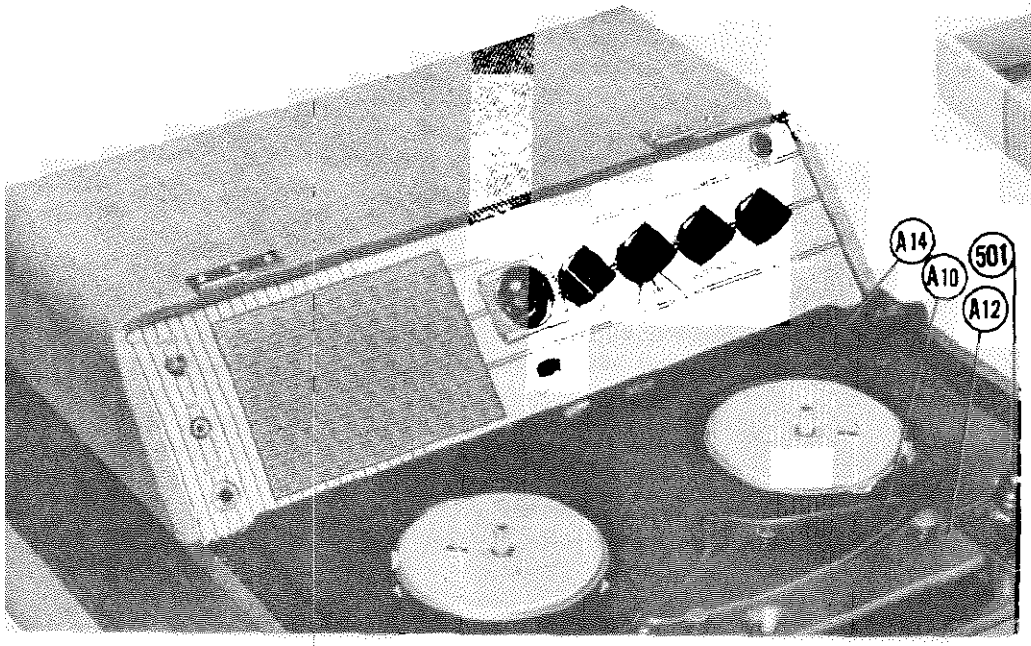
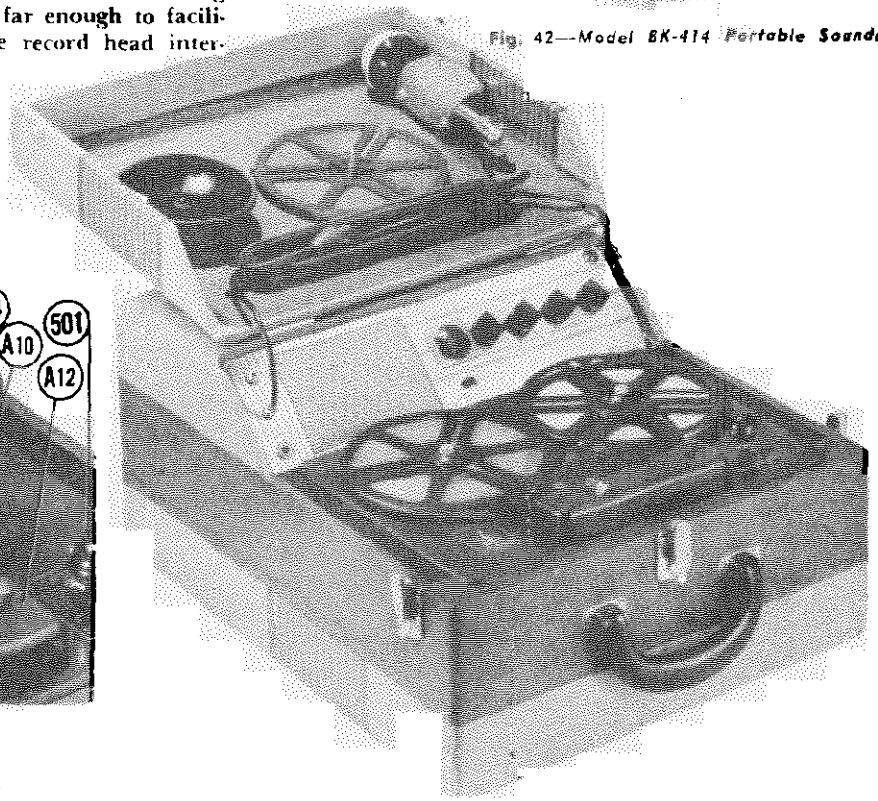


Fig. 43—Model BK-414 Control Panel View, and Disassembly Step No. 1



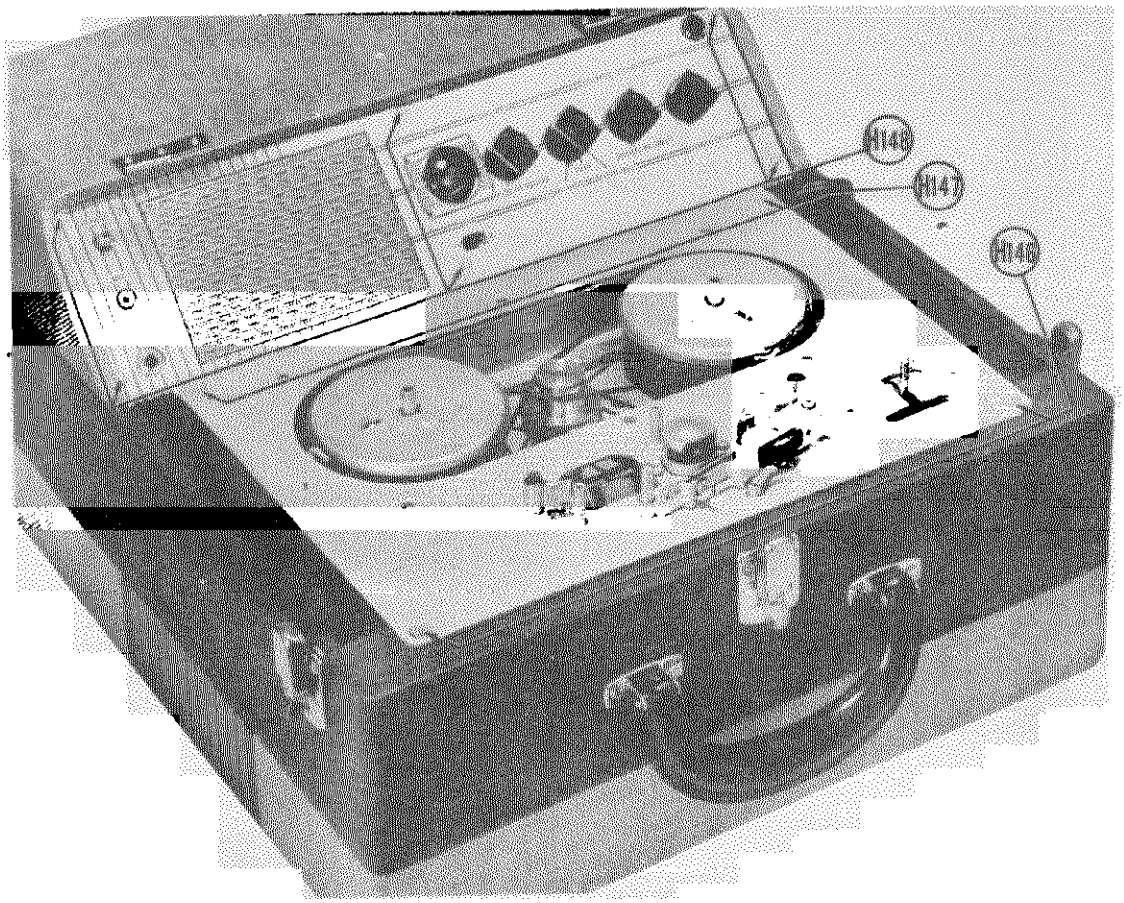


Fig. 44—*Disassembly Step No. 2, 4 and 7*

connecting cable (W-4) and the motor connecting plug (P-4). (See Fig. 45).

4. Remove the two screws (H-147) holding the mechanism to the hinge and lift the mechanism from the case. (See Fig. 44).

5. Remove the five screws (H-150) holding the ventillating grilles (O-103) and (O-104) to the case. (See Fig. 46). Note: The two screws nearest the control panel must be completely removed to facilitate the removal of the amplifier.

6. Remove the four control knobs (601) from the amplifier control panel. (See Fig. 46).

7. Remove the six screws (H-148) holding the amplifier trim panel in position. (See Fig. 44).

8. Carefully remove the trim panel (A-27, Fig. 47). Note: Some trim panels fit very snugly between top of case and edge of hinge at points shown by arrows, in Fig. 47, and may require a slight amount of prying at these points to lift the trim over the edge of the hinge. Be careful in prying not to bend or damage the trim panel.

9. Remove the three screws (H-152) holding the amplifier to the case. (See Fig. 48).

10. Remove the screw (H-154) holding the amplifier base board in the track. (See Fig. 48).

11. Carefully slide the amplifier unit toward the front of the case and lift it out when the amplifier base board clears the top of the case. (See Fig. 49). Note: While sliding the unit forward, hold the left side of the unit to prevent tearing of the leatherette covering of the case at the point indicated by the arrow in Fig. 49.

12. After servicing amplifier reassemble it in the case in the reverse sequence of steps 1 through 11.

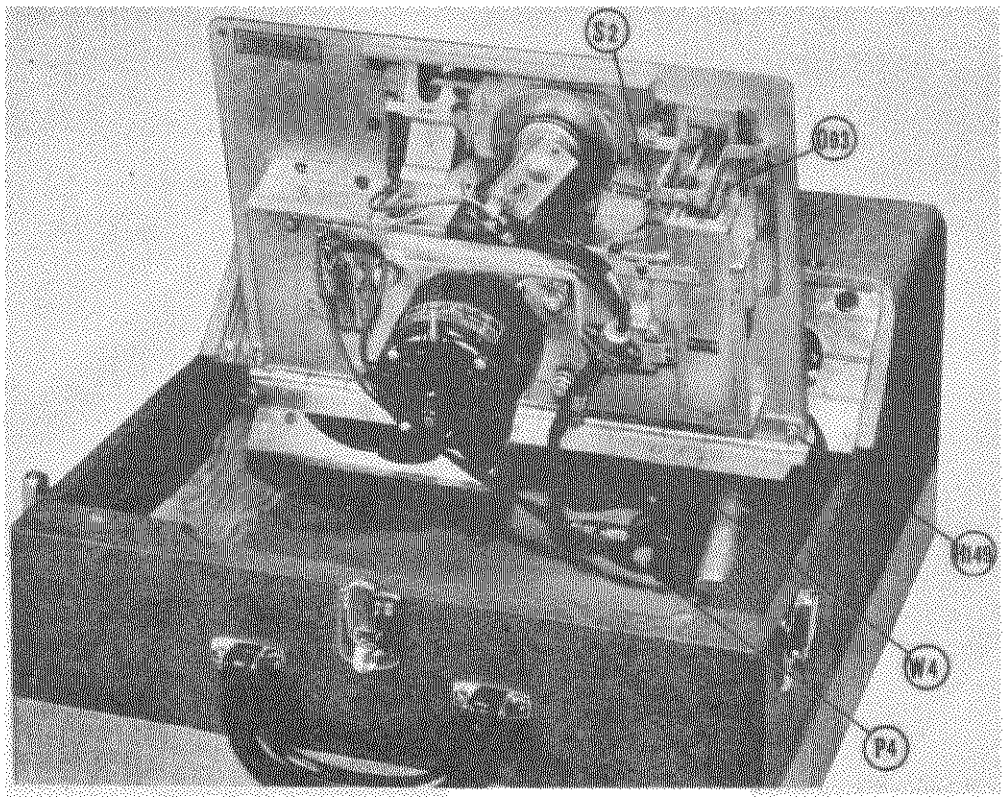


Fig. 45—*Disassembly Step No. 3*

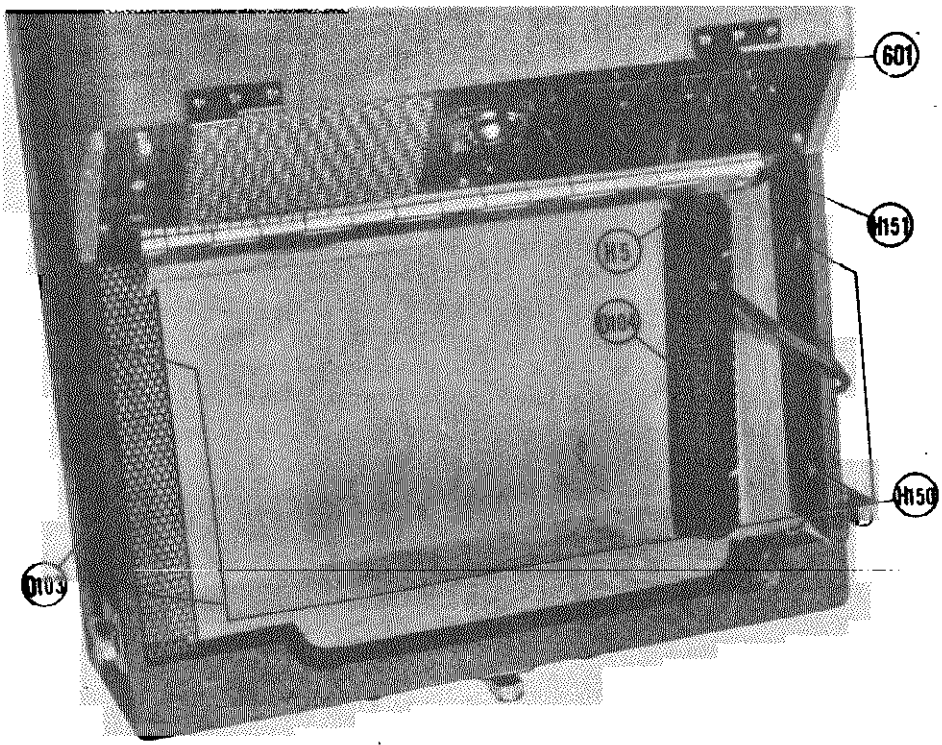


Fig. 46—*Disassembly Step No. 5 and 6*

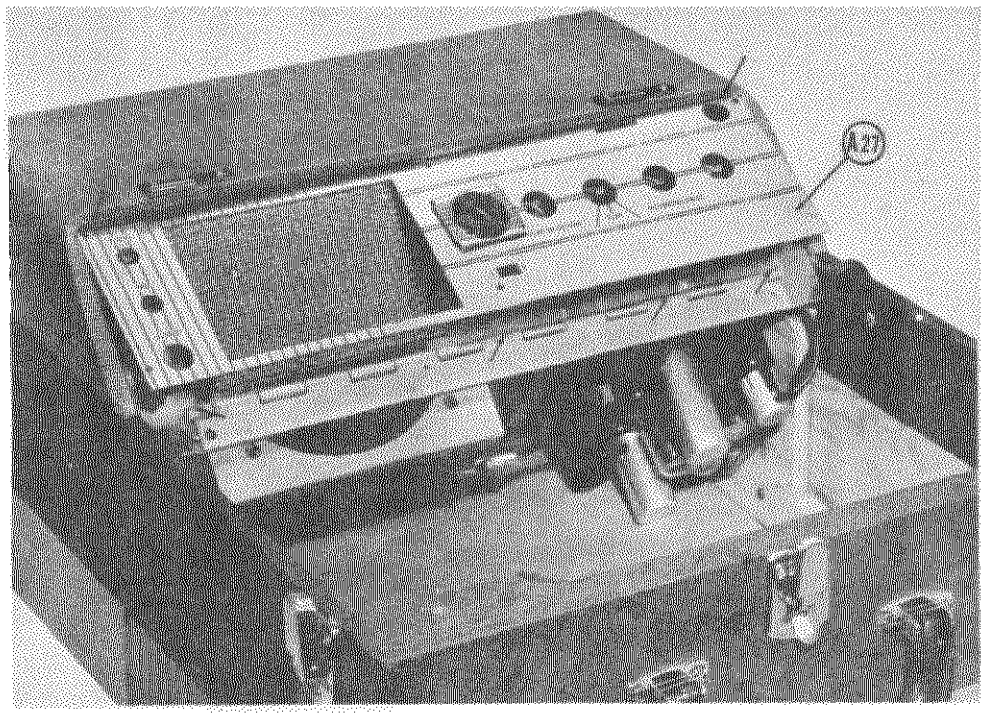


Fig. 47—*Disassembly Step No. 8*

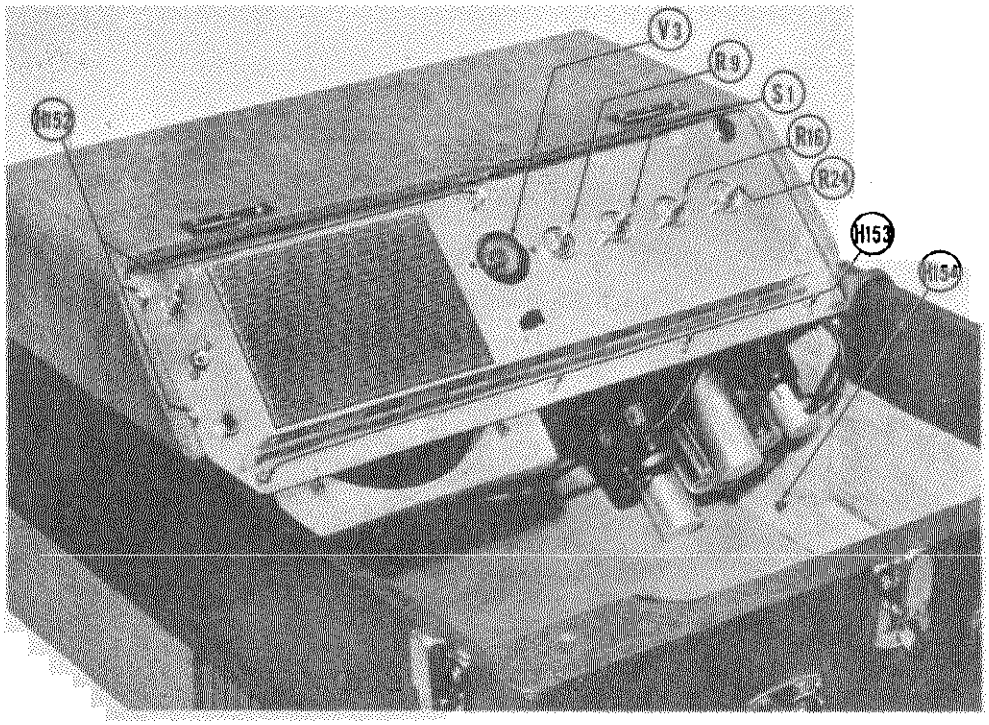


Fig. 48—*Disassembly Step No. 9 and 10*

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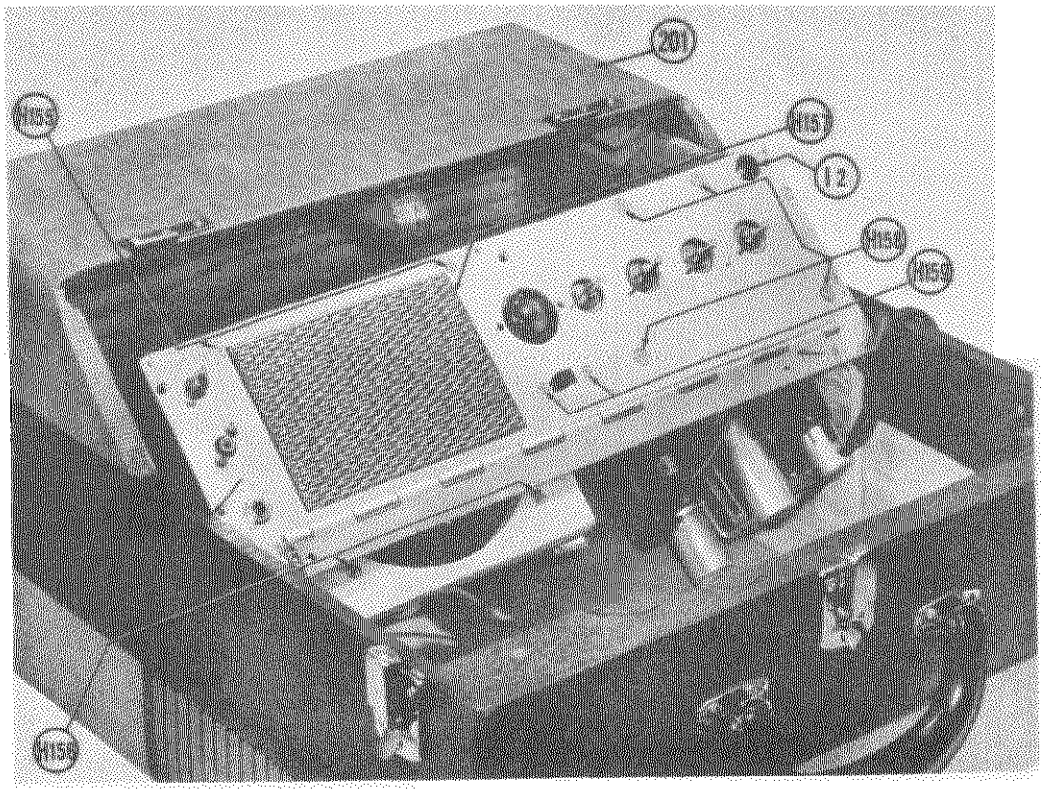

Fig. 49—*Disassembly Step No. 11*

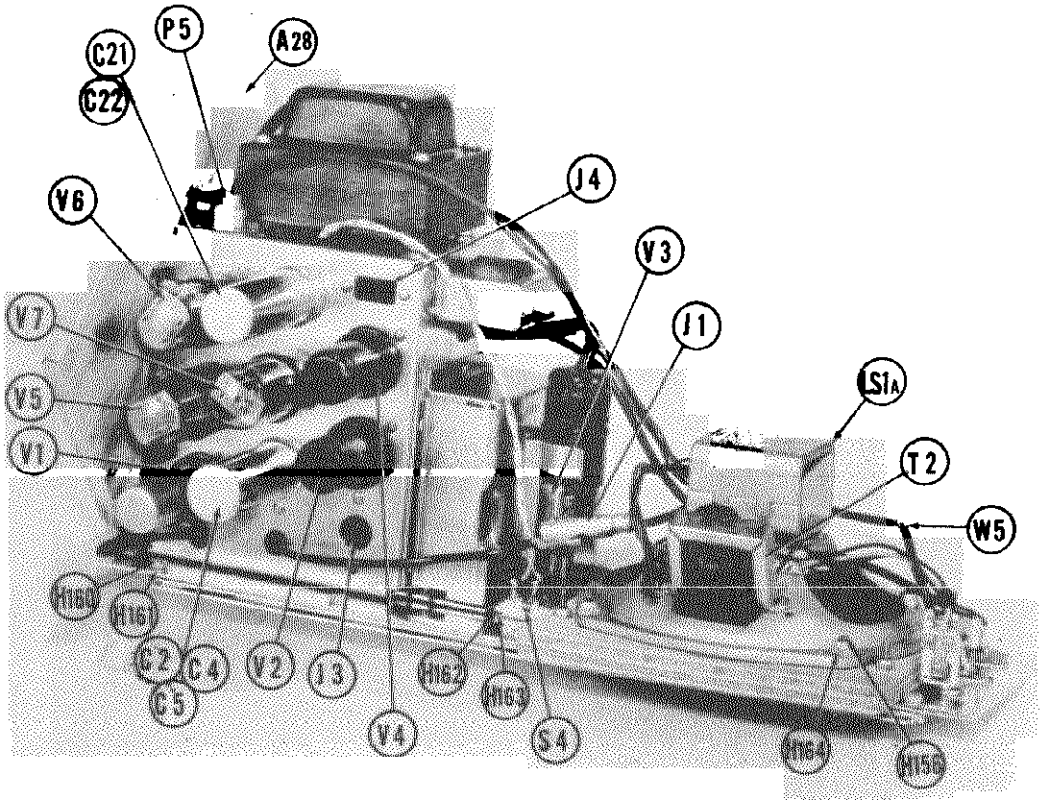

Fig. 50—*Amplifier for Model BK-414—Tube View*

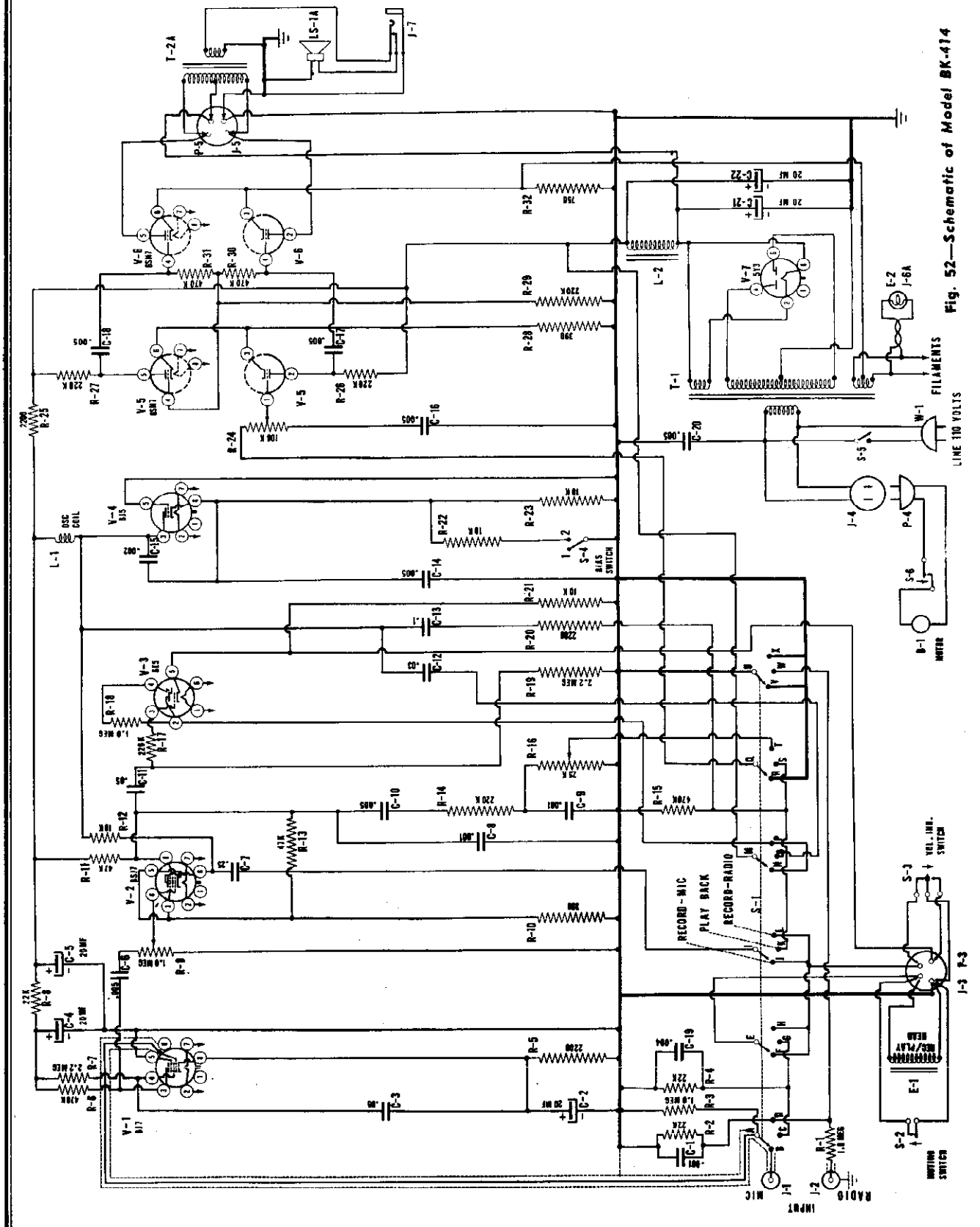

Fig. 52—Schematic of Model BK-414

MODEL BK-414

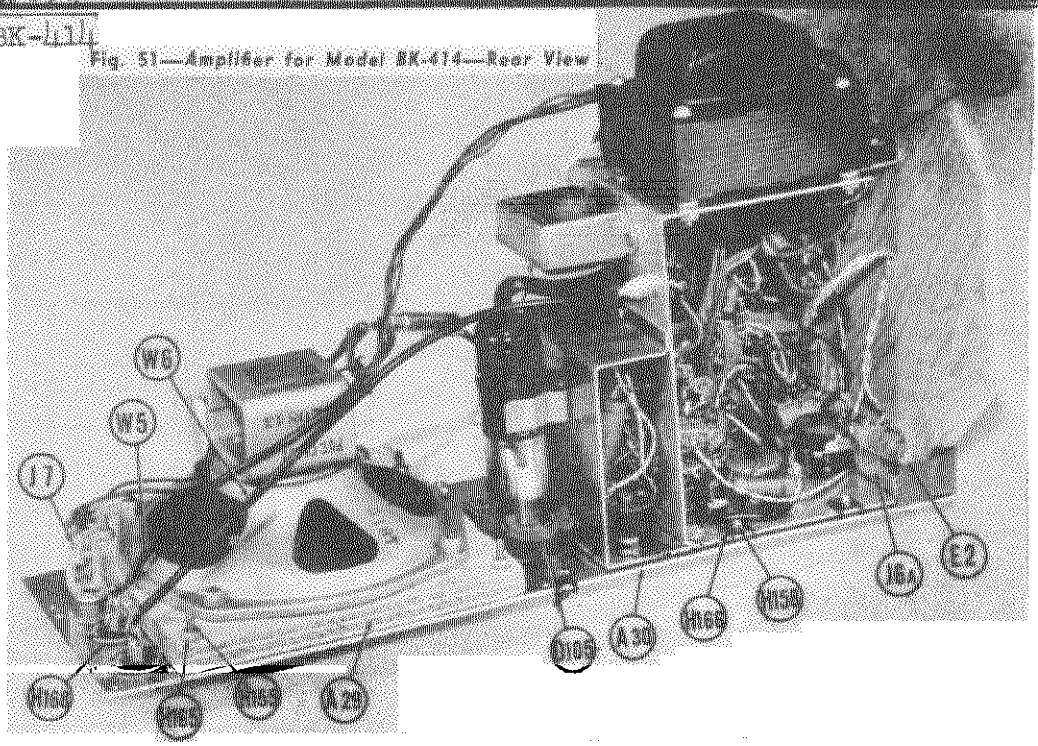

Fig. 51—Amplifier for Model BK-414—Rear View

The electronic circuit of the above amplifier is shown in Fig. 52. Location of the various electronic components may be seen in figures 20 through 26 as well as Fig. 50 and 51.

LIST OF MATERIAL

Symbol	BRUSH Part Number	DESCRIPTION
A-1	206790-501	BOARD, Speaker Mounting: including grille cloth and screen; for mounting 8" speaker.
A-2		FOOT, Mounting: 3/8" thick cork 1 1/4" diameter.
A-3	104215-501	BASE, Microphone.
A-10	206517-501	COVER, Trim: for covering the record and erase head to give dress finish to mechanism; includes rubber moulding (A-11) and knurled thumb screw (H-101).
A-11	106827-1	MOULDING, Rubber: for protecting finish of adjacent trim covers A-14; mounts onto trim cover A-10.
A-12	306518-501	COVER, Trim: for covering the pressure wheel mechanism; includes rubber moulding (A-13) and knurled thumb screws (H-101).
A-13	106827-2	MOULDING, Rubber: for protecting finish of adjacent trim cover A-14; mounts onto trim cover A-12.
A-14	306503-501	COVER, Panel Trim: for covering top panel mechanism to give dress finish; includes control instruction plate.
A-15	106365-501	HOUSING, Clutch bearing: supports and houses clutch bearing.
A-16	206444-501	BRACKET, Pressure Wheel: for mounting pressure wheel and associated mechanism.
A-17	106163-501	PLATE, Motor Shock Mount.
A-18	206409-501	BRACKET, Clutch lifter: Rewind position.
A-19	106122	PLATE, Motor Mounting.
A-20	104213-4	MOUNT, Vibration: Rubber; 5/8" lg. x 19/32" diameter.
A-21	106407-501	BRACKET, Clutch Lifter: Take-up position.
A-22	206293	COVER, Switch: covers switch S-6; overall dimension 3 1/2" lg. x 2" wd. x 1 1/4" high; mtg. flange on one side.
A-23	106408-501	BRACKET, Erase Head Mounting. (Deleted)
A-23A	107272-501	BRACKET, erase head: for mounting new type erase head (see figure 36); mounting hole drilled and tapped to accomodate new type erase head.
A-24	206332	BASE, Erase Head Mounting. (Deleted)
A-25	206139	BRACKET, Capstan Drive Mechanism.
A-26	106394-501	BRACKET, Capstan Bottom Bearing.
A-27	307032	PANEL, trim: Etched; for Amplifier Control panel.
A-28	207326	BOARD, Amplifier Mtg.: 3/8" Plywood drilled for five mtg. screws; overal dimension 9 3/16" lg. x 7 13/16" high x 3/8" thick.
A-29	207050	BOARD, speaker mtg.: 1/2" 5 ply plywood; milled with one 5 1/2" diameter hole for speaker; four speaker mtg. holes, and four holes for mtg. board to panel; overall dimension 6 1/4" long x 6 1/4" high x 1/2" thick.

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A-30	407024	PANEL, recorder mtg.: No. 11 gauge aluminum panel with necessary holes for mtg. complete amplifier equipment; overall dimension 15 31/32" long x 5 1/8" wide.
B-1	206322	MOTOR, A.C.: four pole shaded pole induction type; 1/50 hp.; 1400 R.P.M. full load; 115 v. a.c.; 60 cy.; single phase; .93 amps. at full load; includes cooling fan and No. 18-32 set screw.
C-1	3-106093-3	CAPACITOR, fixed: paper; .001 mfd. ± 20%; 600 VDCW.
C-2	103253	CAPACITOR, fixed: electrolytic; section (=) of 3 sections; 20 mfd; 25 VDCW; 3" long x 1" diameter metal can (can includes C-4 and C-5).
C-3	2-106094-2	CAPACITOR, fixed: paper; .05 mfd. ± 15%; 400 VDCW.
C-4	103253	CAPACITOR, fixed: electrolytic; section (□) of 3 sections; 20 mfd.; 450 VDCW; 3" long x 1" diameter metal can (can includes C-2 and C-5).
C-5	103253	CAPACITOR, fixed: electrolytic; section (Δ) of 3 sections; 20 mfd.; 450 VDCW; 3" long x 1" diameter metal can (can includes C-2 and C-4).
C-6	3-106093-4	CAPACITOR, fixed: paper; .005 mfd. ± 20%; 600 VDCW.
C-7	3-106093-7	CAPACITOR, fixed: paper; .25 mfd. ± 20%; 600 VDCW.
C-8	3-106093-3	CAPACITOR, fixed: paper; .001 mfd. ± 20%; 600 VDCW.
C-9	3-106093-3	CAPACITOR, fixed: paper; .001 mfd. ± 20%; 600 VDCW.
C-10	3-106093-4	CAPACITOR, fixed: paper; .005 mfd. ± 20%; 600 VDCW.
C-11	2-106094-2	CAPACITOR, fixed: paper; .05 mfd. ± 15%; 400 VDCW.
C-12	4-106093-8	CAPACITOR, fixed: paper; .03 mfd. ± 10%; 600 VDCW.
C-13	2-106094-1	CAPACITOR, fixed: paper; .1 mfd. ± 15%; 400 VDCW.
C-14	3-106093-4	CAPACITOR, fixed: paper; .005 mfd. ± 20%; 600 VDCW.
C-15	4-106093-6	CAPACITOR, fixed: paper; .002 mfd. ± 10%; 600 VDCW.
C-16	3-106093-4	CAPACITOR, fixed: paper; .005 mfd. ± 20%; 600 VDCW.
C-17	3-106093-4	CAPACITOR, fixed: paper; .005 mfd. ± 20%; 600 VDCW.
C-18	3-106093-4	CAPACITOR, fixed: paper; .005 mfd. ± 20%; 600 VDCW.
C-19	3-106094-5	CAPACITOR, fixed: paper; .004 mfd. ± 10%; 400 VDCW.
C-20	106100-6	CAPACITOR, fixed: paper; (Mica Mold); .005 mfd. — 20 + 40%; 600 VDCW.
C-21 and C-22	102711	CAPACITOR, fixed: electrolytic; two sections; 20-20 mfd.; 450 VDCW; 3" long x 1" diameter metal can.
E-1	306784-501	RECORD-REPRODUCE HEAD: Includes cable assembly and connecting plug.
E-2	105710-1	LAMP, incandescent: Pilot lamp, 6-8 volts; .25 amps; Bayonet base; Mazda No. 44.
E-3	106441-501	BOARD, terminal: 3 screw terminals mounted on molded bakelite strip 2 1/2" long x 7/8" wide x 1/8" thick; for external speaker connections.
E-4	104099-3	BOARD, terminal: two lug terminals; one lug support; mounted on 1/16" bakelite.
E-5	206684	SHIELD, oscillator: covers oscillator coil and supports clamp for V-3; overall dimension 3 7/8" long x 3 15/16" wide x 1 3/8" high.
E-6	104099-2	BOARD, terminal: one lug terminal; one lug support mounted on 1/16" thick bakelite; used on speaker assembly.
E-7	106469	MAGNET, erase head.
E-8	L-83	LUG, terminal.
E-9	206931	POLEPIECE, top: for new type erase head (see figure 36).
E-10	106939	MAGNET, erase head: for new type erase head (see figure 36).
E-11	206932	POLEPIECE, bottom, for new type erase head (see figure 36.)
H-1	3219-5	GROMMET, rubber: fits 3/8" hole in 1/16" panel; I.D. 9/32".
H-2	7618-3	GROMMET, rubber: fits 5/16" hole in 1/16" panel; I.D. 3/16".
H-3		SCREW, wood: No. 6 x 3/4"; mounts speaker to baffle board.
H-4		WASHER, plain: 3/8" x 9/32" x 1/32"; steel cad plated.
H-5	103890	CLAMP, power cord: lock type; used on early units only.
H-5	105859-1	CLAMP, power cord: strain relief type; .530" diameter x .545" long.
H-6		SCREW, self tapping: type " Z"; No. 4 x 1/4" binding head; secures oscillator shield to chassis.
H-7		WASHER, internal lock: No. 8.
H-8		NUT, hexagon: No. 8-32.
H-9		SCREW, self tapping: No. 10 x 3/4"; type " Z"; rd. hd.
H-10	103838-4	NUT, speed: "U" type; fits .072—.081 panel thickness; for type No. 10 " Z" screws.
H-11	100511	CLAMP, cable: for routing speaker cable along floor of cabinet.
H-12		SCREW, wood: No. 6 x 1/2"; rd. hd.; for mounting H-11.
H-13 and H-14	obsolete	SCREWS AND WASHERS: obsolete; new type pilot lamp holder clips onto flange of speaker frame above indicator rod. (see J-5 for new lamp holder).
H-15		SCREW, wood: No. 6 x 5/8; Phillips round head.
H-16	104788	CLIP, microphone support.
H-17	106723	ESCUTCHEON: for 6E5 Volume Indicator.
H-18	107185	NUT, reel clamping: knurled cap; 3/4" diameter skirt; 9/16" diameter cap; tapped at top for 8-32 thread; drilled at bottom 3/8" diameter; 5/16" high.
H-19		NUT, hex: No. 8-32, small; 7/32" across flats, 3/32" thick.
H-20		SCREW, set: No. 8-32 x 5/8" long; allen head; cup point.

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LIST OF MATERIAL

Symbol	BRUSH Part Number	DESCRIPTION
H-21		SCREW, machine: No. 5-40 x 11/16" long; round head; brass, cad. plated.
H-22		SCREW, machine: No. 4-40 x 3/4" long; round head; brass.
H-23		WASHER, internal lock: No. 4; bronze.
H-101		SCREW, knurled thumb: No. 6-32 x 1/4" long; brass-antique bronze; secures trim covers A-10 and A-12.
H-102		SCREW: No. 10-24 x 3/8; shakeproof, bd. hd.; motor mounting.
H-103		SCREW, set: No. 8-32 x 1/4; hollow cup; for drive pulley.
H-104		WASHER, external lock: No. 10; for motor mounting.
H-105	106120-1	WASHER, motor mounting.
H-106	106527	WASHER, spacer: for clutch bearing housing (deleted on later units).
H-107		NUT, hex: 3/8-32; secures erase bracket sleeve.
H-108		SCREW, machine: No. 6-32 x 3/8 round head; record head mounting.
H-109		WASHER, internal lock: No. 6 int.; record head mounting.
H-110	106454-1	SPEED NUT, Tinnerman: pressure pad adjustment.
H-111		NUT, hex: No. 4-40; pressure pad adjustment.
H-112		SCREW, machine: No. 4-40 x 1/2; pressure pad adjustment.
H-113		PIN, cotter: 1/16" diameter x 7/16" long; for control lever.
H-114		WASHER, plain: No. 8; for control lever.
H-115	106117	PIN, clutch lifter.
H-116		WASHER, internal lock: 1/2"; bearing housing mounting.
H-117	106157	NUT, hex: bearing housing mounting. 1/2-20 N. C. two thread.
H-118		WASHER, plain: No. 8; clutch bearing thrust.
H-119		SCREW, machine: No. 5-40 x 1/2"; fl. hd.; motor switch (S-6) mounting.
H-120		WASHER, internal lock: No. 6; switch cover mounting.
H-121		SCREW, type " Z": No. 6 x 1/4"; round head; switch cover mounting.
H-122	106170	HINGE, erase head bracket.
H-123	106179	WASHER, spacer: motor vibration.
H-124	106671	WASHER, plain: .172" I.D., x 1/2" O.D. x .049" thick; motor vibration mounting.
H-125		WASHER, internal lock: No. 8; motor vibration mounting.
H-126		NUT, hex: No. 8-32; motor vibration mounting.
H-127		PIN, cotter: 1/16" diameter x 1 1/2" long; erase head bracket mounting.
H-128		WASHER, internal lock: No. 3/8"; capstan bearing mounting.
H-129		NUT, hex: No. 3/8-32: capstan bearing mounting.
H-130	106173	WASHER, flat: spacer, capstan drive.
H-131	106269	CLAMP, cable: record head cable clamp.
H-132		WASHER, spring lock: No. 10; capstan lower bracket mounting.
H-133		SCREW, cap: No. 10-32 x 3/8"; socket head; capstan lower bracket mounting.
H-134		SCREW, machine: No. 4-40 x 1/2"; round head; erase head mounting (deleted see H-22).
H-135		WASHER, internal lock: No. 4; erase head mounting. (deleted see H-23).
H-136	106331	CLAMP, erase magnet (deleted).
H-137	106155	RIVET, solid: mounts clutch raising lever assembly.
H-138	Deleted	CLAMP, cable: secure cables from record head and switch (S-3).
H-139		WASHER, internal lock: No. 8; mounts ribbon guide posts.
H-140		SCREW, machine: No. 8-32 x 3/8"; round head brass; mounts ribbon guide posts.
H-141	206159	LATCH, trip lever.
H-142		WASHER, flat: latch retaining; No. 8 plain.
H-143		SCREW, machine: No. 6-32 x 1/4" long; round Phillips head; mounts capstan drive assembly.
H-144		SCREW, machine: No. 6-32 x 1/4" long. fl. hd.; mounts capstan drive assembly.
H-145		SCREW, machine: No. 5-40 x 1/2" long; fl. hd.; mounts item S-3.
H-146		SCREW, self tapping: P.K. type "A"; No. 10 x 1" fl. hd. for mounting mechanism panel to case.
H-147		SCREW, machine: No. 10-32 x 3/8" fl. hd.; for mounting mechanism panel to hinge.
H-148		SCREW, self tapping: P.K. type " Z"; No. 4 x 3/16" bd. hd.; for mounting trim panel to amplifier control panel.
H-149		NUT, hex: No. 10-32; for mounting mechanism panel to hinge.
H-150		SCREW, wood: No. 4 x 3/8" round head; for mounting ventilator grilles to case.
H-151	207051	HINGE, panel: for mounting recorder mechanism to amplifier panel.
H-152		SCREW, wood: No. 6 x 1/2" flat head; for mounting amplifier panel to case.

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LIST OF MATERIAL

Symbol	BRUSH Part Number	DESCRIPTION
H-153		SCREW, machine: No. 6-32 x ¼" round head; for mounting hinge to amplifier panel.
H-154		SCREW, wood: No. 8 x 1" round head; for locking amplifier mounting board in track of case.
H-155		SCREW, machine: No. 6-32 x ⅞" flat head; for mounting speaker mounting board to amplifier control panel.
H-156		SCREW, machine: No. 8-32 x 1" flat head; for mounting speaker to speaker mounting board.
H-157	207053	GRILLE, speaker.
H-158		SCREW, self tapping: P.K. type " Z", No. 10 x ⅜" flat head; for mounting amplifier chassis to amplifier control panel.
H-159		SCREW, machine: No. 4-40 x ¼" flat head; for mounting bias switch (S-4) to control panel (model BK-414 only).
H-160		NUT, hex: No. 6-32; for mounting hinge to amplifier control panel.
H-161		WASHER, internal lock: No. 6; for mounting hinge to amplifier control panel.
H-162		NUT, hex: No. 4-40; for mounting bias switch (S-4) to amplifier control panel.
H-163		WASHER, internal lock: No. 4; for mounting bias switch (S-4) to amplifier control panel.
H-164	104870-7	NUT, elastic stop: No. 8-32; cad. plated; for mounting speaker to speaker mounting board.
H-165	104870-6	NUT, elastic stop: No. 6-32; cad. plated; for mounting speaker mounting board to amplifier control panel.
H-166	103838-4	SPEEDNUT: for mounting amplifier chassis to control panel. Same as H-10.
H-167		SCREW, self tapping: P.K. type " Z"; No. 10 x ¾" flat head; for mounting amplifier chassis to amplifier mounting board.
H-168	106739	WASHER, insulating: for microphone input jack located on control panel.
I-1	106705	ROD, pilot indicator: translucent; lucite; amber; 3" long x ¼" diameter; one end rounded other end beveled 45°.
I-2	1-105708-1.	LENS, indicator light: pilot light jewel.
J-1	106763	CONNECTOR, female contact: microphone input jack; single contact; extension type.
J-2	104546	CONNECTOR, female contact: radio input jack; single contact phonoplug type.
J-3	106730	CONNECTOR, female contact: record-play head connector; four round contacts; wafer socket type.
J-4	104765	CONNECTOR, female contact: power receptacle for motor circuit; two (2) rectangular contacts; molded bakelite; 10 amps at 250 v. or 15 amps at 125 v.
J-5	106730	CONNECTOR, female contact: output transformer circuit; four round contacts; wafer socket type.
J-6	106786	LAMPHOLDER, pilot light: bayonet base type; for 6-8 volt pilot lamp; clip on type mounting; solder lug connections.
J-6-A	105707	HOLDER, indicator lamp: pilot lamp bracket (model BK-414 only).
J-7	21421	JACK, output: for tip and sleeve type plug; see wiring diagram figure 52.
L-1	103865	COIL, oscillator: 30 mh. ± 5 mh. at 1000 cps.; "Q" not less than 1 at 1000 cps.; for 30 K.C. bias oscillator circuit.
L-2	200925	REACTOR, filter: choke; 10 hy.; 62 ma.; 300 ohms D.C. resistance; open metal frame; 2⅞" long x 1½" wide x 1⅝" high; 2 mounting holes 2⅜" center to center.
LS-1	305975	SPEAKER, magnetic: 3.2 ohms voice coil; permanent magnet type; overall dimension 8 3/32" diameter x 3 53/64" deep. R.M.A. Std. Mtg.
LS-1-A	207496	SPEAKER: 3-4 ohm voice coil Jensen Model P6-T, spec. no. S3914.
MI-1	206789-501	MICROPHONE, crystal: Brush Development Company Model BA-106-B.
MS-1	11293-2	PAD, felt: for erase head bracket.
MS-2	106129	PAD, felt: for ribbon pressure at record-play head.
O-1	104655	SHIELD, grid cap: for V-1 (6J7) grid; 27/32" diameter x 1" long cad. plated.

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LIST OF MATERIAL

Symbol	BRUSH Part Number	DESCRIPTION
O-2	100699-4	CLIP: for mounting V-3 (6E5 tube) volume indicator; 1¼" long x 1¼" high x 9/16" wide (overall dimensions).
O-3	106930	SPACER, polepiece: brass; for new type erase head (see figure 36).
O-50	BK-921	REEL, Ribbon: empty; 7" diameter x 3/8" thick.
O-51	106516	RETAINER, thumb screw: flat washer; 3/8" diameter x .015 thickness; hole .120" diameter.
O-52	104307-5	RING, retaining: "Truarc"; I.D. .281"; cat. No. 5100-31.
O-53	206147	CUP, reel drive: reel support; 3.925" diameter x 15/64" deep.
O-54	106423-501	TRIGGER, rewind: actuates automatic rewind trip lever; located in rewind reel cup sub-assembly.
O-55	106152	TRIGGER, take-up: actuates automatic stop trip lever; located in take-up reel cup sub-assembly.
O-56	206148	CUP, clutch: faces on clutch; 3.937" I.D. x 1/8" deep.
O-57	106351-501	POST, reel: sub-assembly; supports reel cups.
O-58	106146	FELT, clutch: clutch facing.
O-59	106366-501	PULLEY, clutch: sub-assembly; 3 25/32" diameter x 15/64" thick; pulley "V" angle 60°
O-60	106212	BEARING, clutch thrust: oilite; .750" O.D., .315" I.D. x .031" thick.
O-61	106213	RETAINER, oil: felt; 5/8" O.D., 5/16" I.D., 3/32" to 1/8" thick.
O-62	106472	PULLEY, belt drive: overall dimension—1.656" diameter x 1 3/32" high; 3 belt grooves, 1 large diameter and 2 small diameter; mounts on drive motor shaft .3130—.3135 diameter.
O-63	105711-3	BEARING, reel post: standard oilite No. A-375-3; press fitted to item A-15; reamed to .188" I.D.
O-64	104307-1	RING, retaining: "Truarc" No. 5100-25; I.D. .225".
O-65	106262	POST, ribbon guide: 5/8" long x .370" diameter; one end tapped for No. 8-32 machine screw.
O-66	206320	GUIDE, ribbon: left hand; overall dimension 29/32" long x 23/32" wide x 25/32" high.
O-67	206321	GUIDE, ribbon: right hand; overall dimension 29/32" long x 23/32" wide x 25/32" high.
O-68	106119	SPRING, shift rod: control lever; free length 27/32" long; I.D. 7/32"; consists of 9½ coils of No. 18 B. & S. GA. spring bronze.
O-69	104307-6	RING, retaining: "Truarc" No. 5100-18; .170/.164 I.D.
O-70	7553	BALL, steel: 3/16" diameter; ball actuator for switch S-6.
O-71	106270-501	ROD, control lever: shift rod; 3 17/32" long x 3/16" diameter.
O-72	106401	INSULATOR, switch cover: made from .032" thick Wilmington fyberoid armature slot paper cut 5 11/16" long x 1 15/16" wide; folded 1 1/8" from each end.
O-73	206460-501	CAPSTAN, drive: sub-assembly, complete; includes spindle, spindle bearing, flywheel, pulley, lower bearing, and mounting bracket.
O-74	106143	SLEEVE, erase pin: mounts erase bracket hinge (H-122) and supports erase pin (O-75); overall dimension ½" square x 3/8" high; one end threaded 3/8-32; sleeve I.D. ¼",
O-75	106142	PIN, erase: actuates erase head bracket to engage head; 1 17/32" long x .240" diameter; stop flange at one end 1/32" thick; .028" wide retainer slot milled 3/4" from flange end.
O-76	106340	BELT, rubber: clutch drive; circular shape 8 5/8" diameter x 1/8" cross sectional diameter.
O-77	106339	BELT, rubber: motor drive; circular shape 3 5/8" diameter x 1/8" cross sectional diameter.
O-78	106364-501	BEARING, capstan spindle: sub-assembly; overall dimension 1" long x .374" diameter with flange .748" diameter x .032" thick near threaded end; thread size 3/8-32.
O-79	106137	DISC, flywheel: for capstan drive assembly; uses 3 each; overall dimension 3" diameter x .060" thick; indexing notch 1/8" x 1/32" along outer circumference.

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LIST OF MATERIAL

Symbol	BRUSH Part Number	DESCRIPTION
O-80 O-81 O-82	Sold only as one sub-assembly unit part No. 106338-501	CAPSTAN, drive: sub-assembly; includes items O-80, O-81, and O-82 press fitted and riveted together; individual parts not readily replaceable.
O-83	106127	SHAFT, pressure wheel: overall dimension 11/16" long x .1239" diameter.
O-84	106125	WHEEL, pressure: rubber tire mounted on metal rim with oilite bearing; overall dimension 1" diameter x 5/16" wide; bearing 7/16" long x .314" diameter, 1/8" center hole.
O-85	106128	SPRING, pressure wheel: Special; made from No. 16 G.A. (.037) music wire; overall dimension 2 1/8" long x 7/16" wide x 11/32" high.
O-86	206410	LEVER ASSEMBLY, raising; two (2) levers part No. 106113 riveted to a lever raising link part No. 106118; functions to engage or disengage the turntable clutches,
O-87	106616	SPRING, compression: clutch lever; free length 27/32"; consists of 9 1/2 coils .312" max. O.D.; 3 lb. force at 5/8" compressed length, ± 5%.
O-88	106405	SPRING, extension: for head locking slide sub-assembly; free length 11/16" center of end loop to center of other end loop; consists of 24 coils .255 O.D.; 4 lb. force at expanded length of 1 5/16".
O-89	106153	LEVER, rewind trip: for tripping automatic rewind controls; overall dimension 7/16" x 9/16" x 1 1/2".
O-90	106154	LEVER, take-up trip: for tripping automatic stop controls; overall dimension 2 3/16" x 27/32" x 9/16".
O-91	206112	SLIDE, latch cam: functions to reset take-up trip lever; overall dimension 6 1/8" long x 2 39/64" wide x 5/8" high.
O-92	206502	LEVER, clutch: actuates clutch raising lever assembly; overall dimension 7 11/16" long x 1 3/8" wide x 1 7/32" high.
O-93	206169	GATE, latching: functions to latch the clutch lever and the head locking slide; overall dimension 2 43/64" long x 1 3/8" wide x 13/16" high.
O-94	206391-501	SLIDE, head locking: functions to lock the erase head in its engaged position; overall dimension 8 15/16" long x 3 1/16" wide by 13/16" high.
O-95	106615	SPRING, extension: for trip bar extension return; free length 1 3/16" including end loops; consists of 22 1/2 coils, close wound, .255 O.D.; 4 lb. force at extended length of 1 15/16"; made from .032" diameter stainless steel type 302.
O-96	106406	SPRING, extension: for latch cam return; free length 1" including end loops; consists of 20 coils, close wound, .281 max. O.D.; 1 lb-14 oz. force at extended length of 1 23/32"; made from .026" diameter music wire.
O-97	106404	SPRING, extension: for latching gate; free length 3/4" including end loops; consists of 22 coils close wound, from .017" diameter music wire; coils 3/16" O.D.; 12 oz. force at extended length of 1 9/32".
O-98	Same as O-97	SPRING, extension: for rewind trip lever.
O-99	206392-501	BAR, trip lever sub-assembly; attached to trip lever bar link; part of control mechanism.
O-100	103142	CLIP, latch cam retainer: General Industries Co. part No. 21914; 7/16" long; made from No. 11 Ga. steel music wire.
O-101	106160	CAM, latch: part of control mechanism; overall dimension 1 5/32" long x 21/32" wide x 3/8" high.
O-102	106617	SPRING, extension: for trip lever latch; free length 27/32" including end loops; consists of 14 1/2 coils close wound from .028" diameter stainless steel type 302; coils .205" O.D.; 2 3/8 lbs. force at extended length of 1 1/8".
O-103	207126	GRILLE, ventilator: for left side of case (Model BK-414 only).
O-104	207060	GRILLE, ventilator: for right side of case (Model BK-414 only).
O-105	107220	BUSHING, tube: rubber bushing for protecting volume indicator tube.
P-1	106738-3	CONNECTOR, male contact: microphone input plug; single pin contact .125" diameter; phono-plug type with opening in shield for .175" diameter core.
P-2	106738-3	CONNECTOR, male contact: radio input plug; same as P-1.

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LIST OF MATERIAL

Symbol	BRUSH Part Number	DESCRIPTION
P-3	106765	CONNECTOR, male contact: record/play head connection; four pin-type contacts mounted and indexed on wafer insulator. Does not include shell (part number 106764).
P-4	1-107306-1	CONNECTOR, male contact: power connection of A.C. motor; 2 prong contacts; .138" x .230" opening for wire.
P-5	106765	CONNECTOR, male contact: output transformer circuit; four pin-type contacts mounted and indexed on wafer insulator. Does not include shell (part number 106764).
R-1	3-106771-3	RESISTOR, fixed: 1 megohm ± 20%; ½ watt; radio input circuit.
R-2	3-106771-7	RESISTOR, fixed: 22,000 ohms ± 20%; ½ watt; radio input circuit.
R-3	3-106771-3	RESISTOR, fixed: 1 megohm ± 20%; ½ watt; V-1 grid return.
R-4	3-106771-7	RESISTOR, fixed: 22,000 ohms ± 20%; ½ watt; reproduce-head shunt (play-back only).
R-5	3-106771-2	RESISTOR, fixed: 2200 ohms ± 20%; ½ watt; V-1 cathode.
R-6	103806-12	RESISTOR, fixed: 470,000 ohms ± 10%; ½ watt; V-1 plate load.
R-7	3-106771-8	RESISTOR, fixed: 2.2 megohms ± 20%; ½ watt; V-1 screen.
R-8	3-106771-7	RESISTOR, fixed: 22,000 ohms ± 20%; ½ watt; decoupling and B± filter for V-1,
R-9	103469	RESISTOR, variable: 1 megohm; potentiometer; "Play" or "Record" volume control.
R-10	3-106771-5	RESISTOR, fixed: 390 ohms ± 20%; ½ watt; V-2 cathode.
R-11	2-106772-3	RESISTOR, fixed: 47,000 ohms ± 10%; 1 watt; V-2 screen.
R-12	2-106772-2	RESISTOR, fixed: 18,000 ohms ± 10%; 1 watt; V-2 plate load.
R-13	2-106772-3	RESISTOR, fixed: 47,000 ohms ± 10%; 1 watt; V-2 screen to cathode.
R-14	3-106771-1	RESISTOR, fixed: 220,000 ohms ± 20%; ½ watt; monitor volume limiting.
R-15	103806-12	RESISTOR, fixed: 470,000 ohms ± 10%; ½ watt; V-5 grid return (play-back only).
R-16	103469-2	RESISTOR, variable: 25,000 ohms; potentiometer; monitor volume control (record-radio only).
R-17	3-106771-1	RESISTOR, fixed: 220,000 ohms ± 20%; ½ watt; V-3 grid.
R-18	3-106771-3	RESISTOR, fixed: 1 megohm ± 20%; ½ watt; B± supply to 6E5 target.
R-19	3-106771-8	RESISTOR, fixed: 2.2 megohm ± 20%; ½ watt; V-3 grid return.
R-20	3-106771-2	RESISTOR, fixed: 2200 ohms ± 20%; ½ watt; frequency compensating network.
R-21	1-106771-9	RESISTOR, fixed: 10,000 ohms ± 5%; ½ watt; closes shadow of 6E5 until erase-pin is pressed (not shown on photographs).
R-22	1-106771-9	RESISTOR, fixed: 10,000 ohms ± 5%; ½ watt; increases 30 KC bias current from V-4.
R-23	1-106771-9	RESISTOR, fixed: 10,000 ohms ± 5%; ½ watt; V-4 cathode.
R-24	106762-1	RESISTOR, variable 100,000 ohms; potentiometer; tone control (play-back and monitor only); includes power switch S-5.
R-25	3-106772-4	RESISTOR, fixed: 2200 ohms ± 20%; 1 watt; B + voltage dropping.
R-26	3-106771-1	RESISTOR, fixed: 220,000 ohms ± 20%; ½ watt; phase inverter (V-5) plate load (1st section).
R-27	3-106771-1	RESISTOR, fixed: 220,000 ohms ± 20%; ½ watt; phase inverter (V-5) plate load (2nd section).
R-28	3-106771-5	RESISTOR, fixed: 390 ohms ± 20%; ½ watt; phase inverter (V-5) cathode.
R-29	3-106771-1	RESISTOR, fixed: 220,000 ohms ± 20%; ½ watt; phase inverter (V-5) voltage divider.
R-30	103806-12	RESISTOR, fixed: 470,000 ohms ± 10%; ½ watt; pushpull output (V-6) grid (1st section).
R-31	103806-12	RESISTOR, fixed: 470,000 ohms ± 10%; ½ watt; pushpull output (V-6) grid (2nd section).
R-32	103713-40	RESISTOR, fixed: 750 ohms ± 5%; ½ watt; V-6 cathode.
S-1	106746-3	SWITCH, rotary: record-play selector; 2 sections, 3 poles each section, 3 positions.

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LIST OF MATERIAL

Symbol	BRUSH Part Number	DESCRIPTION
S-2	106909-501	SWITCH, lever: reproduce head muting switch; S.P.S.T. actuated by control lever mechanism.
S-3	106916-501	SWITCH, lever: renders volume indicator inoperative until erase head is engaged; S.P.D.T.
S-4	106801-1	SWITCH, slide: bias level; S.P.S.T.
S-5	See R-24	SWITCH, power: part of tone control R-24.
S-6	106317-501	SWITCH, lever: operates A.C. motor when actuated by control levers.
T-1	204902	TRANSFORMER, power: filament and plate type; input 117 v., 60 cycles, single phase; three secondary windings as follows—(1) high voltage 300 v. E.S.C. at 80 ma., leads red, red and yellow, and red, (2) rectifier filament 5 volts at 2 amps., leads yellow and yellow, (3) filament 6.3 volts at 4.8 amps., leads green, green and yellow, and green; overall dimensions 3¾" long x 3⅛" wide x 3½" high.
T-2	200923	TRANSFORMER, A.F. output: plate coupling type; primary impedance—22,000 ohms; 10 ma. E.S.C.; secondary—3.2 ohms; overall dimensions 2⅜" long x 1 5/16" high x 1½" wide.
T-2-A	107497	TRANSFORMER, A.F. output: plate coupling type; primary impedance 22,000 ohms; 10 ma. E.S.C.; secondary— 3 to 4 ohms; overall dimensions 1¾" lg. x 1½" wd. x 1⅜" high.
U-1	406800-501	AMPLIFIER, A.F.: record/reproducer amplifier chassis, wired, complete with tubes.
V-1	7075	TUBE, electron: R.M.A. No. 6J7; input amplifier.
V-2	13678	TUBE, electron: R.M.A. No. 6SJ7; second stage; current converter.
V-3	105206	TUBE, electron: R.M.A. No. 6E5; record volume indicator.
V-4	9834	TUBE, electron: R.M.A. No. 6J5; 30 K.C. bias oscillator.
V-5	103185	TUBE, electron: R.M.A. No. 6SN7 GT.; twin-triode; phase invert
V-6	103185	TUBE, electron: R.M.A. No. 6SN7 GT.; twin-triode; pushpull power output.
V-7	102705	TUBE, electron: R.M.A. No. 5Y3-GT; rectifier, full wave; D.C. power supply.
W-1	206923	CABLE ASSEMBLY, power: P.O.S.J. 32, two conductor No. 18; stranded; rubber insulated; includes plug.
W-2	206741-501	CABLE ASSEMBLY, volume indicator: includes socket and socket shield for 6E5 tube; 5 color coded wires as follows: one (1) white-yellow tracer, one (1) white-red tracer, one (1) white-black tracer, one (1) white-blue tracer, one (1) white-green tracer; 1 megohm resistor; spaghetti tubing for covering all wires.
W-3	106515	STRAP, ground: No. 30 (.010) B & S GA. Phos. Bronze; overall length 2¾"; 11/64 diameter punch hole each end.
W-4	207203-501	CABLE, head extension: for connecting the record head and switch S-3 (located on mechanism panel) to amplifier (Model BK-414 only).
W-5	207059-501	CABLE, input extension: for microphone input jack on control panel to amplifier; includes input jack, shielded cable, and plug.
W-6	207059-501	CABLE, input extension: for radio input jack on control panel to amplifier; includes input jack, shielded cable, and plug.
X-1	106740	SOCKET, tube: 8 prong wafer type; mounting holes spaced 1½" center to center.
101	506690-501	CABINET; for housing complete recorder-reproducer mechanism and amplifier equipment for Brush Model BK-411 Soundmirror.
201	507055-501	CASE, carrying: for mounting amplifier and recorder mechanism; includes lid (Model BK-414).
501	106296	KNOB, control shift: for shifting positions of control mechanism; overall dimension 1" diameter; tapped for No. 10-32 thread; Kurz-Kasch, Inc. part No. S-801-10D.
601	2-103468-2	KNOB, control: for amplifier controls; walnut finish; push-on type w/spring; for ¼" shaft flattened to .156"; depth of shaft hole 17/32"; overall dimension 1" diameter x ⅝" high; Kurz-Kasch Inc. part No. S-453-29.

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Since the initial preparation of the BK-411 and BK-414 Service Manual, a considerable amount of service information has become available through field experience. This supplement is therefore issued to bring this information to the serviceman's attention and should be read thoroughly in conjunction with the manual. In addition to the items noted below, a revised symptom-cause-remedy chart is appended which has been based on this experience.

OUTPUT PLUG AND SHORT CIRCUITING

In early production of the BK-411 and BK-414, the output plug was mounted so that the shell of the plug could come in contact with the chassis and it was possible for a short circuit to occur from B+ to ground through the metal shell of this plug. This failure would cause a loud hum and might burn out either the rectifier or the output transformer. As soon as this condition was noted, an immediate change was made in production and all "Soundmirrors" in stock were protected by the addition of an insulating washer over the prongs of the output plug, making it impossible for the plug shell to ground to the chassis. All recorders should be checked to see that either the output plug socket has been remounted so that the plug shell cannot short or the insulating washer is present.

REDUCTION OF HUM

Excessive hum in these recorders is most commonly due to improper placement of the grid lead of the first 6J7 tube. This lead should be carefully oriented for minimum hum.

FAILURE OF MOTOR SWITCH

In early production of the BK-411 and BK-414, some difficulty has been encountered in the field with the motor switch's failing to operate, usually due to the actuator ball's having jumped out of the switch. If the ball is replaced and the recorder tripped into automatic rewind, it can be seen that the blade on which this ball rides almost escapes from under the ball. This switch should be carefully adjusted so that the ball remains positioned over the edge of the blade and the ball cannot escape. After this has been done, the switch should be checked to see that when the control lever is in the neutral position, the ball is actually in the center of the dimple made to receive it. In later production of the "Soundmirror", a protuberance was staked out on the side of the actuator lever so that the ball is not permitted to escape. In most recent construction, the pivot tongue on Part #092, Figure 11, Page 8, has been lengthened so that this pivot point can be adjusted by bending the tongue to prevent difficulty in adjustment of the motor switch.

If the recorder has the new type of clutch operating lever so that the pivot tongue can be adjusted, the following procedure should be used:

1. Loosen the clutch adjusting set screws (H-20) five or six turns each.

2. Raise the mechanism panel.

3. Move the control lever to the "Stop" position and release it. This assures that the mechanism is in the "Stop" condition.

4. Remove the two screws (H-121) holding the switch cover (A-22) over the automatic motor switch and remove the cover with its fiber inner lining.

5. Loosen but do not remove the two screws holding the clutch lifter bracket

assembly (A-18, Fig. 15) in place so the assembly can be moved freely. If the spring is distorted, straighten it or replace the assembly.

6. At this time check the positioning of the clutch operating lever (O-92, Fig. 14). In its neutral position, the axis of the round rod of the control lever (O-71, Fig. 5) should lie on the center line of the clutch operating lever. This means that the angular excursion of the clutch operating lever should be the same from neutral to the "Fast Forward" limit stop as it is from neutral to the "Fast Reverse" limit stop. In no case should the excursion from neutral to the "Fast Reverse" limit stop exceed the excursion from neutral to the "Fast Forward" limit stop. If the neutral position must be shifted slightly, it may be done by bending sideways the narrow section of the clutch operating lever (O-92, Fig. 11) that serves as a pivot, since the neutral position is determined by this pivot and the spring (O-87, Fig. 11).

7. The clutch lifter bracket assembly should now be so located that with the clutch operating lever centered, and the backlash of the connecting linkages taken up by moving the dimpled end of the clutch raising lever toward the motor, the ball actuator (O-70, Fig. 15) just drops into the dimple of the clutch raising lever. Tighten the two screws (H-169) securely.

8. Check to make sure that in the "Fast Forward" and "Play-Record" positions of the mechanism the raising lever does not jam and distort the bronze spring near the end where it is riveted.

9. Check to make sure that in the extreme excursion of "Rewind" and "Fast Reverse" positions the ball actuator (O-70, Fig. 15) cannot drop out.

10. Check to make sure that in both the "Fast Forward" and the "Fast Reverse" positions, the motor switch contacts close firmly, and that they are open in the "Stop" position.

11. If the spring of the clutch lifter bracket associated with the take-up reel is distorted, it should be repaired or the assembly replaced as is indicated above.

12. When replacing this assembly, adjust its position so that the dimple of the lifter lever causes maximum displacement of the bronze spring when moving from the "Stop" condition to the "Fast Reverse" condition. Check to make sure that in "Rewind" position the lifting lever does not jam and distort the bronze spring near the end where it is riveted. Tighten the two screws (H-169) securely.

13. Replace the switch cover (A-22) and tighten its screws securely.

14. Lower the unit back down onto the cabinet and adjust the clutches.

NOISY MOTOR

When an apparently noisy motor is encountered in the BK 411 or BK-414, first the clutch drive belts and then the capstan drive belt should be disengaged from the motor to definitely establish that the vibration is originating in the motor itself. If this is the case, the fan should be carefully examined for loose or bent blades. Many cases of vibration prove to be due to the shock mounts of the motor having become misaligned in shipments so that one mount is jammed and the motor is not really isolated from the chassis. A few "Sound-mirrors" were constructed in which the ground strap for the motor was of much too heavy material and transmitted vibration to the chassis. In almost all cases, if the fan is in good condition and

the shock mounts are free and functioning properly, the motor noise will be found to be unobjectionable.

BELT GUIDE

Some difficulty was encountered in early production with the clutch drive belt, Part O-76, Figure 8, Page 6, jumping on the motor pulley so that the belt rubbed against itself and wore out quite rapidly. This problem has been eliminated by the use of a shorter and heavier belt and by the installation of a belt guide. This belt guide, Part #207143, should be installed under the motor mounting screw, Part H102, Figure 12, Page 9, and adjusted so that the belt does not touch the guide but is prevented by the guide from jumping out of its proper grooves. To install this guide the present motor mounting screw will require replacement with a half-inch No. 10 self-tapping screw. The belt guide is slipped under the screwhead and a No. 10 flat washer placed over the belt guide and a lock washer between the screwhead and the flat washer.

PRESSURE BRACKET BENDING

Quite frequently complaints of low volume, distorted recording and poor high frequency response prove to be due to the pressure bracket, A16, Fig. 9, Page 6, bending at the point where the arm joins the bracket, which in turn causes the head pad, MS2, no longer to bear directly on the recording head gap. This bending has only occurred in certain brackets which had a sharp corner in place of a radius in the arm of the bracket and then, only in machines which used the early relatively heavy head locking slide spring, Part O-88, Figure 11, Page 8. When this condition is discovered, the pressure wheel bracket should be replaced with one which has a satisfactory radius at the bends, and the head locking slide spring replaced with one of the newer type springs which will eliminate the violent recoil of this bracket which has contributed to the original bending.

MUTING SWITCH

Early production of the BK-411 "Soundmirror" was shipped without the installation of the muting switch which silences the recorder during automatic rewind. This switch, S-2, Part #106909-501, should be mounted on the inner side of the control rod bracket as shown in Figure 2. Most of these recorders have this bracket drilled for the mounting of this switch; however, if these holes have not been drilled, holes should be drilled as indicated in Figure 1. The

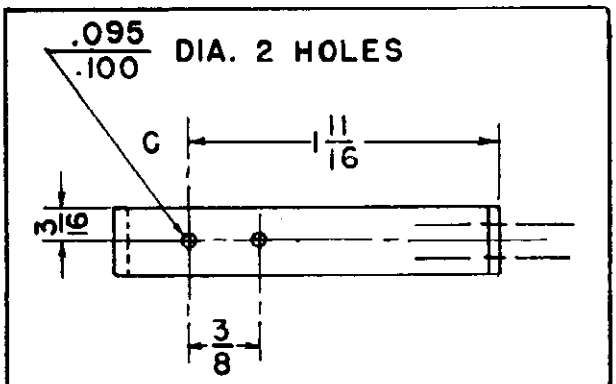
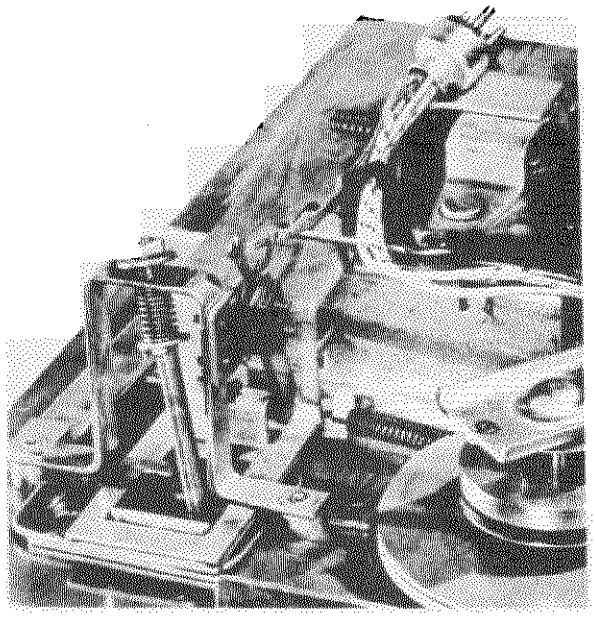
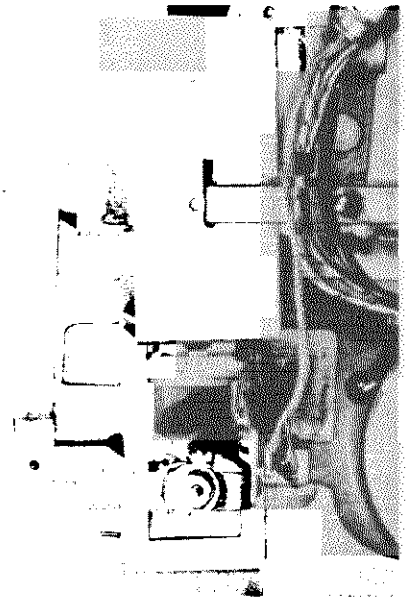


Figure 1

switch is mounted on the control rod bracket as shown in Figure 2 by means of two No. 4 self-tapping screws. On most recorders a shielded lead has been brought over to the switch position and taped back, which should be connected to the switch. However, if the lead is not present, a shielded lead should be run from the head plug and connected across the head. The shield of the lead should be connected to the inner blade of this switch and the center conductor to the outer contact. After mounting, the switch should be adjusted so that the actuator button passes inside of Part O-93, Figure 14, in all positions except automatic rewind, in which position the button is actuated by O-93.



Control Mechanism
In Fast Reverse Position
Switch Contacts Open



Control Mechanism
In Automatic Rewind Position
Switch Contacts Open

Figure 2 MUTING SWITCH

ELIMINATION OF RADIO AND TELEVISION INTERFERENCE

When operated in high field strengths of FM or television stations, the BK-411 and BK-414 "Soundmirrors" are sometimes subject to interference. In the case of interference from television stations, this sometimes appears as a loud hum or whistle, due to the synchronizing signals' getting into the recorder. To eliminate this interference, the steps listed below should be tried in order:

1. A 50 mm condenser should be added between the point on the rotary selector switch, Part S1, Figure 25, to which the grid of V-1 returns, and the center or ground lug on the three-terminal strip which is situated on the front panel of the amplifier adjacent to the selector switch.

2. The condenser, C-4, bypassing the screen of the first gain stage, should be changed to the extent of removing the condenser connection from the cathode pin of the tube socket and connecting it to the ground lug on the condenser C-1, C-3, C-6.

3. A mica .001 condenser should be added from the cathode pin of V-1 to the same ground point on the electrolytic condenser as used in "2".

4. A mica .001 condenser should be added from the screen of V-1 to the same point on the electrolytic condenser as was used in "2" and "3".

INSTALLATION OF VU METER ON BK 401, BK 403, BK-411 AND BK-414 "SOUNDMIRRORS"

Requests have been received from the field, from time to time, for information on the connection of a VU meter to replace the cathode eye used as a volume indicator on the "Soundmirror". The changes required to do so are very simple, involving the connection of a VU meter from ground to the screen of

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the recording stage through a capacitor and, in the case of the BK-411 and BK-414, the addition of a series limiting resistor.

For the BK-401 and BK-403, the coupling capacitor from the recording stage screen to the 6E5 grid, C-25, should be changed from 0.1 mfd to 0.05 mfd, 600 volts. The meter is then connected directly from the capacitor to ground and the 6E5 tube removed.

In the case of the BK-411 and BK-414, the coupling capacitor, C-11, 0.05 mfd, should be changed to a 0.1 mfd, 600 volt capacitor, in series with a 6800 ohm 1/2 watt resistor. The meter is then connected from the 6800 ohm resistor to ground and the 6E5 tube removed.

In the case of the BK-411 and BK-414, the frequency response of the meter will be within $1\frac{1}{2}$ db over the normal recording range and is down only 5 db at 10 kc. In the case of the BK-401 and BK-403, the frequency response will be about $\pm$ 3 db over the range from 50 to 10,000 cycles. Due to the fact that the source impedance is not that recommended for the standard VU meter, the dynamic characteristics of the meter will be slightly altered. However, we believe that this will not be sufficient to interfere with its utility.

CONNECTION OF BK-411 AND BK-414 TO PERMIT MONITORING DURING MICROPHONE RECORDING AND USE AS A PUBLIC ADDRESS SYSTEM

In the BK-411 and BK-414, the amplifier has been deliberately constructed so that it is not possible to monitor during microphone recording. This has been done to eliminate the possibility of spoiling recordings by accidentally opening the monitor gain control and producing acoustic feedback during the recording process. However, in cases where the microphone is to be placed in another room or where the "Soundmirror" may be needed as a low-power public address system, it may be advantageous to make a modification of this circuit.

The necessary connection is made on the rear deck of the selector switch. The end of the 470K resistor, which is now common with the white lead with black tracer which goes to ground, should be removed from the switch. The resistor should be left connected to ground. A jumper should be run from the terminal thus vacated to the third terminal on the left which has a white lead with yellow tracer which goes to the rotor of the monitor gain control. With this change, the monitor amplifier will be in operation in recording from both microphone and radio. Therefore, care must be exercised when the microphone is in the vicinity of the recorder not to open the monitor gain control while recording.

SYMPTOM	CAUSE	REMEDY
DOES NOT RECORD		
a. Cathode eye does not light.	1. Record play switch in play position. (Fig. 6)	1. Set controls as outlined in operating instructions.
b. Cathode eye lights but does not indicate. Monitor O.K.	1. No input. 2. Erase pin not depressed. (Fig. 2) 3. Erase switch (S-3) not operating. 4. Defective coupling condenser C 7 or C 6. 5. Defective tube V-2.	1. Check input connections. 2. Check trim plate to see that it is not obstructing erase head. 3. Check for dirty or poorly adjusted contacts. 4. Replace. 5. Replace.
c. Eye indicates. Monitor O.K.	1. Defective coupling condenser C.7. 2. Shorting erase-switch S-3. 3. Defective head E-1.	1. Replace. 2. Adjust switch and leads. 3. Replace.
FAILURE TO DRIVE		
a. Motor operates but reels do not revolve.	1. Defective belt O-76. (Fig. 8) 2. Trim cover binding A-10. (Fig. 4) 3. Defective belt O-77. (Fig. 8) 4. Improper clutch adjustment.	1. Replace. 2. Adjust position of cover. 3. Replace. 4. Adjust according to instruction Pg. 41.
b. Motor does not run.	1. Ball jumped from position O-7. (Fig. 38) 2. Defective switch S-6. (Fig. 38) (See supplement) 3. Motor plug out P-4. (Fig. 16) 4. Fan blocked. 5. Capstan bearing binding O-78, A-26. (Fig. 37)	1. Replace ball and readjust according to supplement. 2. Clean and adjust contacts. 3. Insert P-4 into S-4. 4. Dress and/or lace wire leads. 5. Align bearing, lubricate. If bearing is damaged, replace.
FAILURE TO DRIVE IN REWIND	1. Improper clutch adjustment	1. Adjust Page 41

SYMPTOM	CAUSE	REMEDY
	2. Improper ribbon guide adjustment. 3. Rewind clutch lifter bracket requires adjustment A-18. (Fig. 38) 4. Pressure wheel assembly (A-16 Fig. 38) does not disengage--head locking slide spring too weak O-88. (Fig. 11)	2. Adjust, Page 42. 3. Reform phosphor bronze spring and adjust bracket. See supplement. 4. Replace spring O-88.
FAILURE TO DRIVE IN FAST FORWARD	1. Improper clutch adjustment. 2. Improper ribbon guide adjustment. 3. Clutch lifter bracket maladjusted A-21. (Fig. 38)	1. Adjust clutches, Page 41. 2. Adjust ribbon guides, Page 42. 3. Reform phosphor bronze spring, adjust bracket; see supplement.
BREAKS TAPE	1. Insufficient head pad pressure. 2. Pressure roller not adjusted or spring deformed.	1. See ribbon tension adjustment, Pg. 42. 2. See roller pressure adjustment, Pg. 42.
FAILURE TO AUTOMATICALLY REWIND	1. Rewind trigger binding on reel O-54. (Fig. 38) 2. Rewind trigger bent. 3. Rewind trigger spring too weak. 4. Bar, trip lever (O-99, Fig. 12) binding. 5. Recorder not fully cocked take-up trip lever O-90 (Fig.13) did not catch on trip lever latch H-141. (Fig. 13)	1. Reposition reel to allow free movement of trip. 2. Reshape as in O-54, Fig. 38. 3. Reshape to increase tension. 4. Clean dirt, burrs or cause of binding and lubricate parts with Molycote thinned with carbon tetrachloride or use S A E 10 oil. 5. Oil take-up trip lever. Replace spring if necessary O-98. Bend lip on part H-141 toward part O-91 at their point of contact to allow part H-141 to travel greater distance.
FAILURE TO STOP AUTOMATICALLY	1. Reel binding take-up trigger O-55. (Fig. 38) 2. Take-up trigger bent.	1. Reposition reel to allow free movement of trip. 2. Reshape trigger O-55 as in Fig. 38.

SYMPTOM	CAUSE	REMEDY
	3. Take-up trip lever binding in reel cup.	3. Loosen hold down reel nut so as not to buckle cups.
MOTOR CONTINUES TO RUN	1. Switch improperly adjusted S-6. (Fig. 38)	1. Adjust switch contacts to open in stop position.
CONTROL KNOB FAILS TO LATCH	1. Latching gate binding O-93. (Fig. 14)	1. Clean dirt burrs or cause of binding, lubricate parts with Molycote or SAE 10 oil, replace spring O-97, Fig. 14, if necessary.
	2. Trim cover jamming pressure wheel or link (See Pg. 3) (Trim Cover)	2. Reposition covers to allow free movement of mechanism.
	3. Erase head binding on trim plate or not rising fully.	3. Reposition trim plate or file trim plate to allow head clearance.
POOR ERASE	1. Misaligned erase head.	1. See adjustment, Page 38.
	2. Head is dirty.	2. Brush away tape accumulation with stiff bristle brush.
	3. Ribbon guide mis-adjusted.	3. See ribbon guide adjustment, Pg. 42.
	4. Weak magnets.	4. Replace.
REWINDS SPONTANEOUSLY	1. Rewind trip lever misformed.	1. Reshape rewind trip lever O-54 as in Fig. 38.
	2. Tape wound loosely.	2. See adjustment of ribbon guides, Pg. 42.
HUM With Volume Control Open	1. Defective input, defective mike, etc.	1. Check connections and grounds.
	2. Mike plug grounding on panel.	2. On models BK-414 readjust trim plate A-27 or enlarge hole.
	3. Grid lead to V-1 misplaced.	3. Dress grid lead for minimum hum.
	4. High voltage transformer leads not dressed down to chassis.	4. Dress against chassis.

SYMPTOM	CAUSE	REMEDY
	5. Defective first stage tube V-1.	5. Replace.
	6. Poor ground connection on chassis.	6. Check all ground connections.
MECHANICALLY NOISY	1. Belt Whipping.	1. Adjust motor pulley O-62, Fig. 38.
	2. Loose or bent fan.	2. Straighten or tighten.
	3. Dirty clutch bearing.	3. Disassemble and clean, Page 37.
	4. Dirty capstan bearings.	4. Disassemble and clean, Page 35.
	5. Capstan belt hitting belt guide or head lead.	5. Move guide or head lead.
	6. Spaghetti on flywheel drive pins misplaced. (See Fig. 37)	6. Reposition, Page 36.
POOR FREQUENCY RESPONSE		
a. No Highs	1. Insufficient head pad pressure (Pg.42)	1. See adjustment of ribbon pressure, Page 42.
	2. Pressure pad not parallel to recording head gap.	2. Bend arm so pad is parallel and adjust pressure.
	3. Misadjustment of recording head.	3. Readjust, See Page 40.
	4. Compensating condenser C-12 failed.	4. Replace.
	5. Dirty head.	5. Clean.
b. No Lows	1. Insufficient bias. Note: Bias may be measured with a sensitive A-C voltmeter by placing a ten ohm resistor in series with ground lead from head.	1. See Page 16 Record bias circuit.
	2. C-13 or R-20 defective.	2. Replace.
	3. Low capacity coupling condensers.	3. Replace.
LOW OUTPUT	1. See above poor frequency response.	
	2. Low emission tube.	2. Replace.
	3. Defective head.	3. Replace.
	4. Defective output transformer or speaker.	4. Replace.

SYMPTOM	CAUSE	REMEDY
NO OUTPUT	1. Set not turned on.	
	2. Head plug out.	
	3. Output plug out.	
	4. Output plug shorted.	4. Replace. Add insulated washer.
	5. Speaker leads shorted.	
	6. Shorting link missing between terminals 1 and 2 on output terminal strip E-3.	6. Replace.
	7. Tube out.	
MICROPHONIC	1. Defective V-1.	1. Replace.
	2. Defective V-2.	2. Replace.
	3. Defective V-5.	3. Change V-5 to 6SN7 if 6SL7 was used.
LOOSE REWIND	1. See Tape Tension, Page 42.	
TOO SLOW		
a. Fast Forward	1. See failure to drive above.	
b. Fast Rewind	1. See failure to drive above.	
c. Record or Play	1. Capstan binding in bearings.	1. Clean, see Page 35.
	2. Line voltage too low.,	
	3. Capstan belt off groove.	3. Replace.
TOO FAST	1. Pressure assembly not engaged.	1. Correct cause of binding.
WOW AND FLUTTER	1. Pressure wheel defective, binding or rubbing on capstan bearing housing.	1. Adjust or replace.
	2. Excessive pressure of pressure pad against record/play head.	2. Adjust.
	3. Binding motor shaft bearing.	3. Clean, align, or replace.
	4. Binding capstan lower bearing.	4. Clean and align.
	5. Binding, reel-post bearing.	5. Disassemble and clean, Page 37.
	6. Damage of capstan drive belt.	6. Replace.
	7. Bent capstan.	7. Replace.

MODELS BK-442, BK-443P,
BK-437, BK-437S, BK-439,
BK-441

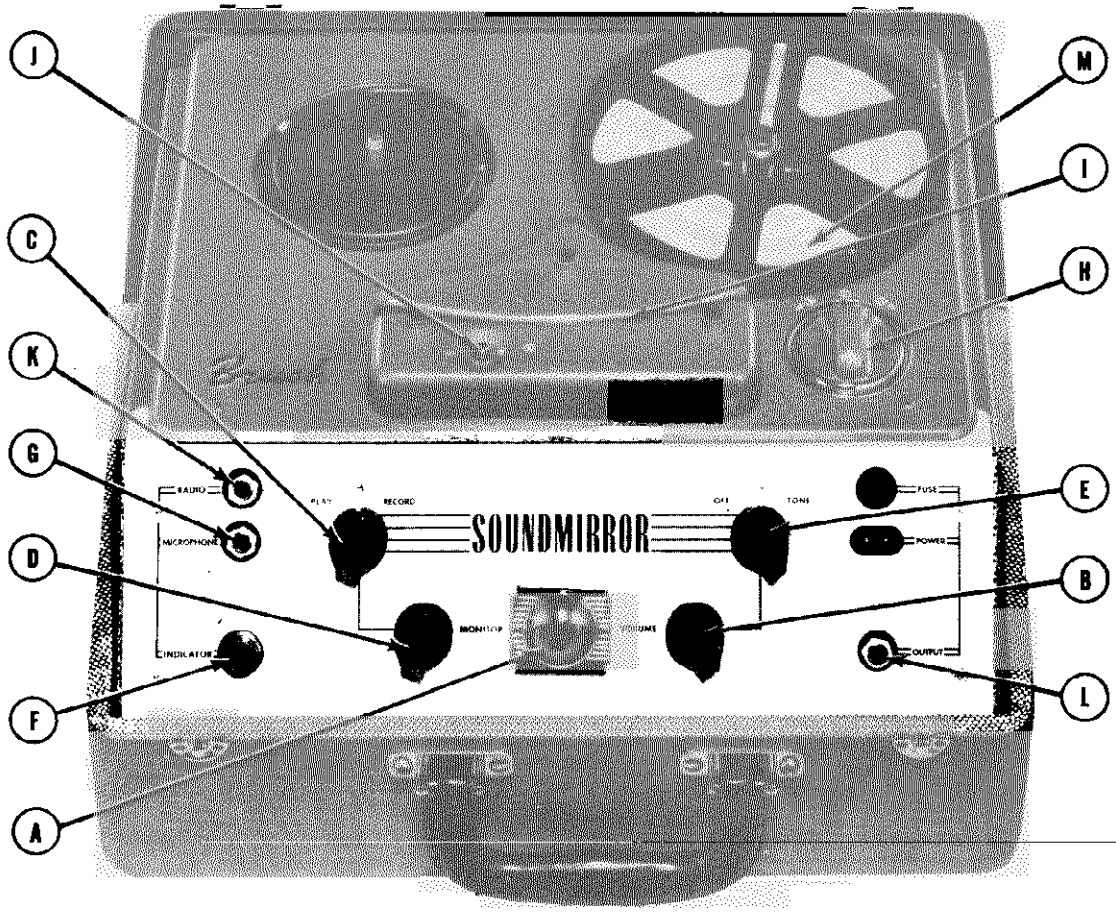
INTRODUCTION

This manual contains service information for a new series of "Soundmirrors" whose principal distinguishing characteristic is a rotary knob control in place of the lever control.

Most important in this line are the BK-442 table unit and the BK-443P portable unit which are covered in detail in the text. A number of variations of these will be encountered in the field such as the "-1" (50 cycle) units and the "S" units operating at one-half the tape speed. A number of mechanical chassis are in the field, designated by the model number BK-437 or BK-437S. Service information on these is precisely the same as on the mechanical sections of the complete machines. Small numbers of other machines of this series will be encountered in the field under model number BK-439 and BK-441. These are both table models which vary from a BK-442 only in the combination of speaker and output transformer employed. Specific service on these is otherwise the same as for the BK-442.

Certain of these models appear in an Underwriters' approved form and carry a further letter designation "U". The principal difference is the use of a number of extra shields for power wiring and these shields must be replaced when servicing such a unit.

FIGURE 1—PORTABLE SOUNDMIRROR



SOUNDMIRROR DESCRIPTION

The following letters "A" to "M" with description pertain to figures 1 and 2 for table model or portable model.

A. Recording Volume Indicator
B. Play or Record Volume Control
C. Selector Switch—Play or Record
D. Speaker Monitor Volume Control
E. Line Power Switch and Tone Control
F. Line Power Indicating Lamp
G. Microphone Input Connection
H. Tape Transport Control Knob

MODELS BK-442, BK-443P, BK-
437, BK-437S, BK-439, BK-44

I. Tape Slot—Play or Record
J. Erase Button—When recording depress this button in addition to moving the Control to Record Position
K. Radio Input Jack
L. Output Jack for External Speaker
M. Indexing Disc

Standard equipment with all models includes one 7-in reel of Magic Ribbon* magnetic recording tape, one empty metal take-up reel and Brush non-directional microphone with cord and jack connection and detachable base.

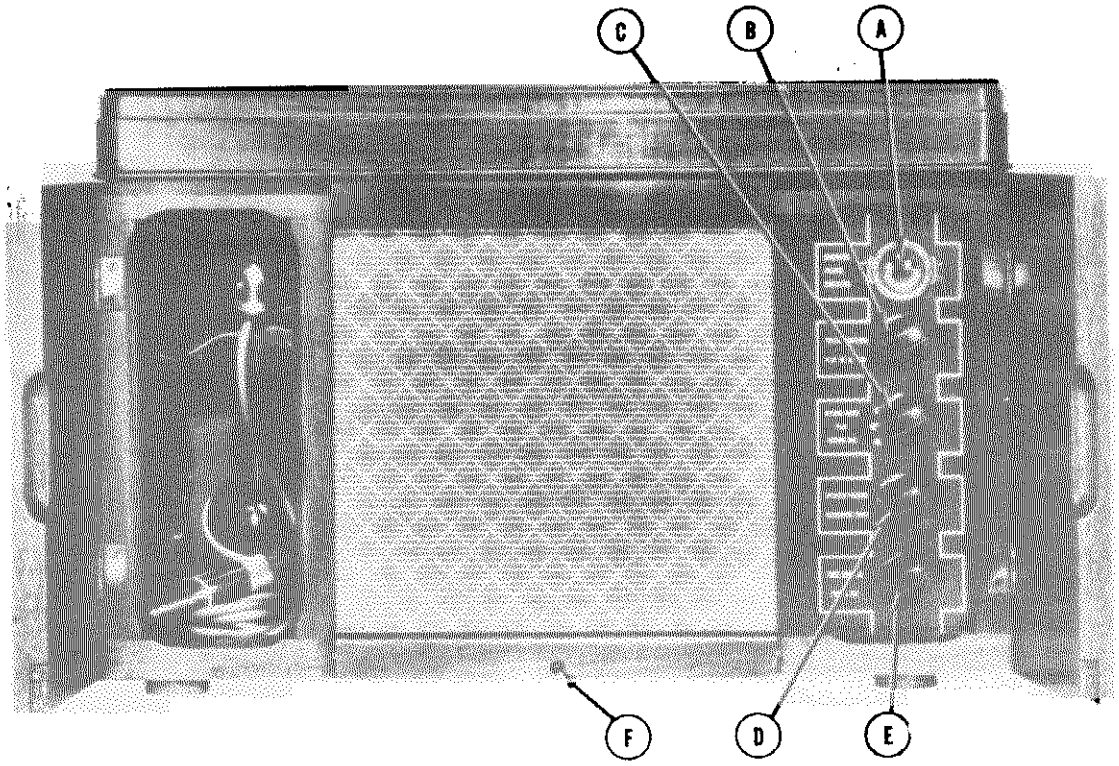


FIGURE 2—TABLE MODEL SOUNDMIRROR

MECHANICAL FUNCTIONS

The Soundmirror uses a single motor with one rubber belt to drive the capstan and another, crossed, to drive both turntable pulleys. Thus, whenever the motor is running, the pulleys revolve in opposite directions at constant speed.

Cemented to the top surface of each of the pulleys is a felt pad capable of engaging the lower surface of the associated turntables with the action of a light friction clutch. The direction of rotation of the pulleys is such that each turntable, when resting on its pulley, tends to reel in tape. A pair of cams are provided, one under each reel shaft, mounted and adjusted so that they can be used to lift the associated turntable free of its pulley. Two small felt pads which are mounted on springs on the pulley face remain in contact with the turntable when it is elevated and offer a slight amount of reverse drive torque when tape is being pulled from a reel. This action provides back tension to the tape and insures that the tape is wound tightly in fast forward and fast reverse.

The capstan is rotated by the motor by means of the smaller drive belt and provides a means for driving the tape at a fixed linear speed. This drive becomes effective when the pressure roller assembly is moved in and engages the tape against the capstan drive spindle. Under these conditions, the tape which ordinarily would have moved at fast forward speed is held to a constant playing speed by the capstan, the slippage in the felt clutch of the takeup reel turntable compensating for the difference in speeds.

The main arm performs several functions. When the control knob is depressed and rotated into play (record) position it rotates the main arm and locks into position. (1) The spring extending from the main arm applies a force against the erase pin providing a jam proof arrangement for depressing the pin either before or after the motion of the arm takes place. (2) The micro-switch actuator releases the micro-switch arm for operation. If no tape is present, the micro-switch arm passes through the slot in the tape guide, and the motor will not run. (In fast forward or fast rewind this feature is inoperative and the motor will run with or without tape). (3) The pressure wheel presses the tape against the capstan spindle, causing the tape to be driven at constant speed.

MODELS BK-442, BK-443P, BK-437, BK-437S, BK-439, BK-441

The tape is also pressed against the two heads by the erase pressure pad assembly and the roller pressure pad assembly to insure close contact between the tape and the heads in the region of the gaps.

Steps in a typical operation are as follows:

FAST FORWARD: The control knob is rotated in direction of # 3. This rotates the clutch lever which turns on the motor and raises the rewind turntable, allowing the takeup turntable to remain engaged.

FAST REWIND: The control knob is rotated in the direction of #2. This rotates the clutch lever which turns on the motor and raises the takeup turntable, allowing the rewind turntable to remain engaged.

PLAY-RECORD: The control knob is depressed in the #1 position and rotated clockwise in the direction of #3, the clutch levers engage in the same fashion as occurs in fast forward; the control arm presses the roller assembly against the tape and capstan, thus giving the tape a constant linear speed, the micro-switch arm is released for operation and the erase spring engages the erase pin.

OFF: In any case when the control knob is rotated to the off (#1) position, the clutch lever is centered, opening the motor switch and allowing both turntables to engage their clutches. This acts as a brake to halt the motion of the tape.

PORTABLE MODEL GENERAL DISASSEMBLY

To Remove Sub Assembly From Case

1. Remove the two small trim covers (A-201 and A-203) held in place by three knurled thumb screws.
2. Remove the four binding head screws, then the main trim cover (A-205).
3. Remove the three screws (H-245) at the rear of the mechanical chassis.
4. Remove the two screws (H-244) holding the handle to the case.
5. Lift assembly out of the case slightly and disconnect the power supply, plug and the speaker plug. Remove the main sub assemblies.
   (a) This exposes the power supply which is attached to the case, and the speaker assembly.
6. Disconnect the erase head plug, the record head plug, and the motor plug.
7. Remove the four 8-32 flat head screws (H-235) located on each side of the mechanism.
8. Remove the two 10-32 screws (H-237) located on the front corners of the mechanism.
9. Remove the mechanism by sliding it away from the amplifier.

To Remove the Amplifier

10. Remove the four screws (H-233) on the front etched panel.

To reassemble the unit the exact reverse is done carefully when attaching the mechanism so that the projecting edge of the front etched panel goes between the erase spring actuator and the main chassis of the mechanism.

NOTE: Symbols for the mechanical chassis are shown on the exploded view page 23.

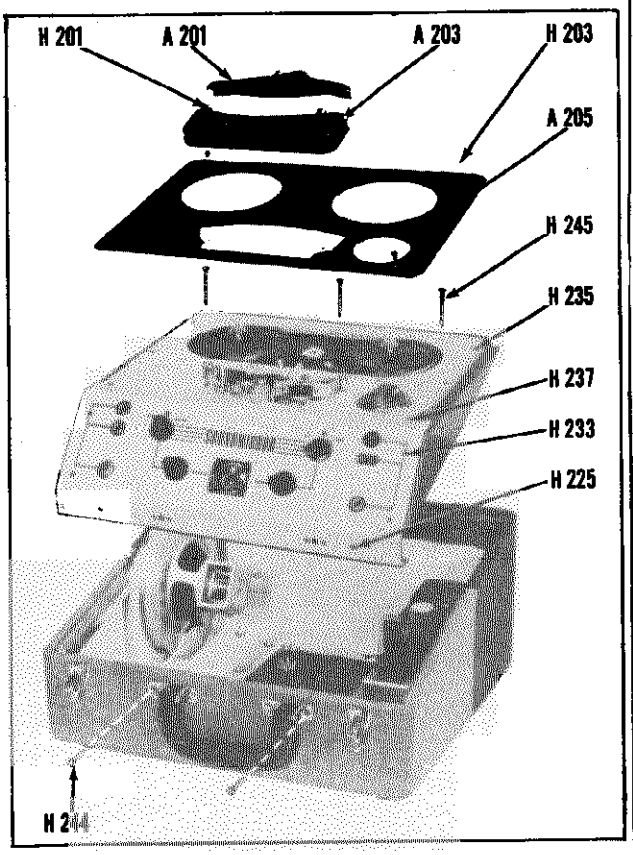


FIGURE 3—PORTABLE DISASSEMBLY

TABLE MODEL GENERAL DISASSEMBLY

To Remove Amplifier From Cabinet

1. Disconnect the Soundmirror from the power source.
2. Remove the cardboard back from the cabinet.
3. Disconnect the record head plug, speaker plug, erase head plug, motor plug, and remove the microphone and radio jacks from the output jack board. (Removing clamp which secures them).
4. Remove the pilot lamp holder from its mounting.
5. Pull off the control knobs located on the front panel.
6. Remove the screws which hold the amplifier to the bottom of the cabinet.
7. Slide the amplifier out of the rear of the cabinet.

To Remove the Mechanical Chassis From the Cabinet

8. Follow steps 1 through 3, (with the exception of jacks).
9. Remove the reels.

MODELS BK-442, BK-443P, BK-437, BK-437S, BK-439, BK-4

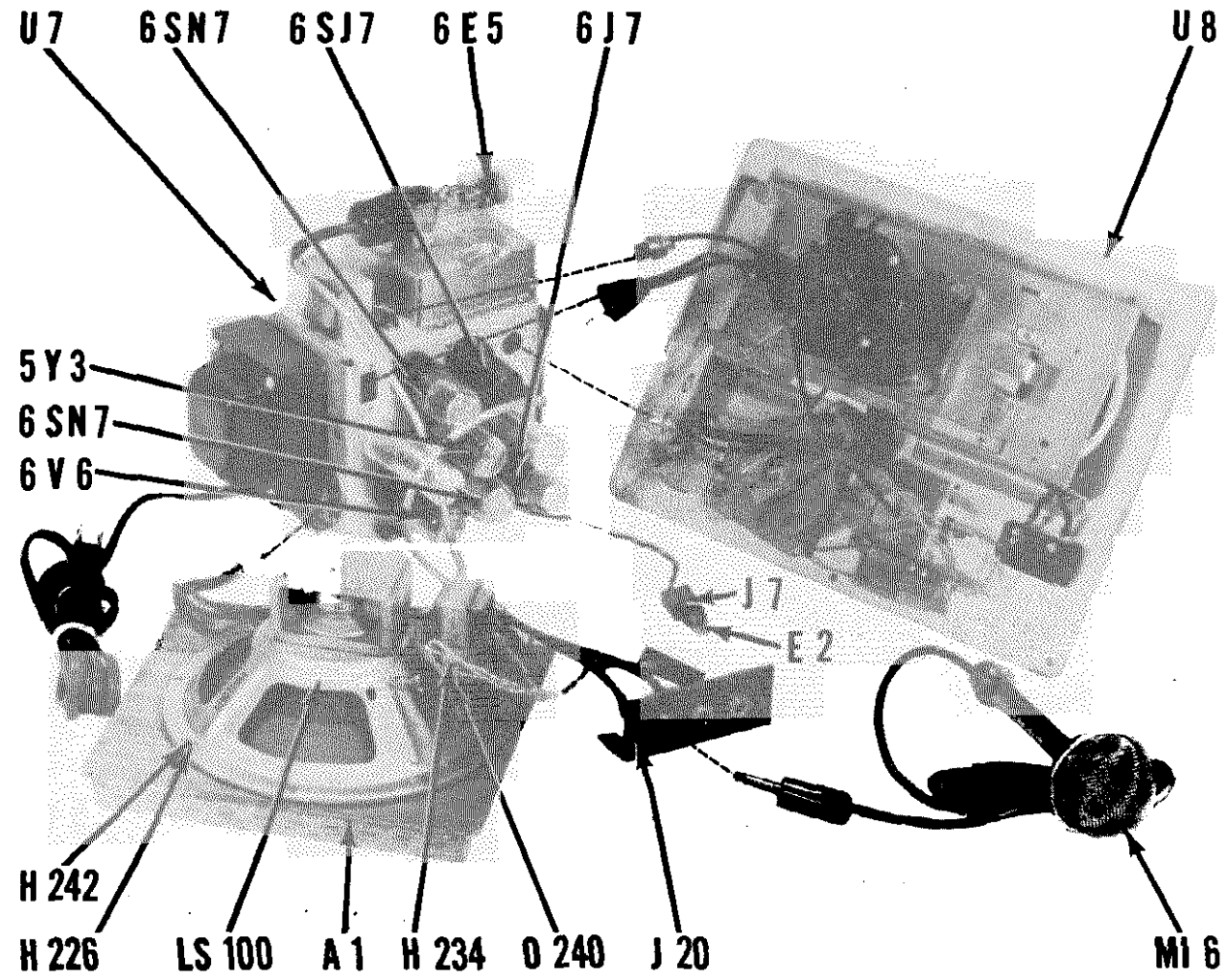


FIGURE 4—TABLE MODEL DISASSEMBLED

10. Remove the two small trim covers (A-200 and A-202) held in place by three knurled thumb screws.
11. Remove the four binding head screws, then the main trim cover (A-204).
12. Remove the four screws which mount the mechanical chassis to the cabinet and lift the chassis from the cabinet.

To Remove the Speaker

13. Remove the mechanical chassis and amplifier, steps 1 through 12 (above).
14. Remove the screw which mounts the speaker cable clamp to the bottom of the cabinet.
15. Remove the speaker output jack from the jack output board.
16. Remove the four screws which mount the speaker to the grille board and lift the speaker out of the cabinet.

NOTE: Symbols for the mechanical chassis are shown in the exploded view, Page 23.

SERVICE PROCEDURE

The operation and function of the portable and ta model Soundmirrors are basically the same, except the disassembly and reassembly as previously outlin The following information is incorporated for both.

TUBE REPLACEMENT

Tubes are made accessible by removing the ba cover from the table model cabinet. For the portal model follow steps 1 to 5 on page 4.

CAUTION: To avoid burns and cuts caused by heat tubes and moving fan blades, turn the power off, a allow the fan to stop and the tubes to cool befc attempting tube replacement.

PILOT LIGHT REPLACEMENT

To replace the table model pilot light, the ba cover of the cabinet must be removed. To replace pc

MODELS BK-442, BK-443P, BK-437, BK-437S, BK-439, BK-441

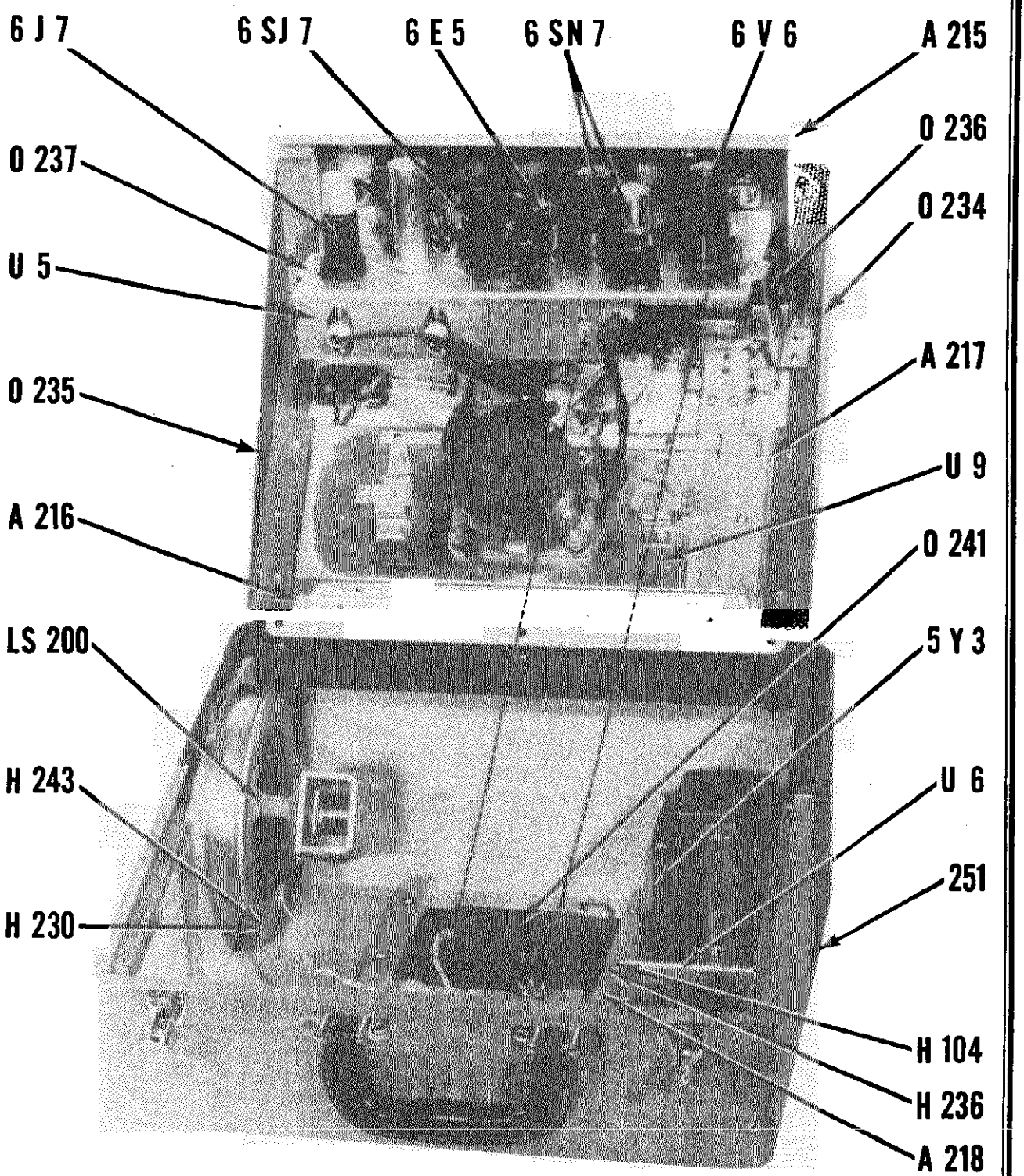


FIGURE 5—PORTABLE SOUNDRMIRROR DISASSEMBLED

table model pilot light unscrew lens from etched panel. (Both are bayonet base bulbs).

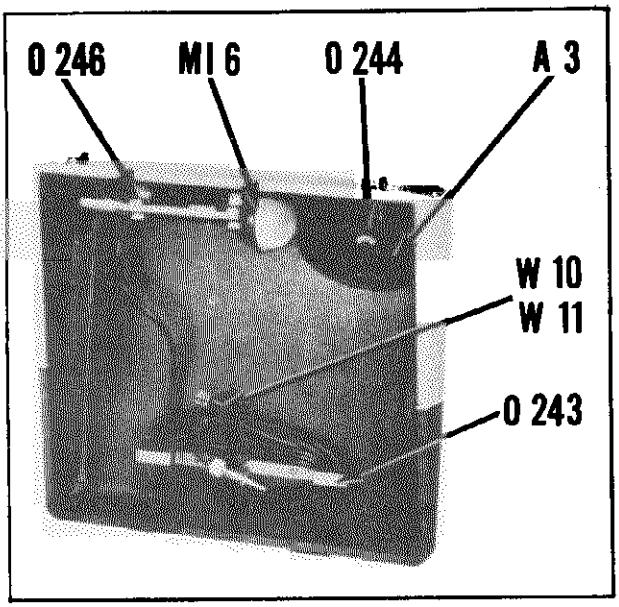


FIGURE 6—PORTABLE SOUNDMIRROR COVER

REPLACEMENT OF PRESSURE WHEEL ASSEMBLY

The pressure wheel assembly consists of a bracket, spring, shaft, wheel, and pressure pad which is attached to the bracket. To replace the complete assembly:

1. Remove the small trim cover and the "Tru-Arc" retaining ring.
2. Lift the assembly off the post, being careful not to damage the spring.
3. Slide the spring out the end of the bracket. The wheel and shaft will come out easily.
4. Replace parts in reverse sequence of steps 1, 2, & 3.

REPLACEMENT OF PRESSURE PAD

The friction between the pressure pad and the ribbon will in time wear the felt pad. When it becomes necessary to replace this pad, any quick drying cement may be used. Care should be taken to prevent any cement from getting on the felt which contacts the ribbon. After replacement is made, the pressure should be adjusted as outlined on adjustment of ribbon tension.

ADJUSTMENT OF ROLLER PRESSURE

The pressure of the rubber wheel against the ribbon and the capstan spindle is adjusted at the factory. It is not recommended that any adjustment be attempted in the service field, but that the defective part be replaced.

If the ribbon tends to crawl up or down on the capstan spindle, it indicates that the spring may not be seating properly in the grooves of the wheel shaft. If this is not the cause, then the spring may have been bent in a manner causing more pressure from one arm than the other. Since this is a critical adjustment it is recommended the spring be replaced rather than adjusted.

ADJUSTMENT OF RIBBON TENSION

This tension is measured by attaching a spring balance to the end of a piece of ribbon drawn only through the erase head, then through the record head. The tension required to move the tape through the erase head should be from 1 to 1½ oz.

The pressure of the ribbon against the erase head can be adjusted by bending the spring located on the erase arm assembly.

The pressure of the ribbon against the record head can be adjusted by turning the screw (H-112) mounted on the pressure wheel bracket assembly. (Be sure to first loosen the hex nut (H-111) before making adjustment).

ADJUSTMENT OF RIBBON GUIDES

The ribbon guides (0-67 and 0-209) are located beneath the head trim cover and are mounted on the panel with the guide posts (0-65) by mounting screws (H-209). The guides must be mounted so that they will be parallel to the path to the tape.

RECORD–PLAY HEAD REPLACEMENT

1. Remove the mechanical chassis from the unit.
2. Remove the record-play head mounting screws.
3. Unsolder the three wires from erase switch (S-20), cut the lashing holding the head cable to the capstan bracket (A-25).
4. Remove the capstan drive assembly mounting screws (H-221, H-222 and H-224) and carefully lower the assembly away from the panel enough to slip the record-play head (E-21) out of the hole.
5. Assemble the capstan drive assembly and the record-play head by placing the head and the mounting clamp (H-131) between the flywheel and the bracket.
6. Hold the assembly in the left hand and position it onto the panel while tightening the flat head screw (H-224) to hold the drive assembly until the other mounting screws are placed in position in the following sequence.
   (a) The screw (H-222) between the head and capstan spindle.

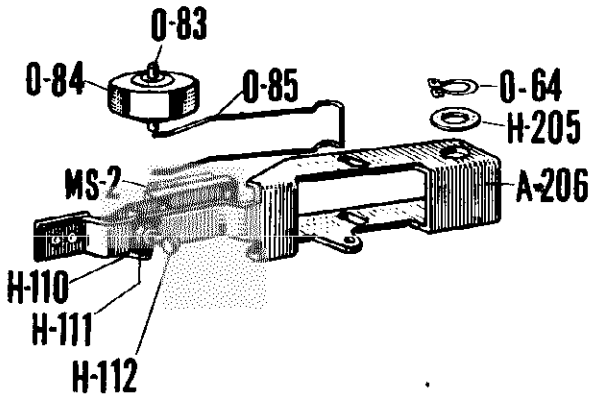


FIGURE 7—PRESSURE WHEEL ASSEMBLY

MODELS BK-442, BK-443P, BK-437, BK-437S, BK-439, BK-441

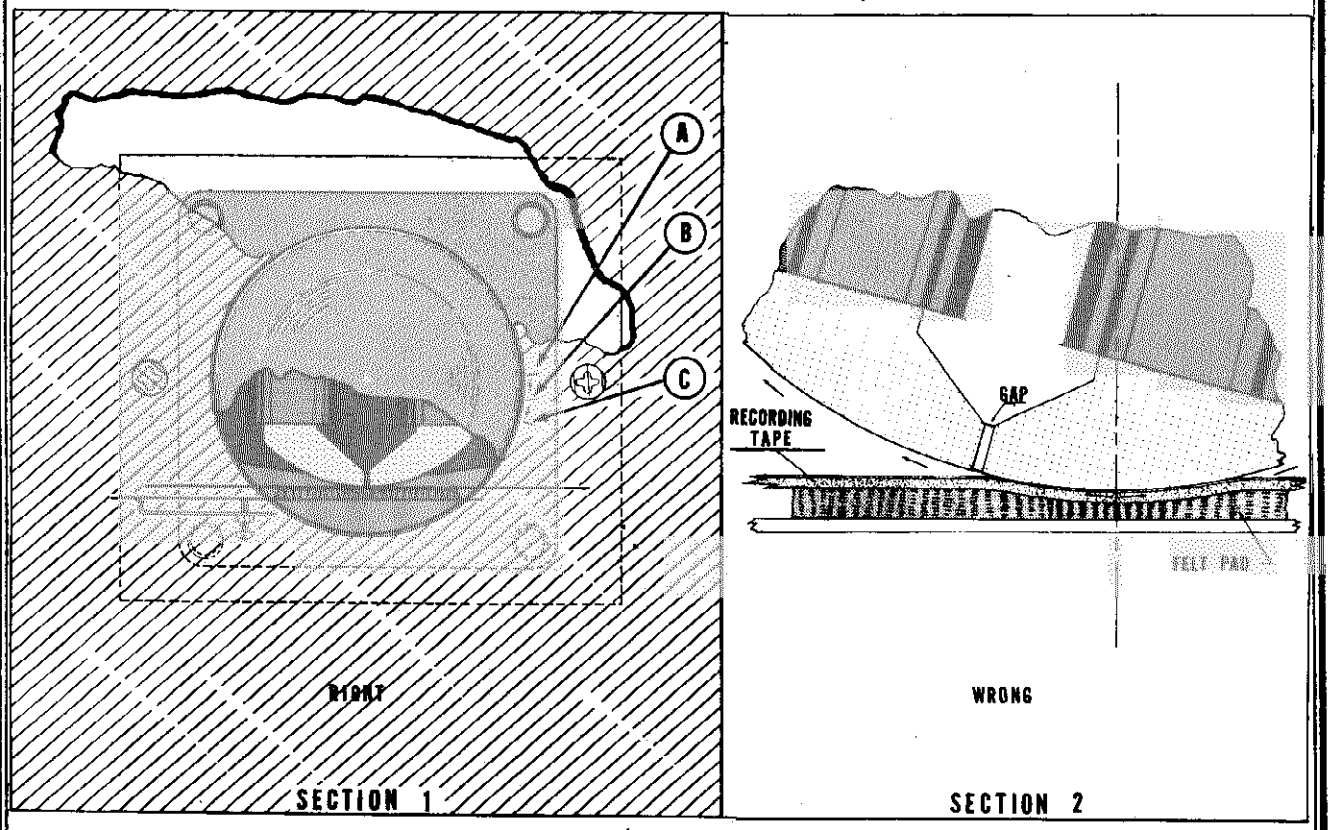


FIGURE 8—RECORD-PLAY HEAD ADJUSTMENT

(b) The screw nearest the erase head (E-20).
(c) The screw (H-221) between the capstan spindle and the right-hand ribbon guide (O-65).

7. Adjust the head for hum cancellation as outlined in the following paragraph.
8. Tighten all screws completely.

Adjustment of Record Play Head for Minimum Hum and /or Maximum High Frequency Response

Excessive hum during any pause in the recording while the unit is in the play-back position may be caused by magnetic lines of force being radiated from sources such as the motor, power transformer, filter choke, etc., inductively creating an unbalanced voltage in the play-back head.

This condition may be corrected by reestablishing the balance by properly directing the magnetic lines of force through the two windings of the head. This is accomplished by slightly rotating the head either clockwise or counter-clockwise as the case may require.

To find the correct position:

1. Turn the power on and allow the tubes to warm.
2. Set the Amplifier Controls for play-back operation at full volume.
3. Remove the small trim covers.
4. Loosen the mounting screws (H-222) on either side of the record-play head (E-21) enough to allow the head to be rotated slightly.
5. Place the ribbon around the back side of the record-play head and the capstan drive spindle (0-78).
6. Turn the control knob to the "Play" position, control knob depressed and rotated clockwise in the direction of #3.
7. Rotate the record-play head in either direction until a point of minimum hum is found. NOTE: If the head requires excessive rotation to reduce the hum sufficiently to meet the dynamic range specification, the head should be replaced.
8. Tighten the screws to hold the head in this position.
9. Turn the control knob to the "off" position #1 to stop the reels. The cut-a-way of the head (Fig. 8) shows how the polepieces should contact the ribbon. If the head is rotated too far in either direction the gap will not contact the ribbon which will result in a lack of high frequencies or no signal at all being recorded or reproduced.

To check this condition:

10. Place a mark on the panel at point "B" of Figure 8 to identify the "minium hum" position of step 7. The mark should be made in line with the end edge of the opening in the record head.
11. Place a recorded portion of the ribbon through the record-play head (E-21) and the capstan drive spindle (0-78).
12. Turn the control knob again to the "Play" position.

13. Loosen the record-play head mounting screws (H-222) enough to rotate the head toward "A" or "C" while listening to the signal being reproduced by the ribbon.

When the position is found which allows the higher frequencies to be reproduced, place a second mark on the panel to identify this position. If this position does not coincide with the position of least hum, then a choice or a compromise position must be made.

14. Alternately tighten the screws to lock the head in the position chosen.

ERASE HEAD REPLACEMENT

1. Remove mechanical chassis from the unit.
2. Remove the mounting assembly by removing the three screws (H-225) which secure it to the chassis.
   (a) Cut lashing which holds the head cable to the capstan bracket.
3. Remove the mounting plate.

REPLACEMENT OF BELTS

Belts should be replaced whenever they show noticeable wear .When replacing either belt, check height of motor pulley to be sure that capstan drive belt is parallel to the panel. Under normal operation, rubber dust from the clutch belt will accumulate. This dust should be removed thoroughly from the mechanism.

REPLACEMENT OF TURNTABLE ASSEMBLY

1. Remove the "Tru-Arc" retaining ring, using No. 22 "Tru-Arc" pliers.
2. Lift the turntable assembly from the reel post. The assembly is divided into upper and lower cups.
3. Reassemble parts in order shown on page 23. Be sure the cups fit together with insides facing each other and indexed according to the notches and slots in their edges.

NOTE: If the reel guide pin is broken off, the reel post (O-203) must be replaced. If the pin is more than slightly bent it will be badly weakened by straightening. The post should be replaced.

4. Install the assembly on the reel post and replace the "Tru-Arc" retaining ring making sure it fits into the groove on the reel post, and that its sharper edge is up.

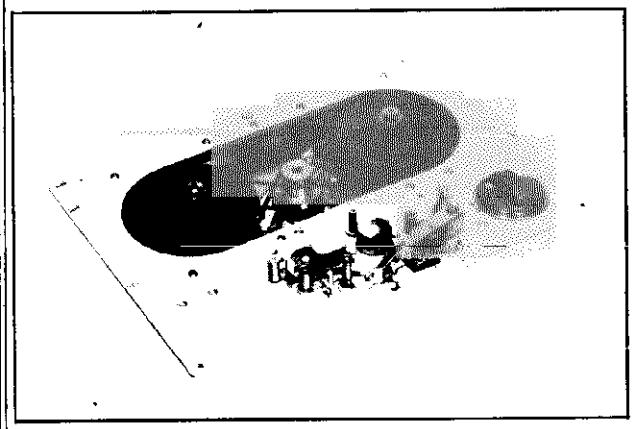


FIGURE 9—MECHANICAL CHASSIS, TOP VIEW

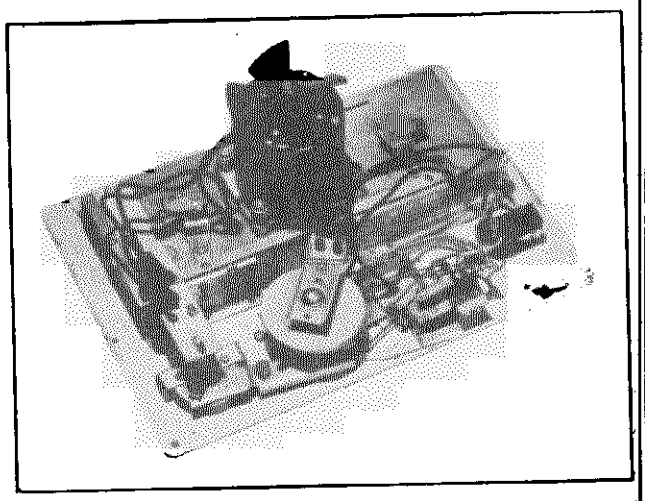


FIGURE 10—MECHANICAL CHASSIS, BOTTOM VIEW

REPLACEMENT OF CLUTCH ASSEMBLY

1. Remove the mechanical chassis from the unit.
2. Remove the turntable assembly.
3. Remove the clutch belt.
4. Remove the two screws (H-215) which mount the clutch lifter bracket assembly (A-21 and A-211). Slide the assembly out at one side being careful not to distort the clutch lifter spring attached to the bracket.
5. While holding the clutch raising lever in its extreme position, carefully remove the small "Tru-Arc" retaining ring (O-69) and washer (H-210) located at the lower end of the reel post. This requires the use of No. 0018 "Tru-Arc" pliers.
6. Lift out the reel post assembly being careful not to lose the clutch lifter pin (H-115). This allows the clutch and pulley to be lifted from the clutch bearing assembly.
7. The felt clutch is cemented to the upper face of the pulley and ground flat after assembling. Under normal conditions it should not require replacement, however, if damaged it is possible that pulley assembly (O-202) should be replaced.
8. If necessary, remove the clutch-pulley bearing assembly (O-204) by removing the hex nut (H-117) on lower panel of chassis. Replace any damaged or worn out parts.
9. Reassemble the clutch pulley, the reel post, and the lifter pin and install onto the clutch bearing.
10. Install the washer and "Tru-Arc" retaining ring on the lower end of the reel post.

ADJUSTMENT OF CLUTCHES

The clutches are adjusted and set at the factory and under normal conditions should not require readjustment.

If it becomes necessary to replace any part of the

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clutch assembly, readjustment becomes necessary and proper procedure is as follows:

The power should be turned off, a loaded reel placed on the supply turntable, and the control knob rotated from the neutral position #1, towards fast forward postion #3. As this is done the supply turntable should rise very slightly, not over 1/32 of an inch. If the turntable does not rise this amount, the locking nut (H-19) on the clutch adjusting screw (H-20) should be loosened with pliers or wrench, and the Allen screw turned in with a #8 Allen Wrench until this amount of lift is obtained.

The adjustment should then be relocked, and with the control in the fast forward position, the turntable should be lifted by taking hold of the reel post. Make certain that it still has vertical clearance when it is fully elevated and in position.

The loaded reel should then be moved to the take-up turntable, the control knob rotated towards the fast rewind position #2 and the reel observed for lift. Adjustment should be made as previously outlined.

When both reels are properly adjusted, and do not bind when they are engaged, the recorder should operate satisfactorily. If the recorder does not operate satisfactorily it is possible that:

(a) Clutch pads are dirty and require cleaning.
(b) Tape guides (O-67) and (O-209) have been bent and are causing too much drag on the tape.

REPLACEMENT OF MOTOR

1. Remove the mechanical chassis from the unit.
2. Remove the rubber belts.
3. Remove the toggle switch bracket (A-212) from the chassis.
   (a) Disconnect Motor Wire.
4. Disconnect motor wire from plug.
5. Remove the two binding head screws which mount the motor to the chassis.
6. Loosen the 8-32 Allen head set screw and remove the drive pulley from the motor shaft.
7. Remove the 4 hex nuts which mount the motor to the plate assembly (A-19).
8. To replace the rubber shock mounts (A-20): (a) remove the 4 hex nuts holding the mounts in place. (b) remove the motor mounting plate (A-17) from the plate assembly. (c) remove the rubber mounts from the plate and intstall new ones. (d) install onto plate assembly and replace screws.

NOTE: It is best to replace all four rubber mounts to assure proper balance of motor. Be sure to replace ground wire (W-3) to prevent electrical hum from motor.

9. Install new motor and reassemble onto chassis in reverse order.
10. After installation of rubber belt adjust the height of the drive pulley so that the capstan belt is parallel to the panel.
11. Adjust the position of the motor on the chassis to a point which causes least vibration of the drive belt, and which gives the greater tension to the clutch belt.

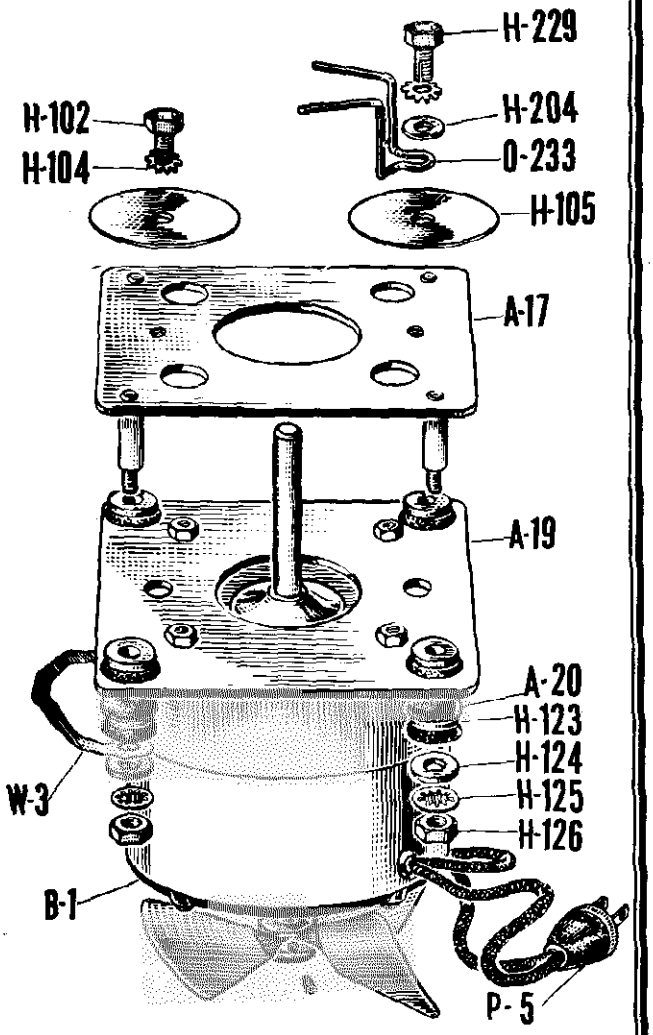

FIGURE 11—MOTOR ASSEMBLY

ADJUSTMENT OF THE MOTOR SWITCH BRACKET

The motor switch bracket (A-214) is used to accomplish two functions. It centers the control knob and clutch lever, and it regulates the motion of the clutch lever.

As little play as possible must be had between the switch and the bracket in the fast forward, fast reverse and off positions.

Rotate the control knob clockwise to the fast forward position #3 and slowly move it to the off (centered) position #1. If the bracket moves more than 1/64" to contact the face of the bat, it must be moved closer to the motor switch to take up this play. The same holds true for fast reverse, knob rotated counterclockwise in the direction of #2.

REPLACEMENT OF CAPSTAN ASSEMBLY

(1) Remove the mechanical chassis from the unit.

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(2) Remove the capstan drive belt.

(3) Remove the two Allen head screws (H-133) on base.

(4) Carefully pull out the capstan assembly and base bracket (A-26) take care that the ball bearing (O-231) on the base of the capstan assembly is not lost.

(5) Replace parts and/or assemblies in reverse as outlines above.

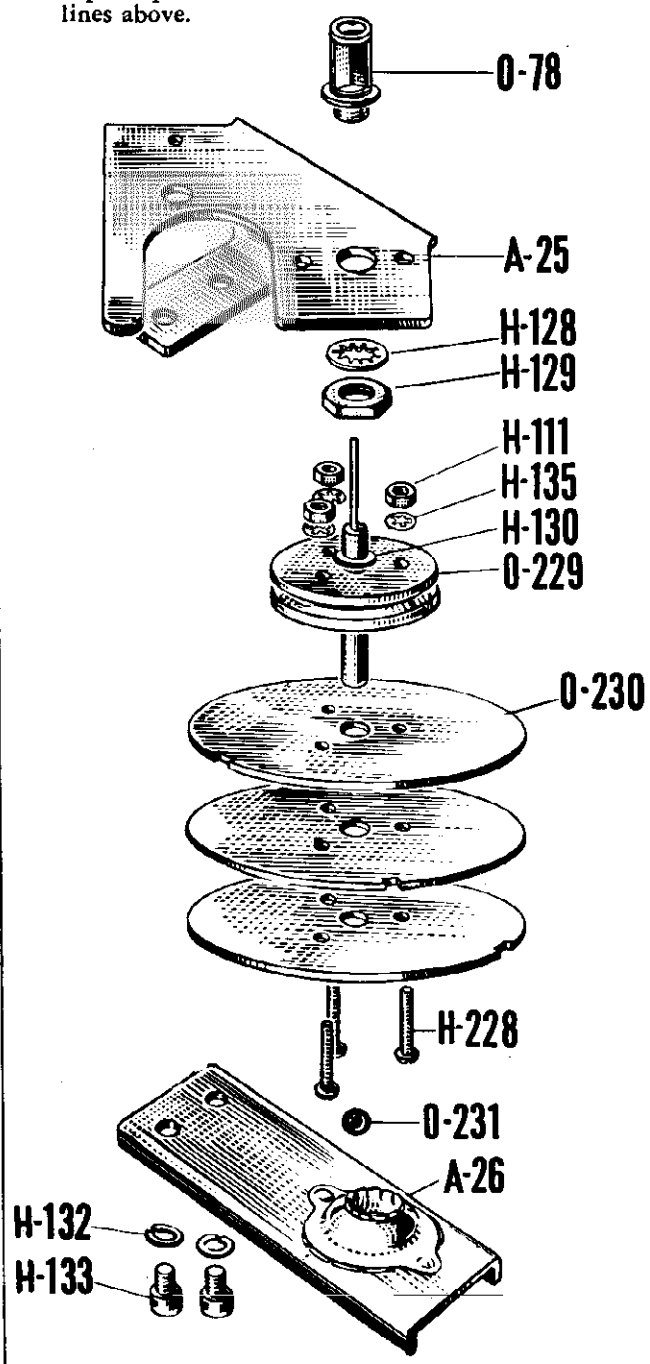

FIGURE 12—CAPSTAN ASSEMBLY

(a) When tightening the two Allen head screws, make certain that they are tightened alternately to avoid moving the bottom bracket away from its true center, thus applying a force perpendicular to the shaft of the capstan.

REPLACEMENT OF TAPE TRANSPORT CONTROL SPRINGS

Push a screw driver up through the slot of the cup assembly (O-216). Tap lightly and knob can be removed. The control knob spring (O-213) will then be released (O-216). Remove the "Tru-Arc" retaining ring and washer, and the control shaft spring (O-214). When assembling, make sure that the turned edge of the control shaft spring falls into its square limit stop. Upon completion of assembly the knob should have as little play as possible in the vertical elevated position.

LUBRICATION

MOTOR—The Motor should be oiled once every three months with Number 20 SAE Oil. Caution: Do Not Over-Oil.

MECHANISM-All moving or sliding parts should be cleaned thoroughly of any dirt, common dust, or rubber dust that may have accumulated. After cleaning, apply a thin coat of light oil to all sliding surfaces. Wipe off excessive oil. Do not allow oil to get onto the belts or the driving surfaces of the pulleys. The cam surface of the control arm and the cam follower should also be greased periodically.

OILITE BEARINGS—The following are of this type and need very little lubrication.

1. Clutch Pulley Bearing
2. Capstan Spindle Bearing
3. Pressure Wheel Bearing.

SOUNDMIRROR VARIATIONS (BK-442, BK-443-P) 50 CYCLE

Aside from the standard line of "Soundmirrors", Brush also furnishes units capable of operating on 50 cycles, (110, 150, 220, 250) volts.

These units will be designated as BK-442-1, BK-443-P-1 and will be identical in construction to the standard models of the BK-442 and BK-443 with the following exception:

1. Motor, 50 cycle, #207259.
2. Pulley, 50 cycle, #107248.
3. Transformer, 50 cycle with taps for 110, 150, 220, 250 volts, #208369.

To mount the above transformer:

(a) Bracket #107621-4.

(b) Brackets #106665-1 (two required).

Slow Speed (1 hour)

These units will be designated as BK-442-S and BK-443-PS and are identical in construction to the standard BK-442 and BK-443-P except:

1. Slow Speed Motor pulley, #108357.
2. Slow Speed Capstan, #209800-501.

The amplifier is compensated by:

(a) Shorting C-9 connections.

(b) C-17 and C-19 will be .004 mmf condenser #3-106094-5.

(c) C-10 should be 1 mmf condenser #2-106094-1.

Combination 50 Cycle Slow Speed

These units will be designated as BK-442-S-1, BK-443-PS-1 and are combination slow speed 50 cycle units and are identical to the BK-442 and BK-443-P with the following exceptions:

MODELS BK-442, BK-443P, BK-437, BK-437S, BK-439, BK-441

1. Motor, 50 cycle #207259.
2. Motor Pulley, slow speed 50 cycle #109786.
3. Capstan, slow speed #209800-501.

Amplifier compensation:

(a) Shorting C-9 connections.

(b) C-17 and C-19 will be .004 mmf condenser #3-106094-5.

(c) C-10 should be 1 mmf condenser #2-106094-1.

CONNECTION OF THE SOUNDMIRROR TO A RADIO

The Brush Soundmirror may be electrically connected to any radio receiver. This is to be preferred to placing a microphone at the loudspeaker because of speaker distortions and room noises.

A simple direct connection can be made from the voice coil terminals of the radio input of the Soundmirror. Use the radio input jack of the Soundmirror. No shielding is needed.

No method is ideal for the so-called AC/DC receivers but the above method may be used.

These receivers are not isolated from the power lines and can be potential hazards if not carefully treated. The loudspeaker voice coil must be isolated completely from the remainder of the circuit. It may be necessary to use an isolation transformer.

If "professional" type recordings are desired, a radio technician should make the following recommended connections to the radio receiver. See Fig. 13. In these circuits recording volume control setting is independent of radio speaker volume. These circuits are not recommended for AC/DC type receivers Where Fig. 14 is used, it is possible in most cases to play back through the radio amplifier. Remove the plug from the microphone input jack and place it in the output jack of the Soundmirror, and operate the Soundmirror in the play position.

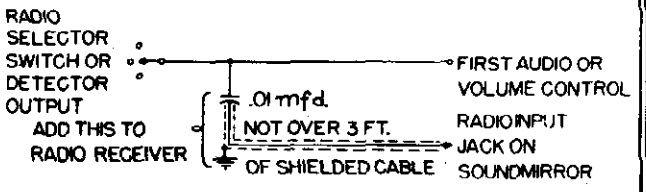

FIGURE 13—CONNECTION OF THE SOUNDMIRROR TO A RADIO

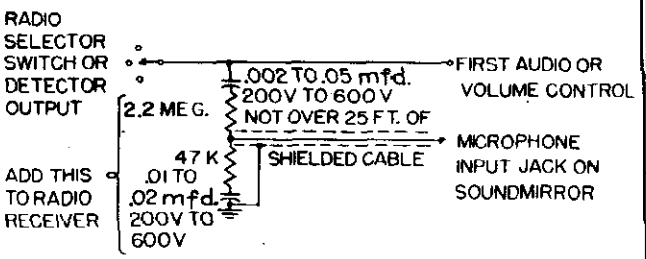

FIGURE 14—CONNECTION OF THE SOUNDMIRROR TO A RADIO

LIST OF MATERIAL

Symbol	Part Number	Description
A-1	206790-501	BOARD, speaker mounting: includes grille cloth and screen.
A-3	104215-501	BASE, microphone.
A-13	106827-2	BEADING, rubber.
A-17	106163-501	PLATE, motor shock mount.
A-19	106122	PLATE, motor mounting.
A-20	104213-4	MOUNT, vibration: rubber.
A-21	106407-501	BRACKET, clutch lifter: take up side.
A-25	206139	BRACKET, capstan drive.
A-26	106394-501	BRACKET, capstan; bottom bearing assembly.
A-200	108613-PL1	COVER assembly, head: Dark.
A-201	110326-PL1	COVER assembly, head: Light.
A-202	310255-501	COVER assembly, pressure wheel: Dark.
A-203	310311-501	COVER assembly, pressure wheel: Light.
A-204	310254-501	COVER assembly, panel: Dark.
A-205	310208-501	COVER assembly, panel: Light.
A-206	210094	BRACKET, pressure wheel; record head.
A-207	110147-501	KNOB, control: assembly, Dark.
A-208	110312-501	KNOB, control: assembly; Light.
A-209	110036	PLATE, erase head mounting.
A-210	110029	BRACKET, erase switch.
A-211	210180-501	BRACKET, clutch lifter: supply side.
A-212	110014	PLATE, switch mounting.
A-213	107998	PLATE, switch.
A-214	110032	BRACKET, switch actuator.
A-215	110327-PL1	PANEL, etched: assembly.
A-216	210133	SPACER, left side.
A-217	210134	SPACER, right side.
A-218	110162	BLOCK, wood: ventilator hold down.
A-219	10-108082-1	HANDLES, for Table Model.
A-220	206699	PANEL, control: embossed.
B-1	206322	MOTOR, drive: A.C. 115 V; 60 cycles; four pole; shaded pole induction type; includes cooling fan and set screw.

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Symbol	Part Number	Description
B-2	207259	MOTOR, drive: A.C. 115 V; 50 cycles; four pole; shaded pole induction type; includes cooling fan and set screw.
B-11	206432-501	MOTOR assembly, 60 cycle; includes 60 cycle motor; B-1; and motor mounting assembly; motor mounting assembly is the same for 50 or 60 cycle motor.
B-12	107524-PL1	MOTOR assembly, 50 cycle; includes 50 cycle motor; B-2; and motor mounting assembly; motor mounting assembly is the same for 50 or 60 cycle motor.
E-6	104099-2	BOARD, terminal.
E-20	110098-501	ERASE HEAD, assembly; includes cable assembly and connecting plug.
E-21	310226-501	RECORD REPRODUCE HEAD Assembly: Includes cable assembly and connecting plug.
E-22	11528-35	LUG, soldering.
H-1	5-3219	GROMMET, rubber.
H-9		SCREW, self tapping: #10 x ¾" long; type "Z"; round head.
H-11	100511	CLAMP, cable.
H-17	106723	ESCUTCHEON; for 6E5 Volume indicator.
H-18	107185	NUT, reel clamp; Antique Bronze.
H-19		NUT, hex: #8-32 small pattern.
H-20		SCREW, set: #8-32 x ⅝" long; allen head; cup point.
H-101		SCREW, knurled thumb: #6-32 x ¼" long; Antique Bronze.
H-102		SCREW, machine: #10-24 x ⅜" long; Sems hex head.
H-103		SCREW, set: #8-32 x ¼" allen head; cup point.
H-104		WASHER, external lock: #10.
H-105	106120-1	WASHER, motor mounting.
H-107		NUT, hex: ⅜-32.
H-109		WASHER, internal lock; #6.
H-110	106454-1	NUT, speed: Tinnerman C-991-440; #4-40.
H-111		NUT, hex: #4-40.
H-112		SCREW, machine: #4-40 x ½" long; round head.
H-115	106117	PIN, clutch lifter.
H-116		WASHER, internal lock: ½".
H-117	106157	NUT, hex: ½-20 N. C. 2 thread.
H-123	106179	SPACER, vibration mounting.
H-124	106671	WASHER, plain: .172" I.D. x ½" O.D. x .049" thick.
H-125		WASHER, internal lock: #8.
H-126		NUT, hex: #8-32.
H-128		WASHER, internal lock: ⅜".
H-130	106173	SPACER, capstan drive: fibre, used when necessary.
H-132		WASHER, spring lock: #10.
H-133		SCREW, cap: # 10-32 x ⅜" long; socket head.
H-135		WASHER, internal lock: #4.
H-152		SCREW, wood: #6 x ½" long; flat head.
H-160		NUT, hex: #6-32.
H-200	107185-1	NUT, reel clamp: Chrome.
H-201		SCREW, knurled thumb: #6-32 x ¼" long: Chrome.
H-202		SCREW, machine: #4-40 x 3/16" long; slot B.H.; Antique Bronze.
H-203		SCREW, machine: #4-40 x 3/16" long; slot B.H.; Chrome.
H-204		WASHER, plain: #10.
H-205	108566	WASHER, shim.
H-206	1-104914	CLAMP, cable.
H-207		SCREW, #8 x½" long: P. K.; type "Z."
H-208		SCREW, machine: #6-32 x ⅜" long; round head.
H-209		SCREW, machine: #8-32 x ⅜" long; Sems hex head; elw.
H-210	108605	WASHER, shim.
H-211	110089	WASHER, plain: control shaft.
H-212		SCREW, machine: #4-40 x 5/16" long; filister head.
H-213		SCREW, machine: #4-40 x ⅜" long; flat head.
H-214		WASHER, plain: #4.
H-215		SCREW, thread cutting: #6-32 x ⅜" long; Sems hex head; elw.
H-216		SCREW, machine: #4-40 x 1" long; Philips flat head.
H-217		SCREW, machine: #8-32 x 5/16" long; Philips round head.
H-218		WASHER, internal lock: 15/32".
H-219		SCREW, #6 x ¼"; Thread cut; Type "1".
H-220	L-83	LUG, soldering.

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Symbol	Part Number	Description
H-221		SCREW, machine: #6-32 x ¼" long; Sems hex head.
H-222		SCREW, machine: #6-32 x ⅜" long; Sems hex head.
H-223		SCREW, machine: #6-32 x ¼" long; filister head.
H-224		SCREW, machine: #6-32 x ¼" Philips flat head.
H-225		SCREW, machine: #6-32 x ⅜" Philips flat head.
H-226		WASHER, plain; #6.
H-227		SCREW, machine: #6-32 x ¼" long; Philips binding head.
H-228		SCREW, machine: #4-40 x ¾" Philips head.
H-229		SCREW, machine: #10-24 x ½" long; Sems hex head; type "1" thread cut ELW.
H-230		WASHER, external lock: #6.
H-231		WASHER, external lock: #8.
H-232		SCREW, Machine: #4-40 x ½" long; Philips round head; Antique Bronze.
H-233		SCREW, machine: #6-32 x ½" long; Philips flat head.
H-234		SCREW, machine: #6-32 x 1¾" long; Round head.
H-235		SCREW, machine: #8-32 x ⅜" long; Philips flat head.
H-236		SCREW, machine: #10-32 x ⅜" long; Philips round head.
H-237		SCREW, machine: #10-32 x ⅝" long; Philips flat head.
H-238		SCREW, wood: #4 x ⅜" long; Philips round head.
H-239		SCREW, wood: #6 x ¼" long round head.
H-240		SCREW, wood: #6 x ⅜" long; Philips round head.
H-241		SCREW, wood: #6 x 7/16" long; Philips round head.
H-242		SCREW, wood: #6 x ½" long; Philips round head.
H-243		SCREW, wood: #6 x 1⅜" long; round head.
H-244	110197	SCREW, machine: to fasten handle to case and recorder.
H-245	110196	SCREW, machine: to fasten base mounting plate.
J-20	210182-501	JACK assembly.
J-21	21421-2	JACK, midget.
LS-1	305975	SPEAKER; Cinaudagraph: 3.2 ohms voice coil; Table Model.
LS-100	310792-501	SPEAKER assembly; includes speaker, transformer and cable assembly; Table Model.
LS-200	210165-501	SPEAKER assembly; includes cable assembly; Portable Model.
LS-201	308912	SPEAKER, R.C.A. accordion; Portable Model.
MI-5	211032-501	MICROPHONE, crystal: includes base, and cable assembly.
MI-6	200977-501	MICROPHONE, crystal: does not include base A-3.
MS-2	106129	PAD, pressure; record head.
MS-4	110075	PAD, pressure: erase head.
O-50	304838-501	REEL, Ribbon: Empty.
O-51	106516	RETAINER, thumb screw: flat washer.
O-52	104307-5	RING, retaining: "Truarc"; Cat. No. 5100-31; 281" I.D.
O-56	206148	CUP, clutch.
O-62	106472	PULLEY, motor drive: one half-hour recorder, 60 cycles.
O-64	104307-1	RING, retaining: "Truarc" No. 5100-25; .225" I.D.
O-65	106262	POST, ribbon guide.
O-67	206321	GUIDE, ribbon: right hand.
O-69	104307-6	RING, retaining: "Truarc" no. 5100-18; .170"-.164" I.D.
O-74	106143	SLEEVE, erase pin.
O-76	106340	BELT, rubber; clutch drive.
O-77	106339	BELT, rubber: capstan drive.
O-78	106364-501	BEARING, capstan spindle: sub-assembly.
O-83	106127	SHAFT, pressure wheel; record head.
O-84	106125	WHEEL, pressure; record head.
O-85	106128	SPRING, pressure wheel; record head.
O-200	206950	DISC, indexing.
O-201	210055-1	CUP, reel drive: reel support.
O-202	107980-501	PULLEY, clutch: sub-assembly.
O-203	109300-501	POST, reel: sub-assembly.
O-204	1-210072-501	BEARING assembly, clutch support.
O-205	108357	PULLEY, motor drive: one hour recorder 60 cycles.
O-206	107248	PULLEY, motor: one half hour recorder; 50 cycles.

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Symbol	Part Number	Description
O-207	109786	PULLEY, motor: one hour recorder; 50 cycles.
O-208	210093-501	PRESSURE WHEEL assembly, tape pressure; record head.
O-209	210043	GUIDE, ribbon: left hand.
O-210	110056-501	ARM assembly, erase head pressure.
O-211	110076	SPRING, pressure arm.
O-212	110078	SPRING, pressure wheel bracket.
O-213	110039	SPRING, control knob.
O-214	110030	SPRING, control shaft.
O-215	104307-10	RING, retaining: "Truarc" No. 5100-34; .304" .311" I.D.
O-216	110058-501	CUP assembly, control.
O-217	110061-501	SHAFT assembly, control.
O-218	110028	CLAMP, control mounting.
O-219	110027	SPRING, leaf: erase switch.
O-220	110016	PIN, erase switch actuating.
O-221	104644-2	RING, retaining: Waldes Kohinoor; Type "E" No. 5133-12; .094" I.D.
O-222	110057-501	CONTROL ARM assembly.
O-223	110052	SPRING, erase actuator.
O-224	110046	ARM, switch disabling.
O-225	206460-501	CAPSTAN, drive: assembly includes spindle, spindle bearing, flywheel, pulley, lower bearing, and mounting bracket, one-half hour recorder.
O-226	209823-501	CAPSTAN, drive: assembly includes spindle, spindle bearing, flywheel, pulley, lower bearing, and mounting bracket, one hour recorder.
O-227	208190-501	CAPSTAN, drive: sub-assembly with plates for one half-hour recorder.
O-228	209800-501	CAPSTAN, drive: sub-assembly with plates for one hour recorder.
O-229	108189-501	CAPSTAN, drive: sub-assembly includes shaft and pulley for one-half or one hour recorder.
O-230	108192	DISCS, flywheel: for all types of recorders.
O-231	104636-1	BALL, steel: 1/8" diameter.
O-232	310090-501	CHASSIS assembly, mechanical: includes posts; clutch lifter lever; clutch lever.
O-233	207143	GUIDE, belt.
O-234	210199-501	PLATE assembly, right side.
O-235	210198-501	PLATE assembly, left side.
O-236	210192-501	SUPPORT assembly, right side.
O-237	210193-501	SUPPORT assembly, left side.
O-238	110026	GRILLE, speaker.
O-239	106697-1	GRILLE, cloth: for speaker.
O-240	111015	SPACER, speaker transformer.
O-241	210189	GRILLE, ventilator.
O-242	206903	BACK, cabinet: Table Model.
O-243	210178	REEL, cord.
O-244	105785	HOLDER, microphone base.
O-245	110802-PL1	ADAPTER, microphone: to adapt microphone to floor stand.
O-246	104788	CLIP, microphone.
P-2	110636	CONNECTOR, male contact: 2 prong.
P-5	106765	CONNECTOR, male: 4 prong; does not include shell P-11.
P-11	106764	SHELL; for connector P-5.
S-20	110086	SWITCH, erase; includes mounting screws.
S-21	110059-501	SWITCH assembly, tape brake.
S-22	110111	SWITCH, toggle.
U-5	110203-PL1	AMPLIFIER, assembly: Portable Model; does not include power supply U-6.
U-6	310209-501	CHASSIS, assembly power supply: complete; Portable Model.
U-7	110250-PL1	AMPLIFIER, A.F.: Record/reproducer amplifier chassis, wired, complete with tubes; Table Model.
U-8	110347-PL1	RECORDER assembly, mechanical chassis; rotary knob; Table Model.
U-9	110206-PL18	RECORDER assembly, mechanical chassis; Portable Model.
W-3	106515	STRAP, ground.
W-10	108672-1	CABLE, power: eliptical used on earlier models, has been replaced on later models by a circular power cable #111178-1. Not interchangeable.
W-11	111178-1	CABLE, power: circular used on later models (replaces eliptical power cable #108672-1. Not interchangeable).
151	309039-501	CABINET: for housing complete recorder/reproducer mechanism and amplifier; Table Model.
251	510194	CASE, carrying: for mounting amplifier and recorder mechanism; includes cover.
601	2-103468-2	KNOB, control: for amplifier controls.

SYMPTOM	CAUSE	REMEDY
POOR FREQUENCY RESPONSE	1. Accumulation of dirt on ribbon, residue on record/play head.	1. Clean head.
	2. Too much or too little bias. This can be caused by the frequency varying from the desired 40 Kc.	2. Replace faulty component.
	3. Defective component in compensating network.	3. Replace.
RIBBON SPEED TOO SLOW	1. Pressure pads on record and erase head—excessive pressure.	1. Readjust.
	2. Rewind clutch misadjusted causing it to be engaged.	2. Readjust.
	3. Capstan flywheel shaft binding.	3. Clean capstan and realign.
	4. Motor shaft binding in bearings.	4. Loosen bearings and oil or replace motor.
	5. Capstan badly worn.	5. Replace.
WOW AND FLUTTER	1. Pressure wheel defective, binding, or rubbing on capstan bearing housing.	1. Replace defective wheel. Remove source of binding (check wheel for possible source), also check alignment of pressure spring against shaft. See "Adjustment of Roller Pressure", Page 7.
	2. Excessive pressure of pressure pad against record/play head.	2. Readjust—See "Adjustment of Ribbon Tension" Page 7.
	3. Binding motor shaft bearing.	3. Replace motor.
	4. Binding capstan lower bearing.	4. Replace capstan drive assembly.
	5. Binding reel-post bearing.	5. Clean or replace bearing or reel-post.
	6. Damaged capstan drive belt.	6. Replace belt.
	7. Bent capstan.	7. Replace capstan drive assembly.
RIBBON BREAKS AT CAPSTAN SPINDLE	1. Too little pressure on head pads.	1. Adjust pressure pads.
	2. Dirty capstan spindle.	2. Clean.
	3. Worn capstan spindle.	3. Replace.
	4. Tape guide post bent.	4. Align to right angle with panel.
	5. Pressure wheel worn.	5. Replace.
FAILURE TO MOVE TAPE WITH POWER ON	1. Tape not properly threaded thru tape break switch.	1. Thread tape properly.
	2. Fuse blown.	2. Replace.
	3. Clutch misadjusted.	3. Adjust.
	4. Capstan drive belt worn.	4. Replace.
	5. Defective motor switch.	5. Replace.
	6. Defective motor.	6. Replace.
	7. Defective tape break switch.	7. Replace.
	8. Tape break switch not adjusted properly.	8. Adjust.
	9. Switch disabling arm bent.	9. Adjust.
NO ERASE AND THE EYE DOES NOT OPERATE	1. Erase button not depressed	1. Press
	2. Erase switch not functioning	2. Adjust
	3. Defective record play switch S1	3. Replace
	4. Erase actuater spring bent	4. Adjust by bending or replace
INSUFFICIENT OR NO ERASE, EYE OPERATES	1. Dirty head	1. Clean
	2. Faulty 6SN7 V3	2. Replace
	3. Faulty Component in V3 circuit	3. Replace

	4. Faulty Erase head	4. Replace
	5. Insufficient pressure on erase head pad.	5. Adjust
DOES NOT RECORD, EYE FUNCTIONS	1. Shorted Head	1. Replace
	2. Faulty wiring to record head	2. Correct Wiring
	3. C 26 open	3. Replace
	4. Faulty Contact on S1	4. Clean or replace
DOES NOT RECORD, EYE DOES NOT FUNCTION	1. Erase button not pressed	1. Press
	2. Erase switch not functioning	2. Adjust
	3. Defective record play switch S1	3. Replace
	4. Erase actuater spring bent	4. Adjust by bending or replace
	5. Faulty 1st stage 6J7 or Component	5. Replace
	6. Faulty 2nd stage 6SJ7 or Component	6. Replace
DISTORTION IN PLAYBACK, MONITOR OK	1. Worn Head pad on record head	1. Replace
	2. Insufficient pressure on head	2. Adjust V
	3. Leaky C 26	3. Replace
	4. Flutter	4. Clean capstan or replace if worn
DISTORTED RECORDING	1. Insufficient or no bias	1. Check tube V3 and components in associated circuit.
HIGH HUM	1. Defective tubes or ground connections.	1. Replace or rewire accordingly.
	2. One side of filament shorted to ground.	2. Check Pilot lamp holder and associated wiring.
	3. Open grid circuit.	3. Rewire.
	4. Microphonic tube.	4. Replace defective tube.
MICROPHONICS	1. Microphonic 6J7 tube V-1	1. Select non-microphonic tube and replace.
WEAK OR NO OUTPUT	1. Defective fuse, power cord or plug.	1. Replace
	2. Poor contacts or wiring connections on output plug.	2. Clean contacts or replace wire.
	3. Defective tubes.	3. Replace.
	4. Defective cord or resisitors.	4. Replace.
	5. Defective output transformer or speaker.	5. Replace.
	6. Open playback head.	6. Replace.
	7. Dirty pole pieces of playback head.	7. Clean.
	8. Defective selector switch contacts.	8. Clean or replace.
	9. Defective power transformer.	9. Replace.
FAILURE OF CAPSTAN TO PULL RIBBON	1. Capstan spindle-shaft binding in lower bearing.	1. Replace capstan drive assembly.
	2. Broken or weak capstan drive belt.	2. Replace belt.
	3. Capstan spindle jammed with accumulated ribbon residue on bearing.	3. Clean throughly.
	4. Roller pressure insufficient.	4. See "Adjustment of Roller Pressure" Page 7.
FAILURE TO TAKEUP RIBBON OR WINDS TO LOOSELY ON TAKEUP REEL	1. Clutches misadjusted.	1. Readjust—See "Adjustment of Clutches" Page 9.
	2. Ribbon guides misadjusted.	2. Readjust—See "Adjustment of Ribbon Guides", Page 7.
	3. Clutch belt slipping.	3. Clean motor drive pulley with carbon-tetrachloride. Reposition motor to tighten belt. If unsatisfactory, replace belt.

VOLTAGE AND RESISTANCE CHART

These measurements are from indicated Pin to Ground. Voltages are plus unless otherwise indicated, and are at 117 Volts, 6(cycle. K indicates value of resistance times 1000. Remove line connection when measuring resistances.

TUBE	POSITION	MEASURE	PIN 1	2	3	4	5	6	7	8
V-1	PLAY	VOLTAGE	0	30*	100	35	0	—	30*	1.1
		RESISTANCE	0	22 K	500 K	2.2 meg.	0	22 K	22 K	2200
6J7***	RECORD	VOLTAGE	0	30*	95	37	0	—	30*	1.1
		RESISTANCE	0	22 K	500 K	2.2 meg.	0	22 K	22 K	2200
V-2	PLAY	VOLTAGE	0	30*	0	0	3.5	120	30*	110
		RESISTANCE	0	22 K	0	1 meg.	390	45 K	22 K	150 K
6SJ7	RECORD	VOLTAGE	0	30*	0	0	3	100	30*	120**
		RESISTANCE	0	22 K	0	1 meg.	390	45 K	22 K	150 K
V-3	PLAY	VOLTAGE	0	0	0	0	0	0	30*	30*
		RESISTANCE	220 K	open	22 K	220 K	open	22 K	22 K	22 K
6SN7	RECORD	VOLTAGE	—40xx	300x	0	—39	300x	0	30*	30*
		RESISTANCE	220 K	100 K	22 K	220 K	100 K	0	22 K	22 K
V-4	PLAY	VOLTAGE	0	160	6	0	30	1.2	30*	30*
		RESISTANCE	470 K	150 K	2200	220 K	300 K	2200	22 K	22 K
6SN7	RECORD	VOLTAGE	0	155	6	0	30	1.1	30*	30*
		RESISTANCE	470 K	150 K	2200	25 K	300 K	2200	22 K	22 K
V-5	PLAY	VOLTAGE	0	30*	310	325	0	0	30*	19
		RESISTANCE	0	22 K	100 K	100 K	470 K	open	22 K	390
6V6	RECORD	VOLTAGE	0	30*	300	315	0	0	30*	17
		RESISTANCE	0	22 K	100 K	100 K	470 K	open	22 K	390
V-6	PLAY	VOLTAGE	30*	0	0	0	0	30*	—	—
		RESISTANCE	22 K	open	2.2 meg.	open	0	22 K	—	—
6E5	RECORD	VOLTAGE	30*	30	—¾	310	0	30	—	—
		RESISTANCE	22 K	1 meg.	2.2 meg.	100 K	0	22 K	—	—
V-7	PLAY	VOLTAGE	—	350	—	325 a.c.	—	325 a.c.	—	350
		RESISTANCE	22 K	100 K	22 K	100 K	open	100 K	open	100 K
5Y3	RECORD	VOLTAGE	—	330	—	310 a.c.	—	310 a.c.	—	330
		RESISTANCE	22 K	100 K	22 K	100 K	open	100 K	open	100 K

NOTES

*—6.3 volts a.c. between pins so marked—4.5 volts a.c. on 6J7 pins 2 to 7.

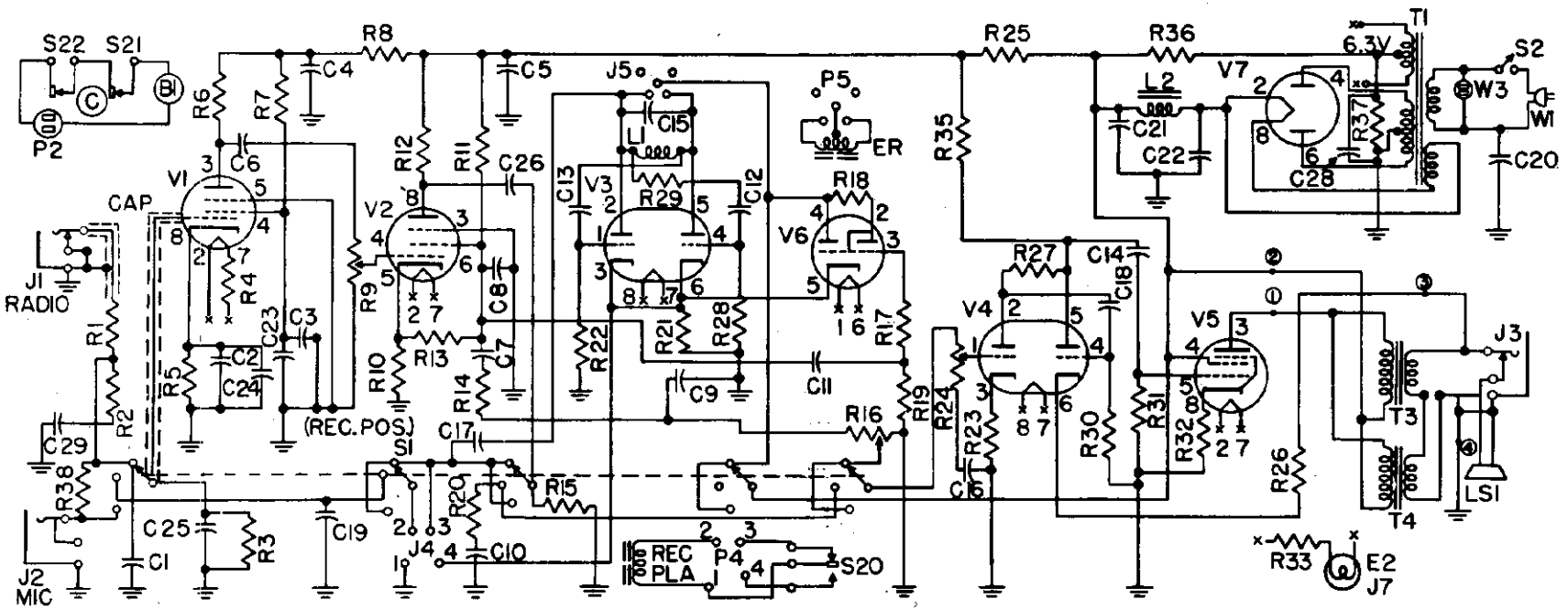
**—70 volts at 40 kc.

***—Grid Cap—130 ohms play—1 meg. record.

x—80 volts at 40 kc.
xx—25 volts at 40 kc.

Signal measurements: Line 117 volts, 60 cycles. Record position 0.2 volts, 300 cycle signal radio input, V-3 removed. Measured with electronic a.c. voltmeter (½ meg. input).

Location	Signal Strength	Location	Signal Strength	Location	Signal Strength	Location	Signal Strength
Radio input	0.2 Volts	V-2 Plate-Pin 8	1. Volt	V-4 Pin 5	9 Volts	V-5 Pin 3	130 Volts
V-1 Grid-Cap	.005 Volts	V-2 Screen-Pin 6	5. Volts	V-4 Pin 1	9 Volts	Voice Coil-output	2.8 Volts
V-1 Plate-Pin 3	0.7 Volts	V-6 Pin 3	3. Volts	V-4 Pin 2	23 Volts		
V-2 Grid-Pin 4	0.7 Volts	V-4 Pin 4	0.8 Volts	V-5 Pin 5	23 Volts		



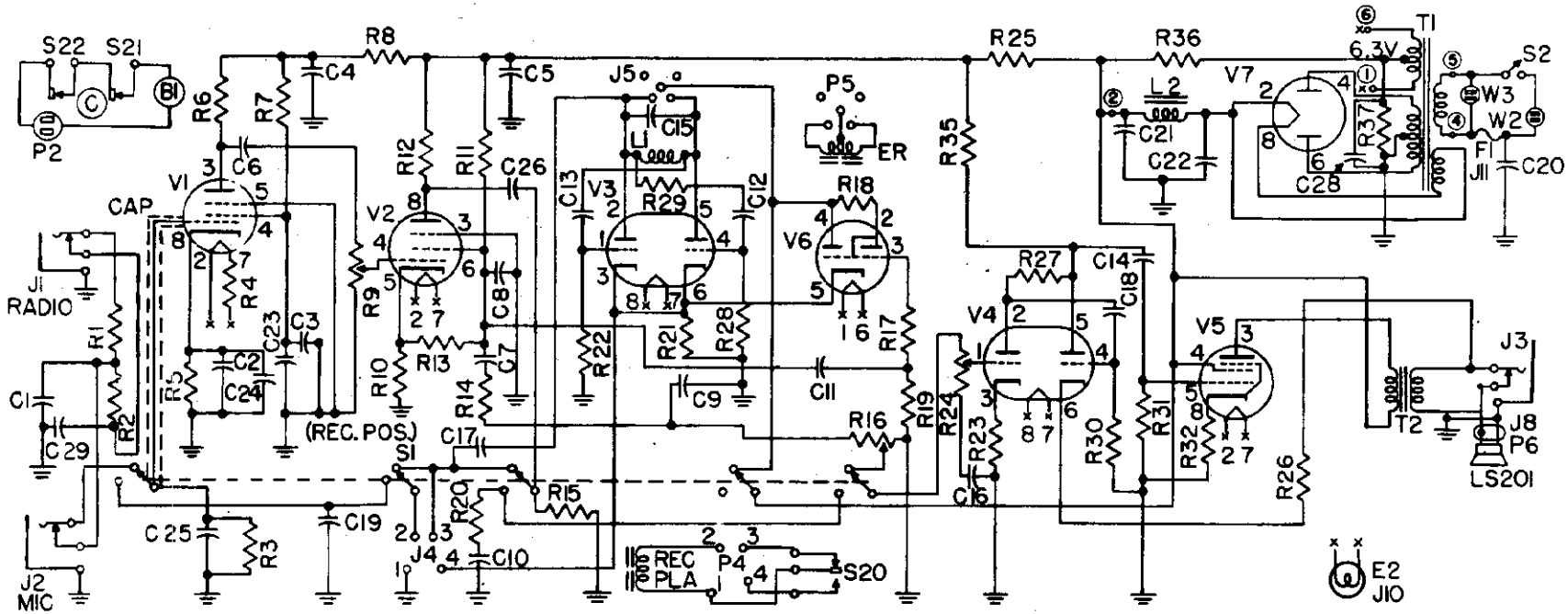
SYM.	DESCRIPTION	PART NUMBER
B-1	MOTOR	206322
C-1	.001 MFD.	3-106093-3
C-2	20-20-20 MFD., 450-450-25 V.	103253
C-3	.05 MFD.	2-106094-2
C-4	20-20-20 MFD., 450-450-25 V.	103253
C-5	20-20-20 MFD., 450-450-25 V.	103253
C-6	.005 MFD.	3-106093-4
C-7	.05 MFD.	2-106094-2
C-8	.001 MFD.	3-106093-3
C-9	.001 MFD.	3-106093-3
C-10	.05 MFD.	2-106094-2
C-11	.05 MFD.	2-106094-2
C-12	.0001 MFD.	1-109354-3
C-13	.0001 MFD.	1-109354-3
C-14	.005 MFD.	3-106093-4
C-15	.001 MFD.	1-106972-5
C-16	.005 MFD.	3-106093-4
C-17	.002 MFD.	2-106093-6
C-18	.005 MFD.	3-106093-4
C-19	.002 MFD.	2-106093-6
C-20	.005 MFD.	106100-6
C-21	20-20 MFD., 450-450 V.	102711
C-22	20-20 MFD., 450-450 V.	102711
C-23	.001 MFD.	1-106972-5
C-24	.001 MFD.	1-106972-5
C-25	50 MMFD.	1-107461-2
C-26	.25 MFD.	3-106093-7
C-28	.05 MFD.	1-109348-5
C-29	.03 MFD.	3-106093-8
J-1	JACK	21421-2
J-2	JACK	21421-2
J-3	JACK	21421-2
J-4	SOCKET, WAFER-4 CONTACT	106730

SYM.	DESCRIPTION	PART NUMBER
J-5	SOCKET, 5 CONTACT	107470
J-6	SOCKET, 4 CONTACT	106730
J-7	SOCKET, PILOT LAMP	107340
L-1	COIL, OSCILLATOR	103865
L-2	CHOKE, FILTER	200925
LS-1	SPEAKER, MAGNETIC	305975
P-1	PLUG, 4 PRONG	106765
P-2	CONNECTOR, MALE-2 PRONG	110636
P-4	PLUG	106765
P-5	PLUG	107469
R-1	1 MEG. 1/2 W.	3-106771-3
R-2	22 K. 1/2 W.	3-106771-7
R-3	1 MEG. 1/2 W.	3-106771-3
R-4	5 1 W. (OR 4.7 OR 5.1)	1-106005-3
R-5	2.2 K. 1/2 W.	3-106771-2
R-6	470 K. 1/2 W.	1-107989-9
R-7	2.2 MEG. 1/2 W.	3-106771-8
R-8	22 K. 1/2 W.	3-106771-7
R-9	1 MEG. POTENT.	103469
R-10	390 1/2 W.	3-106771-5
R-11	47 K. 1 W.	2-106772-3
R-12	47 K. 1 W.	2-106772-3
R-13	47 K. 1/2 W.	2-106771-10
R-14	100 K. 1/2 W.	2-106771-12
R-15	220 K. 1/2 W.	3-106771-1
R-16	25 K. POTENT.	103469-2
R-17	220 K. 1/2 W.	3-106771-1
R-18	1 MEG. 1/2 W.	3-106771-3
R-19	2.2 MEG. 1/2 W.	3-106771-8
R-20	4.7 K. 1/2 W. ALT. 103713-22	103806-18
R-21	22 K. 1/2 W.	3-106771-7
R-22	220 K. 1/2 W.	3-106771-1
R-23	2.2 K. 1/2 W.	3-106771-2

SYM.	DESCRIPTION	PART NUMBER
R-24	100 K. POTENT.	106762-1
R-25	2.2 K. 1 W.	3-106772-4
R-26	2.2 K. 1/2 W.	3-106771-2
R-27	220 K. 1/2 W.	3-106771-1
R-28	220 K. 1/2 W.	3-106771-1
R-29	22 K. 1/2 W.	3-106771-7
R-30	470 K. 1/2 W.	103806-12
R-31	470 K. 1/2 W.	103806-12
R-32	390 1 W.	2-106772-5
R-33	5 1 W.	1-106005-3
R-35	47 K. 1 W.	2-106772-3
R-36	220 K. 1/2 W.	3-106771-1
R-37	22 K. 1/2 W.	3-106771-7
R-38	1 MEG. 1/2 W.	3-106771-3
S-1	SWITCH, SELECTOR	106746-3
S-2	SWITCH, PART OF R-24	
S-20	SWITCH, ERASE	110086
S-21	SWITCH ASSEM., TAPE BREAK	110059-501
S-22	SWITCH, TOGGLE-S.P.D.T.	110111
T-1	TRANSFORMER, POWER	204902
T-3	TRANSFORMER, OUTPUT	200923
T-4	TRANSFORMER, OUTPUT	200923
V-1	TUBE, ELECTRON 6J7	7075
V-2	TUBE, ELECTRON 6SJ7	105205
V-3	TUBE, ELECTRON 6SN7	103185
V-4	TUBE, ELECTRON 6SN7	103185
V-5	TUBE, ELECTRON 6V6	102709
V-6	TUBE, ELECTRON 6E5	105206
V-7	TUBE, ELECTRON 5Y3	102705
W-1	CORD, POWER	206823
W-3	CONNECTOR, FEMALE-2 CONTACT	104765

MODEL BK-442 SCHEMATIC

MODEL BK-442



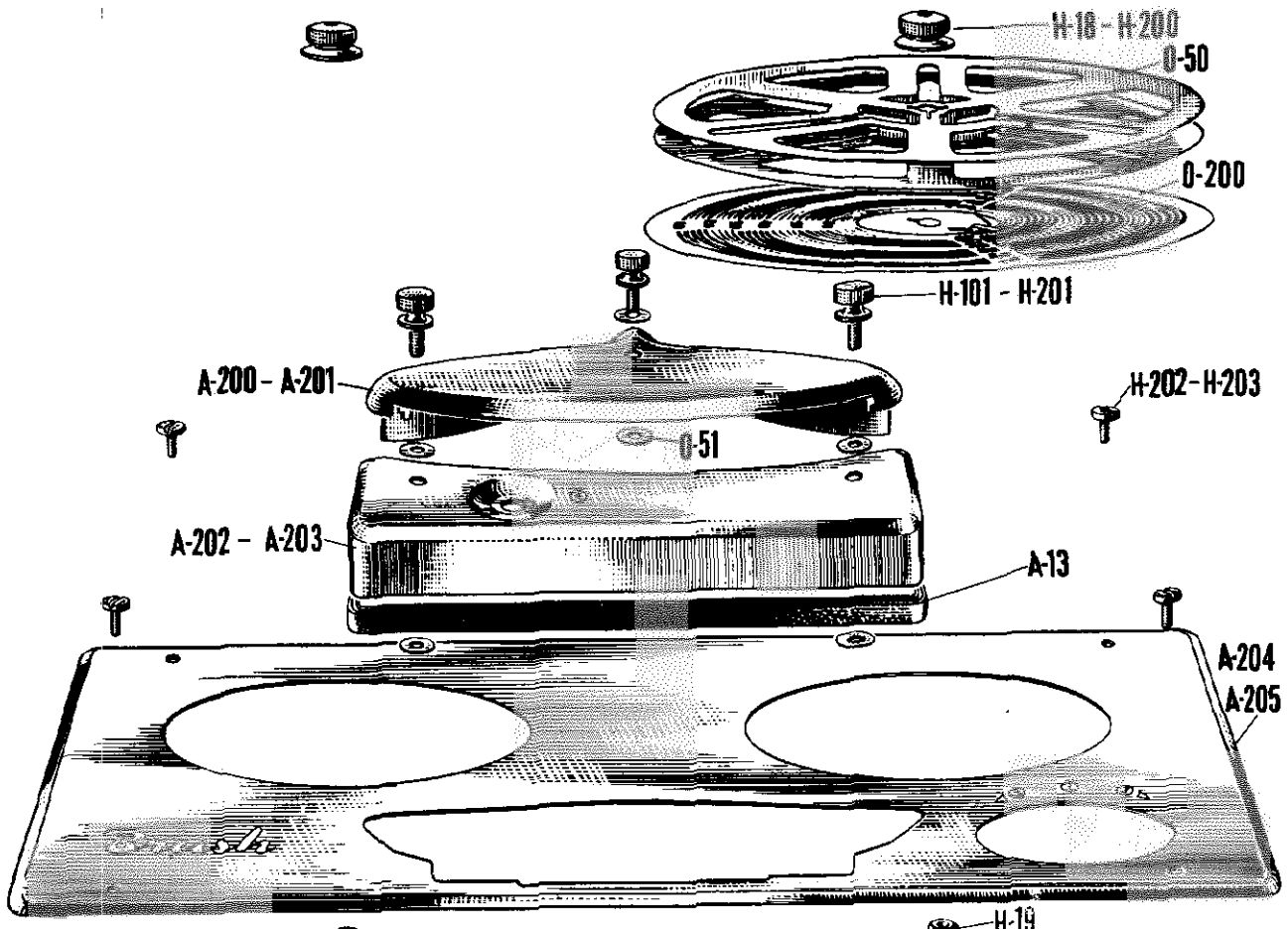
SYM.	DESCRIPTION	PART NUMBER
B-1	MOTOR	206322
C-1	.001 MFD.	3-106093-3
C-2	20-20-20 MFD., 450-450-25 V.	103253
C-3	.05 MFD.	2-106094-2
C-4	20-20-20 MFD., 450-450-25 V.	103253
C-5	20-20-20 MFD., 450-450-25 V.	103253
C-6	.005 MFD.	3-106093-4
C-7	.05 MFD.	2-106094-2
C-8	.001 MFD.	3-106093-3
C-9	.001 MFD.	3-106093-3
C-10	.05 MFD.	2-106094-2
C-11	.05 MFD.	2-106094-2
C-12	.0001 MFD.	1-109354-3
C-13	.0001 MFD.	1-109354-3
C-14	.005 MFD.	3-106093-4
C-15	.001 MFD.	1-105972-5
C-16	.005 MFD.	3-106093-4
C-17	.002 MFD.	2-106093-8
C-18	.005 MFD.	3-106093-4
C-19	.002 MFD.	2-106093-8
C-20	.005 MFD.	106100-6
C-21	20-20 MFD., 450-450 V.	102711
C-22	20-20 MFD., 450-450 V.	102711
C-23	.001 MFD.	1-105972-5
C-24	.001 MFD.	1-105972-5
C-25	50 MMF.	1-107461-2
C-26	.25 MFD.	3-106093-7
C-28	.05 MFD.	2-106094-2
C-29	.03 MFD.	3-106093-5
E-2	LAMP, PILOT	105710-1
F-1	FUSE	102525-9
J-1	JACK	21421-2
J-2	JACK	21421-2

SYM.	DESCRIPTION	PART NUMBER
J-3	JACK	21421-2
J-4	SOCKET, WAFER-4 CONTACT	106730
J-5	SOCKET, 5 CONTACT	107470
J-8	CONNECTOR	106546
J-10	HOLDER, INDICATOR LAMP	110352
J-11	HOLDER, FUSE	107147
L-1	COIL, OSCILLATOR	103865
L-2	CHOKE, FILTER	200825
LS-201	SPEAKER, MAGNETIC	308812
P-1	PLUG, 8 PRONG	104212-3
P-2	CONNECTOR, MALE-2 PRONG	110656
P-4	PLUG	106765
P-5	PLUG	107469
P-6	PLUG	106738-5
R-1	1 MEG. 1/2 W.	3-106771-3
R-2	22 K. 1/2 W.	3-106771-7
R-3	1 MEG. 1/2 W.	3-106771-3
R-4	5 1 W. (4.7 OR 5.1)	1-106065-3
R-5	2.2 K. 1/2 W.	3-106771-2
R-6	470 K. 1/2 W.	1-107989-8
R-7	2.2 MEG. 1/2 W.	3-106771-8
R-8	22 K. 1/2 W.	3-106771-7
R-9	1 MEG. POTENT.	103469
R-10	390 1/2 W.	3-106771-5
R-11	47 K. 1 W.	2-106772-3
R-12	47 K. 1 W.	2-106772-3
R-13	47 K. 1/2 W.	2-106771-10
R-14	100 K. 1/2 W.	2-106771-12
R-15	220 K. 1/2 W.	3-106771-1
R-16	25 K. POTENT.	103489-2
R-17	220 K. 1/2 W.	3-106771-1
R-18	1 MEG. 1/2 W.	3-106771-3
R-19	2.2 MEG. 1/2 W. ALT. 103806-18	3-106771-8

SYM.	DESCRIPTION	PART NUMBER
R-20	4.7 K. 1/2 W.	103713-22
R-21	22 K. 1/2 W.	3-106771-7
R-22	220 K. 1/2 W.	3-106771-1
R-23	2.2 K. 1/2 W.	3-106771-2
R-24	100 K. POTENT.	106762-1
R-25	2.2 K. 1 W.	3-106772-4
R-26	2.2 K. 1/2 W.	3-106771-2
R-27	220 K. 1/2 W.	3-106771-1
R-28	220 K. 1/2 W.	3-106771-1
R-29	2.2 K. 1/2 W.	3-106771-2
R-30	470 K. 1/2 W.	103806-12
R-31	470 K. 1/2 W.	103806-12
R-32	390 1 W.	2-106772-5
R-35	47 K. 1 W.	2-106772-3
R-36	220 K. 1/2 W.	3-106771-1
R-37	22 K. 1/2 W.	3-106771-7
S-1	SWITCH, SELECTOR	106746-3
S-2	SWITCH, PART OF R-24	
S-20	SWITCH, ERASE	110086
S-21	SWITCH ASSEM., TAPE BREAK	110059-501
S-22	SWITCH, TOGGLE-S.P.D.T.	110111
T-1	TRANSFORMER, POWER	204902
T-2	TRANSFORMER, OUTPUT	208913
V-1	TUBE, ELECTRON 6J7	7075
V-2	TUBE, ELECTRON 6SJ7	105205
V-3	TUBE, ELECTRON 6SN7	103185
V-4	TUBE, ELECTRON 6SN7	103185
V-5	TUBE, ELECTRON 6V6	102709
V-6	TUBE, ELECTRON 6E5	105206
V-7	TUBE, ELECTRON 5Y3	102705
*W-2	CONNECTOR, MALE-2 CONTACT	108673
W-3	CONNECTOR, FEMALE-2 CONTACT	104765

*W-2 Elliptical power socket has been replaced in later models with a circular receptacle #111180 (cables not interchangeable).

MODEL BK-443 SCHEMATIC


H-18 - H-200
O-50
O-200
H-101 - H-201
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H-202 - H-203
O-51
A-202 - A-203
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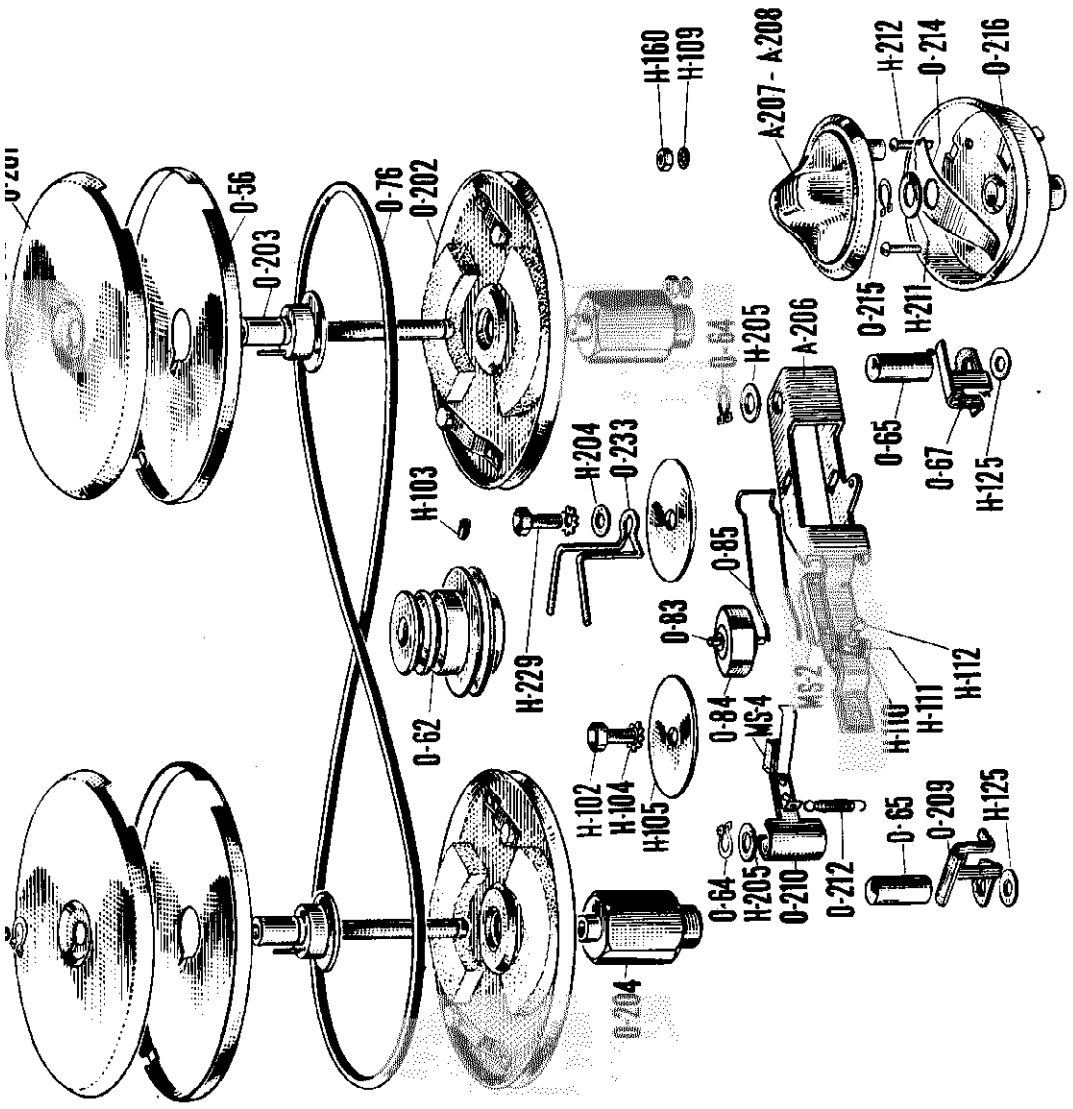
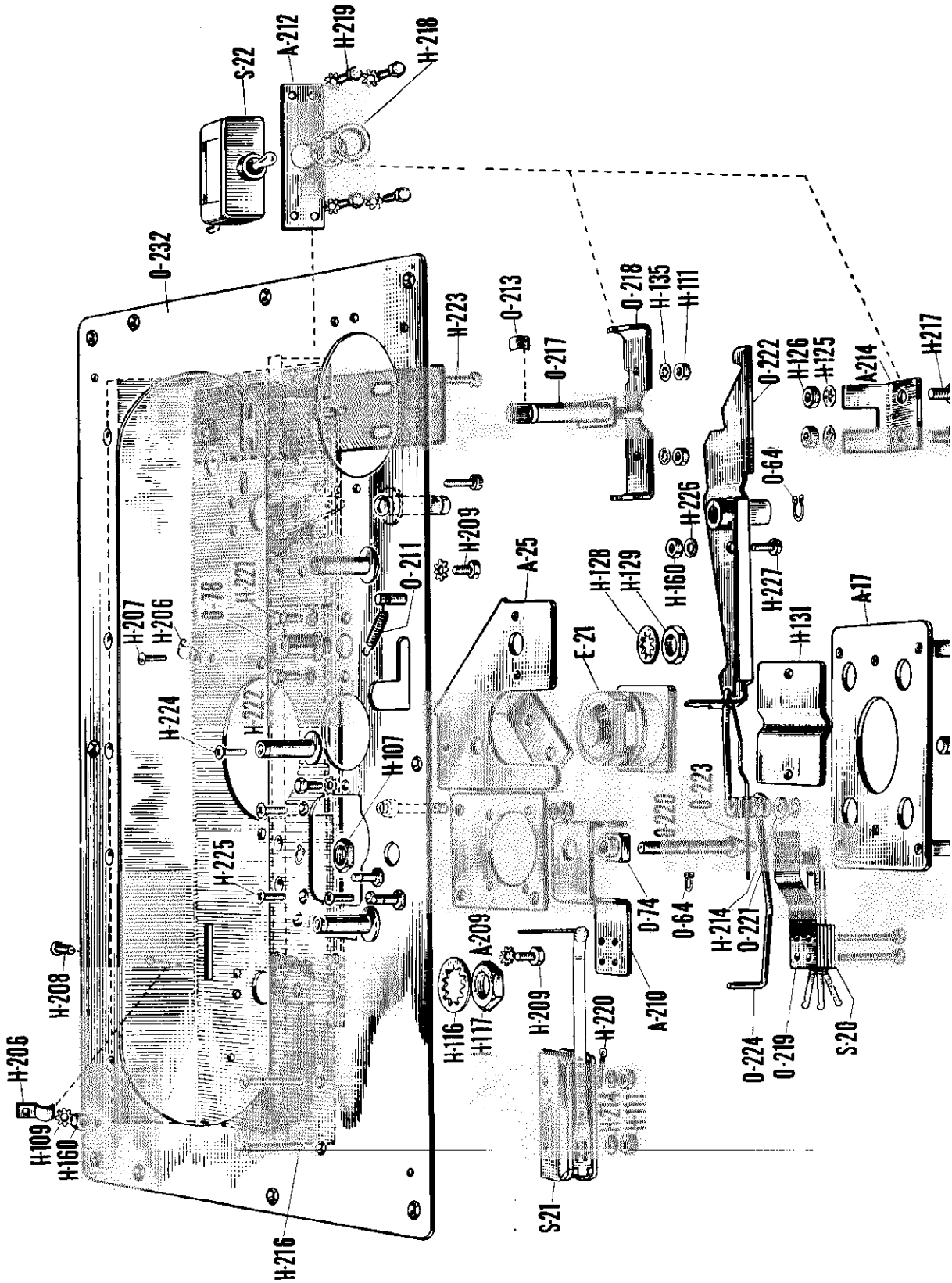
A-204
A-205
H-19

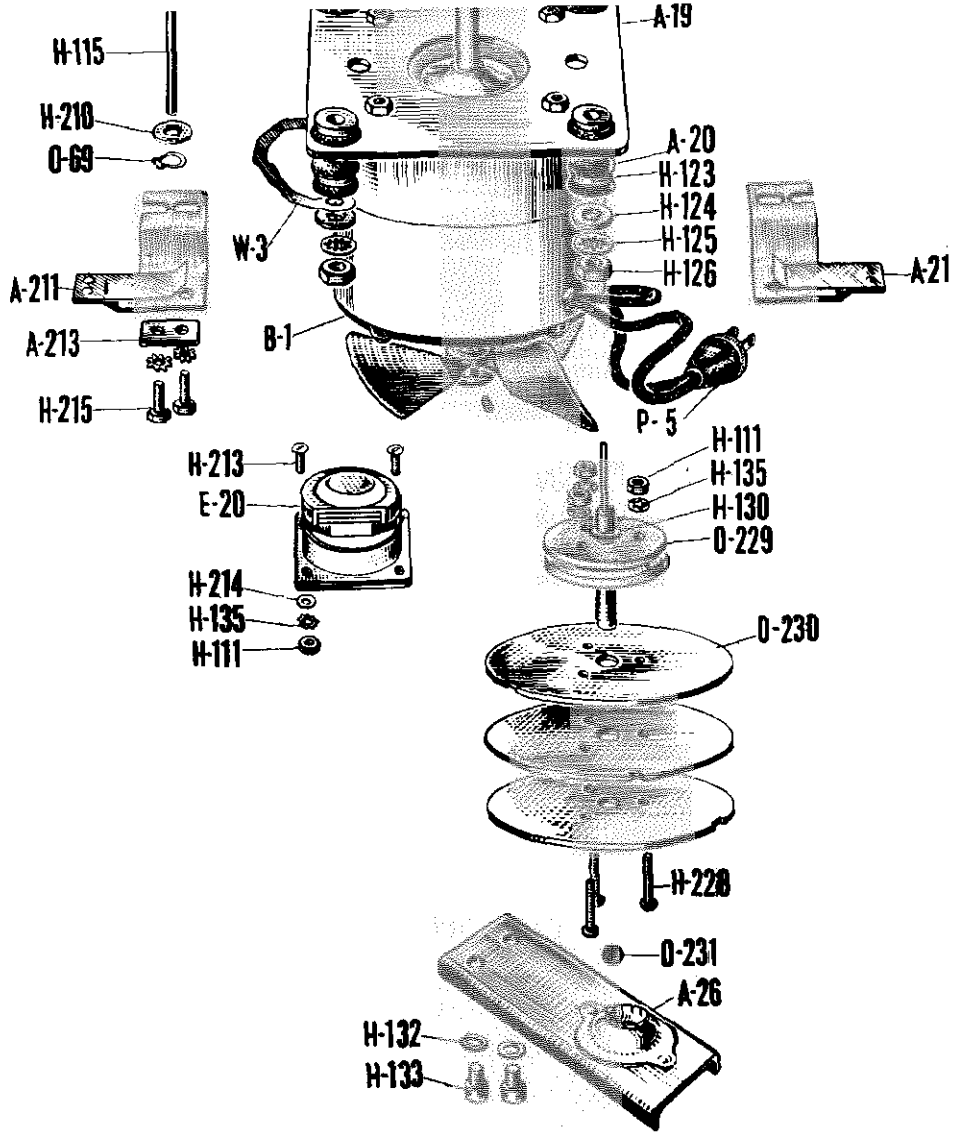
MODELS BK-442, BK-443T, BK-437, BK-437S, BK-439, BK-441



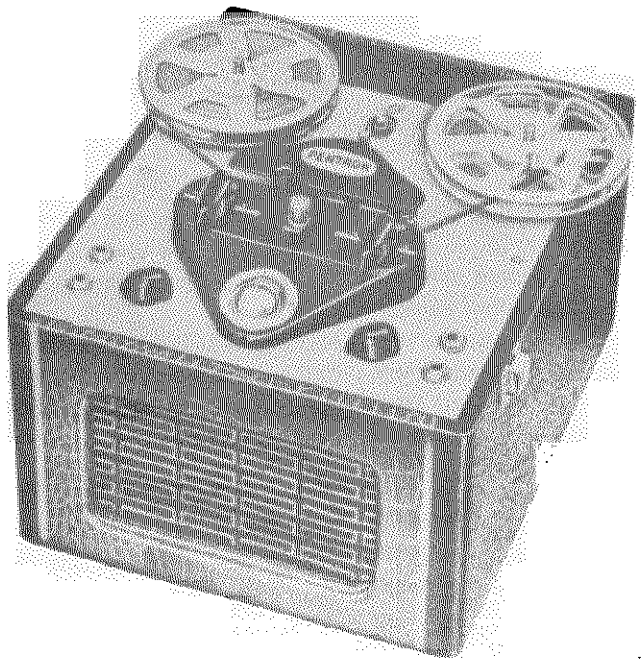
TAPE REC. PAGE 22-89,90 BRUSH

MODELS BK-442, BK-443P, BK-437, BK-437S, BK-439, BK-441





MECHANICAL CHASSIS, EXPLODED VIEW



The Pentron tape recorder is an instrument for making high fidelity recordings of music or speech on magnetic tape. Realistic reproduction of the recordings is provided by a self-contained, high power amplifier and speaker.

A brief description of the operating components follows. It is recommended that the prospective operator use this to familiarize himself with their operation before attempting to use the instrument.

TAPE — The Pentron recorder uses ¼" wide Magnetic Recording Tape with Type A winding. Type A winding simply means that the magnetic coating or dull side of the tape is wound facing in. Type B tape (dull side facing out) can be changed to Type A for use on this machine by merely rewinding with a half twist.

Either plastic or paper recording tape can be used. For best results, use a red oxide tape, preferably plastic. Since the Pentron recorder is very easy on tape, it is quite practical to use the higher priced plastic tape. Recordings can be played back and tape re-used many thousands of times without noticeable change in performance.

For use on this machine tape may be wound on either the popular 7" reel (1200 feet) or any smaller size reel.

Tape can be spliced by bringing the ends together (not lapped) and applying a small piece of transparent scotch tape to the shiny side on plastic tape or to the grey side on paper tape.

Always keep tape clean and store preferably in humidor cans, much the same as you would movie film.

CAPSTANS — There are two Capstans which control the speed of the recorder. The small Capstan which carries the tape past the heads at a speed of 3¾" per second, (one hour playing time in one direction on a 1200' reel), or the larger Capstan which moves the tape at 7½" per second, (one-half hour playing time in one direction on a 1200' reel). The smaller Capstan is permanently built into the machine and should not be removed unless service is required. The larger Capstan is a sleeve which can be slipped over the smaller Capstan and tightened effectively by turning its knurled head a few turns in a clockwise direction. MASTER CONTROL KNOB MUST BE IN "IDLE" POSITION, MACHINE MUST BE TURNED OFF, AND MOTOR RELEASE PIN MUST BE IN THE "IN" POSITION SO THAT CAPSTAN CANNOT BE PUT ON TOO TIGHTLY. Otherwise difficulty will be experienced in removing the Capstan. To remove the large Capstan, the motor must be turned OFF, the motor release pin in the OUT position, and with the Master Control Knob in the IDLE position, proceed to unscrew the Capstan. The initial loosening can be accomplished by grasping the knurled portion of the Capstan and giving it a quick twist in a counter-clockwise direction. If capstan is difficult to remove, grasp right hand reel spindle and push firmly toward rear of case at same time turning capstan counter-clockwise.

The smaller or slow speed Capstan is used for economic long period playing. The reproducing qualities are about the same as that of a very good AM radio broadcast.

The larger or high speed Capstan is recommended where best high fidelity is required particularly on exceptionally fine music, the reproducing qualities being equivalent to that of a very fine FM radio broadcast.

A recording made at high speed must be played back at high speed and similarly, a recording made at slow speed must be played back at slow speed.

DUAL TRACKS TWO CHANNEL — After a reel of tape has been recorded, the reel with the tape will be on the left hand spindle. To record on the second channel, turn the reel over and place it on the right hand spindle. It will then be in position for recording or playing back on the second track. On completion of the second track, you are then ready to repeat playing of the first track without rewinding. Switching of the reels selects the right track.

POWER SUPPLY — This unit operates only on 110 Volt, 60 Cycle, AC current. Use of any other supply directly into the unit will result in serious damage to the Amplifier section.

MECHANICAL INTERLOCK — An automatic mechanical interlock, not visible from outside, makes it impossible to actuate one control knob while the other is being used. Therefore, do not attempt to force the knobs.

TONE CONTROL — The Tone Control also contains the master switch which turns the amplifier and mechanism OFF and ON. The click of this switch can be heard when this Control Knob is turned to the extreme counter clockwise position.

The Tone Control decreases the high frequency response when turned clockwise. It is automatically disconnected during recording. Therefore, when recording from a radio be sure the tone control on the radio is set for maximum treble. These highs may be subdued with the Tone Control on Recorder during playback.

VOLUME CONTROL — This controls the volume for both playing and recording. For recording, the Volume Control should be set according to the reactions on the Volume Indicator Eye.

EXTERNAL AMPLIFIER JACK — To use your tape recorder with an external amplifier simply connect the external amplifier to the proper jack. The VOLUME and TONE controls on the recorder should be turned completely clockwise; the recorder will then operate through the external amplifier. Use the volume and tone controls on the external amplifier for proper adjustment.

EXTERNAL SPEAKER JACK—When an external speaker (3.2 voice coil) is connected to your recorder the internal speaker is automatically disconnected and the entire output will be heard through the external source. For privacy of playback a set of low impedance earphones can be plugged into this jack.

RADIO JACK — For recording or enjoying any radio program, plug your radio tuner in the Radio Jack, using other controls in the conventional manner for recording or listening. The radio jack will also take the output of any external high fidelity, high impedance pick up.

MOTOR RELEASE PIN — When this pin is pulled to the OUT position, the motor is engaged with the flywheel. When it is in the IN position the motor and flywheel are disengaged.

Always leave the Pin in the IN position when the machine is not in use. This prevents bumps or dents in the rubber surface of the flywheel which result in rough operation.

OPERATION

MASTER CONTROL KNOB — When this knob is turned to the PLAY position, the machine will reproduce the program recorded on the tape.

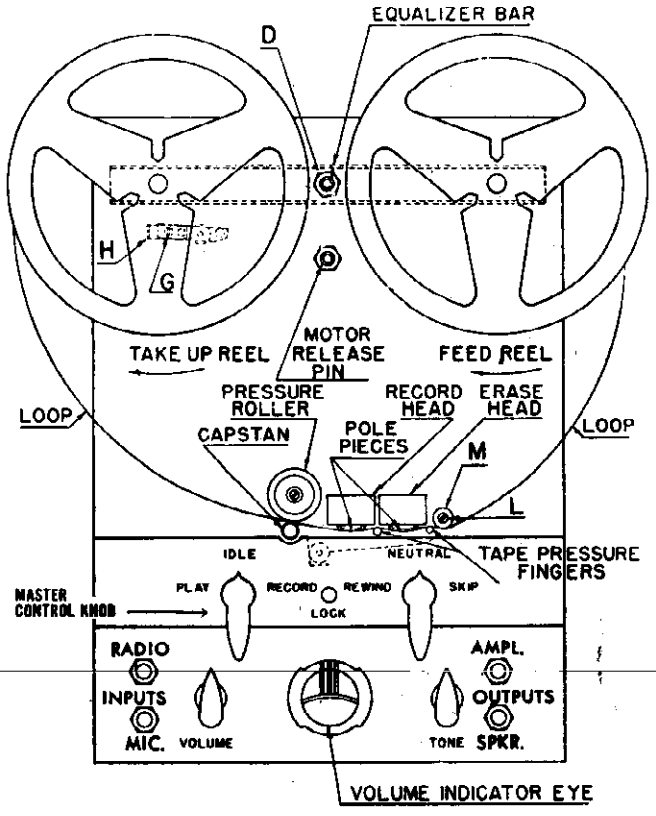


FIGURE - 1

When turned to the RECORD position, the machine will record whatever material that is desired. This position cannot be gone into without first pressing the RED

readjustment, the following procedure will put the unit in operating condition. This outline covers a complete readjustment of all parts and all may not be required in every case. In the event that only individual adjustments are required, these can be made by following the applicable instructions.

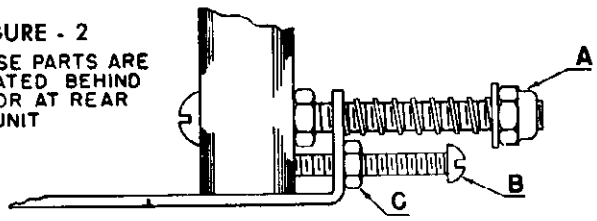


FIGURE - 2
THESE PARTS ARE LOCATED BEHIND MOTOR AT REAR OF UNIT

ADJUSTING MOTOR DRIVE — The motor drive is adjusted by the turning of screw B (Fig. 2). The correct amount of engagement is determined by stopping the large capstan with the finger while it is running in the play position. When this becomes rather difficult to do, there is sufficient engagement to insure proper operation. Loosening screw B increases engagement; tightening screw B decreases engagement.

Do not adjust screw B beyond proper engagement as this will place unnecessary and excessive load on the motor which might result in distortion and wows. After adjustment has been made with screw B, lock in place with nut C.

Nut A has been adjusted in the factory and ordinarily need not be touched. If for any reason, sufficient engagement cannot be obtained by adjusting screw B, turn Nut A several revolutions clockwise. Before replacing unit in the case, loosen the large capstan. To do so, it may be necessary to hold the flywheel located at the lower end of the capstan shaft.

TRACTION OR "DRAG" ON REEL SPINDLES—Loosen Screw D (Figure 1) to move Equalizer Bar forward or backward. With Control Knob in IDLE position and with an equal amount of tape on each reel move the Equalizer Bar back until a slight amount of drag is noticeable on each reel spindle. Check by drawing a small loop of tape from each reel. These loops should stay immobile. If the reels take up the slack at this point, the amount of drag is too great and should be relieved very slightly.

Should the tape have a tendency to wind up or creep onto the Take-Up Reel while making the above adjustment, correction can be made by maneuvering the Nuts EE and FF (Figure 3) backwards on the Tie Bar. These parts are located on the underside of the Top Mechanism Plate and below the Feed Reel.

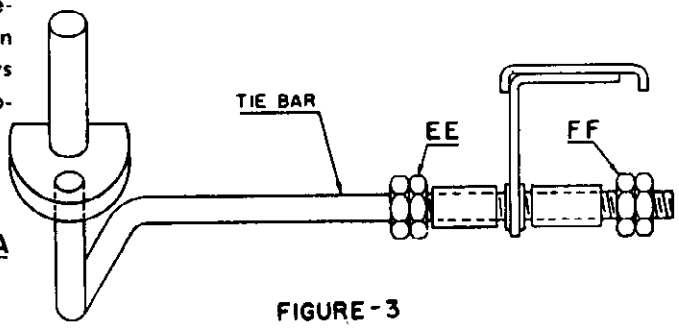


FIGURE - 3

TAKE UP ON TAKE UP REEL — Take up adjustment on the Take Up Reel is required if when the Control Knob is placed in the PLAY or RECORD position, a loop of tape feeds out before the Take Up Reel starts turning, or if the Tape Pressure Fingers in front of the Heads are not engaged with the tape before the Take Up Reel starts turning.

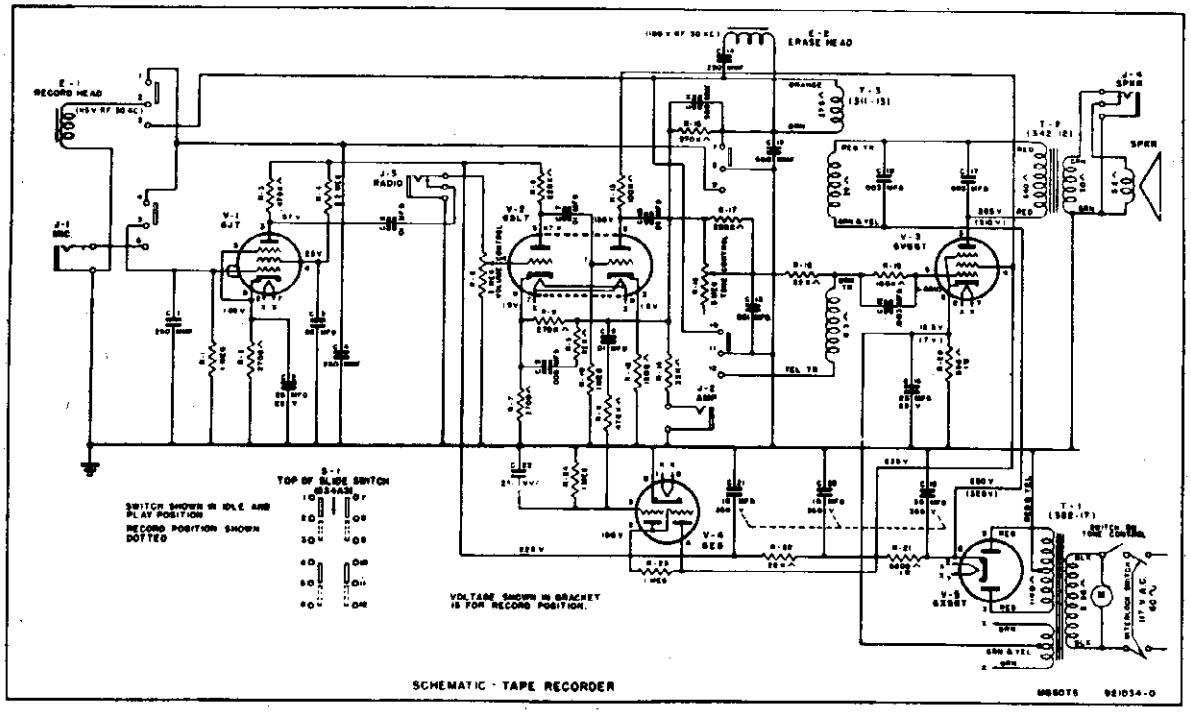
This adjustment is accomplished by loosening screw G (Figure 1) and moving bar H towards the Equalizer bar for decreasing the time required for the Take Up Reel to start turning and, of course bar H must be moved away from Equalizer Bar to increase the time.

TAPE PRESSURE FINGER ADJUSTMENT — For most satisfactory results the tape should lay across the full face of the Pole Pieces. Too little coverage of the Pole Piece face will result in indistinct recordings and reproductions. Too much pressure will be accompanied by increased drag and unnecessary wear on the tape. The Tape Pressure Fingers are properly adjusted when the tape is depressed approximately 1/16" from the front face of the Pole Piece. This is accomplished by loosening Screw L (Figure 1) and moving Post M to the desired location.

HINTS

MONITORING — When recording from an external source, (such as FM or AM tuners, phono pickup) the program may be heard by plugging earphones into the amplifier jack.

FLAT SPOT — Flats may develop on the flywheel if the motor release pin is not pushed in (according to direction) while machine is not in use. To remedy this condition, set the machine in play position and let run until flats are removed.



PARTS LIST

Qty. Per Unit	Part Number	Description
1	899-3	Flat Belt (Fly Wheel to Take-up Reel)
1	899-2	Flat Belt (Motor Pulley to Feed Reel)
1	711-B-57	Motor Mounting Plate
1	964-A-58	Capstan Bearing
1	714-A-110	Capstan (3.75" per second)
1	714-A-111	Capstan (7.5" per second)
1	714-A-113	Motor Release Pin
1	964-A-40	"Play-Record" Cam Assembly
1	964-A-27	Fly Wheel with Tire
1	943-B-4	Record Head
1	943-B-5	Erase Head
1	714-A-82	Adjusting Nut "D" (Equalizer Bar)
1	711-A-193	Head Bracket
1	714-A-41	Motor Pulley
6	711-A-195	Spring Anchor Disk
1	713-A-3	Tie Rod
1	964-A-25	Pressure Roller Assembly
1	712-A-8	Spring (Interlock Bar)
1	712-A-10	Spring (Take-up Pulley—Feed Reel)
1	712-A-5	Spring (Take-up Bar—Take-up Reel)
1	712-A-6	Spring (Pressure Roller Slider)
2	712-A-9	Sleeves (Tie Bar)
1	964-B-7	Equalizer Bar and Pulley Assembly
1	964-A-72	Record Pole Piece
1	964-A-73	Erase Pole Piece
1	367-C-2	Motor
1	534-A-3	Slide Switch
1	345-A-12	Speaker
1	556-1	Eye Tube Socket, 6 Prong (Steatite-Type)
1	558-A-4	Floating Octal Tube Socket
2	558-A-2	Octal Tube Socket
1	352-17	Power Transformer (T-1)
1	342-12	Output Transformer (T-2)
1	311-13	Oscillator Transformer (T-3)
2	552-1	Jack (Phono)
4	111-10521	Resistor, 1 Meg ½ Watt (R-1, R-10, R-23, R-24)

Qty Per Unit	Part Number	Description
2	111-27221	Resistor, 2700 Ohms ½ Watt (R-2, R-7)
2	111-47421	Resistor, 470 K Ohms, ½ Watt (R-3, R-11)
1	111-22521	Resistor, 2.2 Meg ½ Watt (R-4)
1	111-82321	Resistor 82 K, ½ Watt R-5)
1	124 A 50413-7	Volume Control .5 Meg Audio Taper (R-6)
2	111-22421	Resistor 220 K Ohms, ½ Watt (R-8, R-17)
2	111-27421	Resistor 270 K Ohms, ½ Watt (R-9, R-12, R-15)
2	111-10421	Resistor 100 K Ohms, ½ Watt (R-13, R-19)
1	111-15221	Resistor 1500 Ohms, ½ Watt (R-14)
2	111-22321	Resistor 22000 Ohms, ½ Watt (R-18, R-22)
1	126 A 50413-4	Tone Control .5 Meg Audio Taper (R-16, with switch)
1	111-68231	Resistor 6800 Ohms, 1 Watt (R-21)
1	111-39131	Resistor 390 Ohms, 1 Watt (R-20)
1	285 5064	Lytic 30-10-10 MFD. 350V (C-19, C-20, C-21, C-16, 25 MFD. 25V)
1	273-2561	Lytic Tubular 25 MFD. 25V (C-2)
1	263-1024	Condenser Tubular, .001 MFD. 400V (C-12)
2	263-3024	Condenser Tubular, .003 MFD. 400V (C-5, C-15, C-17)
1	232-3024	Condenser Mica .003 MFD. 400V (C-18)
3	263-1034	Condenser Tubular .01 MFD. 400V (C-6, C-7, C-9)
2	263-5034	Condenser Tubular .05 MFD. 400V (C-3, C-10)
4	232-2515-2	Condenser Mica 250 MMF. 500V (C-1, C-4, C-8, C-14, C-22)
2	232-5015	Condenser Mica 500 MMF. 500V (C-13, C-14)

SECTION 1
GENERAL

INTRODUCTION

SCOPE OF MANUAL

This booklet is written for the express purpose of guiding the repairman in the servicing of Revere Tape Recorders. When Revere Tape Recorders are brought in for servicing, a complete disassembly, inspection, repair and reassembly is recommended.

Such servicing should be done with a thorough understanding of this Service Manual in order to maintain the high quality workmanship originally built into each recorder. In the long run, this will reduce service call-backs and result in greatest customer satisfaction.

MODELS COVERED

This manual covers the following models of the Revere Tape Recorder:

T-100 (105-120 V, 60 cps)
TR-200 (105-120 V, 60 cps)
TS-300 (105-120 V, 50 cps)
TS-301 (210-240 V, 50 cps)

SPECIFICATIONS

POWER CONSUMPTION

Power consumption is 100 watts.

WEIGHT

Weight of the recorder is approximately 25 pounds.

RECORDING MEDIUM

Recorders are furnished with Tape No. 111, plastic backing, made by Minnesota Mining and Manufacturing Company. Any equivalent magnetic-recording tape having the following specifications may be substituted: paper or plastic base, 1/4 inch wide, magnetic-oxide coated, "A" wind, five-inch reel capacity.

TAPE SPEED

Recording or playback tape speed is 3.75 inches per second.

Playing time is one hour using a five inch reel with manual turnover (1/2 hour per side).

RAPID TAPE TRANSPORT

Rapid Forward Speed: approximately ten times normal playing speed, accomplished without disturbing or re-threading the tape.

Rewind: approximately 30 times normal playing speed; 600 feet of tape may be rewound in approximately one minute without disturbing or re-threading the tape.

INPUT CONNECTIONS

Two jacks on the rear of the recorder permit microphone input at 220,000 ohms (suitable for signals from minus 90 VU to minus 30 VU), and radio-phonograph input at one megohm (suitable for signals from minus 3 VU to plus 30 VU).

OUTPUT CONNECTIONS

Normal playback output is through a 5x7-inch elliptical, built-in, permanent magnet, dynamic speaker. Extension speaker jack on the back of the recorder permits output to any external speaker system having a 3.2 ohm impedance.

RECORD-PLAYBACK HEAD

Recorder is equipped with Shure Brothers, Inc. Model TR-5 head.

DRIVE MOTOR

Four pole, shaded-pole motor is rated at 1/80 horsepower.

MICROPHONE

Controlled reluctance dynamic microphone, rated 52 db below one-volt-per-dyne-per-square-centimeter is furnished.

RADIO ATTACHMENT CORD

Attachment cord with input plug and speaker clips permits connection of recorder to external input or output.

ERASURE

Erasure of saturated 400 cps signal by high frequency erase head exceeds 55 db.

MODELS T-100, TR-200,
TS-300, TS-301

FREQUENCY RESPONSE

POSITION TONE CONTROL	FREQUENCY RESPONSE
▲ Treble	±3 db, 100-7500 cps
Normal	±3 db, 60-6500 cps (-10 db at 50 and 7000 cps)
▼ Bass	±3 db, 50-3500 cps

DISTORTION

Amplifier distortion at low levels is less than 2 per cent total harmonic content. At 5 watts (maximum undistorted output) distortion is 8 per cent at 1000 cps.

Tape distortion at nominal recording level is less than 3 per cent; at maximum recording level, it is less than 10 per cent.

SIGNAL TO NOISE RATIO

Ratio exceeds 45 db at normal recording level.

TUBE COMPLEMENT

1 - 6SJ7
1 - 6K6-GT
1 - 6V6-GT
2 - 6J7
1 - 6X5-GT (Rectifier)

OPTIONAL ACCESSORIES

The following accessories are available as optional equipment:

Ear phone set (single ear type with special Revere plug).

Microphone extension cord (extends microphone lead 15 feet).

Microphone stand (Shure Brothers, Inc.).

CONTROLS AND INDICATORS

(Controls and indicators are illustrated in Figure 1.)

PILOT LAMP

Indicates power on-off condition.

FUNCTION SWITCH

Permits selection of recording, playback, rewind and stop operations.

RAPID FORWARD LEVER

Engages drive mechanism for rapid forward speed.

ON-OFF, VOLUME CONTROL

Turns recorder on and off; controls volume of input and output signals.

TONE CONTROL

Governs tone quality of output signal.

INSTANT STOP ARM

Starts and stops tape instantaneously.

RECORDING LEVEL INDICATOR

Dual-level neon indicator shows nominal recording level (two per cent distortion) and overload recording level (eight per cent distortion).

TIME-FOOTAGE INDICATOR

Shows elapsed time in terms of minutes and feet of tape.

RECORD SAFETY BUTTON

Prevents accidental erasures by controlling movement of Function switch to RECORD position.

OPERATING INSTRUCTIONS

Operating procedures are printed here for convenient reference. For complete detailed instructions, see Operating Instructions, a booklet furnished with every Revere Tape Recorder.

PRELIMINARY OPERATIONS

For all operations, place recorder in condition as follows:

(1) Turn Function switch to STOP.
(2) Turn On-Off switch to ON.
(3) Thread tape from left-hand reel through head slot to right-hand reel with dull side of tape against head (facing toward rear of recorder).

Recorder is now in readiness for any sequence of operations as described below.

TO RECORD

(4) Connect MICROPHONE or PHONO-RADIO jack (on back of recorder) to appropriate input signal source.

(5) Depress Record Safety button.
(6) Turn Function switch to RECORD position corresponding to type of input in use (MICROPHONE or PHONO-RADIO).
(6a) For machines equipped with an Instant Stop arm: A preliminary adjustment of the Volume control, using a sample signal, should be made while holding the recording tape at a standstill with the Instant Stop arm. For best recording level, adjust Volume control so that one-half section of the Recording Indicator glows for average input signal.
(7) Start recording.

NOTE

If Tape Recorder being serviced is not equipped with Instant Stop arm, immediately adjust Volume control so that approximately one-half of Recording Indicator glows on average signal.

TO REWIND

(4) Turn Function switch to REWIND.

TO PLAYBACK

(4) Turn Function switch to PLAY.
(4a) To reach a desired section of tape quickly, Rapid Forward lever may now be actuated, resulting in accelerated forward motion of tape.
(5) Adjust Volume control and Tone control.

TO SHUT-OFF

To cease any recorder operation, turn Function switch to STOP. Then turn ON-OFF switch to OFF.

NOTE

Always store recorder with Function switch in STOP position.

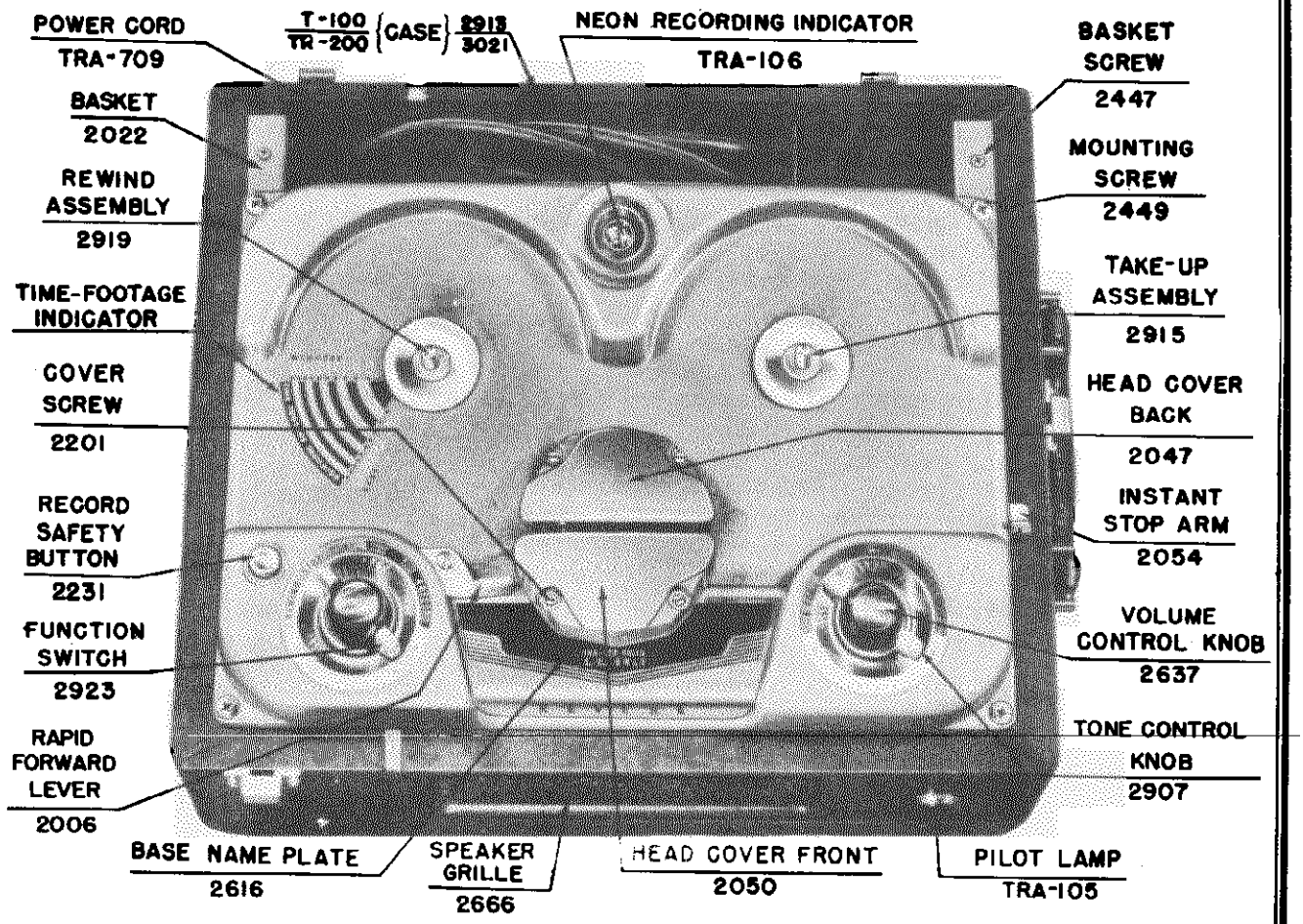


FIG. 1 - Revere Tape Recorder Controls and Indicators.

MODELS T-100, TR-200,
TS-300, TS-301

SECTION 2
SERVICING MECHANICAL SYSTEM

TROUBLE SHOOTING

The following trouble-shooting methods are general guides to quick isolation of mechanical difficulties.

NOTE

All friction drive surfaces should be cleaned with carbon tetrachloride. Because of their precision tolerances and critical surface finishes, all worn mechanical parts should be replaced with new factory-supplied parts.

Trouble	Possible Cause	Remedy
A-Weak Volume.	(1) Dirty head.	Remove front head cover, clean head with carbon tetrachloride or alcohol.
	(2) Worn or missing pressure pad.	Replace pad (Fig. 2); fasten with household cement.
	(3) Wrong type of tape.	Use tape as specified in Section 1.
	(4) Reversed tape wind.	Use "A" type wind (dull side of tape facing head laminations, see Fig. 2).
B-No Erase.	(1) Erase pressure pad missing.	Replace pad (Fig. 2); fasten with household cement.
	(2) Defective electrical components.	See Section 3.
C-No Sound.	(1) Head plug and/or tubes out of socket.	Insert head plug in socket. Insert tubes in sockets.
	(2) Defective electrical components.	See Section 3.
D-Tape Slippage.	(1) Excessive take-up.	See Section 2, Take-up Assembly.
	(2) Oil on capstan or pressure roller.	Clean capstan and pressure roller with carbon tetrachloride.
	(3) Smooth driving surface on capstan.	Replace with new capstan (#2910).
	(4) Excessive drag on storage reel.	Adjust rewind brake as explained in Section 2, Rewind Brake Adjustment.
	(5) Insufficient tension of pressure roller against capstan.	Replace pressure roller spring (Fig. 11).
E-Drive Irregularities.	(1) Binding flywheel due to insufficient clearance between flywheel shaft and bearing.	Replace flywheel assembly (#2910, Fig. 7) and flywheel bearing (#2209, Fig. 11).
	(2) Irregularities in surface of rubber idler.	Replace idler.
	(3) Binding pressure-roller bearing.	Clean bearing surface. Replace pressure roller if necessary.
	(4) Smooth surface on flywheel rim.	Replace flywheel.
	(5) Oil on drive surfaces.	Clean capstan, pressure roller, flywheel, idler, motor pulley, take-up, and rewind pulley with carbon tetrachloride.
	(6) Excessive motor vibration.	Fan blade out of balance; replace. Tighten mounting screws. Replace defective motor.
F-Insufficient Take-up.	(1) Oil on clutch plate.	Clean with carbon tetrachloride.
	(2) Weak clutch spring.	Check for correct "free" length (21/32" to 23/32", Fig. 8).

Trouble	Possible Cause	Remedy
G-Slow Rapid-Forward Speed.	(1) Oil on clutch plate.	Clean with carbon tetrachloride.
	(2) Rewind brake out of adjustment.	Refer to Section 2, Rewind Brake Adjustment.
	(3) Insufficient clearance between reel and back head cover.	Adjust for sufficient clearance.
H-Tape Spill.	(1) Improper brake and cam adjustment.	Refer to Section 2, Knockout Cam and Brake Adjustments.
I-Defective Instant Stop Brake.	(1) Instant stop spring out of adjustment.	Refer to Fig. 11.
J-Slow Rewind.	(1) Take-up brake and cam out of adjustment.	Refer to Section 2, Knockout Brake and Cam Adjustments.
	(2) Eccentric out of adjustment.	Refer to Section 2, Eccentric Adjustment.

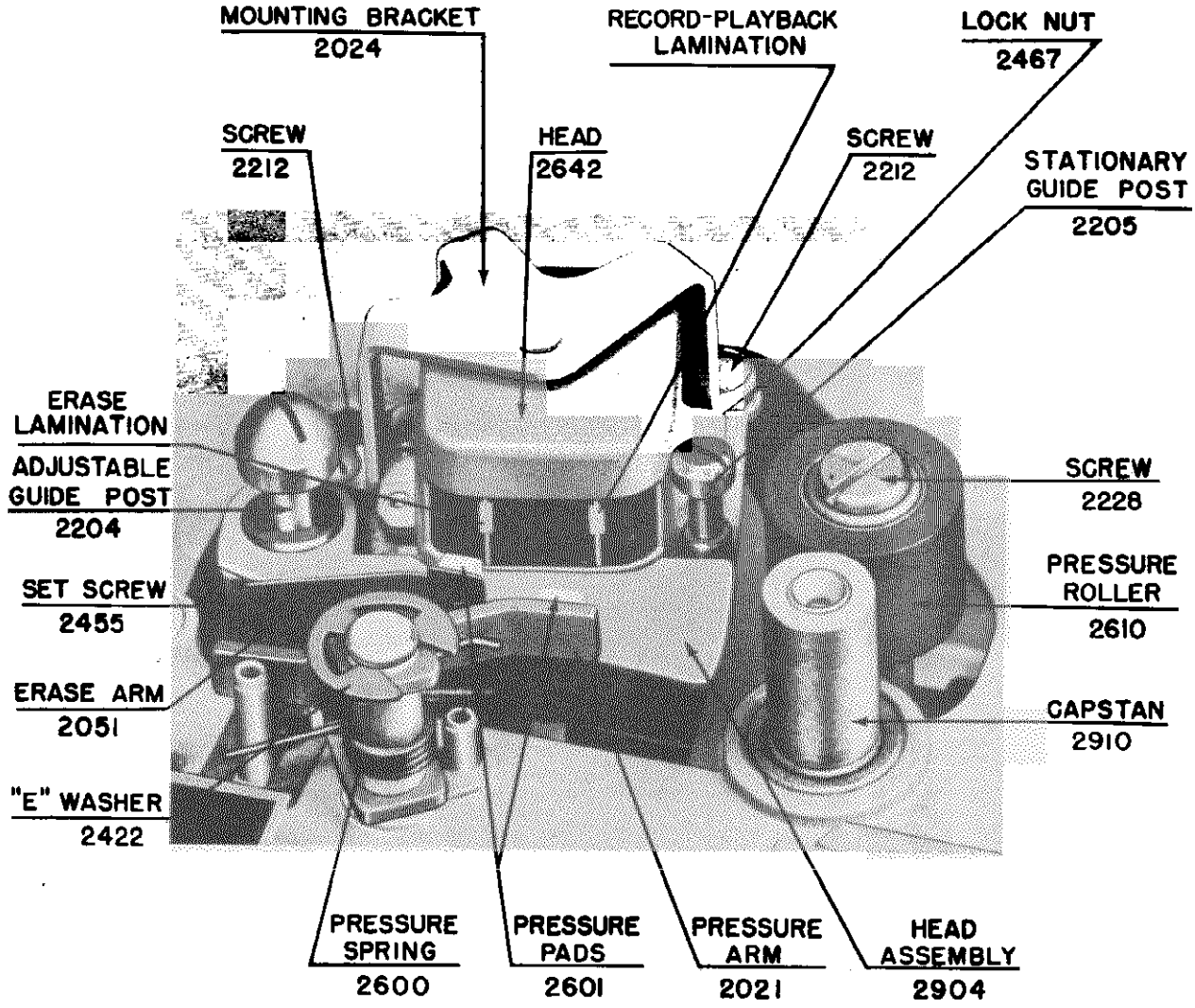


FIG. 2 - Recorder with Head Covers Removed Showing Head Mechanism.

MODELS T-100, TR-200,
TS-300, TS-301

REPAIR PROCEDURE

It is recommended that this section be thoroughly understood before any work is begun. Mechanical assemblies can then be easily serviced in the step-wise fashion indicated and with reference to the illustrations.

HEAD REPLACEMENT

If recording head has been proven defective, the following step-wise procedure should be followed:

(1) Remove head covers.

(2) Remove mounting bracket #2024 (note assembly of #2212 screws and #2467 lock nuts, see Fig. 2).

(3) Remove head wire leads from clips on under side of top casting and remove head plug from socket.

(4) Place Function switch in PLAY position and remove head wiring and plug through clearance in casting.

(5) Return Function switch to STOP position.

(6) The tape guide post #2204 will have to be re-aligned with the position of the head. This is accomplished by loosening set screw #2425 and adjusting the guide for maximum signal output using a 1000 cycle head alignment tape.

REMOVING RECORDER FROM CASE

(1) Place tape recorder on table or bench. Remove all literature and spare parts from basket. Remove basket screws (#2447) and mounting screws (#2449, see Fig. 1).

(2) Lift basket from case.

(3) Slide mechanism to rear of case (about 1/4 inch) and lift out.

REMOVING AMPLIFIER FROM MECHANISM

(1) Removal: Place machine face down in wooden rack (see Fig. 3). Remove only truss head screws shown in illus-

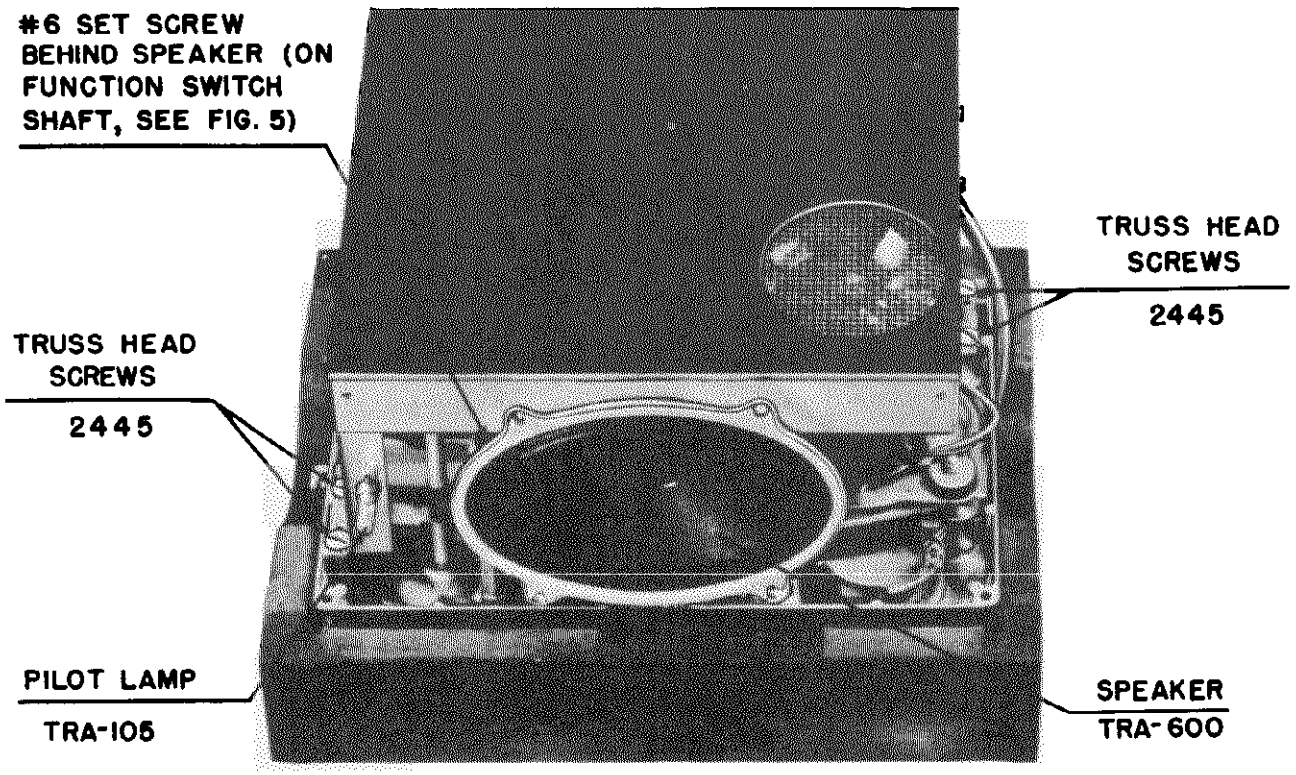


FIG. 3 - Bottom View of Recorder with Case Removed.

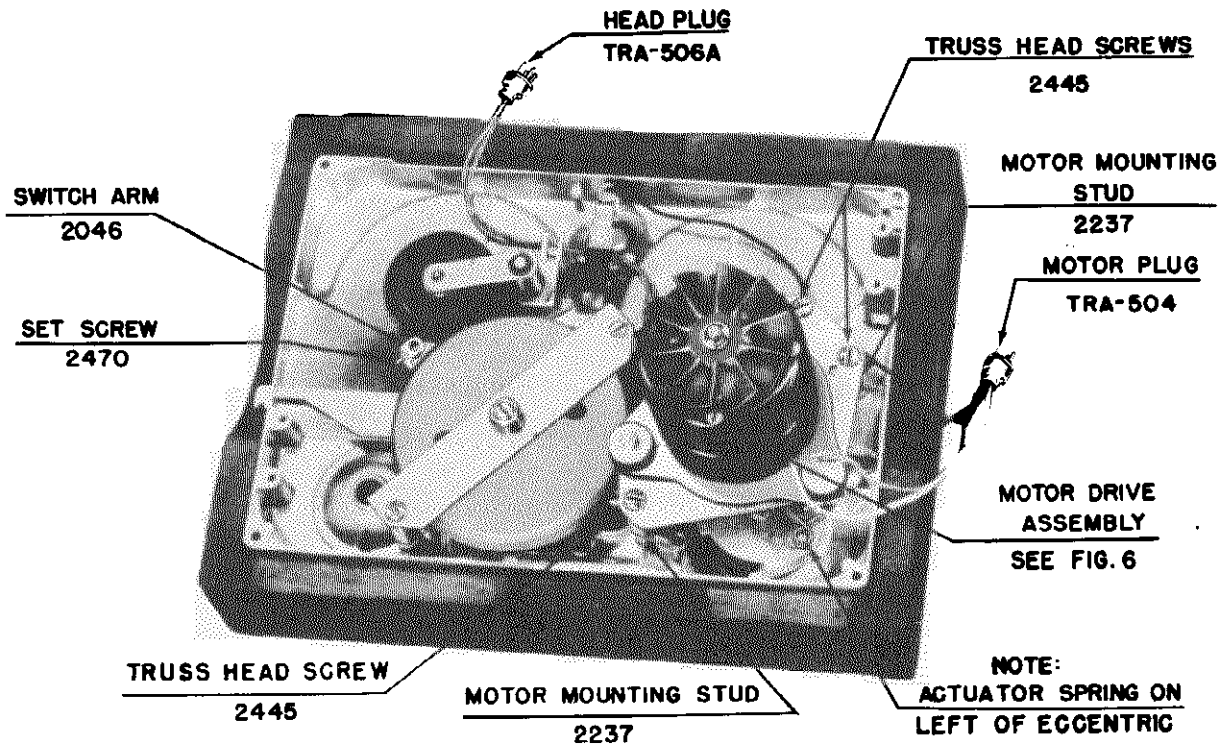


FIG. 4 - Bottom View of Recorder with Case and Amplifier Removed.

tration. Disconnect head and motor plugs from amplifier (see Fig. 4). Turn Function switch to REWIND position. Loosen set screw on switch arm (#2046). Return Function switch to STOP position. Remove amplifier from mechanism.

(2) Assembly (see Fig. 3): Place mechanism face down in wooden rack. Position amplifier above mechanism. Insert Function switch shaft through switch arm (#2046) and into boss in body casting (see Fig. 10). Turn Function switch to REWIND position; tighten switch-arm set screw against flat on switch shaft. Return Function switch to STOP position. Replace truss head screws (#2445) through amplifier mounting bracket. Replace head and motor plugs.

NOTE

Function switch should be in STOP position to remove pressure from rubber drive surfaces.

MOTOR DRIVE ASSEMBLY

NOTE

It is advisable that pulley spring (#2664) and eccentric (#2253) remain in their original positions.

Recorders built for 50 cycle operation have clip (#2053) mounted on right side of actuator (#2033) as viewed in Fig. 6.

(1) Disassembly: (See Fig. 4). Remove truss head screws (#2445). Lift motor free from motor mounting studs (#2237).

CAUTION

Do not damage fan blades.

(2) Inspection: (See Fig. 6). Check motor shaft for free rotation. Inspect idler wheel for wear. Check actuator (#2033) for free rotation on lower motor

bracket (#2901) bearing surface. Inspect motor pulley for wear.

(3) Repair: If motor shaft binds, tap motor with rawhide hammer. If this fails to allow free motor shaft rotation, replace motor.

Replace worn idler wheel. Replace worn motor pulley.

(4) Reassembly: Assemble motor assembly in sequence as shown in exploded view (Fig. 6). Check position of actuator spring (#2617) as noted in Fig. 4.

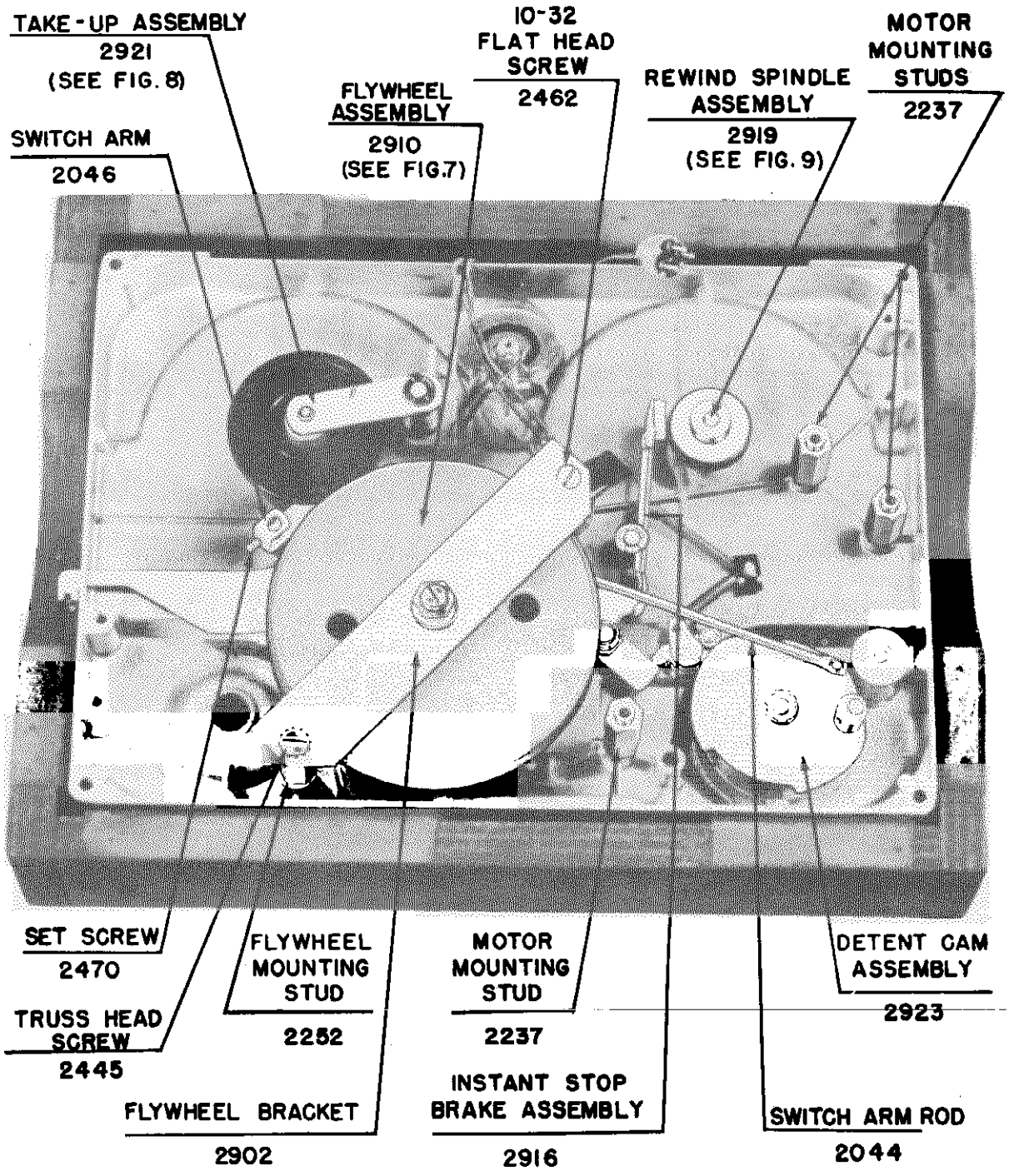


FIG. 5 - Bottom View of Recorder after Removing Motor Drive Assembly.

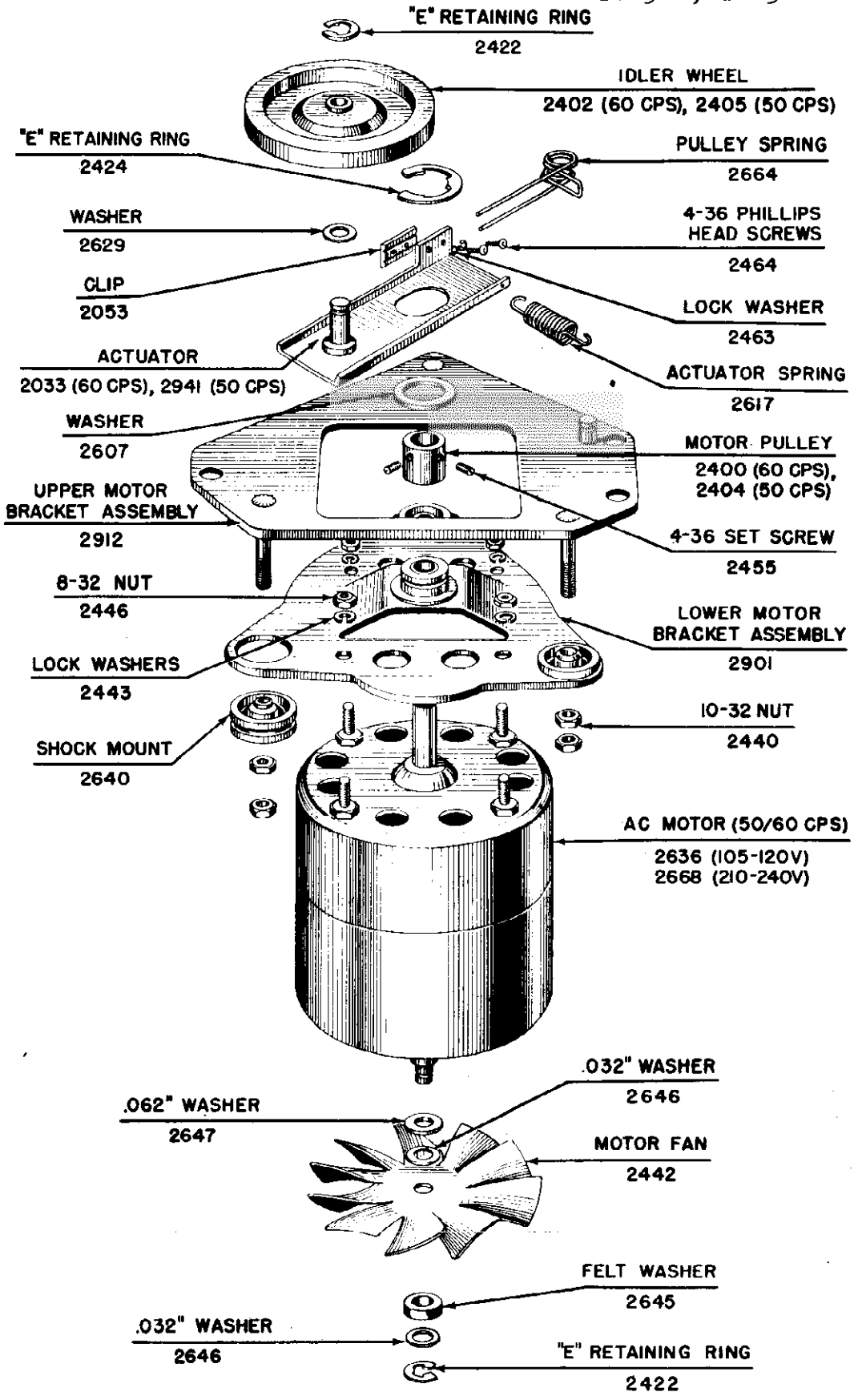


FIG. 6 - Exploded View, Motor Drive Assembly.

MODELS T-100,
TR-200, TS-300,
TS-301

FLYWHEEL ASSEMBLY

(1) Disassembly: (See Fig. 7.) Remove screws (#2462) and (#2445) from flywheel bracket. Lift bracket (#2902) from studs (#2252). Lift thrust ball (#2431) and thrust disc (#2042) from thrust socket.

(2) Inspection: Inspect thrust ball (#2431), thrust disc, (#2042) and flywheel (#2910) surfaces for burrs and wear.

(3) Repair: Replace worn parts. Capstan bearing (Fig. 11) should be replaced if capstan shaft circumference indicates wear.

(4) Reassembly: Lubricate thrust ball (#2431) and socket with Andox "B" Grease. Lubricate capstan shaft with Stan-Oil No. 75. Assemble parts in order shown in Fig. 7. Set thrust adjusting screw (#2229) to allow flywheel 3/64 inch vertical play along capstan shaft axis. Tighten loc.. nut (#2232).

TAKEUP ASSEMBLY

(1) Disassembly: (See Fig. 8.) Disconnect ends of arm spring (#2615). Remove "E" retaining rings (#2422 and #2423). Lift assemblies from stud (#2224) and spindle assembly (#2915).

(2) Inspection: Inspect take-up wheel (#2926) rubber surface, felt pad, and clutch plate (#2040) for wear. Check clutch spring (#2650) for correct free length (21/32 inch to 23/32 inch).

(3) Repair: Replace worn parts. Clean takeup pulley and clutch plate with carbon tetrachloride.

(4) Reassembly: Reassemble parts in specified relation (see Fig. 8). Be sure brake assembly (#2932) moves freely about stud (#2224). Clip arm spring (#2615) to arm assembly (#2917) and brake assembly (#2932).

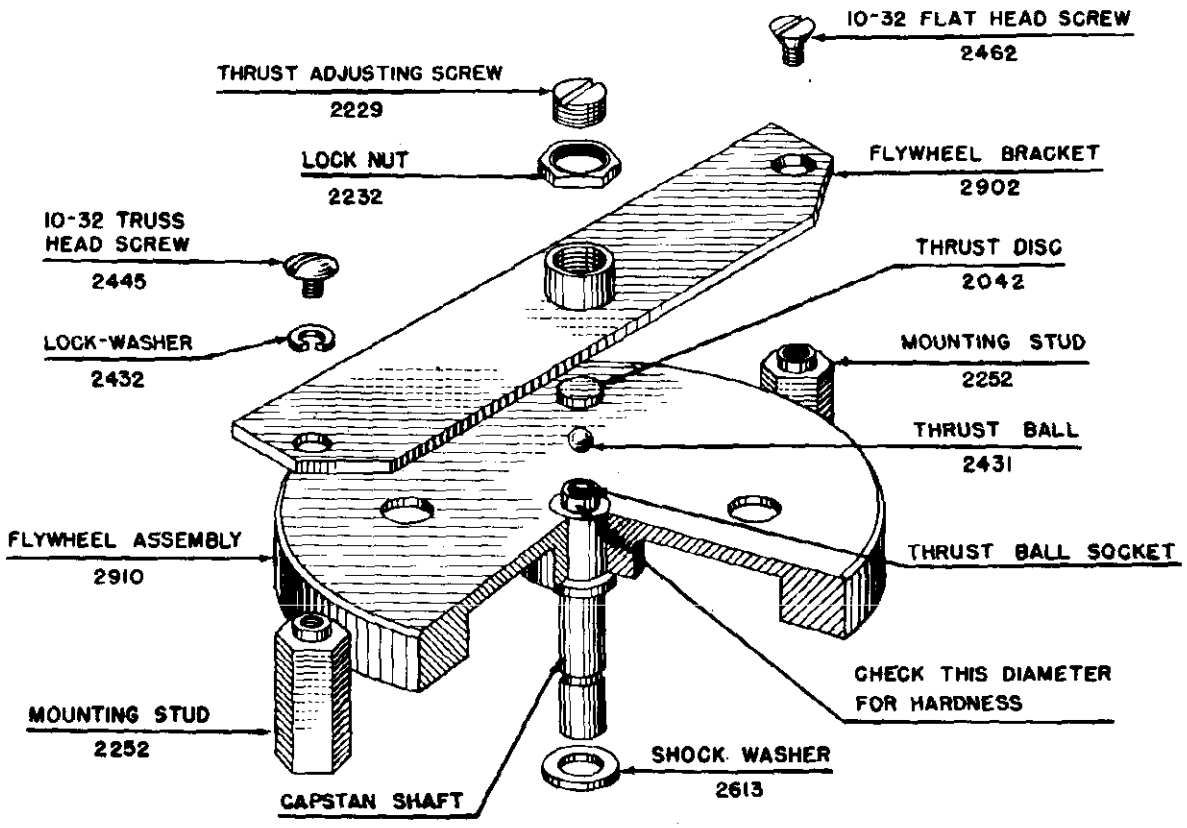


FIG. 7 - Exploded View, Flywheel Assembly.

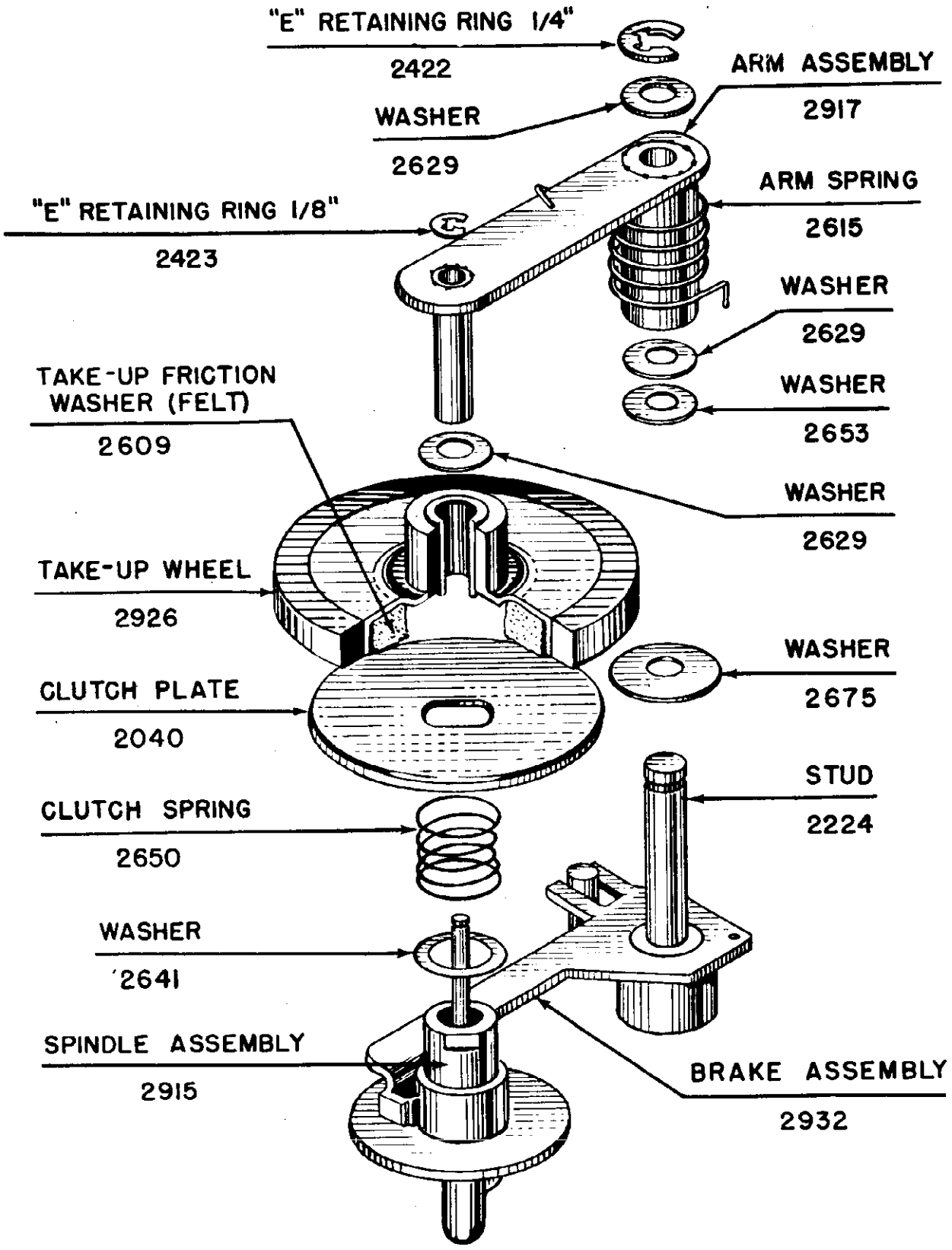


FIG. 8 - Exploded View, Takeup Spindle Assembly.

MODELS T-100, TR-200,
TS-300, TS-301

REWIND ASSEMBLY

(1) Disassembly: (See Fig. 9.) Loosen set screws (#2429). Lift rewind pulley assembly (#2403), karropak washer (#2654) and felt washer (#2658) from rewind shaft assembly (#2919). Slip rewind shaft assembly (#2919) out of bearing (#2612).

(2) Inspection: Check rewind pulley (#2403) surface, rewind shaft (#2919) and bearing (#2612) for wear.

(3) Repair: Replace worn parts.

(4) Reassembly: Grease rewind shaft (#2919) with ANDOX "B" Grease. Assemble as shown in Fig. 9. Tighten set screws (#2429) against flats of rewind shaft (#2919), allowing 1/64 inch play along axis of shaft.

KNOCKOUT CAM AND BRAKE ADJUSTMENTS

Fig. 10 illustrates further adjustments and checks which must be made. The following step-wise procedure is necessary.

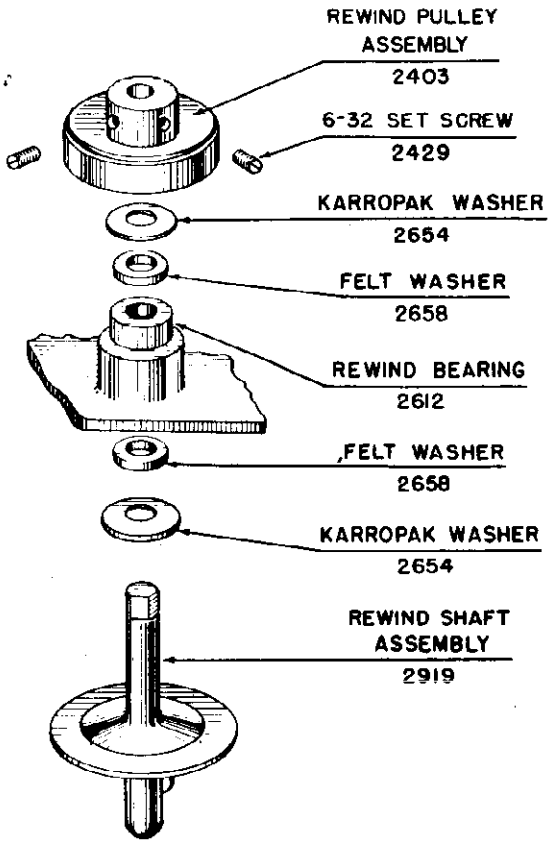


FIG. 9 - Rewind Assembly.

(1) With Function switch in REWIND position, be sure set screw is clamped against flat on Function switch shaft.

(2) With Function switch in PLAY position, adjust for 3/32 inch clearance between clutch knockout cam (#2933) and takeup arm assembly (#2917).

(3) With Function switch in REWIND position, adjust ear for .015 inch clearance between shoe of brake assembly (#2932) and shaft of takeup spindle assembly (#2915).

Upon completion of steps 1 through 3, the following steps indicate proper operation.

(4) With Function switch in PLAY and RECORD position, takeup wheel (#2926) should contact flywheel and takeup spindle assembly (#2915) should be disengaged from shoe of brake assembly (#2932).

(5) With Function switch in STOP position, brake assembly (#2932) should engage takeup spindle assembly (#2915) and takeup wheel should be disengaged from flywheel.

(6) With Function switch in REWIND position takeup wheel (#2926) should be disengaged from flywheel (#2910), and shoe of brake assembly (#2932) should be disengaged from takeup spindle assembly (#2915).

REWIND BRAKE ADJUSTMENT

Place Function switch in STOP position and adjust for 1/64 inch clearance between felt pad and shaft (see Fig. 11).

INSTANT STOP SPRING ADJUSTMENT

Place Function switch in PLAY position and adjust for 1/8 inch clearance as noted in Fig. 11.

ECCENTRIC ADJUSTMENT

Rotate eccentric (#2253, see Fig. 11) around its mounting pin to afford:

(1) Maximum power to rewind spindle with Function switch in REWIND position and,

(2) Maintain clearance between idler and motor pulley, with Function switch in STOP position.

NOTE

As viewed in Fig. 11, top flat surface of eccentric should be flush with end of its mounting pin.

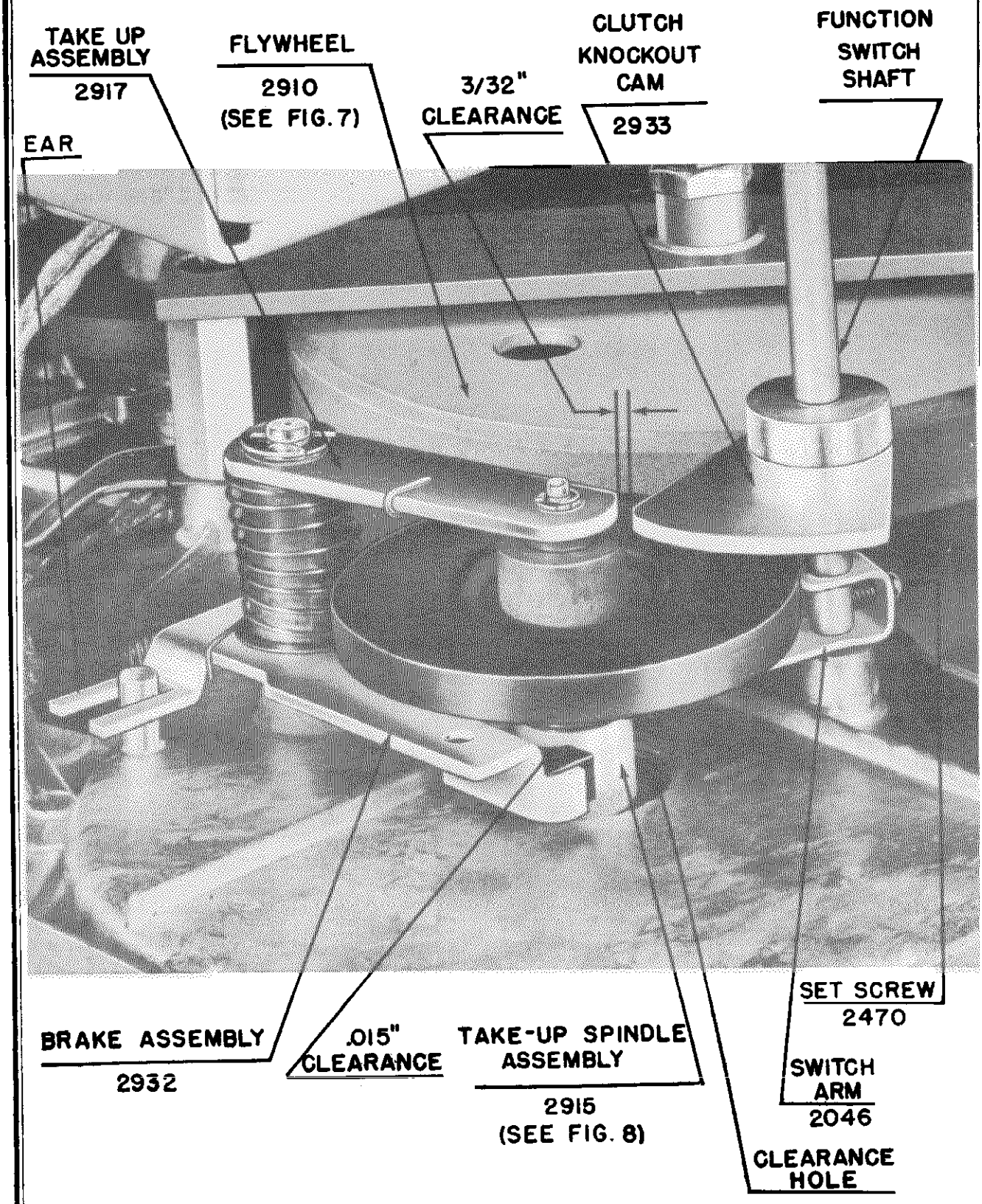


FIG. 10 - Knockout Cam and Brake Adjustments.

MODELS T-100, TR-200,
TS-300, TS-301

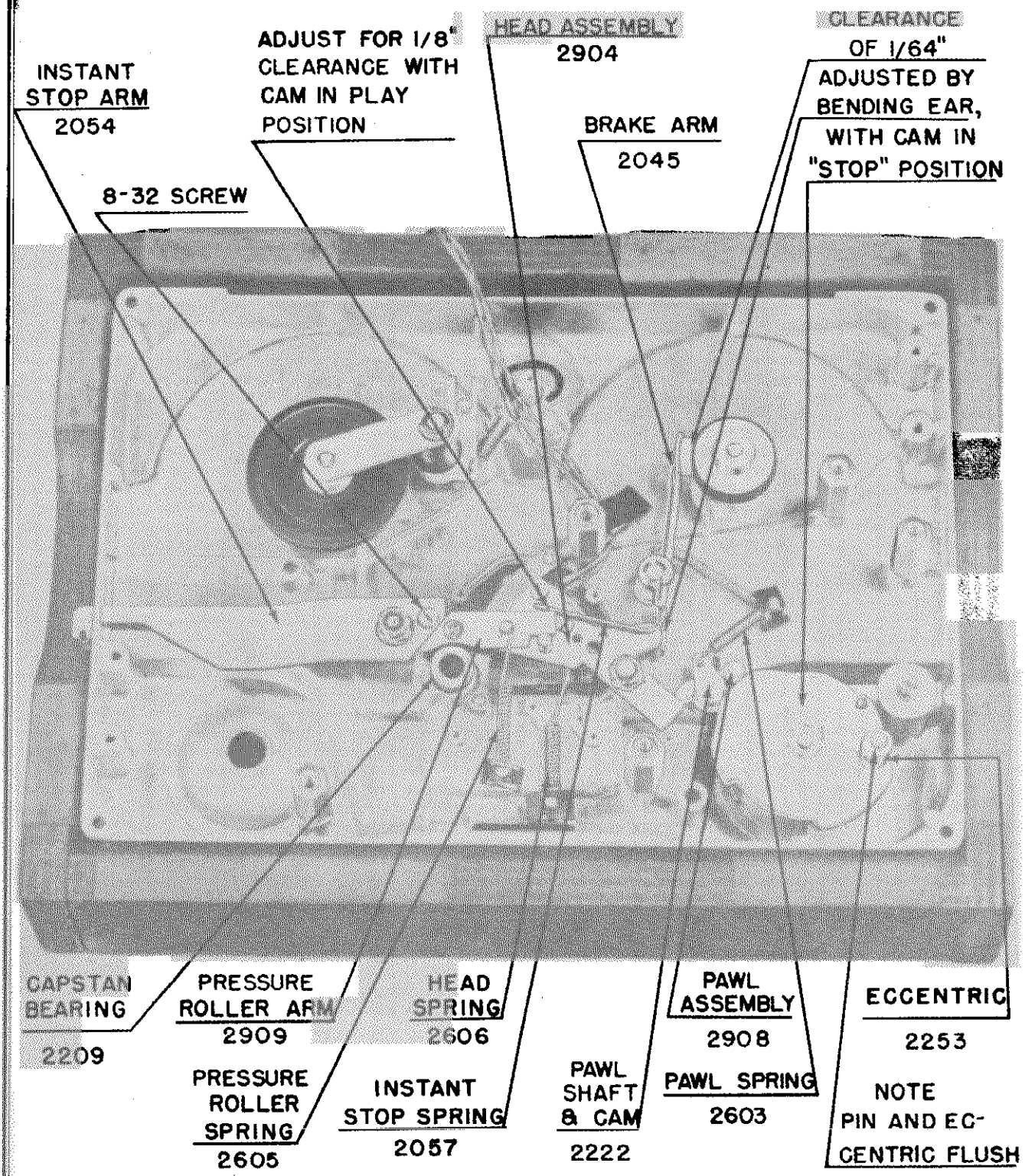


FIG. 11 - Bottom View of Recorder After Removing Flywheel Assembly.

MODIFICATIONS

Since the first Revere Tape Recorders were made, continued research has brought about improved features. The following paragraphs describe how any Revere Tape Recorder not already equipped with these improvements, can easily be modified to include them.

INSTANT STOP ARM

Recorders below Serial No. 15100 are not equipped with the Instant Stop arm; however, this feature can be added to these machines. Consult the factory for information.

MODIFIED CLUTCH BRAKE

An improved clutch-brake assembly can be installed on all machines below Serial No. 18600. Referring to Figure 12, procure and assemble parts as shown, enlarging clearance hole for takeup spindle assembly (see Fig. 10) to 1 inch diameter.

IMPROVED FLYWHEEL

Check shaft diameter noted in Figure 7. If this diameter is not "file hard", replace flywheel assembly (#2910) and capstan bearing (#2209).

MECHANICAL PARTS LIST

This parts list is tabulated with reference to the main mechanical groups. Individual parts listed are used only once except as otherwise stated.

ORDERING INFORMATION

To order any part listed below, specify part name and part number; preceed part number with "TR-". (Example: Top Mechanism Casting, TR-2001.)

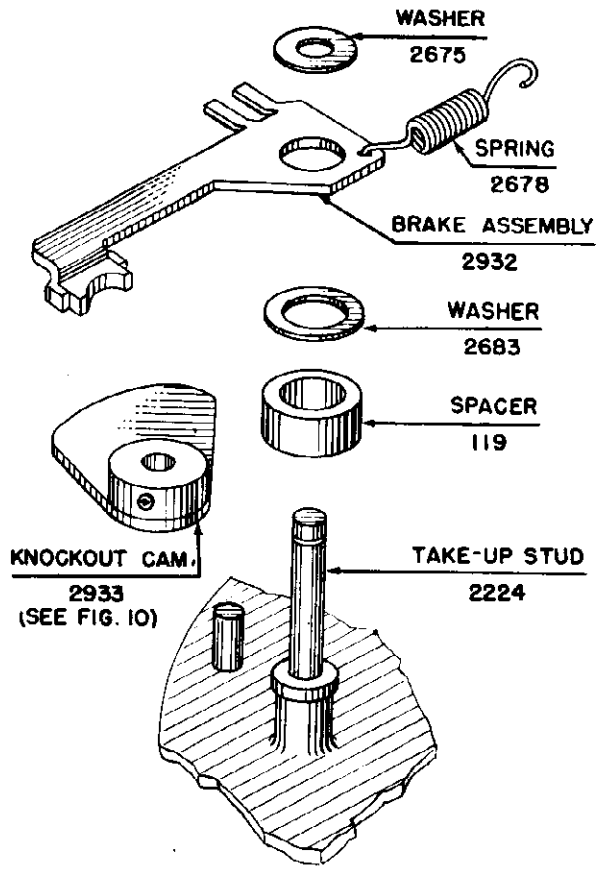


FIG. 12 - Clutch Brake Assembly.

MAIN CASTING GROUP (#2918)

2001	Top Mechanism Casting
2224	Take-up Swivel Stud
2612	Rewind Bearing
2239	Rapid Forward Brake Stud
2441	Rollpin
2675	Spacing Washer
2435	Rollpin
2458	Rollpin
2243	Rapid Forward Bushing
2209	Flywheel Bearing
2230	Pressure Roller Pivot Arm Stud
2227	Head Casting Pivot Arm Stud

HEAD ASSEMBLY GROUP (#2904)

2002	Head Casting
2024	Head Mounting Bracket
2026	Head Casting Guide
2031	Head Casting Pivot Arm
2055	Shim for Head Casting

MODELS T-100, TR-200,
TS-300, TS-301

2204	Adjustable Record Tape Guide Post
2205	Stationary Record Tape Guide Post
2241	#5-40 Screw, Head Guide
2421	Tape Guide Set Screw,. #4-36
2433	#6-32 x 5/16" Flat Head Screw (three used)
2631	Head Casting Arm Washer
2632	Head Casting Arm Washer
2642	Record Head, Shure Bros. Inc. Model TR-5
2455	Adjustable Record Tape Guide Set Screw

DETENT CAM ASSEMBLY (#2923)

2030	Detent Cam
2214	Detent Cam Hub
2216	Detent Pin Pulley Shifter
2220	Detent Pin Pawl Lock
2439	Groove Pin, Cam
2460	Detent Cam Groove Pin
2900	Detent Assembly, Switch-Nut-Washer

PAWL GROUP

2006	Rapid Forward Lever
2222	Pawl Shaft and Cam
2603	Pawl Tension Spring
2633	Pawl Shaft Washer
2639	Rapid Forward Washer
2908	Pawl Assembly

MOTOR GROUP

2422	"E" Retaining Rings (two used)
2402	Idler Wheel, 60 cycle
2405	Idler Wheel, 50 cycle
2424	"E" Retaining Ring
2629	Spacer Washer
2053	Spring Retaining Clip
2033	Actuator Arm
2903	Actuator Arm Assembly, 60 cycle
2941	Actuator Arm Assembly, 50 cycle
2664	Pulley Actuator Spring
2464	#4-36 Phillips Head Screw (two used)
2463	Lock Washer (two used)
2617	Actuator Spring
2607	Spacer Washer (two used)
2400	Motor Pulley, 60 cycle
2404	Motor Pulley, 50 cycle
2912	Upper Motor Bracket Assembly
2455	Screw (two used)
2446	#8-32 Nuts (four used)
2443	Lock Washers (four used)
2901	Lower Motor Bracket Assembly
2636	Motor, 50-60 cycle, 105-120 V
2668	Motor, 50-60 cycle, 210-240 V
2440	#10-32 Nuts (six used)
2647	Spacer Washer
2646	Spacer Washers .032" (two used)

FLYWHEEL GROUP

2462	#10-32 Flat Head Screw
2229	Thrust Adjusting Screw
2232	Lock Nut
2902	Flywheel Bracket
2445	#10-32 Truss Head Screw
2432	Lock Washer
2252	Flywheel Mounting Stud (two used)
2042	Thrust Disc
2431	Thrust Ball
2910	Flywheel Assembly
2613	Shock Washer

TAKE UP SPINDLE GROUP

2422	"E" Retaining Ring 1/4"
2629	Spacer Washers (three used)
2917	Take-up Swivel Assembly
2423	"E" Retaining Ring 1/8"
2615	Take-up Pulley Spring
2653	Spacer Washer
2926	Take-up Wheel Assembly
2675	Spacer Washer
2040	Clutch Plate
2650	Clutch Spring
2641	Take-up Bearing Spring Washer
2915	Spindle Assembly
2932	Brake Assembly
2678	Brake Spring
2609	Take Up Friction Washer (Felt)

REWIND SPINDLE GROUP

2403	Rewind Pulley
2429	#6-32 Set Screw (two used)
2654	Karropak Washer (two used)
2658	Felt Spacer Washer (two used)
2919	Rewind Shaft Assembly (two used)

SECTION 3
SERVICING ELECTRICAL SYSTEM

Each unit is tested at the factory for noise, hum, sensitivity, frequency response, power output and erase. Shipment, misuse, wear, and aging, all contribute to the need of service. It is the intention of this section to acquaint the serviceman with the characteristics of a normal operating unit and possible defects, so that his servicing problems can be reduced.

PRELIMINARY CHECKS

(1) Be sure all tubes are firmly seated in their sockets.

(2) Check voltages for valves given in Fig. 13 using a vacuum-tube voltmeter. These may vary from those given due to circuit variables and loadings.

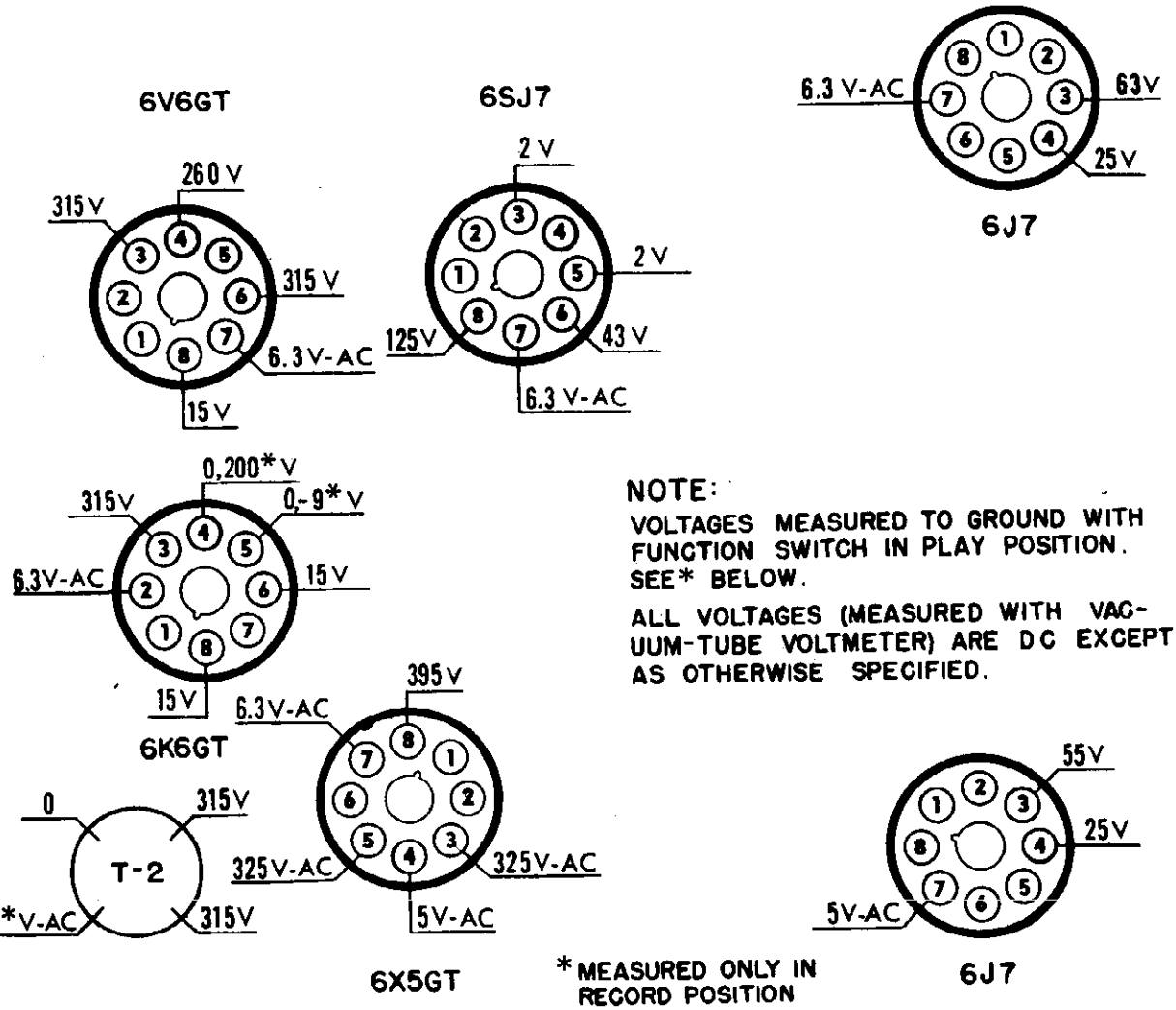


FIG. 13 - Socket-Pin Voltages.

MODELS T-100, TR-200,
TS-300, TS-301

NOTE

Neon lamp Recording-Level Indicator is biased with a DC potential in addition to audio-frequency signal voltage.

TEST TAPE

It is helpful to pre-record a tape with the following signals:

(1) Low intensity, 1000 cps for sensitivity checking.
(2) Nominal intensity, 120 and 5000 cps for frequency response.
(3) High intensity, 1000 cps for power output.
(4) Variable frequency for speaker rattle.

CONDENSERS-RESISTORS

Before checking condensers or resistors observe polarity of ohmmeter and allow tubes to cool.
(1) Condensers should be checked for DC leaks. (D.C. resistance should exceed 200 megohms.) Open condensers can only be checked by by-passing suspected condenser with a similar good one.
(2) Check for noisy resistors in input circuit by by-passing suspected resistor with .1 mfd condenser.

FUNCTION SWITCH

Control of major recorder operations is accomplished by operation of the Function switch.

FUNCTION SWITCH POSITIONS → / RECORDER COMPONENTS ↓	REWIND	STOP	PLAY	RECORD PHONO RADIO	RECORD MICROPHONE
Record-Playback Head (Fig. 14, 15) Connected to:			Amp. Input	Amp. Output	Amplifier Output
6K6 Tube (Erase)				X	X
1st 6J7 Tube; Compensating Network (Fig. 14)			X		
2nd 6J7 Tube; 6SJ7, 6V6, and 6X5 Tubes; Volume Control	X	X	X	X	X
Phono Jack	X	X		X	
Microphone Jack					X
Speaker	X	X	X	(Muted)	
Tone Control			X		

X = OPERATIVE CONDITION

Amplifier Operation Chart

CIRCUIT DIAGRAMS

A complete schematic circuit diagram is shown in Figure 16. In addition, Figures 14 and 15 show simplified circuits for the recorder head when the Function switch is in the PLAY and RECORD positions.

The coil L-1 is used for both recording and playing back signals on the tape. The .003 mfd. condenser, shunting L-1, resonates the coil thereby intensifying the higher audio frequencies. When the recorder is in RECORD position, L-2 is energized with a 25 kc erase signal. Frequency compensation occurs during playback only. See Fig. 14.

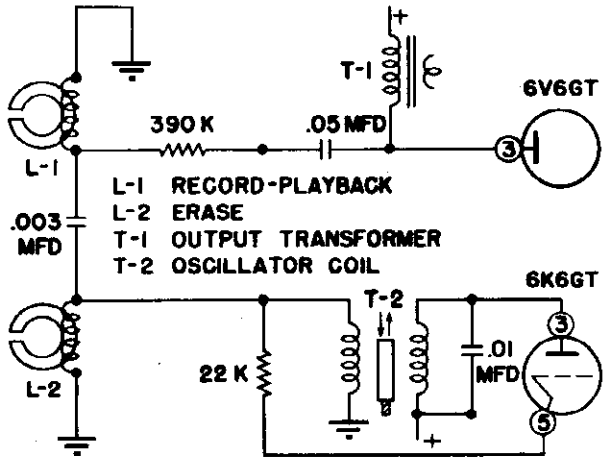


FIG. 15 - Recording Head Circuit.

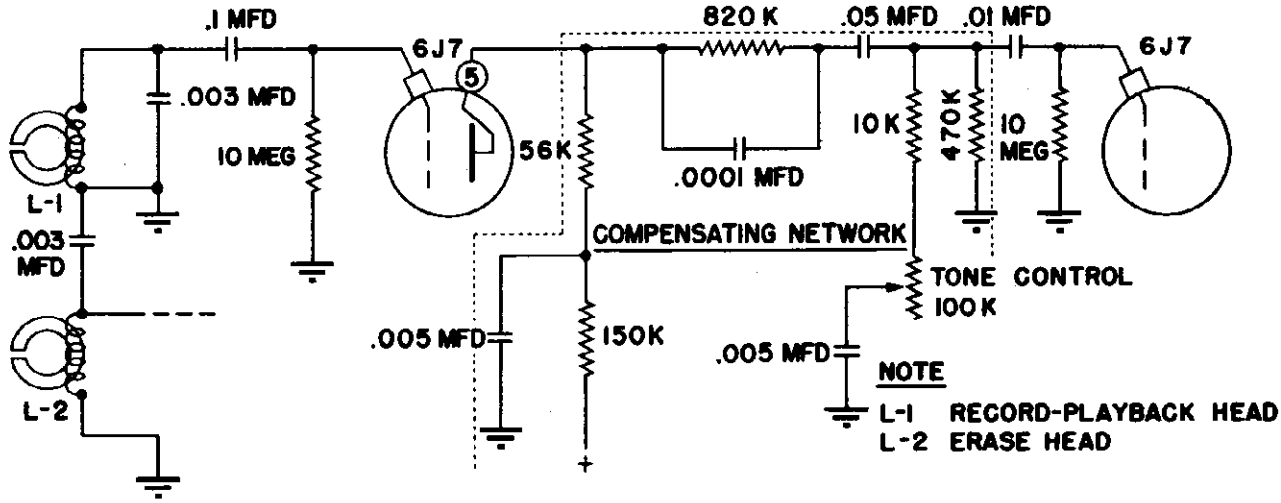


FIG. 14 - Simplified Playback Head Circuit.

TROUBLE SHOOTING

DEFECT	SYMPTOM	CHECK
A-Recorder Dead	(1) Pilot light and glass tubes dead with Off-On switch in ON position, motor inoperative.	Power cord or switch open.
	(2) Motor operates; glass tubes, pilot light dead.	Power-transformer primary or fila ment winding open.
	(3) Motor operates, glass tubes lighted.	Check 6X5 GT tube.
	(4) Burnt odor.	6X5 GT tube shorted (operate for 3 minutes after replacing tube to revea transformer damage by excessiv heating).
	(5) Burnt odor (AC unit connected to DC).	6X5 GT tube OK; check power switc and transformer primary for open.
	(6) Burnt odor (115 volt unit plugged into 230 volt supply).	6X5 GT tube shorted; electrolytic con denser, C-21, shorted; R-28 oper power-transformer primary ope

MODELS T-100, TR-200,
TS-300, TS-301

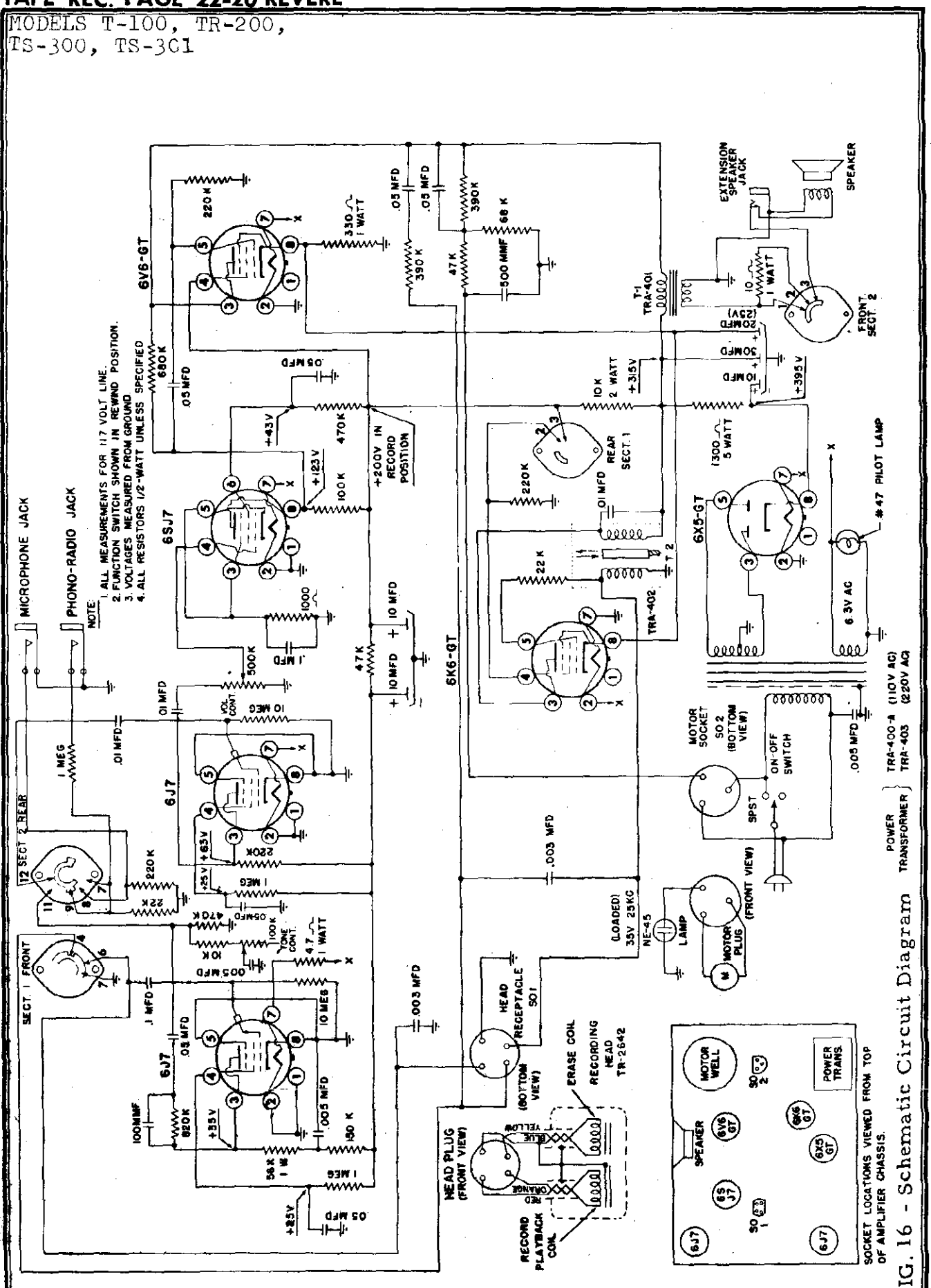


FIG. 16 - Schematic Circuit Diagram

DEFECT	SYMPTOM	CHECK
		(operate 30 minutes after repairing if transformer appears OK).
	(7) No sound from speaker. Glass tubes and pilot light operating; Recording Level indicator inoperative.	Defective tubes; open primary in T-1; open secondary, power transformer; C-5, C-8, C-10 open.
	(8) Recording Level indicator operates; no sound from speaker in PLAYBACK or RECORD; Extension Speaker jack dead.	Contacts on Function switch open; T-1 secondary open (check with Extension Speaker jack contacts open).
-Dead Playback Only	Appears to operate properly in RECORD position; no sound in PLAYBACK. Recording Level indicator operating.	1st stage 6J7 tube defective; contacts in Function switch open; R-2, R-13, R-14 open; C-2, C-15 open.
-Weak Playback Only	Operates properly in RECORD.	Check items immediately above (B); C-1 open.
-Weak or Distorted Record	OK in PLAYBACK on a pre-recorded tape.	Check C-7 for leakage (remove head plug and check for DC Voltage on R-26). Erase not operating (check for 35 volts AC across secondary of T-2). Replace head plug; check for AC across both sides C-14.
-Weak or Dead RECORD-PHONO	OK in MICROPHONE RECORD position.	Open phono circuit through switch. R-1, R-4, or radio attachment cord open.
-Weak or Dead RECORD MICROPHONE	OK in PHONO RECORD.	Open microphone circuit through switch. Microphone or its cord defective.
-Recording Level Indicator Inoperative	Records and plays properly but Recording Level indicator not operating.	Loose or defective indicator lamp. C-7 open.
-Recording Level Indicator Always Glows	Not affected by Volume control.	Defective C-7.
-Recording Level Indicator Glows on PLAYBACK Only	Affected by Volume control. Weak or distorted playback (parasitic oscillation).	Open C-13.

DEFECT	SYMPTOM	CHECK
J-Tone Control Inoperative	No control of tone in PLAYBACK.	Open Tone control R-31. Open C-12. NOTE: Tone control operates only on PLAYBACK.
K-Records with Background Hum	Playback-hum high; lower on pre-recorded tape.	C-21 defective; cathode to filament leakage in 2nd stage 6J7, 6SJ7, 6V6 GT, or 6K6 GT tubes.
L-Hum On PLAYBACK Only	Falls off with decrease in Volume control level.	Cathode to filament leakage in 6J7 tube.
M-Microphonic	Dies out when volume level is reduced.	Tap 1st Stage, 6J7 tube, for indication. (Retain 1st stage microphonic tube as replacement in 2nd stage.)
N-Loss of High Frequencies in PLAYBACK	Pre-recording "boomy".	Check C-17.
O-Loss of Low Frequency in PLAYBACK	Pre-recording "tinny".	R-31, C-11, or C-12 open.
P-Noisy in PLAYBACK	(1) "Shot effect"; high frequency hiss.	R-13 noisy, R-31, C-11, or C-12 open.
	(2) Low frequency "rumble".	R-2 or R-14 noisy.
Q-No Erase	Records over previous recordings without erasing.	Defective 6K6 GT tube. First, remove head plug from SO-1 and check for AC voltage across secondary of T-2; replace head plug; check voltage again. C-9 open or shorted; T-2 shorted or R-5 open. NOTE: Adjust T-2 for 35 volts AC across L-2.

ELECTRICAL PARTS LIST

The electrical system parts list is keyed to the figures throughout this manual; circuit symbols as tabulated in this list represent the components similarly labelled in the figures. (For resistor and condenser locations, see Fig. 17.)

When ordering parts for the electrical system, specify circuit symbol (if one is given in the parts list), part number and part description. (Example: R1, TRA 302, 1 megohm, 20%, 1/2 watt.)

CIRCUIT SYMBOL	PART NO.	DESCRIPTION
	RESISTORS	
R1, R2, R3	TRA 302	1 megohm, 20%, 1/2 watt
R4, R5	TRA 309	22,000 ohm, 20%, 1/2 watt
R6, R7, R8, R9	TRA 305	220,000 ohm, 20%, 1/2 watt

CIRCUIT SYMBOL	PART NO.	DESCRIPTION
	RESISTORS - Continued	
R10, R11	TRA 300	10 megohm, 20%, 1/2 watt
R12	TRA 313	820,000 ohm, 10%, 1/2 watt
R13	TRA 318	56,000 ohm, 10%, 1 watt
R14	TRA 315	150,000 ohm, 10%, 1/2 watt
R15, R16	TRA 321	470,000 ohm, 20%, 1/2 watt
R17	TRA 307	10,000 ohm, 20%, 1/2 watt
R18, R19	TRA 317	47,000 ohm, 20%, 1/2 watt
R20	TRA 322	1,000 ohm, 20%, 1/2 watt
R21	TRA 308	10 ohm, 20%, 1 watt
R22	TRA 303	68,000 ohm, 20%, 1/2 watt
R23	TRA 312	330 ohm, 20%, 1 watt
R24, R26	TRA 301	390,000 ohm, 20%, 1/2 watt
R25	TRA 316	68,000 ohm, 10%, 1/2 watt
R27	TRA 311	10,000 ohm, 10%, 2 watt
R28	TRA 319	1,300 ohm, 10%, 5 watt
R29	TRA 304	4.7 ohm, 10%, 1/2 watt
R30	TRA 306	100,000 ohm, 20%, 1/2 watt
R31	TRA 320	Volume-Tone control
	CONDENSERS	
C1, C2, C3, C4, C5, C6, C7	TRA 203	.05 mfd, 400v, paper tubular
C8, C9, C10	TRA 205	.01 mfd, 400v, paper tubular
C11, C12	TRA 207	.005 mfd, 600v, paper tubular
C13, C14	TRA 204	.003 mfd, 600v, paper tubular
C15, C16	TRA 202	.1 mfd, 200v, paper tubular
C17	TRA 208	100 mmf, 10%, 500v mica
C18	TRA 209	500 mmf, 20%, 400v ceramic
C19	TRA 206	005 mfd, 1000v, paper tubular
C20	TRA 200	15-15 mfd, 350v, electrolytic
C21	TRA 201	10-30-25 mfd, 450-350-25v, electrolytic
	MISCELLANEOUS	
S1	TRA 511	Function Switch
T1	TRA 401	Output Transformer
T2	TRA 402	Oscillator Coil
	TRA 105	Pilot Lamp (#47)
	TRA 106	NE 45 Neon Recording Indicator Lamp
	TRA 400	Power Transformer, 105-120 volts
	TRA 403	Power Transformer, 210-240 volts
	TRA 512	Speaker Plug (Male)
	TRA 600	5x7 Speaker
	TRA 709	Power Cord Assembly
	TRA 801	Trimount Stud
	TRA 900	Chassis Assembly
	TRA 901	Radio Attachment Cord
	TRA 904	Microphone
	TRA 905	Microphone Extension Cord Jack (Female)
	TRA 906	Microphone Plug (Male)
	TRA 100	6V6 GT Vacuum Tube
	TRA 101	6X5 GT Vacuum Tube
	TRA 102	6J7 Vacuum Tube
	TRA 103	6K6 GT Vacuum Tube
	TRA 104	6SJ7 Vacuum Tube

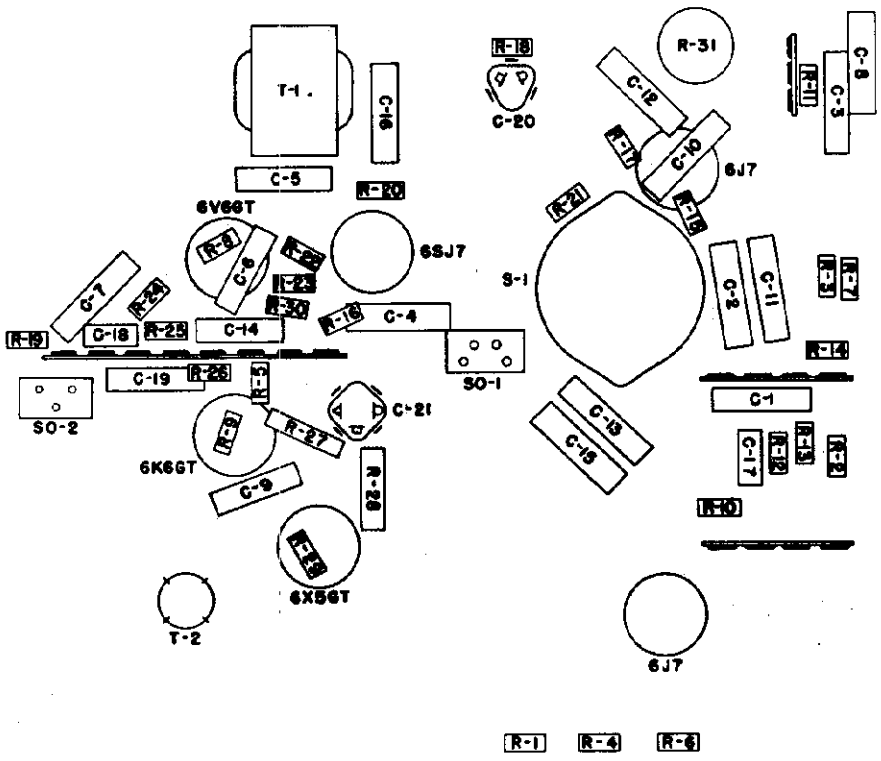
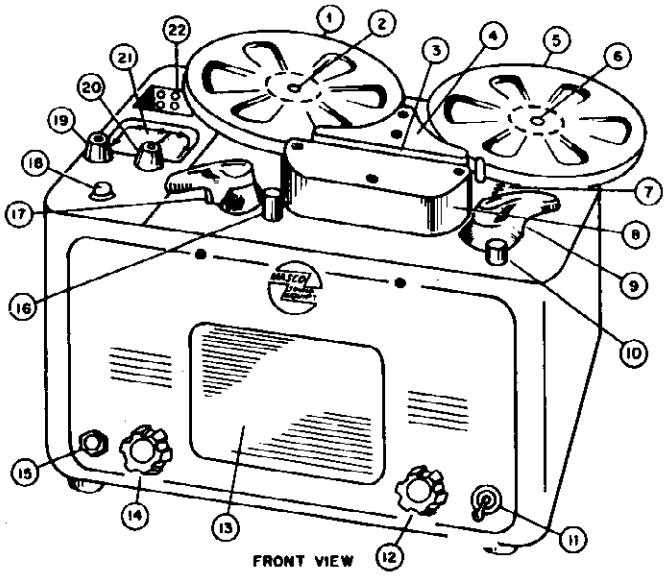
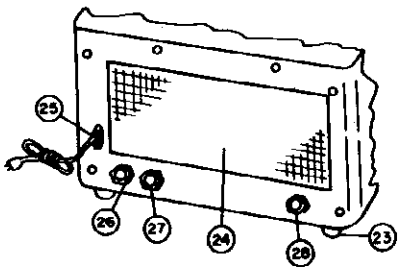


FIG. 17 - Electrical Component Locations, Bottom View of Amplifier.

MASCO SOUND REEL DUAL SPEED DUAL-TRACK MAGNETIC TAPE RECORDER



FRONT VIEW



REAR VIEW

MARK SIMPSON
MODELS D-37, D-37R, DC-37R, LD-37, LD-37R

SPECIFICATIONS

POWER CONSUMPTION: 80 watts at 117 volts, 60 cps (Models D-37, DC-37, LD-37)
95 watts at 117 volts, 60 cps (Models D-37R, DC-37R, LD-37R)

POWER OUTPUT: 5 WATTS (to internal or external speaker)

HUM LEVEL: 50 db below full output

FREQUENCY RESPONSE: 80-8500 cps ±3 db at 7.50"/sec.
80-5000 cps ±3 db at 3.75"/sec.

SIGNAL-TO-NOISE RATIO: 45 db at 7.50"/sec. 40 db at 3.75"/sec.

ERASE AND BIAS FREQUENCY: 60 Kc

INPUTS: (1) Microphone-1 megohm impedance, .003 volts sensitivity
(1) Radio-Phono-0.5 megohm impedance, 0.4 v. sensitivity
(1) External Speaker, 8-16 ohm voice coil, 5 watts
(1) External Amplifier, 500 ohms, 1.7 volts to line or amplifier (any 500 ohm or high impedance radio-phono input may be used)

MONITORING: The EXTERNAL SPEAKER jack takes a phono-type plug and may be used with any headphones for HEADPHONE MONITORING simultaneously with recording. The INTERNAL SPEAKER may also be used for monitoring.

MONITOR SWITCH: On tone control

AMPLIFIER CONTROLS: (1) Volume; (1) Tone

SPEAKER: 6" PM. 3.2 ohm voice coil

PLAYBACK EQUALIZATION: Seperate for each speed

REWIND SPEED: 1200 feet in 3 minutes (approx.)

RECORDING VOLUME LEVEL INDICATOR: Neon bulb also acts as Pilot Light in "PLAYBACK"

TAPE TIME (with 1200' reel): 7.50"/sec. - 1 hr. dual track; 1/2 hr. single track
3.75"/sec. - 2 hrs. dual track; 1 hr. single track

TAPE: Any "A" wound tape (dull or coated side facing in toward hub of reel) may be used.

AMPLIFIER TUBES: (1) 12AX7 equalized tape playback pre-amplifier
(1) 6SL7GT dual purpose microphone voltage amplifier and intermediate amplifier.
(1) 6SN7GT dual purpose: recording head driver in "RECORD" output amplifier tube driver in "PLAYBACK"; monitor amplifier in "RECORD"

MODELS D-37, D-37R,
DC-37R, LD-37, LD-37R

(1) 6V6GT 60 Kc. Bias and erase oscillator in "Record", power output amplifier in "Playback".
(1) 6X5GT full wave rectifier

AM RADIO TUNER: (Models D-37R, LD-37R, DC-37R only); TUBES:
(1) 6BA6 RF amplifier
(1) 6BE6 Oscillator-converter
(1) 6SF7 IF amplifier and detector
(1) Selenium Rectifier

Radio ON-OFF Switch on radio tuner operates a seperate power supply for the tuner.

CALL OUT DIAGRAM LEGEND

1. SUPPLY REEL — Reels up to 7" in diameter may be used.
2. SUPPLY REEL SPINDLE — Threaded (6-32) to permit bolting down of reels.
3. TAPE SLOT — Can be used for attaching recording counter.
4. RECORD AND ERASE HEAD — Shure Type TR5H. Head mounts on head alignment pins and may be replaced without any special alignment tools. Head is kept firm by means of a felt pressure pad.
5. TAKE-UP REEL — 7", supplied with recorder.
6. TAKE-UP REEL SPINDLE — Threaded (6-32). Braking pressure is applied to this spindle shaft during "Rewind" to ensure even winding of tape and to prevent slippage.
7. ELAPSED TIME INDICATOR SCALES
8. CAPSTAN TURRET — Feeds tape at constant speed.
9. CONTROL LEVER No. 1-&2- position control:
   Position 1: Off-Stop tape - Rewind
   Position 2: Record - Playback
10. RECORD PUSHBUTTON — Used for recording at either speed. This button must also be depressed to ERASE
11. MAIN POWER SWITCH — Turns on amplifier and motor. If control levers are at OFF motor will idle with capstan disengaged.
12. TONE CONTROL AND MONITOR SWITCH — Continuous Treble attenuation type tone control. The control is not effective when recording, CORRECT tonal values being determined by the equalizing circuits. The MONITOR SWITCH, operated by the tone control, allows the user to listen while recording.
13. SPEAKER
14. VOLUME CONTROL — Used for adjusting the recording volume level and also for controlling the volume in "Playback"
15. MICROPHONE INPUT — Takes standard phone-type plug.
16. 3.75 SPEED CHANGE PUSHBUTTON — Used only when recording or playing back at 3.75"/sec.
17. CONTROL LEVER No. 2- a 3- position control:
   Position 1: Rewind
   Position 2: Off-Stop Tape
   Position 3: Record - Playback
18. VOLUME LEVEL INDICATOR AND PILOT LIGHT — Neon bulb acts as indicator of correct recording volume in "Record" and as pilot light at all other times.
19. TUNING CONTROL — For built-in AM radio (models with radio only).
20. RADIO ON-OFF SWITHH — Main power switch must be ON to permit radio to be operated (models with r adio only).
21. RADIO DIAL
22. MICROPHONE STORAGE COMPARTMENT (on models without radio only)
23. BUMPER FEET
24. REMOVABLE BACK — Perforated for ventilation and provided with safety interlock to automatically disconnect power when back is removed.
25. AC POWER CORD — For operation on 117 volts, 60 cycles AC only.

26. EXTERNAL SPEAKER AND MONITOR JACK Delivers full audio power to external 8-16 ohms speaker or headphones.
27. EXTERNAL AMPLIFIER OUTPUT
28. RADIO AND PHONOGRAPH INPUT Any radio, tuner or phonograph can be adjusted for use with this input.

TAPE RECORDER, RADIO TUNER, VOLTAGE AND RESISTANCE CHARTS

VOLTAGE MEASUREMENTS			
TUBE	6BA6	6BE6	6SF7
Pin #1	-0.85V DC	-2V DC	--
#2	0	0	-0.85V DC
#3	0	0	0.6V DC
#4	6.3V AC	6.3V AC	107 V DC
#5	94V DC	94V DC	-0.95V DC
#6	102V DC	60V DC	90V DC
#7	0.3V DC	0	6.3V AC
#8	-	-	0

All voltages to ground, measured with 20,000 ohm/volt meter.

RESISTANCE MEASUREMENTS			
TUBE	6BA6	6BE6	6SF7
PIN #1	3.2 meg.	15,000	0
#2	0	0.2	3.2 meg.
#3	0	0	270
#4	0.3	0.3	33,000
#5	28,000	28,000	520,000
#6	33,000	38,000	28,000
#7	150	4.7	0.3
#8	-	-	0

All resistances measured to ground.

INSTALLATION

This recorder is designed to operate from 105-125 volts 60 cycles AC. Operation on any other voltage or frequency may result in serious damage and/or improper operation and will void the guarantee. If in doubt consult your MASCO dealer or power company.

1. Insert the AC power plug into any 105-125 volt, 60 cycle AC socket.
2. Remove full reel of tape, empty take-up reel and microphone from storage.

OPERATION

Before reading the operating instructions, it is suggested that you familiarize yourself with the various controls and features of your recorder as described in the preceding pages.

TO RECORD FROM MICROPHONE

1. Make certain that CONTROL LEVERS No. 1 and 2 are at OFF.
2. Place MAIN POWER SWITCH TO ON
3. Place full reel of tape on the SUPPLY REEL SPINDLE so that the glossy side of the tape faces you and the reel will unwind counter-clockwise. Make certain that one of the slots in the hub of the reel engages the fin or key of the reel spindle.
4. Place the empty take-up reel on the TAKE-UP REEL SPINDLE, making sure that the reel slot engages the fin at the base of the spindle.
5. Unwind about 2 feet of tape from the Supply Reel. Drop the tape into the TAPE SLOT and run it in FRONT of the tape guide pin on the right of the RECORD HEAD housing.
6. Insert free end of tape into slot on take-up reel and rotate the reel counter-clockwise (to the left) for a few turns until the tape is engaged. BE SURE THAT THE GLOSSY SIDE OF THE TAPE FACES YOU. Rotate reel to take up slack.
7. By this time the neon-bulb PILOT LIGHT should be glowing steadily to indicate that the equipment is warmed up and ready to operate. Plug microphone into MICROPHONE INPUT.
8. Depress the RECORD PUSHBUTTON. While keeping the button depressed, rotate CONTROL LEVER No. 1 to "RECORD" position.
9. The PILOT LIGHT goes out as a result of the above operation and becomes the RECORDING VOLUME LEVEL INDICATOR. Hold the microphone firmly in the hand about 6 to 12 inches away from the mouth. While speaking into the

microphone in a normal tone of voice, rotate the VOLUME CONTROL clockwise until the neon bulb VOLUME LEVEL INDICATOR flickers occasionally. The VOLUME CONTROL should not be advanced to the point where the neon bulb glows continuously, to avoid distortion. IT IS RECOMMENDED THAT THE USER MAKE SEVERAL TEST RECORDINGS TO GAIN EXPERIENCE WITH THE PROPER SETTING OF THE RECORDING VOLUME LEVEL.

10 You may now Record. To listen to the recording being made, you may, at this point, turn on the internal SPEAKER by means of the MONITOR SWITCH on the TONE CONTROL, or you may plug in an external speaker (8 to 16 ohms voice coil) or headphones at the EXTERNAL SPEAKER jack. The TONE CONTROL setting has no EFFECT WHILE recording.

11. To Record at 7.50 inches per second (for hihg fidelity reproduction), rotate CONTROL LEVER No. 2 to RECORD position. The tape will begin to move and you may proceed to record.

12. To record at 3.75 inches per second. FIRST depress the 3.75 SPEED CHANGE PUSHBUTTON, and while keeping this BUTTON FIRMLY DEPRESSED, ROTATE CONTROL LEVER No. 2 to RECORD POSITION. You may now proceed to record.

To Record from External Radio, Phonograph, Tape or Wire Recorder

1. The output of any radio, radio-tuner, phonograph, tape or wire recorder may be connected through a suitable cable to the RADIO-PHONOGRAPH INPUT. An output of 0.5 volts or more is required. The necessary modifications can be made by any competent radio serviceman.
2. Recording is accomplished in the same manner as described under "TO RECORD FROM MICROPHONE."

To Record from Built-In Radio (Models D-37R, DC-37R, LD-37R)

a. Prepare machine for recording as under "INSTALLATION" and paragraphs 1 through 8 of "TO RECORD FROM MICROPHONE", except that microphone is not plugged in.
b. Turn on MONITOR SWITCH on TONE CONTROL.
c. Turn RADIO SWITCH TO "ON".
d. Tune in desired station. The hank of antenna wire supplied should be extended about the room or may be connected to an external antenna.
e. Adjust RECORDING VOLUME LEVEL INDICATOR (NEON BULB) by means of the VOLUME CONTROL for correct recording level, as in paragraph 9 under "TO RECORD FROM MICROPHONE" and proceed to record as described in that section.

To Record on the Second Track

Having recorded one track of an entire reel, to record on the second track merely lift the full TAKEUP reel, turn it upside down and place it on the SUPPLY REEL SPINDLE. Place the empty reel on the TAKEUP REEL SPINDLE. Rethread and continue to record as under "TO RECORD FROM MICROPHONE".

To Stop Tape

To stop Tape at any time, always operate Control Lever No. 2 FIRST to STOP TAPE position, then turn CONTROL LEVER No. 1 to STOP TAPE Position.

To Rewind

a. Stop tape as above.
b. Put CONTROL LEVER No. 1 into REWIND POSITION.
c. Put CONTROL LEVER No. 2 into REWIND POSITION.
d. Turn VOLUME CONTROL to minimum.

To Change Tape Speeds while Recording

1. Stop tape by operating CONTROL LEVER No. 2 only to STOP TAPE position.
2. If you were recording at 7.50 inches per second and desire to change to 3.75, FIRST depress the 3.75 SPEED CHANGE PUSHBUTTON, and, while keeping this button depressed, turn CONTROL LEVER No. 2 to RECORD position.
3. If you were recording at 3.75 inches per second, to change to 7.50 simply turn CONTROL LEVER No. 2 back to RECORD position.

To Play Back Tape Recordings

a. Follow the procedures under "INSTALLATION" in paragraphs 1 through 7 of "TO RECORD FROM MICROPHONE" except that microphone is not plugged in.

NOTE: Recordings made at 3.75 inches per second MUST BE PLAYED BACK AT THE SAME SPEED, and similarly for recordings made at 7.50 inches per second.

b. Rotate CONTROL LEVER No. 1 to PLAYBACK position.
c. Rotate CONTROL LEVER No. 2 to PLAYBACK position.
d. Adjust VOLUME AND TONE CONTROLS for suitable loudness and desired tone quality.

Changing the Tape Speed or Stopping Tape during PLAYBACK is accomplished in the same manner as during RECORD.

Erasing of Tape - is accomplished in the same manner as recording, except that nothing is recorded. Erasing occurs automatically when RECORDING NEW MATERIAL ON TAPE WHICH WAS PREVIOUSLY USED.

SERVICE AND MAINTENANCE

Care of Tape

The storage and care of tape is important. Reels of tape should be stored where they will not be subjected to extremes of temperature and humidity. Rewind tape once before using when it has been stored 6 months or longer. It is recommended that new reel of tape be rewound once before recording.

Cleaning the Capstan and Recording Head is important after reasonable use. Dirt and slight gum deposits from the tape gradually accumulate on the recording head and rubber capstan. The recording head and capstan may be reached for cleaning by removing the two Phillips-head screws from the RECORD AND ERASE HEAD HOUSING and gently lifting off the housing cover. Clearing is accomplished by means of a cloth dipped in carbon tetrachloride (obtainable from radio parts suppliers, hardware stores, drug stores, etc.)

Service

Proper care of your recorder will result in excellent service for years to come. Follow these simple rules:

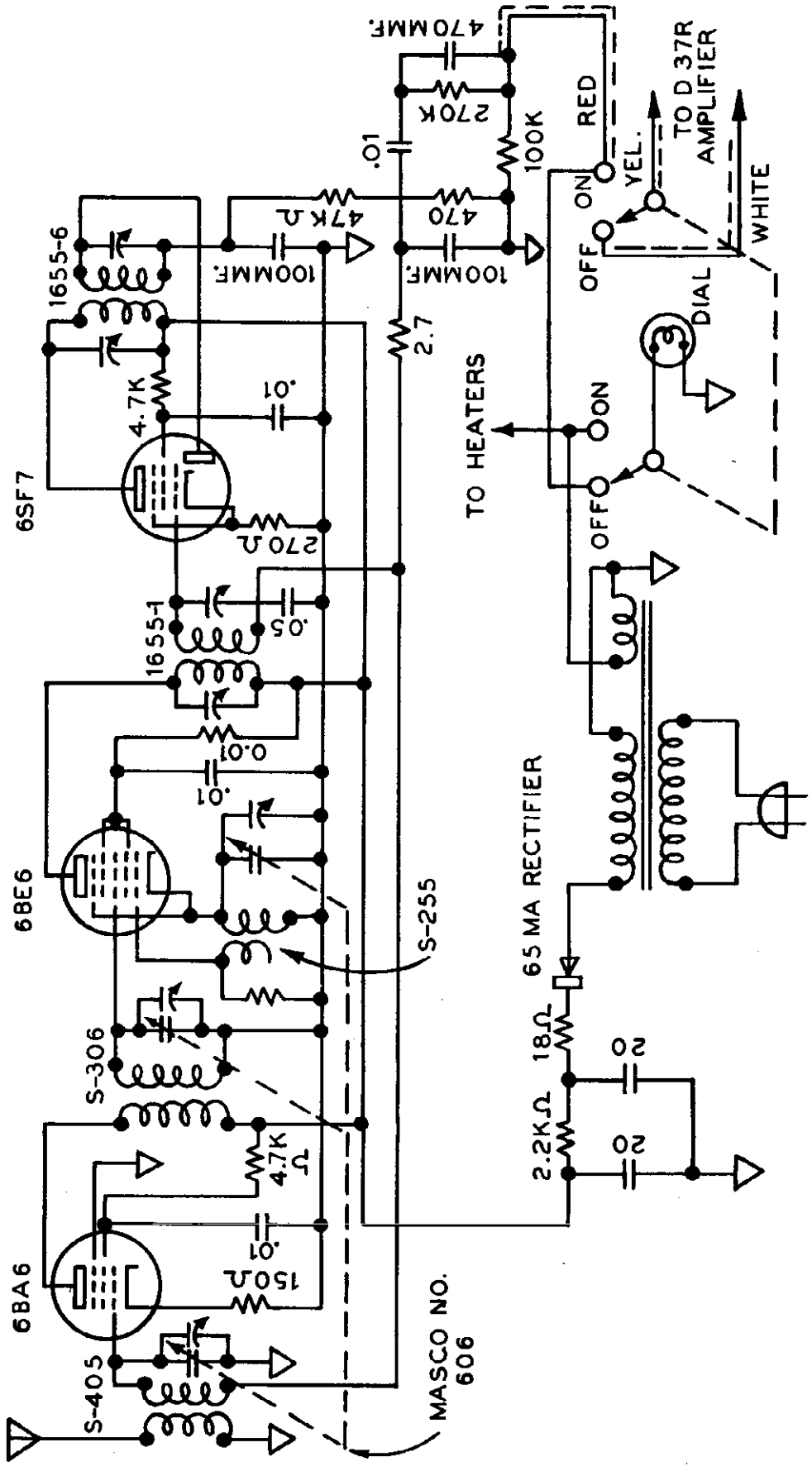
NEVER OIL your recorder. Surfaces which are subject to wear are provided with oil-less bearings sealed for a lifetime operation.

THIS EQUIPMENT SHOULD BE SERVICED ONLY BY QUALIFIED TECHNICIANS. DO NOT remove the top plate of the mechanism. Doing so will VOID the warranty.

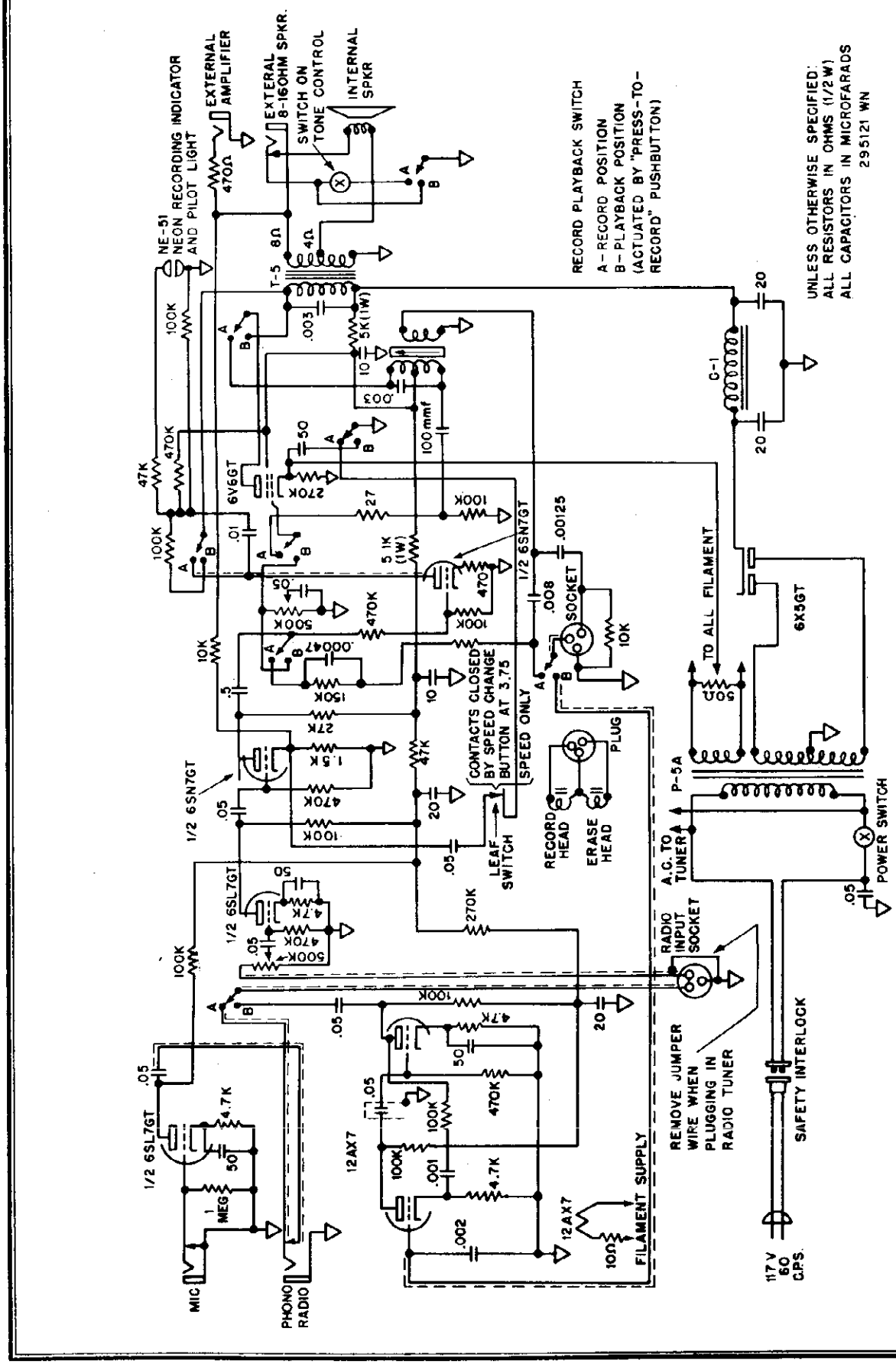
FOR BEST RESULTS: When beginning to record or playback, always use the right-hand CONTROL LEVER No. 1 FIRST. When stopping tape, always use the left-hand CONTROL LEVER No. 2 FIRST.

MAKE SURE ALL CONTROLS ARE IN OFF POSITION BEFORE IEAVING YOUR RECORDER.

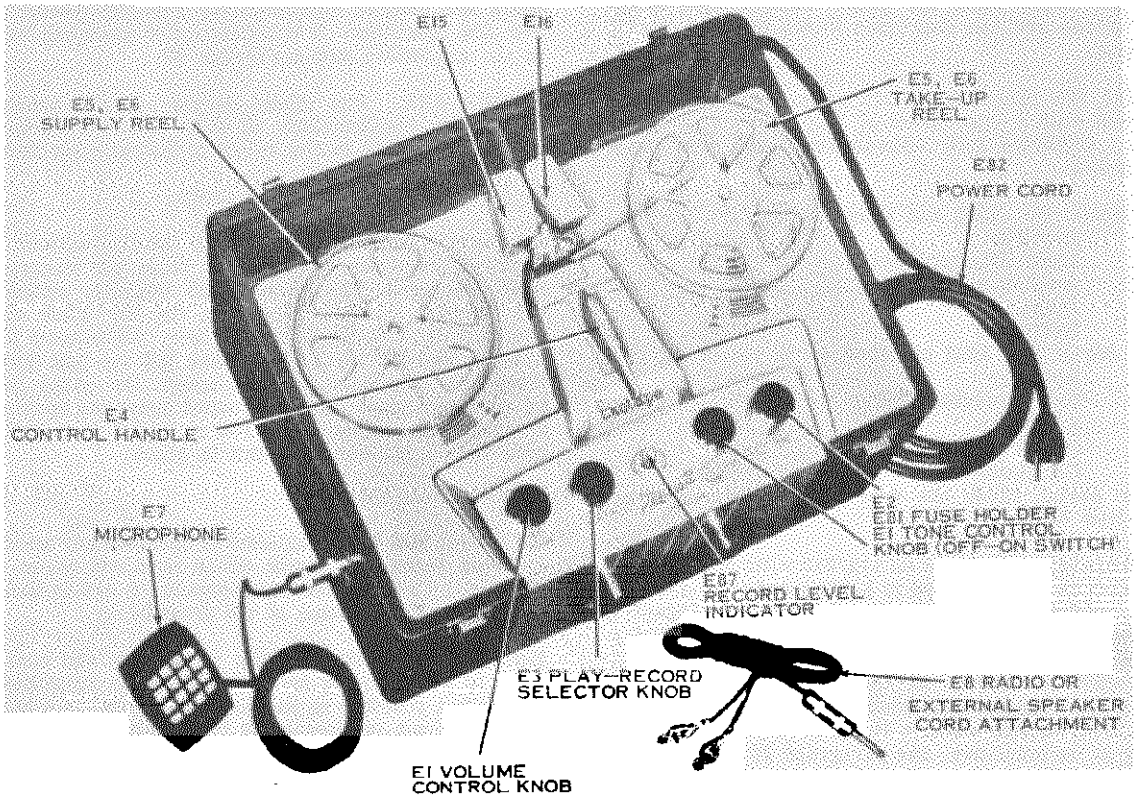
MODELS D-37, D-37R,
DC-37R, LD-37, LD-37R



MODELS D-37, D-37R,
DC-37R, LD-37, LD-37R



Service Instructions



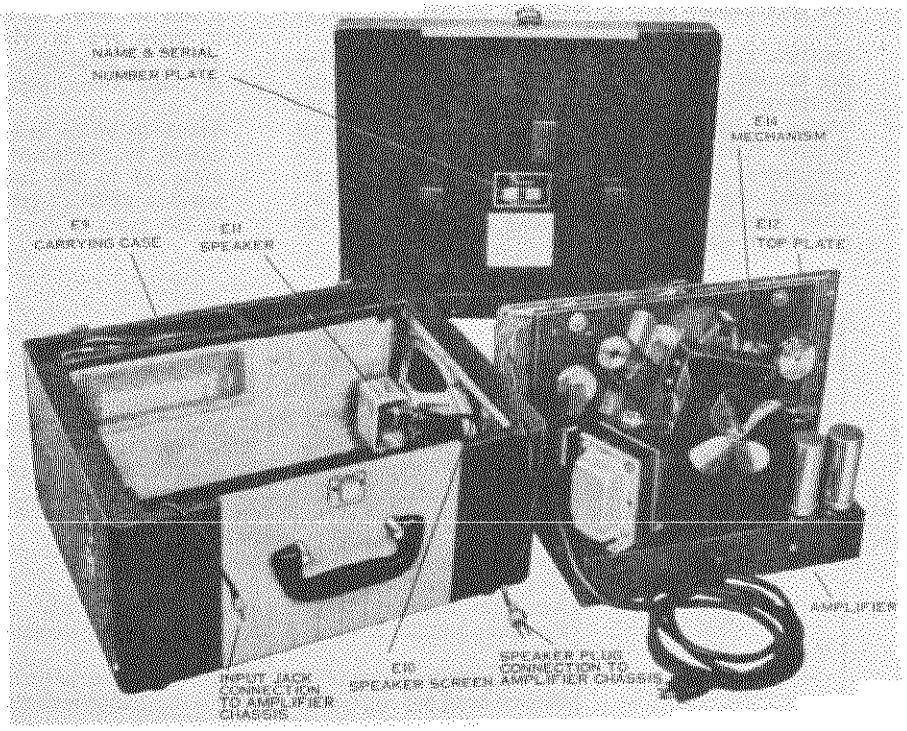


Figure 1.

Unit Removed From Case

MODELS 109, 110, 111, 112

2. DESCRIPTION OF MODELS.

The EKOTAPE models 109, 110, 111 and 112 described in this manual are all of the same basic design and construction. All are portable models and include the same accessories. Model 109 is the basic unit; all other models have slight variations and are described in the following paragraphs.

Model 109 operates on 117 volts at 60 cycles per second with a tape speed of 3-3/4 inches per second. Different tube compliments have been used as follows:

Serial No. 5202 and Below - See figure 8.

Rectifier	5Y3GT
Input (Playback only)	6AU6
Amplifier	12AT7
Output	6V6GT
Oscillator	6V6GT

Serial No. 5203 to 12249 - See figure 9.

Rectifier	5Y3GT
Input (Playback only)	5879
Amplifier	12AX7
Output	6V6GT
Oscillator	6V6GT

After Serial 12250 the type 12AX7 is replaced by two type 6AV6.

MODEL 110. Operates on 115/230 volts at 50 cycles per second. Tape speed is 3-3/4 inches per second. The amplifier is the same as Model 109 except a larger power transformer is used which incorporates a tapped primary for selection of 115 or 230 volt operation as shown in the schematic, figure 9. Units are shipped connected for 115 volt operation. For 230 volt operation it is necessary to move one wire in the amplifier, see paragraph 20. The motor pulley is larger and the flywheel tire is smaller on this model than on Model 109. After Serial 12250, the type 12AX7 tube is replaced by two type 6AV6.

MODEL 111. Operates on 117 volts at 60 cycles per second. Tape speed is 7-1/2 inches per second. Mechanically, this model is the same as Model 109 except motor pulley to flywheel tire ratio is different to give faster tape speed. The amplifier has some differences from Model 109 to accommodate the increased tape speed (see schematic, figure 10.) After Serial 12250, the 12AX7 is replaced by two type 6AV6 tubes.

MODEL 112. Operates on 115/230 volts at 50 cycles per second. Tape speed is 7-1/2 inches per second. The amplifier is the same as Model 111 except a larger power transformer is used which incorporates a tapped primary for selection of 115 or 230 volt operation as shown in the schematic, figure 10. Units are shipped connected for 115 volt operation. For 230 operation, it is necessary to move one wire in the amplifier, see paragraph 20.

NAMEPLATE. The model number, serial number and power requirements of each unit are stamped on the nameplate in the cover of the carrying case.

3. REMOVING UNIT FROM CASE.

All service work except cleaning the head assembly requires removal of the unit from the carrying case, figure 1. To remove the chassis, remove the screws in the corners of the top plate and carefully lift out the complete unit. Disconnect the speaker and the input plugs; then lift the unit free. When replacing the unit, connect the plugs and be sure the power cord is looped under the speaker to clear all moving parts and is in the slot in the case before lowering the unit in place.

4. TROUBLE CHART.

No matter how well equipment is designed and manufactured there are faults which normally occur in service. This section is designed to aid in quick location and correction of the troubles.

Before starting disassembly of the unit and actual point to point testing for troubles in the amplifier, it is often possible to localize the trouble to a particular circuit or component by simple preliminary tests and checks. Set the power switch to its ON position and make sure that power is being supplied to the unit. Lift up the top plate and inspect tubes. If one or more tubes do not light up, test the tubes. If tubes are in working condition, remove bottom cover of amplifier and check for loose connections or other visual signs of troubles.

Troubles which are not listed in this chart or which cannot be corrected by normal procedure should be referred to the factory or an Authorized Ekotape service station, giving the model and serial number of the unit.

TROUBLE	CAUSE	REMEDY
1. Motor and amplifier inoperative with switch ON.	Blown fuse. Power supply source. Damaged power cord assy. Broken OFF-ON switch.	Replace fuse, par. 5. Check for correct voltage as shown on nameplate. Repair or replace. Replace tone control and switch assembly.
2. Sound is fuzzy, faint, distorted, or no sound.	Dirty head. Over-recorded or under-recorded tape. Amplifier defect. Pressure pad not functioning. Worn or dirty pressure pad. Record head not operating.	Clean head, par. 6. Do not remove or change position of head. See Operating Guide. Check amplifier, par. 16. Check action of pressure pad lever. Replace or clean pressure pad lever assembly. Check oscillator bias voltage to record head, par. 11.
3. No sound, but motor operates and tubes light.	Amplifier trouble. Open circuit to speaker.	Check amplifier, par. 16. Check continuity through plug to speaker.

4. Not erasing.	Dirt on face of head. Oscillator coil assy or tube not operating. Defective erase coil in head.	Clean head, par. 6. Replace oscillator coil or tube, par. 11. Replace head, par. 11.
5. Erasing incomplete - background of old recording audible.	Erase head not operating properly. Pressure pad worn or not properly adjusted.	Check erase voltage with AC vacuum tube voltmeter. Should be approximately 45 volts, par. 11. Check erase head continuity. Adjust pressure pad or replace.
6. Does not record.	Record coil open. Insufficient bias voltage.	Replace head unit. Check bias voltage across record head with AC vacuum tube voltmeter. Should be approximately 100 volts. If low, check bias oscillator circuit, par. 11.
7. Does not reproduce. Sound of amplifier only.	Open coil in head. Open in input circuit.	Replace head unit, par. 11. Check circuit, par. 16.
8. No drive, noisy or irregular drive on REWIND.	Rewind belt broken, dirty or defective. Control knob loose. Motor mount misaligned. Drive pulley loose. Bent or damaged motor bracket or engagement bracket lever. Lift lever out of adjustment.	Replace rewind belt, par. 8. Tighten control knob setscrew. Realign motor mount, par. 14. Tighten pulley set screw. Adjust or replace bracket lever to normal operating position, par. 14. Adjust lift lever, par. 13.
9. Tape rewinds slowly (creeps) at stop position.	Motor mount misaligned. Bent or damaged motor engagement bracket lever.	Realign motor mount, par. 14. Replace or adjust bracket lever, par. 14.
10. No drive, noisy or irregular drive on FAST forward.	Drive belt broken, dirty or Broken fast forward spring. Trip brake spring not clearing rewind belt. Motor out of alignment.	Replace drive belt, par. 8 Replace spring. Adjust trip brake spring, par. 14. Align motor, par. 14.
11. Supply reel over runs on fast forward.	Broken brake spring or unhooked trip spring. Trip brake tension to light.	Replace brake spring or fasten trip spring. Adjust trip brake, par. 14.
12. Take-up reel does not take up tape on PLAY position.	Broken or defective take-up drive belt. Dirt under take-up disc or dirt in reel spindle. Lift lever out of adjustment. Broken or defective lift lever spring.	Replace belt, par. 8 Clean and lubricate reel spindle, par. 7 and 8. Adjust lift lever, par. 13. Replace spring, par. 13.
13. Tape overruns from rewind to stop.	Brake lever spring E31, fig. 4, broken. Take-up pulley and shaft E60, fig. 4, out of adjustment. Pads on brake yoke, E30, missing.	Replace spring. Adjust take up disc and shaft assy, par. 8. Replace brake yoke, E30, fig. 4.
14. Uneven sound, wows causes by tape slipping.	Foreign substance caked on pinch roller or capstan. Worn or damaged pinch roller. Broken or defective pinch roller spring. Uneven pull on supply reel due to gummy or dirty bearing. Excessive pressure pad tension on heads.	Clean roller and capstan, par. 6. Replace pinch roller assembly. Replace spring. Clean supply reel spindle, par. 7 and 8. Relieve pressure pad tension.
15. Howl or ringing sound.	Microphonic tube.	Replace defective tube, par. 17.
16. Troubles common to radio receivers.	Defective components.	Check and replace in accordance with standard practice, par. 16.

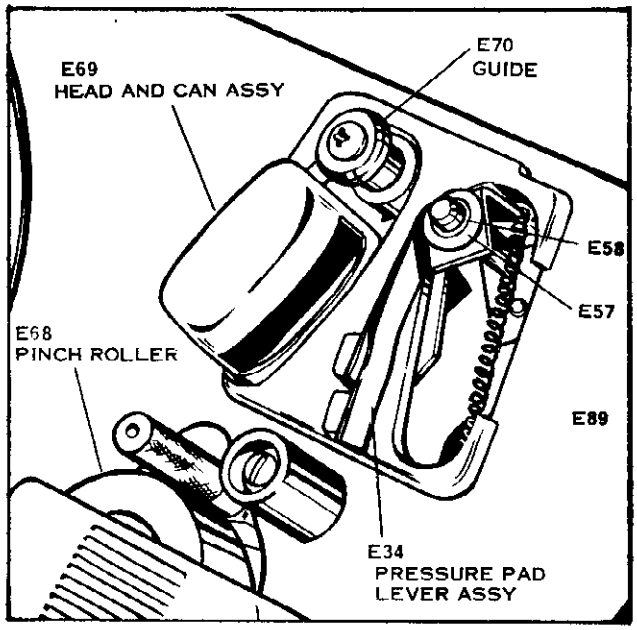


Figure 2. Record Head and Pressure Pads

5. FUSE.

Before replacing the fuse, determine cause of fuse failure. A standard cartridge type 3AG 2-ampere fuse is installed in a fuse holder at the right side of the top panel.

6. CLEANING.

When operation of the unit indicates cleaning is required (see Trouble Chart), wipe off the record and erase head contact surfaces (figure 2) carefully with a clean dry cloth. If dirt is caked or hard and will not come off with a dry cloth, dampen the cloth slightly with carbon tetrachloride.

NOTE

Do not use a brush or excessive amount of solvent on the pole surfaces.

Also clean the capstan and guide roller in the same manner.

7. LUBRICATION.

In normal use, the EKOTAPE requires no lubrication. Motors, flywheel shaft and spindles operate in oilite bearings. When unit is disassembled for repair, clean all bearings and lubricate with light oil. If cam and lever actions become sluggish and slow to respond, it may be due to gum or dirt in the pivots and under the levers. To clean and lubricate the levers, remove the top plate, paragraph 9. Clean off all old lubricant, accumulated dirt and gum with a clean cloth and cleaning solvent. Apply lubricant in thin film on working surfaces only. Do not over lubricate.

LUBRICANTS TO USE.

Oilite bearings only - Light machine or spindle oil.

Moving parts - Wadhams BRB#1 or Lubriplate.

8. REPLACING SPINDLE DRIVE BELTS.

The FAST FORWARD and REWIND spindle drive belts, figure 3, can be replaced without disassembly other than removing chassis from the carrying case, figure 1. Use care in handling the drive belts to prevent distortion or contact with grease or oil. Be sure there is no grease or oil on pulleys.

Start installing either belt by working it over the drive pulley under the motor mount. With the belt in the drive pulley groove, carefully work it over the spindle pulley flange to prevent distortion.

The FORWARD take-up spindle drive belt is located under the top plate, figure 4. Remove the top plate, paragraph 9. Loosen set screw in fast forward drive pulley, figure 6, and remove reel shaft assembly. Remove pulley assembly and work belt over pinch roller.

Clean and lubricate bearing and shaft with light machine oil. Work new belt over pinch roller; then reassemble reel shaft, FORWARD drive pulley and FAST FORWARD drive pulley. With control knob in FORWARD position, tighten FAST FORWARD drive pulley set screw E63, figure 6, at point where there is 0.010 to 0.015 inch clearance between pulley and bearing.

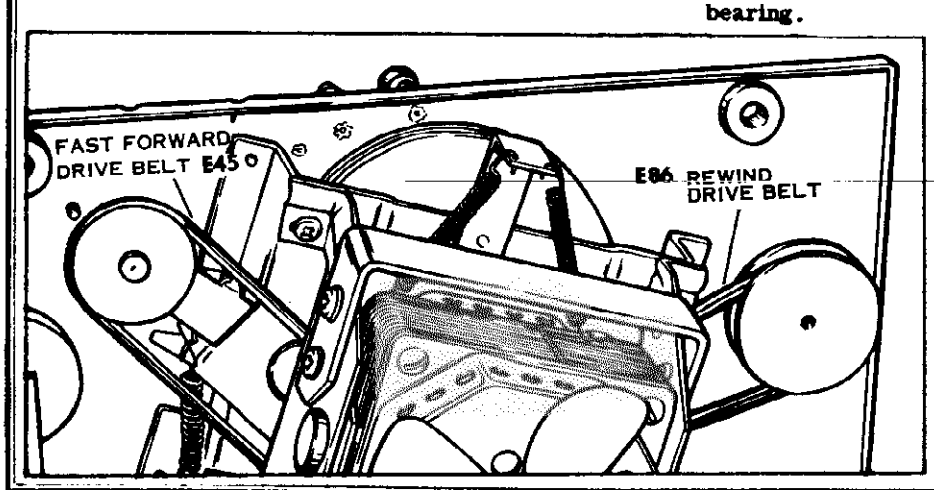


Figure 3.

Reel Drive Belts

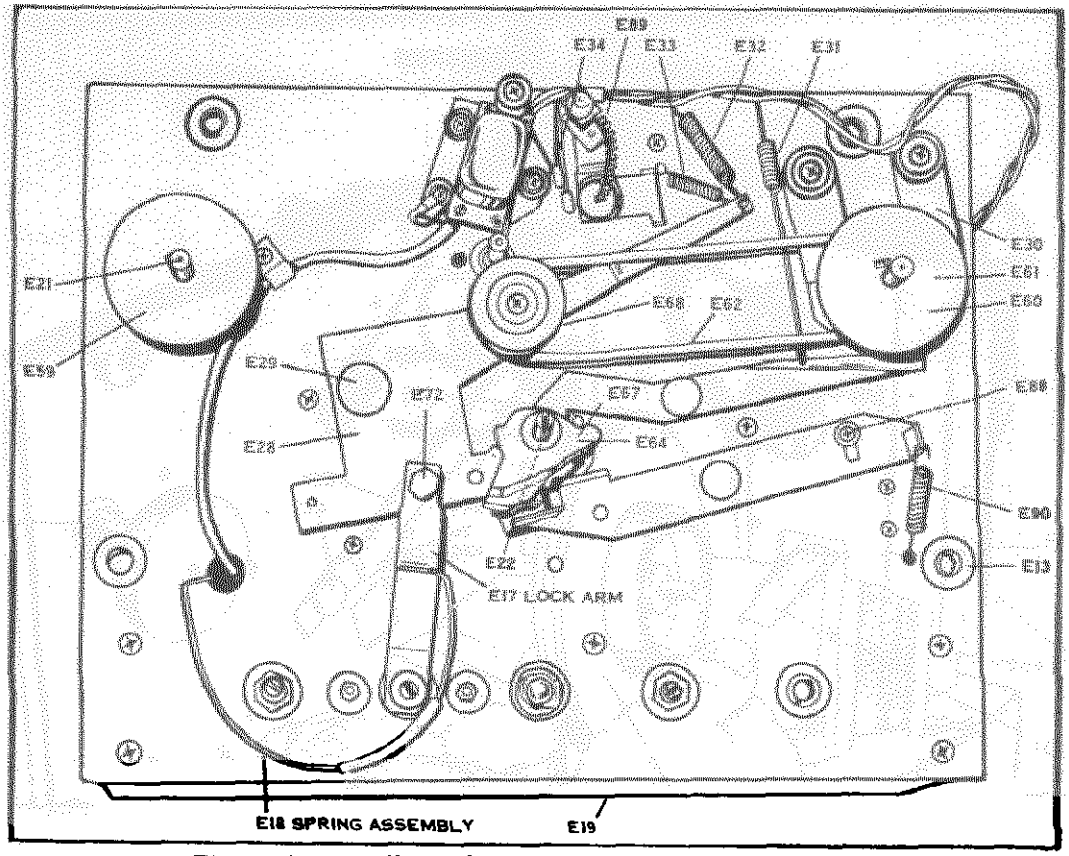


Figure 4. Top Plate of Chassis with Top Plate Removed

9. REMOVING TOP PLATE.

Removal of the top plate is required for access to the operating mechanism, figure 4. This plate is rubber mounted on the mechanism mounting plate and held in place by four screws and large washers installed from the back of the chassis. Remove the fuse holder cover, and pull off the VOLUME and TONE control knobs. The selector knob and control knob each have a socket head set screw which must be loosened before removing the knob. Remove the cover over the pressure pads; then remove the retaining ring, tension washer and lift off the pressure pad assembly. Remove the top plate attaching screws and washers, and carefully work the top plate off the rubber mounts. Whenever the top plate is removed, clean and lubricate the mechanism, paragraph 7, and check its action. Replace the top plate with the attaching screws, washers and lockwashers. The lower right hand screw (from rear) also attached the grounding strap.

Install the pressure pad assembly, tension washer, retaining ring, spring and cover. Replace knobs and fuse holder.

10. REPLACING FLYWHEEL.

Irregularities on the flywheel drive tire or capstan require replacement of the flywheel assembly, figure 5.

Place the control knob at STOP. Remove the chassis from the case, figure 1, and remove the top plate, paragraph 9.

Unhook the motor springs, fast forward spring and remove rewind belt from reel shaft spindle. Remove five screws attaching the flywheel support bracket and pull off the bracket and flywheel.

When installing a new flywheel, check fit in bearings carefully and be sure bearing is snug in mount. If bearing fit is sloppy or binds, replace the bearings. After the flywheel and bracket are reinstalled, check for free operation while rotating before turning on motor. If flywheel is tight, tap flywheel to align bearings. Connect motor springs, fast forward spring and rewind belt. Check operation on REWIND, STOP, FORWARD and FAST before completing reassembly, paragraph 14. Be sure fast forward drive is in proper position before attaching springs, see figure 6

11. RECORD HEAD AND OSCILLATOR.

Check oscillator bias voltages with a-c vacuum tube voltmeter, referring to L, of figures 8, 9 and 10, for rated erase and record voltages. When tests indicate record or erase coil in the record head and can assembly is defective, replace the assembly. Remove the top plate, paragraph 9; then remove three screws and washers attaching the assembly to the mounting plate and lift off the head.

When installing the new head, connect wires to the head terminals as indicated in the following sketch. Be sure plastic tubing covers the shielded lead. The

MODELS 109,
110, 111, 112

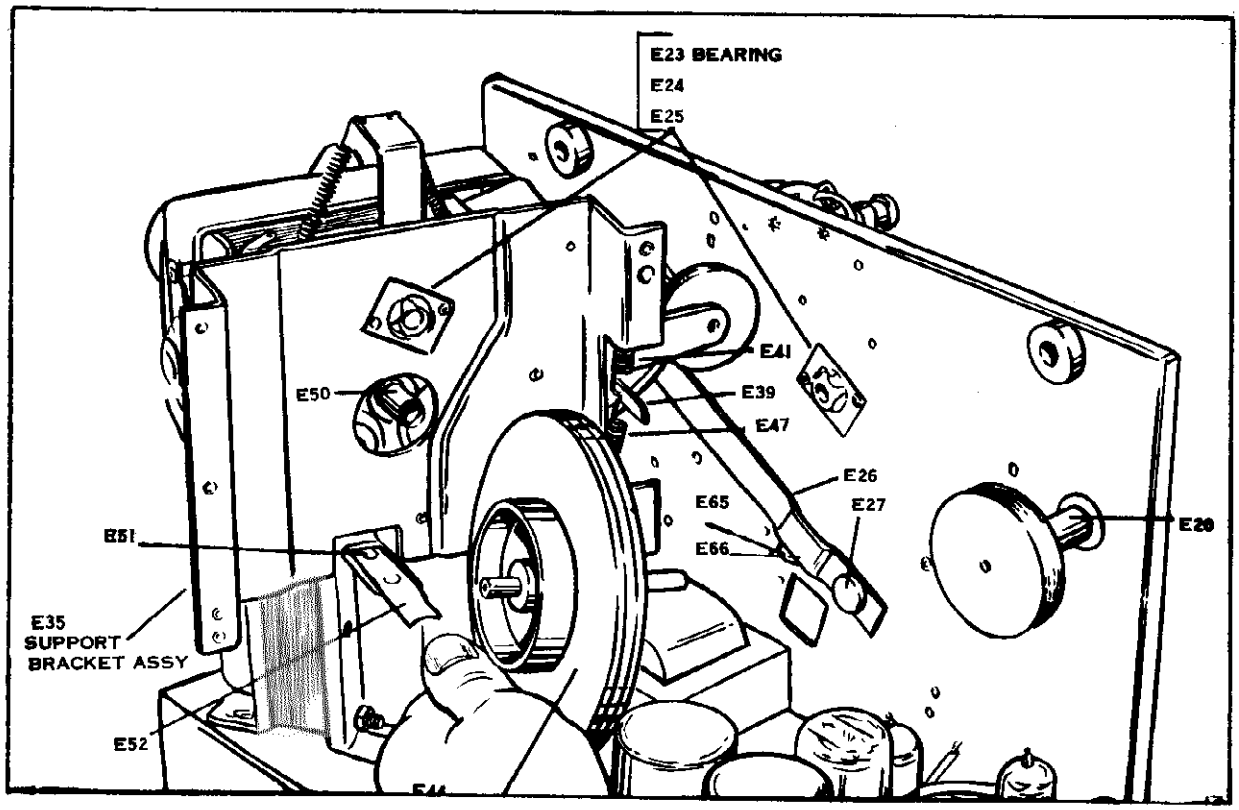
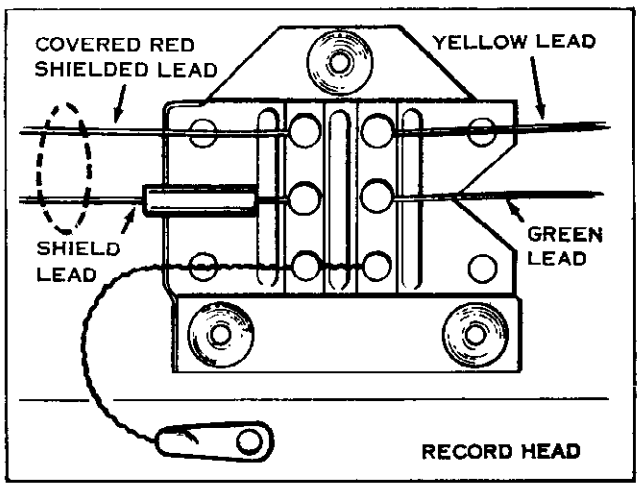


Figure 5. Replacing Flywheel Assembly

ground strap terminal goes between one of the mounting screw heads and washers. After the head is replaced, it will be necessary to align it for optimum output level and maximum high frequency response. If a constant frequency tape is not available, play back a tape previously recorded. Adjust the three head mounting screws for maximum high frequency response.



12. RECORD LOCK ARM.

The record lock arm, E17, figure 4, interlocks RECORD position of the selector knob in FORWARD position only. It is an indexing arm which automatically returns selector knob to PLAY position when the control knob is moved to any other position.

To remove the arm, remove the spring assembly first; then loosen two socket head set screws in the hub.

To install the arm, set the control knob at FORWARD and turn the selector shaft to its extreme counterclockwise position; install the arm with indexing ball in the index hole in the pinch roller lever and shaft assembly; then move arm approximately 1/16 inch farther counterclockwise tighten set screws in place and replace spring assembly, E18.

The PLAY-RECORD switch shaft has been previously drilled and the cone point set screw should go into this indentation in the shaft.

If a new PLAY-RECORD switch or record lock has to be installed, position the record lock arm as instructed in the previous paragraph, then with the cone point set screw removed, drill a 1/32 inch indentation in the switch shaft with a No. 38 drill. Install the spring as shown in figure 4. Check operation by turning control knob to STOP. The record lock arm should move counterclockwise and turn selector knob to PLAY position.

NOTE

On record lock arm assembly, E17, figure 4, loosen adjusting screw in slot of arm and adjust steel ball in hole in pinch roller lever in record position and tighten screw.

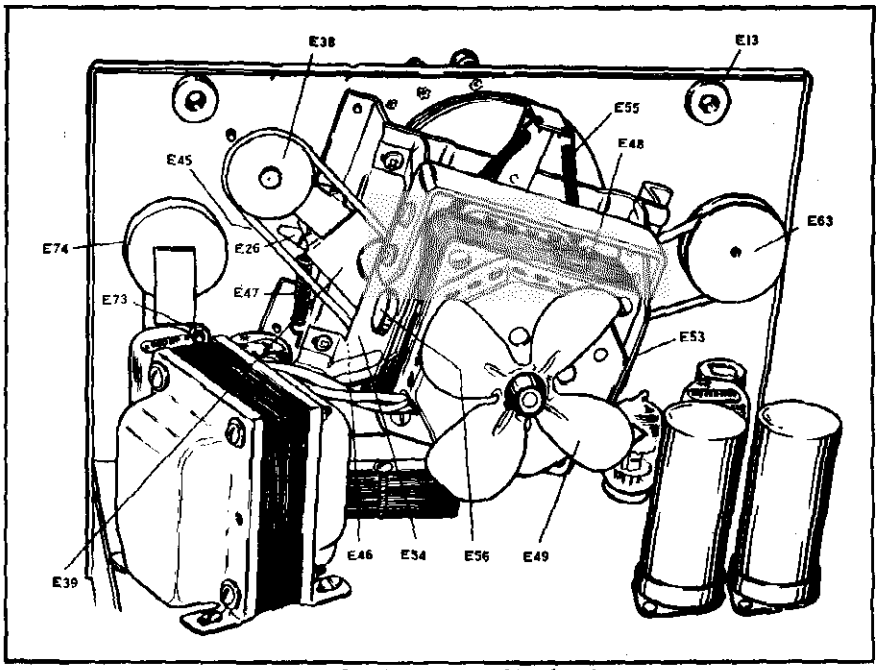


Figure 6. Operating Mechanism

13. FAST FORWARD - REWIND LIFT LEVER ADJUSTMENT.

The top plate must be removed to adjust the lift lever clearance, paragraph 9. Place control knob in FORWARD position and turn adjusting screw, E88, figure 4 holding lock nut, E73, figure 6, until clearance between lever and ball in pulley is 1/16 to 1/32 inch. Turn control knob to REWIND position and check to be sure lever lifts take-up spindle. Hold adjustment screw in position with a screw driver from the top and tighten the lock nut.

14. REPLACING MOTOR.
When replacing motor, it is necessary to adjust the drive clearance carefully so the mechanism will function properly in all control knob positions. Two different styles of motors are used, one with a square frame and the other with a round. Consult the parts list for proper type of motor as well as mounting brackets when ordering replacements.

With all springs attached check the following:

a. FAST FORWARD position - the fast forward drive belt should engage the motor drive pulley and fast forward drive pulley, E38, with kick out lever, E26, clear of fast forward plate and pulley assembly, E39, figure 6. The trip pin on the fast forward drive mechanism should engage the brake trip of the trip assembly passing beyond the "dog" of the brake trip not exceeding 1/16 inch. This prevents overrun or looping of the tape in going from "Fast Forward" to "Forward." To correct any misalignment of above, loosen the four mounting screws and with all springs attached and mechanism in "Fast Forward" position, make adjustments by shifting motor bracket in slotted mounting holes. After proper adjustment is made, hold bracket in position and tighten the four mounting screws.

NOTE
Check fast forward brake spring to see that a clearance of approximately 3/64 inch exists between spring and rewind belt in "Fast Forward" and "Forward" positions.

b. REWIND and STOP position - motor drive pulley should not touch anything at STOP position. At REWIND, motor drive should engage the rewind belt. Adjustment is made by slightly bending the rocker arm bracket on the motor mounting bracket E51, figure 5.

c. FORWARD position - motor should engage flywheel tire only. Adjustment is made by moving motor bracket in slotted mounting holes.

15. OPERATION MECHANISM.
Removal of top plate, paragraph 9, and disassembly for replacement of the flywheel, paragraph 10, are sufficient to make all parts accessible for replacement. Illustrations throughout the manual are keyed to the parts list at the back of the book for replacement purposes.

Spindles can be replaced by loosening set screws in the drive pulleys on the bottom. Replace the brake yoke assembly, E30, figure 4, when pads are worn or otherwise ineffective. The assembly is held in place by two rubber mounts and screws and is easily replaceable. Refer to paragraph 8 for adjusting.

The pinch roller is replaced by removing the center attaching screw. When installing a new roller, be sure it fits without play but revolves freely.

If any of the mechanism levers are bent, damaged or excessively worn, replace the complete mounting plate assembly or return the complete unit to the factory for repair.

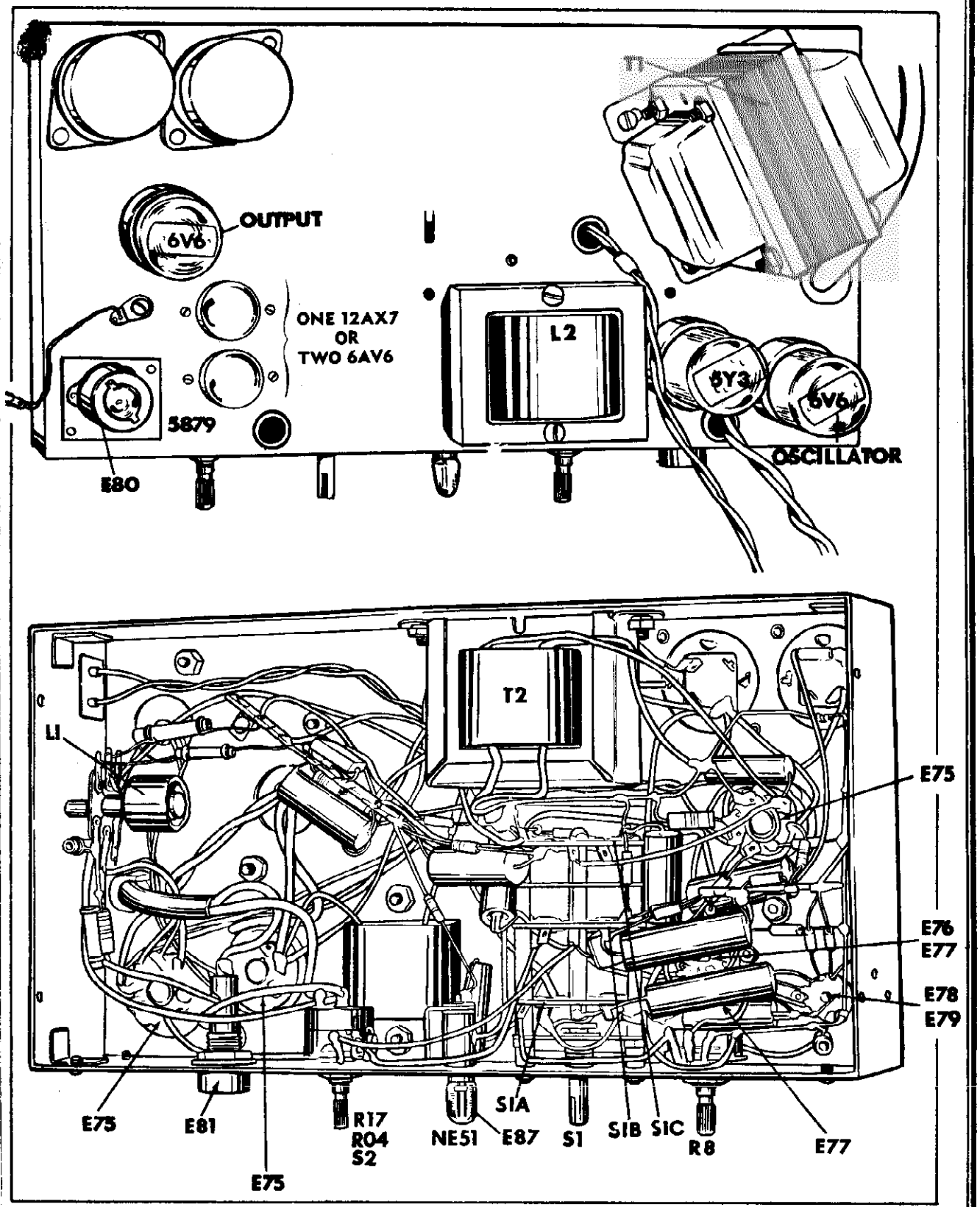


Figure 7. Top and Bottom Views of Amplifier

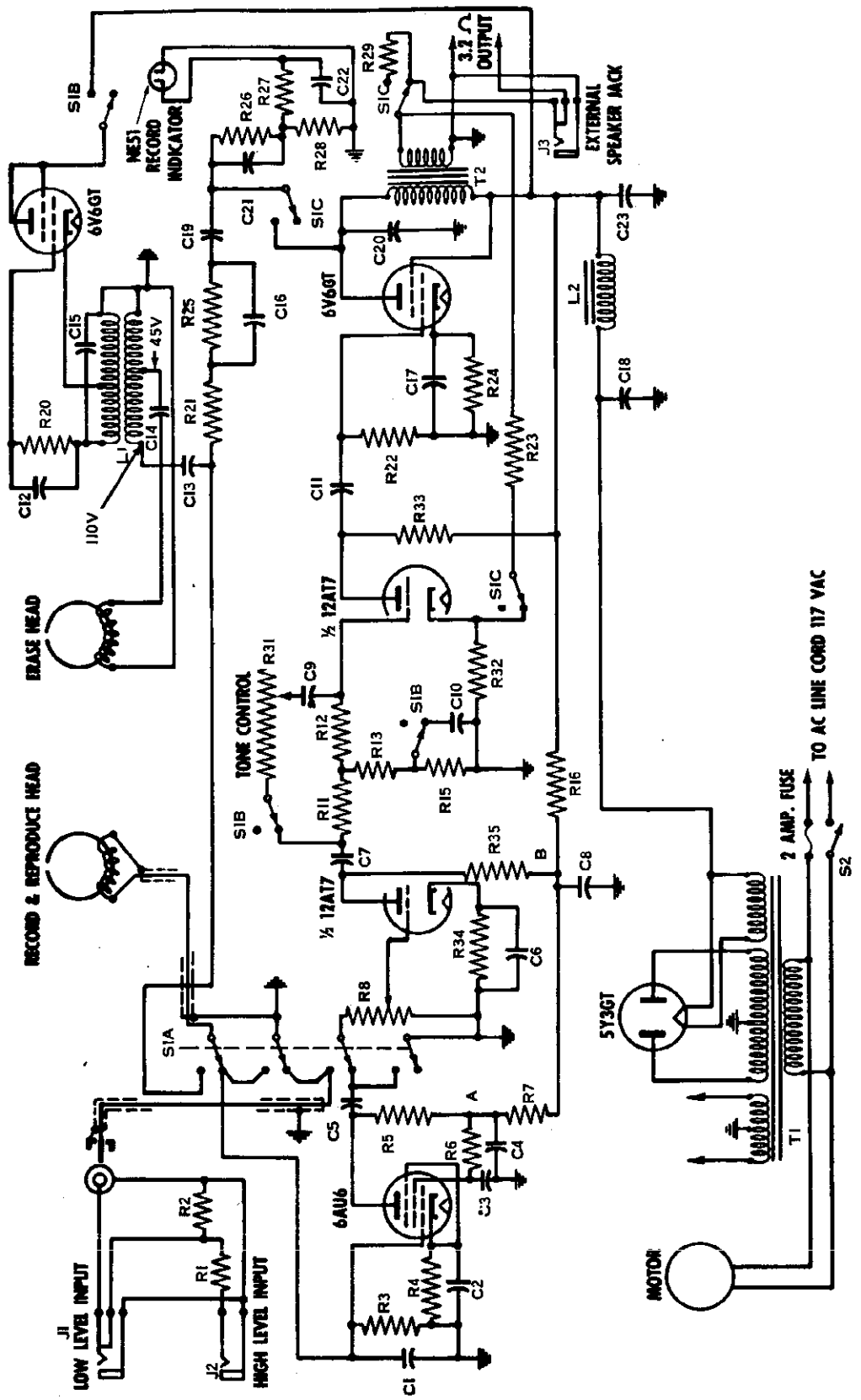


Figure 8. Schematic - Model 109 (Up to Serial No. 5202)

MODEL 109

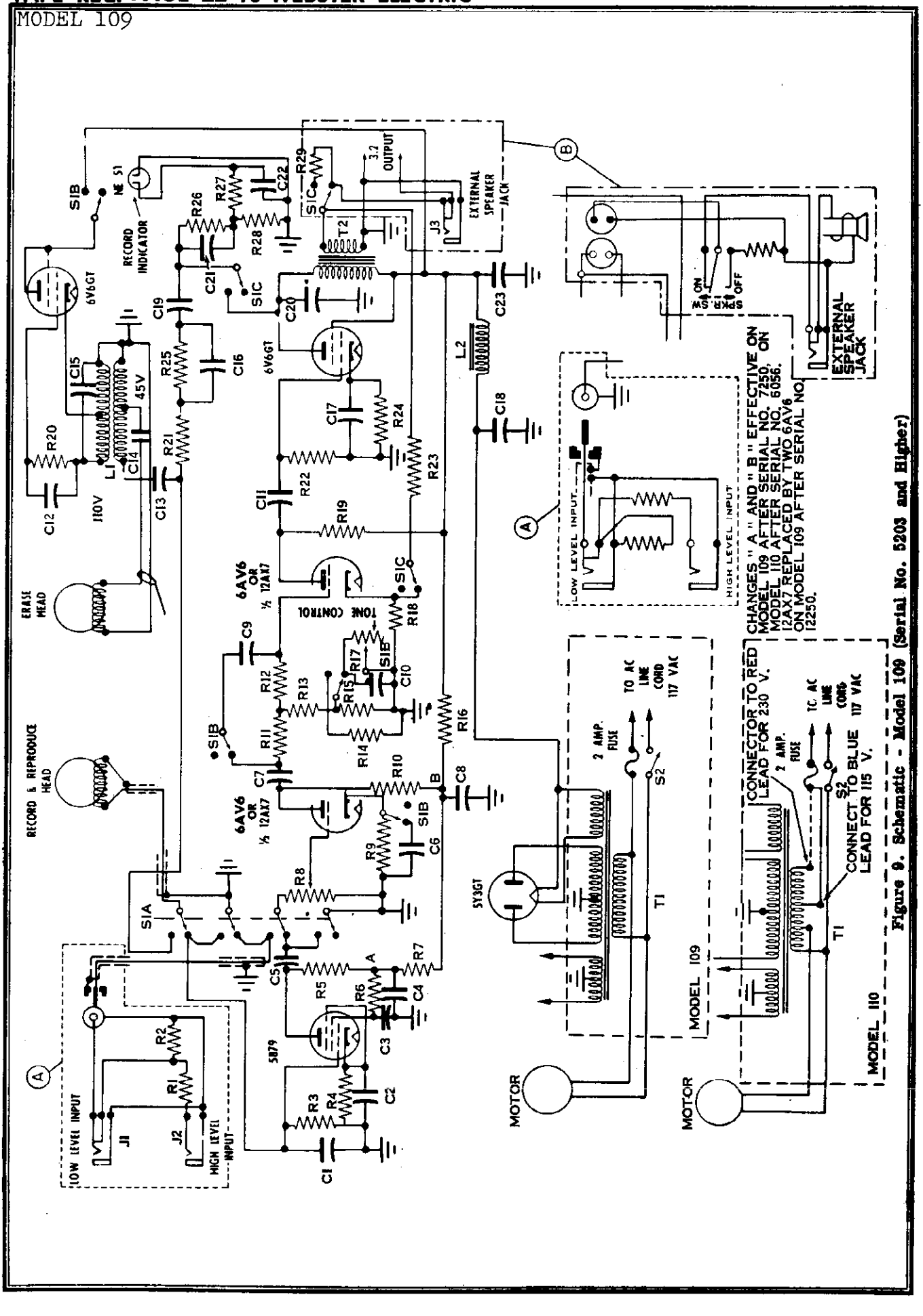


Figure 9. Schematic - Model 109 (Serial No. 5203 and Higher)

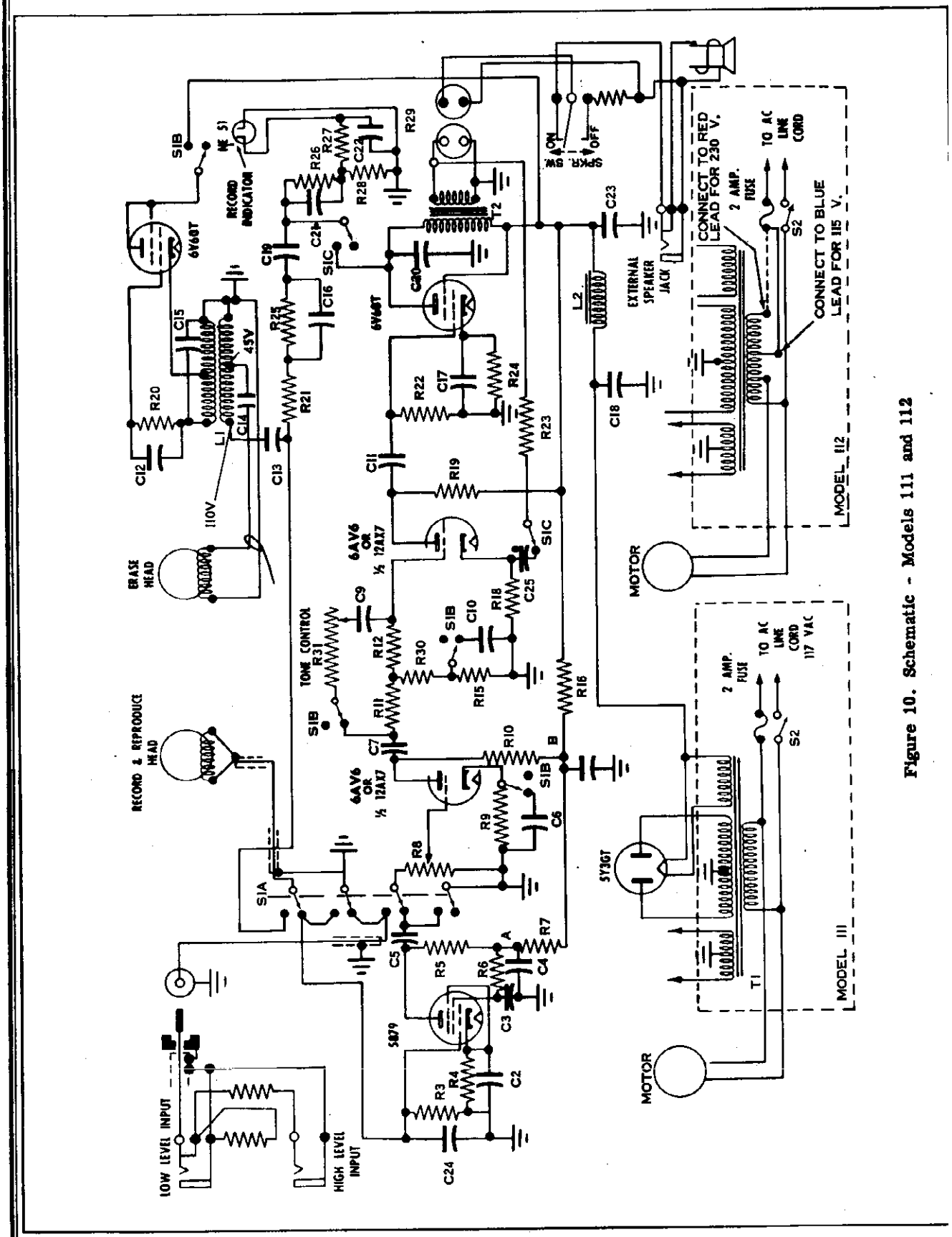


Figure 10. Schematic - Models 111 and 112

MODELS 109,
110, 111, 112

Tube	Pin Voltages 1	2	3	4	5	6	7	8	9
				Model 109 (Up to Serial No. 5202)					
6AU6		.55	6.2 AC	6.2 AC	75	25	.55		
12AT7	130		1.7	6.2 AC	6.2 AC	110		1.7	6.2 AC
6V6		6.2 AC	230	250			6.2 AC	12.5	
6V6 (OSC.)		6.2 AC	250	250	-50		6.2 AC		
5Y3GT		4.95 AC		270 AC		270 AC		4.95 AC	
				Models 109 (Serial No. 5203 and up) 110, 111, & 112					
5879			.75	6.2 AC	6.2 AC		30	50	.75
12AX7	118		1	6.2 AC	6.2 AC	102		.95	6.2 AC
6AV6 (1st)		.95	6.2 AC	6.2 AC			102		
6AV6 (2nd)		1.5	6.2 AC	6.2 AC			118		
6V6		6.2 AC	245	265			6.2 AC	14	
6V6 (OSC.)		6.2 AC	265	265	-75		6.2 AC		
5Y3GT		4.95 AC		270 AC		270 AC		4.95 AC	

All voltages DC unless otherwise indicated. Point A - 198 volts
Point B - 220 volts
Measurements made from point indicated to chassis using 20,000 ohm per volt meter with RECORD - LISTEN switch in RECORD position and unit operating at rated line voltage.
Refer to Schematics, figures 8, 9, and 10

Figure 11. Voltage Measurements

16. AMPLIFIER.

As shown in the schematic diagrams, figure 8, 9 and 10, there are several variations in the basic amplifier used on EKOTAPE models. Use of the schematics, voltage tables (figure 11) and views of the amplifier (figure 7) should be made in trouble shooting and repairing the amplifier.

For tube replacement and access to the top of the amplifier only, refer to paragraph 3.

For access to the bottom of the amplifier, remove the amplifier bottom plate which is held in place by two screws at each end of the amplifier. When troubleshooting on the amplifier, always be sure the power is of correct voltage and frequency indicated on the nameplate in the cover of the carrying case. Also be sure to use the voltage values in the schematics and charts which apply to the model being tested. Before starting troubleshooting procedure, make a careful visual check for loose connections or other obvious defects.

17. TUBES.

Location of tubes is shown in figure 7. For access to the tubes, remove four screws, and lift the top plate carefully from the case, paragraph 9. Tube complements for the various models are listed in paragraph 2. When removing tubes, excessive movement of the tube in its socket weakens socket pins and spreads the contacts in the sockets, so remove carefully. Insert new tubes so that key in the tube base lines up with keyway in tube socket, and push down firmly until tube locks in the socket.

18. VOLTAGE MEASUREMENTS.

All voltage measurements indicated in figure 11 are made from points indicated to chassis with a 20,000 ohm-per-volt meter and with RECORD-PLAY switch in RECORD position. Power supply must be same as indicated on nameplate in cover of carrying case.

19. RESISTOR AND CAPACITOR MEASUREMENTS.

All resistors and capacitors are keyed to the schematics, figures 8, 9 and 10 and are listed with their values in the parts list. The same reference numbers are also used in the top and bottom views of the amplifier, figure 7.

20. CHANGING FROM 115 VOLTS TO 230 VOLTS.

Models 110 and 112 have a power transformer tapped for 115 or 230 volt operation. Both models are shipped connected for 115 volt operation. To change from 115 to 230 volt operation, change one connection in the amplifier as follows:

The black wire coming from the fuse holder is connected to a lug on a terminal strip in the chassis. This lug is connected to a blue wire coming from the power transformer. This is the 115 volt connection. There is another lug on the terminal strip which is connected by a red wire to the power transformer. For 230 volt operation remove the black wire from the lug with the blue transformer wire and resolder it on the lug with the red transformer wire.

After changing to 230 volt operation, mark the nameplate in the cover of the carrying case for future reference when servicing is required.

21. IMPORTANT ORDERING INSTRUCTIONS.

Most of the parts listed in the following parts lists are illustrated in various illustrations in this instruction manual. Parts are indicated on the illustrations with reference numbers which also appear in the parts lists.

When ordering parts always refer to the model and serial number stamped on the name plate inside the top cover of the unit for which the parts are required.

It is preferable to replace complete sub-assemblies both from the standpoint of saving time on the repairs and for better performance of the equipment after it has been repaired.

ELECTRICAL PARTS
See schematics, figures 8, 9 and 10

SYMBOL	PART NAME	PART NO.
C1	CAPACITOR, CERAMIC, .0017 MFD 500V (USED ON MODELS 109 & 110 ONLY. MODELS 111 & 112 USE C24 IN PLACE OF C1.)	241-14260-2
C2	CAPACITOR, ELECTROLYTIC, 50 MFD 6V	S6063
C3	CAPACITOR, PAPER, .1 MFD 400V	S3595
C4	CAPACITOR, ELECTROLYTIC, 40-40 MFD 450V, 40 MFD 25V (INCLUDES C4, C8 & C17)	241-14238
C5	CAPACITOR, PAPER, .05 MFD 400V	S4261
C6	CAPACITOR, ELECTROLYTIC, 50 MFD 6V	S6063
C7	CAPACITOR, PAPER, .1 MFD 400V	S3595
C8	(SEE C4)	
C9	CAPACITOR, MICA, .00005 MFD 500V	29670-2
C10	CAPACITOR, PAPER, .05 MFD 400V	S4261
C11	CAPACITOR, PAPER, .05 MFD 400V	S4261
C12	CAPACITOR, CERAMIC, .003 MFD 500V	241-14260-1
C13	CAPACITOR, CERAMIC, .001 MFD 500V	S6005-5
C14	CAPACITOR, CERAMIC, .0017 MFD 500V	241-14260-2
C15	CAPACITOR, CERAMIC, .003 MFD 500V	241-14260-1
C16	CAPACITOR, MICA, .0002 MFD 500V	29670-4
C17	(SEE C4)	
C18	CAPACITOR, ELECTROLYTIC, 40-40 MFD 450V (INCLUDES C18 & C23)	241-14236
C19	CAPACITOR, PAPER, .05 MFD 400V	S4261
C20	CAPACITOR, CERAMIC, .003 MFD 500V	241-14260-1
C21	CAPACITOR, PAPER, .05 MFD 400V	S4261
C22	CAPACITOR, PAPER, .0005 MFD 600V	S4556
C23	(SEE C18)	
C24	CAPACITOR, CERAMIC, .0005 MFD 500V (MODELS 111 & 112 ONLY. OTHER MODELS USE C1)	S3750
C25	CAPACITOR, PAPER, .25 MFD 150V (MODELS 111 & 112 ONLY)	241-14974
J1	LOW LEVEL INPUT JACK BRACKET AND CONNECTOR ASSY (MICROPHONE) MICROPHONE JACK ONLY	242-14190 S4323
J2	HIGH LEVEL INPUT JACK (RADIO/PHONO)	S4323
J3	EXTERNAL SPEAKER JACK	S4324
L1	OSCILLATOR COIL ASSY	242-14603
L2	FILTER CHOKE	811A-1
R1	RESISTOR, 510,000 OHM 1/2 WATT	29501-53
R2	RESISTOR, 22,000 OHM 1/2 WATT	29501-29
R3	RESISTOR, 510,000 OHM 1/2 WATT	29501-53
R4	RESISTOR, 1,000 OHM 1/2 WATT	29501-11
R5	RESISTOR, 240,000 OHM 1/2 WATT	29501-48
R6	RESISTOR, 1 MEGOHM 1/2 WATT	29501-57
R7	RESISTOR, 22,000 OHM 1/2 WATT	29501-29
R8	VOLUME CONTROL, 500,000 OHM	241-14233
R9	RESISTOR, 2,000 OHM 1/2 WATT (MODEL 109 UP TO NO. 5202 USES R34 IN PLACE OF R9)	29501-14
R10	RESISTOR, 240,000 OHM 1/2 WATT (MODEL 109 UP TO NO. 5202 USES R35 IN PLACE OF R10)	29501-48
R11	RESISTOR, 100,000 OHM 1/2 WATT	29501-41
R12	RESISTOR, 100,000 OHM 1/2 WATT	29501-41
R13	RESISTOR, 5,100 OHM 1/2 WATT (MODELS 109 AND 110 ONLY, MODELS 111 AND 112 USE R30)	29501-21
R14	RESISTOR, 51,000 OHM 1/2 WATT (MODEL 109 NO. 5203 AND HIGHER AND MODEL 110 ONLY)	29501-35
R15	RESISTOR, 1 MEGOHM 1/2 WATT	29501-57
R16	RESISTOR, 22,000 OHM 1/2 WATT	29501-29
R16	RESISTOR, 5,100 OHM 1/2 WATT (USED WHEN 6AV6 TUBE REPLACES 12AX7	29501-21
R17	TONE CONTROL WITH OFF-ON SWITCH S2 (MODEL 109 NO. 5203 AND HIGHER AND MODEL 110 ONLY, OTHER MODELS USE R31)	241-14234
R18	RESISTOR, 2,000 OHM 1/2 WATT (ALL MODELS EXCEPT 109 UP TO NO. 5202 ONLY WHICH USES R32)	29501-14
R19	RESISTOR, 240,000 OHM 1/2 WATT (USED ON ALL MODELS EXCEPT MODEL 109 UP TO NO. 5202 WHICH USES R33)	29501-48
R20	RESISTOR, 10,000 OHM 1 WATT	29501-76
R21	RESISTOR, 240,000 OHM 1/2 WATT	29501-48
R22	RESISTOR, 240,000 OHM 1/2 WATT	29501-48
R23	RESISTOR, 8,200 OHM 1/2 WATT	29501-23
R24	RESISTOR, 300 OHM 1 WATT	29501-98
R25	RESISTOR, 240,000 OHM 1/2 WATT	29501-48
R26	RESISTOR, 390,000 OHM 1/2 WATT	29501-51
R27	RESISTOR, 51,000 OHM 1/2 WATT	29501-35
R28	RESISTOR, 51,000 OHM 1/2 WATT	29501-35
R29	RESISTOR, 10 OHM 1/2 WATT	29501-94
R30	RESISTOR, 3,600 OHM 1/2 WATT (USED ON MODELS 111 & 112 ONLY, OTHER MODELS USE R13)	29501-19
R31	TONE CONTROL WITH OFF-ON SWITCH S2 (USED ON MODEL 109 SERIAL NO. UP TO 5202 AND ON MODELS 111 & 112 ONLY, ALL OTHER MODELS USE R17)	241-14234-1
R32	RESISTOR, 1,000 OHM 1/2 WATT (USED ON MODELS 109 SERIAL NO. UP TO 5202 ONLY ALL OTHER MODELS USE R18)	29501-11
R33	RESISTOR, 51,000 OHM 1/2 WATT (USED ON MODELS 109 SERIAL NO. UP TO 5202 ONLY, ALL OTHER MODELS USE R19)	29501-35
R34	RESISTOR, 1,000 OHM 1/2 WATT (USED ON MODEL 109 UP TO SERIAL NO. 5202 ONLY, ALL OTHER MODELS USE R9)	29501-11
R35	RESISTOR, 51,000 OHM 1/2 WATT (USED ON MODEL 109 UP TO SERIAL NO. 5202 ONLY, ALL OTHER MODELS USE R10)	29501-35
S1	SELECTOR SWITCH ASSY MODEL 109 UP TO SERIAL NO. 5202 MODELS 109 & 110 MODELS 111 & 112	242-14555 242-14555-3 242-14555-4
S2	OFF-ONNSWITCH (PART OF TONE CONTROL R17 & R31)	
T1	POWER TRANSFORMER MODELS 109 & 111 MODELS 110 & 112	242-14228 242-15004
T2	OUTPUT TRANSFORMER	242-14230

MECHANICAL PARTS

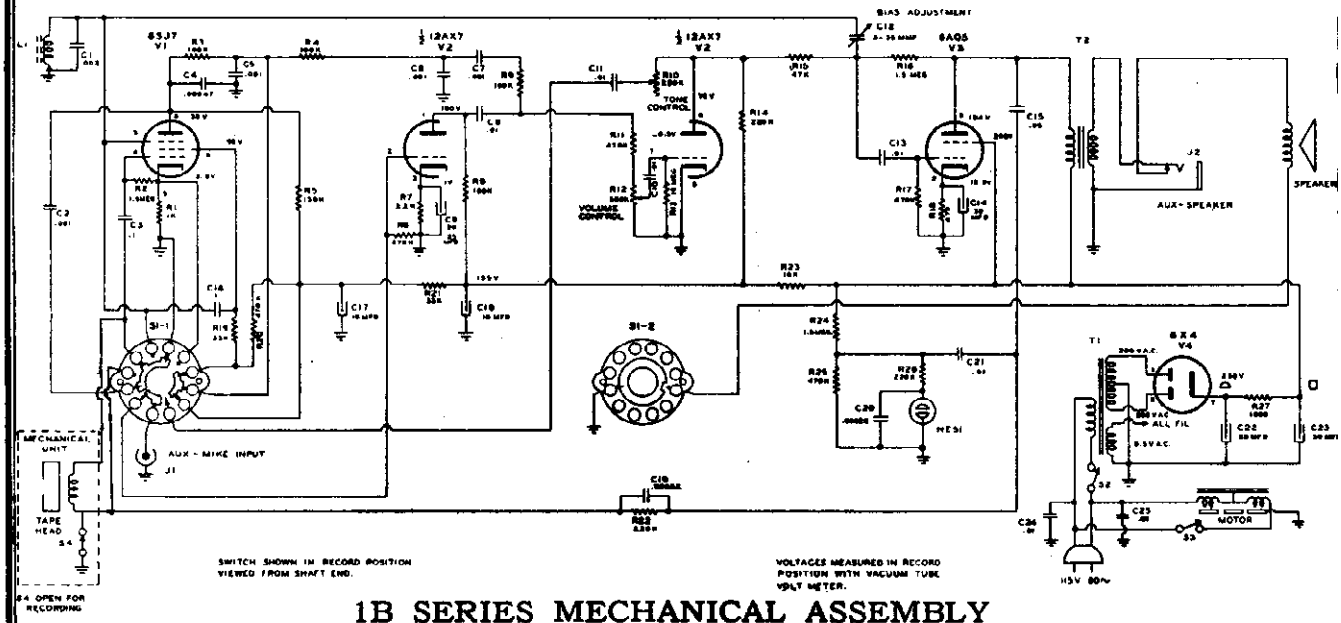
See schematics, figures 2 to 6

SYMBOL	PART NAME	PART NO.
E1	TONE CONTROL KNOB	241-14066
E2	FUSE ASSEMBLY KNOB	242-14054
E3	SELECTOR KNOB	241-14071
	SELECTOR KNOB SET SCREW, CONE POINT, SOCKET HD. NO. 8-32 X 1/4 IN.	29542-1
E4	CONTROL HANDLE	241-14072-1
	CONTROL HANDLE SET SCREW, CONE POINT, SOCKET HD. NO. 8-32 X 1/4 IN. SPECIAL	241-15116
E5	REEL, 5 IN.	241-14067
E6	REEL AND TAPE, 5 IN.	241-14068
E7	MICROPHONE ASSEMBLY	242-14069
E8	EXTERNAL SPEAKER CORD AND PLUG ASSY	242-14288
E9	CARRYING CASE	241-14053
E10	SPEAKER SCREEN	241-14057
E11	SPEAKER	241-14070
E12	TOP PLATE ASSEMBLY	242-14147
E13	TOP PLATE MOUNTING GROMMET	241-14221
E14	OPERATING MECHANISM ASSEMBLY	242-14051
E15	RECORD HEAD COVER, LEFT	241-14082-3
E16	RECORD HEAD COVER, RIGHT	241-14082-4
	COVER SCREW, RECESSED OVAL HD, NO. 4-40 X 3/8 IN.	29528-5
E17	RECORD LOCK ARM ASSEMBLY	242-14073
E18	RECORD LOCK ARM SPRING ASSEMBLY	242-14762
E19	MOUNTING PLATE ASSEMBLY	242-14079
E20	SUPPLY REEL SPINDLE BEARING	241-14081
E21	TAKE UP REEL SPINDLE BEARING	241-14082
E22	CONTROL SHAFT BEARING	241-14083
E23	SELF ALIGNING BEARING	241-14084
E24	BEARING RETAINER	241-14085
E25	BEARING RETAINER EYELET	P955L-3
E26	FAST FORWARD RELEASE LEVER	241-14088
E27	PIVOT	241-14089
E28	PINCH ROLLER LEVER AND SHAFT ASSY	242-14090
E29	PINCH ROLLER PIVOT	241-14093
E30	BRAKE YOKE ASSEMBLY	242-14096
E31	BRAKE LEVER SPRING	241-14099
E32	PINCH ROLLER SPRING	241-14187
E33	BELL CRANK SPRING	241-14116
E34	PRESSURE PAD LEVER ASSY ON UNITS BELOW SERIAL 5550	242-14200
E34	PRESSURE PAD LEVER ASSY ON UNITS ABOVE SERIAL 5550	242-15154
E35	SUPPORT BRACKET-ASSEMBLY	242-14123
E36	REWIND PULLEY ASSEMBLY	242-14103
E37	REWIND PULLEY SHAFT	241-14107-1
E38	FAST FORWARD ARM AND PULLEY ASSY	242-14106
E39	FAST FORWARD PLATE AND PULLEY ASSY	242-14111
E40	PULLEY PLATE PIVOT	241-14115
E41	FAST FORWARD PULLEY SPRING	241-14116
E42	FAST FORWARD TRIP ASSEMBLY	242-14117
E43	FAST FORWARD BRAKE SPRING	241-14119
E44	FLYWHEEL ASSEMBLY	* 242-14124
E45	FAST FORWARD BELT	241-14129-2
E46	TRIP MECHANISM SPRING	241-14130
E47	FAST FORWARD MECHANISM SPRING	241-14131
E48	MOTOR (SQUARE FRAME)	241-14133
E48	MOTOR (ROUND FRAME)	241-15306
E49	MOTOR FAN	241-14134
E50	MOTOR PULLEY	* 241-14135-2
E51	MOTOR MOUNTING BRACKET AND SPRING ASSY (SQUARE FRAME)	242-14136

SYMBOL	PART NAME	PART NO.
E51	MOTOR MOUNTING BRACKET AND SPRING ASSY (ROUND FRAME)	242-14136-1
E52	MOTOR ROCK SPRING	241-14139
E53	MOTOR SUSPENSION BRACKET, R. H.	241-14140
E54	MOTOR SUSPENSION BRACKET, L. H.	241-14141
E55	MOTOR RETURN SPRING	241-14220
E56	MOTOR SHOCK MOUNT	241-13685-1
E57	PRESSURE PAD WAVE WASHER	241-12059
E58	PRESSURE PAD RETAINING RING	29651-1
E59	SUPPLY SHAFT AND DISC ASSEMBLY	242-14142
E60	TAKE UP SHAFT AND DISC ASSEMBLY	242-14145
E61	TAKE UP PULLEY AND DISC ASSEMBLY	242-14148
E62	TAKE UP DRIVE BELT	241-14129-3
E63	SUPPLY PULLEY	241-14152
E64	CONTROL CAM AND SHAFT ASSEMBLY	242-14153
E65	CONTROL CAM WASHER	29602-133
E66	CONTROL CAM RETAINING RING	29650-2
E67	CONTROL CAM INDEX SPRING	241-14154
E68	PINCH ROLLER ASSEMBLY	242-14155
E69	RECORD HEAD AND CAM ASSEMBLY	242-14159
E70	TAPE GUIDE ASSEMBLY	242-14181
E71	TAPE GUIDE TOP	241-14205
E72	INDEX BALL (CONTROL CAM & LOCK ARM)	241-13609
E73	LIFT LEVER ADJUSTING LOCK NUT	241-12035
E74	FAST FORWARD PULLEY ASSEMBLY	242-14785
E75	TUBE SOCKET, 8 PRONG OCTAL	54530
E76	TUBE SOCKET ASSY (12AT7 & 12AX7)	242-14541
E77	TUBE SOCKET - 6AV6 - 7 PIN MINATURE	241-12175
E77	TUBE SOCKET, 12AT7 & 12AX7 9 PIN MINATURE	241-13119
E78	TUBE SOCKET AND PLATE ASSY (5879)	242-14630
E78	TUBE SOCKET AND PLATE ASSY (6AU6)	242-14746
E79	TUBE SOCKET (5879)	241-14646
E79	TUBE SOCKET (6AU6)	241-14226
E80	TUBE SHIELD (5879)	241-14645
E80	TUBE SHIELD (6AU6)	241-14227
E81	FUSE HOLDER	241-14245
E82	AC LINE CORD AND PLUG ASSEMBLY	241-14240
E83	INPUT CORD AND PLUG ASSEMBLY	241-12001-1
E84	BRACKET & MOTOR ASSY (SQUARE FRAME)	* 242-14132
E84	BRACKET & MOTOR ASSY (ROUND FRAME)	242-15304
E85	CHASSIS BOTTOM COVER	242-14242
E86	REWIND DRIVE BELT	241-14129-1
E87	RECORD LEVEL INDICATOR	241-14225
E89	PRESSURE PAD SPRING ON SERIAL 5550 AND HIGHER	241-14219
E90	LIFT LEVER SPRING	241-15210

*PARTS SHOWN FOR MODEL 109. OTHER MODELS AS FOLLOWS

FLYWHEEL (MODEL 110)	242-14124-2
FLYWHEEL (MODEL 111)	242-14124-1
FLYWHEEL (MODEL 112)	242-14124-3
MOTOR PULLEY (MODEL 110)	241-14135-3
MOTOR PULLEY (MODEL 111)	241-14772-1
MOTOR PULLEY (MODEL 112)	241-15032-1
BRACKET AND MOTOR ASSY (MODEL 110) SQUARE	242-14132-2
BRACKET AND MOTOR ASSY (MODEL 110) ROUND	242-15304-1
BRACKET AND MOTOR ASSY (MODEL 111) SQUARE	242-14132-1
BRACKET AND MOTOR ASSY (MODEL 111) ROUND	242-15304-2
BRACKET AND MOTOR ASSY (MODEL 112) SQUARE	242-14132-3
BRACKET AND MOTOR ASSY (MODEL 112) ROUND	242-15304-3



1B SERIES MECHANICAL ASSEMBLY OPERATION

Precautionary Service: Unnecessary service to correct supposedly defective recording equipment frequently is due to operational errors on the part of the recordist. Here are a few typical examples from factory service files:

1—Improper feed-in of the disc pick-up arm; incorrect operation of the mercury switch; erratic operation of the tape reel clutch plates.—All may result from failure to level the 1B10 TAPE RECORDIO.

2—Failure to record or play tape, operation normal in other positions.—(a) Wind all slack tape on the take-up reel before attempting to record or play; (b) Tape threaded on the wrong side of the mercury switch actuating lever. Occurs when tape is threaded with the turntable removed. Tape must pass around the lever on the side nearest the control knob.

The ability to recognize such errors promptly is an important asset in servicing this equipment. Paragraphs following are intended to familiarize service personnel with the mechanical functions of the tape assembly and thereby facilitate quick and accurate trouble-shooting.

Mercury Switch: The mercury switch, with its mounting assembly, acts as an off-on switch and is held open when the control knob is in the off position. If recording tape has not been threaded around the capstan drive and the mercury switch lever, the turntable will operate in only the Phono, Reverse, and Forward positions of the control knob; and the tape reels will operate only in the Reverse and Forward positions. In Off position, a cam section of the function shift lever contacts the stud portion of the mercury switch assembly—the rod that protrudes through the base plate. This cam tilts the mercury switch assembly so that the switch circuit is opened. In Phono, Reverse, or Forward positions the function shift lever, through the switch actuator lever, contacts the stud portion of the mercury switch assembly and holds the switch in a closed position. Thus, voltage is applied to the motor.

Automatic Shut-Off: Note that in Record and Playback positions the function mechanism does *not* hold the mercury switch closed. The switch is closed by the tension of the tape against the switch lever as it passes from the capstan to the take-up reel. This arrangement permits automatic shut-off in Record and Playback. When all of the tape has been wound on the take-up reel, the tension against the mercury switch lever is released and the switch tilts to open the motor circuit.

Pressure Pad and Pinch Roller: When the control knob is in either Record or Playback Position, the function shift lever contacts the pressure pad and pinch roller assembly actuating spring. This brings the pinch roller in firm contact with the tape and the driving capstan. The pressure pad at the same time contacts the recording tape and holds it firmly against the recording head.

The driving capstan is located on the turntable center spindle. The large 10″ turntable acts as a flywheel to minimize any flutter or wow effect that might result from fluctuation in tape velocity. The recording head is a very short distance from the driving capstan, thus lessening the possibility of the tape whipping as it passes across the recording head and causing flutter in the recording. The net result of this driving arrangement is excellent frequency response with a minimum of distortion.

Reel Clutch Assemblies: With the control knob in the Reverse or Forward position, the function shift lever actuates the pressure pad and pinch roller assembly spring, and this assembly is pulled from contact with the tape by the coil tension spring. In Reverse position, the function shift lever depresses one end of the front lift lever, which in turn lifts the front (take-up) reel assembly off the clutch. Now there is no restraining force applied to the front reel, and the back (supply) reel rewinds the tape rapidly.

The opposite condition is true when the control knob is placed in the forward position. Here the function shift lever depresses the rear lift lever to disengage the rear reel from the clutch assembly. The front reel then is free to wind the tape in a forward direction.

Erase Head: In the Record position the erase head contacts the tape, and erases the lower track only, just before it passes over the recording head. Thus, tapes may be re-recorded as often as desired.

The Bias Switch is opened, in Record position, by an actuating sleeve in the shifting mechanism. In all positions, other than Record, the bias switch is connected directly across the recording head through the amplifier function switch. This short-circuit condition is opened by the function switch in playback position.

ADJUSTMENTS

Model 1B10 TAPE RECORDIO is completely adjusted for satisfactory operation when shipped from the factory. In the event that adjustments may become necessary, the following procedure should be followed.

Adjustment of Lift Lever, Control of Reel Pan: In the Forward speed position, the rear reel pan must be raised to a position that clears the clutch plate. At the same time the front pan must be lowered to contact the clutch plate, and the lift lever must clear the lower end of the reel pan shaft by approximately 1/32" to 1/16". Adjustment of the lift lever is made by bending the short unflanged section of the lever immediately under the reel pan shaft.

To adjust in the Reverse speed position, the opposite of the above conditions are true.

In the Record and Playback positions the lift levers must clear both reel pan shafts so that both pans contact the clutch plates.

Tracking of the tape through the recording head is controlled by tipping the tape capstan slightly with the two adjusting screws located under the mounting flange of the auxiliary shaft housing, and under the base plate. The capstan should be adjusted so that the tape tracks in the center, or toward the top of the guide slot in the recording head—never towards the bottom of the guide slot.

Pressure Pad Adjustment: Remove the pinch roller cover plate to reach the lock nut on the pressure pad adjusting screw. Set the function knob in the Record position. Turn the adjusting screw in against the pressure pad spring until the pad just contacts the recording head. Then turn the screw one-half to three-quarters of a turn clockwise and tighten the lock nut.

LUBRICATION

Reel Pan Shaft, Reel Sheave, Reel Sheave Bearing, and Reel Pan Clutch Springs.

(a) Remove Truarc "E" ring on lower end of reel pan shaft; lift reel pan and clutch plates off machine to expose parts to be lubricated. (In removing "E" ring, be careful that no burr is turned up on the shaft at the edge of the ring slot.)

(b) Use SAE 10 oil on reel pan shaft and on the inside only of the reel sheave bearing.

(c) Use SAE 10 oil between reel sheave bearing and the hub of the reel sheave. It is not necessary to remove the sheave since there is a countersink well at the top of the reel sheave hub into which the oil may be placed and allowed to run down through the bearing.

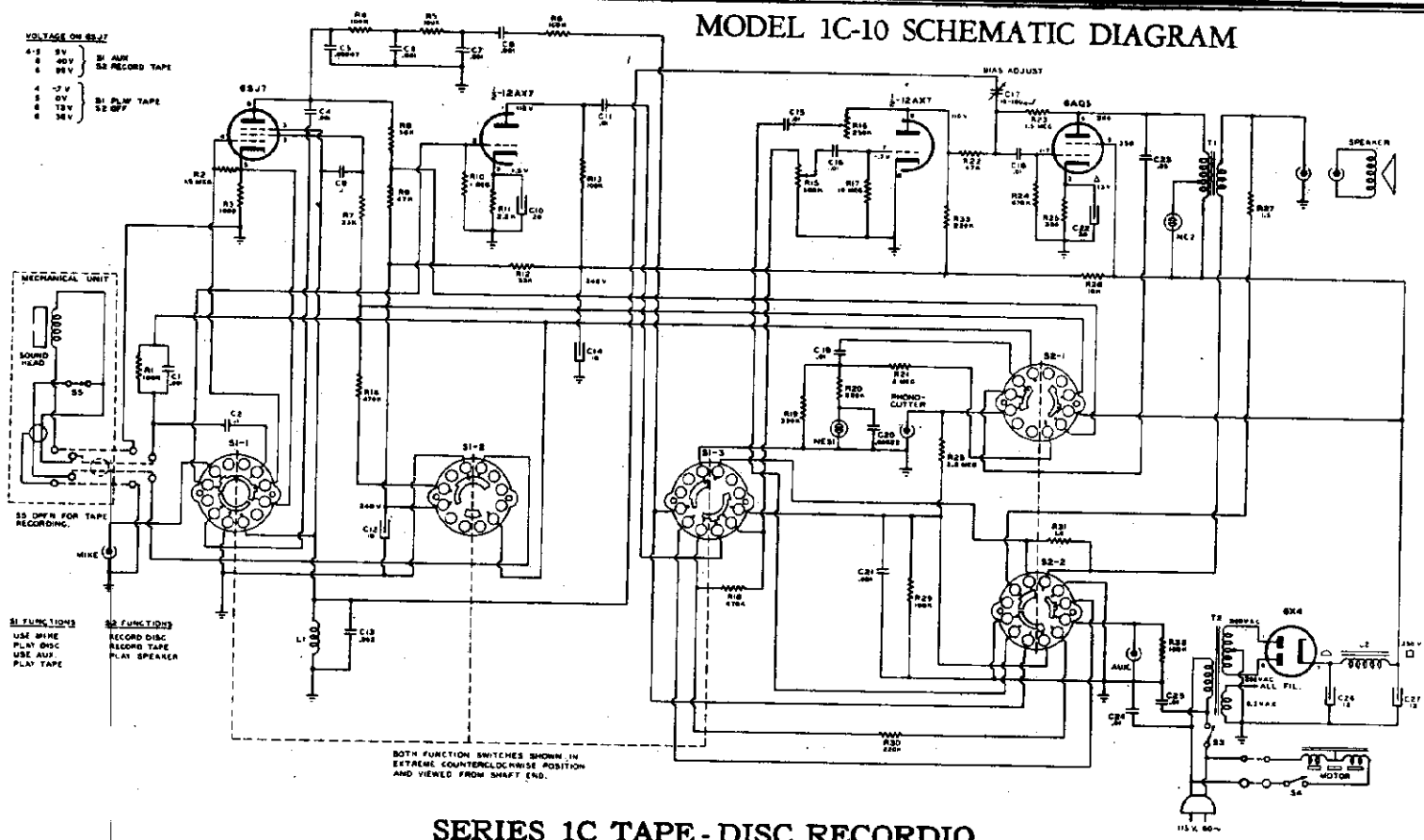
NOTE: DO NOT OVER-LUBRICATE IN PARAGRAPHS B & C. Excessive oil will throw out onto the base plate or belt. Recommended amount is 2 or 3 drops on the reel pan shaft, and 5 or 6 drops on the sheave. The bearing is porous bronze and will hold a reasonable amount of oil to afford continuous lubrication.

(d) The felt pads on the clutch plates are saturated with SAE 10 oil. Here, again, do not over-lubricate. Do not add oil unless it is absolutely necessary, and then sparingly. The shearing of the oil in the pads is partially responsible for the drive of the clutches. Therefore, do not over-saturate the felt. There is sufficient oil in the felt when medium finger pressure causes a small bead of oil to appear along the edge of the felt. When the finger pressure is released, all oil should be reabsorbed by the felt.

Turntable Drive Wheel Shaft and Bearing: Set the tape assembly on edge and raise the rubber tire drive wheel in the bearing as far as it will go. There will be sufficient room to apply 2 or 3 drops of SAE 10 oil to the shaft on top of the bearing. Bearing is porous bronze and will hold sufficient oil to afford continuous lubrication. *CAUTION:* No oil can be tolerated on the rubber tire drive wheel.

The Motor Bearings are fed by an oil wick and should not require new lubrication. If they are lubricated, a few drops of SAE 10 oil may be placed on the rotor shaft so as to run down into the bearing assembly.

Pinch Roller: Remove cover plate and apply not more than one (1) drop of #10 oil to the stud holding the pinch roller. Extreme care should be exercised to prevent any oil reaching the rubber section of the pinch roller.



SERIES 1C TAPE - DISC RECORDIO

OPERATION

Failure to level the instrument may result in improper feed-in of the pickup arm (85), incorrect operation of mercury switch (76), erratic operation of tape reel clutch plates (96) (97), and an unbalanced condition of disc recording arm (85) when in disc record position.

The mercury switch (76) and its mounting assembly (51) acts as an off-on switch, and is held in an off position when the control knob (82) is in the off position. Without recording tape being threaded around the drive capstan, the turntable (99) will operate in only the "Phono", "Reverse", and "Forward" positions of control knob (82) and the tape reels will operate only in the "Reverse" and "Forward" positions of control knob (82). When in "off" position, a cam section of function shift lever (80) contacts the stud portion of mercury switch assembly (51), which protrudes through base plate (32). This cam section tilts the mercury switch assembly (51), to which is attached mercury switch (76) to such an extent that the circuit of the mercury switch (76) is opened and held in this position until control knob (82) is again moved. When moving the control knob (82) to "Phono", "Reverse", or "Forward" positions, the function shift lever (80), which is attached to control knob (82) lets the switch actuator lever (71) contact the stud position of the mercury switch assembly (51) which in turn holds the mercury switch (76) in a closed position and voltage is applied to the motor.

A reel (3" or 5" diameter) of either plastic or paper base recording tape is placed on the rear reel pan (45) and over reel sleeve bushing (41) with one slot of the reel engaging key (42). A second but empty reel, is placed on the front reel pan (45) and locked in position with key (42). The rear reel is to be turned so the tape will be taken from the rear side.

With the control knob (82) in "off" position, unwind approximately three feet of tape. If plastic tape is used, the dull side should be on the inside; if paper, the oxide (black or red) side on the inside. The tape is placed around the turntable and the end is fastened to the front reel. The slack in the tape is taken up by turning the front reel. When tape is tightened, it will slide under the turntable and contact the rubber capstan. The recorder is now ready for operation, and with proper amplifier control selection, the tape can be recorded or played back. To record tape the control knob (82) is moved forward slightly, and then to the right until it is aligned with the record position. The control knob (82) is then pushed forward and at the same time, the record lock button (86) is pulled toward the operator to permit full engagement of control knob (82) in the record position.

When in record position, erase head (52) contacts the recording tape and erases the lower track only at the instant just prior to passing over the recording head.

Bias switch (60) is opened by sleeve (12) when in record position. In all positions other than record, the bias switch (60) is connected directly across the recording head (66) through the amplifier's function switch.

When in either the record or playback position the tape always travels from the rear reel to the front reel. Only the lower track of the tape is recorded or played back. Upon the completion of the transfer of tape from the rear reel to the front reel, to continue recording or playback it is necessary to remove the front reel, inverting it and placing it on the rear platform and at the same time putting the empty reel from the rear platform onto the front platform. The tape is again threaded in accordance with procedure outlined above. In this manner, one hour full recording time or playback time is available from a 5" reel of tape. Recording speed or playback speed is 3¾" per second.

When control knob (82) is in either record or playback position, the function shift lever (80) contacts the pressure pad and pinch roller assembly actuating spring (101). This brings the pinch roller (103) in firm contact with the tape and the driving capstan. The pressure pad (102) which is also a part of this assembly, is brought into contact with the recording tape and holds it firmly against the recording head (66). This assures firm contact between the driving capstan and the tape, as well as holding the recording tape firmly against the recording gap which is a part of the recording head (66). The driving capstan is in turn driven by the large 10" turntable which acts as a flywheel, thus minimizing any flutter or wow effect as a result of changing velocity of the tape. The recording head is only a very short distance from the driving capstan, thus minimizing the possibility of whipping of the tape as it travels across the recording head which would result in flutter.

With control knob (82) in reverse or forward position, the function shift lever (80) actuates spring (101), and the pinch roller and pressure pad assembly is pulled out of contact with the recording tape by spring (98). In reverse position, the function shift lever (80) depresses one end of lift lever (56) which in turn lifts the front reel assembly off the clutch. When this happens, there is no restraining force applied to the front reel; consequently the back reel rewinds tape very rapidly. The opposite condition is true when the control knob (82) is placed in the forward position. Here the function shift lever (80) depresses the rear lift lever (56) which disengages the rear reel from the clutch assembly. The front reel will then rapidly wind tape in a forward direction. The fast forward or fast reverse speed is approximately 20 to 1 over the 3¾" per second normal recording or playback tape speed.

To play standard 78 RPM phonograph records, it is only necessary to position the control knob (82) in the phono position. With the control knob (82) in the phono position, the function shift lever (80) depresses both the front and rear lift levers (56) thus disengaging both the front and rear reel clutches. This eliminates the driving of the tape, and the only function the unit performs is to actually turn the turntable. In playing phonograph records, the rear portion of the pickup arm (85) is depressed, and a standard playback needle is inserted in the pickup cartridge (65), and it is held in position with the thumb screw.

It is possible to cut disc recordings from recorded information on the tape or any external source which might be fed into the amplifier. To cut home recordings, it is necessary to remove the playback needle from pickup cartridge (65) and insert a standard 5/8" recording stylus. The recording blank is placed on the turntable, being sure that the off-center hole of the recording blank is inserted over the drag pin (30), thus assuring the disc to revolve constantly with the turntable. The pickup arm (85) is lifted off the tone arm rest (83) and the point of the cutting stylus is placed on the outer edge of the recording blank at the approximate location at which the recording is to start. These operations are performed with the control knob (82) in the off position. The rear of the pickup arm is lifted by the finger extending to the right side. At a certain point, there will be a definite feeling of the pickup arm locking into position; and at this location, the follower arm (61) engages the lead screw (23). It is now only necessary to move the control knob into the phono position if the recording is being done from some source other than the tape. Place knob into the playback position if it is desired that information on the tape be recorded on a recording blank. With the proper setting of the amplifier controls the information will be recorded on the disc, and it is desirable that occasionally the thread from the cutting operation of the cutting stylus be wiped toward the center of the turntable so as to wrap around the turntable spindle. Upon completion of the disc recording, it is only necessary to apply a slight downward pressure to the lift finger of the pickup arm, and it will be disengaged from the holding lock, thus permitting it to be lowered to its normal position and will then be ready for phono playback by exchanging needles.

The 1C series tape-disc Recordio incorporates features for automatic shutoff upon the completion of the recording or playback of a reel of tape. This is accomplished by the tension of the tape holding the mercury switch assembly (51) in a position so that the mercury switch (76) is closed, thus permitting power to be supplied to the motor. When in the record or playback position and the tape tension is released as a result of all the tape being wound on the forward reel, the switch assembly which includes the mercury switch is permitted to tip in a manner opening the motor circuit, thus automatically stopping the unit.

Frequently, it is desirable to record a full half-hour program of uninterrupted music and this can be accomplished by recording music from records to tape. So as to eliminate any interruptions between records, it is possible to, at the conclusion of one record, stop the forward reel by hand, thus releasing the tape tension and permitting the mercury switch assembly (51) to open the motor circuit. At this time, the records can be interchanged on the turntable, the pickup arm again placed on the second record, and the tape tension tightened by a slight clockwise rotation of the forward reel. This will again position the mercury switch assembly so as to close the motor circuit, thus starting the recording process. This procedure can be continued until the entire reel of tape is recorded; and when it is played back, there will be no apparent interruptions from one record to the next.

GENERAL ADJUSTMENTS

It is seldom necessary to make any adjustment on the 1C series tape-disc Recordio in the field, as it is shipped from the factory completely adjusted for satisfactory operation. In the event that adjustments may become necessary, it is recommended that the following procedure be followed.

Adjustment of lift lever (56), Control of reel pan (45). Adjustment is easily made in the forward and reverse positions. In the forward speed position, the rear reel pan (45) must be raised to the position that it clears the clutch spring (97). At the same time the front pan (45) must be lowered to contact the clutch spring (96) and the lift lever must clear the lowet end of the reel pan shaft (43) by approximately 1/32" to 1/16". The adjustment of the lift lever (56) is made by bending the short unflanged section of the lever immediately under the reel pan shaft (43). To adjust in the reverse speed position, the opposite of the above condition is true. In the record and playback positions the lift lever (56) must clear both reel pan shafts (43) so that both the pans will contact the clutch springs (96-97).

Tracking of the tape through the recording head (66) is controlled by tipping the tape capstan (53) slightly with the two adjusting screws (27) located under the mounting flange of the auxiliary shaft housing (55) under the base plate (32) of the machine. The capstan (53) should be so adjusted that the tape tracks in the center or toward the top of the guide slot in the recording head (66) - never toward the bottom of the guide slot.

To adjust the pressure pad (102) against the tape recording head (66), it is necessary to remove the pinch roller cover plate (104) to reach the lock nut (107) on the pressure pad adjusting screw (106). To adjust the pad (102) for proper pressure against the tape recording head (66), set the speed shift lever (82) in the record position. Turn the adjusting screw (106) in against the pressure pad spring (102) until the pressure pad just contacts the recording head (66). Then turn the screw one-half to three-quarters of a turn clockwise and tighten the lock nut (107).

Engagement of follower arm (61) to lead screw (23) during disc recording operations. When lifting the rear section of pickup cutter arm assembly (85), the follower arm (61) should engage the lead screw (23) before the rear of the pickup arm locks in the up position. This engagement should be at a point of between ⅛ and ¼ inch before the pickup arm locks. If it is necessary to adjust this point of engagement, it can be accomplished by slightly bending follower arm (61). If the follower arm engages the lead screw too tightly, an excessive load will be put on the lead screw, thus injecting wow in the recording. If the engagement is not sufficiently heavy, there is a possibility of grouping which is the result of the follower arm lifting up on the threads of the lead screw (23) rather than moving along in a smooth and continuous pattern.

GENERAL LUBRICATION

To lubricate reel pan shaft (43), reel sheave (36), reel sheave bearing (33), and reel pan clutch springs (97-96).

a. Remove TRUARC "E" ring (75) on lower end of reel pan shaft (43) and lift reel pan (45) and clutch springs (96-97) off machine to expose parts to be lubricated. In removing "E" ring (75), care must be exercised to see that no burr is turned up on the shaft (43) at the edge of the ring slot.

b. Use SAE10 oil on reel pan shaft (43) and the inside only of the reel sheave bearing (33).

c. Use SAE20 oil between reel sheave bearing (33) and the hub of the reel sheave (36). It is not necessary to remove the sheave from the machine since there is a countersink well at the top of the reel sheave hub into which the oil may be placed and allowed to run down through the bearing. Do not over-lubricate in paragraphs B and C, as excessive oil may throw out onto the base plate or belt of the machine. On the reel pan shaft, two or three drops, and on the sheave, five or six drops is sufficient. The bearing is porous bronze and will hold a reasonable amount of oil to afford continuous lubrication.

d. The felt pads on the clutch springs (96-97) are saturated with SAE60 oil. The shearing of the oil in the pads is partially responsible for the drive of the clutches; therefore, do not over-saturate the felt. There is sufficient oil in the felt when medium finger pressure on the felt causes a small bead of oil to appear along the edge of the felt. With a release of the pressure, all the oil should be reabsorbed by the felt.

Turntable drive wheel shaft (47) and bearing (48). It should not be necessary to disassemble the drive in order to lubricate. If the machine is set on edge and the rubber tire drive wheel raised in the bearing as far as it will go, there is sufficient room to apply two or three drops of SAE10 oil to the shaft on top of the bearing. This bearing is of porous bronze and will hold a reasonable amount of oil to afford continuous lubrication. No oil can be permitted on the rubber tire drive wheel.

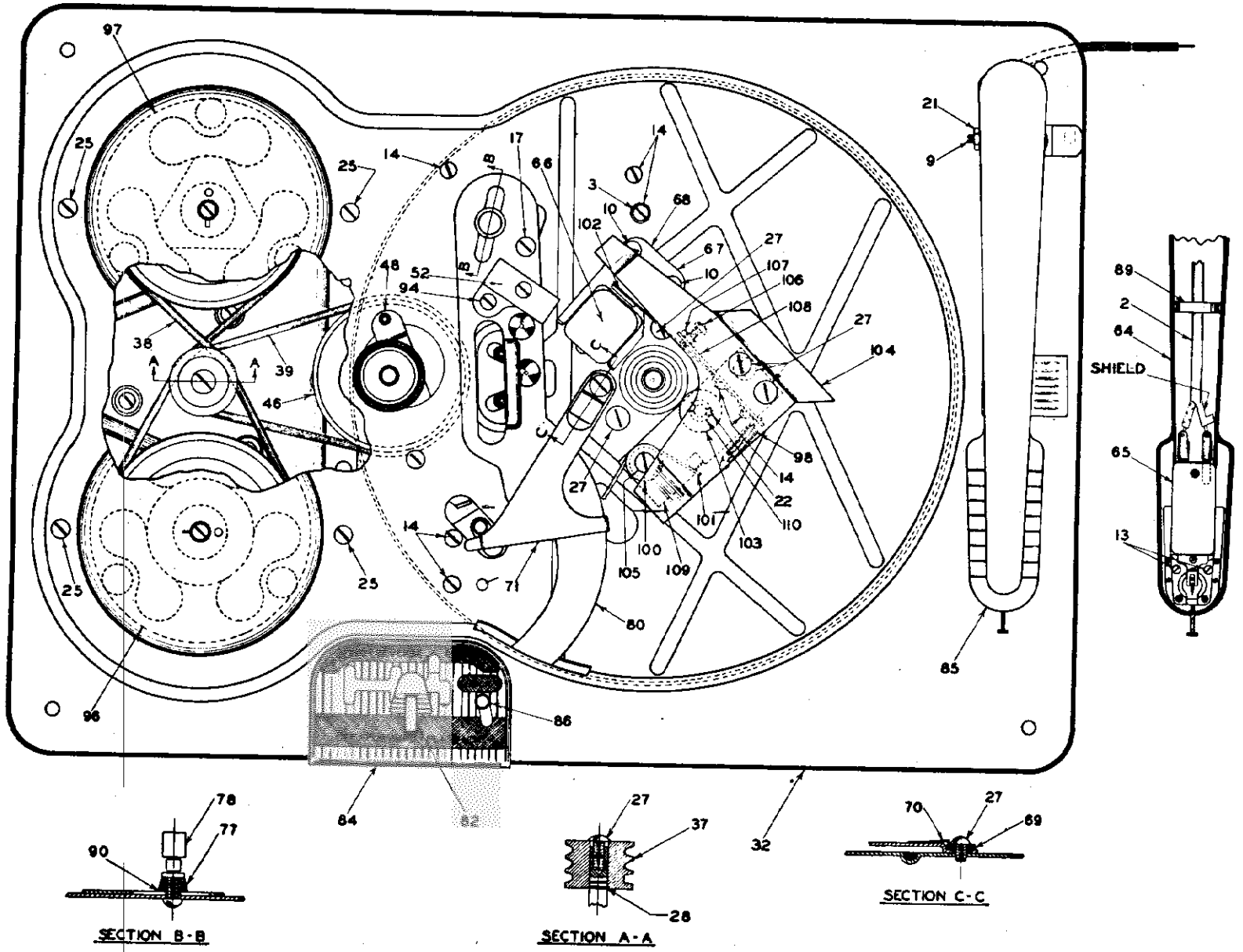
The motor (29) bearings are fed with an oil wick and should not require new lubrication. If they are to be lubricated, use only SAE10 oil and it can be accomplished by placing a few drops of oil on the rotor shaft so as to run down into the bearing assembly.

The auxiliary shaft housing assembly (55) is packed with Torrington Houghton twister ring grease and SAE20 oil at the factory and should not need lubrication.

Pivot post (63) and bushing (74) may be lubricated by raising the tone arm to its highest position and putting two or three drops of SAE20 oil on the post. It is well then to move the post up and down several times so as to secure equal distribution of the oil over the entire bearing surface.

Pinch roller (103). Remove cover plate (104) and use not more than one drop of No. 10 oil to the stud holding the pinch roller (103). Extreme care should be exercised to assure no oil reaching the rubber section of the pinch roller.

Figure 1 — Top View



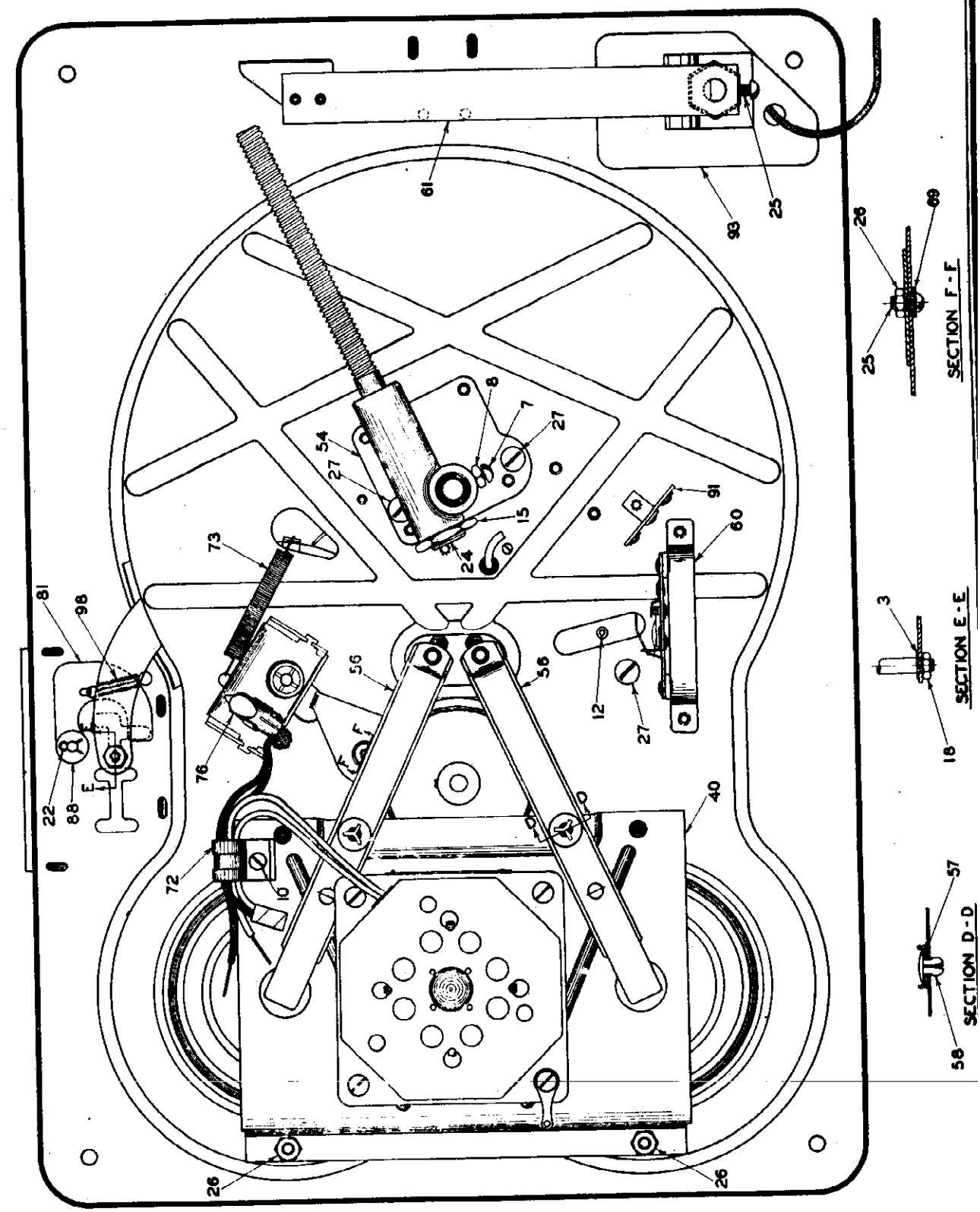


Figure 2 — Bottom View

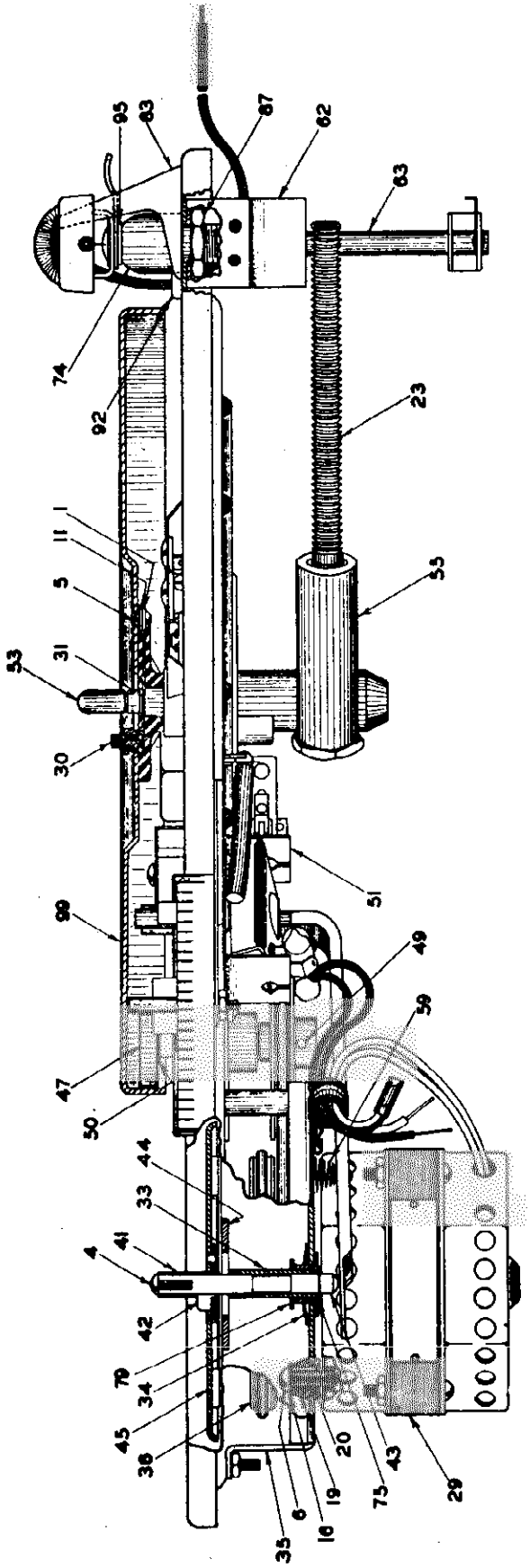


Figure 3 — Front View