Film-Tech

The information contained in this Adobe Acrobat pdf file is provided at your own risk and good judgment.

These manuals are designed to facilitate the exchange of information related to cinema projection and film handling, with no warranties nor obligations from the authors, for qualified field service engineers.

If you are not a qualified technician, please make no adjustments to anything you may read about in these Adobe manual downloads.

www.film-tech.com

SERVICE INSTRUCTIONS

OPTICAL & MAGNETIC SOUND MANUAL THREADING PROJECTORS

DESIGN 302 / 8302

Bell & Howell

PHOTO SALES COMPANY
GENERAL SERVICE DEPT.
7100 McCORMICK ROAD
CHICAGO, ILLINOIS 60645

PART NO. 70448 PRINTED IN U.S.A. OCTOBER 1964

Introduction

This Instruction Book has been prepared to aid the serviceman in the repair and servicing of the Bell & Howell 16-mm Filmosound Projectors, Designs 302 and 8302. An illustrated parts catalog is included at the rear of the manual to identify replacement parts for all projectors. All parts in the exploded view illustrations are indexed in their suggested order of removal. Where disassembly and reassembly of parts is quite obvious, no attempt has been made to elaborate on the removal or installation of such parts. When making specific repairs or replacements, the serviceman must use his own judgement in eliminating unnecessary steps of procedure.

The five projector models covered by these instructions (302L, 302M, 8302A, 8302B and 8302C) are almost indentical in design and construction. Specific differences are noted in the instructions and in the Usable on Code column of the parts lists at the rear of the manual. It is also important to note that some 302M and 8302 model projectors are equipped with oil cups installed in the top of the gear case, while others are of the "factory sealed lubrication" design. Except for this difference in lubricating parts and in the gear case casting, oil cup projectors and permanently lubricated projectors are identical. Projector design variations are listed in the Design Index Chart, preceding page.

SPECIAL MAINTENANCE PRECAUTIONS.

For the most part, disassembly and reassembly of the projectors is relatively simple. Before attempting repairs, however, it is suggested that the serviceman run an operating test to verify customer complaint and then check the Trouble Shooting section to determine the possible cause of the trouble.

LUBRICATION.

Proper lubrication of parts is of vital importance. When overhauling projectors, always clean parts thoroughly of old lubricant and relubricate during reassembly only with recommended Bell & Howell projector oil and grease. Do not over-lubricate, and be sure to wipe away any excess lubricant with a lint-free cloth. Proper lubricants are indicated in paragraph 22.

SPECIAL SERVICE TOOLS.

Special service tools available from Bell & Howell for use in servicing Filmosound Projectors are illustrated in figure B. Refer to the accompanying tool list for tool numbers and applications. The tool number is stamped in each Bell & Howell tool.

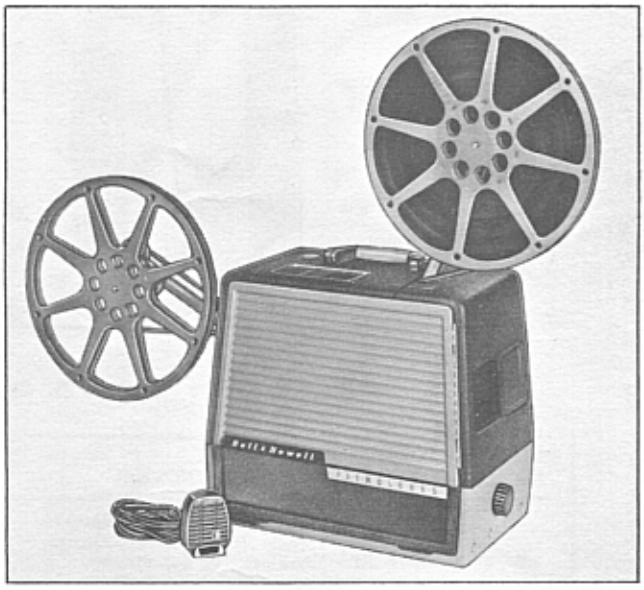


Figure A. Design 8302 Filmosound Projector

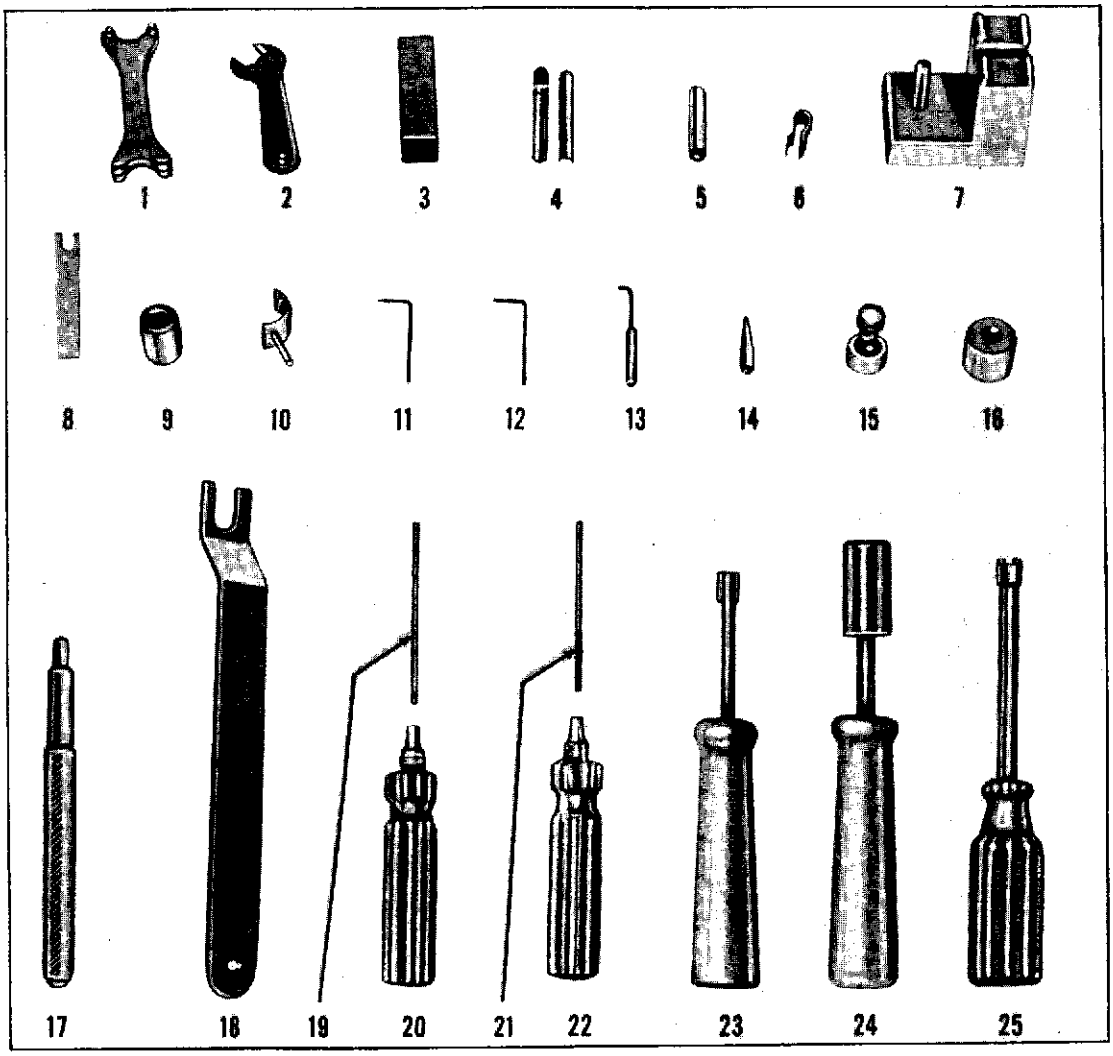


Figure B. Special Service Tools

INDEX NO.	TOOL NO.	FUNCTION
1	ST-244-F1	Fan housing bearing removal
2	S-10309-F1	Lens carrier adjustment
3	S-4529-N4	Shuttle tooth height gage
4	S-4007-F14	Quills (use with Index No. 7)
5	S-4007-F5	Sleeve (use with Index No. 7)
6	No. 1459	Clip (use with Index No. 7)
7	S-4007-F11	Fixture (for assembling shutter and counter shaft parts)
8	S-15177-N4	Shim gage (for gear clearance)
9	S-4007-F6	Sleeve (use with Index No. 7)
10	S-15638-N6	Film guide clearance gage
11	G-165-F3	Setscrew wrench
12	G-167-F3	Setscrew wrench (Bristo)

INDEX NO.	TOOL NO.	FUNCTION
13	S-14986-X1	Setscrew wrench (Bristo)
14	S-15177-F3	Cone (sprocket installation)
15	S-15177-N2	Gage (sprocket adjusting)
16	S-15177-N1	Gage (sprocket shaft adj.)
17	S-14878-F1	Drift punch (bearing removal)
18	S-10310-F2	Wrench (shuttle shaft holding)
19	G-167-X2	Setscrew wrench (Bristo)
20	G-167-F1	Handle (for Index No. 19)
21	G-165-X2	Setscrew wrench (Bristo)
22	G-165-F1	Handle (for Index No. 21)
23	S-19028-F4	Wrench (for clutch disassembly)
24	S-19028-F3	Wrench (for clutch disassembly)
25	S-12264-F3	Wrench (for governor cap)

Disassembly Procedure

NOTE

Disassembly procedures are keyed and cross-referenced to the exploded views located in the Parts Catalog section of this book. The exploded views can be folded outward beyond the edge of the book so that text and illustrations can be referred to simultaneously. Follow the procedures as outlined, eliminating unnecessary steps where desired.

1. AMPLIFIER AND PROJECTOR. (See figure 1.)

a. Remove the case feet (1), lock washers (2) and bottom plate (3). Remove four screws (4) and carefully withdraw the amplifier (5) from the projector case. Be sure to disconnect all connecting cable plugs from the amplifier.

NOTE

No specific disassembly instructions are given for the amplifier. Refer to the appropriate schematic diagram at the end of the Parts Catalog section for proper voltage and parts replacement information. Correct amplifier troubles by normal circuit tracing techniques.

b. Remove the screws (6), flat washers (7), cushions (8) and spacers (9) and withdraw the projector (10) from the projector case (11).

c. The reel arms (14) and (15) are normally stored in the projector case. Remove the reel arm spring belts (12) and (13) by disconnecting the ends and carefully pulling them free of the case. Refer to paragraph 15 for disassembly instructions relevant to the rear reel arm and to paragraph 16 for the front reel arm.

2. PROJECTOR MAIN COMPONENTS. (See figure 2.)

a. Remove the condenser assemblies (1) and (2) and projection lens (3) from the projector. Refer to paragraph 6b for disassembly of the relay condenser and to paragraph 9e for disassembly of the 45-50mm condenser. Do not attempt to disassemble the projection lens.

b. Loosen the knurled screw (4) and remove the exciter lamp cover (5). Press down slightly on the exciter lamp (6), twist the lamp and remove it from its socket.

c. The gear case assembly (14), blower housing (17), governor cap assembly (19) and lamphouse and motor assembly (20) can be removed as a unit by removing two screws (7) or (7A) and two Sems screws (8). The screws (7) are used in 302L projectors only; screws (7A) and support bracket (7B) are used in all other models.

d. Free the gear case assembly by removing screws (9) and (11), the latter also serving to attach the guide rail (12) and spacer washers (13). Separate the gear case (14) from the blower housing, being careful not to damage the teeth of the counter gear (22, figure 5) as it passes the thrust nut (1, figure 8). When assembled, the counter gear engages the motor pinion (3, figure 8).

e. Remove the screws (15 and 16) and separate the blower housing (17) from the lamphouse (20). Remove two screws (18) and separate the governor cap assembly (19) from the lamphouse.

3. GEAR CASE - FRONT COVER AND CLUTCH MECHANISM. (See figure 3.)

a. Remove the pressure plate assembly (1) from the rear of the lens carrier and, if necessary, disassemble as follows: Press in on the spring cups (1A) until the cups and springs (1B) can be removed. Remove screws (1C) and disassemble the remaining parts.

b. Remove the rubber knob (2). Unscrew the hex nut (3) and partially unscrew the clutch knob assembly (4) until the retaining ring (5) can be removed. Unscrew the knob assembly completely and catch the spacer (6) as it drops free.

c. Note that a small pin in the plate and shaft assembly (13) engages a hole in the gate operating block (9). These two parts must be disengaged while the front cover assembly (8) is being removed. Lift out the gate operating block (9).

d. Unscrew the fillister head screw (10) and remove the gate operating lever (11). Loosen the setscrew (12) and disassemble the plate and shaft assembly (13) and eccentric bushing (14) from the front cover. Unscrew the special screw (19) and carefully remove the idler gear shaft (15), idler gear (16), eighteen steel balls (17) and large flat washer (18) from the boss on the rear of the front cover.

e. Loosen the pilot screw (20) and disengage the tip of the clutch lever stud (21) from the hole in the clutch lever (22). Remove the clutch lever, torsion spring (23) and clutch plunger (24).

4. GEAR CASE - SPROCKETS AND GEARS. (See figure 4.)

a. Remove the two screws (1) and film strippers (2).

b. Remove the sprocket guard screw (3), sprocket guard assembly (4), spring (5) and tension washer (6) from the end of each sprocket shaft. Use the Bristo wrench and handle (21 and 22, figure B) to loosen the setscrews (7). Remove sprocket assemblies (8), being careful not to damage the felt washers located inside the sprockets.

c. Remove screws (9) and film guides (10). Remove screws (11) and lens carrier retainers (12) and lift off the lens carrier (20). Remove the screw (13), ball retaining spring (14) and steel ball (15) from the lens carrier. Unscrew the two screws (16) from the pressure plate adjustment nuts (17) and disassemble the pressure plate carrier (18) from the lens carrier.

CAUTION

The inner tip of the lens lock screw (19) is peened and this screw should not be removed from the lens carrier.

d. Note that an ear on each film tension clip (22) engages a slot in the aperture plate. Remove the screws (21), the film tension clips (22), the thrust spring (23) and the aperture plate (24). The 302L projector is equipped with a variable aperture plate (see inset, figure 4); all other models are equipped with a fixed-aperture plate. Remove the framer shaft assembly (25).

e. Loosen setscrews (26) with the Bristo wrench and handle (19 and 20, figure B). Turn the setscrews out far enough to permit removal of the sprocket shafts (27). Remove the sprocket shafts, upper gear (28), and the worm wheel (29) with its spacer washer (30). Note that each sprocket shaft is drilled to receive a felt oil wick (27A). These should be discarded and replaced.

NOTE

All 8302 Models and the 302M are equipped with a loopsetter assembly (31) which is held in place by the screw (21) which holds the lower tension clip (22), and an adjacent screw (9) which attaches the lower film guide (10). Do not disassemble unless the spring (31B) is in need of replacement.

5. GEAR CASE - SHUTTER AND SHUTTLE. (See figure 5.)

a. Insert the special wrench (18, figure B) behind the shutter supports as shown in figure C. The wrench must engage the flats on the shuttle shaft (13). Remove shutter retaining nut (1) with an open-end wrench and lift out the shutter supports (2) and the shutter (3). The oil baffle (4) and lubricator assembly (5) should be removed together, as a unit. Removal of the special screws (7) will free the lubricator assembly (5), shuttle (8) and shuttle pins (9). A "class-fit" number is etched into each shuttle in the location indicated by the letter A in figure 5. If the shuttle requires replacement, be sure that the new shuttle has the same class fit number as the old one.

b. Before removing the parts indexed 10 through 24, note the location of the steel balls (12, 14, 21 and 23). When repairs necessitate the complete disassembly of the gear case, these steel balls must be discarded and replaced with new ones.

NOTE

Steel balls used by Bell & Howell are carefully graded and balls of different grades must not be intermixed. When ordered in quantities of 1000 or more, the grade is indicated on the bottle. When ordered in quantities of less than 1000, the balls are all of one grade and must not be intermixed with any steel balls you already may have on hand.

c. Loosen the two setscrews (10) by inserting the Bristo wrench through the access hole in the side of the gear case below the lens carrier mounting surface. Remove the shoulder screw (10A), spring (10B) and the collar (11) and remove and discard the steel balls (12). From the rear of the gear case, remove the shuttle shaft (13) and discard the steel balls (14). Remove the oil felt (15) from the shuttle shaft.

d. Loosen two setscrews (16) and remove the worm drive extension (17). Loosen the setscrews (18 and 19) and withdraw the worm gear (20). Discard the steel balls (21). From the rear of the gear case, remove the counter gear (22), steel balls (23), and the oil felt (24). Discard the steel balls.

e. Remove the flat head screw (25) and the spring clamp (26). Remove the oiler felt (27) from the hole between the two bearings (28) with a tweezers. If either or both of the bearings (28) are in need of replacement, they can be removed by driving them out with the special drift punch (17, figure B). Be sure to save the shims (29) located behind the shoulder of the bearings.

6. BLOWER HOUSING. (See figure 6.)

a. Note that Design 302L projectors are equipped with the adjustable fire shutter (items 1 through 5); all other models are equipped with the manually controlled heat filter (items 15 through 20). Disassemble parts as necessary for replacement.

b. When disassembling the condenser assembly (9), note that the condenser for Design 302L projector has a one-piece condenser holder and handle; in all other models, the condenser handle is removable.

7. GOVERNOR CAP ASSEMBLY. (See figure 7.)

a. Unscrew the special nut (1) with a spanner wrench. Then unscrew the fillister head screw (2) and remove the radial bearing (3). Remove the worm shaft and drive blade (4) and felt washer (5). Use the special tool (25, figure B) to remove screw (6). Remove clutch cover (7) and bronze washer (8), taking care not to dislodge the spring (9) or steel balls (11).

b. Note how the parts indexed 9 through 12 are

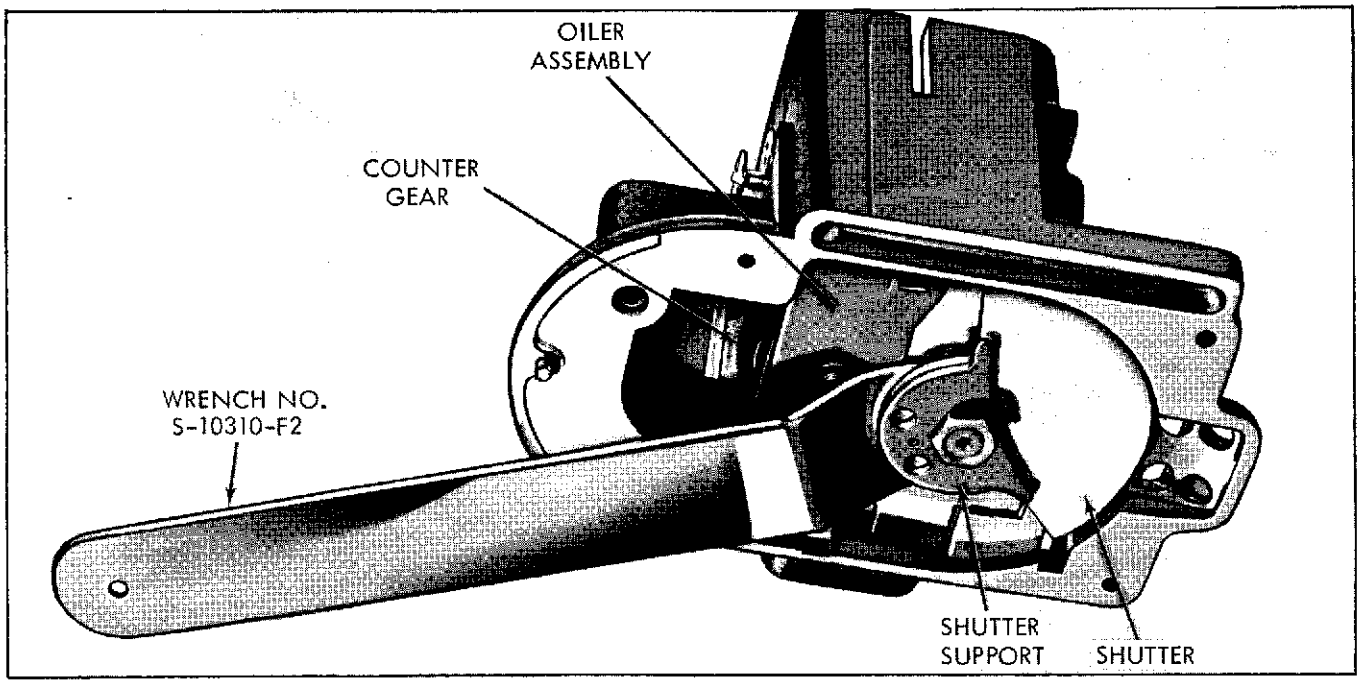


Figure C. Removing Shutter with Tool No. S-10310-F2

assembled before removing the clutch cam (10). Then remove the spring (9), the clutch cam (10), the three steel balls (11) and the clutch ball retainer (12). Remove the rear take-up pulley (13), being careful not to lose any of the eighteen bearing rollers (14).

c. Unscrew the screw (15) and then remove the retaining washer (16), ball bearing (17) and worm wheel (18). Now reach inside of the governor cap and remove the retaining pin (19). Pull out the shaft (20). Remove the retaining ring (21), ball bearing (22) and retaining ring (23).

d. The plug button (24) is used to plug the grease packing hole in the governor cap (25).

8. MOTOR, GOVERNOR AND FAN. (See figure 8.)

a. Insert tool No. S-19028-F4 (23, figure B) over the armature shaft and push back on the thrust washer (2) to disengage it from the thrust nut (1). Unscrew the thrust nut and remove the tool and thrust washer. Remove the motor pinion (3), the bearing rollers (4) and two pinion washers (5). Use tool No. S-19028-F3 (24, figure B) as shown in figure D and push against the spring retainer (7) until the dowel pin (6) can be removed with a drift punch. Remove spring retainer (7) and spring (8).

b. Loosen setscrews (9) and remove the governor (10) and governor brushes (11).

NOTE

Model 302L projectors are equipped with an open-end brush housing (21) with the bearing (16) protected by a cap (13) and the end of the armature secured by a hex nut (14) with locking washer (15) and shim washer (15A). These parts are not required in all other models.

c. Unscrew the motor brush caps (17) and remove the motor brushes and springs (18), or (18) and (19).

d. Remove four screws (20) and the motor brush

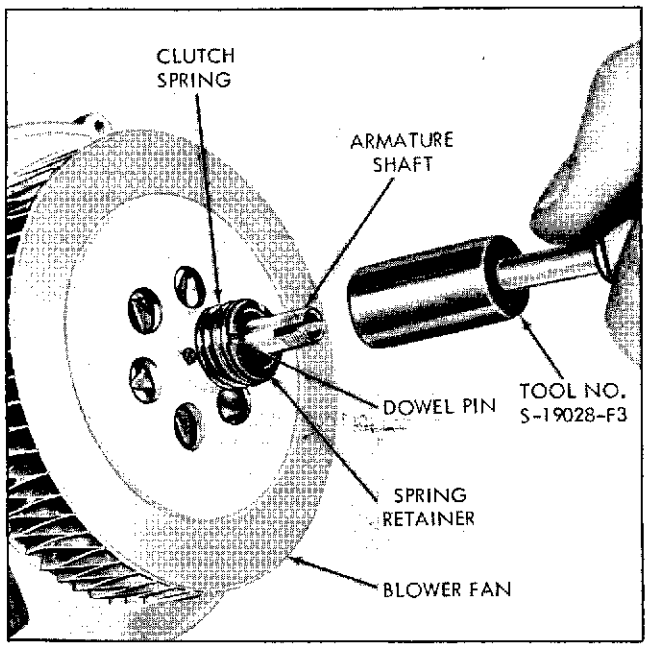


Figure D. Using Clutch Tool No. S-19028-F3

housing (21). Press the bearing (16) from the motor brush housing and remove the spacer washer (22) from the armature shaft.

e. Tap out and discard the spring pin (23) and remove the blower fan assembly (24). Remove the spring (25) from the armature shaft (all models except 302L). On the 302L, remove the spring washer (25A), bearing ring (25B) and spacer (25C) from the armature shaft. Withdraw the armature assembly (27) from the motor housing, being careful that it does not slip forward during removal.

f. Unscrew the stator retaining nuts (28) from the four studs (29) and carefully withdraw the stator assembly (30) from the motor housing.

9. LAMPHOUSE. (See figure 9.)

a. Remove the reflector assembly (1) from the lamphouse. The retaining ring (1A) on the reflector holds the unit in position.

b. Unscrew the fillister head screws (2) and remove the lamphouse cap (3) and the air-circulating tube (4).

c. Unscrew the lamp lock screw assembly (5). Remove the fillister head screws (6) to detach the terminal box assembly (7). Do not remove the heat conducting ring (8) unless necessary for replacement.

d. Unscrew the fillister head screw (9) and remove the condenser friction spring (10) from the lamphouse and motor housing (11).

e. The condenser assembly (12), which was removed in paragraph 2, is disassembled by removing the lens retaining snap ring (13). Be careful that the spring (15) does not release suddenly and cause possible damage to the lens (14). Remove the condenser lens (14), spacer spring (15), and a second condenser lens (16) from the condenser lens housing (17).

f. When removing the condenser lenses, wrap them separately and mark them "inner" and "outer" to insure proper reassembly. If the two lenses should become intermixed accidentally, place them side by side, flat surface down, on a piece of white paper. When looking straight down at the lenses, note that each has a circular reflection. The lens with the smaller circle of reflection is the outer lens (14).

10. STABILIZER ROLLERS AND OPTICAL SLIT. (See figure 10.)

a. Before attempting to disassemble the stabilizer, note carefully the manner in which it is assembled. Loosen the setscrew (1) and remove the cap (2). Withdraw the assembled stabilizer parts as a unit from the stud (14). Disengage the torsion spring (5) and separate the stabilizer assembly into two units.

b. Loosen the screw (4) and remove the torsion spring (5). Remove the screw (6) and disassemble the roller stud (7), plain roller (8), and lower stabilizer arm (9). Remove the screw (10) and disassemble the roller stud (11), flanged roller (12), and stabilizer arm (13). Unscrew and remove the stud (14) and lock nut (15).

NOTE

When removing stabilizer parts, be careful not to damage the optical slit assembly (45). If the optical slit must be removed, scribe or mark a line on the slit barrel flush with its mounting boss so that the slit can be reassembled in approximately the same position. Then loosen the setscrew (43) and withdraw the optical slit, taking care not to lose the locking slug (44).

11. SOUNDHEAD - SOUND SPROCKET AND SNUBBER ROLLER. (See figure 10.)

a. Remove the screw (16), the sprocket guard (17), the spring (18), and tension washer (19) from the sprocket shaft (23). Loosen the setscrew (20) and slide the sprocket assembly (21) from its shaft. Loosen setscrew (22) and withdraw the sprocket shaft (23), washer (24) and gear (25). Remove and discard the felt lubricator (23A) located in a hole in the sprocket shaft. Remove the screws (26), the film guide (27), and two spacer washers (28).

b. Remove the single screw (29) and hex nut (30) and two shorter screws (31) and lift off the complete snubber assembly. If this unit must be disassembled, note the manner in which the ends of the torsion spring (34) engage shaft (33) and bearing (35).

c. Unscrew the idler roller stud (38) and remove the idler roller (40) and spacer (39).

12. SOUNDHEAD - SOUND DRUM AND FLYWHEEL. (See figure 11.)

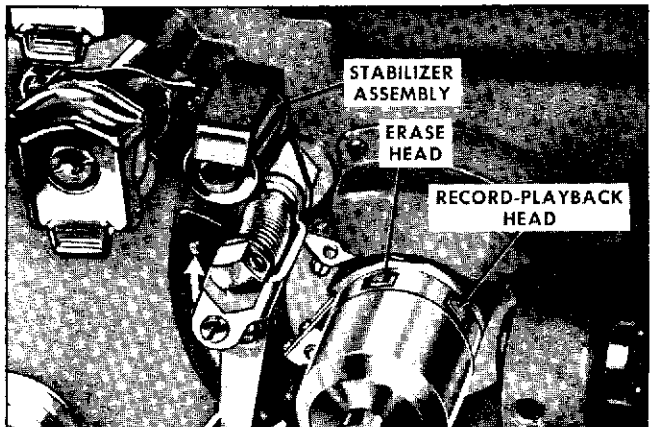
NOTE

Electrical and magnetic sound components of the soundhead need be removed only if preliminary test inspections indicate a need for replacement. The removal of the pilot lamp (41), relay (47), exciter lamp socket (51), phase reactor (52), switches (53, 54 and 66) and cables (61 and 68) require only the unsoldering of leadwires and the removal of attaching hardware. If the sound drum is to be replaced completely, remove as outlined in steps a and b following. If only the magnetic heads are to be replaced, proceed as outlined in paragraph 13.

a. Remove the three screws (1), bearing cap (2), spring retainer (3) and compression spring (4). Remove two screws (5) and the light shield cover (6). Note the manner in which the torsion spring (11) is engaged; then remove the screw (7), eccentric (8), detent lever (9), spacer washer (10) and spring (11).

b. Remove the hex nut (25), screw (27) and washers (26 and 28), and remove the quill retaining clamp (29). Remove the retaining ring (30), grasp the sound drum

and, while supporting the weight of the flywheel, withdraw the sound drum from the soundhead until the rear end of the shaft is free of the bearing (36). Remove the flywheel retaining spring (32) and withdraw the sound drum assembly completely from the soundhead casting, meanwhile lifting out the flywheel (33). Do not remove the lever (35) unless in need of replacement.



13. MAGNETIC HEADS AND COILS. (See figure 11A.)

NOTE

The magnetic heads and coils of the sound drum assembly can be replaced by following the procedure outlined below. The sound drum need not be
make
rough
heads
check
magne
film, c
stripi

a. Inspec
nifying gl
travel wil
or steps,
quarter o.
contact area and are cause for head replacement.

require replacement of the damaged coil, as outlined in the following steps.

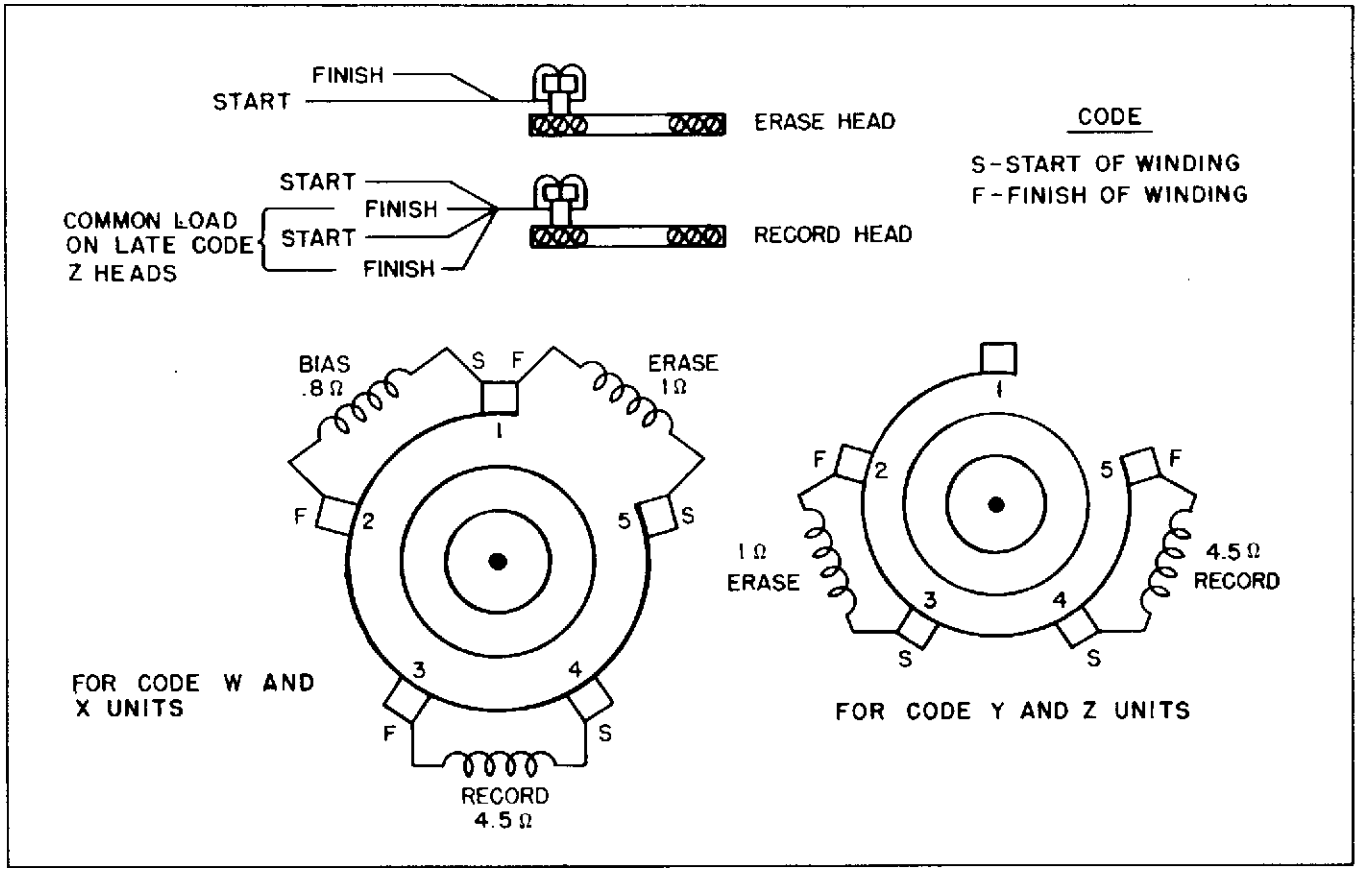


Figure F. Magnetic Head Coil Identification and Connections

c. Shift the function lever to the OPT (optical) position and remove the screw (12, figure 11), washer (13), and roller (14). Remove two screws (5) and the light shield cover (6).

d. Refer to figure 11A and remove the screw (6) and washer (7). Shift the function lever to the MAG (magnetic) position and remove the screw and washer at the opposite end of the hum shield. Place the function lever at a point mid-way between the optical and magnetic positions, and carefully lift off the shield cover (5). Remove the remaining screw (6) and washer (7) and lift off the hum shield (4).

e. Loosen the screw (10, figure 11A), and carefully lift the record-playback arm (16) as far as possible but without placing a strain on the coil leads. While holding the arm in this position, tighten the screw (10).

f. Shift the function lever to a position such that the record-playback head (figure E) is facing directly up. Carefully apply a drop or two of acetone at the points where the head pole pieces enter the coil forms.

CAUTION

Do not apply acetone to the coils. If acetone runs onto the coil windings, remove at once with a clean, lint-free cloth.

g. Allow approximately 30 seconds for the acetone to soften the cement. Then, while holding the arm (16, figure 11A) firmly in place, insert a jeweler's screwdriver between the pole piece (11) and the coil form and carefully pry the coils (12) from the arm. As soon as one coil begins to loosen, shift the screwdriver to the other coil and begin to loosen this one. When both coils are loose, slip them away from the pole piece.

h. With the function lever in mid-position, loosen the center screw in the arm (16) and remove the record-playback head.

i. The erase head is removed in the same manner as the record-playback head (steps e through h, preceding).

j. With the heads (pole pieces) removed, the resistance of the coils can be checked without danger of magnetization. Remove twine and tape (2) from the terminal ring (3) and carefully unsolder the two leads from terminal 1 (figure F). The resistance of the coils should be approximately as indicated in figure F. Shorted coils must be replaced.

k. Should it be necessary to replace a coil (bias and record coils must be replaced as a set), carefully disconnect the coil leads from the terminal ring. Coil leads must be connected as shown in figure F. Coils and their leads can be identified as follows:

Erase coil - wound with heavier gage wire than the record-playback coil. The longest of its two tinned leads is the start of the winding.

Bias coil - part of record-playback coil assembly. Wound with heavier gage wire than record coil and the longest of its two leads is the start of the winding.

Record coil - part of record-playback coil assembly. Wound with lighter gage wire than the other coils, and the longest of its leads is the start of the winding.

NOTE

Refer to paragraph 42 for head and coil reassembly instructions.

14. PROJECTOR CASE. (See figure 12).

Except for the carrying handle, tilt mechanism and speaker, it is doubtful that projector case parts will require replacement. Merely refer to the exploded view illustrations and remove damaged parts in indexed sequence. Inspect speaker cone for damage.

15. REAR REEL ARM. (See figure 13.)

a. Remove the fabric take-up belt (1). Press out the shaft (2) and remove the take-up arm assembly (3 through 14).

b. Remove the screw (3) and twist the cover (4) slightly to disengage the return spring (6) from the lock pin (14A). Lift off the cover and return spring.

c. Remove the screw (7), plunger (8), and rewind gear (9). Unscrew the hex nut (10) and the bearing retaining ring (11). Remove the nineteen steel balls (13), take-up pulley (12) and nineteen more steel balls (13) from the take-up arm assembly (14). Be careful not to lose any of the steel balls.

d. Unscrew the rewind drive gear (15) from the shaft of the take-up drive pulley assembly (16) by turning clockwise to loosen the left-hand thread. If necessary, wrap tape around the rewind drive gear (15) and drive pulley (16) so that they may be firmly grasped to unscrew one from the other. Remove take-up drive pulley slowly, cupping hand around it to catch the plunger (17) and compression spring (18) which will pop out as the pulley is removed.

e. Carefully remote the spring (22). Unscrew the shoulder screw (20) to remove the rewind lock lever (21). The headless setscrew (19) acts as a plug for the grease packing hole and is easily removed.

f. The bearing retainer ring (23) is press fitted in place and will have to be pried out if it ever becomes necessary to remove the sixteen roller bearings (24) from the rear reel arm (25).

g. To disassemble the take-up spindle pulley assembly (12), support the reel end of the spindle in a "Vee" block and use a straight punch to drive out the roll pin (12A). Separate the reel clip (12B) from the spindle.

16. FRONT REEL ARM. (See figure 14.)

a. Unscrew the clutch cover screw (1) and remove the cover (2) and bronze washer (3). Carefully remove the three steel balls (4), clutch cam (5) and clutch ball retainer (6).

b. Lift the pulley (7), with bearing rollers (8), the shim or shims (9) and the spindle washer (10) from the reel spindle (13). The same number of shims (9) must be installed during reassembly of the reel arm.

c. Remove split retaining washer (11) and disassemble the reel spindle (13) and washers (12 and 14) from the front reel arm.

d. Unscrew the bearing retainer (15) and press the bearing (16) from the front reel arm.

e. Support the reel end of the spindle in a "V" block and drive out roll pin (13A) with a straight punch to free the reel clip (13B), plunger (13C) and spring (13D).

17. AMPLIFIER. (See figure 15.)

a. Normally, the replacement of tubes and the fuse is the only disassembly necessary.

b. To remove tubes, simply pull them straight up from the sockets, taking care not to damage tube pins, particularly on miniature tubes.

c. The knobs on the front panel are secured with setscrews. The microphone jack is secured with a nut.

d. To gain access to internal parts of the amplifier, unscrew four sheet metal screws, from the bottom and remove the base plate assembly. Take care not to pull the leads which are solder grounded to a terminal on the inside of the base assembly. Refer to the schematic diagrams, figures 17 and 18 for complete amplifier service and parts replacement information.

Repair

18. CLEANING OPTICAL PARTS.

Clean the projection lens, both condenser assemblies and the reflector with Bell & Howell lens cleaning tissue and Optikleen lens cleaning fluid. First remove accumulated dust with a camel's hair brush; then wipe on lens cleaning fluid with a clean, soft cloth and polish with lens tissue. Be careful not to leave fingerprints on lens surfaces, and do not attempt to disassemble the projection lens. Clean only the exposed lens elements.

19. CLEANING OPTICAL SLIT AND MAGNETIC HEADS.

a. Clean the exposed elements of the optical slit assembly (45, figure 10) with lens tissue wrapped about a toothpick. If lens cleaning fluid is necessary, dampen the lens tissue sparingly. Do not disassemble the optical slit assembly.

b. Clean the mirror on the sound drum assembly (31, figure 11) in the same manner as the optical slit assembly, being careful not to disturb the mirror mounting in the process.

c. Clean the magnetic heads with a piece of linen wrapped about a toothpick and dipped in denatured alcohol. Do not flood the heads with alcohol; moisten only enough to remove foreign materials.

CAUTION

Only alcohol should be used as a cleaning agent for the magnetic heads.

20. CLEANING FILM PATH PARTS.

Film path parts are those components (aperture plate, pressure plate, sprockets, film rollers) which are contacted by the film during operation. In addition to the normal accumulation of dirt, such parts may also acquire a build-up of film emulsion. Clean with a soft cloth dampened with carbon-tetrachloride. If deposits of hardened emulsion remain, scrape away such deposits with a toothpick or sharpened orange stick. An aperture brush or toothpick can be used to remove foreign matter from between sprocket teeth.

21. CLEANING MECHANICAL PARTS.

Blow dust and dirt from chassis and housings with compressed air, and wipe electrical components (tubes, transformers, motors) with a clean, soft cloth. All other mechanical parts should be cleaned with carbon tetrachloride to remove old grease and lubricating oil. Dry parts thoroughly with compressed air or with soft, lint-free cloths. During reassembly, be sure to lubricate parts as necessary.

22. LUBRICATION INSTRUCTIONS.

a. Whenever it is necessary to disassemble the intermittent mechanism or to perform extensive major repairs to the gear housing, all oil storage pads should be removed and discarded. Cover the bottom of a small pan with about 1/4-inch of oil (Bell & Howell Spec. No. 1543) and insert one end of the new wick or pad in this oil. Do not immerse

pads in oil. Allow wicks to stand until they are completely saturated with oil; then remove them from the pan and allow the excess to drain away.

NOTE

When installing the lubricator assembly (5, figure 5), make certain that the tongue of the pad is firmly in contact with the shuttle cam before tightening shuttle pin retaining screws.

b. Place a light film of oil (Spec. No. 1543) on all rotating shafts during reassembly and speck all gear teeth with grease (Spec. No. 1544).

c. After reel arms are reassembled, remove the grease plug and pack the cavity around the spindle parts with grease (Spec. No. 345).

d. When governor cap is reassembled, remove the grease cup and pack the housing with grease (Spec. No. 345).

23. GENERAL REPAIR INSTRUCTIONS.

Except as noted below, reconditioning of projector parts for possible re-use is impractical. When a part is obviously damaged, or its condition is doubtful, replace with a new part. Specific repair instructions for the amplifier and sound system will be found in paragraphs 24 through 37, following. Refer to the wiring diagrams at the end of the parts list for electrical circuitry and proper replacement parts.

a. Film path components should be inspected for signs of scratches or rough burrs that might damage the film. Minor defects can sometimes be removed by polishing with fine emery cloth.

b. Binding in the heat filter or fire shutter components (figure 6) can sometimes be attributed to bent parts. Straighten parts as necessary and check operation.

c. Be sure to inspect all wiring for frayed insulation or bare spots. Such wiring should be replaced. Make certain that all solder connections are secure.

24. ERASE FAILURE.

a. With projector and amplifier set for magnetic recording, measure the RF voltage across pins 1 and 3 on rear amplifier receptacle connector J1. All RF measurements should be made with a suitable vacuum tube voltmeter. With the record interlock in, reading should be 6 volts across the erase winding and 0.3 volts across the bias winding (figure F).

b. If no voltage is present, or if voltage is incorrect, check for continuous ground or open up to the interlock relay. Make certain that relay contact is functioning properly. Check to see that neon indicator lights and stays lit with the projector running forward and the record button pressed in.

c. Check RF voltages at terminal strip mounted inside the soundhead casting. Check continuity with an ohmmeter.

NOTE

Any tools used in the vicinity of the magnetic head should be demagnetized immediately before use. If a DC ohmmeter is used, the input transformer and head must be demagnetized; therefore, use only a low-voltage AC supply and AC voltmeter for continuity checks.

25. NOISY TUBES (12AY7) OR TRANSISTOR.

a. Mica leakage generates a frying or hash noise. If this noise occurs when the amplifier is in the optical position, replace the 12AY7 tube. However, be sure no stray light is striking the photocell.

b. If this noise occurs only when in the magnetic playback position, replace the transistor (part no. 29637 or 29638).

26. FLOATING MOUNT FOR 12AY7 TUBE.

When installing the 12AY7 tube, apply no more pressure than is absolutely necessary to reset the tube firmly in its socket. Excessive pressure may cause the socket to slip out of the bottom of the shield, thereby interfering with the function of the floating mount. Also, make certain that the tube shield is vertical and not cocked at an angle, or it may interfere with flywheel rotation.

NOTE

Be sure to check all tube pins and straighten, if necessary, before installing tubes. Use a commercial tube pin straightener or long-nose pliers.

27. MICROPHONICS.

a. Microphonics which occur when the amplifier is in the optical playback position is caused either by a microphonic photocell or microphonic tubes. Correct trouble by trial replacement.

b. Microphonics which occur when the amplifier is in the magnetic playback position only is caused either by a microphonic 12AY7 tube or microphonic playback head.

28. TEST PROBE.

Amplifier output voltage can best be checked with a test probe which can be fabricated from standard radio components as shown in figure G.

29. CHECKING THE AMPLIFIER.

a. Check the quality of all tubes on a standard tube

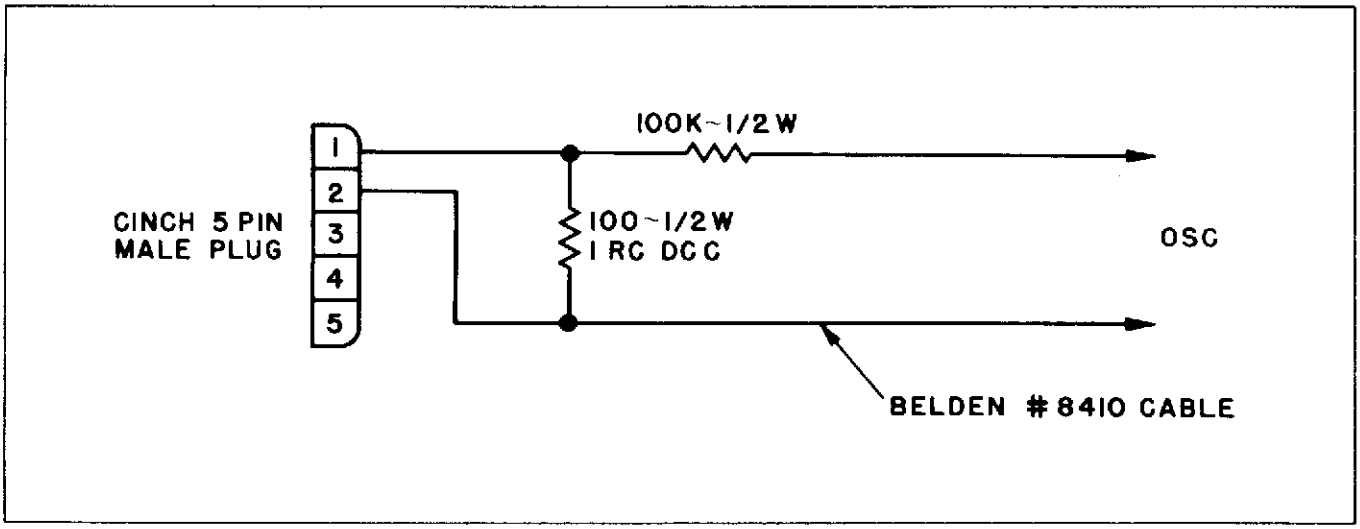


Figure G. Fabricated Test Probe

tester, and replace those tubes which test low.

b. Check tube socket voltages.

c. Switch to optical sound and connect an audio oscillator into the microphone jack. Connect a 16-ohm load resistor to the single speaker jack and connect an oscilloscope and AC voltmeter across the resistor.

d. Set the oscillator to 1000 cps, turn tone control to maximum treble and volume control to full volume. Gradually increase oscillator level while observing oscilloscope trace. The amplifier should develop 11.3 volts before distortion becomes apparent.

e. Disconnect the oscillator, AC voltmeter and resistance load and, with speaker connected, turn on the projector. Pass a piece of card stock back and forth through the exciter lamp beam (between optical slit and sound drum). A loud thumping noise should be produced each time the card interrupts the beam. If this thumping noise does not occur, check the photocell and the photocell voltage supply and coupling circuits.

f. Reconnect the 16-ohm resistance load, the AC voltmeter and the oscilloscope (step c). Connect the fabricated test probe (figure G) to the oscillator and the magnetic input of the amplifier. Set the oscillator to 1 KC and the oscillator output at 160 millivolts. Amplifier output voltage should be 11.3 volts.

30. RECORD LEVEL LAMP.

a. If the record level glow lamp fails to light, check for loose or broken leadwire connections. Disconnect the lamp leads and apply 110 volts AC across the lamp. If the lamp fails to light, the complete lamp and holder assembly must be replaced.

b. It should be noted that if the 0.04 uf capacitor (part no. 29632) breaks down, the record level lamp will stay lighted continuously.

c. If the record level lamp should light without a signal, the amplifier may be oscillating in the record position (oscillation developing as master VOLUME control is brought up from low volume position). Check the dressing of the leads from the function switch to the terminal strip.

31. REPLACING THE FUNCTION SWITCH.

If the function switch should fail for any reason, it must be replaced with an exact duplicate (part no. 29613) to avoid disturbances which might otherwise be created because of differences in wiring.

32. REPLACING ELECTROLYTIC CAPACITORS.

To remove twist-lock electrolytic capacitors, unsolder capacitor leads, straighten the twist-lock terminals and remove capacitor. If the wafer sockets are in need of replacement, the attaching rivets must be drilled out. Use machine screws and hex nuts to install new sockets.

33. REPLACING VOLUME AND TONE CONTROLS.

If the master VOLUME and/or TONE control must be replaced, make a sketch or list of leadwire terminal connections and colors to insure proper reconnection of wires to the new control.

34. MICROPHONE AND PHONO JACKS.

Do not insert plugs into jacks except when a signal is actually being introduced into the amplifier. If there is excessive noise pick-up, make sure that the jacks are properly insulated from the amplifier chassis and that the contacts are normally closed.

35. SENSITIVITY.

When recording, the MIC VOL control must be in the maximum position and the master VOLUME control used to limit volume. This method will provide

the best signal-to-noise ratio on low-volume levels. Because of the difference in sensitivity of magnetic heads, the recording level must be individually adjusted for each amplifier. Test record and adjust until the record level lamps are flashing frequently on the peaks.

36. REPLACING POWER TRANSFORMER.

Most power transformer failures are due to cable breaks and defective connections. Be sure to check all wiring connections from transformer to connector pins before replacing the transformer. The transformer must be phased (par. 66) after removal or replacement. See the following table for continuity checks. All DC resistances are ± 10% and do not include wire resistances.

Winding	Pin Nos.	DC Resistance
Primary	3 - 4	3.85 ohms
Secondary	9 - 10 (11 c.t.)	155.0 ohms

37. RELAY INTERLOCK SYSTEM.

a. The function of the interlock system is to prevent recording or erasing of film unintentionally. The relay has two sets of contacts. One set (normally open) are holding contacts so that the relay will hold closed as voltage is applied to the coil once the record button has been pushed. Voltage to relay actually is available only when the projector motor switch is on and the direction switch is in forward position. When the relay is not energized, the output of the amplifier is short-circuited (see figure 17 or 18) and the bias and erase current is disconnected from the heads. When the button is pushed, the relay should hold in and the interlock neon indicator should light, the bias and erase is connected to the heads and the short-circuit is removed from the amplifier output. When the projector line switch is shut off, the relay should be de-energized (light extinguished) and upon turning line switch on again it should not light up until you depress red button. When the interlock is energized and the machine is running forward, if you should reverse the machine (which should not normally be done) the relay may buzz slightly before lamp is extinguished. This usually has no detrimental effect on the recording.

b. In checking the relay, double check not only by pressing button as in normal operation but by holding button in. If equipment functions properly with button held in it is a definite indication that contacts are not holding properly. To remove the interlock relay, amplifier must first be removed completely.

c. Visually check all relay contacts. If contacts are not "making" properly, bend with long nose pliers. Be extremely careful not to bend any more than necessary, as excessive bending will impair function. There should be a minimum of 1/64 inch overtravel or wiping of contacts.

d. If contacts appear satisfactory visually, check continuity of holding coil with an ohmmeter. DC resistance should be approximately 1500 ohms. Replace if necessary. Be sure in replacing, however, that it is the relay and not a loose or broken lead that is causing the trouble.

Reassembly and Adjustments

38. GENERAL.

Reconditioning of parts for possible re-use in the projector is not practical. Replace all worn or damaged parts with new ones during reassembly. Be sure to replace all wiring which has cut or frayed insulation and check all soldered connections to make certain that they are secure. During reassembly, lubricate parts as instructed in paragraph 22.

39. FRONT REEL ARM. (See figure 14.)

a. Insert the bearing (16) into the reel arm (17) and screw in the bearing retainer (15). Insert the reel spindle (13) up through the washer (14) and bearing (16).

b. On the projecting round shaft replace the washer (12). Work the split retaining washer (11) down into position on the spindle. Be sure the split retaining washer engages the groove in the shaft. Install the spindle washer (10) and the same amount of shim washers (9) that were removed in disassembly. Slip the pulley (7) onto the shaft with the hollow side up. Insert eighteen roller bearings (8) between the pulley and the reel spindle and lubricate.

c. Place the clutch ball retainer (6) into the pulley with the ears up. Position the clutch cam (5) on the clutch ball retainer so that the ear on the inside diameter of the retainer (6) engages the curved slot in the clutch cam (5) and also so that the small end of each of the three cutouts in the outer diameter of the clutch cam (5) is in a counterclockwise direction from the larger end of each cutout.

d. Place a steel ball (4) into each of the three slots in the outside diameter of the clutch cam (5) and in between the two ears of the clutch ball retainer which project into the slots. Lubricate the balls lightly with B & H projector oil.

e. Install the bronze washer (3) and clutch cover (2) and screw in the fillister head screw (1).

40. REAR REEL ARM. (See figure 13.)

a. Place a film of B & H Spec. No. 345 grease on the shoulder inside the take-up pulley (12). Then place nineteen steel balls (13) in this film of grease. When placed in position properly, the nineteen steel balls will form a complete circle, with the last ball just touching the first. Carefully insert the take-up pulley (12) with the steel balls in place, up through the take-up arm. Where the shaft of the take-up pulley starts to project out from the take-up arm, there is a beveled shoulder in the take-up arm (14). Place a layer of grease on this beveled shoulder and then position nineteen more steel balls (13) in this grease so that they also form a complete circle.

b. Very carefully screw the bearing retaining ring (11) to the shaft until the ring just touches the balls. Then back it off 1/4 turn to allow for free operation of all parts. Hold the shaft as steady as possible so as not to disturb the placement of the steel balls during installation of the retaining ring.

c. Apply a light film of oil to the plunger (8) and assemble the plunger to the take-up pulley (12). Install the rewind gear (9) and the special screw (7).

d. Install the lock pin (14A) and attach the spring (6) to the cover (4) with the screw (5). Engage the lock pin (14A) with the keyhole slot in the spring (6); then rotate the cover slightly to lock it in position and install the screw (3).

e. If the sixteen bearing rollers (24) were removed, install and lubricate them. Press fit a new bearing retainer ring (23) in place over the bearings.

f. Insert the compression spring (18) and plunger (17) into the rear reel arm (25). While holding the spring and plunger in place with a piece of shim stock, slip the drive pulley (16) up into position so that it holds the spring and plunger in place. Because of the left-hand thread, screw the rewind drive gear (15) in a counterclockwise direction onto end of drive pulley shaft.

g. Attach rewind lock lever (21) to rear reel arm with lock lever attaching screw (20). Hold spring (22) between small stud on lock lever and small stud in rear reel arm.

h. The hole into which the headless setscrew (19) is inserted should be packed with B & H grease before replacing the screw.

i. Place take-up arm (14) in position on rear reel arm (25) and insert shaft (2). The shaft (2) must be pressed in place with arbor press or other suitable equipment.

j Slip the belt (1) over the two pulleys. Check the action of the lock lever (21) to see that it will lock and disengage the two gears.

k. Latch the lock lever (21). Swing the reel clip (12B) to open position and check to be sure that pin (14A) releases latch (21).

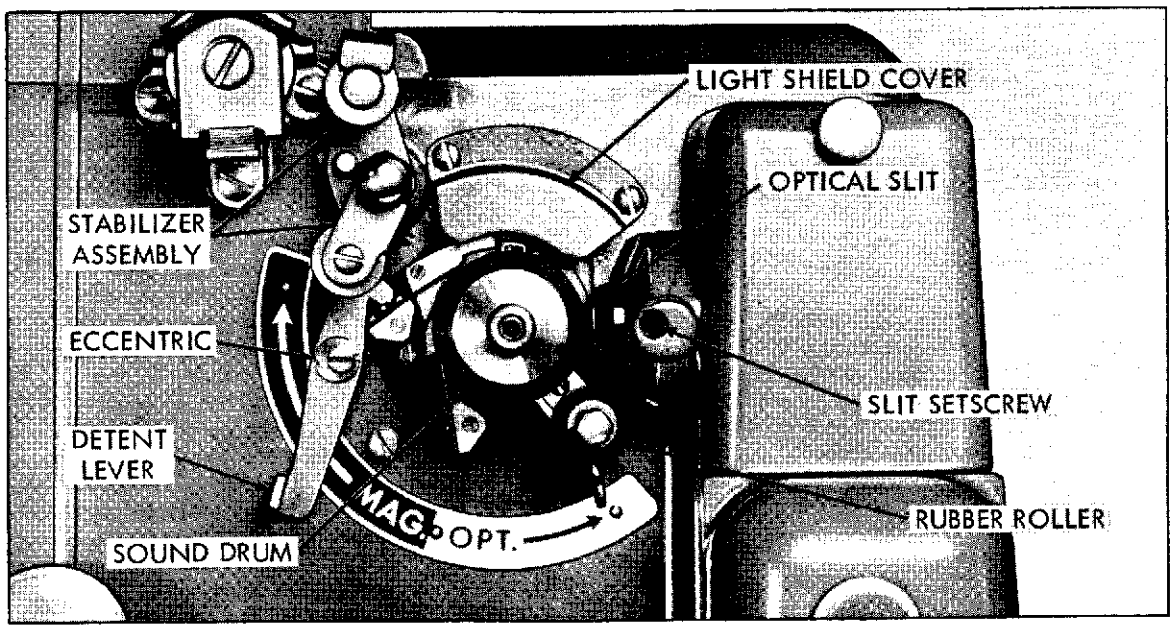


Figure H. Projector Soundhead Reassembled

41. PROJECTOR CASE. (See figure 12.)

Reassemble projector case parts by reversing the disassembly procedure. Refer to the appropriate schematic diagram at the end of the Parts Catalog for speaker wiring connections. During reassembly, place a drop of oil on each reel arm holder roller pin and a light film of grease on each carrying handle post.

NOTE

Complete soundhead reassembly is covered in paragraphs 42 through 45, following. Figure H illustrates the soundhead as it should appear when assembled.

42. MAGNETIC HEADS AND COILS. (See figure 11A.)

a. Apply a light coat of 3M cement No. EC847 to the tie-bar between the coils. Hold the coils in proper position until the cement hardens.

b. Secure a piece of tape to the sound drum surface so that the inner edge of the tape extends far enough beyond the inner edge of the drum to pass under the magnetic head. With the coil tie-bar resting on the tape, carefully press the pole pieces into coil structure. Be sure to press the pole pieces squarely into place until seated in the coil structure.

c. When the pole pieces are seated in the coil structure, apply 3M cement No. EC847 to the walls of the pole piece where they contact the coil form. Apply cement with a toothpick and be careful not to get cement on the contact face of the pole piece. Insert the assembled pole piece and coil assembly into the arm and tighten the retaining screw just enough to hold the parts in place.

d. Remove tape from sound drum and clean drum surface with a soft cloth. Wrap a 0.003 shim around the sound drum. Loosen the locking screw (10, figure 11A) and lower the arm (16) until the face of the pole piece is flush with the surface of the shim slightly above the surface of the sound drum. Tighten the locking screw.

e. With a zero to five-ounce compression type gage (IMTRA Corp., Cambridge, Mass.), measure the pressure required to depress the head until the face of the pole piece is flush with the surface of the sound drum. Correct erase head pressure is 4-1/2 oz. and is adjusted by loosening the screw (10) and raising or lowering the erase arm (9) slightly. Correct record-play pressure is 1-1/2 oz. for full-track film and 4-1/2 oz. for quarter- or half-track film. Adjust by loosening the screw (10) and raising or lowering the record-play arm (16) slightly.

f. Refer to paragraphs 64 and 65 for final head adjustments. Then install the hum shields (4 and 5).

43. SOUNDHEAD - SOUND DRUM AND FLYWHEEL. (See figure 11.)

NOTE

Reassemble soundhead electrical components (pilot lamp (41), relay (47), exciter lamp socket (51), phase reactor (52) and switches (53, 54 and 66) by reversing the disassembly procedure and making leadwire connections per the appropriate schematic diagram at the rear of the Parts Catalog. Also refer to the assembled view of the soundhead, figure H. Make certain that the relay is securely mounted to eliminate possible shorting due to shifting.

a. Attach lever (35) to sound drum assembly with two screws (34). With bearing (36) pressed in place, insert the end of the sound drum shaft straight through its opening in the sound head. Support the assembly while installing the flywheel (33) and its retaining spring (32). Then guide the sound drum shaft into the bearing (36) and install the shaft retaining ring (30).

b. Install the quill retaining clamp (29) with the screw (27), washers (26 and 28) and hex nut (25). Install the spring (4), spring retainer (3), bearing cap (2), and fillister head screws (1). Check to make certain that the retaining spring (32) holds the flywheel securely. The flywheel must rotate smoothly without slippage, or sound flutter will result.

c. Check all electrical connections within the soundhead to make certain that they are secure. Leads must be properly dressed to prevent interference with the movement of mechanical parts.

d. Assemble thrust washer (20) and torsion spring (17) to the roller arm (19). Assemble the roller arm and the pivot stud (24) to the soundhead, tightening the setscrews (18) just enough to hold. Note that the hook end of the spring (17) must engage the top of the roller arm and the bent end must bear against the inner wall of the soundhead casting. Install the spring washer (16) and retaining ring (15) on inner end of the pivot stud. Install the rubber roller (14), flat washer (13) and special hex screw (12) on the protruding shaft of the arm assembly. Refer to paragraph 65, step j, for final adjustment of the roller arm and rubber roller. Then secure the pivot stud with the screws (21), plain washers (22) and stop washers (23).

e. Assemble the eccentric (8) and torsion spring (11) to the detent lever (9) and secure these parts and the spacer (10) to the soundhead with the screw (7). One end of the spring (11) must enter a small hole in the soundhead casting while the other end hooks behind the lever (9). Rotate the sound drum assembly (31) by moving the lever (35) from the optical to the magnetic position, and observe the engagement of the detent lever (9) with the notches in the flange of the sound drum assembly. If necessary, loosen the screw (7) and rotate the eccentric (8) until the detent lever engages smoothly and easily. Then tighten the screw (7) and attach the light shield cover (6) with the screws (5).

44. SOUNDHEAD — SOUND SPROCKET AND SNUBBER ROLLER. (See figure 10.)

a. Assemble the idler roller (40), spacer (39) and stud (38) to the soundhead.

b. Assemble the snubber assembly parts (32 through 37), being sure to engage the spring ends with the small holes in the snubber shaft (33) and sleeve bearing (35). Install the snubber assembly to the soundhead casting with the screw (29) and hex nut (30) and two screws (31), tightening the screws just enough to hold. Refer to paragraph 63 for snubber adjustment.

c. Press a well-lubricated felt lubricator (23A) into the hole in the sprocket shaft (23) and insert the shaft into its opening in the soundhead. Assemble the sprocket driving gear (25) and spacer washer (24) to the shaft as it passes through the pocket in the soundhead, and tighten the setscrew (22) against the flat of the shaft just enough to keep the shaft from turning freely. Assemble the film guide (27) and its spacer washers (28) to the soundhead with the two screws (26). Install tools No. S-15177-N1 (16, figure B) and No. S-15177-N2 (15, figure B) on the sprocket shaft in the same manner as illustrated in figure R. Screw the knurled head portion of the tool in as far as possible, thus drawing the shaft into the correct position. Tool No. S-15177-N1 must bear up tight against the film guide. Tighten setscrew (22) securely and remove the tools.

d. Saturate the felt washer inside the sprocket (21) with projector oil. Slip the cone tool No. S-15177-F3 (14, figure B) over the end of the sprocket shaft to protect the felt washer as the sprocket is installed. Slide the sprocket over the cone, onto the shaft and into the soundhead. Remove the cone tool and once again screw tool No. S-15177-N2 onto the sprocket shaft until snug. Tighten the two driving gear setscrews (20) securely and remove the tool. The sprocket, sprocket shaft and driving gear now should be in proper position.

e. Loosen the film guide screws (26) and insert the film guide clearance tool No. S-15638-N6 (10, figure B) between the sprocket and film guide in the same manner as illustrated in figure T. The tool will fit over the sprocket in only one way. Press the film guide down against the tool and hold lightly while tightening the screws (26). Remove the clearance gage.

f. Assemble the tension washer (19) and spring (18) to the sprocket guard (17) and secure these parts to the sprocket shaft with the screw (16).

45. SOUNDHEAD — STABILIZER ROLLERS AND OPTICAL SLIT. (See figure 10.)

a. Assemble the lock nut (15) to the stabilizer stud (14) and screw the stud into the soundhead. Tighten the nut down against the soundhead casting. Assemble the torsion spring (5) to the lower stabilizer arm (9) with the screw (4). Insert the stud (7) through the plain roller (8) and lower arm (9) and install the screw (6). Set this assembly inside temporarily.

b. Insert roller stud (11) through the flanged roller (12) and upper stabilizer arm (13) and install the screw (10). Hold the assembled lower arm parts just as they would be viewed when installed in operating position and rotate the spring (5) about one-half turn in a clockwise direction, or just enough to clear the flat bottom of the lower arm (9). Hold the spring in this position while assembling the lower arm and spring onto the brass post of the upper arm (13). Engage the hook end of the spring (5) with the grooved spring post on the upper arm (13). The lower arm (9) now should tend to rotate

in a clockwise direction under the tension of the spring.

c. Assemble the stabilizer to the stabilizer stud (14), rotating the lower arm about one-half turn in counterclockwise direction during the installation. With the stabilizer fully in position, the end of the lower arm should bear up against the stop pin located just below the stabilizer stud (14). Install the cap (2) and tighten the setscrew (1) securely. Refer to paragraph 61 for final stabilizer adjustment.

d. Carefully insert the optical slit (45), mask end first, into its opening in the soundhead. If the original slit is being installed, line up the scribe mark on the barrel of the slit with the face of the mounting boss. Insert the locking slug (44) and tighten the setscrew just enough to hold the slit in place. Refer to paragraph 62 for final optical slit adjustment.

46. LAMPHOUSE. (See figure 9.)

a. Install the condenser lens (16), spacer spring (15), coated condenser lens (14) and retaining snap ring (13) into the condenser housing (17). If necessary, refer to paragraph 9 for a method of determining which condenser lens is which. Lay the condenser assembly (12) aside until projector is completely reassembled.

b. Attach the condenser friction spring (10) to the housing (11) with the fillister head screw (9).

c. If for any reason the heat conducting ring (8) was removed, re-cement it in place in the terminal box assembly (7). Fasten the terminal box (7) to the lamphouse with the fillister head screws (6). Screw in the lamp lock screw assembly (5).

d. Slip the air-circulating tube (4) into the lamphouse. Attach the lamphouse cap (3) securely to the lamphouse with the fillister head screws (2).

e. The reflector (1) is fabricated into one unit and is merely pressed into place.

47. MOTOR, GOVERNOR AND FAN. (See figure 8.)

a. Note, in the 302L projector, that the capacitor (34) requires a separate mounting bracket (36). In all other models, the capacitor has an integral mounting strap. Also note that the 302L projector uses a tubular resistor (31D) held in place with a bracket (31C). All other models use the ring-type resistor (32B) secured in place with three retaining springs (32A).

b. Press the bearings (16 and 26) into the brush housing (21) and lamphouse (40) respectively. Carefully insert the stator assembly (30) into the housing and onto the studs (29) and install retaining nuts (28).

c. Very carefully insert the armature (27) into the housing, allowing the shaft to protrude through the bearing (26) just enough to permit the blower fan (24) to be installed. Note that the 302L projector uses a spacer (25C), bearing ring (25B) and spring washer (25A) between the housing and blower fan; all other models use a compression spring (25). Use a new spring pin (23) when installing the blower fan.

CAUTION

Do not permit the armature to drop completely into the housing, or the armature windings may become damaged against the resistor bracket (31C) used in 302L models.

d. Install the spacer washer (22) on the armature shaft and assemble the brush housing (21) to the lamphouse with the screws (20). Insert the motor brushes and springs (18) or (18) and (19) into the brush holders, making certain that the curve in the brush ends matches the curve of the armature. Install the brush caps (17).

e. For 302L projectors only, install the shim washer (15A), locking washer (15) and hex nut (14) on the protruding end of the armature shaft. Turn the hex nut down until tight; then bend the ears of the locking washer up against the flats of the nut. Install bearing cap (13) with three screws (12).

f. Insert the governor brushes (11) into their holders in the brush housing and install the governor on the armature shaft. Make certain that the brushes are bearing flat against the governor rings; then press the governor in place until approximately 1/16 inch of the brushes are exposed beyond the brush holders and tighten the governor setscrews (9) securely.

g. Place the compression spring (8) and spring retainer (7) on the blower fan end of the armature shaft. Use tool No. S-19028-F3 (24, figure B) to compress the spring retainer as shown in figure D until the dowel pin (6) can be installed. Remove the tool.

h. Assemble the thirty-one bearing rollers (4) into the motor pinion (3), using a drop or two of oil to hold the rollers in place. Install a pinion washer (5) on the armature shaft; then the motor pinion, large inner diameter first, and finally another pinion washer (5). Install the thrust washer (2) with the ears facing outward and the thrust nut (1) with the slotted face inward. Use tool No. S-19028-F4 (23, figure B) to press the thrust washer (2) back toward the fan as far as possible and hold it in this position while drawing up the thrust nut. Remove the tool and back up the nut just enough to permit the ears on the thrust washer to drop into the first set of slots in the thrust nut. This tension adjustment should prevent the pinion from slipping on the shaft during operation. However, if slippage should still occur, it may be necessary to replace the spring washer (25A) on 302L projectors or the armature spring (25) on all other models.

48. GOVERNOR CAP ASSEMBLY. (See figure 7.)

a. Lubricate the bearings before reassembling them. Insert the retaining ring (23), ball bearing (22) and

retaining ring (21) into the governor cap (25). Insert the shaft (20) through the ball bearing. Reach in from the opposite side of the governor cap and press the retaining pin (19) into the hole provided in the shaft. Insert the worm wheel (18), ball bearing (17) and retaining washer (16), and secure these parts in place with the truss head screw (15).

b. Place eighteen bearing rollers (14) around the inner diameter of the rear take-up pulley (13). Be sure to lubricate the rollers with B & H grease before reassembling them. Insert the clutch ball retainer (12) into the take-up pulley.

c. Position the clutch cam (10) on the shaft with the slot in the cam engaging the ear on the clutch ball retainer. When the clutch cam (10) has been placed properly, the small ends of the three cutouts in the outer edge will be in a clockwise direction from the large ends of the cutouts.

d. Insert the three steel balls (11) in between the ears on the outside diameter of the retainer and then place the compression spring (9) in the slot in the cam. Install the bronze washer (8), reel drive clutch cover (7) and screw (6). Use special tool No. S-12264-F3 (25, figure B) to screw in the screw (6).

d. Insert the worm shaft (4) through the felt washer (5) and governor cap (25). Install the radial bearing (3) and screw in the fillister head screw (2). Lubricate the radial bearing and pack the space between the bearing and the nut (1) with a liberal amount of B & H grease.

f. Screw on the special nut (1) with a pair of long nosed pliers.

49. BLOWER HOUSING. (See figure 6.)

a. Assemble the lens (11) into the condenser holder (14) with the retaining ring (10). Note that the 302L projector condenser assembly has a one-piece holder and handle; on all other projectors, the handle (13) is removable.

b. If the spring retainer (7) was removed for replacement, fasten the new retainer in place with two No. 2-56 NC by 1/4 inch round head screws and hex nuts in place of the rivets originally used.

c. For 302L projectors only, attach the fire shutter guide to the blower housing with two screws (2). Engage the bent ear of the fire shutter assembly (1) with the slot in the guide and temporarily secure the fire shutter with a piece of tape. Refer to paragraph 59 for fire shutter adjustment.

d. For all projectors except the 302L, engage the bent ends of the heat filter pivot (16) with the upper pair of holes in the heat filter assembly (18). Assemble the heat filter to the filter mounting plate (17) and bend the ears of the mounting plate so that the notches in the ears engage the bent ends of the pivot (16). Fasten the pivot and mounting plate to the blower housing with the screw (15). Assemble the filter actuating crank (20) through the hole in the blower housing and insert the end of the crank through the loops of the actuating link (19). Engage the bent ends of the link with the lower pair of holes in the heat filter (18). Operate the crank to check heat filter operation.

50. GEAR CASE — SHUTTER AND SHUTTLE. (See figure 5.)

NOTE

All 302L projectors are of the permanently-lubricated type as evidenced by the lack of oil cups on the top of the gear case. Some 302M and 8302 models, however, will be of the oil cup design and, in addition to the oil cups in the top of the gear case, will include the special oiler assembly (31). Refer to paragraph 22 for proper lubricating instructions and lubricants. See figure U for proper positioning of oil cup tubes.

a. Install the same quantity of bearing shims (29) on the bearings (28) as were removed in disassembly and press the bearings into the gear case (35).

NOTE

Before replacing shaft bearings (28), note that there is a hole drilled in the barrel of each one. These holes must line up with the ends of the hole that is provided in the gear case for oiler felt (27), so that ends of the oiler felt will continually lubricate shuttle shaft (13) and counter gear shaft (22).

b. Saturate oiler felt (27) with B & H oil. Replace oiler felt (27) by inserting it into one of the shaft bearings and then forcing it into hole that extends between the two shaft bearings. Attach spring clamp (26) between the two shaft bearings with flat head screw (25).

c. Saturate oiler assembly (31) with B & H oil and attach it inside gear case with fillister head screw (30).

d. In order to reassemble shafts (22 and 13), bearings (23 and 14) and felts (24 and 15) correctly and easily, the following directions should be read and followed carefully. Figures J through N will help by illustrating the various steps.

e. Place the tool jig No. S-4007-F11 (7, figure B) on the table in front of you. Slide the brass sleeve No. S-4007-F5 (5, figure B) over the post on the jig. Now slide collar No. S-4007-F6 (9, figure B) over the brass sleeve, being sure the cone surface of the collar is facing up. Place fifteen new steel balls (23) on the cone surface as shown in figure J. Do not grease the steel balls. Then place the counter gear and shaft assembly (22) inside the brass sleeve in the same manner as shown in figure K for the shuttle shaft. Slide the collar on which the steel balls are resting up along the brass sleeve and note the

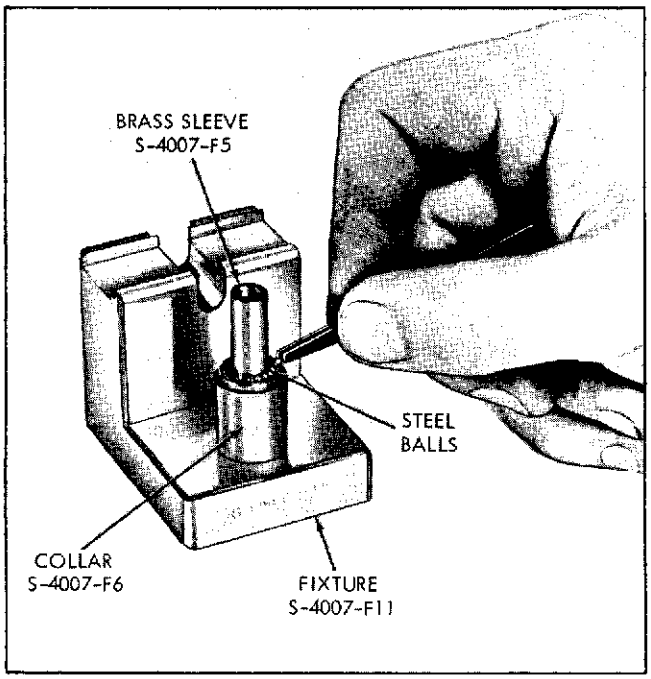


Figure J. Reassembly of Counter Gear and Shuttle Shaft — Step 1

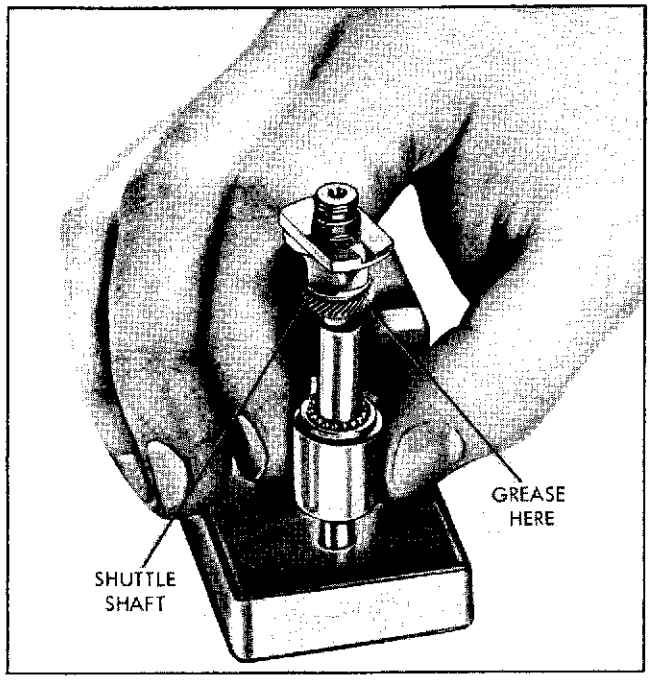


Figure K. Reassembly of Counter Gear and Shuttle Shaft — Step 2

surface on the underside of the counter gear where the steel balls touch. Slide the collar back down, remove the counter gear and place a layer of B & H grease on the surface just noted. The grease will serve to hold the steel balls in place on the counter gear when the collar is finally removed. There should not be any grease on the surface of the steel balls where they touch the collar, otherwise some or all of the steel balls will probably stick to the cone surface of the collar instead of to the counter gear when the collar is removed.

f. Replace the counter gear and shaft (22) in the brass sleeve. Again slide the collar, with the steel balls on it, up along the brass sleeve until the steel balls become inbedded in the thin layer of grease. Slide the collar back down. All of the steel balls should now be in place around the counter gear shaft. Carefully remove and set aside the counter gear and shaft. Remove brass sleeve and cone collar from jig.

g. Take one of the quills No. S-4007-F14 (4, figure B) and place it in the jig as shown in figure L. Now saturate the oil felt (24) with B & H oil and place it in the curvature of the quill in the jig. Carefully pick up the counter gear and place it in the jig so that the grooved portion of the shaft just below the bearings rests in the oil felt as shown in figure L. The steel balls should now be in the grooved shoulder on the rear surface of the jig. Place the other quill over the oil felt so that the two quills match to form a cylinder with the shaft and the oil felt inside.

h. Hold the quills together by slipping on the clip, stock No. 1459 (6, figure B). Remove the gear and the special tools from the jig. Figure M, which uses the shuttle shaft as an example, shows the way it should look if the tools were used properly. Carefully insert the shaft, with quills and clip attached, into the correct bearing hole in the gear case, similar to the manner shown in figure N. Insert the quills into the bearing as far as possible, remove the

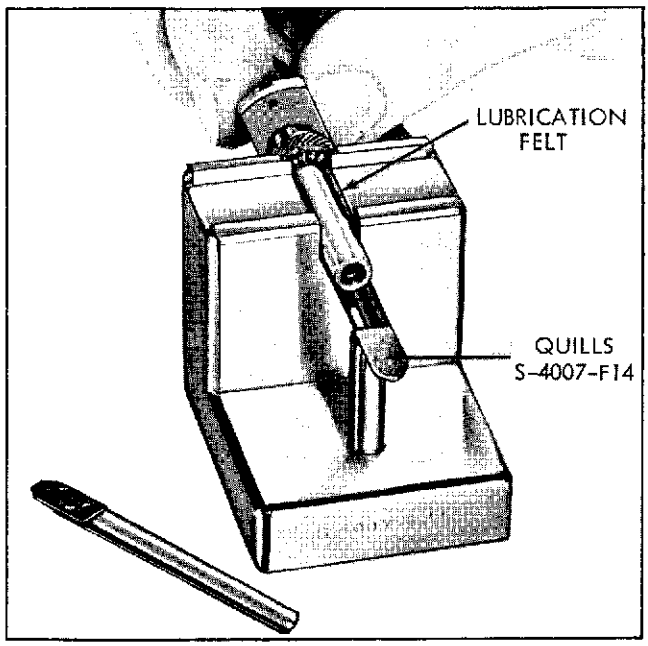


Figure L. Reassembly of Counter Gear and Shuttle Shaft — Step 3

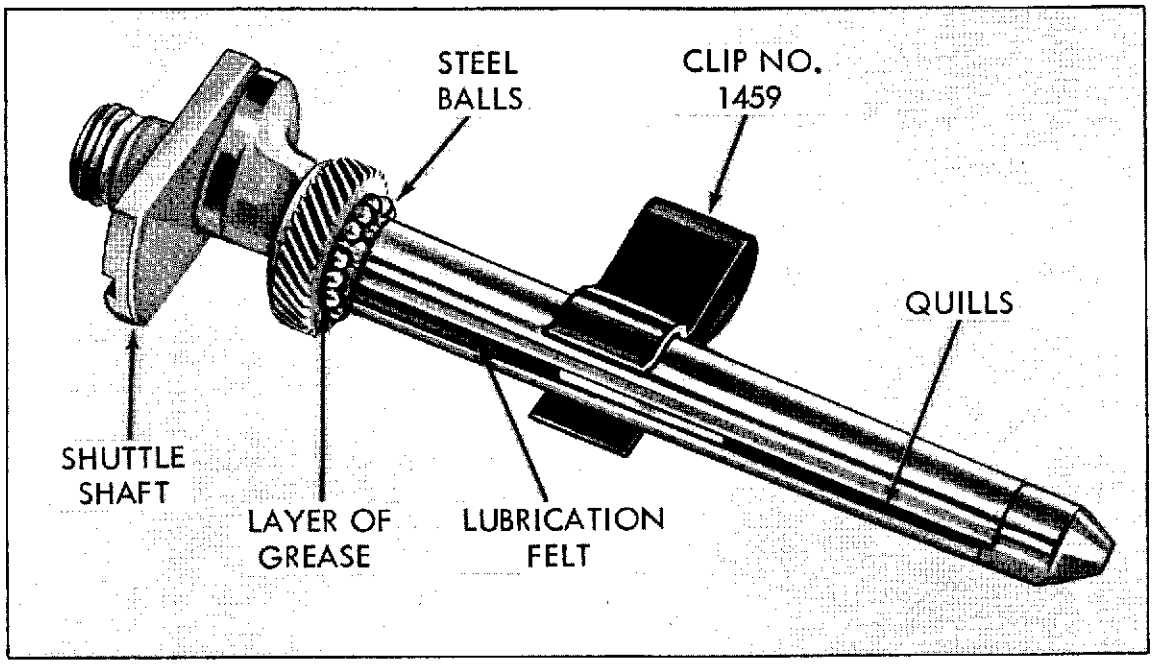


Figure M. Reassembly of Counter Gear and Shuttle Shaft — Step 2

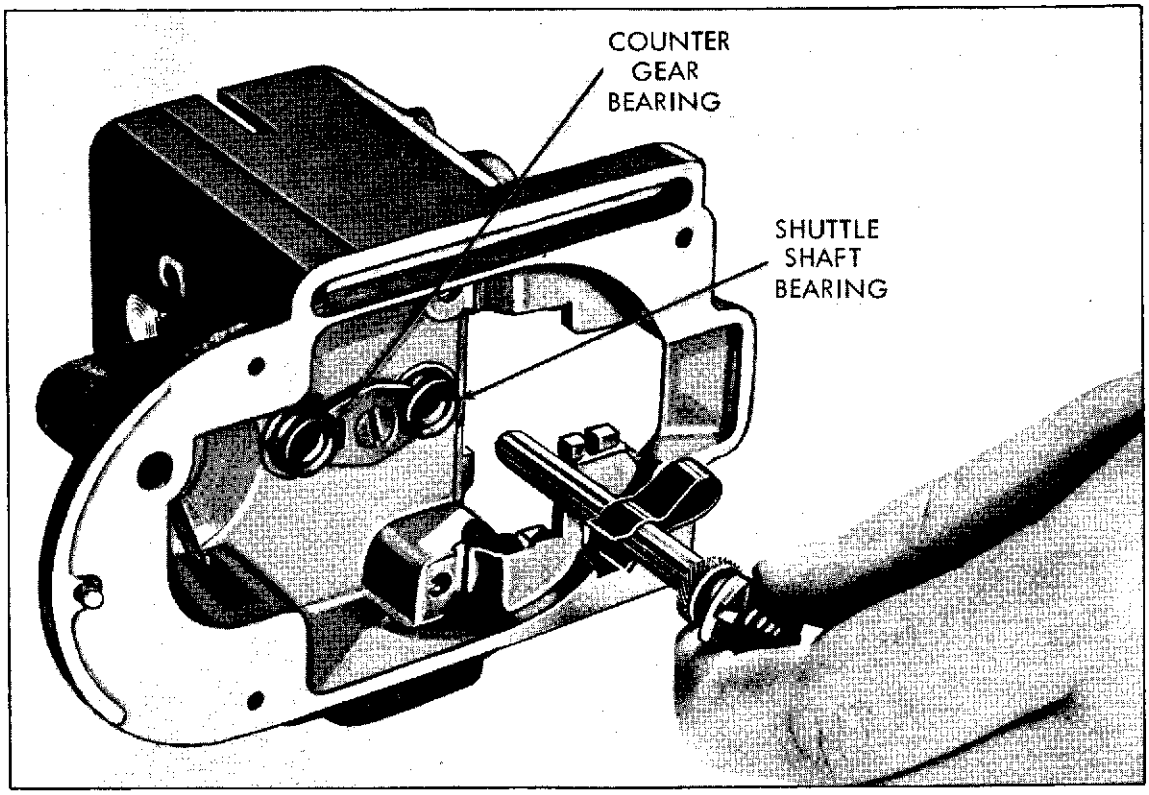


Figure N. Reassembly of Counter Gear and Shaft Assembly — Step 5

clip and insert the quills the rest of the way. When the shaft is all the way in, reach inside the gear case, grasp the end of the quills and pull them all of the way through. The counter gear shaft, steel balls and oil felt are now in their correct position.

i. Hold the counter gear and shaft in place and insert fifteen new steel balls (21) around the shaft on the inside of the gear case. Slip the right-hand worm (20) onto the shaft as far as possible and turn it until one of the setscrews holes lines up with the groove in the shaft. Screw the cone point setscrew (19) into this hole and the flat point setscrew (18) into the other hole. The counter gear and shaft should now be securely and correctly positioned and there should not be any end play present whatsoever.

j. Place the worm extension (17) on the shaft and up against the worm (20). Secure it to the shaft with the setscrews (16).

k. The shuttle shaft (13), fifteen new steel balls (14) and oil felt (15) are assembled in exactly the same manner as described above for the counter gear. Figures J through N illustrate the procedure with the shuttle shaft used as an example. When assembling the shuttle shaft, be sure to line it up properly with the counter gear as shown in figure P. The slot in the shuttle shaft serves as the index mark for the shuttle shaft. When the shuttle shaft is correctly positioned, hold the shaft in place and on the inside of the gear case, install fifteen new steel balls (12), collar (11) (push on as far as possible), the spring (10B) and shoulder screw (10A). The teeth of the gear on the shuttle shaft should now be engaging the counter gear teeth and there should not be any end play present whatsoever. Also, the timing should be exactly as indicated in figure P.

l. Insert the shuttle pins (9) into the double tooth shuttle (8) and position the shuttle on the rear of the gear case. Now push the shuttle pins out until they butt against the gear case and secure them in this position with the special fillister head screws (7).

m. The shuttles are made in four types in order to assure greater ease in good fitting. Each shuttle is marked either 1, 2, 3, or 4 in the spot indicated by the letter A in figure 5. For replacement, a shuttle having the same number as the one removed should be used if possible.

n. Assemble the two sections of oiler assembly (4 and 5) together and saturate felt (6) with B & H projector oil. Press oiler assembly into place.

o. Place one of shutter supports (2) on shuttle shaft so that small pin on support (2) engages timing slot in the shuttle shaft collar (13).

NOTE

Be sure the pin engages the slot. The shutter will not rotate and serious damage to the shutter will result if they are not engaged.

p. Position the shutter (3) on the shuttle shaft and on the top of the shutter support (2). Place the second shutter support (2) on the shutter so that the locating pin goes through the small hole in the shutter and into the first shutter support. Install hex nut (1). Use wrench No. S-10310-F2 (18, figure B) as shown in figure C to engage the shuttle shaft collar and then draw the hex nut (1) on tight with an open end wrench. Figure Q illustrates the rear of the gear case when assembled.

51. GEAR CASE — SPROCKETS AND GEARS. (See figure 4.)

a. Insert the framer shaft and knob assembly (25)

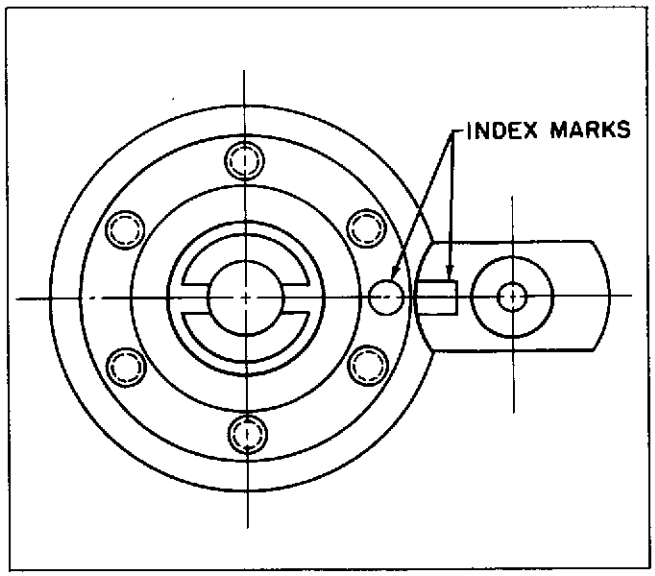


Figure P. Aligning Counter Gear and Shuttle Shaft

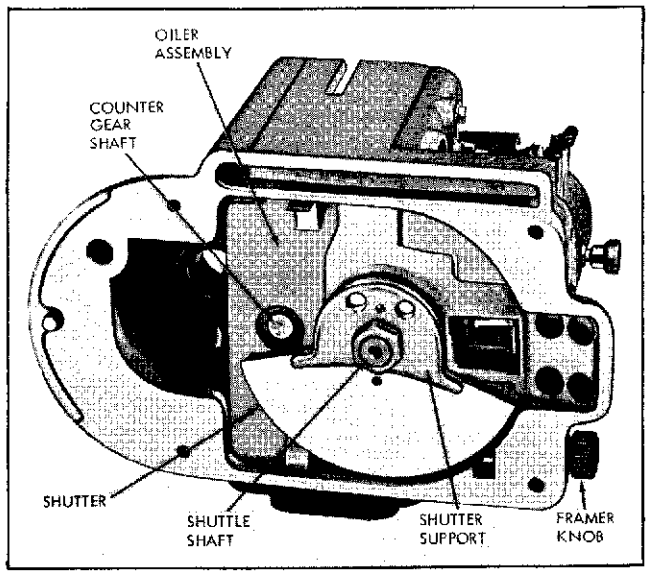


Figure Q. Rear View of Assembled Gear Case

into the side of the gear case. Place the gear case on its back and place the aperture plate (24) in position. Be sure that the framer knob and shaft assembly (25) is all the way in. The eccentric near the end of the framer shaft must engage the ears on the back of the aperture plate with a snug fit. It may be necessary to bend back the ears slightly to accomplish the snug fit.

b. Insert a fillister head screw (21) through the upper film tension clip (22), through the film gage thrust spring (23) and screw it into the hole in the gear case. The clip (22) must fit into the slot in the aperture plate. Attach the lower film tension clip in the same manner.

c. With the aperture plate correctly positioned and flat against the gear case, the height that the shuttle teeth project through the aperture plate slot can be checked. The distance that the shuttle teeth should project above the surface of the aperture plate is 0.028 (± 0.005) of an inch. GO-NO GO gage No. S-4529-N4 (3, figure B) must be used to check this height.

d. Revolve the shuttle cam to the point where the shuttle teeth protrude farthest through the aperture plate. The 0.028 inch step in one end of the gage should strike the teeth and the 0.036 inch step in the other end of the gage should pass over the teeth. The two heights mentioned are clearly marked on the side of the gage.

e. If the shuttle teeth do not project far enough through the aperture plate as determined by gaging, correction is made by disassembly of the counter gear (22, figure 5), and its related parts. Then remove the bearing (28, figure 5) and add shims (29, figure 5) as necessary to bring shuttle teeth height out to the proper dimension.

f. If the shuttle teeth project too far through the aperture plate, correction is made by using another shuttle or by stoning down the shuttle teeth. Avoid bending the shuttle to make a proper fit. Do not alter the grooves in which the shuttle dowel pins (9, figure 5) lie. Make certain that the aperture plate is flat against the gear case when checking the shuttle teeth.

g. Position the pressure plate carrier (18) on the rear of the lens carrier, insert the adjustment nuts (17) from the rear and screw the fillister head screws (16) into the adjustment nuts (17). Instructions for properly adjusting the pressure plate carrier (18) are given in paragraph 55. Secure the steel ball (15) and ball retaining spring (14) to the lens carrier with the fillister head screw (13).

h. Slide the lens carrier assembly into position on the gear case and attach the two lens carrier retainers (12) with the pilot screws (11). The two lens carrier retainers should hold the lens carrier assembly on the gear case but still allow it to slide back and forth freely. Now attach the two film guides (10) with the fillister head screws (9).

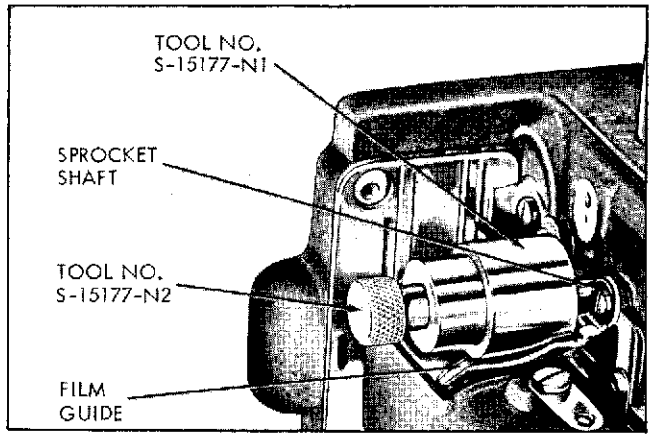


Figure R. Sprocket Shaft Adjustment

NOTE

The 302M and 8302 models are equipped with the loopsetter assembly (31) which is held in place by the screw (21) that attaches the lower tension clip (22) and the adjacent screw (9) which secures the lower film guide (10). Slip the loopsetter up into position and tighten screws just enough to hold. Refer to paragraph 67 for loopsetter adjustment.

i. Insert the upper sprocket shaft (27) into the gear case, assembling the upper gear (28) as the shaft passes through the gear case. Then insert the lower sprocket shaft into the gear case, assembling the sprocket worm wheel assembly (29) and the washer (30) to it as it passes through the gear case. Tighten both flat point setscrews (26) against the flats located near the end of each shaft just enough to prevent the shafts from turning, but not enough to prevent the shafts from being adjusted in or out.

j. Place the sprocket shaft adjusting tools Nos. S-15177-N1 and S-15177-N2 (16 and 15, figure B) on the upper shaft as shown in figure R. Screw the knurled head of the tool into the sprocket shaft as far as possible and tighten the flat point setscrew (26). Do the same thing with the lower sprocket shaft, tightening the other flat point setscrew (26) when the shaft is properly adjusted. Remove the special tools.

k. Before reassembling the sprockets (8), saturate the felt washers which are located inside of the sprockets with B & H oil. Place sprocket cone No. S-15177-F3 (14, figure B), on the end of the upper shaft. Slide one of the sprockets (8) over the cone and onto the shaft as far as possible. It must go inside the upper gear (28).

l. Remove the cone and again screw in the knurled head adjusting tool. Now insert shim No. S-15177-N4 (8, figure B) between the gear and gear case as shown in figure S. Slide the upper gear (28) over against the shim and tighten the two setscrews (7). The shim gives the correct amount of clearance

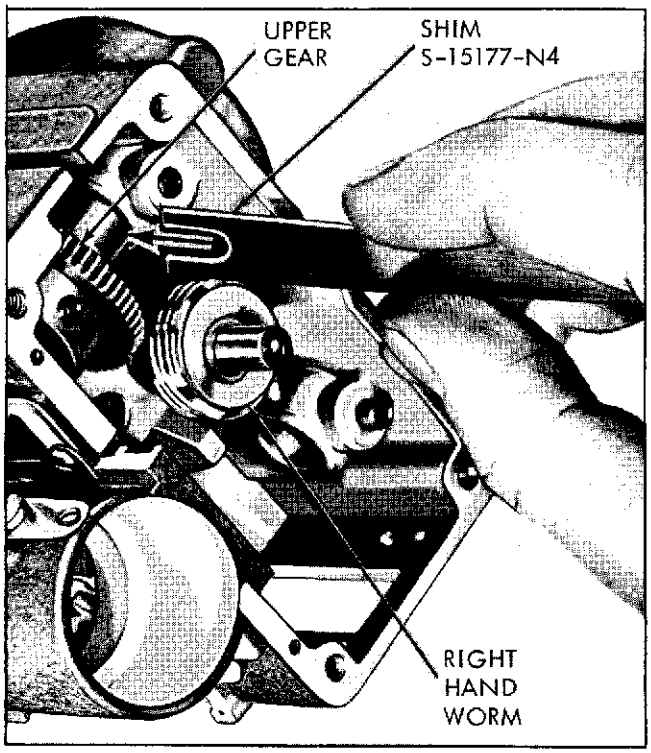


Figure S. Adjusting Upper Gear Clearance

(0.002 inch) between the gear and the gear case, while the knurled screw adjusting tool correctly positions the sprocket on the shaft. Both adjustments are securely held when setscrews (7) are tightened. Remove the special tools.

m. Repeat the same procedure for lower sprocket. Slide sprocket over cone, remove cone and replace it with adjusting screw tool, insert shim, slide sprocket worm wheel against shim, tighten setscrews (7) and remove tools.

n. It would be advisable at this time to adjust the film guides (10). Loosen the screws (9). Place the film guide adjusting tool No. S-15638-N6 (10, figure B) on sprocket as shown in figure T. Slide the tool around the sprocket until it is between the film guide and the sprocket. Press the film guide against the tool and tighten the screws (9). Do the same with the lower film guide.

o. Insert a tension washer (6) and spring (5) into each sprocket guard (4) and attach to the end of the sprocket shafts with the fillister head screws (3). Attach the film strippers (2) with the fillister head screws (1). Refer to Figure U for a view of the gear case interior assembled.

52. GEAR CASE – CLUTCH MECHANISM. (See figure 3.)

a. Insert clutch plunger (24) into the gear case. Place the lower end of the clutch lever (22) into the slot just below the clutch plunger recess. Then insert

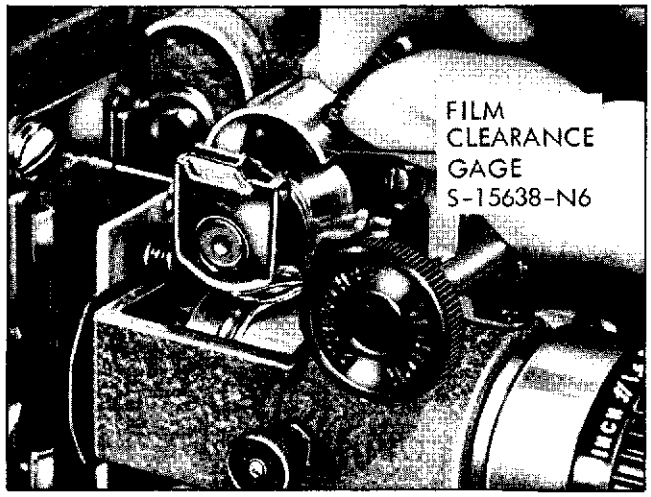


Figure T. Adjusting Sprocket Film Clearance

the clutch lever stud (21) into the gear case so that it engages the hole in the lower tip of the clutch lever (22). Screw in the pilot screw (20).

b. Lubricate the washer (18) with a light coat of B & H grease and place it in position on the boss on the rear of the cover (8). Hold the cover in such a position that the boss and washer will lie flat in the horizontal plane. Place the idler gear (16) in position on the washer. Use a pair of tweezers to place eighteen steel balls (17) around the inside diameter of the idler gear. Insert the idler gear shaft (15). Hold these parts together with your fingers, turn cover over and screw the fillister head screw (19) into the idler gear shaft (15). Draw the screw up tight.

c. Assemble the eccentric bushing (14), plate and shaft assembly (13), fillister head screw (10), gate operating lever (11) and setscrew (12) to the front of the cover.

d. Sparingly lubricate the gate operating block (9) and slip it into the slotted recess on the lens carrier assembly.

e. Carefully position the cover (8) on the gear case. The pin on the plate (13) must engage the hole in the gate operating block (9). This engagement is facilitated if the gate operating block is near the bottom of its slot. Manipulate the gate operating lever (11) slightly until the plate (13) engages the block (9). The cover (8) should now go into place on the gear case easily. Do not force it. If it does not drop into place easily, remove and try again. Attach the cover with the oval head screws (7).

f. Insert the knob assembly (4) through the boss on the left-hand side of the cover and install the retaining ring (5) on the shaft. Insert the shaft through the right-hand boss, the spacer (6), and torsion spring (23) and screw it into the link of the clutch lever and linkage assembly (22). Screw the hex nut (3) securely onto the end of the shaft.

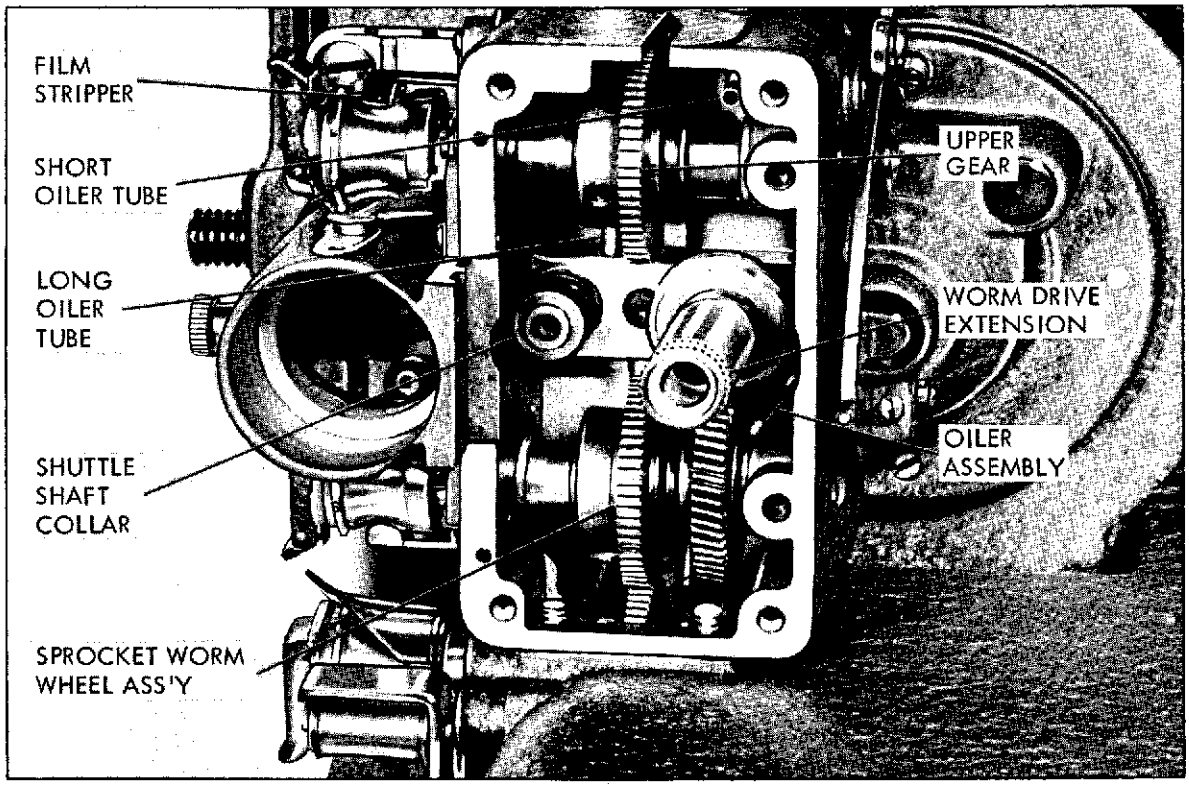


Figure U. Components Properly Installed in Gear Case

g. Hook the spring (23) over the vertical link on the clutch lever and linkage assembly (22) and over the boss on the front cover (8). The spring should tend to keep the clutch disengaged. Place the rubber knob (2) on the counter gear extension.

NOTE

Refer to paragraph 58 for clutch adjustment of the 302M and all 8302 models. Refer to paragraph 59 for adjustment of the clutch mechanism and fire shutter for 302L projectors.

53. PRESSURE PLATE. (See figure 3.)

a. Insert the lower screw (1C) through the spacer (1F), pressure plate yoke (1G) and compression spring (1E) and screw it into pressure plate (1H).

b. Insert the lower screw (1C) through the spacer (1F), pressure plate yoke (1G) and spacer bushing (1D) and screw it into the pressure plate (1H). Assemble the springs (1B) and spring cups (1A) between the screw heads and the outer ear of the yoke.

c. Adjust the pressure plate position as outlined in the following paragraphs.

d. The outer edge of the pressure plate is slotted to provide clearance for the shuttle teeth. Install the assembled pressure plate on the rails of the pressure plate carrier (at the rear of the lens carrier). Close the gate operating lever (17) so that the pressure plate rests against the aperture plate. While sighting along the film channel, slowly turn the rubber knob (2) so that the shuttle makes a full stroke. Check to see that the shuttle teeth are centered in the pressure plate slot during the full course of its travel.

e. If the shuttle teeth strike the edges of the slot during shuttle travel, insert a screw driver into the lens carrier barrel from the front and loosen the two screws (16, figure 4) enough to permit movement of the pressure plate carrier (18, figure 4). Shift the carrier, as necessary, to center the shuttle teeth in the pressure plate slot; then tighten the carrier screws securely.

NOTE

Pressure plate pressure adjustment can be made only after the gear case assembly has been installed (paragraph 55).

54. PROJECTOR FINAL ASSEMBLY. (See figure 2.)

a. Assemble the governor cap assembly (19) to the motor housing (20) with the fillister head screws (18). When doing so, however, be sure the pin on the worm shaft and drive blade assembly (4, figure 7) engages the slot in the face of the governor (10, figure 8).

b. Assemble the blower housing assembly (17) to the motor housing with the two fillister head screws (16) and four fillister head screws (15).

c. When assembling the gear case (14) to the blower housing (17), make sure that the clutch plunger enters the armature shaft and that the counter gear (22, figure 5), meshes easily and properly with the motor pinion (3, figure 8). Do not force the gear case into position.

d. On the back side and across the top of the gear case there is a horizontal channel. The projecting area around this channel should be coated with shellac just before assembling the gear case to the blower housing. The channel is the air passage to the heat filter in the blower housing and the shellac makes the channel air tight.

e. Attach the gear case in the upper right-hand corner with the fillister head screw (9). Attach the gear case in the lower right-hand corner with the second fillister head screw (9). Securely fasten the left-hand side of the gear case with the washers (13), guide rail (12) and fillister head screws (11). The washers (13) fit into the holes in the aperture plate and go between the guide rail and gear case housing.

f. Carefully place the assembled gear case, blower housing, motor housing and governor cap in position on the sound head (21). Note the two locating pins on top of the sound head and take care when meshing the sprocket gears. Secure the assembly with the support brackets (7A), bracket screws (7) and the screw and washer combinations (8).

h. Install the exciter lamp (6). Mount the exciter lamp cover (5) with the knurled screws (4). Install the projection lens (3), and condenser assemblies (1 and 2).

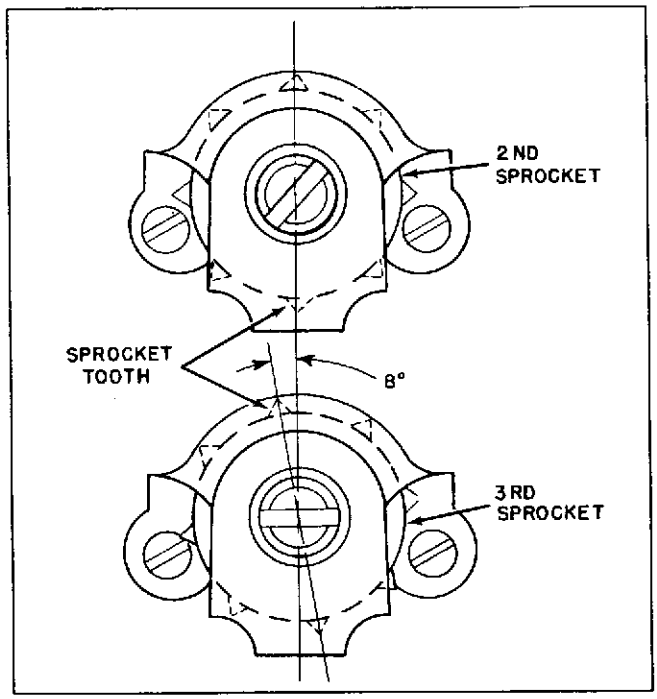


Figure V. Synchronizing Second and Third Sprockets

55. PRESSURE PLATE ADJUSTMENT. (See figure 3.)

a. Make certain that the position of the pressure plate has been properly adjusted (paragraph 53). Then adjust pressure plate pressure as follows:

b. Close the gate operating lever so that the pressure plate is forced against the aperture plate. Loosen the setscrew (12) and, with tool No. S-10309-F1 (2, figure B), turn the eccentric bushing (14) and note that the lens carrier moves in and out slightly. Also note that when the pressure plate (1H) is forced against the aperture plate, the compression springs (1B) are compressed and the yoke (1G) is forced slightly away from the spacer (1F).

c. Adjust the eccentric bushing (14) until the gap between the yoke and spacer is 0.002-inch. Hold the eccentric bushing while tightening the setscrew (12). Recheck the gap and readjust if necessary. This adjustment must be accurate. Improper pressure may result in unsteady pictures or loss of lower film loop during operation.

56. SPROCKET SYNCHRONIZATION.

a. The sprockets are numbered in the order in which the film passes over them. The top sprocket on the gear case is number one, the bottom sprocket on the gear case is number two and the sprocket on the sound head is number three. Sprockets number two and three must be synchronized.

b. There should be an 8 degree difference between the sprocket teeth as shown in figure V. This adjustment is easily made with the use of a special tool like the one shown in figure W. The left-hand side of this figure gives the dimensions of the tool which can be easily made from any 1/16-inch stock of steel, aluminum or bakelite, whichever you might find in your shop.

c. For accuracy in locating the two slots, a steel scale should be used for layout and a Swiss pattern

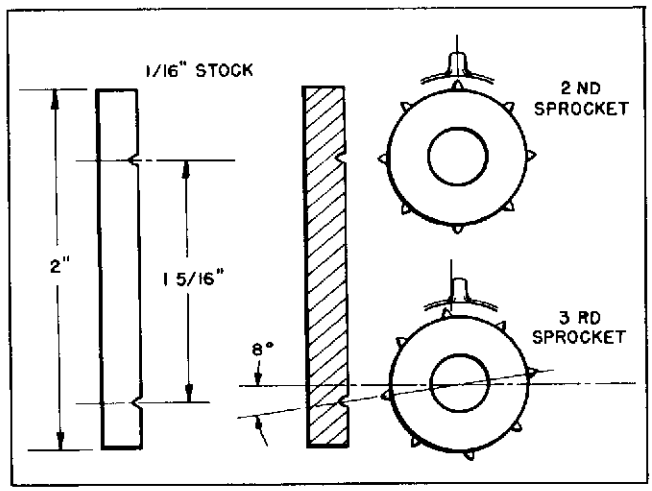


Figure W. Special Synchronizing Tool

file used to make the slots. Knife file No. 2 is ideal for this purpose.

d. Loosen the fillister head screw (16, figure 10) and remove the sprocket guard (17, figure 10). Pull out on the third sprocket until the sprocket can be turned freely by hand. When so doing, the sound sprocket gear in the sound head is disengaged from the second sprocket gear in the gear case.

e. Rotate the projector mechanism by hand (turn the rubber knob, figure 3, index 2) until one of the teeth on the second sprocket is in the vertical as shown in figure V, with the center of the tooth lined up with the center of the tip of the film guide.

f. Note now that a pair of teeth are projecting in the horizontal. Place the upper slot of the gauge over one of the teeth in the horizontal and rotate the third sprocket until one of the teeth fit into the lower slot of the gauge. With the gauge still on the teeth, push the third sprocket into position.

g. Reinstall the sprocket guards over the sprockets with the fillister head screw (16, figure 10).

57. SPEED ADJUSTMENT.

a. The speed adjustment is a critical one and must be very accurate to obtain satisfactory operation, especially with sound. The only truly accurate method of checking speed is with a tachometer.

b. Check the speed at the worm drive extension (17, figure 5). At the silent speed of 18 frames per second, the correct speed is 1080 rpm. At the sound speed of 24 frames per second the correct speed is 1440 rpm. These two settings may vary ± 30 rpm.

c. In the event that a tachometer is not available, an alternate method may be used as follows:

d. Make an endless film loop exactly 90 frames long (26-3/4 inches). At the silent speed of 18 frames per second, the loop will pass through the mechanism 12 times per minute. At the sound speed of 24 frames per second, the loop will pass through the mechanism exactly 16 times per minute. These speeds can be checked by counting the number of times the splice passes a predetermined point.

e. The speed is adjusted by means of the headless setscrew located on each set of contact points on the governor. (See figure X.) These contacts operate under a spring tension.

f. Note that one set of points has a weaker set of springs than the other set. The set of points with the stronger spring controls sound speed.

g. By turning the headless setscrew to either increase or decrease the contact point gaps, the speed can be either decreased or increased. Adjust until the correct speed is obtained for both sound and silent operation.

58. CLUTCH LEVER ADJUSTMENT (302M AND ALL 8302 MODELS). (See figure 3.)

a. Loosen the pilot screw (20), and rotate the clutch knob assembly (4) to the "clutch engaged" position. Hold the knob while rotating the clutch lever stud (21) until the clutch lever (22) remains engaged when the knob is released.

b. Without disturbing the position of the clutch lever stud (21), tighten the pilot screw (20) securely.

59. CLUTCH LEVER AND FIRE SHUTTER ADJUSTMENT - 302L ONLY.

a. Proper adjustment of the clutch lever (22, figure 3) is essential for correct operation of the fire shutter (1, figure 6), because the fire shutter operates on a flow of air which is controlled by the position of the clutch lever. Cooling air enters the projector on the clutch side of the gear case.

b. Operate the projector and engage and disengage the clutch lever with the knob assembly (4, figure 3) while watching the action of the fire shutter. The fire shutter must drop in front of the aperture opening before the clutch lever is pulled back far enough to disengage the clutch. Conversely, the mechanism must start running (clutch engaged) before the fire shutter begins to rise. Loosen the pilot screw (20, figure 3) and adjust the clutch lever stud (21) until these conditions are obtained.

c. In conjunction with the above adjustment, the

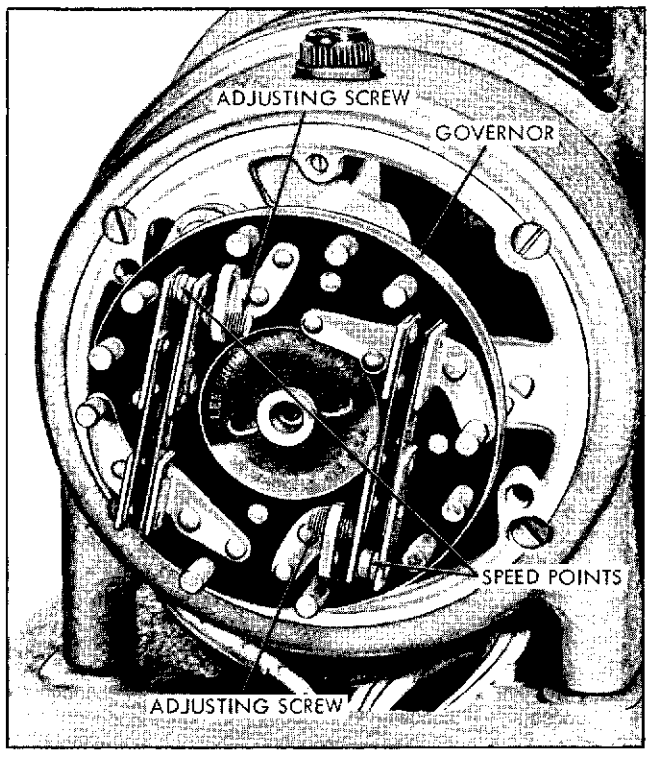


Figure X. Adjusting Governor Speed

setscrew (4, figure 6) also must be adjusted to control the rise and drop of the fire shutter. This setscrew is located directly above the fire shutter and controls the flow of air to the fire shutter, thus making it rise or drop more quickly. When properly adjusted, seal the head of the setscrew with wax.

d. Vibration noises in the clutch mechanism usually can be corrected by making a minor adjustment of the clutch lever stud (21, figure 3). Be sure to tighten the pilot screw (20) securely after adjustments are made. Note that the clutch linkage spring (10, figure 2) must hold the clutch linkage securely against the gear case and over the air hole when the clutch lever is engaged.

60. ASSEMBLING PROJECTOR AND AMPLIFIER INTO CASE. (See figure 1.)

a. Insert the projector (10) up into the case (11) and secure in position with the screws (6), washers (7), cushions (8) and spacers (9).

b. Place the amplifier (5) next to the case and make all cable connections. Insert amplifier into case and secure with the mounting screws (4). Install the bottom plate (3) with the case feet (1) and washers (2).

c. Mount the reel arms (14 and 15) in position and install the spring belts (12 and 13). Make a final check of all wiring and cable connections. Connect amplifier and projector power cables to proper power source and briefly actuate switches to check projector and amplifier operation.

61. STABILIZER ROLLER ADJUSTMENT.

a. The stabilizer assembly must be correctly adjusted to obtain the best sound production. Make an endless loop of "buzz track" sound film and thread it through the second sprocket, the stabilizer assembly, over the sound drum and through the third sprocket on the sound head.

b. Operate the projector in the normal manner for optical sound with the amplifier on and the speaker connected.

c. Loosen the hex nut (14, figure 10) behind the stabilizer arm. Turn the cap (2) to move the stabilizer rollers in or out as necessary until a minimum of sound is audible from the "buzz track" film. Tighten the hex nut after adjustment.

d. Now start and stop the projector several times. Note the position of the plain roller on the bottom half of the stabilizer when the projector is inoperative and then note the position the roller assumes when the projector is operating. The plain roller must come to rest in its operating position within 2-1/2 seconds after film starts through the projector. If it does not, the torsion spring (5, figure 10) must be replaced.

62. OPTICAL SLIT ADJUSTMENT.

a. If the optical slit assembly was removed or disturbed, it must be repositioned correctly to insure satisfactory sound reproduction. The adjustment of the stabilizer (paragraph 61) must be done for correct slit scanning across the sound track before making any adjustment on the optical slit.

NOTE

This adjustment of the optical slit assembly must be done in a quiet location.

b. Thread the projector with a strip of 7000-cycle test film.

c. Turn the amplifier switch on and set the VOLUME control approximately 1/3 of the way up.

d. Look at the optical slit assembly. Note that one end has two small screws in it. This is the end which must be toward the exciter lamp. Note also that the lens on each end is marked and that there is a rectangular slit cut in each mask. The long sides of the rectangle should be parallel with the horizontal.

e. Grasp the optical slit assembly on the exciter lamp side. DO NOT block the exciter lamp rays. Turn the projector switch to the ON position. Move the optical slit assembly forward and backward until the maximum volume is obtained. The long sides of the rectangular slit should still be parallel with the horizontal when the point of maximum volume is reached.

f. Tighten the setscrew (43, figure 10) immediately to lock the optical slit assembly in place. Be very careful not to change the setting of the optical slit when tightening the setscrew. Seal the setscrew with sealing wax.

g. The optical slit adjustment is a VERY CRITICAL ONE. Be careful during adjustment.

h. Special tools for making the optical slit adjustment are available on special order.

63. SNUBBER ADJUSTMENT. (See figure 10.)

a. Thread the projector with a loop of test film. Note the position of the snubber assembly when it is at rest; then start the projector and note the position that the snubber assumes during operation with film. The tension on the snubber assembly must be adjusted so that it will not start to take effect until the snubber has moved approximately 1/16-inch away from the rest position.

b. Loosen the three screws (29 and 31). Rotate the sleeve bearing (35) in either direction to increase or decrease the tension of the snubber spring (34) as desired. Hold the bearing while tightening the screws (29 and 31).

c. Check the action of the snubber and, if necessary, continue to adjust by trial and error method until the correct tension is obtained. The snubber spring should be at rest when the snubber assembly is in the at rest

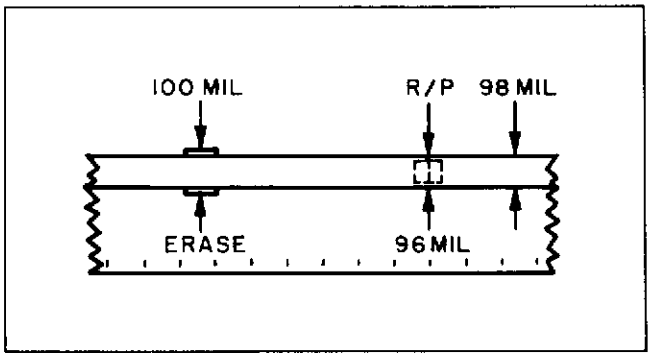


Figure Y. Lateral Location of Magnetic Heads

position. Upon raising the snubber assembly more than 1/16-inch away from rest position, the spring tension must begin to be felt. This tension must increase noticeably as the snubber is raised higher and higher.

64. PRELIMINARY MAGNETIC HEAD ADJUSTMENTS.

a. The proper location of the faces of the pole pieces with respect to the sound track is shown in figure Y. Proper orientation of the pole pieces is illustrated in the "correct position" views of figure Z.

b. Place a light coat of Prussian blue on the face of the pole piece. Place the function lever in the "magnetic" position and thread a loop of magnetic soundstripe film through the soundhead. Start the projector and allow it to run for approximately 30 seconds.

c. Carefully remove the film loop and examine the pattern left by the Prussian blue. The correct pattern will be a rectangle centered over the head gap as shown in the "correct position" views of figure Z. If the blue pattern is not as shown, adjust as follows:

(1) Head too far to the right or left: Loosen the end screw in the arm hub (8 or 15, figure 11A) and move the arm slightly sideways.

(2) Gap not centered in rectangle: Loosen center screw in arm (locking screw for head) and rotate head slightly.

(3) Pattern skewed with respect to gap: Loosen screws on either side of head locking screw and twist head as required.

(4) Triangular or trapezoidal patterns: Twist arm

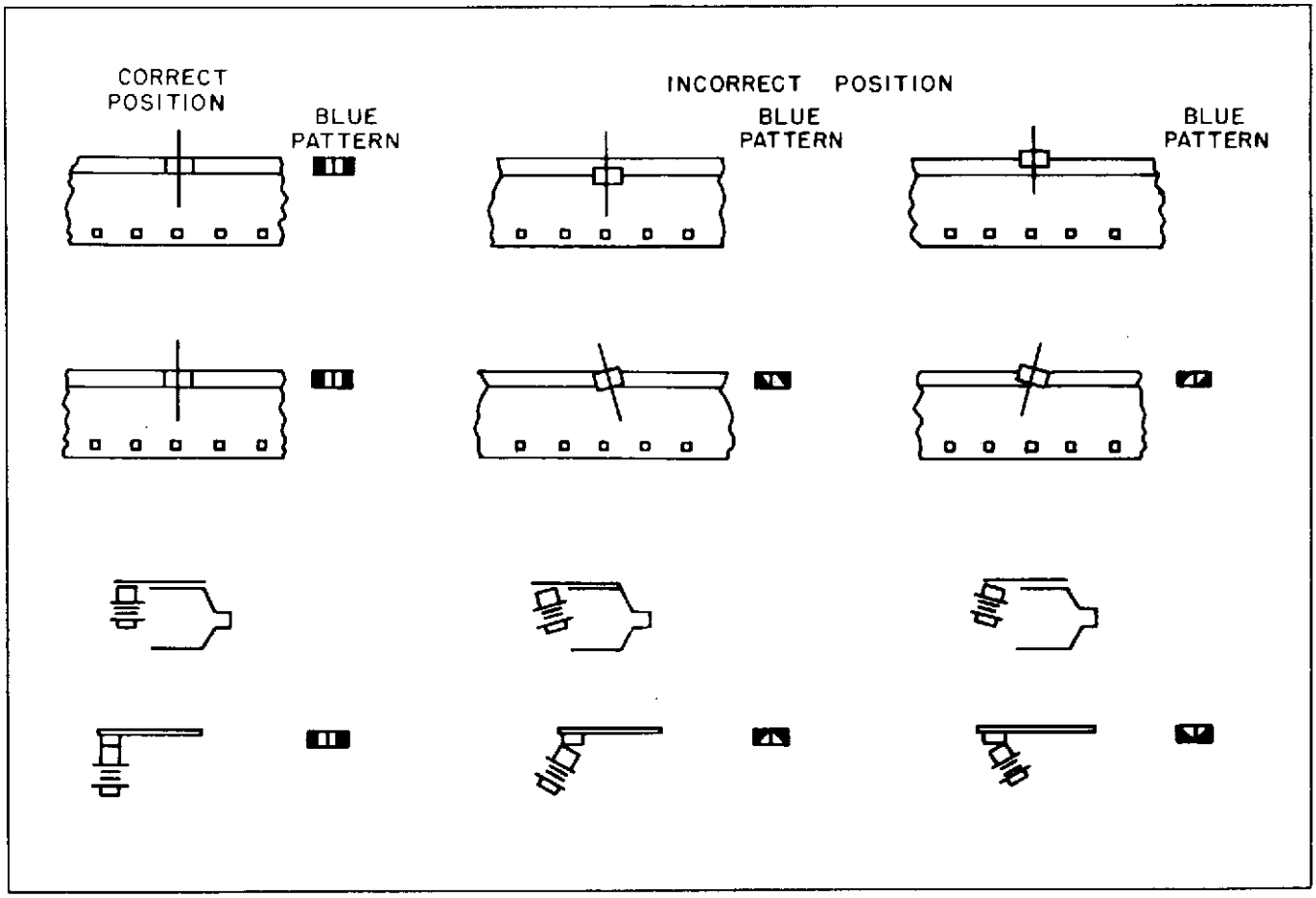


Figure Z. Proper Orientation of Magnetic Heads

to re-level pole piece.

NOTE

Whenever head position is changed, head pressure should be checked (and readjusted, if necessary) as outlined in paragraph 42e.

65. FINAL HEAD ADJUSTMENTS.

a. With the amplifier connected to the projector, connect a 16-ohm non-inductive resistor, an AC voltmeter and an oscilloscope to the single speaker output.

b. Thread the projector either with ASA 16-mm magnetic azimuth film a full-track pre-recorded 3000 cps film made on a projector known to be in correct adjustment.

c. Place the function lever in the "magnetic" position and the amplifier tone control in "max treble" position. Start the projector and adjust the amplifier volume control to produce an output voltage of approximately 2 volts.

d. Loosen the center (head locking) screw on the arm and head assembly (figure 11A) and rotate the head to obtain peak output; then tighten the locking screw securely. Loosen the two screws on either side of the head locking screw. Carefully twist the head to obtain peak output; then tighten these screws securely.

e. Remove the pre-recorded film from the projector and rethread the projector with another full-track film. Connect an audio oscillator (set a frequency of 1KC) to the input jack.

f. Switch to record position and start the projector. Set the volume control to the 2 o'clock position and adjust the oscillator level control until the record lamp glows faintly. Record about 30 feet of track.

g. Stop the projector, switch to playback position, and disconnect the oscillator. DO NOT change the volume control setting. Rewind the film back to the start of the recording and start the projector once more. When approximately half of the recording has passed through the projector, stop the projector and switch to record position. This will erase the balance of the recording. Again start the projector and allow the remainder of the previously recorded film to pass through the projector.

NOTE

The amplifier gain setting is unchanged, but no signal is being applied to the input.

h. Switch to playback position and rewind film back to start of recording. Start the projector and watch the output meter reading. When the erased portion of the recording is reached, output should drop at least 27 db. If output level drops less than 27 db, the erase head must be repositioned by shifting the head from side to side (paragraph 64c, step 3). If head position is changed, be sure to recheck head pressure as outlined in paragraph 42e.

i. Remove film from projector, place function lever in magnetic position, and disconnect resistor, voltmeter and oscilloscope from speaker output.

j. Check to make certain that the rubber roller (14, figure 11) is bearing evenly across the face of the sound drum. If the roller appears cocked, the roller shaft of the arm assembly (19) may be bent. If so, grasp the hex shank of the special screw (12) with a pliers and twist slightly to straighten the shaft. Hook a gram scale beneath the hex shank of the special screw (12, figure 11) and check the force required to pull the rubber roller away from the sound drum. The roller should just leave the drum at a reading of 100 to 110 grams on the scale. Adjust the pivot stud (24, figure 11) to obtain correct lift-off setting.

k. Install the sound drum hum shields (4 and 5, figure 11A).

66. PHASING ADJUSTMENT.

a. Set the projector for magnetic play back. Start the projector and turn the volume and tone controls to their mid-positions.

b. Turn the phase reactor until hum level has been reduced to a minimum.

67. LOOPSETTER ADJUSTMENT - 302M AND 8302 MODELS ONLY. (See figure 4.)

a. The loopsetter assembly is secured in place by the lower film tension clip screw (21) and the adjacent lower film guide screw (9). If the loopsetter was removed, wash the assembly in alcohol. Make sure that the cam (31C) revolves freely on the spindle and that the spring (31B) is positioned so that it bears evenly against the flat on the cam hub. Do not lubricate the spindle.

b. Slip the loopsetter up into position and tighten the two screws (9 and 21) just enough to hold the assembly in place. Turn the rubber manual knob at the front of the gear case until one tooth of the lower sprocket is on an imaginary centerline drawn from the center of the sprocket to the center of the spindle. Check by holding a piece of string tautly between these two points.

c. Place a strip of film in the film channel and close the film gate. Rotate the cam (31C) counterclockwise and check the clearance between the cam and the bottom edge of the film pressure plate. This clearance (0.008 to 0.015-inch) can be adjusted by shifting the loopsetter slightly. Then rotate the cam clockwise and check to make certain that the cam just clears the nearest sprocket tooth. If both clearances exist, tighten screws (9) and (21) securely.

d. Thread the projector with film and start the projector. Check loopsetter operation by pulling out

(enlarging) the lower loop and observing film loop restoration. If the restored loop is too short, the loopsetter is set too close to the pressure plate; if the restored loop is too long, the loopsetter is set too low. Repeat step c until loop restoration is just right.

68. REWIRING FOR SILENT SPEED OPERATION.

Some 8302A and 8302B projectors are initially wired for sound speed operation only and are then designated as models 8302D and 8302E respectively (see Design Index Chart at front of book). If the customer should so desire, these projectors may be converted to silent and sound operation in the following manner.

a. Remove the plug from the silent-sound switch mounting hole in the soundhead and install the silent-sound switch (item 53, figure 11) and nameplate (56).

b. Remove the motor brush housing (paragraph 8) to expose leadwire terminals as shown in figure Z-1. Connect jumper wire (B & H No. 430875) between the silent and sound terminal lugs as indicated.

c. Cut leadwires A and B (figure Z-1) as shown, and reconnect cut ends of these wires to the terminals of the silent-sound switch to complete the rewiring. Reinstall the motor brush housing.

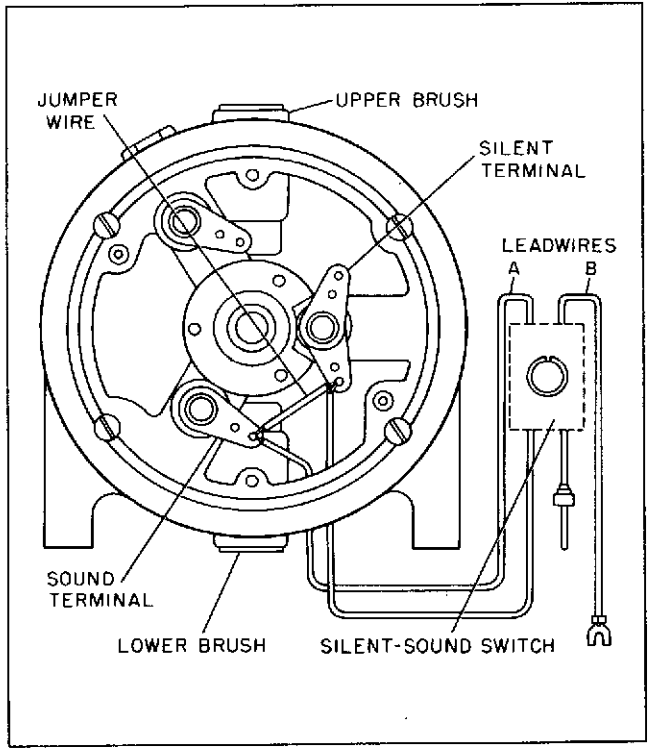


Figure Z-1. Converting Sound-Only Projectors to Silent-Sound Operation

Final Test

69. GENERAL.

It is important that the projector be carefully tested and that certain adjustments to various components be made upon the completion of any maintenance which has included any disassembly and reassembly. Besides the following specific adjustments, the final inspection of a repaired machine should include the running of a reel of film to observe picture steadiness, illumination, etc., and also the quality of sound reproduction.

70. FILM RUNNING TESTS.

a. Make a 18-inch loop of new film, thread it through the mechanism with emulsion side to gate shoe and turn on the motor switch.

b. Allow it to run through the projector 250 times.

c. Remove the film and inspect it for scratches. If scratches are evident, they are probably caused by emulsion which has gathered on the pressure plate. Clean the pressure plate as described in paragraph 20 and repeat the test, using new film.

d. If scratches are again evident on the film, examine aperture plate and pressure plate for scratches. There must not be any scratches on either of the plates. Replace the plates if necessary.

e. Upon completion of reassembly and all necessary adjustments, a sound film should be run through the projector in order to check the mechanical and sound operation. Use a film known to be in good condition and possessing a good sound track.

71. FINAL INSPECTION.

Before returning the projector to the customer, make a rundown of the following items to be sure everything is in good order:

a. Inspect and clean all lenses and the reflector as outlined in paragraph 18.

b. Inspect and clean the sound head and optical slit (par. 19).

c. Inspect and clean all film handling parts (par. 20).

d. Check snubber roller adjustment (par. 63).

e. Check height of shuttle teeth (par. 51, steps c through f).

f. Check film guide adjustment (par. 51n).

g. Check shuttle teeth position (par. 53).

h. Check pressure plate adjustment (par. 55).

i. Check clutch lever and fire shutter adjustment (par. 58 or 59).

j. Check sprocket synchronization (par. 56).

k. Check running speeds (par. 57).

l. Check stabilizer roller adjustment (par. 61).

m. Check optical slit adjustment (par. 62).

n. Check magnetic head adjustment (par. 64 and 65).

o. Check for hum or noise pick-up (par. 66).

p. Be certain that film tests have been made.

q. Check operation of reel arms.

r. Be sure all lubrication has been performed.

s. See that all screws and nuts are secure, and that amplifier is installed properly.

t. Check operation of tilt mechanism.

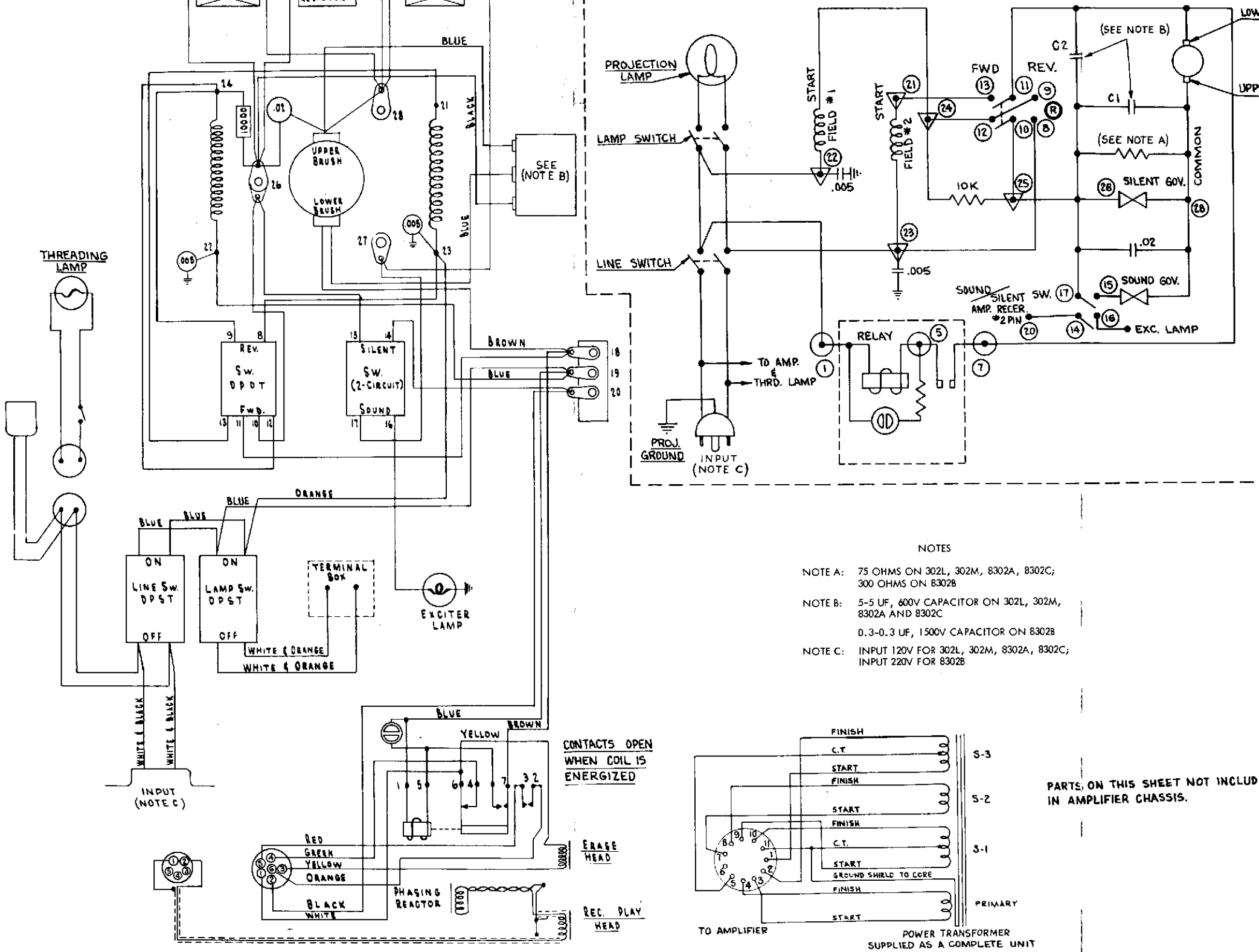
Trouble Shooting Chart

TROUBLE	PROBABLE CAUSE	REMEDY
1. Projector motor does not run, lamp does not light, and amplifier does not operate.	a. Current supply cord not making proper contact with power outlet.	a. Check and make certain that all cords are properly connected and making good contact.
	b. No current at supply outlet.	b. Check outlet with ordinary lamp.
	c. Open circuit in line cord.	c. Check with another cord known to be good.
	d. Line switch defective.	d. Replace defective switch.
2. Lamp lights but motor doesn't run.	a. Motor brushes sticking or worn.	a. Remove brushes and clean out brush holders. If brushes are worn to less than 1/8 inch in length, replace them.
	b. Dirt in governor contacts.	b. Remove governor cap and clean governor breaker points.
3. Motor and amplifier operating but lamp does not light.	a. Lamp burned out.	a. Replace lamp.
	b. Lamp switch not turned on.	b. Check switch to see that it is in ON position.
	c. Lamp switch burned out.	c. Replace defective switch.
4. Speed varies or projector runs too fast.	a. Motor brushes worn. Governor points pitted or dirty.	a. Replace brushes when worn to less than 1/8 inch in length File points or replace governor.
5. Edge of aperture opening uneven and fuzz projecting into picture area.	a. Dirt in aperture opening.	a. STOP PROJECTOR. Lightly but thoroughly clean edges of aperture opening with aperture brush or pipe cleaner.
6. Picture not sharp on screen.	a. Lens or condenser elements may be dirty, oily, or finger-spotted.	a. Use lens tissue and thoroughly clean surfaces of lens and condenser elements. If all dirt cannot be removed in this manner, lens-cleaning fluid should be wiped on the lens surface and followed by a thorough cleaning with lens tissue.
	b. Loose elements in projection lens.	b. Tighten lens retainers.
	c. Film loops too short.	c. Rethread projector.
7. Picture not framed.	a. Framer knob or lever improperly adjusted.	a. Turn framer knob or lever until picture is properly framed.
	b. Film out of frame.	b. Adjust framing until frame line is close to perforation center.

TROUBLE	PROBABLE CAUSE	REMEDY
8. Film does not wind on rear reel arm.	a. Fabric belt on rear reel arm slips.	a. Remove belt and thoroughly clean in dry cleaning solvent. Turn belt inside out or, if necessary, replace with new belt.
	b. Spring belt which runs from governor cap to the pulley on take-up arm may be stretched, kinked, oily, or worn.	b. Slipping may be temporarily corrected by thoroughly cleaning spring belt with dry cleaning solvent. However, if belt is stretched or kinked, it should be replaced with a new one.
	c. Spindle in rewind position.	c. Disengage gears.
	d. Take-up reel bent.	d. Use a good reel.
9. Rear reel arm assembly binds or jerks.	a. Spring take-up belt stretched, kinked, oily, or worn.	a. Wash belt with dry cleaning solvent or replace.
	b. Fabric take-up belt worn or oily.	b. Wash belt with dry cleaning solvent or replace.
10. Film loses loops and picture unsteady.	a. Torn or chipped perforations in film.	a. Check film carefully and eliminate injured film.
	b. Poorly made splice.	b. Resplice film.
	c. Too much clearance between sprocket and film guide.	c. Film guide bent. Adjust to two film thicknesses by bending, or loosen screws and reset clearance (para 51n).
	d. Sprocket guard out of adjustment.	d. Replace spring or tighten retaining screw.
	e. Shuttle does not protrude far enough through aperture plate or stroke is insufficient.	e. Shuttle mechanism and/or aperture plate must be replaced or readjusted.
11. Film scratched.	a. Dirt or emulsion accumulation in film channel or around sprockets and guards.	a. Brush away as much of the free dirt as possible. Remove dust with brush or syringe. Clean with dry cleaning solvent.
	b. Worn film-handling parts such as aperture plate, gate plate, film guards, rollers.	b. Replace worn parts.
12. Heat filter sticks or operates sluggishly.	a. Heat filter mechanism binding.	a. Repair or replace heat filter parts.
13. Poor illumination.	a. Line voltage lower than lamp voltage rating.	a. Use lamps with voltage rating equal to voltage of line supply.
	b. Lamp old, black, and almost ready to burn out.	b. Use new lamp.

TROUBLE	PROBABLE CAUSE	REMEDY
13. Poor illumination (Cont)	c. Lamp inserted crooked in lamphouse.	c. Insert lamp in lamphouse properly and screw cap up snugly.
	d. Heat filter does not rise.	d. Check heat filter operation (Trouble No. 12)
	e. Condensers and lens dirty or oil covered.	e. Clean all lens elements thoroughly.
	f. Reflector mirror tarnished.	f. Polish or replace reflector mirror.
14. No sound	a. Burned out exciter lamp.	a. Replace exciter lamp.
	b. Amplifier not turned on.	b. Check position of amplifier switch.
	c. Fuse blown.	c. Replace fuse.
	d. Defective tube or tubes in amplifier.	d. See that all tubes are in their correct sockets. Test each tube and replace all defective ones.
	e. Speaker cable not plugged in at both ends.	e. Check all cable connections. See that they make proper contact.
	f. Pin jack between amplifier and exciter lamp may not be connected.	f. Make certain the pin jack is properly connected and makes good contact.
	g. Speed switch in SILENT position.	g. Move switch to SOUND position.
15. No sound, exciter lamp lights.	a. Volume control not advanced sufficiently toward the high position.	a. Check position of volume control and gradually advance to high position.
	b. Film incorrectly threaded.	b. Check threading.
	c. Absence of sound record on film.	c. Remove the film; turn on the amplifier. Turn the volume control to high position. Pass a card swiftly back and forth between the sound lens and the sound drum. If a loud thumping sound is heard from the speaker, the equipment is operating properly and the lack of sound would be due to the film.
	d. Defective tubes or photoelectric cell.	d. Test all tubes and photoelectric cell. Replace defective ones.
	e. Exciter lamp damping shield not aligned.	e. Adjust damping shield so that opening in shield is in line with lens of optical slit.
16. Inadequate volume.	a. Volume control not advanced far enough.	a. Advance volume control until sufficient volume is obtained.

TROUBLE	PROBABLE CAUSE	REMEDY
16. Inadequate volume (cont)	b. Poorly made or dirty film.	b. Compare with sound from film of known good quality.
	c. Foreign matter obstructing optical sound system.	c. Clean optical sound system.
	d. Dirty or worn magnetic heads.	d. Clean or replace heads.
17. Unsatisfactory sound quality	a. Motor speed improperly set.	a. Adjust speed (para 57).
	b. Defective tubes or exciter lamp.	b. Replace tubes or exciter lamp.
	c. If quality deteriorates in optical sound only, check for dirt in optical system.	c. Clean and adjust optical system.
	d. If quality deteriorates in magnetic sound only, check for dirty or worn heads, old and dry film, or faulty sound striping.	d. Clean or replace heads; check with good quality sound-stripe film.
18. Poor magnetic recording	a. Defective oscillator tube.	a. Replace oscillator tube.
	b. Dirty or defective relay contacts.	b. Clean contacts or replace relay.
	c. Dirty or worn record-playback head.	c. Clean or replace head.
	d. Incorrect record-playback head pressure.	d. Adjust head pressure.
19. Improper erasing of recording	a. Erase head improperly positioned.	a. Reset erase head position.
	b. Incorrect erase head pressure.	b. Reset erase head pressure.



NOTES

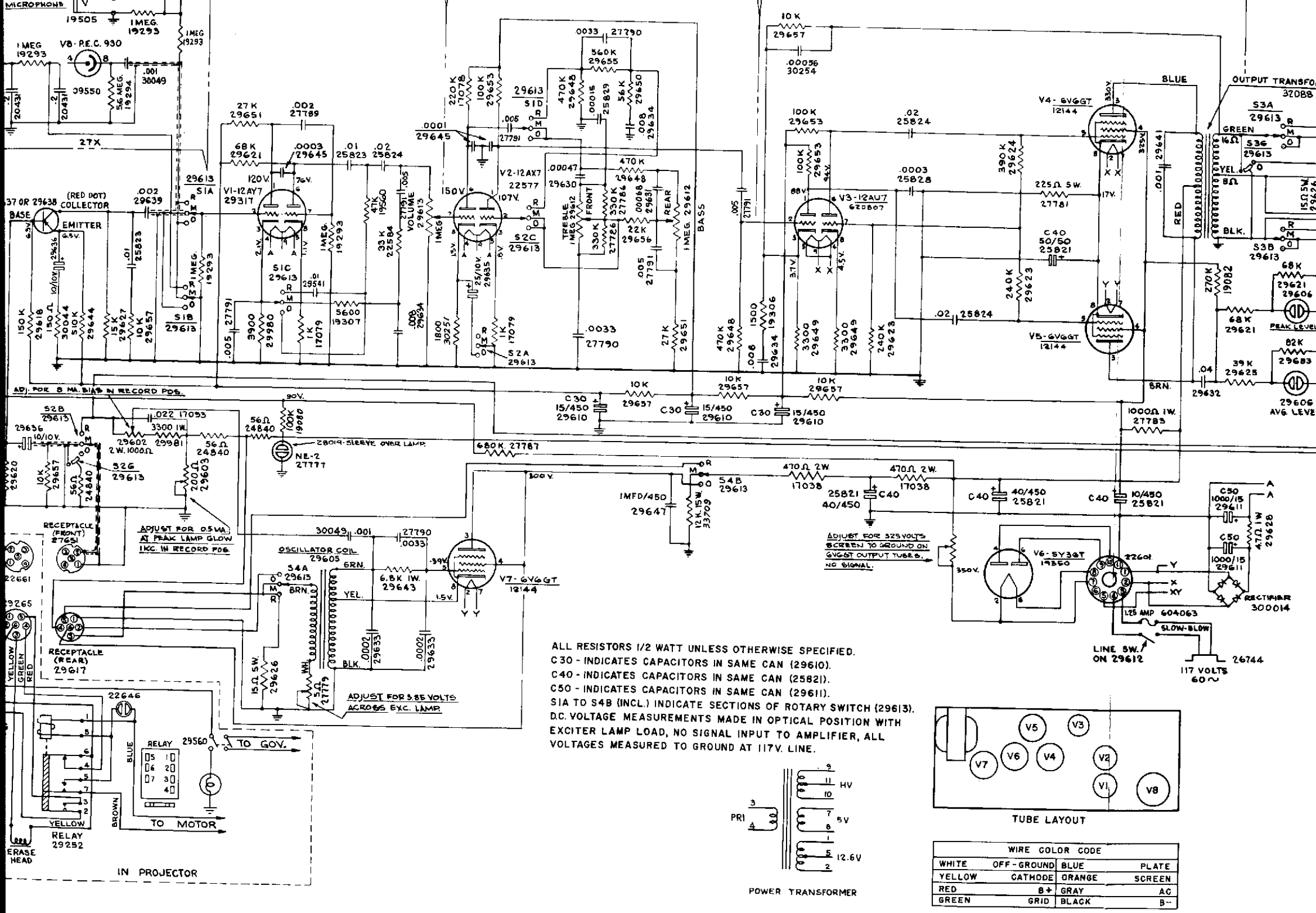
NOTE A: 75 OHMS ON 302L, 302M, 8302A, 8302C; 300 OHMS ON 8302B

NOTE B: 5-5 UF, 600V CAPACITOR ON 302L, 302M, 8302A AND 8302C

0.3-0.3 UF, 1500V CAPACITOR ON 8302B

NOTE C: INPUT 120V FOR 302L, 302M, 8302A, 8302C; INPUT 220V FOR 8302B

PARTS ON THIS SHEET NOT INCLUD IN AMPLIFIER CHASSIS.

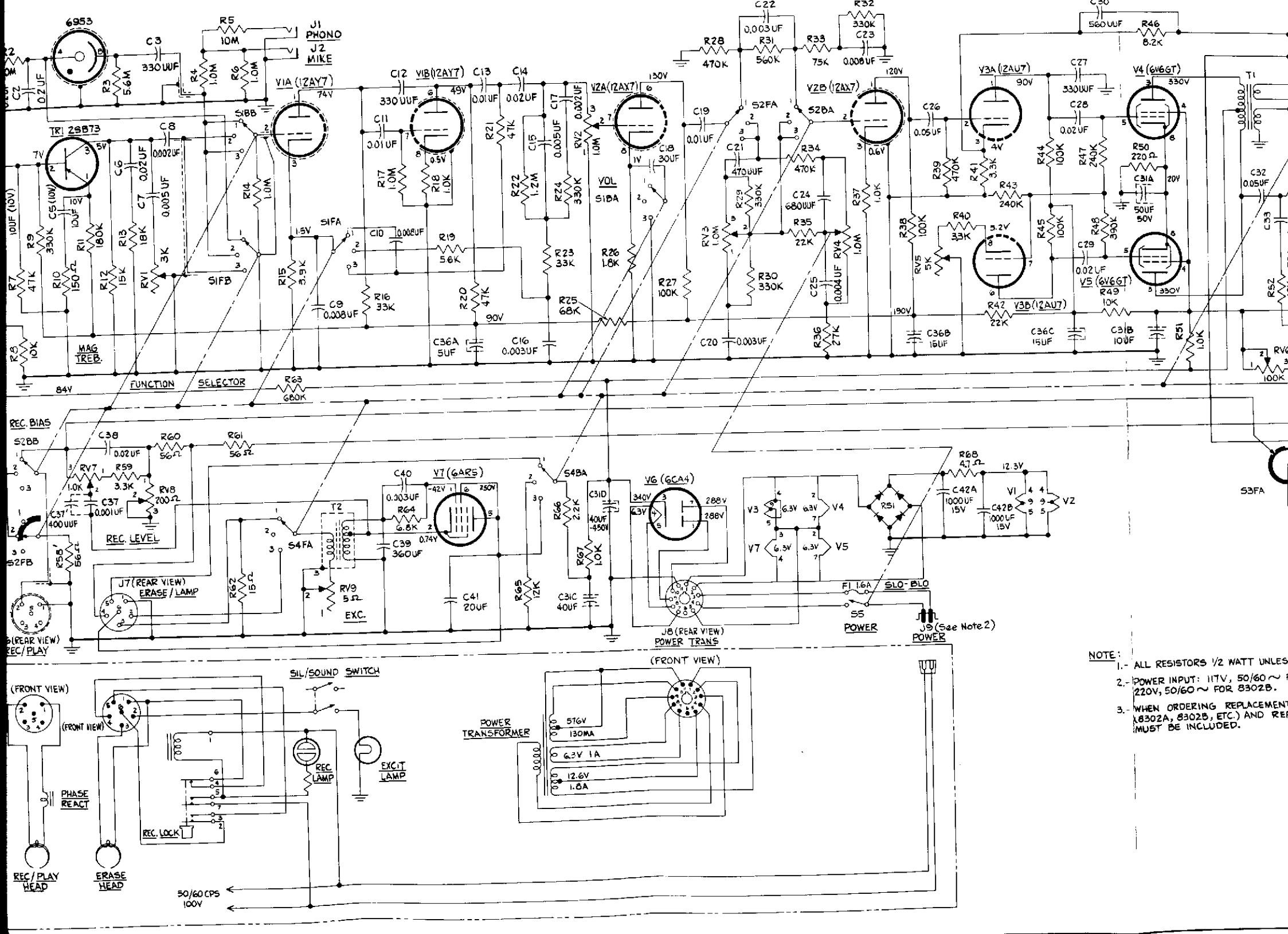


ALL RESISTORS 1/2 WATT UNLESS OTHERWISE SPECIFIED.
C30 - INDICATES CAPACITORS IN SAME CAN (29610).
C40 - INDICATES CAPACITORS IN SAME CAN (25821).
C50 - INDICATES CAPACITORS IN SAME CAN (29611).
S1A TO S4B (INCL.) INDICATE SECTIONS OF ROTARY SWITCH (29613).
D.C. VOLTAGE MEASUREMENTS MADE IN OPTICAL POSITION WITH EXCITER LAMP LOAD, NO SIGNAL INPUT TO AMPLIFIER, ALL VOLTAGES MEASURED TO GROUND AT 117V. LINE.

POWER TRANSFORMER

TUBE LAYOUT

WIRE COLOR CODE			
WHITE	OFF-GROUND	BLUE	PLATE
YELLOW	CATHODE	ORANGE	SCREEN
RED	B+	GRAY	AC
GREEN	GRID	BLACK	B-


6953
J1 PHONO
J2 MIKE
V1A (12AY7)
V1B (12AY7)
V2A (12AX7)
V2B (12AX7)
V3A (12AU7)
V3B (12AU7)
V4 (6V6GT)
V5 (6V6GT)
V6 (6CA4)
V7 (6AR5)
TR1 2SB73
FUNCTION SELECTOR
MAG TREB.
VOL
REC. BIAS
REC. LEVEL
EXC.
ERASE / LAMP
REC/PLAY
POWER TRANS
POWER
SIL/SOUND SWITCH
REC LAMP
EXCIT LAMP
REC. LOCK
PHASE REACT
REC/PLAY HEAD
ERASE HEAD
POWER TRANSFORMER
576V 130MA
6.3V 1A
12.6V 1.8A
50/60 CPS 100V
SLO-BLO
NOTE:
1.- ALL RESISTORS 1/2 WATT UNLES
2.- POWER INPUT: 117V, 50/60 ~
220V, 50/60 ~ FOR 8302B.
3.- WHEN ORDERING REPLACEMENT
(8302A, 8302B, ETC.) AND RE
MUST BE INCLUDED.

PART NUMBER	FIG. & INDEX NO.
M025161	3-4
M025986	4-24
M026171	2-2
	9-12
M026172	2-1
	6-9
M026181	8-27
M026184	8-24
M026312	5-5
M026319	8-18
005000	8-24
005005	8-30
005006	8-27
005014	1-11
005016	12-25
005017	12-24
005019	11-61
005048	11-53
010097	4-25
010324	11-61
010522	6-8
010524	3-22
010602	6-18
01078	5-5
011418	6-8
011419	8-21
011421	1-14
011422	1-15
011423	13-
011424	13-25
011425	13-
011426	13-14
011908	1-11
01477	5-31
02040	1-1
02678	10-45
02794	7-4
03352	5-22
03446	13-21
03460	4-29
03461	4-8,10-21
03464	4-25
03788	3-1
03927	6-1
040162	12-15
040165	12-52
040175	12-24
040176	12-25
040194	1-11
040261	1-3
040643	12-57
040644	12-49
040668	1-15
040669	14-13
040673	2-3
040674	3-4
040678	1-5
040679	12-15
040696	4-31
040704	6-8
040752	8-30
040753	8-27
040763	11-11
040765	12-57
040766	1-11
040771	1-5
040773	11-11
040794	11-41
04523	13-16
04720	3-8
04946	4-4
05382SP	9-5
05647	2-3
05707	3-22
05708SP	9-7
05746	3-24
05774	10-12
05775	10-13
05799	5-22
07022	9-5
07023	2-1
	6-9
07053	10-40
07204	2-2
	9-12
07205	3-8
07213	10-
07544	9-1
0772	3-13
07786	9-7
08252	1A-14
08258	10-8
08338	2-12
08388	9-4
08455	4-22
08456	4-22
08850	9-1
08858	15-25
08867	10-3
08881	12-8
08883	12-2
08887	12-
08909	13-
08910	13-25
08917	12-20
08964	12-
08990	4-4
	10-17
09201	1A-13
09202	1A-11
09203	1A-12
09248	1A-9
09250	1A-8
09251	11-31
	1A-1
09252	12-57
09262	12-30
09282	10-37
09283	3-1
09425	12-33
09431	1-5
09445	5-8
09447	11-
09454	11-65
09455	8-21
09463	11-52
09469	11-19
09470	11-40
09550	15-14
	17-
09551	11-68
09577	4-19
09651	13-14
09653	13-12
09654	13-
09655	1-14
100018	11-62
100027	12-23A
100029	12-14
100031	12-13
100037	12-46
100116	12-36
10306	5-13
10324	8-3
10350	8-22
10388	8-13
10390	8-15
10529	5-29
10540	7-13
10547	7-5
10554	7-1
10565	3-2
10747	14-6
10749	7-12
10750	7-9
11036	14-7
11054	5-6
11055	5-25
11110	5-10B
11147	4-30
	10-24
112	3-19
11268	10-22
11269	4-26
11276	5-20
11279	5-17
11280	5-11
11281	5-19
11282	5-16
	5-18
11462	13-15
11463	13-9
11466	13-22
11470	13-20
11471	13-24
11472	13-23
11474	13-11
11475	13-10
11478	13-1
11521	12-26
11569	6-5
11709	2-19A
11713	3-18
11757	4-3
11761	4-10
	10-27
11762	4-2
11795	4-17
11796	3-1H
11799	4-12
11852	4-24
11859	4-7
	10-20
11868	4-28
	10-25
12071	3-1B
12087	3-3
12128	13-18
12129	13-17
12641	10-43
12719	4-18
12720	3-1G
12762	8-25B
12776	3-1A
12778	3-1C
12864	7-7
	14-2
13366	9-8
13387	9-3
13525	12-27
13581	8-7
13586	8-1
13587	8-2
13589	8-8
1367	14-9
13691	1-7
1375	14-11
13982	8-31D
14175	11-60
145	4-15
15203	4-11
15582	7-8
	14-3
15617	1A-10
15634	3-6
15690	9-18
1587	3-7
16184	3-5
16191	3-21
16198	3-1D
16207	3-1F
16217	6-12
16243	4-5
	10-18
16244	4-6
	10-19
16698	7-6
17038	17-
17078	17-
17079	17-
17093	17-
17182	14-15
17183	14-16
17312	10-39
17313	2-4
17315	11-51
17317	10-42
17320	1-9
17321	1-6
17327	2-6
17345	1-8
17351	11-64
17362	10-44
17373	11-66
17388	2-7
17620	11-22
17896	14-12
	14-14
19031	8-33
19080	17-
19082	17-
19293	17-
19294	17-
19306	17-
19307	17-
19505	17-
19560	17-
19561	17-
20431	17-
20623	11-21
20717	3-23
20726	7-16
20727	7-21
20728	7-25
20731	7-20
20808	11-15
21280	12-52B
21490	9-15
21491	9-13
21736	12-38
21765	10-32
21779	10-9
21780	10-7
	10-11
21781	10-14
21782	10-2
21793	10-1
21821	10-15
21898	1-12
21982	2-8
22031	11-58
22457	3-12
22464	8-37
	11-69
22601	15-2
22603	1A-4
22609	1A-15
22610	1A-
22615	1A-7
22621	1A-5
22623	1A-3
22631	12-1
22637	11-9
22638	11-8
22639	11-7
22640	11-10
22642	11-46
22643	11-42
22644	11-49
22646	11-41
22650	11-45
22652	11-34
22661	11-40A
22685	11-6
22716	7-17
	7-22
22717	7-3
22740	10-38
23101	9-3
23106	2-5
23108	7-25
23109	9-17
23110	11-32
23111	6-14
23112	3-2
23116	6-13
	9-19
23255	10-33
23256	10-35
23257	10-36
23258	10-34
23261	11-33
23288	12-18
23414	12-17
	12-19
	12-55
23565	9-1A
24147	8-22
24599	8-38
24840	17-
24947	13-2
24954	11-26
25108	10-28
25190	6-6
25243	9-10
25356	13-5
25580	15-8
25606	11-47
25713	11-24
25716	11-17
25717	11-35
25718	11-12
25742	11-21
25821	17-
25823	17-
25824	17-
25828	17-
25829	17-
25966	8-25
25984	7-15
25985	1A-16
26085	8-15A
26238	7-18
26245	8-23
26379	11-62
26465	1-
26503	12-28
26631	3-1H
26637	12-32
26906	8-33A
26981	10-5
27239	7-3
	8-16
	11-36
27296	1-4
27434	8-39
27469	3-1E
27483	11-4
27484	11-3
27485	11-2
27486	11-30
27487	10-41
27531	5-13
27651	15-13

PART NUMBER	FIG. & INDEX NO.
27706	7-24
27777	17-
27779	17-
27781	17-
27783	17-
27786	17-
27787	17-
27789	17-
27790	17-
27791	17-
27901	12-9
27902	12-10
27907	12-5
27908	12-3
27914	11-57
27915	11-56
27916	12-
27925	12-29
27938	14-17
27944	11-45
27947	1-13
27948	12-22
27950	12-21
28021	11-67
28048	12-12
28059	15-7
28088	12-52A
28200	15-5
28600	8-32B
29002	9-9
29194	11-63
29248	11-38
29250	12-58
29251	12-59
29252	11-47
29253	11-46
29282	8-34
29285	11-39
29287	11-48
29290	8-18
29296	11-54
29309	11-37
29312	8-17
29313	8-19
29417	11-14
29541	17-
29560	11-53
29561	8-32A
29570	5-27
29589	4-27A
	10-23A
29590	4-27
	10-23
29602	17-
29603	17-
29605	17-
29606	17-
29610	17-
29611	17-
29612	17-
29613	17-
29618	17-
29620	17-
29621	17-

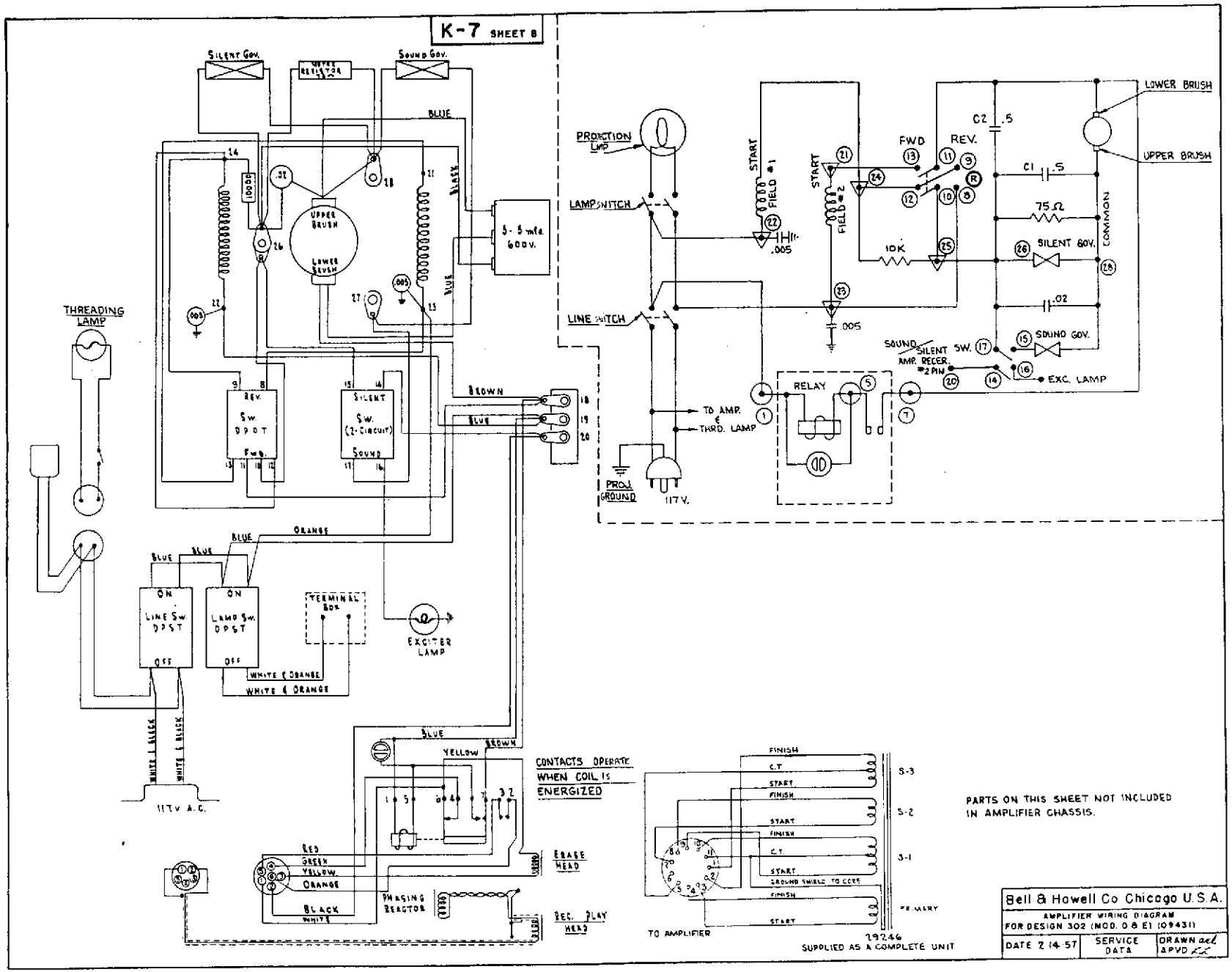
PART NUMBER	FIG. & INDEX NO.
29623	17-
29624	17-
29625	17-
29626	17-
29627	17-
29628	17-
29630	17-
29631	17-
29632	17-
29633	17-
29634	17-
29635	17-
29636	17-
29637	17-
29638	17-
29639	17-
29641	17-
29643	17-
29644	17-
29645	17-
29647	17-
29648	17-
29649	17-
29650	17-
29651	17-
29653	17-
29655	17-
29656	17-
29657	17-
29683	17-
29684	15-19
29685	15-20
29686	15-16
29687	15-17
29980	17-
29981	17-
30034	4-20
30044	17-
30049	17-
30107	13-8
30108	13-6
30110	13-14A
30120	8-26
30122	13-4
30134	6-2
30157	11-13
	11-20
30158	11-16
30159	11-23
30160	11-18
30162	2-9
	11-1
30163	4-16
	4-21
	4-31A
	10-6
	10-10
	11-5
30164	4-1
	4-9
	10-26
30165	3-10
30167	2-11
30169	10-4

PART NUMBER	FIG. & INDEX NO.
30170	11-50
30171	10-31
30173	2-9
	2-16
	9-2
	9-6
	10-29
	13-3
30175	2-18
30176	7-6
30177	2-15
30178	12-6
30194	11-29
30230	11-11
30251	17-
30254	17-
30390	4-3
	10-16
30572	2-21A
30772	13-7
30785	8-32C
30795	7-23
31550	6-15
32065	14-1
32088	15-1
32185	2-7B
32186	2-7A
32196	3-14
32197	3-11
32278	12-60
32511	14-17
32595	5-35
32601	6-16
32602	6-19
32603	6-20
32606	6-17
32609	3-23
32953	4-31B
33709	17-
35208	8-36
35214	8-34
35215	13-4
35217	2-5
35222	11-54
35223	11-53
3954	10-30
	11-59
400031	12-
400032	12-
4080	1A-6
4255	4-23
4258	2-13
	11-28
430037	12-44
430062	12-37
430076	12-56
430097	12-42
430105	12-11
430114	12-4
430138	12-14
430142	12-39
430144	12-40
430145	12-35
430189	12-43

PART NUMBER	FIG. & INDEX NO.
430192	12-45
430193	12-41
430234	12-31
430243	12-34
430253	12-53
430254	12-54
430257	12-50
430264	12-47
430325	12-51
430354	11-47A
430356	12-12
430357	12-48
430365	12-23
430366	12-23B
430413	15-7
430451	12-16
430462	12-58
430465	14-13D
430466	14-13C
430477	8-20
430482	12-59
430485	12-
430493	12-60
430495	11-67
430506	15-8
430613	7-19
430639	8-19
430673	12-56
430675	1-
430676	8-32B
430680	8-34
430690	12-55
430729	12-60
430731	11-47
430732	11-67
430747	8-11
430748	1-4
430749	11-47A
430886	15-1
430891	15-5
430893	15-2
430895	15-13
430898	15-22
430899	15-3
430900	15-16
430901	15-19
430902	15-20
430903	15-17
430937	5-35
4460	5-30
45722	7-1
4664	8-11
M50014	8-31B
M50834	8-31C
M50888	8-30
M51142	8-8
M56243	6-14
M56274	8-17
M56773	5-35
M56817	4-20
5014	6-10
5110	5-3
5111	5-2
5112	5-1

PART NUMBER	FIG. & INDEX NO.
5113	5-9
5123	5-7
5148	4-13
5160	3-9
5162	8-25A
5193	8-5
5200	8-29
5201	8-28
5206	9-10
5238	7-11
	13-13
	14-4
5247	6-3
5266	11-27
5296	5-28
5306	9-14
5343	8-6
5469	5-6
5495	7-14
	14-8
5514	7-10
	14-5
5557	5-33
5618	4-14
5626	6-7
5629	14-10
5636	3-21
5639	3-20
5692	8-25C
570	2-10
5893	6-4
	13-19
600986	11-25
607103	13-12B
	14-13B
607106	13-12A
	14-13A
6093	5-32
6129	7-2
620760	11-61A
6715	3-17
6716	6-6
	9-9
6926	9-16
6953	15-14
7495	8-12
7591	8-31A
7856	11-43
80144	8-35
8066	6-11
80665	3-12
8179	1-2
	12-7
82727	8-33
866	5-34
873	2-9
890	3-16
891	3-15
8918	5-10A
9117	8-14
9121	11-55
9207	8-3
9208	8-4
9260	5-12

PART NUMBER	FIG. & INDEX NO.
9260 (Cont)	5-14
	5-21
	5-23
9426	5-15
	5-24
9428	8-10
9558	5-4
9567	11-44
965	3-11
966	3-14
9718	8-20
97510	7-23
98798	7-19



B+H 09431 DIAGRAM FOR DESIGN 302 OPTICAL/MAGNETIC SOUND
MODEL D AND E 2-14-57