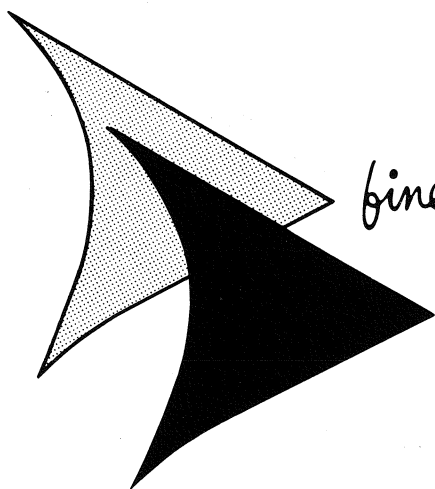


## **SERVICE INSTRUCTIONS**

# **FILMOSOUND PROJECTORS DESIGNS 202 and 302**



*finer products through imagination*

**Bell & Howell**

**GENERAL SERVICE DEPT.  
7125 N. KIMBALL AVE.  
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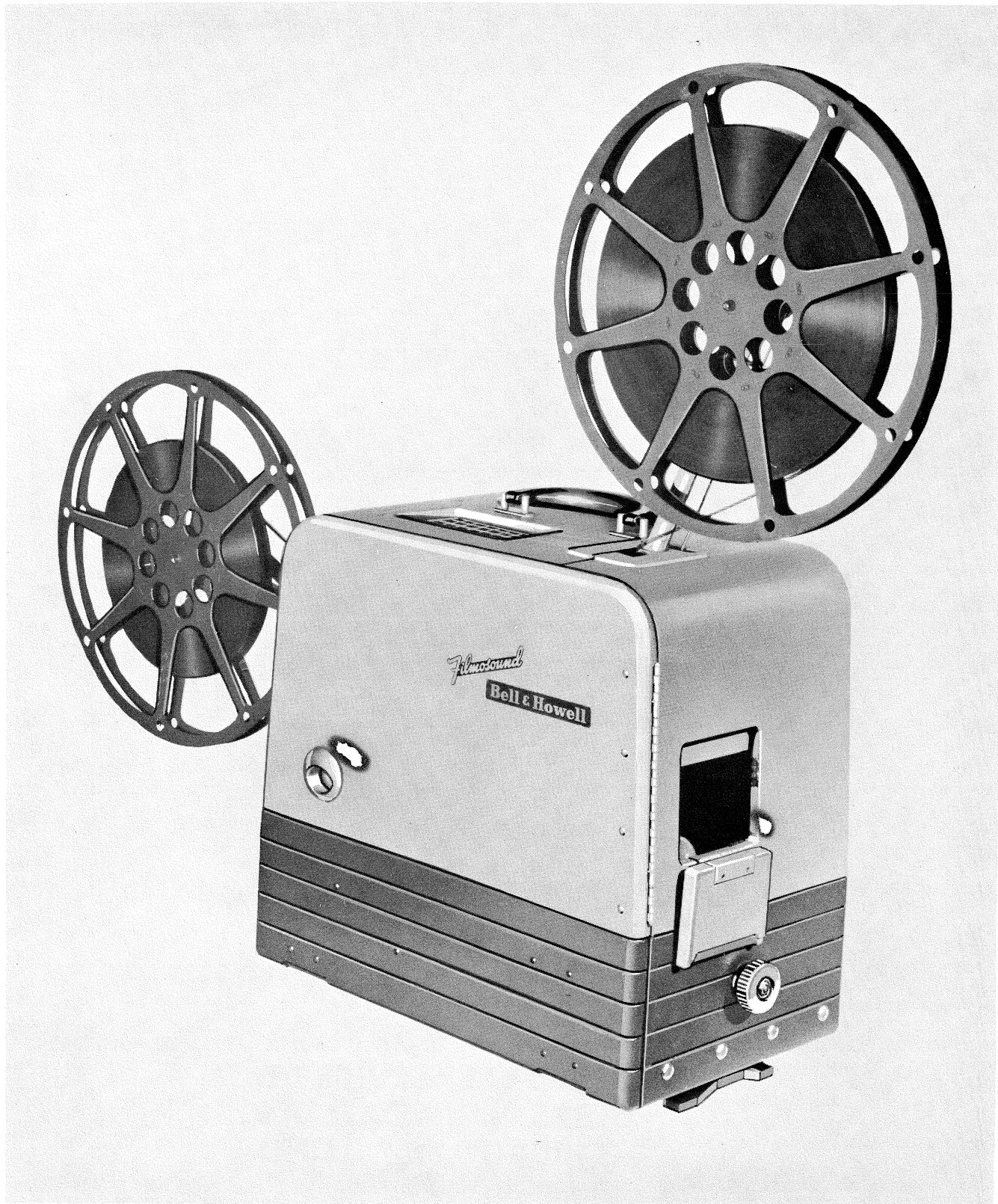


Figure A. Optical—Magnetic Filmosound Projector

# Introduction

## GENERAL.

This manual contains service instructions for 16mm magnetic and optical Filmosound Projectors having design numbers 202 B and C, 302 B and C, 302 D and E and 302 D and E (equipped with factory sealed lubrication systems).

Due to the similarity of these designs, much of the material contained herein applies to all four designs. Certain material will apply to a special feature or technique applicable to only one, two or three designs.

In order to provide a quick identification of material applicable to a specific design, the following design code has been assigned:

Design No.	Design Code
202 B and C	W
302 B and C	X
302 D and E (Not equipped with Factory Sealed Lubrication through serial number N95101)	Y
302 D and E (Equipped with Factory Sealed Lubrication on serial numbers N95102 and up)	Z

Paragraph headings or titles of Illustrations not suffixed with a design code, contain information applicable to all four designs. Headings or titles suffixed with a letter or letters in parenthesis (i.e. Input transformer (Code W, X) ) indicate that this material applies only to the specific design to which the code letters apply, in this example, designs 202 B and C and 302 B and C.

Where only minor variations occur, they are referred to either by a note in the manuscript or an insert in the illustration.

An illustrated parts catalog section is included, at the back of the manual, to identify replacement parts. The exploded views illustrate the form and location of the parts of a typical unit. Refer to the "Design Code" and "Part Number" columns for the part number of the part used in a specific projector design.

## LUBRICATION.

Wherever a lubricant is called for, it is essential that the specified lubricant be used except

in the case of the Code W, X and Y equipment where the substitution of high grade ball-bearing grease may be permitted, if Bell & Howell grease is not available.

## NOTE

The Manufacturer will not accept any responsibility for the performance of Code Z (Factory Sealed Lubrication) equipment if lubricants, other than those specified, are used. The design of this system is based upon the use of lubricants of known physical and chemical properties. These lubricants have been thoroughly tested to insure that reactions between additives do not produce injurious by-products or changes in structure which would cause either lubricant failure or excessive wear.

## BRIEF DESCRIPTION OF PROJECTOR.

In addition to reproducing sound on conventional optical film, the 202 and 302 Filmosound projectors are capable of recording sound on magnetic soundstripe film. The magnetic sound components are incorporated in the sound head and consist of a magnetic record-playback head and an erase head (which are located behind the sound drum), a rubber film tension roller, and a recording interlock system (refer to paragraph 42). The magnetic head and interlock system are suitably connected to the amplifier and projector electrical systems.

Magnetic film may be recorded or played back at either the 16 or 24 frame speed. There will be a slight loss of fidelity at the slower speed. Normal sound (optical) film must be projected at the 24 frame speed.

The amplifier is an integral part of the projector, yet is easily removable from the bottom of the case for tube replacement or service. It performs the following functions: (1) optical playback amplifier, (2) magnetic recording amplifier, (3) magnetic playback amplifier, and (4) speech and music amplifier for commentary with silent films. The different functions are accomplished by manipulating the function switch on the front panel.

In addition to the function switch, the following controls are located on the front panel:

(1) A "RECORDING LEVEL" light which gives a visual indication of the magnetic recording level. The neon-type lamp should flash brightly on the peaks, or high-intensity sounds, during recording.

(2) The "VOLUME" control - a combination on-off switch and master volume control, which is used to turn on the amplifier and to control amplifier volume in all its functions.

(3) The "TONE" control (behind the "VOLUME" control knob), which is inoperative when recording magnetically.

(4) The microphone volume ("MIC VOL") control.

(5) A "PHONOGRAPH" and a "MICROPHONE" jack for phonograph and microphone inputs. Phonograph input volume must be controlled with the volume control on the phonograph.

The amplifier rear panel has two output connections: a 16-ohm single speaker connection and an 8-ohm dual speaker connection. The 8-ohm connector also may be used to monitor the record amplifier output through headphones and/or a volume level meter. The monitoring feature is optional and requires a simple patch cord assembly. The sound-stripe switch on the rear panel changes an equalization network in the amplifier input so that recording at "HALF TRACK" is approximately 3 db higher than at "FULL" track.

The phono and microphone sensitivity is sufficient for all high output crystal pick-ups and microphones of the high impedance type.

The signal-to-noise ratio in either optical or magnetic play is in keeping with the standards of the photographic industry for a unit of this type.

Reserve gain in optical position at 1000 cycles is in excess of 18 db; reserve gain in magnetic play is adequate. A variation in magnetic film striping will change the reserve gain. In all cases with proper recording level, full power output is obtained at 1000 cycles when playing back and advancing VOLUME control to maximum. Frequency response from 50 to 7000 cycles with TONE control provides full range of tone color.

## RECOMMENDED SERVICE STATION TEST EQUIPMENT.

The following equipment is recommended for properly servicing the 202 and 302 Filmosound projectors. This equipment is available commercially in both standard assembled units and also in kit form.

(1) Audio oscillator with frequency ranges 20-20,000 cycles per second at 0.5 volts minimum output.

(2) Vacuum-tube voltmeter.

(3) AC voltmeter.

(4) 5 inch oscilloscope.

(5) Special test probe (refer to paragraph 31 for details).

(6) 16-ohm dummy load (suggest the use of 25-ohm, 25-watt resistor tapped at 8 and 16 ohms).

(7) Head demagnetizer (Ampex).

(8) Input transformer demagnetizer (consists of a motor field, B & H Part No. 12844, connected directly across the line with a toggle switch).

(9) Extension cable, which consists of one male plug (Part No. 22568), one female plug (Part No. 22561), and a 4-foot length of 3-conductor cable.

(10) Power transformer extension cable, which consists of one plug (Part No. 22517), one receptacle (Part No. 22601) and a 4-foot length of 10-conductor cable.

(11) Set of standard tools such as screw drivers, soldering iron or gun, wrenches etc.

## SPECIAL SERVICE TOOLS.

Special service tools supplied by Bell & Howell for use in servicing Filmosound Projectors are illustrated in figure B. Refer to the accompanying chart for tool numbers application. The tool number is stamped in each Bell & Howell designed tool.

INDEX NO.	TOOL NO.	FUNCTION
1	ST-244-F1	Remove bearing in the fan housing (not necessary to service the Design 202)
2	S-10309-F1	Adjust lens carrier assembly
3	S-4529-N4	GO-NO GO gage to check the height of shuttle teeth
4	S-4007-F14	Quills used to assemble the counter gear shaft and the shuttle shaft to gear case
5	S-4007-F5	Brass sleeve used in the reassembly of counter gear shaft and shuttle shaft to the gear case
6	Stock 1459	Clip to hold quills on shaft
7	S-4007-F11	Fixture used to assemble steel balls and felt to the shuttle shaft and counter gear shaft
8	S-15177-N4	Shim for adjusting gears
9	S-4007-F6	Sleeve used to assemble steel balls around shuttle shaft and counter gear shaft
10	S-15638-N6	Adjust clearance between film guides and sprockets
11	G-165-F3	Used for socket set screws
12	G-167-F3	No. 6 Bristo wrench for socket set screws
13	S-14986-X1	Bristo wrench for socket set screws



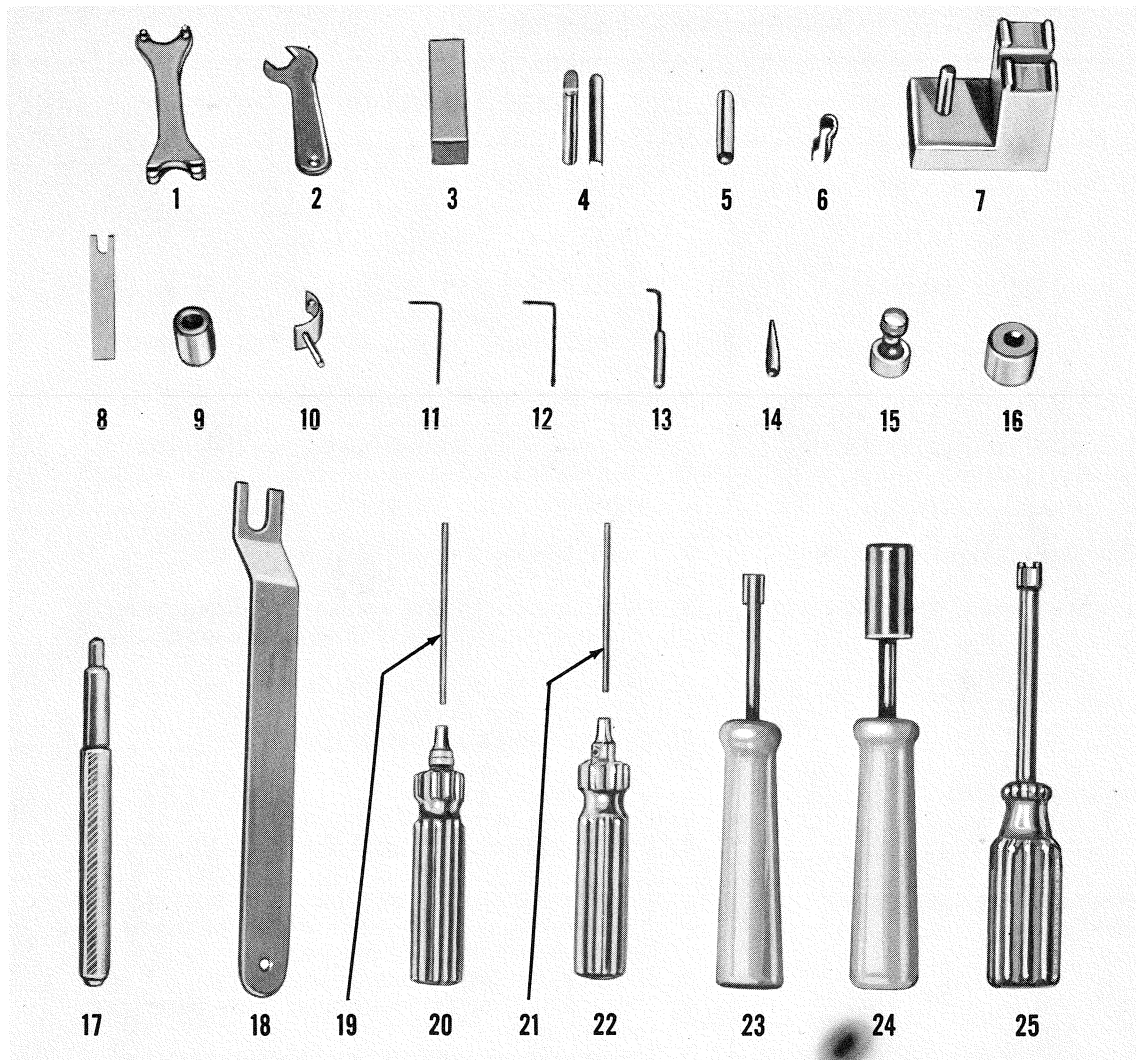


Figure B. Special Service Tools

INDEX NO.	TOOL NO.	FUNCTION
14	S-15177-F3	Cone for assembling sprockets to shafts
15	S-15177-N2	Adjust sprockets
16	S-15177-N1	Adjust sprocket shafts
17	S-14878-F1	Drift punch to remove bearings in gear case
18	S-10310-F2	Hold shuttle shaft when removing and assembling shutter
19	G-167-X2	No. 10 Bristo wrench for socket set screws
20	G-167-F1	Handle for No. 10 Bristo wrench
21	G-165-X2	No. 8 Bristo wrench for socket set screws
22	G-165-F1	Handle for No. 8 Bristo wrench
23	S-19028-F4	Clutch disassembly wrench
24	S-19028-F3	Clutch disassembly wrench
25	S-12264-F3	Spanner wrench for governor cap

## TROUBLE SHOOTING CHART

TROUBLE	DEFECT AND/OR REMEDY
A. Magnetic sound but no optical sound	<ol style="list-style-type: none"> <li>1. Replace exciter lamp.</li> <li>2. See that lamp is lighted. Check exciter lamp socket and wiring.</li> </ol>
B. Optical sound but no magnetic sound	<ol style="list-style-type: none"> <li>1. Replace type 5879 tube or transistor in pre-amplifier.</li> <li>2. Signal trace amplifier (par 31 and 32).</li> <li>3. Check wiring of sound head bearing and shaft assembly.</li> <li>4. Check function switch (par 35).</li> </ol>
C. Recording level lamp glows but no recording on film	<ol style="list-style-type: none"> <li>1. Interlock relay not making contact (par 42).</li> <li>2. Film not tracking over magnetic heads. Adjust stabilizer rollers (par 68).</li> </ol>
D. Recording level lamp fails to glow	<ol style="list-style-type: none"> <li>1. Check lamp and wiring (par 34).</li> </ol>
E. Projector records but does not erase	<ol style="list-style-type: none"> <li>1. Oscillator circuit not working. Switch to optical sound; if exciter lamp lights, check continuity of erase coil.</li> <li>2. Check wiring of leads from bearing and shaft assembly (sound drum).</li> <li>3. Erase head not contacting film.</li> </ol>
F. No sound from amplifier	<ol style="list-style-type: none"> <li>1. Check tubes.</li> <li>2. Check fuse on rear of amplifier.</li> <li>3. Check voltages and signal trace (par 31 and 32).</li> </ol>
G. Excessive crackling and popping or frying noises	<ol style="list-style-type: none"> <li>1. If either microphone or phonograph is used, remove plugs. If the noise stops, the input leads are not shielded properly.</li> <li>2. Replace type 5879 tubes or transistor.</li> <li>3. Check amplifier for shorting or loose wires and connections.</li> <li>4. Check governor and all brushes for excessive arcing.</li> </ol>
H. Microphonic or ringing noises	<ol style="list-style-type: none"> <li>1. Replace type 5879 and 12AX7 tubes, and check 5879 tube shield to be sure it clears sound shaft.</li> <li>2. Check photocell shield can.</li> <li>3. Demagnetize heads.</li> <li>4. Check type 5879 tube in pre-amplifier (W and X). to be sure socket is floating.</li> <li>5. Check components on photocell socket.</li> <li>6. Check input transformer to be sure it is floating on rubber mounts (W and X).</li> <li>7. Demagnetize input transformer (W and X).</li> </ol>
I. Magnetic sound output low or distorted	<ol style="list-style-type: none"> <li>1. Compare optical sound output which should be same quality. If optical sound is good, clean magnetic heads (par 21). If optical sound is also poor, signal trace amplifier (par 31 and 32).</li> </ol>
J. High background noise level	<ol style="list-style-type: none"> <li>1. Record at higher level.</li> <li>2. Move microphone farther away from projector.</li> <li>3. Loose amplifier retaining screws. Tighten.</li> <li>4. Excessive pick-up (par 77).</li> </ol>

# Disassembly Procedure

## NOTE

Disassembly procedures are keyed and cross-referenced to the exploded views, figure 1 through 14, which are 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 followed at the same time. Follow the procedures as outlined, eliminating unnecessary steps wherever possible.

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

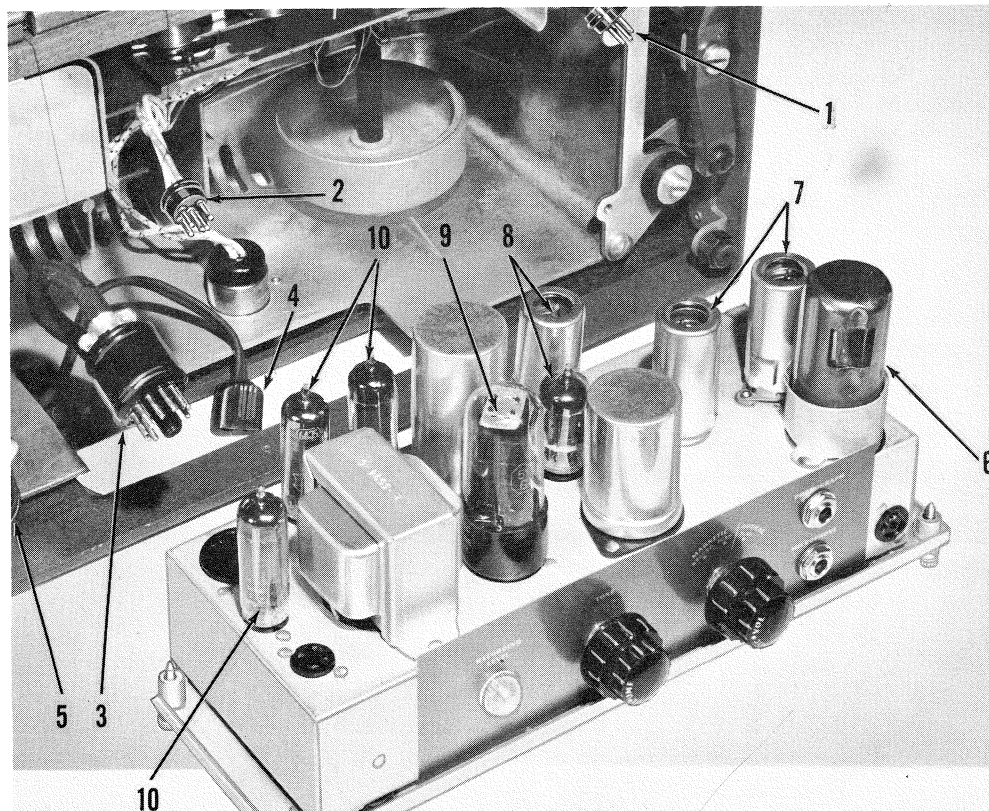
a. Unscrew four knurled head screws (6) and carefully withdraw the amplifier (7) from the bottom of the projector. At the same time disconnect wiring as follows (see figure C): (1) Disconnect the record playback plug from the front amplifier connector, (2) disconnect the power plug from the two prong rear amplifier connector and (3) disconnect the power transformer plug and exciter lamp plug from the top of the amplifier.

b. Remove the screws (28 and 29, figure 11) and take off the terminal cover (30, figure 11). Disconnect

the two pilot lamp leads from the terminals marked "1" and "3" on the terminal strip. Replace terminal cover and attaching screws unless repair of wiring is necessary.

c. Remove the fillister head screw (1, figure 1), washers (2), rubber cushions (3) and spacers (4), withdraw the projector (5) from the bottom of the case (8).

d. The take-up arm (9) and front reel arm (11) are normally stored in the case. The take-up spring belt (10) and front reel arm spring belt (12) can be removed by disconnecting the ends and pulling them free of the case.



1. Record-playback plug
2. Exciter lamp plug
3. Power transformer plug
4. Power input plug
5. Pilot lamp leads
6. Photocell
7. 5879 electron tubes
8. 12AX7 electron tubes
9. 5Y3GT electron tubes
10. 6AQ5 electron tubes

Figure C. Removing Amplifier

**2. PROJECTOR. (See figure 2.)**

a. Pull the relay condenser (1) and 45-50 mm condenser (2) from the projector. Remove the projection lens (3).

b. Unscrew the knurled head 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. Remove the gear case (14), blower housing (17), governor cap (19), and lamphouse, governor and motor (20) as a complete unit by removing two binding head Sems screws (7) and two fillister head screws (8).

d. Detach the gear case assembly (14) from the blower housing by removing the fillister head screws (9), clutch lever spring (10), fillister head screws (11), guide rail (12) and washers (13). Separate the gear case (14) from the blower housing, being careful not to damage the teeth of the fiber counter gear (22, figure 5), which may get caught on the thrust nut (1, figure 8) if caution is not exercised. Note that when the gear case is assembled to the blower housing, the counter gear (22, figure 5) engages the motor pinion (3, figure 8).

e. Unscrew four fillister head screws (15), two fillister head screws (16) and separate the blower housing assembly (17) from the motor housing.

f. Unscrew the two fillister head screws (18) and remove the governor cap assembly (19) from the lamphouse governor and motor (20).

**3. GEAR CASE - CLUTCH MECHANISM. (See figure 3.)**

a. Remove the pressure plate assembly (1 through 7) from the rear of the lens carrier and, if necessary, disassemble as follows: Press in on the spring cup (1) and remove the spring cup and compression spring (2). Unscrew the fillister head screws (3) and separate the

bushings (4), spacers (5), yoke (6) and pressure plate (7).

b. Remove the rubber knob (8). Unscrew the hex nut (9). Then partially unscrew the knob assembly (10), remove the retaining ring (11) and unscrew the knob assembly the rest of the way. The spacer (12) will drop out as the knob assembly is removed.

c. Before removing the screws (13) which attach the front cover (14), note that there is a small pin in the plate (19) which engages the hole in the gate operating block (15). These two parts must be disengaged while the front cover is being removed. Remove the gate operating block (15).

d. Unscrew the fillister head screw (16) and remove the gate operating lever (17). Loosen the set screw (18) and disassemble the plate and shaft assembly (19) and eccentric bushing (20). Unscrew the fillister head screws (25) and carefully remove the assembled idler gear shaft (21), idler gear (22), eighteen steel balls (23) and washer (24).

e. Loosen the pilot screw (26) and disengage the clutch lever stud (27) to remove the clutch lever linkage (28) and torsion spring (29). Remove the clutch plunger (30).

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

a. Unscrew a fillister head screw (1) to remove each film stripper (2).

b. Unscrew one special head screw (3) and remove a sprocket guard assembly (4) with its spring (5) and tension washer (6) from each sprocket shaft.

c. Use the Bristo wrench (21 and 22, figure B) to loosen the headless set screws (7). Slide the sprocket assemblies (8) off the shafts, being careful not to damage the felt washers which are located inside the sprockets.

d. Unscrew the fillister head screws (9) and re-

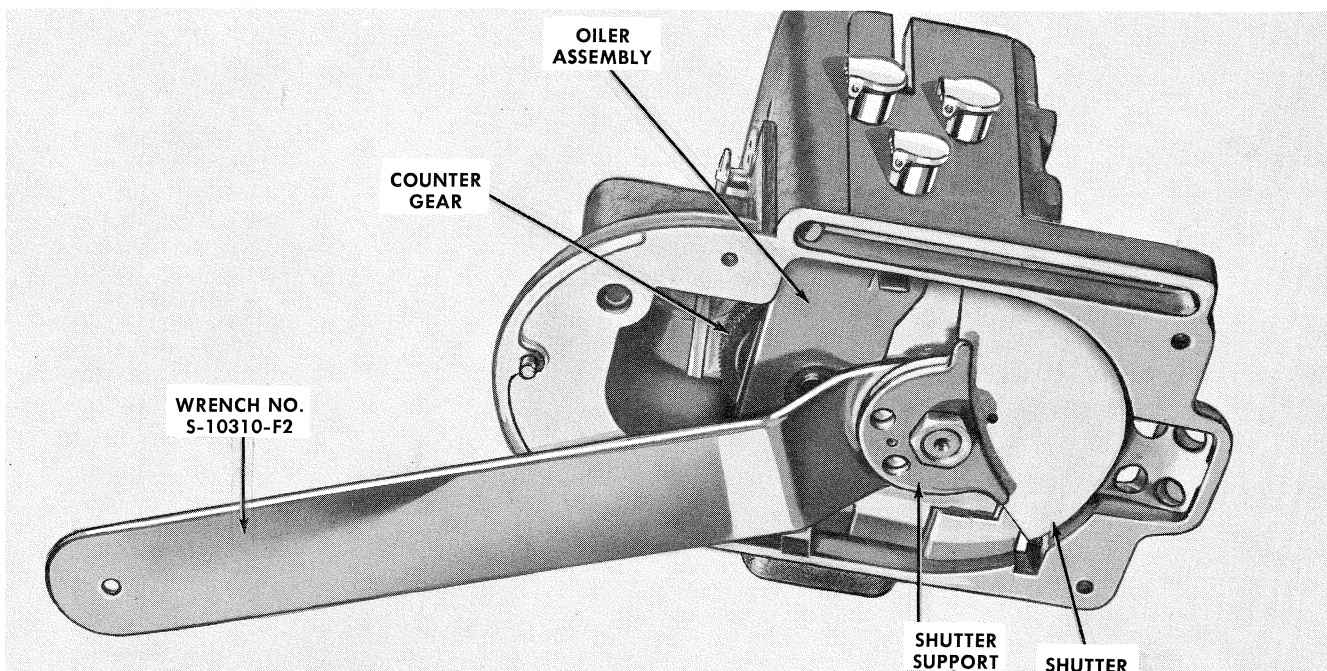


Figure D. Removing Shutter with Tool No. S-10310-F2.

move the film guides (10). Unscrew the pilot screws (11) to remove the lens carrier retainers (12). Slide the lens carrier assembly all the way out.

e. Unscrew the fillister head screw (13) to remove the ball retaining spring (14) and steel ball (15). Unscrew the fillister head screws (16) to remove the pressure plate adjustment nuts (17) and pressure plate carrier (18).

**CAUTION**

Never try to remove the lens lock screw (19) from the lens carrier (20).

f. Note that the film tension clips (22) fit into a slot in the aperture plate. Unscrew the fillister head screws (21) to remove the upper and lower film tension clips (22) and the film gate thrust spring (23). The aperture plate (24) is now free to be removed. Remove the framer shaft and knob assembly (25).

g. Use the Bristo wrench (19 and 20, figure B) to loosen the socket set screws (26). Turn the screws out far enough to clear the side of the flat in the end of the sprocket shafts (27). Remove the upper sprocket shaft (27). The washer (28), upper gear (29) and spring washer (31) will come out as the shaft is removed. Remove the lower shaft in the same manner and catch another washer (28), the sprocket worm wheel assembly (30) and another spring washer (31) as they become loose.

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

a. Insert the wrench (18, figure B) behind the shutter supports (2) as shown in figure D. The tool must engage the flat sides of the shuttle shaft (13). Then use a common open end wrench to remove the hex nut (1). Lift out the shutter supports (2) and the shutter (3). The oil baffle (4) and lubricator assembly (5) must be removed as a unit and should not be separated unless necessary. (Code Z.) Remove screws (7) to release lubricator assembly. Do not remove the lubricator felt (6) unless necessary. Unscrew the special fillister head screws (7) to remove the double tooth shuttle (8) and dowel pins (9). If a replacement shuttle (8) is being ordered, be sure to order the correct class fit (either 1, 2, 3 or 4). The class-fit number is etched into the shuttle in the location indicated by the letter "A" in figure 5.

b. Before removing parts indexed 10 through 24, note the location of the steel balls (12, 14, 21 and 23).

#### NOTE

Every time the gear case is disassembled, the 60 steel balls that are removed should be discarded and replaced by 60 new steel balls in reassembly. The steel balls used by Bell & Howell are carefully graded and balls of different grades should not be inter-mixed. When ordered in bottles of 1000 or more, the grade is indicated on the bottle. When ordered in lots of less than 1000, the balls are all of one grade and should not be mixed with any steel balls you already have on hand.

Loosen the two socket set screws (10). This can be done easily by inserting the Bristo wrench in through the hole located in the side of the gear case, directly under where the lens carrier assembles to the gear case. Remove the collar (11) and remove and discard the fifteen steel balls (12). From the rear of the gear case, remove the shuttle shaft (13). Remove and discard the fifteen steel balls (14). Remove the oil felt (15) from the shuttle shaft.

c. Loosen two set screws (16) and remove the worm drive extension (17). Loosen the set screws (18 and 19) and carefully remove the worm gear (20). Remove and discard the fifteen steel balls (21). Note that the set screw (18) has a flat point while set screw (19) has a cone point which must engage the shallow, pointed slot in the counter gear and shaft (22). From the back side of the gear case, remove the counter gear (22), fifteen steel balls (23) and the oil felt (24). Discard the steel balls (23).

d. Unscrew the flat head screw (25) to remove the spring clamp (26). Remove the oiler felt (27).

e. If it is necessary, the shaft bearings (28) can be removed by driving them out with the drift punch (17, figure B) from inside of the gear case. There may or may not be one or more bearing shims (29) behind the collar of each bearing. These are placed there at the factory and the same number of shims must be replaced behind the same bearing in reassembly.

f. Unscrew the fillister head screw (30) to remove the oiler assembly (31). The oilers (32, 33 and 34) (Codes W, X, Y) are a press fit in the gear case (35) and should not be removed unless it is absolutely necessary.

#### 6. BLOWER HOUSING. (See figure 6.)

a. Carefully remove the fire shutter assembly (1). Unscrew two self-tapping screws (2) to remove the fire shutter guide (3).

#### NOTE

Extreme care should be maintained in the handling of the fire shutter during both disassembly and reassembly.

b. Do not remove the set screw (4) which is sealed in position after adjustment of the fire shutter. Do not remove the stud (5) which is press-fitted into the blower housing (8). If the spring retainer (7) needs replacement, carefully drill out two rivets (6) to detach.

c. Disassemble the relay condenser assembly (9) by removing the retainer spring (10) and the condenser lens (11). Unscrew the round head screw (12) to remove the handle (13) from the holder (14).

#### 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 unscrew truss head 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 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 the shaft (20) out. Remove the retaining ring (21), ball bearing (22) and retaining ring (23).

d. The fillister head screw (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) into the armature shaft and push back on the thrust washer (2) enough to disengage it from the thrust nut (1). Unscrew the thrust nut and remove the tool and thrust washer. Remove the motor pinion (3), thirty-one roller bearings (4) and the pinion washer (5). Using tool No. S-19028-F3 (24, figure B) as shown in figure E, push against the spring retainer (7) to remove the dowel pin (6). A straightened-out paper clip will facilitate the removal of the dowel pin. Remove the spring retainer (7) and spring (8).

b. On the opposite end of the armature shaft, loosen the two set screws (9) and remove the governor (1), but be careful not to lose the three governor brushes (11) which may pop out as the governor is removed.

c. Unscrew the fillister head screws (12) and remove the bearing retaining cap (13).

### CAUTION

As the hex nut (14) and washer (15) are removed, **DO NOT** allow the armature (27) to slip forward because the armature windings may catch on the resistor clamp (31) and damage the armature windings.

Flatten out the ears on the locking washer (15); then hold the blower fan (24) with one hand while unscrewing the hex nut (14). Remove the locking washer and radial bearing (16).

d. Unscrew the brush caps (17) and remove the motor brush springs (18) and motor brushes (19).

e. Unscrew the fillister head screws (20) to remove the brush holder (21) and spacer (22).

f. Now tap out the spring pin (23) and remove the blower fan (24), spring (25) and ball bearing (26).

g. Remove the armature (27) from the opposite side of the motor housing. Unscrew the field retaining nuts (28) and carefully remove the stator assembly (29). Unscrew the fillister head screw (30) to remove the resistor clamp (31) and resistor (32).

h. (Code Y-Z) When removing stator assembly, be careful not to damage the three filter capacitors located adjacent to the stator. Release the three spring clips (31A) and lift out the governor resistor (32A).

## 9. LAMPHOUSE. (See figure 9.)

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

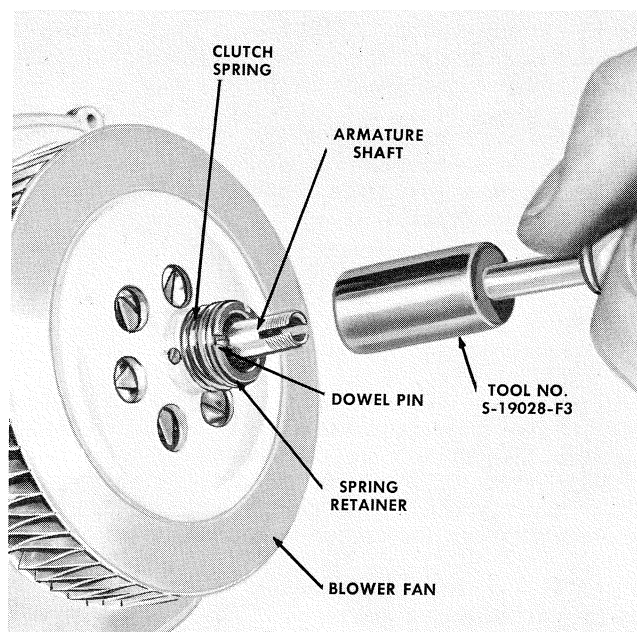


Figure E. Using Tool No. S-19028-F3

b. Unscrew the fillister head screws (2) to remove the lamphouse cap (3). Lift out 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.

d. Unscrew the fillister head screw (9) to 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). When doing this, be careful the spring (15) does not release suddenly and cause possible damage to the lens (14). Remove the condenser lens (14), spacer spring (15), a second condenser lens (16) and the condenser lens housing (17).

f. If possible, do not get the two condenser lenses mixed up. However, if they do get mixed up, they can be differentiated between when both lenses are placed side by side with the flat surfaces down on a white background. When looking straight down at the lenses, there will appear to be a circular reflection in each lens. However, the circle will be larger in one than in the other. The lens (14) which has the smaller part number will have the smaller reflection, while the lens (16) having the larger part number will have the larger reflection.

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

a. Before disassembling any part of the stabilizer, take careful note of how it is assembled. Loosen the set screw (1) and remove the cap (2) and washer (3). The washer may or may not be used, but be sure to replace the same amount of washers in reassembly if any are removed now. Remove the complete stabilizer assembly from the shaft now. Unhook the spring (5) from the pin and separate the



stabilizer into two units.

b. Loosen the fillister head screw (4) to remove the torsion spring (5). This is a very small screw, so be careful not to lose it. Unscrew the fillister head 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). Remove the stabilizer stud (14) and lock nut (15).

#### NOTES

When removing stabilizer roller parts, take great care not to disturb or damage the optical slit assembly.

If removal is necessary, note carefully the mounting position of the optical slit assembly so that the new unit can be installed in very close to the same position.

c. Do not disturb or remove the optical slit assembly (49) unless absolutely necessary. If necessary for replacement, loosen the set screw (47) and withdraw the optical slit assembly. Take care that the plug (48) which bears against the optical slit assembly does not fall out.

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

a. Unscrew the fillister head screw (16) and remove the film stripper (17). Unscrew the special fillister head screw (18) and remove the sprocket guard (19), spring (20) and tension washer (21) from the sprocket shaft. Loosen set screw (22) and slide sprocket assembly (23), spring washer (24) and spacer washer (25) off the shaft. Now loosen the set screw (26) enough to clear the flat in the sprocket shaft (27) and pull the shaft out. Once the shaft is removed, the washer (28) and sprocket driving gear (29) are free to be removed. Unscrew the fillister head screws (30) to remove the film guide (31).

b. Unscrew the fillister head screw (32) and remove the hex nut (33) and cable clamp (34). Unscrew two shorter fillister head screws (35) and dismount the snubber assembly as a unit. Remove the one fillister head screw (36) and separate the snubber shaft (37), spring (38), bearing (39), retaining plate (40) and bracket and roller assembly (41).

c. Unscrew one idler roller stud (42) to remove the idler roller (44) and spacer (43). Remove four Phillips head screws (45) and two sound head brackets (46).

d. In earlier projectors a different snubber assembly was used which is interchangeable with the latest snubber assembly discussed in step b. To disassemble the former, proceed as follows:

e. Unscrew the fillister head screw (50) and remove the snubber bearing (51) and torsion spring (52), noting how the torsion spring is assembled. Remove the bearing plate (53). Unscrew the snubber studs (54), which will allow the spring retainer (55), hex nut (56), idler rollers (57) and snubber lever (58) to be separated.

#### 12. SOUND DRUM, SHAFT AND MAGNETIC SOUND COMPONENTS. (See figure 11.)

#### NOTE

Magnetic sound components should not be removed unless parts need replacement. (See Servicing The Magnetic Heads, paragraph 70.)

a. Unscrew the fillister head screws (1) and remove the bearing cap (2), spring retainer (3) and spring (4).

b. Unscrew two fillister head screws (5) and remove the light shield cover (6). Unscrew one fillister head screw (7) and detach the eccentric bearing (8), detent lever (9), spacer (10) and spring (11).

c. Unscrew the lever screw (12) from the roller arm (16) and remove the rubber roller (13). Slip off the retaining ring (14) and remove the spring (15) and roller arm (16). Do not disturb or remove the fillister head screws (17) or clamp strap (18), which secure the adjustment of pivot stud (19), unless absolutely necessary.

#### CAUTION

Use the greatest care in removing magnetic sound components and related wiring.

d. Disconnect wiring from the terminal strip (41) to the bearing and shaft assembly (22). Remove the retaining ring (20). Withdraw the bearing and shaft assembly (22) partially while supporting the flywheel (24). Slip off the retaining ring (23) and remove the flywheel and spring (21). Withdraw the bearing and shaft assembly from the sound head.

e. Unscrew the round head screws (25) to remove the lever (26) if replacement is required. Remove the radial bearing (27) from the sound head (68).

#### 13. INTERLOCK RELAY AND HARNESS. (See figure 11.)

a. Unscrew the fillister head screw (28) and oval head screw (29) and remove the terminal cover (30) and speed nut (31). Disconnect the two black-with-white-tracer leads from terminals Nos. 3 and 6 on the terminal strip (51).

b. Unscrew the fillister head screws (32 and 33) to free the cable clamp (34) and terminal strip (41). Unscrew the bushing (35) which will free the relay and related parts (36 thru 45). Disconnect the leads to the exciter lamp socket (49) and pilot lamp (47). The socket may be removed by unscrewing the fillister head screws (48) if desired to keep wiring intact.

c. Remove the round head screw (36), lockwasher (37) and shield (38). Pull out the return spring (40) and remove the button (39). Unscrew the round head screw (42) and remove the bracket (43). Refer to paragraph 42 and figure H for repair.

d. Remove the push-on fastener (46) and withdraw the pilot lamp (47).

**14. SWITCHES, TERMINAL STRIP AND RELATED ITEMS.** (See figure 11.)

a. Disconnect wiring and the resistor (53) from the terminal strip (51). Unscrew the Phillips head screw (50) to remove the terminal strip (51) and insulation (52). Unscrew the Phillips head screws (54) to remove the capacitor (55).

b. Unscrew the hex nuts (56) and remove the switches (57) and name plate (58). Unscrew the hex nuts (59) and remove the switches (60 and 61), name plates (62 and 63) and discs (64). Remove the strain relief bushing (66) and line cord assembly (65).

c. If the line receptacle (67) required replacement, drill out the rivets which attach it and remove the receptacle.

**15. AMPLIFIER.** (See figure C.)

a. Normally the replacement of tubes and the 1-1/2 ampere fuse is the only disassembly necessary. For the information on repair of the amplifier, refer to paragraphs 27 through 40.

b. To remove tubes, simply pull them from the sockets taking care not to damage tube pins, particularly on miniature tubes. The type 5879 tubes and one 12AX7 tube are enclosed by conventional miniature tube shields.

c. The knobs on the front panel are push-on type and easily pulled off. The microphone and phono jacks are each secured with check nuts.

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.

**16. PROJECTOR CASE.** (See figure 12.)

a. Tilt knob mechanism (1 through 9) can be removed as a unit by turning on the hex shaft of the friction cup (8) in a clockwise direction. The tilt foot unit (10 through 13) will become free as the tilt knob mechanism becomes disengaged from it. The tilting knob (2) must be held by hand while using the wrench on the hex shaft, which has a left-hand thread.

b. Unscrew the hex nut (1) and remove the tilting knob (2) and bronze washer (3). Note how the spring (4) is assembled in the friction band (5) before removing them. Unscrew the pilot screw (6) and remove the tilting pinion (7). Then detach the friction cup (8) which has a left-hand thread and pinion washer (9).

c. Unscrew the fillister head screw (10) to remove the lock washer (11), tilting foot bar (12) and tilt rack (13). If necessary, remove the foot assemblies (14) and lock washers (15).

d. Unscrew the flat head screws (16) to remove the door pull plate (17) and door pull (18). Unscrew the round head wood screws (19) to detach the door catch (20).

e. Remove the hex nuts (21), internal teeth lock washers (22) and spacer washer (23) and washer plate (24). Grasp the handle and remove all of the handle parts as a unit. Then disassemble the handle posts (25 and 26), handle pins (27) and torsion spring (28). Note how the spring fits into the handle and also how it keeps the handle (29) down against the projector case and away from the grill. Remove the rear adapter plate (30).

f. Unscrew the Phillips head screw (31) and remove four reel arm plates (32), front reel arm holder assembly (33 through 36) and rear reel arm holder assembly (37 through 40). Remove the set screws (33 and 37), slide out the pins (34 and 38) and remove the rollers (35 and 39) from the reel arm holder plates (36 and 40).

g. Unscrew the threading lamp (41) from the receptacle assembly (43). Unscrew the wood screw (42) to free the receptacle assembly. The leads to the receptacle assembly are placed under the padding inside the case and must be disconnected to effect removal of receptacle.

h. Pull out the flat head nails (45) to remove the catch strike (44).

i. The speaker and door assembly (46 through 49) is hinged to the projector case. To remove, open the door and lift off the lower hinges.

j. Remove the dot fastener (50) from the top of the case (57). Unscrew two check nuts (51), remove one lock washer (52) and lower the transformer assembly (53) from the case.

k. Remove the aperture brush (54), oil can (55) and spring belt (56) whenever their use is required.

**17. SPEAKER.** (See figure 12.)

If the cable and connector (48) required replacement, unscrew the self-tapping screw (46) and remove the cable clamp (47). Carefully disconnect the cable from the speaker voice coil.

**18. 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 9). On code Z units, take out the screw (7-J), twist the cover (7-K) slightly to disengage return spring (7-H) from lock pin (7-L) and lift off the cover and spring. Unscrew the screw (7-D) or (3) and remove the rewind gear (4). Then unscrew both the hex nut (5) and the bearing retaining ring (6). Remove the nineteen steel balls (8), take-up pulley assembly (7) the nineteen more steel balls (8) from the take-up arm assembly (9). Be careful not to lose any of the steel balls.

b. Unscrew the rewind drive gear (10) from the shaft of the take-up drive pulley assembly (11) by turning clockwise to loosen the left-hand thread. If necessary, wrap tape around the rewind drive gear (10) and drive pulley (11) so that they may be firmly grasped to unscrew one from the other. Remember that they have a left-hand thread. Be careful not to let the drive pulley fall out. Now remove the take-up drive pulley slowly, cupping hand around it to catch the plunger (12) and compression spring (13) which will pop out as the pulley is removed.

c. Carefully remove the spring (17). Unscrew the shoulder screw (15) to remove the rewind lock lever (16). The knurled head screw (14) acts as a plug for the grease packing hole and is easily removed.

d. The bearing retainer ring (18) is press fitted in place and will have to be pried out if it ever becomes necessary to remove any of the sixteen roller bearings (19) from the rear reel arm (20).

e. (Code Z) To disassemble the take-up spindle pulley assembly (7-C), support the reel end of the spindle in a "Vee" block and use a straight punch to drive out the roll pin (7-G). Separate the reel clip (7-F) from the spindle.

**19. 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. The steel ball (13a) and spring (13b) need not be removed from spindle.

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

## *Cleaning and Lubrication*

**20. OPTICAL PARTS.**

Clean the projection lens, both condensers and the reflector. The front and rear elements of the projection lens should be cleaned. Do not attempt to take the lens apart for any further cleaning. The cleaning should be done with either the Bell & Howell Lens Cleaning Kit or Filmo lens cleaning tissue. If only a slight amount of dust has accumulated on the lenses, use lens cleaning tissue to remove the dust. If, however, any fingerprints, oil, grease or other accumulation of dirt is present, Bell & Howell Optikleene lens cleaning fluid should be wiped on the lens surfaces. Then clean thoroughly with lens cleaning tissue. Clean condenser lens and reflector in the same manner.

**21. SOUND HEAD AND OPTICAL SLIT.**

a. Clean the front and rear lens elements of the optical slit assembly (49, figure 10) with lens tissue wrapped around a toothpick. Apply Optikleene lens cleaning fluid sparingly if necessary. Do not attempt to disassemble the optical slit assembly. Clean the mirror on the bearing and shaft assembly (22, figure 11) in the same way using extreme care not to disturb the mirror mounting.

b. Both the record and erase heads should be cleaned thoroughly. This can be accomplished readily by using a matchstick wrapped in a lint-free piece of cloth, preferably linen (an entirely suitable cloth is included in the Lens Cleaning Kit).

## CAUTION

Only alcohol should be used as a cleaning agent.

Do not flood the heads with alcohol; moisten only enough to remove foreign materials.

**22. FILM HANDLING PARTS.**

Film handling parts include aperture plate, gate shoe, stabilizer rollers, sprockets and other surfaces over which the film must pass. All of these parts should be cleaned with a soft cloth. If any dirt has accumulated and hardened, moisten the soft cloth with carbon tetrachloride and rub the dirt off. Follow this with a polishing with a soft, dry cloth. Be very careful not to scratch the polished surface. If any emulsion has collected, remove it with a toothpick or an orange stick

cut to a knife edge. Dirt that may have accumulated between the teeth of the sprocket wheels should be cleaned out with a small, soft brush or soft cloth. Clean the aperture opening with the aperture brush.

**23. MECHANISM PARTS.**

Any part other than those already mentioned should be cleaned with carbon tetrachloride to remove old grease and lubricating oil. Dry thoroughly. The most ideal method of drying is with compressed air. However, this method is highly impractical in many instances. Therefore, dry with a clean cloth as much as possible and then allow parts to dry thoroughly in air.

**24. LUBRICATORS AND STORAGE PADS (Code Z).**

a. Whenever it is necessary to disassemble the intermittent or perform other major repairs to the mechanism, remove all oil storage and metering pads. Wash pads in naphtha until they are clean. Perform this operation before proceeding with other repairs—this will provide adequate time for drying and relubrication of pads. Replace any pads which are discolored or show visible signs of wear. After all pads are thoroughly dry, insert one end of each pad in pan containing approximately 1/8 inch of oil, Bell & Howell Spec. No. 1543. Allow pads to stand in oil until completely saturated. Do not immerse pads in oil. When pads are completely impregnated with oil, allow them to drain.

b. Wash the projector head and all shafts with petroleum solvent and dry all parts.

c. Insert the pads in their proper location.

**NOTE**

When installing the lubricator assembly, push it toward the cam until the tongue of the pad is firmly contacting the cam, then tighten the shuttle pin retaining screws. Recheck to be sure that the pad is in contact with the cam.

d. Place a light film of Spec. No. 1543 oil on all shafts before assembling. Coat all gear teeth with grease, Bell & Howell Spec. No. 1544.

e. After disassembling the takeup arm, wash all parts with petroleum solvent, then reassemble and repack with grease, Bell & Howell Spec. No. 345. Disassemble the governor cap. Wash all parts with petroleum solvent and relubricate with grease, Spec. No. 345.

# Repair

(See Figures G-1 thru G-3 Inclusive)

## 25. GENERAL.

Reconditioning parts for possible re-use in the projector is not practicable. Mechanical parts which are physically damaged must be replaced with new parts. Specific phases of repair of the amplifier and electrical system are presented in the following paragraphs to aid in servicing the projector. The order in which they are presented is not a procedure recommendation.

## 26. ERASE FAILURE.

a. Make sure all controls are in their proper positions. Measure RF voltage between pins Nos. 1 and 3 on rear amplifier connector J1. Make all RF measurements with suitable vacuum-tube voltmeter. Reading should be 6 volts across erase winding and approximately 0.3 volts across bias winding (with record interlock in).

b. If no voltage or incorrect, check condenser C1, and check switch S1f in the record position.

c. Check for continuous grounding or open up to the interlock relay. Check if relay contact itself is not functioning properly. See that interlock neon indicator lights and stays lit when you press the record button and have machine going forward.

d. Check RF voltages at terminal strip mounted on inside of projector. Check to see if there is a break at that point or break in flex leads. Check continuity with ohmmeter.

### NOTE

If DC ohmmeter is used, input transformer and head must be demagnetized. Any tools used in the vicinity of the head should be demagnetized immediately before use.

## 27. NOISY TUBES OR TRANSISTOR. (5879 or 12AY7)

a. Mica leakage generates a frying and hash noise. If it occurs when the amplifier is in optical position, it is very probably the input tube. If the hum is excessive in the optical position, the 12AX7 tube V4 should be replaced.

### NOTE

Be sure no stray light is striking the photocell.

b. If crackle or frying noise appears only when in the magnetic playback position, replace 5879 tube or transistor.

## 28. TYPE 5879 TUBE FLOATING MOUNT. (CODES W, X)

In removing and reinstalling 5879 tube V2, apply no more pressure than is absolutely necessary to

reset tube firmly in socket. Excessive pressure applied in mounting this tube may cause the socket to slip out of bottom of shield thereby interfering with function of floating mount. When reinstalling shield, be sure it is vertical and not cocked; if it is cocked, it may interfere with rotation of sound shaft or flywheel.

### NOTE

Bear in mind that on all miniature tubes the pins must be checked and straightened if necessary before installing in socket. A commercial pin straightener is available from radio supply houses or in a pinch, long nose pliers can be used.

## 29. MICROPHONICS.

a. Microphonics which occur when the amplifier function switch is in the optical playback position may be due to (1) microphonic photocell or, (2) microphonic tubes.

b. Microphonics in magnetic playback position only may be due to: (1) microphonic type 5879 tube or (2) magnetized input transformer T1 (refer to paragraph 30) or (3) microphonic playback head.

### CAUTION

Use head demagnetizer tool; do not remove top shield or disturb head adjustment. Check components on photocell socket.

## 30. INPUT TRANSFORMER. (CODES W, X)

Wherever it is necessary to check continuity on the input transformer T1 with ohmmeter, be sure to demagnetize the transformer after establishing that it is a good unit. Proceed as follows:

a. Remove all 3 lead connections from transformer. Remove transformer and insert in demagnetizer (refer to Introduction).

b. Turn on current, withdraw slowly to a distance of 12 inches. After withdrawal is completed, shut off demagnetizer.

### CAUTION

Do not touch terminals of transformer while demagnetizing. You may get a heavy shock.

c. Using a variac in minimum voltage position, connect output to terminals 3 and 4 of transformer and gradually bring up to full voltage, 120 volts momentarily, decreasing gradually to minimum voltage position. Reinstall and rewire.

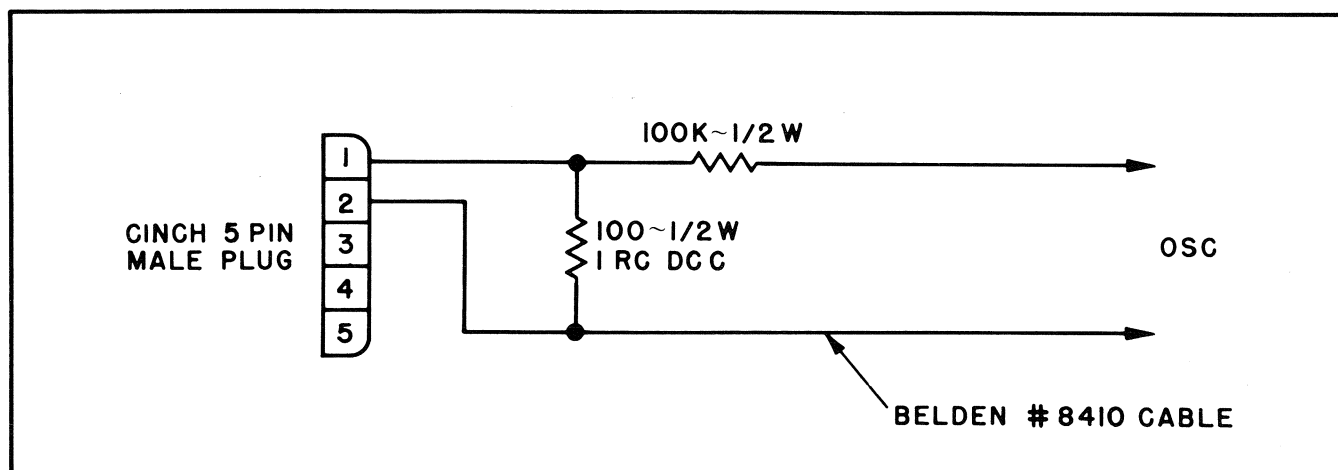


Figure F. Wiring Diagram of Test Probe

d. Transformers on earlier units have 4 terminals, 2 of which are grounded and connected by a common lead to transformer case. Transformers on later units will have single ground lead and are internally grounded to case. When transformer has been removed for demagnetizing, be careful in re-installation process to be sure the rubber grommet shock mounts are actually working. The transformer cannot be forced down against mounts as microphonics will result.

### 31. TEST PROBE.

Assemble a test probe using the circuit of figure F. The resistors are standard radio components.

### 32. CHECKING THE AMPLIFIER.

- Check all tubes and check socket voltages.
- 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.
- Set oscillator to 1000 cps, turn tone control to maximum treble and volume control to full on position.
- Gradually increase oscillator level while observing scope trace. A 202 or 302 B or C amplifier should develop 10 volts minimum across the load before the wave form shows distortion. A 302 D or E should develop 11.3 volts before distortion becomes apparent.
- Disconnect oscillator and connect speaker, turn projector on and flick a card through the exciter beam. A loud thumping noise should be produced by the speaker. If thump is not produced, check photocell and photocell voltage supply and coupling circuits.
- Reconnect resistance load, AC voltmeter and scope. Connect test probe (figure F) to oscillator and magnetic input of amplifier. Set oscillator to 1 KC and oscillator output to 160 millivolts.

Amplifier output voltage should be as stated in paragraph D.

### 33. FILAMENT VOLTAGE FOR TYPE 5879 TUBES. (CODES W, X)

RF is used on the filament of the two type 5879 tubes V2 and V3. When the function switch is placed in the record position, with the projector not running, the filament voltage will be approximately 8 volts, as measured with a vacuum-tube voltmeter. With the projector running and the record button pushed, the filament voltage drops to 7-1/2 volts. This is outside of recommended limits for these tubes. However, life checks have indicated that no detrimental effects will occur.

### 34. RECORDING—LEVEL LAMP.

- If glow lamp fails to light, check for loose or broken connections. Disconnect both leads and check for lighting by applying 110-volt AC. If lamp does not light, replace entire assembly, part No. 22581. The neon bulb itself cannot be replaced. The entire assembly must be replaced.
- Capacitor C23, (figure G-1) 0.033 mfd, has been changed in later machines. The 200-volt capacitor has been replaced by 400-volt 0.01 mfd capacitor, part No. 20419. If this capacitor breaks down, the lamp will stay lighted continuously.
- If amplifier oscillates in record, check lead dressing (as master VOLUME control is brought up from low position, oscillation may develop and lamp will light without signal). The lead (orange) from terminal strip on function switch is one to check.

### 35. REPLACING FUNCTION SWITCH. (Code W)

As a rule, failure of the function switch is not expected to be a problem. Earlier Design 202 projectors used function switch, part No. 22558, and the latest units, part No. 25458, which is considerably smaller in size.

If a switch fails for any reason, it should be replaced with an exact duplicate to avoid disturbances which would otherwise be created because of differences in wiring.

### 36. REPLACING ELECTROLYTIC CAPACITORS.

Can-type twist-lock electrolytic capacitors and tubular capacitors are used exclusively. To remove capacitors, unsolder leads. Straighten twist-lock terminals and remove. If the wafer sockets, part No. 22569, should be broken, it will be necessary to drill out 2 wafer mounting rivets for each socket and install new capacitor and wafer socket replacing rivets with screws.

### 37. REPLACING MASTER VOLUME AND TONE CONTROL.

If replacement of master VOLUME and TONE control is required, care must be taken in removing leads to note their original position. Replace them in exactly the same position when the new control has been mounted.

### 38. MICROPHONE AND PHONO JACKS. (Codes W, X)

Both the microphone and phono input jacks are of the normally closed or shorting type. Plugs should not be inserted into jacks except when a signal is actually being introduced into the amplifier. If there is excessive noise pick-up, be sure that they are properly insulated from the amplifier chassis and that the contacts are normally closed.

### 39. ADJUSTMENT OF OSCILLATOR. (Codes W, X)

In making any adjustment on 1500 ohm resistor R60 always loosen the adjustable contact before attempting to move it. The wire resistor is very fine and any attempt to force the adjustable contact without loosening will break it and necessitate replacement of the resistor.

### 40. SENSITIVITY. (Code W)

Some of the earlier amplifiers had a lower microphone sensitivity than later models. Because of limited sensitivity, the MIC VOL control must be in maximum position. The master VOLUME control is used to limit volume rather than the MIC VOL control in order to provide the best signal to noise ratio on low volume levels. The recording-level lamp will operate differently on different units as there is a difference in sensitivity of the heads. Make test recordings to see what the level is with that particular projector. The lamp should be flashing frequently on peaks.

### 41. REPLACING POWER TRANSFORMER. (Codes W, X)

In the case of apparent power transformer failure, always check the wire connections to plug pins to be sure they are not loosened or open. Most power failure troubles are due to cable breaks and defective connections. The transformer must be

phased (refer to paragraph 77) after removal or replacement. See table below for continuity checks. All d-c resistances  $\pm 10\%$  and do not include resistance of leads.

Winding	Plug Pin Nos.	D-C Resistance
Primary	3-4	3.85 ohms
Secondary	9-10 (11 c.t.)	155.0 ohms
Filament (6.3 v)	1-2 (5 c.t.)	0.115 ohms
Filament (5.0 v)	7-8	0.155 ohms

### 42. 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 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 G) 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 by not only 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.

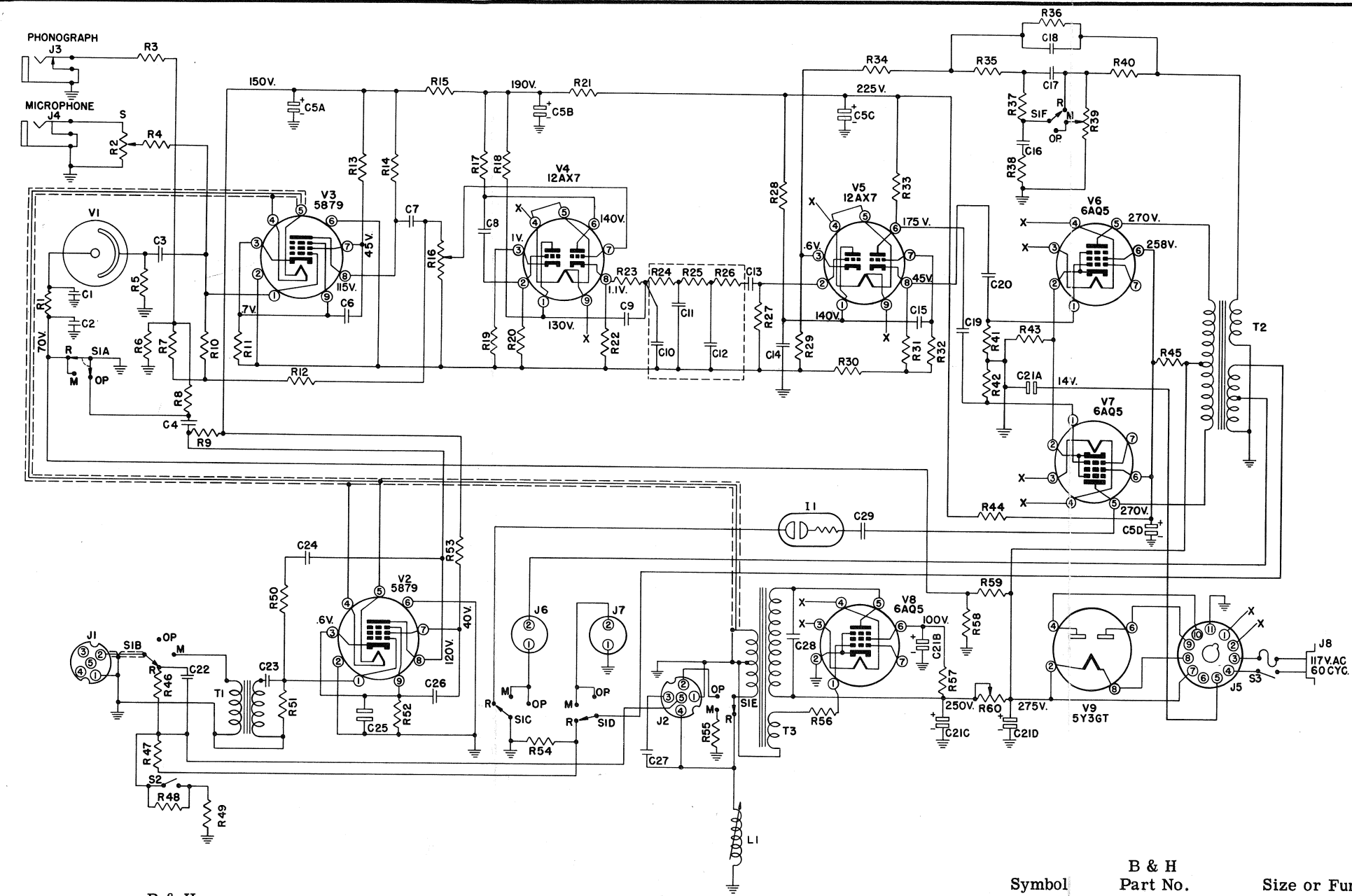
c. Set in position and visually check all contacts. See figure H for normal contact position with button released and depressed. If contacts are not "making" properly, bend with long nose pliers. Be extremely careful not to bend any more than necessary as excessive bending will impair function. There 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 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.

e. Whenever one of the early machines is disassembled for purposes of checking relay, make a small undercut on red button to provide clearance so that button does not bind on screw heads. A file is adequate for the purpose. The degree of taper other than clearance is not critical.



Symbol	B & H Part No.	Size or Function
C1	20431	.2 uf
C2		.2 uf
C3	22698	.001 uf
C4	25823	.01 uf
C5A	22822	10 uf - 450 v
C5B-D		15 uf - 450 v
C6-C9	25823	.01 uf
C10	25825	100 uuf
C11	25826	25 uuf
C12	25827	10 uuf
C13	25823	.01 uf
C14	25828	300 uuf
C15-C17	25823	.01 uf
C18	25825	100 uuf
C19-C20	25824	.02 uf
C21A	25821	50 uf - 50 v
C21B		10 uf - 450 v
C21C-D		40 uf - 450 v
C22	20431	.2 uf
C23	20419	.01 uf
C24	25829	150 uuf
C25	20432	10 uf - 25 v
C26	25823	.01 uf
C27	25819	.5 uf
C28	25820	.0005 uf
C29	25823	.01 uf
F1	16210	Fuse, 2 amp.
I1	22581	Recording level indicator
J1-J2	22568	Front and rear connector
J3-J4	20504	Phono and mike jack
J5	22601	Power receptacle - 11 prong
J6	17086	Speaker connector - 8 ohm
J7	17086	Speaker connector - 16 ohm
J8	22466	Line receptacle - 2 prong
R1	19304	2.2 Meg
R2	25458	1 Meg
R3	19304	2.2 Meg
R4		2.2 Meg (MIC. VOL.)
R5	19561	10 Meg
R6	19293	1 Meg
R7	17083	330 K
R8	19083	560 K
R9	17078	220 K
R10	19294	5.6 Meg
R11	19307	5600
R12	19294	5.6 Meg
R13	19304	2.2 Meg
R14	17070	220 K
R15	19560	47 K
R16	22557	500 K (VOLUME)
R17-R18	19080	100 K
R19	17079	1000
R20	17078	220 K
R21	19308	10 K



Symbol	B & H Part No.	Size or Function
R22	19305	2700
R23	19082	270 K
R24-R27	19014	470 K
R28	19082	270 K
R29	19037	5600
R30	19080	100 K
R31	19305	2700
R32	19082	270 K
R33	19080	100 K
R34	22584	33 K
R35	19079	22 K
R36	19293	1 Meg
R37	19079	22 K
R38	17079	1000

Symbol	B & H Part No.	Size or Function
R39	22557	250 K (TONE)
R40	19079	22 K
R41-R42	19014	470 K
R43	22573	180 - 2 w
R44	19308	10 K
R45	22572	2200 - 1 w
R46	17079	1000
R47	19542	120
R48-R49	24840	56
R50	19083	560 K
R51	19080	100 K
R52	19307	5600
R53	19304	2.2 Meg
R54	22586	15 - 5 w

Symbol	B & H Part No.	Size or Function
R55	22585	5 - 5 w
R56	19308	10 K
R57	22574	27 K - 2 w
R58	19304	2.2 Meg
R59	19294	5.6 Meg
R60	24844	1500 - 10 w
S1	25458	Functions switch, 2 x 3 circuit - 3 position
S2	23264	Half-track, Full switch
S3		On-off switch (on VOLUME)
T1	22560	Input transformer
T2	22559	Output transformer
T3	22563	Oscillator coil

Figure G-1. Amplifier Schematic Diagram Design 202

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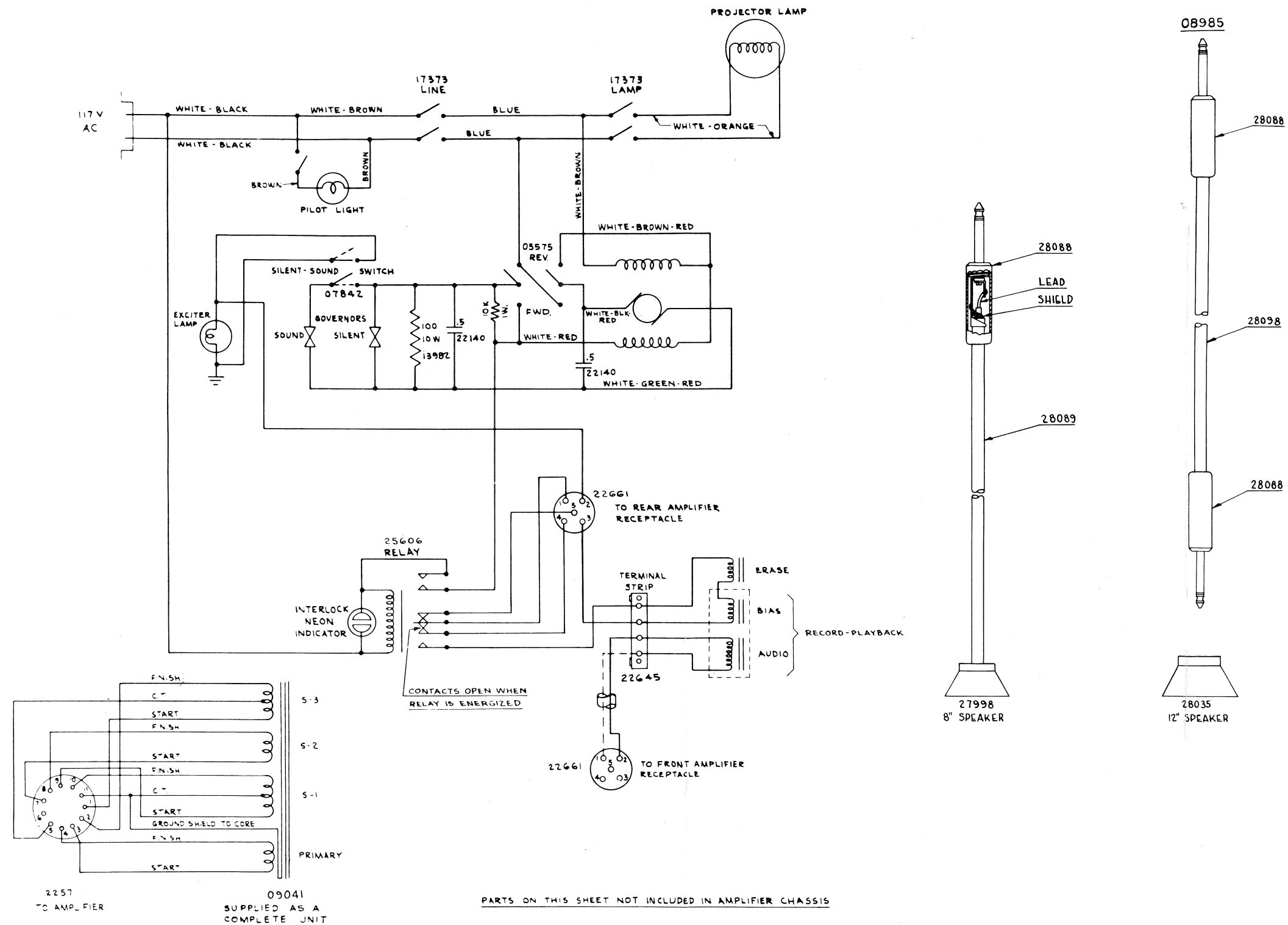


Figure G-2B. Amplifier Schematic Diagram Design  
302 B and C (Sheet 2 of 2)

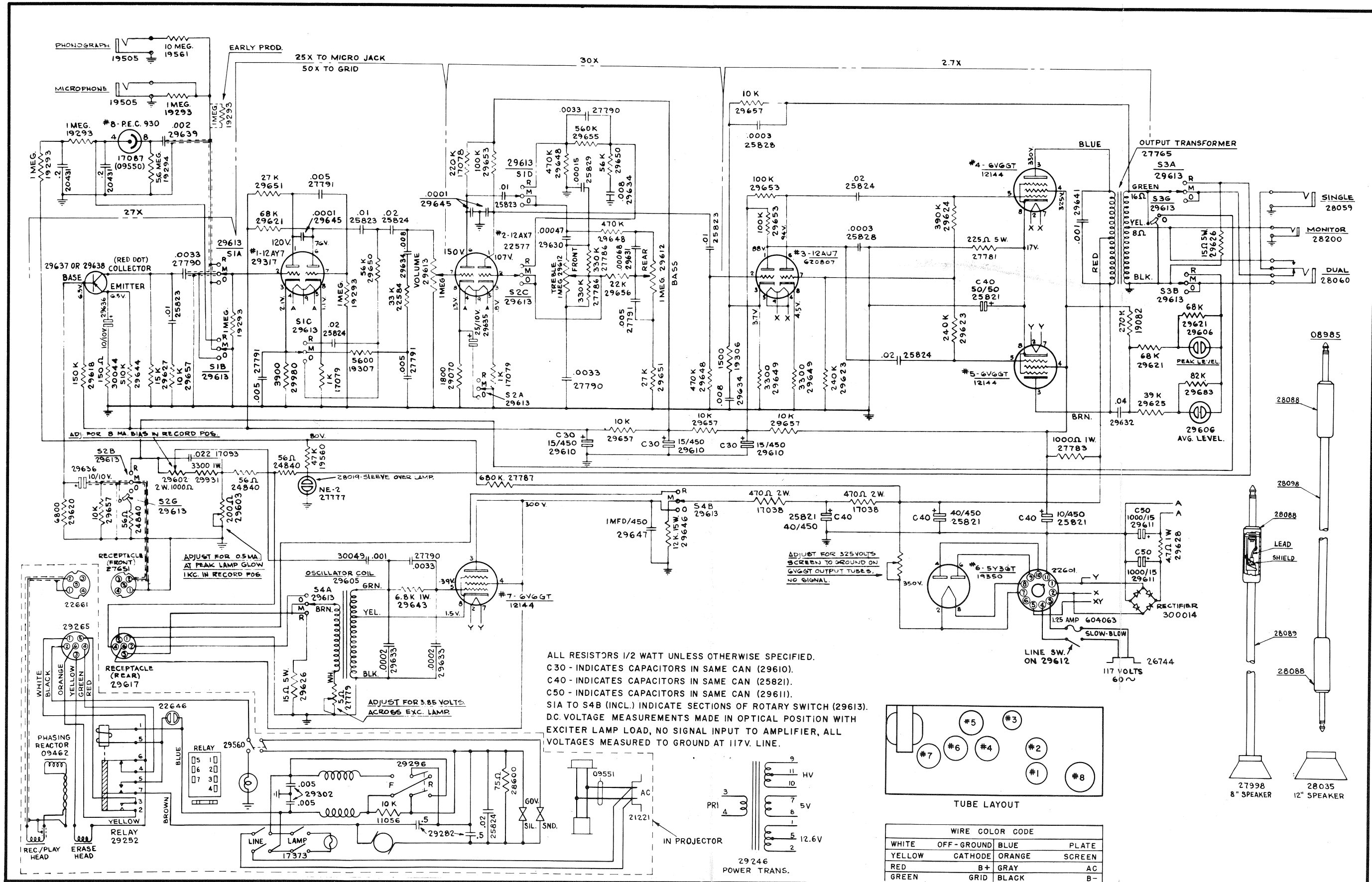


Figure G-3. Amplifier Schematic Diagram Design 302 D and E

## 43. ELECTRICAL CORDS.

If the rubber covered cords have become sticky due to long periods of storage, apply a generous amount of talcum powder to the length of the cord with a soft cloth.

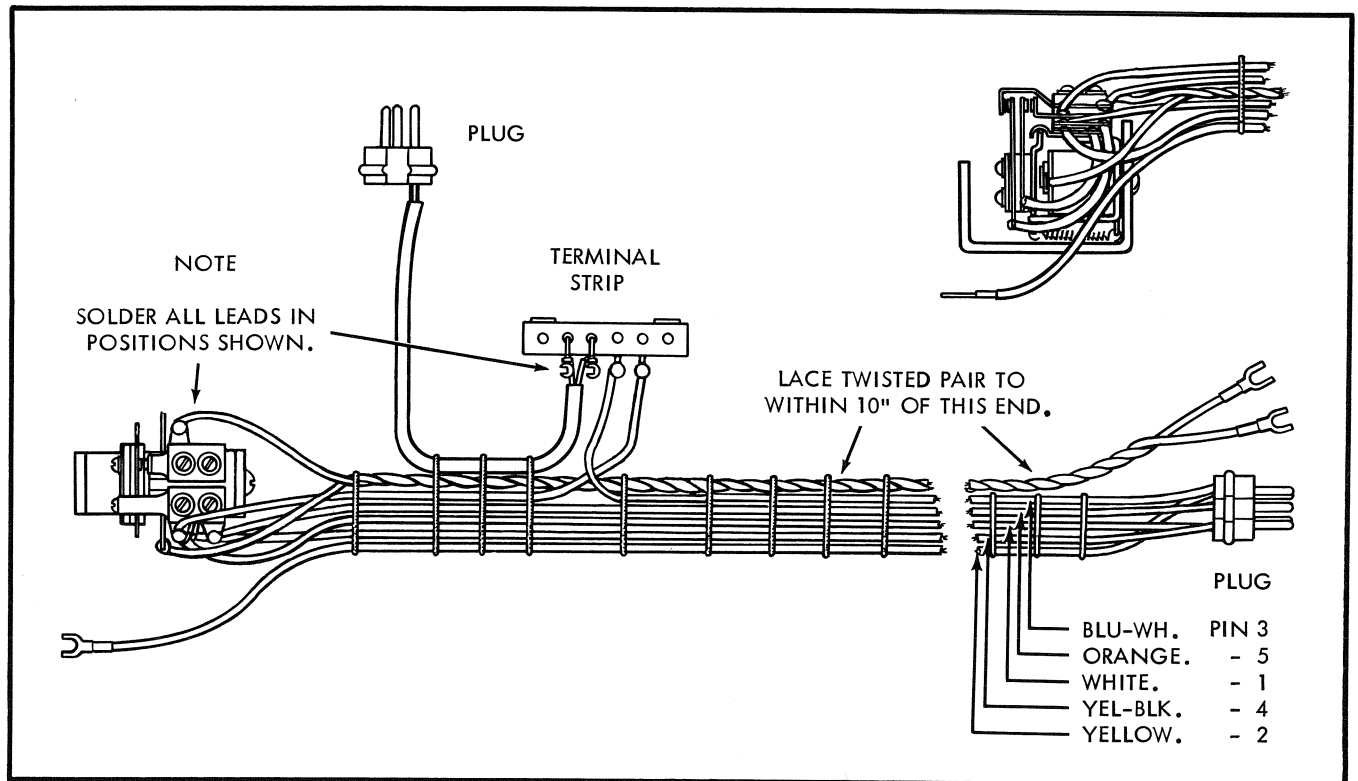


Figure H. Relay Interlock System Diagram (Codes W, X)

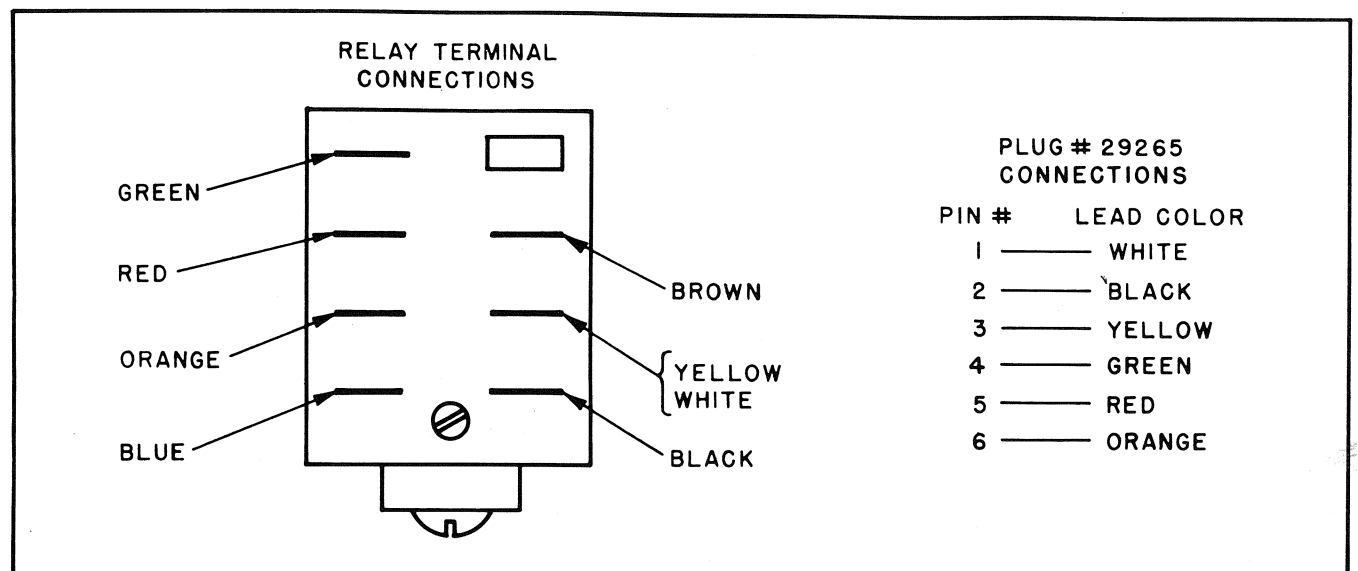


Figure H-1. Relay and Plug Connections (Codes Y, Z)

# Reassembly Procedure

## 44. 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. Replace the spindle washer (10) and the same amount of shim washers (9) that were removed in disassembly. Slip the pulley (7) on 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) in 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. Replace the bronze washer (3) and clutch cover (2) and screw in the fillister head screw (1).

## 45. 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 (7). Then place nineteen steel balls (8) 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 (7) 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 (9). Place a layer of grease on this beveled shoulder and then position nineteen more steel balls (8) in this grease so that they also form a complete circle.

b. Very carefully screw the bearing retaining ring (6) 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.

c. Screw the hex nut (5) on and position the rewind gear (4) on the take-up pulley shaft. Screw in the rewind gear attaching screw (3) (Codes W, X, Y) to securely fasten the parts in place. In Code Z units, place film of oil on plunger (7-E) and insert into spindle (7-C) before installing screw (7-D). Install pin (7-L). Attach spring (7-H) to cover (7-K) with screw (7-I). Engage pin (7-L) in keyhole in spring (7-H) and swing

cover into place and fasten with screw (7-J).

d. If the sixteen roller bearings (19) were removed, lubricate and replace them now. Press fit a new bearing retainer ring (18) in over the bearings.

e. Insert the compression spring (13) and plunger (12) into the rear reel arm (20) and, while holding the spring and plunger in place with your finger, slip the drive pulley (11) up into position so that it holds the spring and plunger in place. Because of the left-hand thread, screw the rewind drive gear (10) in a counterclockwise direction onto end of drive pulley shaft. If necessary, tape the gear and pulley to better secure the two together.

f. Attach rewind lock lever (16) to rear reel arm with lock lever attaching screw (15). Hold spring (17) between small stud on lock lever and small stud in rear reel arm.

g. The hole into which the knurled head screw (14) goes should be packed with B & H grease before replacing the screw.

h. Place take-up arm (9) in position on rear reel arm (20) and insert shaft (2). The shaft (2) must be pressed in place with arbor press or other suitable equipment.

i. Slip the belt (1) over the two pulleys. Check the action of the lock lever (16) to see that it will lock and disengage the two gears.

j. Latch lock lever (16). If unit is equipped with automatic release, swing reel clip (7-F) to open position and check to be sure that pin (7-L) releases latch (16).

## 46. SPEAKER. (See figure 12.)

Connect leads on cable and connector assembly (48) to voice coil on speaker. Attach cable clamp (47) with one self-tapping screw (46).

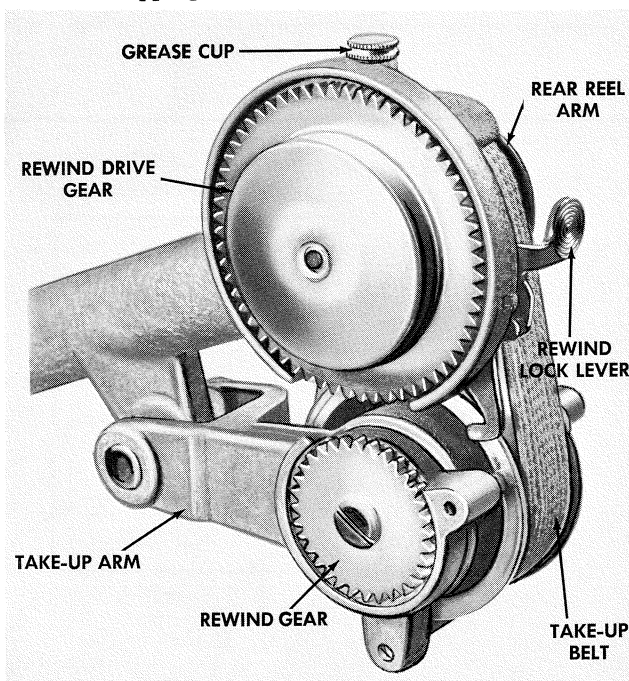


Figure 1. Take-Up Arm and Lock Lever



**47. PROJECTOR CASE.** (See figures 12 and 12A.)

a. Fasten the transformer assembly (figure 12-53) to bracket on the inside top of case (57) with two check nuts (51) and one lock washer (52). On code W and X units the transformer must be positioned for proper phasing after installation of all components. The dot fastener (50) should be layed aside until that time. On code Y and Z units, holes for mounting the transformer in projector case must be measured off and drilled as per template illustrated on figure 12A. Attach transformer, part No. 29246, with four Phillips head screws, part No. 29250, and four washers, part No. 29251. For proper phasing of all units, see paragraph 77.

b. Attach catch strike (figure 12-44) with two flat head nails (45). Make electrical connections to receptacle assembly (43) (see figure J). The leads for the receptacle assembly are located under the padding inside the case. Attach receptacle assembly with round head wood screw (42). Screw in threading lamp (41).

c. Install rollers (39 and 35) with pins (38 and 34). Secure pins to reel arm holder plates (40 and 36) with set screws (37 and 33). Insert assembled reel arm holder assemblies into case. Attach reel arm plates (32) with Phillips head screws (31).

d. Position plates (30) over rear handle mounting hole. Insert spring (28) into rear of handle (29) with small hook in spring going directly into handle on the inside. Insert handle pins (27) and place three handle posts (26) on ends of pins. The fourth handle post (25) has an extra hole in it to accept the end of spring (28). Hold handle pins and handle posts in place with your hand, turn handle post (25) (be sure it is engaging spring (28) when turning it) through one complete turn to put tension on spring, and insert the handle posts through plates (30) and projector case. The spring (28) should now keep the handle down against case and away from grill. If spring forces handle down over grill, remove handle and turn handle post (25) one full turn in the other direction from neutral. Fasten front handle posts with washer plate (24), lock washers (22) and hex nuts (21). Fasten rear handle posts with spacer washers (23), lock washers (22) and hex nuts (21).

e. Attach the door catch (20) to the door with the round head wood screws (19). Position the door pull (18) and door pull plate (17) on the door and secure the two together with the flat head screws (16).

f. Replace lock washers (15) and foot assemblies (14) in the brackets on the front and rear of the cam. Attach the foot bar (12) to the tilt rack (13) with the lock washer (11) and fillister head screw (10).

g. The friction cup (8), which has a left-hand thread, is inserted through the pinion washer (9) and the case and screwed into the tilt bracket inside the case as far as possible. Now insert the tilt rack (13) up through tilt bracket as far as possible. Hold it there and insert pinion (7), being sure the teeth engage the tilt rack teeth. Tighten pilot screw (6). Replace friction band (5). Bend blade spring (4) and place it inside the friction band so that the center of the blade is directly opposite the post on the pinion (7). Replace the bronze washer (3) and knob (2), being sure the two posts inside the knob are on either side of the lips of the friction band (5). Screw on hex nut (1).

**48. AMPLIFIER.**

Replace the base plate assembly with four sheet metal screws. Replace knobs, jacks, tubes, tube shields and tubes as applicable.

**49. SWITCHES, TERMINAL STRIP AND RELATED ITEMS.** (See figure 11.)

a. If the line receptacle (67) was replaced, attach it with two No. 5-40 x 1/4 inch round head screws and hex nuts.

b. Attach the line cord assembly (65) with the strain relief bushing (66). Be sure that enough cord projects into the sound head to reach the terminal strip (51).

c. Make all electrical connections to the switches (57, 60 and 61). See figure J. Fasten the switches (60 and 61) and name plate (62 and 63) to the sound head with the check nuts (59) and locating discs (64). Make certain the discs engage the locating holes in the sound head to properly position the switches. Install the switches (57) and name plate (58) with check nuts (56). Attach the capacitor (55) with the Phillips head screws (54).

d. Attach the terminal strip (51) and insulation (52) with the Phillips round head screws (50). Connect the resistor (53) and all leads from the switches and line receptacle to the terminal strip (51). See figure J.

**50. INTERLOCK RELAY AND HARNESS.** (See figure 11.)

a. Make certain that the interlock relay and harness assembly is completely wired. Refer to figure H and paragraph 42.

b. Fasten the relay mounting bracket (43) to the relay (44) with two round head screws (42). Make electrical connections to the exciter lamp socket (49) and pilot lamp assembly (47). See figure J. Attach the exciter lamp socket (49) with the fillister head screws (48). Install the pilot lamp assembly (47) with the push-on fastener (46).

c. Attach the relay (44) with the bushing (35). Attach the terminal strip (41) and cable clamp (34) with the fillister head screw (32) and pilot screw (33). The cable clamp must secure the interlock relay wiring to the sound head.

d. Insert the button (39) into the bracket (43) and slide the spring (40) through the bracket and button to secure.

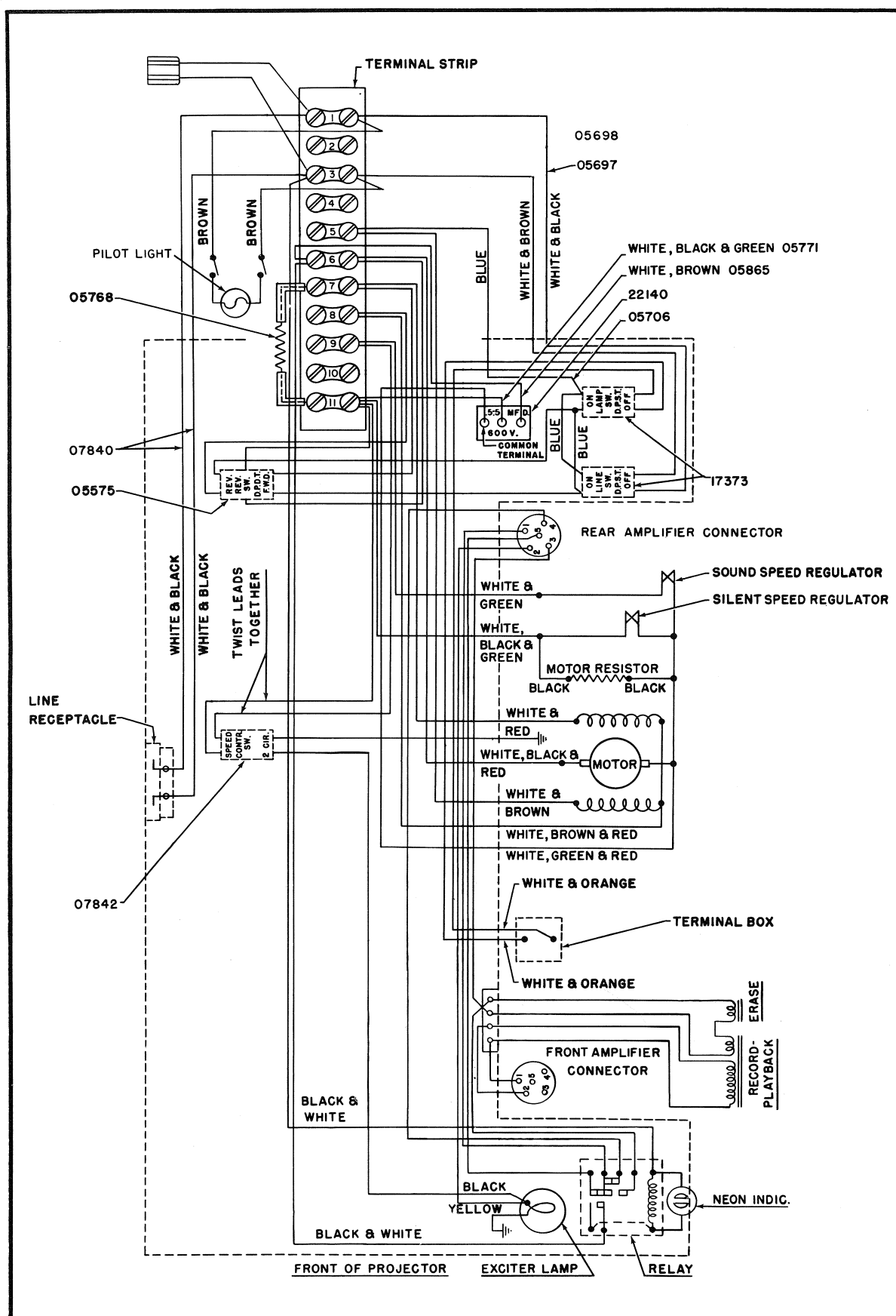
**CAUTION**

Full line voltage is carried on the relay contacts. Make certain the relay is mounted so there is no possibility of shorting due to shifting or jarring.

Attach the relay shield (38) with one round head screw (36) and lock washer (37).

**51. SOUND DRUM, SHAFT AND MAGNETIC SOUND COMPONENTS.** (See figure 11.)

a. Place the radial bearing (27) in the sound head. Fasten the lever (26) to the bearing and shaft assembly (22) with the round head screws (25).



**Figure J. Projector Schematic Wiring Diagram (Codes W, X)**

**CAUTION**

When installing bearing and shaft assembly, do not cock the assembly, which results in jamming the contacts and winding that leads to the magnetic heads.

b. Carefully guide the bearing and shaft assembly through the sound head; place the flat spring (21) over the end of the shaft. While supporting the bearing and shaft assembly adequately, slide the flywheel (24) over the shaft and slip on the spring washer (23) to secure. Insert the end of the shaft into the radial bearing (27). Slip the retaining ring (20) behind the flat spring (21) on the bearing and shaft assembly. Insert the spring (4) and spring retainer (3) and mount the bearing cap (2) with the fillister head screws (1).

**CAUTION**

Make sure the spring washer (23) holds the flywheel securely. Slippage or non-rotation of the flywheel will cause flutter.

c. Make all electrical connections from the bearing and shaft assembly (22) to the terminal strip (41). See figure J. After checking the condition of leads at the terminal strip and coil ends, tie the leads down to the terminal strip (41) with a piece of waxed lacing string.

d. Check electrical connections to the switches (57, 60 and 61), capacitor (55) and terminal strip (51). Install the terminal cover assembly (30) with the speed nut (31), oval head screw (29) and fillister head screw (28).

**CAUTION**

Make certain leads are not pinched or chafed by the terminal cover.

e. Install the pivot stud (19), roller arm (16) and torsion spring (15) with the retaining ring (14). Be sure the spring engages the arm; the free end of the spring should rest against the inside of the sound head. Fasten the rubber roller (13) to the roller arm with the lever screw (12). Attach the clamp strap (18) with the fillister head screw (17).

f. Note that the pivot stud (19) is eccentric so that the position of the rubber roller (13) can be adjusted if necessary. Generally, the original position of the pivot stud will be satisfactory. Refer to paragraph 70i.

g. Attach the spacer (10), torsion spring (11), detent lever (9) and eccentric bearing (8) with the fillister head screw (7). One end of the torsion spring must engage the lever while the other end seats in the small hole in the sound head.

h. Rotate the bearing and shaft assembly (22) by moving the lever (26) from optical to magnetic positions. Observe the engagement of the detent lever (9) with the notches in the bearing and shaft assembly flange. If necessary, loosen the screw (7)

and rotate the eccentric bearing (8) until detent lever engages and releases smoothly and easily.

i. Attach the light shield cover (6) with the fillister head screws (5).

## 52. SOUND SPROCKET AND SNUBBER ROLLERS. (See figure 10.)

a. Fasten two sound head brackets (46) to the sound head with four Phillips binding head screws (45). Attach the spacer (43) and idler roller (44) with the idler roller stud (42).

b. Insert the snubber shaft (37) through the snubber spring (38), bearing (39), and retaining plate (40) so the spring ends engage the mating holes in the shaft (37) and bearing (39). Fasten the bracket and roller assembly (41) to the snubber shaft with the fillister head screw (36).

**NOTE**

For projectors which use the earlier type snubber assembly follow instructions in steps c and d.

c. Insert one of the snubber studs (54) through one of the roller assemblies (57), through the snubber lever (58) and screw the hex nut (56) onto it. Insert the other snubber stud (54) through the other roller assembly (57), through the snubber lever (58) and screw it into the spring retainer (55), being sure the slot in the spring retainer engages the finger on the snubber lever. Slip the snubber bearing plate (53) over the spring retainer.

d. Then place the torsion spring (52) over the shaft of the spring retainer and hook the front end of the spring into the recess on the back side of the spring retainer collar. Assemble snubber bearing (51) over the spring, being sure the terminal on the end of the spring engages the hole in the end of the snubber bearing. Screw the fillister head screw (50) into the end of the spring retainer as far as possible, but keep bearing plate (53) from being pinched under the bearing (51). The bearing plate must turn freely.

e. Mount this assembled unit with the fillister head screws (32 or 32A, and 35). Attach the cable clamp (34) to the longer screw (32) with the hex nut (33) so that the clamp supports and secures the harness for the interlock relay.

f. Note the position of the snubber assembly when it is at rest. Then note the position that the snubber assumes when film is being run through the projector. The tension on the snubber assembly must be such that it will not start to take effect until the snubber has moved about 1/16 of an inch from the "rest" position.

g. To adjust the snubber assembly, proceed as follows: Loosen the three attaching screws (32 or 32A, and 35) and leave them loose while making the adjustment. Turn the snubber bearing (39 or 51) that extends into the sound head in either direction as necessary to either increase or decrease the tension of the snubber torsion spring. Hold the bearing in the desired position and at the same time tighten the three attaching screws (32 or 32A, and 35). Check the action of the snubber. If tension is not felt when the snubber is about 1/16 of an inch

out of the "rest" position, loosen the attaching screws and again adjust until the desired results are obtained.

h. When the condition just stated exists, it means that the torsion spring is at rest when the snubber is in the "rest" position, but upon raising the snubber about 1/16 of an inch, the torsion spring begins to exert pressure on the snubber. As the snubber is raised further, the tension will build up strong enough to take care of all conditions.

i. A felt washer is located inside the sprocket (23). To avoid damaging it, use tool No. S-15177-F3 (14, figure B). Saturate the felt washer with B & H oil. Insert the sprocket shaft (27) into the sound head, assembling the sprocket driving gear (29) and washer (28) to it as it passes through the pocket in the sound head. Tighten the set screw (26) against the flat surface of the shaft just enough to keep the shaft from turning but not so tight as to keep the shaft from being adjusted in or out. Slip spacer washer (25) and spring washer (24) onto the shaft and into the sound head. Assemble the film guide (31) to the sound head with the fillister head screws (30) at this time. Now place tool No. S-15177-N1 (16, figure B) and tool No. S-15177-N2 (15, figure B) on the sprocket shaft as shown 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 should bear up tight against the film guide. Tighten set screw (26) securely at this time. Remove tools.

j. Slip tool No. S-15177-F3 (14, figure B) onto the end of the sprocket shaft. Slide the sprocket (23) over the cone, onto the shaft and into the sound head. Remove the cone tool and again screw tool No. S-15177-N2 (see 15, figure B) onto the shaft. Tighten the two set screws (22). The sprocket, sprocket shaft and driving gear should now be positioned correctly. Remove tool from shaft.

k. Use tool No. S-15638-N6 (10, figure B) to adjust the film guide clearance as follows: Loosen the screws (30) and insert the clearance tool between the sprocket and the film guide as shown in figure T. The tool will fit over the sprocket in only one way. Press the film guide down against the tool and tighten the screws (30). Remove the clearance gauge.

l. Fasten the film stripper (17) with the fillister head screw (16).

m. Insert tension washer (21) and spring (20) into the sprocket guard (19) and attach all of these parts to the sprocket shaft with the fillister head screw (18).

### 53. STABILIZER ROLLER AND OPTICAL SLIT. (See figure 10.)

a. Screw stabilizer stud (14) through the lock nut (15) and into the sound head. Place the torsion spring (5) in place in the lower stabilizer arm (9) and secure it there with the fillister head screw (4). Insert the stud (7) through the plain roller (8), lower arm (9) and then screw the fillister head screw (6) into it. This completes what may be called the lower arm assembly.

b. Insert roller stud (11) through the flanged roller (12) and stabilizer arm (13) and then screw the

fillister head screw (10) into it. Now twist the spring about one-half turn in a counterclockwise direction (looking at spring from the rear), or just enough to clear the flat bottom of the lower arm (9). Hold the spring in this position and at the same time slip the brass post which is located on the upper arm (13), through the lower arm (9) and spring (5). Hook the free end of the spring to the small, grooved post on the arm (13). The spring should now cause the lower arm to rotate in a clockwise direction as far as possible when looking at the stabilizer as it is shown in figure 10.

c. Install the stabilizer on the stud (14), forcing the lower arm assembly about one-half turn in a counterclockwise direction when doing so. After the stabilizer is fully in position on the stud, the lower arm should bear up against the post which is located in the sound head just below where the stabilizer stud is screwed in.

d. Replace bronze washer (3) if any were removed in disassembly, the cap (2) and tighten the set screw (1). For adjustment of the stabilizer assembly, see paragraph 68.

e. If the optical slit assembly (49) was removed, carefully slide it into the sound head. Note that one end of the optical slit has a slightly protruding mask; this end must face the sound drum. Insert the plug (48) and screw in the set screw (47). Adjustment of the optical slit assembly must be made after reassembly of the projector as described in paragraph 69.

### 54. LAMPHOUSE. (See figure 9.)

a. Replace the condenser lens (16), spacer spring (15), coated condenser lens (14) and retaining snap ring (13) in the condenser housing (17). In the event that the two condenser lenses are mixed up, refer to paragraph 9 for a method of determining which is which. Lay the condenser assembly (12) aside until projector is completely reassembled.

b. Attach the condenser friction spring (10) to the motor 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). Position the terminal box (7) under the lamp house and fasten securely with the fillister head screws (6). Screw in the lamp lock screw assembly (5).

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

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

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

a. Carefully place the resistor (32) or (32A) inside of the resistor clamp (31) or clips (31A) and secure the clamp to the inside front of the motor housing (33). Caution is advised so as not to damage the ceramic case around resistor.

b. Insert the 7-mm radial bearing (26) into the front of the motor housing. Carefully insert the stator assembly (29) into the motor housing and screw on the retaining nuts (28).

## CAUTION

When assembling the armature (27), do NOT allow it to slip forward in the motor housing and come in contact with the resistor clamp (31). The result may be torn armature windings which would necessitate replacing the armature with a new one.

c. Carefully insert the armature (27) through the motor housing and allow just enough of the shaft to project through the front of the housing to permit the blower fan (24) to be assembled to it. Slip the armature spring (25) and blower fan (24) onto the shaft. Align the hole in the hub of the blower fan up with the threaded hole in the armature shaft and tap in the spring pin (23).

d. Slip the spacer (22) into the recess in the brush holder (21) and then position the brush holder on the back end of the armature shaft end up against the motor housing. Attach it securely with the fillister head screws (20).

e. Slip the 6-mm radial bearing (16) and the locking washer (15) onto the shaft and up against the brush holder. Screw the hex nut (14) onto the shaft as far as possible and then bend the ears of the locking washer (15) up against the sides of the hex nut. Position the bearing retaining cap (13) up against the brush holder and attach it in place with the fillister head screws (12).

f. Insert the motor brushes and springs (18 and 19) into the brush holder. Be sure that the curvature of the brushes matches the curvature of the armature. Screw in the motor brush caps (17).

g. Insert the three governor brushes (11) into the brush holder and slip the governor (10) onto the end of the armature shaft. Be sure the tips of the governor brushes are bearing flat against the governor rings, and that you can see about 1/16 inch of the governor brushes. Secure the governor to the shaft with the set screws (9).

h. Place the compression spring (8) and spring retainer (7) on the armature shaft. Use tool No. S-19028-F3 (24, figure B) to compress the spring retainer as shown in figure E and then insert the dowel pin (6). Slip a motor pinion washer (5) onto the shaft. Insert thirty-one roller bearings (4) into the motor pinion (3). Place just enough B & H oil on these bearings to hold them in place when positioning the motor pinion on the shaft. Usually about one drop is sufficient. Place the motor pinion (3) on the shaft with the end into which the bearings were placed going on first. Slip another motor pinion washer (5) (when used) and the thrust washer (2) onto the shaft. Screw the thrust nut (1) onto the shaft as far as possible, with the slotted surface going on first. Then use tool No. S-19028-F4 (23, figure B) to press the thrust washer (2) back as far as possible and at the same time screw the thrust nut (1) up against the thrust washer. Remove the tool and back the nut off just enough to allow the two ears on the thrust washer to drop into the nearest slots in the thrust nut (1). The motor pinion should now be positioned under a sufficient amount of force to prevent its slipping on the shaft when the projector is operating. However, should the

motor pinion still slip, the compression spring (8) will have to be replaced. For correct adjustment of the clutch lever, see paragraph 66.

## 56. 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 drop the retaining pin (19) into the hole provided for it in the shaft. Insert the worm wheel (18), ball bearing (17), 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. Replace 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).

e. Insert the worm shaft (4) through the felt washer (5) and governor cap (25). Place the radial bearing (3) on the other end 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) using a pair of long nosed pliers to do it. Before screwing in the fillister head screw (24), pack the hole into which it goes with B & H grease.

## 57. BLOWER HOUSING. (See figure 6.)

a. Attach the handle (13) to the holder (14) with the round head screw (12). Insert the auxiliary lens (11) into the holder and secure it in place with the lens retaining spring (10). Lay the relay condenser assembly (9) aside for insertion into the projector later on.

b. The set screw (4) is for the purpose of adjusting the fire shutter and should not be removed or turned unless the fire shutter requires an adjustment after reassembly. See paragraph 66 for this adjustment.

c. If the spring retainer (7) was removed for replacement, fasten it to the blower housing (8) with two No. 2-56 x 1/4 inch round head screws and hex nuts, which replace the rivets originally used.

d. Attach the fire shutter guide (3) to inside of the blower housing with fillister head screws (2). Carefully insert hooked lip of fire shutter assembly (1) into the fire shutter guide. It would be wise to tape the fire shutter in place temporarily to prevent it from juggling around and causing possible damage

to the hooked lip. Remove the tape when assembling the blower housing to the motor housing.

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

## CAUTION

Refer to Lubrication Instructions before assembling Code Z units. Lubricate as specified.

a. Replace the oilers (32 through 34) into the same hole from which it was removed in disassembly. Replace the same amount of bearing shims (29) on each of the shaft bearings (28) that were removed in disassembly. Use the drift punch (17, figure B) to drive the shaft bearings home in 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 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 K through O 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 K. 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 L for the shuttle shaft. Slide the collar on which the steel balls are resting up along the brass sleeve and note the 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, because 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

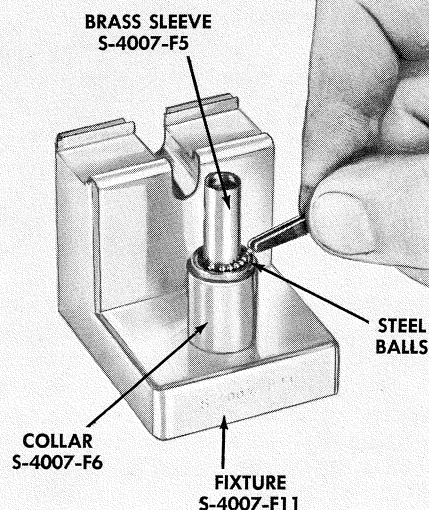


Figure K. Step 1. Reassembly of Counter Gear and Shuttle Shaft

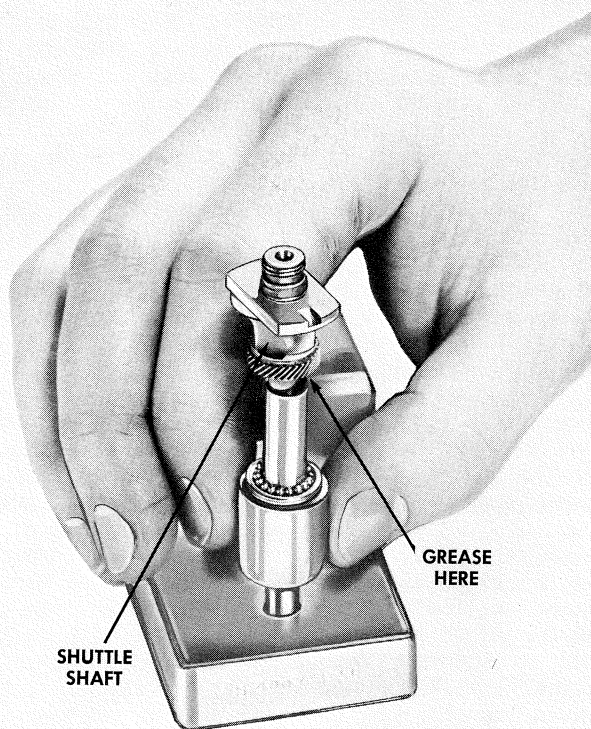


Figure L. Step 2. Reassembly of Counter Gear and Shuttle Shaft



should now be in place around the counter gear shaft. Carefully remove and set aside the counter gear and shaft. Remove the brass sleeve and cone collar from the jig.

g. Take one of the quills No. S-4007-F14 (4, figure B) and place it in the jig as shown in figure M. 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 M. 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 N, 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 O. Insert the quills into the bearing as far as possible, remove the 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 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 set screw holes lines up with the groove in the shaft. Screw the cone point set screw (19) into this hole and the flat point set screw (18) into the other hole. The counter gear

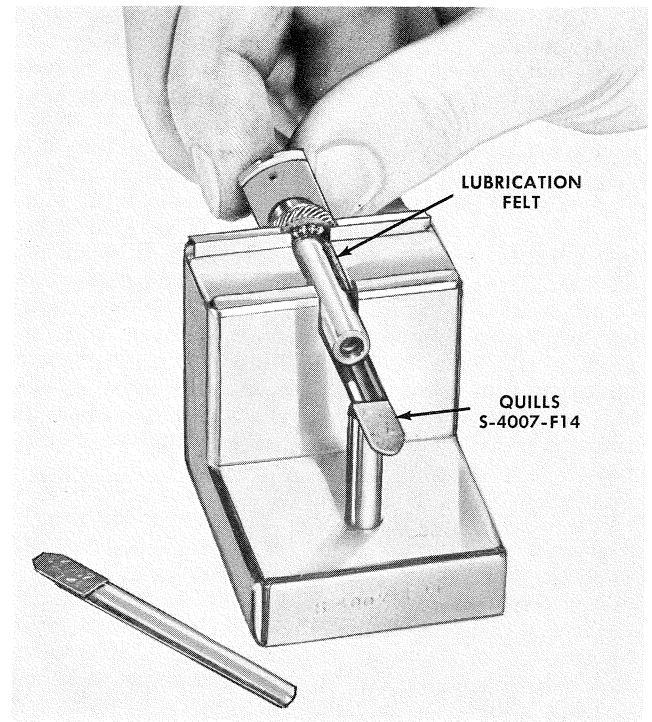


Figure M. Step 3. Reassembling of Counter Gear and Shuttle Shaft

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 set screws (16).

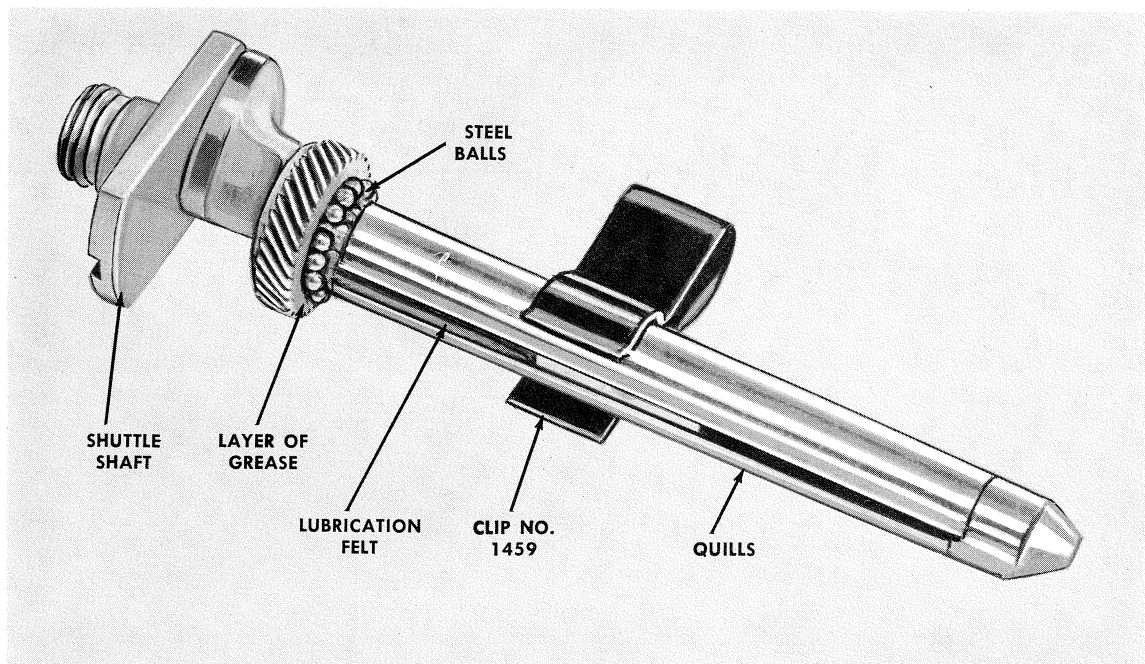


Figure N. Step 4. Reassembly of Counter Gear and Shuttle Shaft

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 K through O 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, replace fifteen new steel balls (12), collar (11) (push on as far as possible) and two flat point set screws (10). 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 as indicated in figure P should be exactly true.

l. Insert the dowel pins (9) into the double tooth shuttle (8) and position the shuttle on the rear of the gear case. Now push the dowel 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 usually should be used.

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. On code Z units, secure oiler assembly in place with fillister head screws (7).

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 small pin in it 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 D to engage the shuttle shaft collar and then draw the hex nut (1) on tight with an open end wrench. A view showing the rear of the gear case assembled is in figure Q.

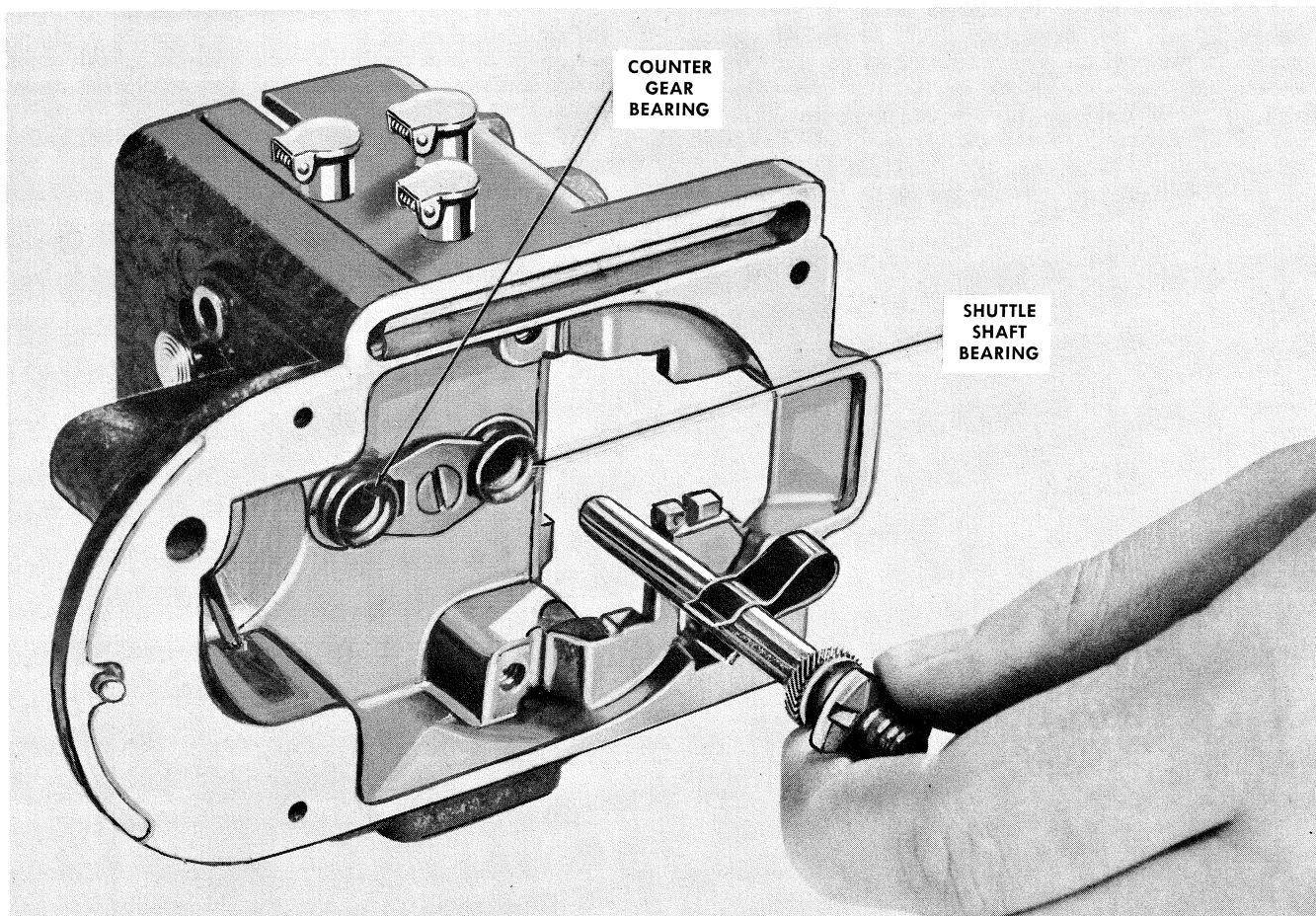


Figure O. Step 5. Reassembly of Counter Gear and Shuttle Shaft

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

a. Insert the framer shaft and knob assembly (25) 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 gate thrust spring (23) and screw it into the hole in the gear case as shown in figure 4. The clip (22) must fit into the slot in the aperture plate. Attach the lower film tension clip in the same manner.

c. Now that the aperture is correctly positioned (be sure it is flat against the gear case), the height that the shuttle teeth project through the aperture plate can be checked. The distance that the shuttle teeth should project above the surface of the aperture plate is 0.028 ( $\pm 0.005$ ) of an inch. GO-NO GO gage No. S-4529-N3 (3, figure B) must be used to check this height.

d. The shuttle cam should be revolved to the point where the shuttle teeth protrude farthest through the aperture plate. The gage is then placed on the rails of the aperture plate. The 0.023 inch step in one end of the gage should strike the teeth and the 0.033 inch step in the other end of the gage should pass over the teeth. If the teeth come at any point between these two settings on the gage, they may be considered set for normal operation. The two heights mentioned are clearly marked on the side of the gage.

e. When 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 fit in the GO-NO GO gage.

f. When the shuttle teeth project too far through

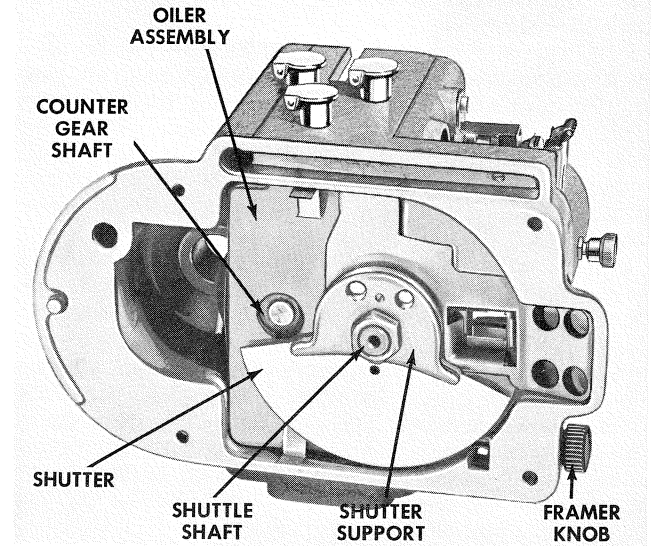


Figure Q. Rear of Gear Case Assembled

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. The lens lock screw (19) should not have been removed from the lens carrier (20). 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 61d. Attach 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).

i. Insert the upper sprocket shaft (27) into the gear case, assembling the upper gear (29) and one of the washers (28) to it as it passes through the gear case. Then insert the lower sprocket shaft into the gear case, assembling the sprocket worm wheel assembly (30) and the other washer (28) to it as it passes through the gear case. Tighten both flat point set screws (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 set screw (26). Do the same thing with the lower sprocket shaft, tightening the other flat point set screw (26)

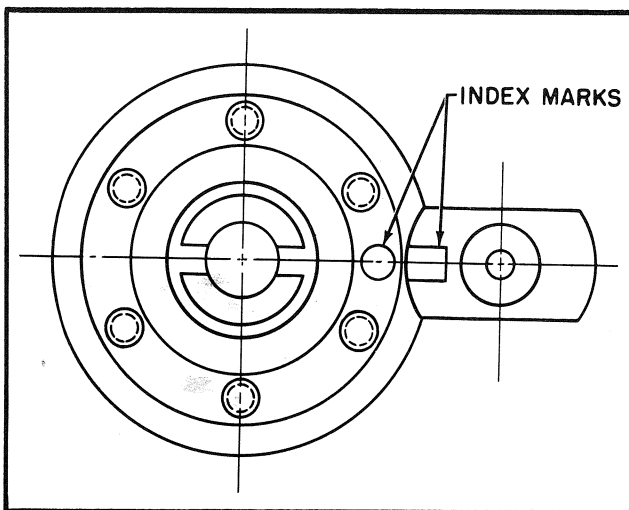


Figure P. Alignment of Counter Gear and Shuttle Shaft



when the shaft is properly adjusted. Remove the special tools.

k. Place a spring washer (31) on each shaft. 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 (29).

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 (29) over against the shim and tighten the two set screws (7). The shim gives the correct amount of 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 set screws (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 set screws (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) as shown in figure 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.

#### 60. GEAR CASE - CLUTCH MECHANISM. (See figure 3.)

a. Insert clutch plunger (30) into the gear case. Place the lower end of the clutch lever (28) into the slot just below the clutch plunger recess. Then insert the clutch lever stud (27) into the gear case so that

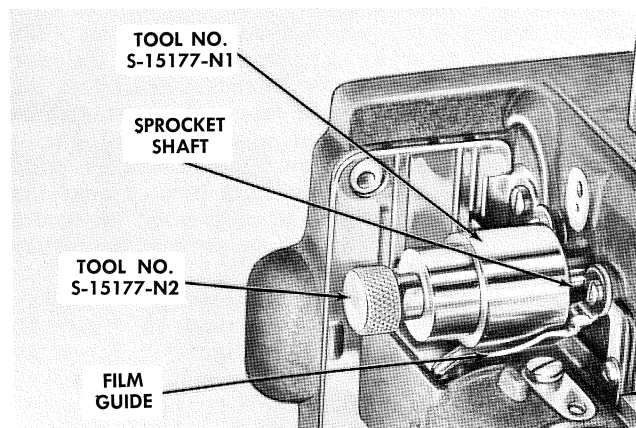


Figure R. Sprocket Shaft Adjustment

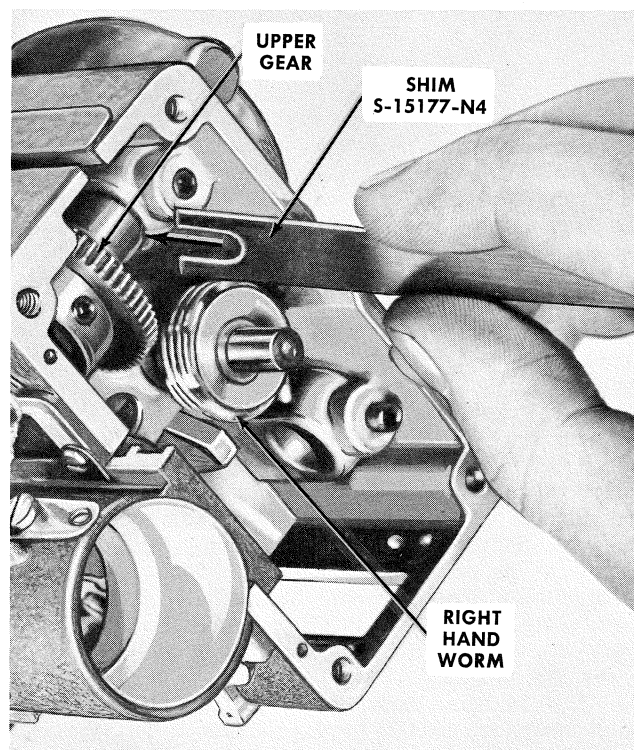


Figure S. Using Shims to Obtain Clearance

it engages the hole in the lower tip of the clutch lever (28). Screw in the pilot screw (26).

b. Lubricate the washer (24) with a light coat of B & H grease and place it in position on the boss on the rear of the cover (14). Hold the cover in such a position that the boss and washer will lay flat in the horizontal plane. Lay the idler gear (22) in position on the washer. Use a pair of tweezers to place eighteen steel balls (23) around the inside diameter of the idler gear. Insert the idler gear shaft (21). Hold these parts together with your fingers, turn cover over and screw the fillister head screw (25) into the idler gear shaft (21). Draw the screw up tight.

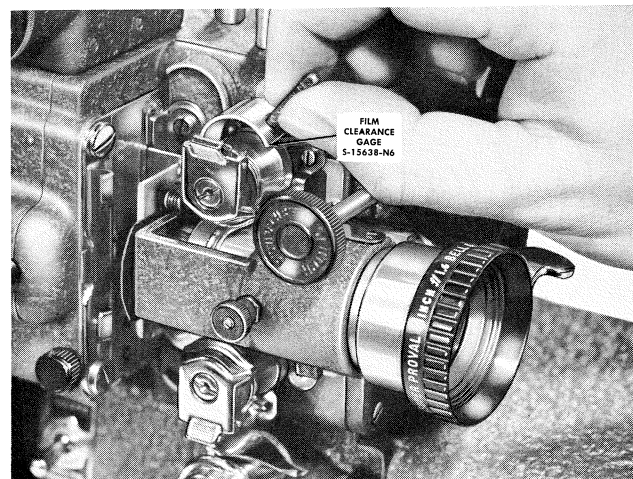


Figure T. Adjusting Film Clearance

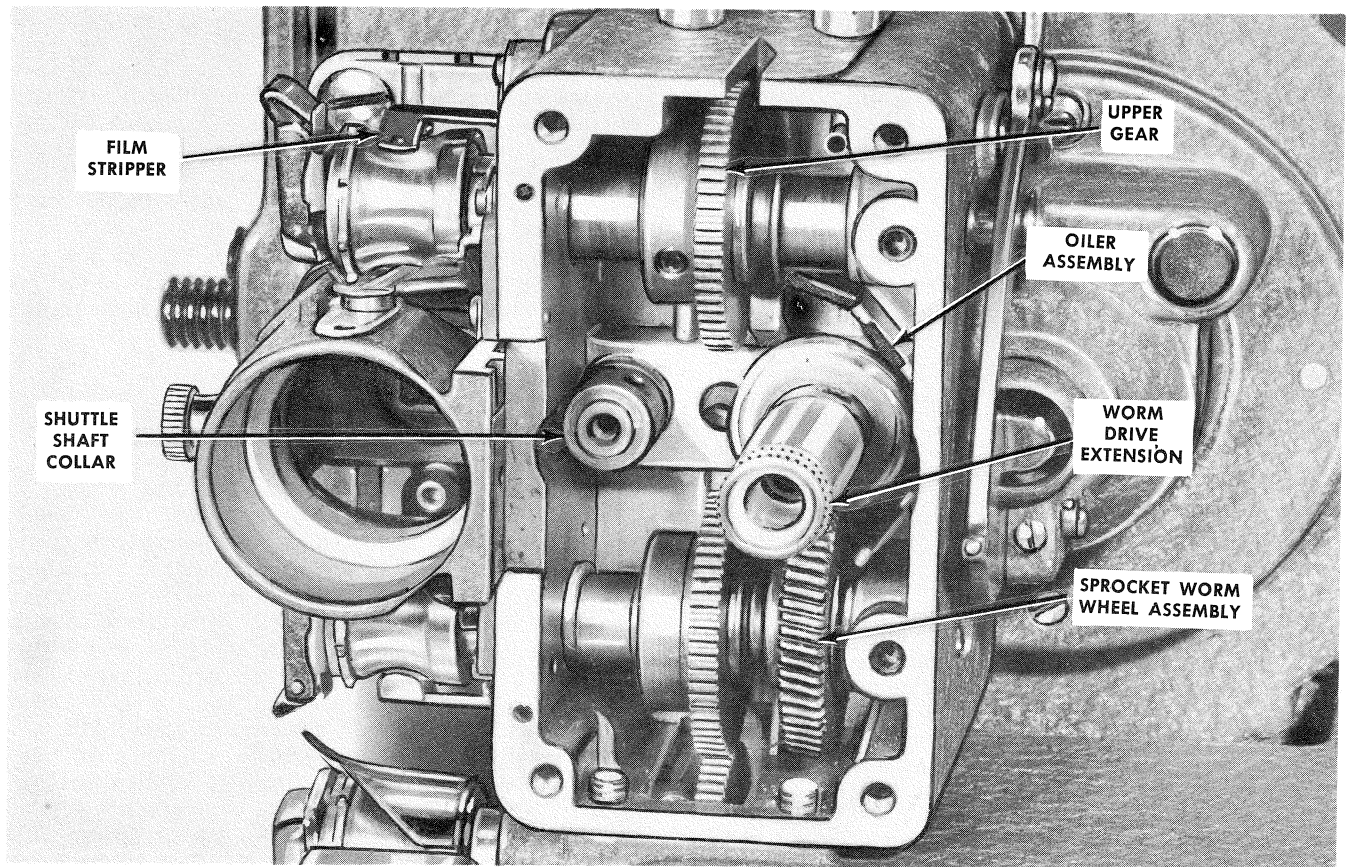


Figure U. Components Properly Installed in Gear Case

c. Assemble the eccentric bushing (20), plate and shaft assembly (19), fillister head screw (16), gate operating lever (17) and set screw (18) to the front of the cover as shown in figure 3.

d. Sparingly lubricate the gate operating block (15) and slip it into the slotted recess on the lens carrier assembly.

e. Carefully position the cover (14) on the gear case. The pin on the plate (19) must engage the hole in the gate operating block (15). This engagement is facilitated if the gate operating block is near the bottom of its slot. Manipulate the gate operating lever (17) slightly until the plate (19) engages the block (15). The cover (14) 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 (13).

f. Insert the knob assembly (10) through the boss on the left-hand side of the cover and then place the retaining ring (11) on the shaft. Insert the shaft through the right-hand boss, the spacer (12), and torsion spring (29) and screw it into the link of the clutch lever and linkage assembly (28). Screw the hex nut (9) onto the end of the shaft, drawing it up tight.

g. Hook the spring over the vertical link on the clutch lever and linkage assembly (28) and over the boss on the front cover (14). The spring should tend to keep the clutch disengaged. Place the rubber knob (8) on the counter gear extension.

#### 61. PRESSURE PLATE. (See figure 3.)

a. Insert the fillister head screw (3) through the spacer (5), bushing (4), pressure plate yoke (6) and screw it into the pressure plate (7).

b. Assemble the compression spring (2) and spring cup (1) between the head of the screw and the outer ear of the pressure plate yoke as shown in figure 3. Attach the bottom half of the pressure plate yoke in the same manner.

c. Adjust the pressure plate for position and pressure as outlined immediately following:

d. POSITION: The outer edge of the pressure plate (7) is slotted in order to provide clearance for the shuttle teeth. Therefore, it is necessary that the pressure plate be correctly positioned.

e. Close the gate lever (17) so that the pressure plate (7) rests on the aperture plate. Sight along the film channel and at the same time turn the hand setting knob (8) so that the shuttle makes a full stroke. Watch the shuttle teeth carefully to see if the teeth are centered in the pressure plate slot during the full course of the teeth travel. If it is, no adjustment for position is necessary. If it is not, the adjustment can be made as follows:

f. Insert a screw driver through the lens carrier and loosen the two screws (16, figure 4) just enough to be able to shift the pressure plate carrier (18, figure 4) slightly to either the left or right as necessary to center the shuttle teeth in the pressure

plate slot. When the correct adjustment is obtained, tighten the two screws (16, figure 4).

g. **PRESSURE:** The pressure adjustment can be made only after the gear case has been assembled to the blower housing. Refer to paragraph 63 for this adjustment.

## 62. PROJECTOR. (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), take pains to make sure 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 fire shutter 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 clutch lever spring (10) and fillister head screw (9). The clutch lever spring should be flat up against the vertical side of the gear case.

f. 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.

g. Carefully place the assembled gear case, blower housing, motor housing and governor cap assemblies 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 with the Sems binding head screws (7) and fillister head screws and washers (8).

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

### NOTE

Before assembling the projector in the case, lubricate it at the points of lubrication shown in figure V and in accordance with the instructions given immediately following.

i. On codes W, X and Y units lay the projector on its side and insert the tip of the oil can into the small hole in each sprocket shaft, including the one on the sound head. Squeeze the side of the can three times in each hole. Place the projector in an upright position and wipe off the excess oil. Then place one drop of oil in each of the three oilers located in the top of the gear case. If any of the felt reservoirs were saturated with oil during the reassembly, no more oil need be added at this time. Be sure to caution the customer to follow the lubrication instructions printed in the booklet he received with the projector. Add grease if necessary to the grease cup in the take-up arm by removing the knurled head screw or plug shown in figure I.

## 63. PRESSURE PLATE ADJUSTMENT. (See figure 3.)

a. The pressure plate position adjustment has already been explained in paragraphs 61c through 61f. The pressure adjustment can only be made after gear case has been securely fastened to blower housing and all four attaching screws securely tightened. The pressure adjustment is done as follows:

b. Close the lens carrier in towards the aperture plate by pushing down on gate operating lever (17). Loosen set screw (18).

c. Use wrench No. S-10309-F1 (2, figure B) and turn on the hex head portion of eccentric bushing (20). Note also that the lens carrier will move in and out slightly. Note that when the pressure plate (7) is against the aperture plate, the compression springs (2) are compressed and the pressure plate yoke (6) is forced slightly away from the spacer (5).

d. When the space between the pressure plate yoke (6) and spacer (5) is 0.002 of an inch, the adjustment is correct. Tighten set screw (18) to lock the adjustment in.

e. Check adjustment after the set screw has been tightened. If tightening of the set screw has forced the pressure plate out of adjustment slightly, loosen and readjust, allowing enough to make up the difference caused by tightening the set screw.

f. Either too little or too much pressure may result in an unsteadily projected picture or in failure of the intermittent mechanism to maintain the lower film loop. This adjustment must be accurate.

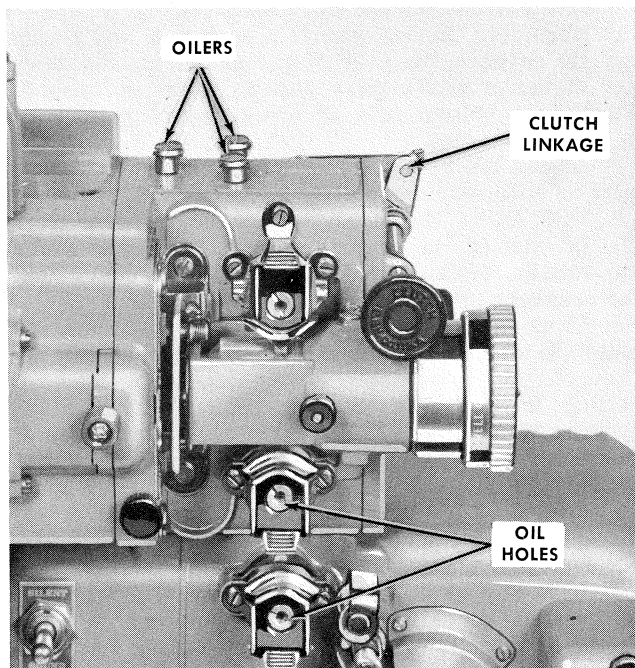


Figure V. View Showing Points of Lubrication



#### 64. 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 W. This adjustment is easily made with the use of a special tool like the one shown in figure X. 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 file used to make the slots. Knife file No. 2 is ideal.

d. Loosen the fillister head screw (18, figure 10) and remove the sprocket guard (19, 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 8) until one of the teeth on the second sprocket is in the vertical as shown in figure X, 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. Replace the sprocket guards over the sprockets as outlined in paragraph 59o.

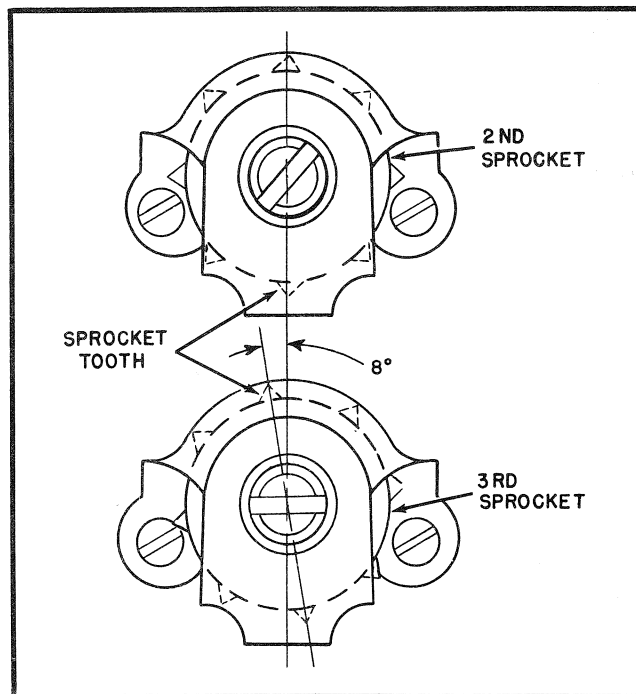


Figure W. Synchronization of Second and Third Sprockets

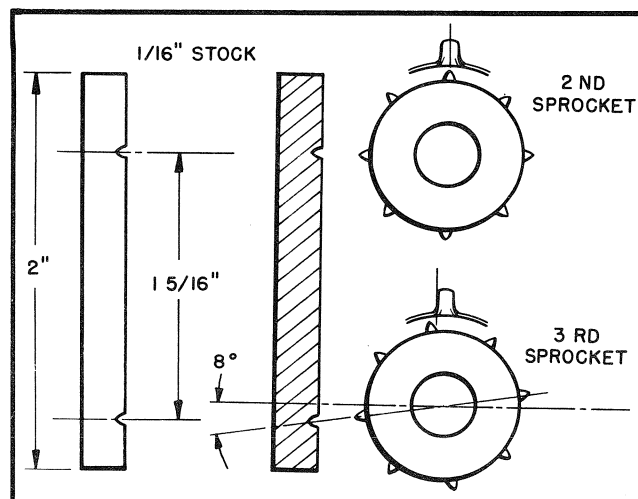


Figure X. Improved Tool for Synchronizing Sprockets

#### 65. SPEED ADJUSTMENT.

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

b. Check the speed at the worn 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  $\pm 30$  rpm.

c. In the event that a tachometer is not available, an alternate method may be used. This method is not as accurate as a tachometer and should not be used if a tachometer is available.

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 set screw located on each set of contact points on the governor. (See figure Y.) 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 set screw 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.

#### 66. CLUTCH LEVER AND FIRE SHUTTER ADJUSTMENT. (See figure 3.)

a. The correct clutch lever (28) adjustment 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 clutch lever. The air enters the projector on the clutch lever side of the gear case.

b. To adjust properly, loosen pilot screw (26) and turn clutch lever stud (27) until the following conditions are obtained.

c. Operate the projector at either sound or silent speed and move the clutch lever back and forth by turning knob assembly (10). The fire shutter must close, or cover the aperture opening, before the clutch lever is pulled back far enough to stop the mechanism. Conversely, in releasing the clutch lever, the mechanism must start running before the fire shutter rises.

d. To facilitate the correct adjustment of the fire shutter, turn the set screw (4, figure 6) either in or out as may be required. This screw is located directly above the fire shutter and will control the flow of air to the fire shutter, thus making it rise or drop more quickly. When properly adjusted, seal set screw in place with wax.

e. If there is any noise resulting from vibrations in the clutch mechanism, it can usually be corrected by a slight adjustment of the clutch lever stud (27).

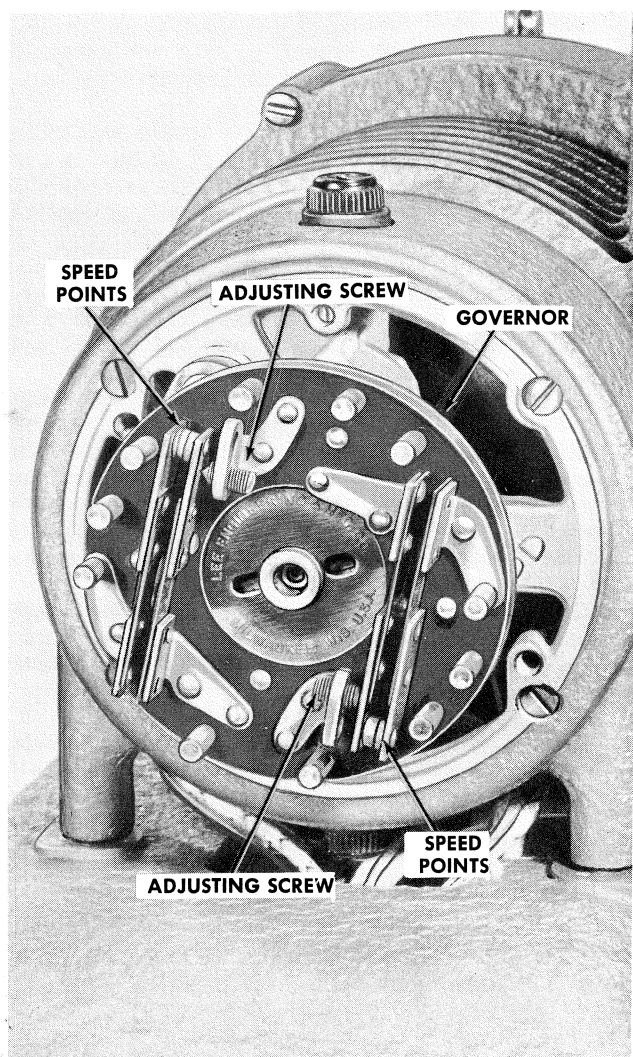


Figure Y. Adjusting Governor Speed

Be sure to tighten pilot screw (26) after adjustments have been made.

f. The clutch lever spring (10, figure 2) must hold the clutch lever snugly against the gear case and over the air hole.

#### 67. ASSEMBLY OF PROJECTOR AND AMPLIFIER IN CASE. (See figure 1.)

a. Install the spring belts (10 and 12). Place the projector (5) in the case (8) and secure with the fillister head screws (1), washers (2), rubber cushions (3) and spacers (4).

b. Remove the screws (28 and 29, figure 11) and terminal cover (30, figure 11). Connect the pilot lamp leads to terminals Nos. 1 and 3 on the terminal strip (51, figure 11.) Replace the terminal cover.

#### CAUTION

Make sure that leads are not chafed or pinched by the terminal cover.

c. Place the amplifier (7, figure 1) next to the projector and case as shown in figure C. Connect cables as follows: (1) Connect the power transformer plug and exciter lamp plug to the receptacles on top of the amplifier (2) connect the power plug to the two prong receptacle on the rear of the amplifier.

d. Install the amplifier (7) with four knurled head screws (6). At the same time connect the record-playback plug into the front of the amplifier. (See figure C.)

#### 68. STABILIZER ROLLER ADJUSTMENT. (See figure Z.)

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 behind the stabilizer arm. Turn the cap 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. Check the alignment of the plain and flanged stabilizer rollers. If necessary, washers (see 3, figure 10) can be added or removed to align the rollers. Misalignment of the stabilizer rollers may cause uneven film tracking around the sound drum and magnetic heads.

e. Readjust the stabilizer roller assembly if necessary (see step c above).

f. 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 time elapsed between starting the film through the projector and the plain roller to come to rest in its operating position should be in 2-1/2 seconds. If it is not, the torsion spring (5, figure 10) must be replaced.

**69. OPTICAL SLIT ADJUSTMENT.** (See figure Z.)

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 68) 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 set screw immediately to lock the optical slit assembly in place. Be very careful not to change the setting of the optical slit when tightening the set screw. Seal the set screw in 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.

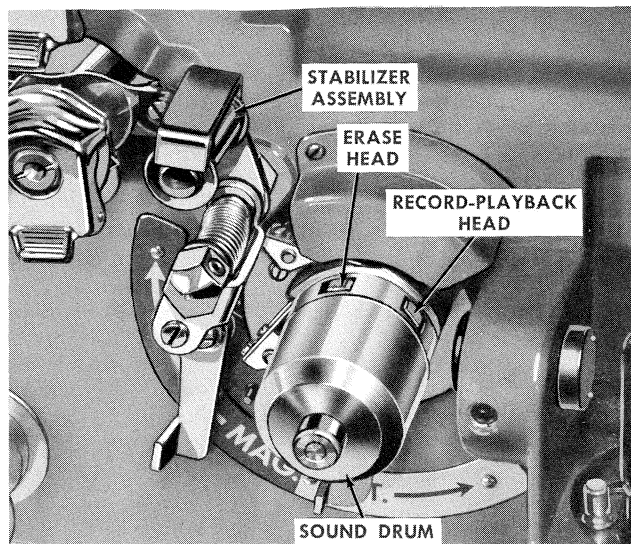
**70. SERVICING THE MAGNETIC HEADS.** (See figure Z-1.)

Figure Z-1. Magnetic Heads and Sound Drum

Unless damaged by rough handling or improper adjustment, the heads have a relatively long life. Frequently, poor sound quality is due to causes other than head failure. Before disassembling the head assembly, check for the following more common causes of poor sound quality:

- a. Amplifier trouble (see paragraph 34 thru 42 inclusive).
- b. Foreign material on faces of head.
- c. Worn or damaged film perforations.
- d. Dry and brittle film.
- e. Buckled film making erratic contact with heads.
- f. Uneven thickness of film coating.
- g. Uneven width of magnetic stripe.
- h. Dirt or other foreign material imbedded in coating.

**71. SOUND DRUM SHAFT AND BEARING ASSEMBLY.**

If the heads are damaged, either remove the sound drum and bearing assembly (see paragraph 12) and send it to the factory for exchange for a rebuilt unit, or replace the damaged parts using procedures contained in the following paragraphs.

**72. INSPECTION OF POLE PIECES AND COILS.** (See figure Z-2.)

a. Use a jewelers loup or other magnifier to inspect the faces of the pole pieces (11 and 13). Fine scratches, in the direction of film travel, seldom effect operation. Deep grooves or steps (caused by extensive operation with 1/4 or 1/2 track film) will prevent proper track contact area and are cause for replacement.

b. Use a low voltage AC supply and an AC voltmeter to check continuity of the head coils (see figure Z-3 for terminal configuration).

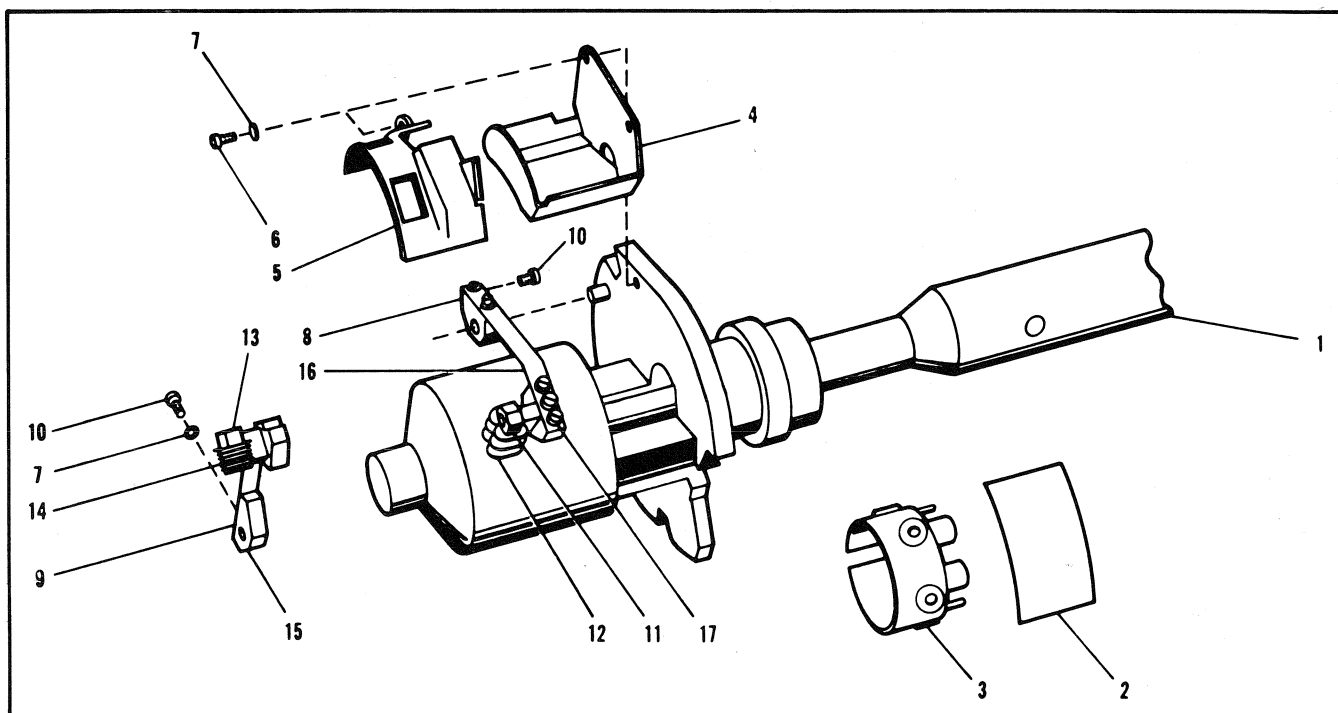
**CAUTION**

Do not check continuity by using a DC powered ohmmeter - the heads would become magnetized.

Open head circuits, unless traceable to broken leads at terminal strip, will require replacement of the damaged coil.

**73. REMOVING POLE PIECES AND COILS.**

- a. Shift function lever to optical position. Remove screw (12, figure 11) and roller (13).
- b. Remove the two screws (5, figure 11) and light shield (6).
- c. Remove the screw (6, figure Z-2) and washer (7).
- d. Shift function lever to the magnetic position and remove the screw and washer at the other end of the hum shield (5, figure Z-2).
- e. Shift function lever to position midway between optical and magnetic positions and carefully lift off the hum shield (5, figure Z-2). Remove the remaining fillister head screw and washer to release the lower hum shield (4).



- |   |   |
|---|---|
| 1. Bearing and shaft assembly                           | 9. Erase arm, hub, and head assembly complete |
| 2. Tape   | 10. Screw                                     |
| 3. Terminal ring  | 11. Record-playback head assembly pole piece  |
| 4. Shield   | 12. Record-playback bobbin and coil assembly  |
| 5. Shield cover   | 13. Erase head assembly pole piece            |
| 6. Screw  | 14. Erase bobbin and coil assembly            |
| 7. Washer   | 15. Hub                                       |
| 8. Record-playback arm, hub, and head assembly complete | 16. Arm                                       |
|   | 17. Center screw                              |

Figure Z-2. Sound Drum and Heads

f. Loosen the screw (10, figure Z-2) and carefully lift the record-playback arm (16) as far as possible, without creating a strain on the coil leads. While holding the arm in this position, tighten the screw (10).

g. Shift the function lever to a position such that the record-playback head is facing straight up.

h. Apply acetone to the head pole pieces at the points where they enter the coil forms.

**CAUTION**

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

i. Allow approximately 30 seconds for the acetone to soften the cement, then while holding the arm (16, figure Z-2) in place, insert a jewelers 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 loosen it. When the two coils are loose, slip them away from the pole piece assembly.

j. Shift the function lever to the mid-position and while holding the pole piece with tweezers, loosen the center screw (17, figure Z-2) and remove the pole piece. If coils require replacement, use acetone as a cement solvent to separate the tie bar from the coil bobbin.

k. In order to remove the erase pole piece follow the same general procedure described in paragraph f thru j inclusive.

l. The pole pieces having been removed, the resistance of the coils can be checked without danger of magnetization. Remove twine and tape from terminal ring (3, figure Z-2) and carefully unsolder and remove the two leads from the terminal (1, figure Z-3). The resistance of the coils will be approximately as indicated in figure Z-3. Shorted coils should be replaced.

m. Should it be necessary to replace a coil (bias and record coils must be replaced as a set), carefully disconnect the leads from the terminal ring (3, figure Z-2). Refer to figure Z-3 for connections.

n. Coils must be connected as shown in figure Z-3. Coils and leads are identified as follows:

(1) Erase Coil - Wound with heavier gage wire than record-playback coil. Coil has two tinned leads and the longer lead is the start of the winding.

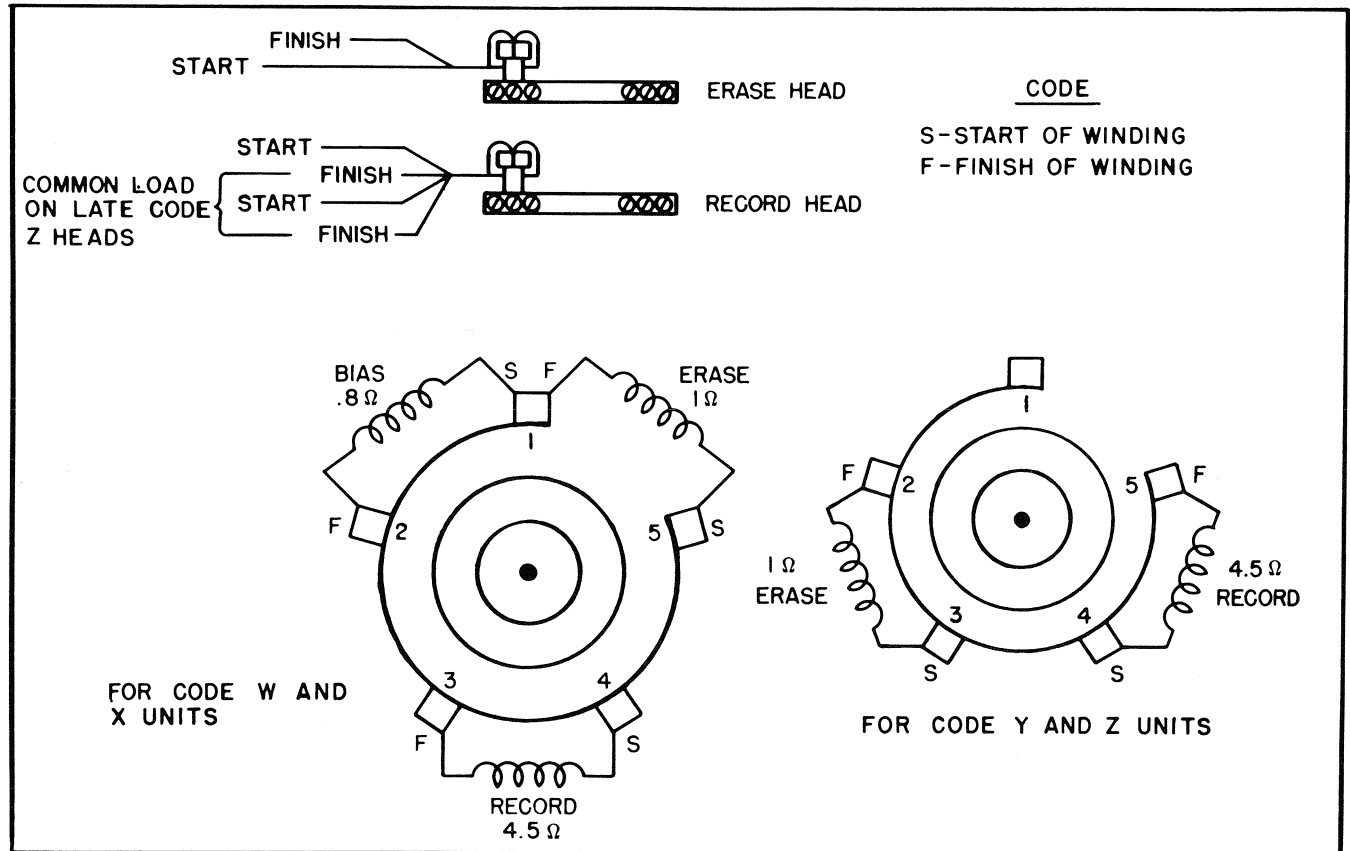


Figure Z-3. Coil Identification and Connections

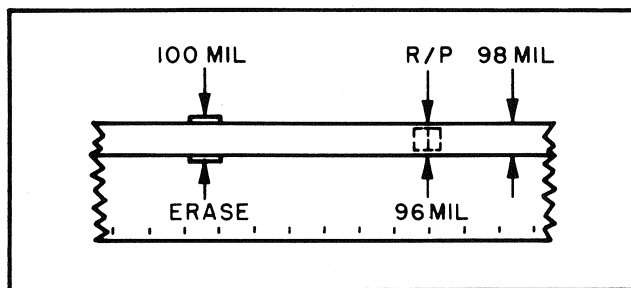


Figure Z-4. Lateral Location of Heads

(2) Bias Coil - (Part of record-playback coil assembly) wound with heavier gage wire than the record coil. Start lead is longer than finish lead.

(3) Record Coil - (Part of record-playback coil assembly) wound with lighter gage wire than bias coil. Start lead is longer than finish lead.

#### 74. REASSEMBLING COILS AND POLE PIECES.

a. Apply a light coat of 3M cement No. EC847 to the tie bar between the coils. Place the coils in position and hold in place until the cement sets.

b. Place a piece of tape on the sound drum surface with the end of the tape extending over the inner edge of the drum enough to pass under the magnetic head.

c. With the coil tie-bar resting on the tape, carefully press the pole piece into the coil structure.

d. After 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 an orange stick or toothpick and be careful not to get cement on the contact face of the pole piece.

e. Insert pole piece and coil assembly into the arm and tighten retaining screw just enough to hold head in place.

#### 75. PRELIMINARY HEAD ADJUSTMENTS.

a. Remove tape from sound drum. Loosen arm locking screw (10, figure Z-2) and lower arm (16) until face of pole piece is a few thousandths above the surface of the sound drum. Tighten the locking screw.

b. Measure the pressure required to depress the head until the face of the pole piece is flush with the face of the sound drum. Measurement should be made with a compression type ounce (0 thru 5 oz.) or gram (10 thru 80 gram) gage such as those manufactured by IMTRA Corp., Cambridge, Massachusetts. Correct erase head pressure is 4-1/2 oz.—adjust by loosening a screw (10) and raising or lowering arm. Correct record-play pressure is 1-1/2 oz. for full track film and 4-1/2 oz. for 1/4 or 1/2 track film. Loosen screw (10) and raise or lower arm (16) as required.

c. The location of the faces of the pole piece with

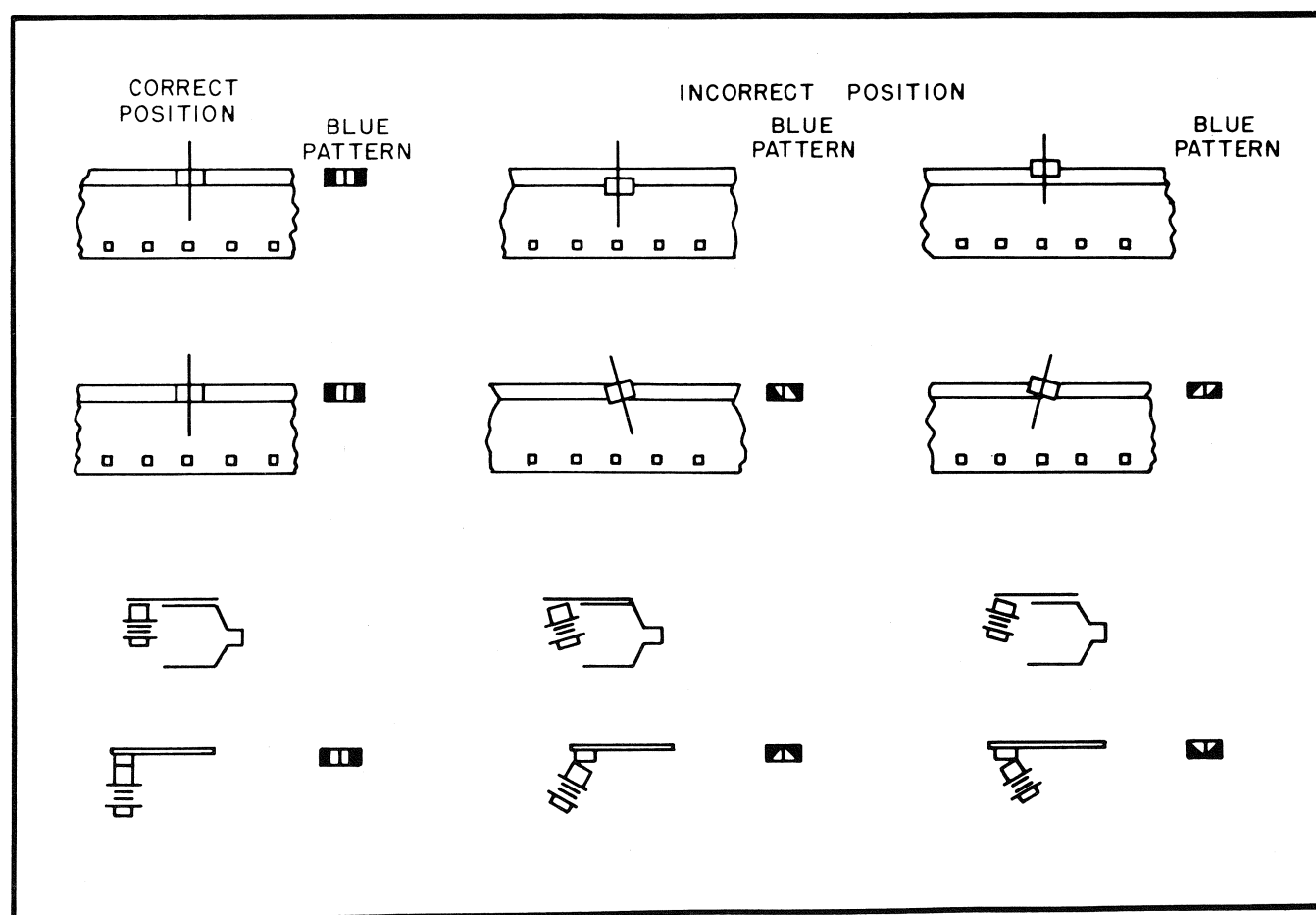


Figure Z-5. Head Orientation

respect to the track must be as shown in figure Z-4. The orientation of the pole pieces must be shown in "correct" views as shown in figure Z-5.

d. Place a light coat of prussian blue on the face of the pole piece. Place function lever in magnetic position. Thread a loop of magnetic film thru the sound head. Start projector and allow it to run for approximately 1/2 minute.

e. Carefully remove film from sound head and examine the pattern left by the prussian blue. The correct pattern will be a rectangle centered over the headgap as shown in "correct" column of figure Z-5.

f. If blue pattern is not as shown in "correct" position as shown in figure Z-5, adjust as follows:

(1) Head too far to right or left - loosen end screw in block (8 or 15, figure Z-2) and move arm sideways.

(2) Gap not centered in rectangle - loosen screw (17) and rotate head.

(3) Pattern skewed with respect to gap - loosen two end screws (adjacent to screw (17) ) and twist head as required.

(4) Triangular or trapezoidal patterns - twist arm to re-level pole piece.

#### 76. FINAL HEAD ADJUSTMENTS. (See figure Z-2.)

a. Connect the amplifier to the projector. Connect a 16 ohm resistor, AC voltmeter and oscilloscope

to the single speaker output.

b. Thread the projector with either ASA 16 mm magnetic azimuth film or a full track prerecorded 3000 cps film made on a projector known to be in correct adjustment. Place function switch in magnetic position. Place tone control in "max treble" position.

c. Start projector and adjust volume control to produce an output voltage of approximately 2 volts.

d. Loosen head locking screw (17) and rotate head to peak output position. Tighten locking screw.

e. Loosen two screws adjacent to screw (17) and twist head to peak output position. Tighten the retaining screws.

f. Remove prerecorded film from the projector and re-thread with another full track film. Connect an audio oscillator (set to frequency of 1 K.C.) to the input jack.

g. Switch to record position and start projector. Set volume control to 2 o'clock position and adjust oscillator level control to correct recording level (on 202 and 302 B and C, lamp should glow faintly - on 302 D and E, peak lamp should barely glow). Record about 30 feet of track.

h. Stop projector. Switch to playback and disconnect oscillator. Do not change volume control setting.

i. Rewind film back to start of recording and start projector. When approximately 1/2 of recording has passed thru the projector, stop projector and switch to record. Start projector and allow the remainder



of the film to pass thru the projector.

#### NOTE

Amplifier gain setting is unchanged but no signal is being applied to input.

j. Switch to playback and rewind film to start of recording.

k. Start projector and note output meter reading. When erased position of previous recording is reached, output should drop at least 27 db. If level drops less than 27 db, erase head is not properly positioned. (See figure Z-4.) Shift head from side to side as required and recheck erase-down. When head position is changed, head pressure should be rechecked, as per paragraph 75b.

l. Remove film from projector. Place function lever in magnetic position. Check to make sure that rubber roller (13, figure 11) is bearing evenly across the face of the sound drum. On codes W and X units, it will be necessary to grasp the hex screw (12, figure 11) and twist it to straighten the shaft, if the shaft has been bent out of line. On code Y and Z units, adjust screws located behind the exciter lamp in order to realign roller.

m. Connect a gram scale to the roller screw and check force required to pull roller off of drum. Roller should just leave drum at a force of 100 to

110 grams. Adjust pivot stud (19, figure 11) to obtain correct lift-off force. Install and secure hum shields (4 and 5, figure Z-2).

#### 77. PHASING.

a. Set projector for magnetic playback. Start projector and turn volume and tone controls to mid-points.

b. (W and X.) (See figure 12.) Remove dot fastener (50) and top check nut (51). Loosen record nut and rotate transformer to obtain minimum output reading. Tighten nut and replace top check nut and dot fastener.

c. (W and X.) Place projector on its back, connect speaker in place of lead resistor and remove inspection plate from the bottom of the amplifier. Turn on projector and turn volume control to maximum volume position. Dress the following leads for minimum noise.

(1) Unshielded slate colored lead from pin 1 of input transformer to function switch.

(2) Silver shielded lead from pins 2 and 1 on front connector (head connector) to function switch.

(3) Unshielded leads from terminal of terminal strip to input transformer.

d. (Y and Z.) Turn hum coil adjustment screw adjacent to pivot screw (19, figure 11) to reduce hum level to minimum.

## Final Test

#### 78. 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.

#### 79. 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 22 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.

#### 80. 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 (par. 20).

b. Inspect and clean the sound head and optical slit (par. 21).

c. Inspect and clean all film handling parts (par. 22).

d. Check snubber roller adjustment (par. 52, steps f through h).

e. Check height of shuttle teeth (par. 59, steps c through f).

f. Check film guide adjustment (par. 59n).

g. Check shuttle teeth stroke (par. 61).

h. Check pressure plate adjustment (par. 63).

i. Check clutch lever and fire shutter adjustment (par. 66).

j. Check sprocket synchronization (par. 64).

k. Check running speeds (par. 65).

l. Check stabilizer roller adjustment (par. 68).

m. Check optical slit adjustment (par. 69).

n. Check magnetic head adjustment (par. 70).

o. Check for hum or noise pick-up (par. 77).

p. Be certain that film tests have been made.

q. Check operation of reel arms.

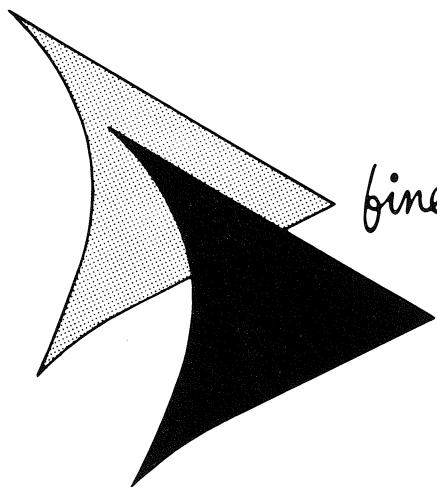
r. Be sure all lubrication has been performed.

s. See that all screws and nuts are secure, and that amplifier is installed properly (par. 67).

t. Check operation of tilt mechanism.

## **PARTS CATALOG**

# **FILMOSOUND PROJECTORS DESIGNS 202 and 302**



*finer products through imagination*

**Bell & Howell**

**GENERAL SERVICE DEPT.  
7125 N. KIMBALL AVE.  
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# *Parts Catalog*

The following breakdown lists and illustrates the serviceable parts of the Optical-Magnetic Film-sound Projectors. Parts are identified by part number and description. When ordering parts, be sure to include both part number and description.

The exploded view illustrations serve to identify and show the relationship of parts. For this reason, extensive reference to these views is made throughout the service text. The exploded views themselves are cross-referenced to the pertinent disassembly and reassembly paragraphs.

Parts for the amplifier assembly can be readily identified by reference to the overall view, figure C, and the amplifier schematic diagrams, figure G.

In order to provide a quick identification of material applicable to a specific design the following design code has been assigned:

Design No.	Design Code
202 B and C	W
302 B and C	X
302 D and E (Not equipped with Factory Sealed Lubrication thru Serial number N95101)	Y
302 D and E (Equipped with Fac- tory Sealed Lubri- cation Serial number N95102 and up)	Z

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
AMPLIFIER ASSEMBLY				
1	17173	SCREW, base plate attaching . . . . .	4	All
2	07003	PLATE ASSY, base (includes items 3 through 5) . . . . .	1	All
3	17098	SCREW, self-tapping, No. 4, type Z . . . . .	1	All
4	24842	PLATE, inspection . . . . .	1	All
5	NPN	PLATE SUBASSY, base . . . . .	1	All
6	22580	KNOB, master volume control . . . . .	1	W,X
6	29687	KNOB, volume . . . . .	1	Y,Z
7	22579	KNOB, tone control . . . . .	1	W,X
7	29685	KNOB, tone control (bass) . . . . .	1	Y,Z
7	29684	KNOB, tone control (treble) . . . . .	1	Y,Z
8	22605	KNOB, mic-vol control . . . . .	1	W,X
9	22604	KNOB, function switch . . . . .	1	W,X
9	29686	KNOB, function switch . . . . .	1	Y,Z
10	25580	HOLDER, fuse . . . . .	1	All

For electrical components of amplifier assembly, see figure G.

OPTICAL-MAGNETIC FILMOSOUND PROJECTOR, MODELS 202 and 302

1-		FILMOSOUND PROJECTOR . . . . .	1	All
1-1	17321	SCREW, fil hd . . . . .	4	All
-2	13691	WASHER . . . . .	4	All
-3	17345	CUSHION . . . . .	8	All
-4	17320	SPACER . . . . .	4	All
-5	NPN	PROJECTOR ASSY (see figures 2 thru 11 for breakdown) . . . . .	1	All
-6	12823	SCREW, knurled hd . . . . .	4	W,X
-6	29195	SCREW, pan hd . . . . .	4	Y,Z
-7	08256	AMPLIFIER ASSY . . . . .	1	W
-7	09046	AMPLIFIER ASSY . . . . .	1	X
-7	09431	AMPLIFIER ASSY . . . . .	1	Y,Z
-8		CASE ASSY (see figures 12 and 12A for breakdown) . . . . .	1	All
-9	09655	ARM ASSY, reel and take-up (see figure 13 for breakdown) . . . . .	1	All
-10	21898	BELT, spring, rear reel arm . . . . .	1	All
-11	08905	ARM ASSY, front reel (see figure 14 for breakdown) . . . . .	1	All
-12	22660	BELT, spring, front reel arm . . . . .	1	W
-12	27947	BELT, spring, front reel arm . . . . .	1	X,Y,Z

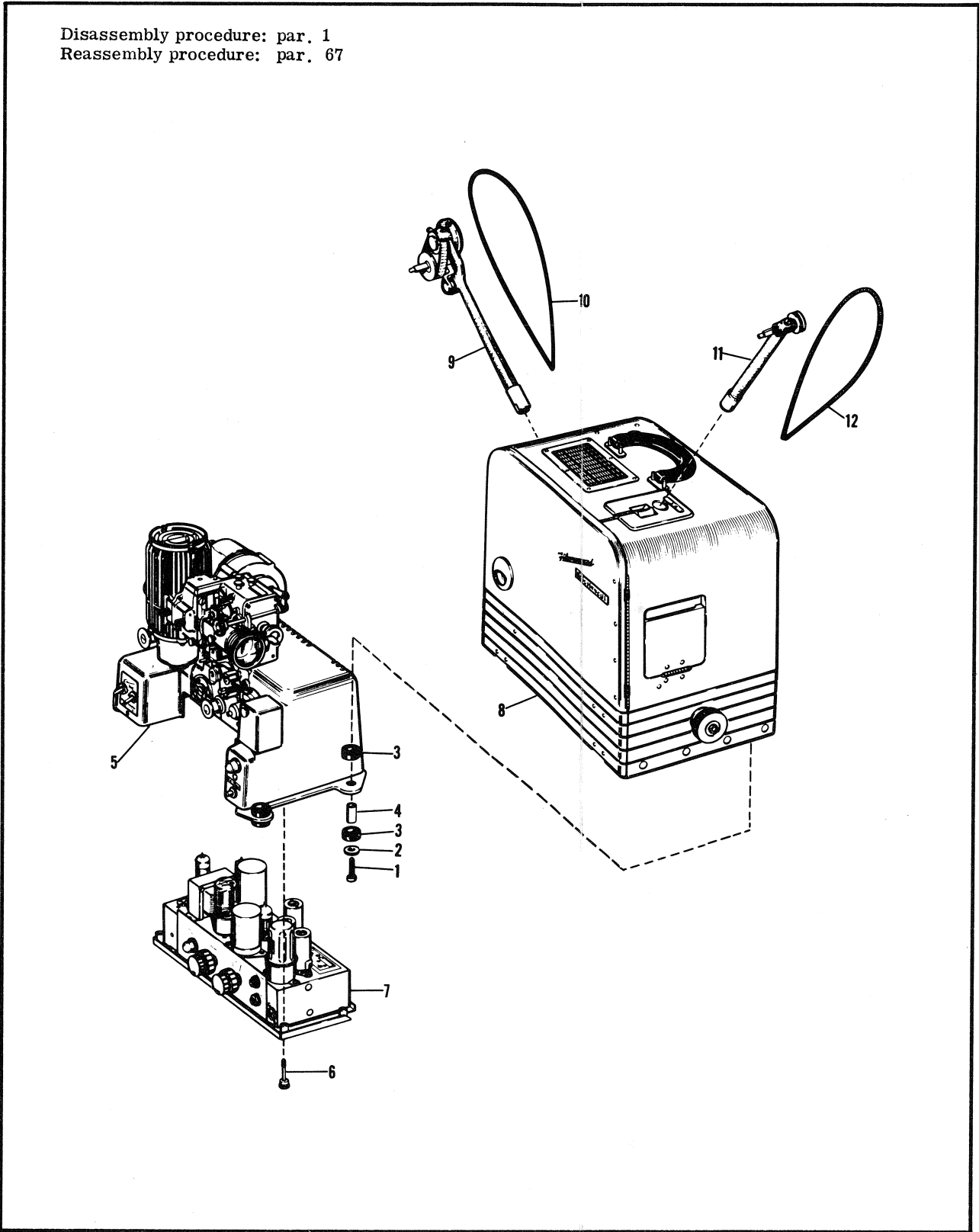


Figure 1. Optical-Magnetic Filmosound Projector

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
PROJECTOR ASSEMBLY				
2-1	07023	CONDENSER ASSY, relay (see figure 6 for breakdown) . . . . .	1	All
-2	07204	CONDENSER ASSY, 45-mm - 50-mm (see figure 9 for breakdown) . . . . .	1	All
-3	05647	LENS AND RING ASSY, coated, 2-inch projection. . . . .	1	All
-4	17313	SCREW, knurled hd . . . . .	1	All
-5	23106	COVER, exciter lamp . . . . .	1	All
-6	17327	LAMP, exciter . . . . .	1	All
-7	17388	SCREW, sems binding hd . . . . .	2	All
-7A	3837	SCREW . . . . .	2	All
-7B	12661	WASHER, lock . . . . .	2	All
-8	21982	SCREW, fil hd, with washer . . . . .	2	All
-9	20714	SCREW, fil hd . . . . .	2	All
-10	16189	SPRING, clutch lever . . . . .	1	All
-11	30167	SCREW, fil hd, No. 5-40 . . . . .	2	All
-12	5641	RAIL, guide . . . . .	1	W
-12	27472	RAIL, guide . . . . .	1	X,Y,Z
-13	4258	WASHER . . . . .	2	All
-14	NPN	GEAR CASE ASSY (see figures 3, 4, and 5 for breakdown) . . . . .	1	All
-15	20715	SCREW, fil hd . . . . .	4	All
-16	5211	SCREW, fil hd . . . . .	2	All
-17	NPN	HOUSING ASSY, blower (see figure 6 for breakdown) . . . . .	1	All
-18	10349	SCREW, fil hd . . . . .	2	W,X
-18	30175	SCREW, fil hd . . . . .	2	Y,Z
-19	NPN	CAP ASSY, governor (see figure 7 for breakdown) . . . . .	1	All
-20	NPN	LAMPHOUSE, GOVERNOR AND MOTOR (see figures 8 and 9 for breakdown) . . . . .	1	All
-21	NPN	SOUND HEAD ASSY (see figures 10 and 11 for breakdown). . . . .	1	All

PROJECTOR ASSEMBLY (CONT)				
3-	03788	PRESSURE PLATE ASSY (includes items 1 thru 7) . . . . .	1	W
3-	09283	PRESSURE PLATE ASSY (includes items 1 thru 7) . . . . .	1	X,Y,Z
3-1	12776	CUP, spring . . . . .	2	All
-2	12071	SPRING, compression . . . . .	2	All
-3	12778	SCREW, fil hd . . . . .	2	All
-4	16198	BUSHING . . . . .	2	All
-4A	27469	SPRING, compression . . . . .	1	X,Y,Z
-5	16207	SPACER . . . . .	2	All
-6	12720	YOKE, pressure plate . . . . .	1	All
-7	22198	PLATE, pressure (short). . . . .	1	W
-7	26631	PLATE, pressure (long) . . . . .	1	X,Y,Z
-8	23112	KNOB, rubber . . . . .	1	All
-9	12087	NUT, hex, No. 10-32. . . . .	1	All
-10	07025	KNOB ASSY . . . . .	1	All
-11	16184	RING, retaining . . . . .	1	All
-12	15634	SPACER . . . . .	1	All
-13	1587	SCREW, oval hd, No. 8-32. . . . .	4	All
-14	07205	FRONT COVER AND PIN ASSY . . . . .	1	All
-15	5160	BLOCK, gate operating . . . . .	1	All
-16	971	SCREW, fil hd, No. 5-40 . . . . .	1	All
-17	16181	LEVER, gate operating . . . . .	1	All
-18	22457	SCREW, headless set, No. 5-40 . . . . .	1	All
-19	0772	PLATE AND SHAFT ASSY . . . . .	1	All
-20	966	BUSHING, eccentric . . . . .	1	All
-21	891	SHAFT, idler gear . . . . .	1	All
-22	890	GEAR, idler . . . . .	1	All

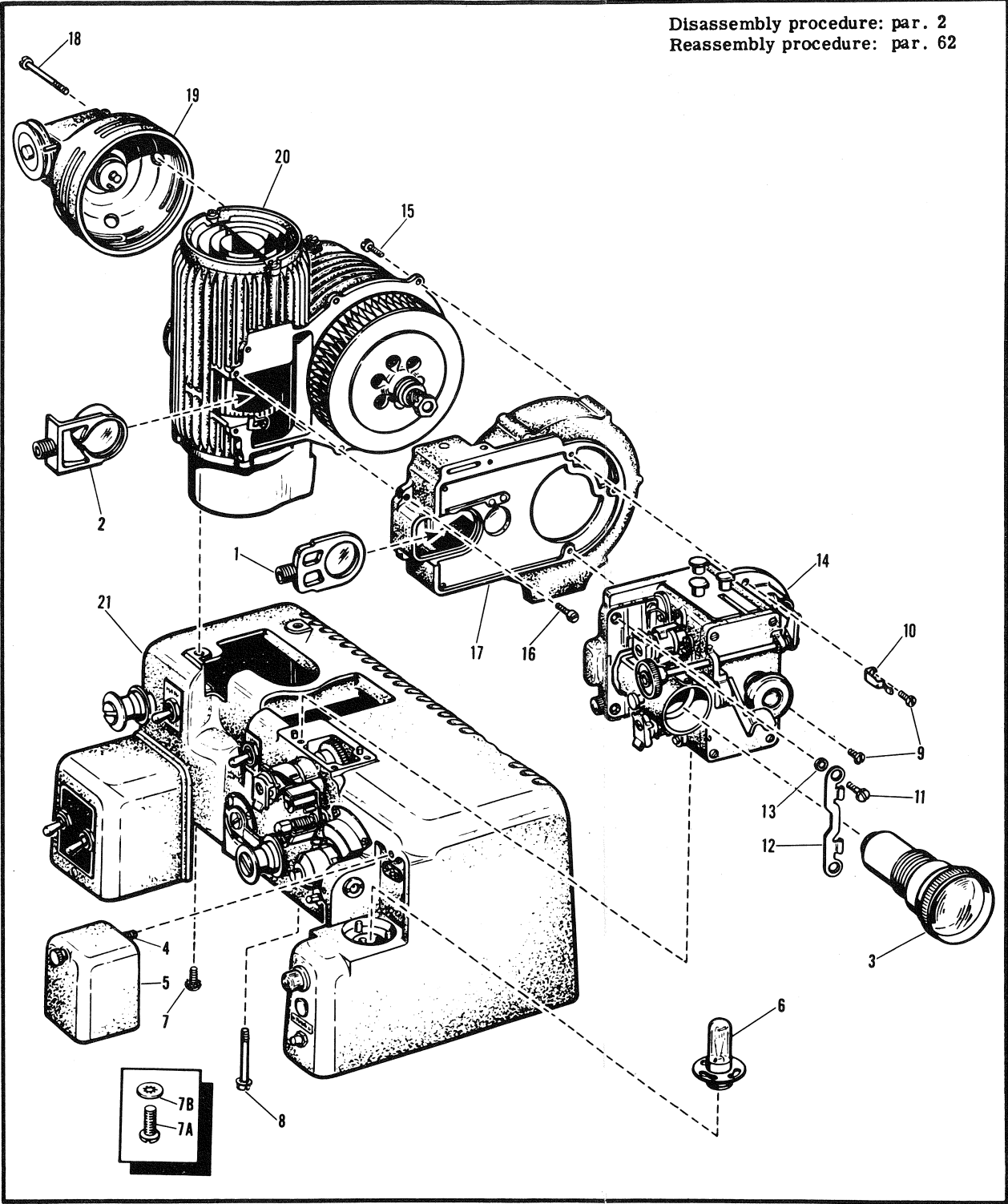


Figure 2. Projector Assembly

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
PROJECTOR ASSEMBLY (CONT)				
3-23	6715	BALL, steel, 1/16 in. . . . .	18	All
-24	11713	WASHER . . . . .	1	All
-25	112	SCREW, fil hd, No. 5-40 x 1/4 in. . . . .	1	All
-26	5639	SCREW, pilot, No. 4-40 . . . . .	1	All
-27	16191	STUD, clutch lever . . . . .	1	All
-28	05707	CLUTCH LEVER AND LINKAGE ASSY . . . . .	1	All
-29	20717	SPRING, torsion . . . . .	1	All
-30	05746	CLUTCH PLUNGER AND PIN ASSY . . . . .	1	All
PROJECTOR ASSEMBLY (CONT)				
4-1	7493	SCREW, fil hd, No. 4-40 . . . . .	2	W
-1	27640	SCREW, fil hd, No. 4-40 . . . . .	2	X,Y,Z
-2	11762	STRIPPER, film . . . . .	2	All
-3	11757	SCREW, fil hd, No. 6-40 . . . . .	2	W,X,Y
-3	30390	SCREW, fil hd, No. 6-40 . . . . .	2	Z
-4	08990	SPROCKET GUARD ASSY . . . . .	2	All
-5	16243	SPRING . . . . .	2	All
-6	16244	WASHER, tension . . . . .	2	All
-7	11859	SCREW, headless set, No. 8-32 . . . . .	2	All
-8	03461	SPROCKET ASSY . . . . .	2	All
-9	7493	SCREW, fil hd, No. 4-40 x 3/16 in. . . . .	4	W
-9	27640	SCREW, fil hd, No. 4-40 x 3/16 in. . . . .	4	X,Y,Z
-10	11761	GUIDE, film . . . . .	2	All
Not shown	25108	WASHER . . . . .	2	Y,Z
-11	15203	SCREW, pilot, No. 4-40 . . . . .	4	All
-12	11799	RETAINER, lens carrier . . . . .	2	All
-13	5148	SCREW, fil hd, No. 6-32 . . . . .	1	W,X
-14	5618	SPRING, ball retaining . . . . .	1	W,X
-15	145	BALL, steel . . . . .	1	W,X
-16	12075	SCREW, fil hd, No. 2-56 . . . . .	2	W,X
-17	11795	NUT, pressure plate adjustment . . . . .	2	All
-18	12719	CARRIER, pressure plate . . . . .	1	All
-19	24821	SCREW, lens lock . . . . .	1	W,X
-19	09577	SCREW, lens lock . . . . .	1	Y,Z
-20	24933	CARRIER, film gate and lens . . . . .	1	W,X
-20	30034	CARRIER, film gate and lens . . . . .	1	Y,Z
-21	5021	SCREW, fil hd, No. 2-56 . . . . .	2	All
-22	03462	CLIP ASSY, film tension (upper) . . . . .	1	All
-22	03463	CLIP ASSY, film tension (lower) . . . . .	1	All
-23	4255	SPRING, film gate thrust . . . . .	1	All
-24	11852	PLATE, aperture . . . . .	1	All
-25	010097	FRAMER SHAFT AND KNOB ASSY . . . . .	1	All
-26	11269	SCREW, headless set, No. 10-32 . . . . .	2	All
-27	29590	SHAFT, sprocket . . . . .	2	All
-27A	29589	LUBRICATOR, sprocket shaft . . . . .	2	Z
-28	11147	WASHER . . . . .	2	All
-29	11868	GEAR, upper . . . . .	2	All
-30	03460	SPROCKET WORM WHEEL ASSY . . . . .	1	All
-31	6419	WASHER, spring . . . . .	2	W

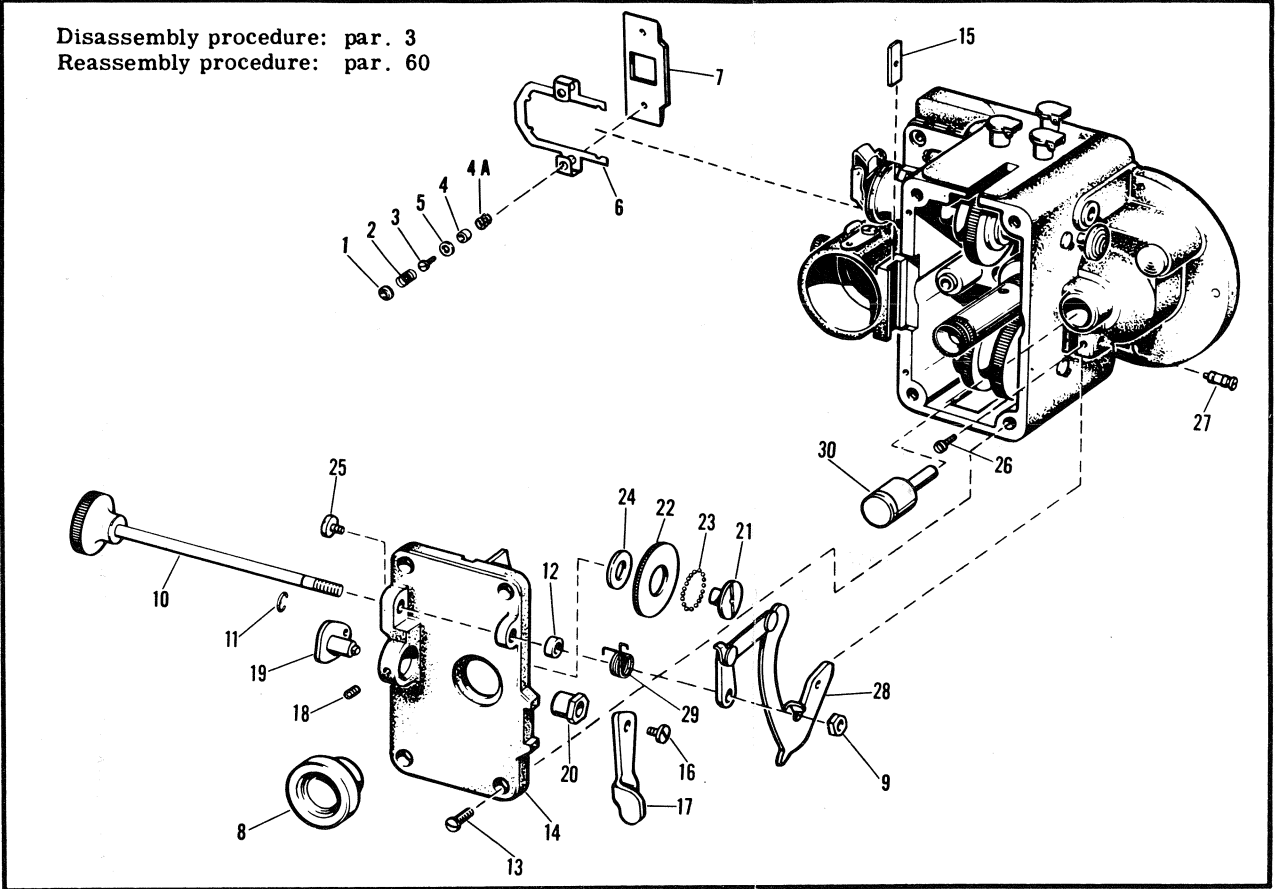


Figure 3. Gear Case Assembly (1 of 3 illust.)

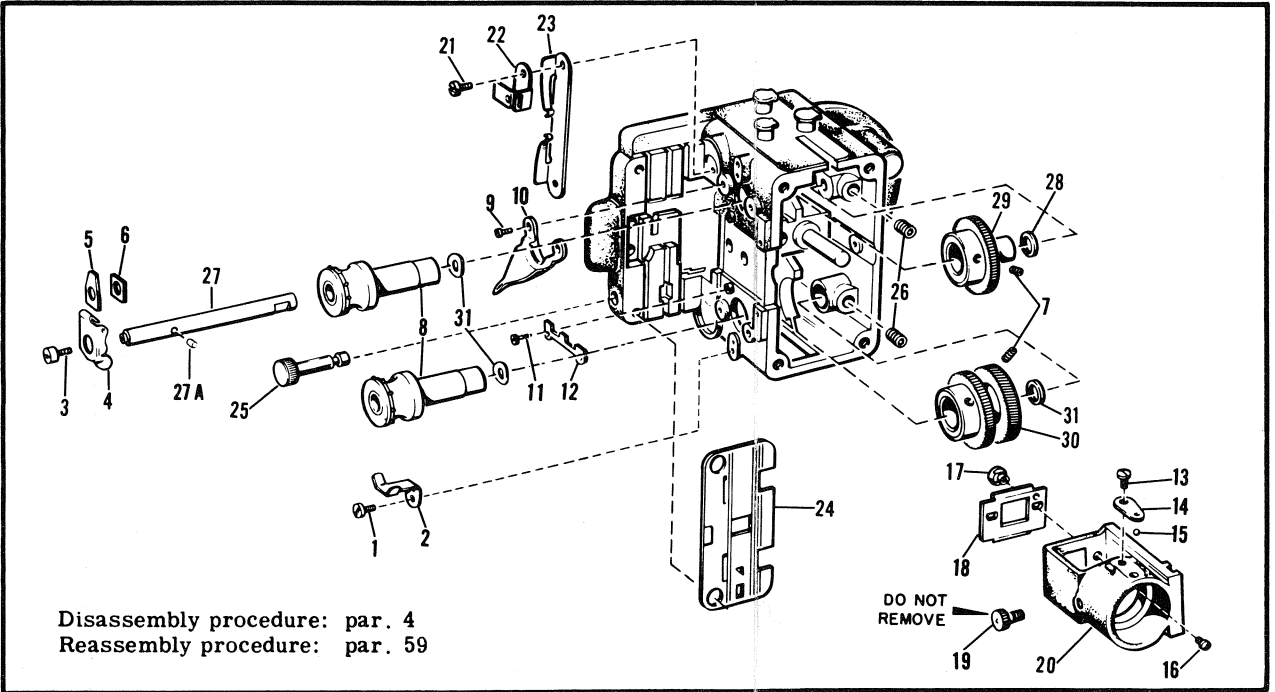


Figure 4. Gear Case Assembly (2 of 3 illust.)



Fig. and Index No.	Part No.	Description	Units Per Assy	Code
PROJECTOR ASSEMBLY (CONT)				
5-1	5112	NUT, hex, 5/16-32	1	All
-2	5111	SUPPORT, shutter	2	All
-3	5110	SHUTTER	1	All
-4	9558	BAFFLE, oil	1	All
-5	01078	LUBRICATOR ASSY (includes item 6)	1	All
-6	5469	FELT, lubricator	1	All
-7	5123	SCREW, special, fil hd	2	All
-8	8933	SHUTTLE, double tooth	1	All
-9	5113	PIN, dowel	2	All
-10	11282	SCREW, headless set, No. 8-40	2	All
-10A	8918	SCREW, shoulder, No. 5-40	1	X,Y,Z
-10B	11110	SPRING, compression	1	X,Y,Z
-11	11280	COLLAR	1	All
-12	9260	BALL, steel, 1/16 in.	15	All
-13	** 5322	SHAFT, shuttle	1	W,X
-13	* 27531	SHAFT, shuttle	1	Y,Z
-14	9260	BALL, steel, 1/16 in.	15	All
-15	9426	FELT, oil	1	All
-16	11282	SCREW, headless set, No. 8-40	1	All
-17	11279	EXTENSION, worm drive gear	1	All
-18	11282	SCREW, headless set, No. 8-40	1	All
-19	11281	SCREW, headless set	1	All
-20	11276	WORM, right-hand	1	All
-21	9260	BALL, steel, 1/16 in.	15	All
-22	05799	COUNTER GEAR AND SHAFT ASSY	1	All
-23	9260	BALL, steel, 1/16 in.	15	All
-24	9426	FELT, oil	1	All
-25	11055	SCREW, flat hd, No. 10-32	1	All
-26	11054	CLAMP, spring	1	All
-27	29570	FELT, oil	1	All
-28	5296	BEARING, shaft	1	All
-29	10529	SHIM, bearing	AR	All
-30	4460	SCREW, fil hd, No. 2-56 x 1/8 in.	1	W,X,Y
-31	01477	OILER ASSY	1	W,X,Y
-32	6093	OILER	1	W,X,Y
-33	5557	OILER	1	W,X,Y
-34	866	OILER	1	W,X,Y
-35	23120	CASE, gear	1	W,X,Y
-35	30588	CASE, gear	1	Z

PROJECTOR ASSEMBLY (CONT)				
6-1	03927	FIRE SHUTTER ASSY	1	All
-2	25185	SCREW, self-tapping, No. 2	2	W,X
-2	30134	SCREW, self-tapping, No. 2	2	Y,Z
-3	5247	GUIDE, fire shutter	1	All
-4	5893	SCREW, headless set, No. 10-32	1	All
-5	11569	STUD	1	All
-6	25190	RIVET	2	All
-7	5626	RETAINER, spring	1	All
-8	08030	HOUSING, blower and spring assy	1	All
-9	07023	CONDENSER ASSY, relay (includes items 10 thru 14)	1	All
-10	5014	SPRING, relay condenser lens retaining	1	All
-11	8066	LENS, condenser, auxiliary, 47-mm	1	All
-12	16217	SCREW, Phillip's rd hd, No. 5-40	1	All
-13	23116	HANDLE, condenser	1	All
-14	23111	HOLDER, relay condenser	1	All

\*\* Used with shuttle 8933 having square ends on teeth (old style).  
\* Used with shuttle 8933 having 10° angle on teeth (new style).

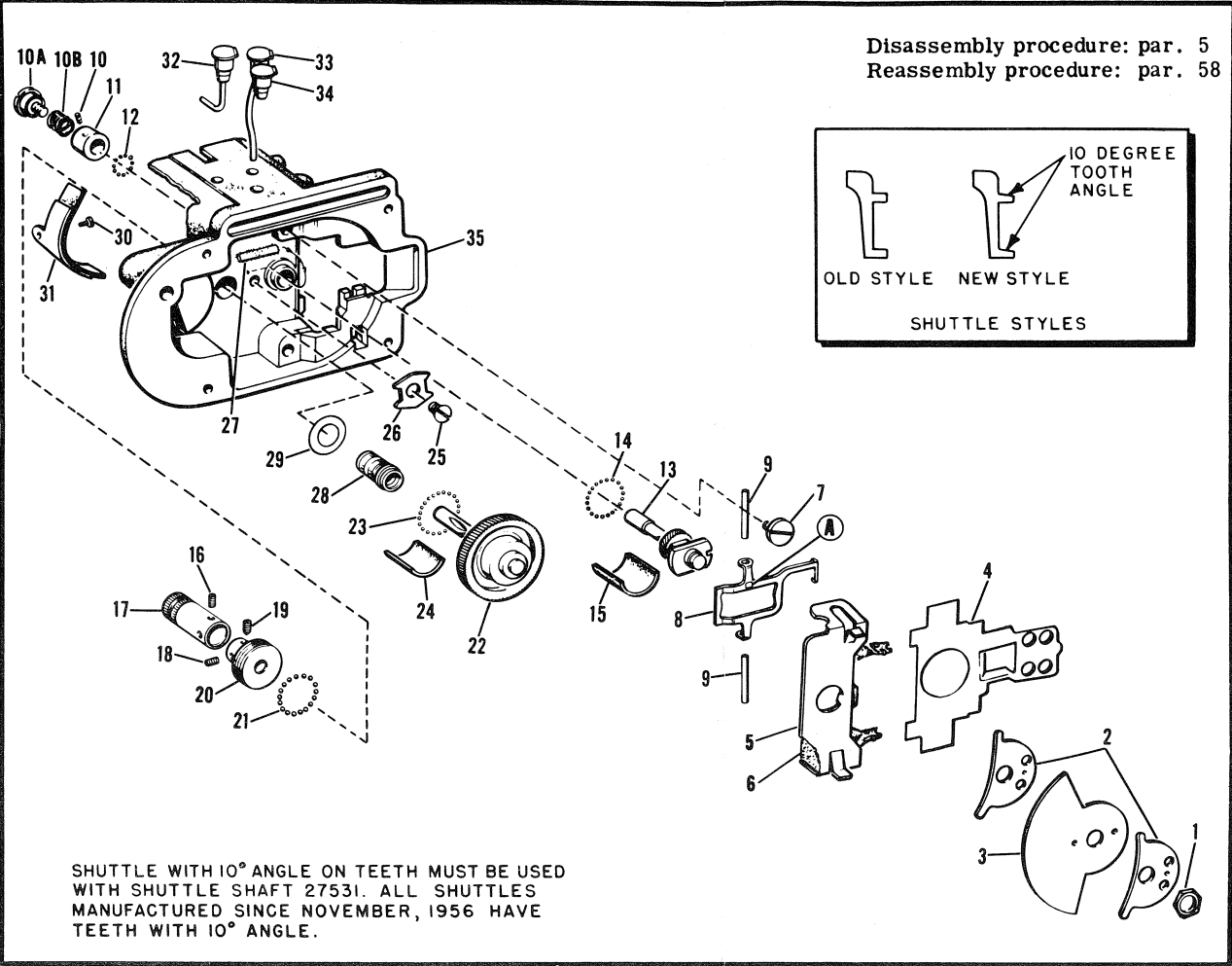


Figure 5. Gear Case Assembly (3 of 3 illust.)

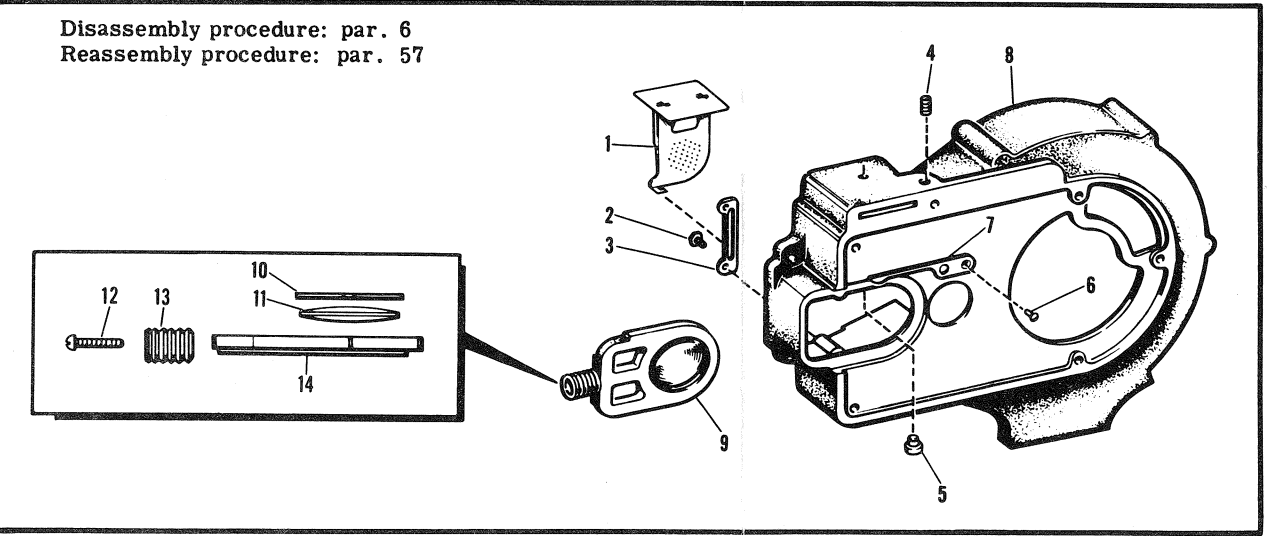


Figure 6. Blower Housing and Relay Condenser

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
PROJECTOR ASSEMBLY (CONT)				
7-1	10554	NUT, special . . . . .	1	All
-2	6129	SCREW, fil hd, No. 4-36 . . . . .	1	All
-3	27239	BEARING, radial . . . . .	1	All
-4	02794	WORM SHAFT AND DRIVE BLADE ASSY . . . . .	1	All
-5	10547	WASHER, felt . . . . .	1	All
-6	16698	SCREW, fil hd, No. 8-32 . . . . .	1	W,X
-6	32065	SCREW, fil hd, No. 8-32 . . . . .	1	Y,Z
-7	12864	COVER, reel drive clutch . . . . .	1	All
-8	15582	WASHER, bronze . . . . .	1	All
-9	10750	SPRING, compression . . . . .	1	All
-10	5514	CAM, clutch . . . . .	1	All
-11	5238	BALL, steel . . . . .	3	All
-12	10749	RETAINER, clutch ball . . . . .	1	All
-13	10540	PULLEY, rear take-up . . . . .	1	All
-14	5495	ROLLER, bearing . . . . .	18	All
-15	25984	SCREW, Phillip's truss hd, No. 8-32 . . . . .	1	All
-16	20726	WASHER, retaining . . . . .	1	All
-17	22716	BEARING, ball, radial . . . . .	1	All
-18	26238	WHEEL, worm . . . . .	1	All
-19	98798	PIN, retaining . . . . .	1	All
-20	20731	SHAFT, take-up pulley, upper . . . . .	1	All
-21	20727	RING, retaining . . . . .	1	All
-22	20716	BEARING, ball, radial . . . . .	1	All
-23	97510	RING, retaining . . . . .	1	W,X,Y
-23	30795	RING, retaining . . . . .	1	Z
-24	27706	BUTTON, plug . . . . .	1	X,Y,Z
-24	10551	SCREW, fil hd, 1/4-24 . . . . .	1	W
-25	23108	CAP, governor . . . . .	1	All

PROJECTOR ASSEMBLY (CONT)				
8-1	13586	NUT, thrust . . . . .	1	All
-2	13587	WASHER, thrust . . . . .	1	All
-3	9207	PINION, motor . . . . .	1	All
-4	9208	BEARING, roller . . . . .	31	All
-5	5193	WASHER, motor pinion . . . . .	1	All
-6	5343	PIN, dowel . . . . .	1	All
-7	13581	RETAINER, spring . . . . .	1	All
-8	13589	SPRING, compression . . . . .	1	All
-9	Com1	SCREW, headless set, flat pt, No. 8-32 . . . . .	2	All
-10	9428	GOVERNOR, motor . . . . .	1	All
-11	4664	BRUSH, governor . . . . .	3	All
-12	9579	SCREW, fil hd, No. 3-48 . . . . .	3	W,X
-13	10388	CAP, bearing retaining . . . . .	1	W,X
-14	9117	NUT, hex . . . . .	1	W,X
-15	10390	WASHER, locking . . . . .	1	W,X
-16	10356	BEARING, radial, 6-mm . . . . .	1	All
-17	15636	CAP, motor brush . . . . .	2	W,X
-17	29312	CAP, motor brush . . . . .	2	Y,Z
-18	12909	SPRING, motor brush . . . . .	2	W,X
-18	29290	SPRING, motor brush . . . . .	2	Y,Z
-19	12918	BRUSH, motor . . . . .	2	W,X
-19	29313	BRUSH, motor . . . . .	2	Y,Z
-20	9718	SCREW, fil hd, No. 6-40 . . . . .	4	All
-21	07719	GOVERNOR BRUSH HOLDER HOUSING ASSY . . . . .	1	W
-21	09205	GOVERNOR BRUSH HOLDER HOUSING ASSY . . . . .	1	X
-21	09455	GOVERNOR BRUSH HOLDER HOUSING ASSY . . . . .	1	Y,Z

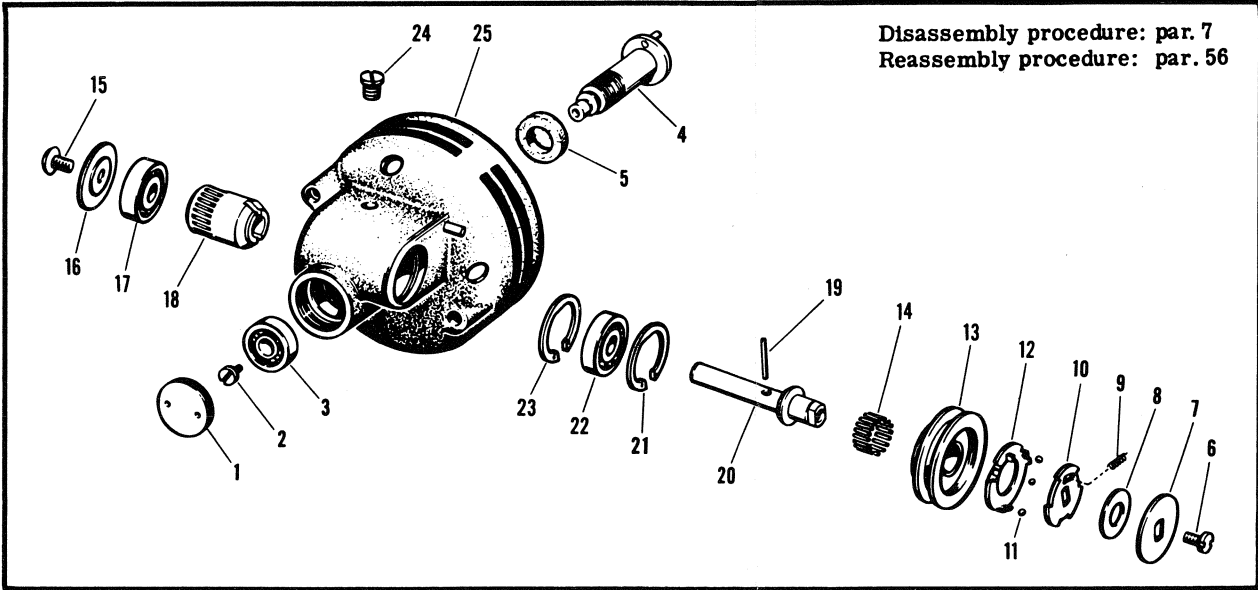


Figure 7. Governor Cap Assembly

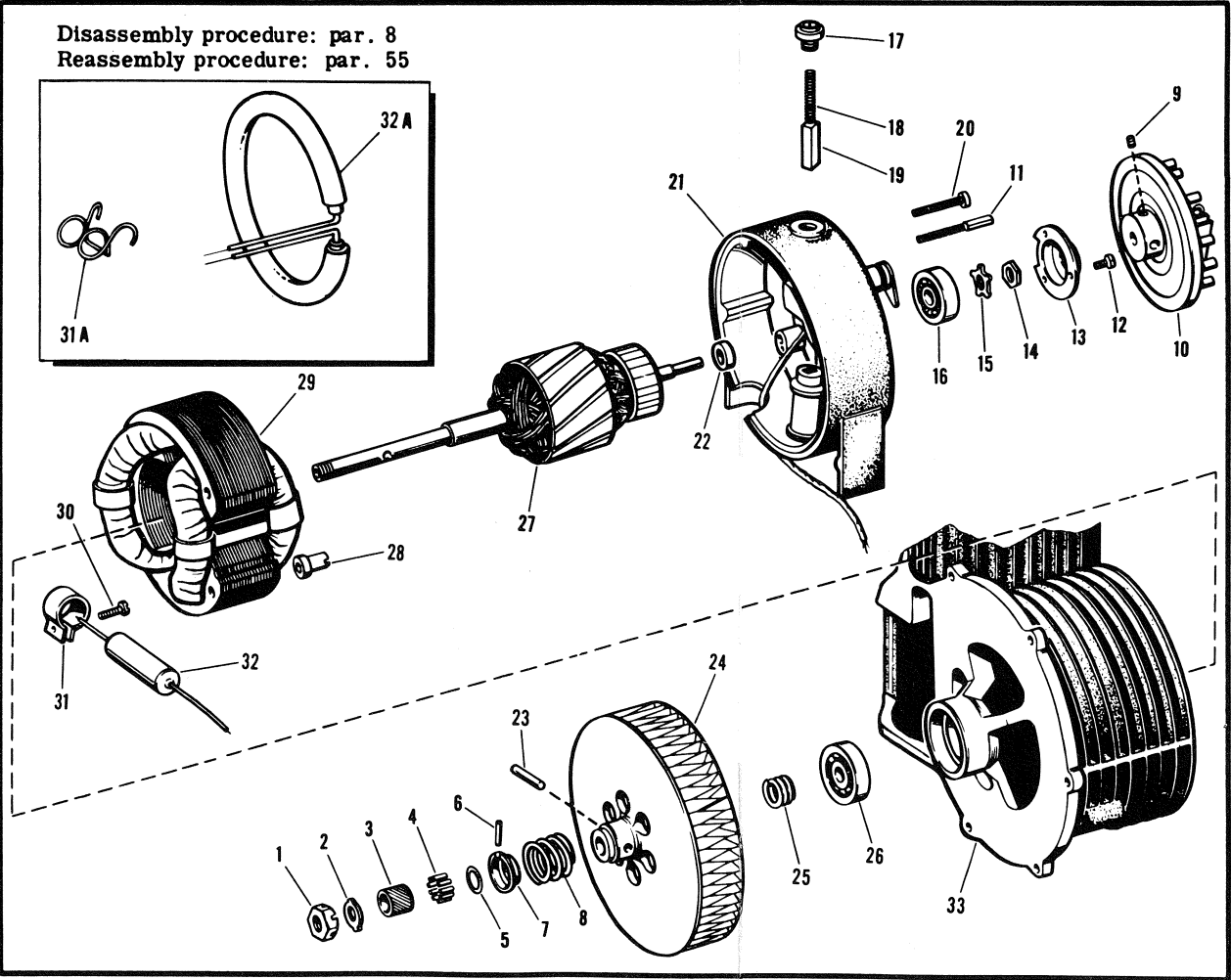


Figure 8. Fan, Governor and Motor

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
PROJECTOR ASSEMBLY (CONT)				
8-22	*10350	SPACER.....	1	W,X
-22	*20855	SPACER.....	1	W,X
-22	24147	WASHER.....	1	X,Y,Z
-23	26245	PIN, spring.....	1	All
-24	08076	BLOWER FAN ASSY.....	1	All
-25	25966	SPRING, armature.....	1	All
-26	30120	BEARING, ball, 7-mm radial.....	1	All
-27	08382	ARMATURE ASSY.....	1	W,X
-27	09100	ARMATURE ASSY.....	1	X,Y,Z
-28	5201	NUT, field retaining.....	4	All
-29	05567	STATOR ASSY (for No. 08382 armature).....	1	W,X
-29	09451	STATOR ASSY (for No. 09100 armature).....	1	X,Y,Z
-30	1738	SCREW, fil hd, No. 3-48.....	1	W,X
-31	13983	CLAMP, resistor.....	1	W,X,Y
-31A	29561	SPRING, double torsion.....	3	Y,Z
-32	13982	RESISTOR, 100 ohm.....	1	W,X,Y
-32A	28600	RESISTOR, 75 ohm.....	1	Y,Z
Not shown	11056	RESISTOR, 10,000 ohm, 1-w.....	1	Z
Not shown	25824	CAPACITOR, 0.02 mfd.....	1	Z
Not shown	30785	CAPACITOR, 0.005 mfd.....	2	Z
-33	NPN	HOUSING, motor.....	1	All

PROJECTOR ASSEMBLY (CONT)				
9-1	08850	REFLECTOR ASSY.....	1	All
-1A	23565	RING, snap.....	1	All
-2	20715	SCREW, fil hd, No. 5-40.....	2	W,X
-2	30173	SCREW, fil hd, No. 5-40.....	2	Y,Z
-3	23101	CAP, lamp house.....	1	All
-4	08388	TUBE, air circulating.....	1	All
-5	07022	LAMP LOCK SCREW ASSY.....	1	All
-6	5211	SCREW, fil hd, No. 5-40.....	3	W,X
-6	30173	SCREW, fil hd, No. 5-40.....	3	Y,Z
-7	07786	TERMINAL BOX ASSY.....	1	All
-8	13366	RING, heat conductive.....	1	All
-9	6756	SCREW, fil hd, No. 2-56.....	1	W
-9	29002	SCREW, fil hd, No. 2-56.....	1	X,Y,Z
-10	25243	SPRING, condenser friction.....	1	All
-11	NPN	HOUSING, motor.....	1	All
-12	07204	CONDENSER ASSY, 45-50-mm (includes items 13 thru 19).....	1	All
-13	21491	RING, lens retaining snap.....	1	All
-14	5306	LENS, condenser coated.....	1	All
-15	21490	SPRING, lens spacer.....	1	All
-16	6926	LENS, condenser.....	1	All
-17	23109	HOUSING, condenser.....	1	All
-18	23116	HANDLE, condenser.....	1	All
-19	15690	RIVET, condenser handle.....	1	All

\*Interchangeable

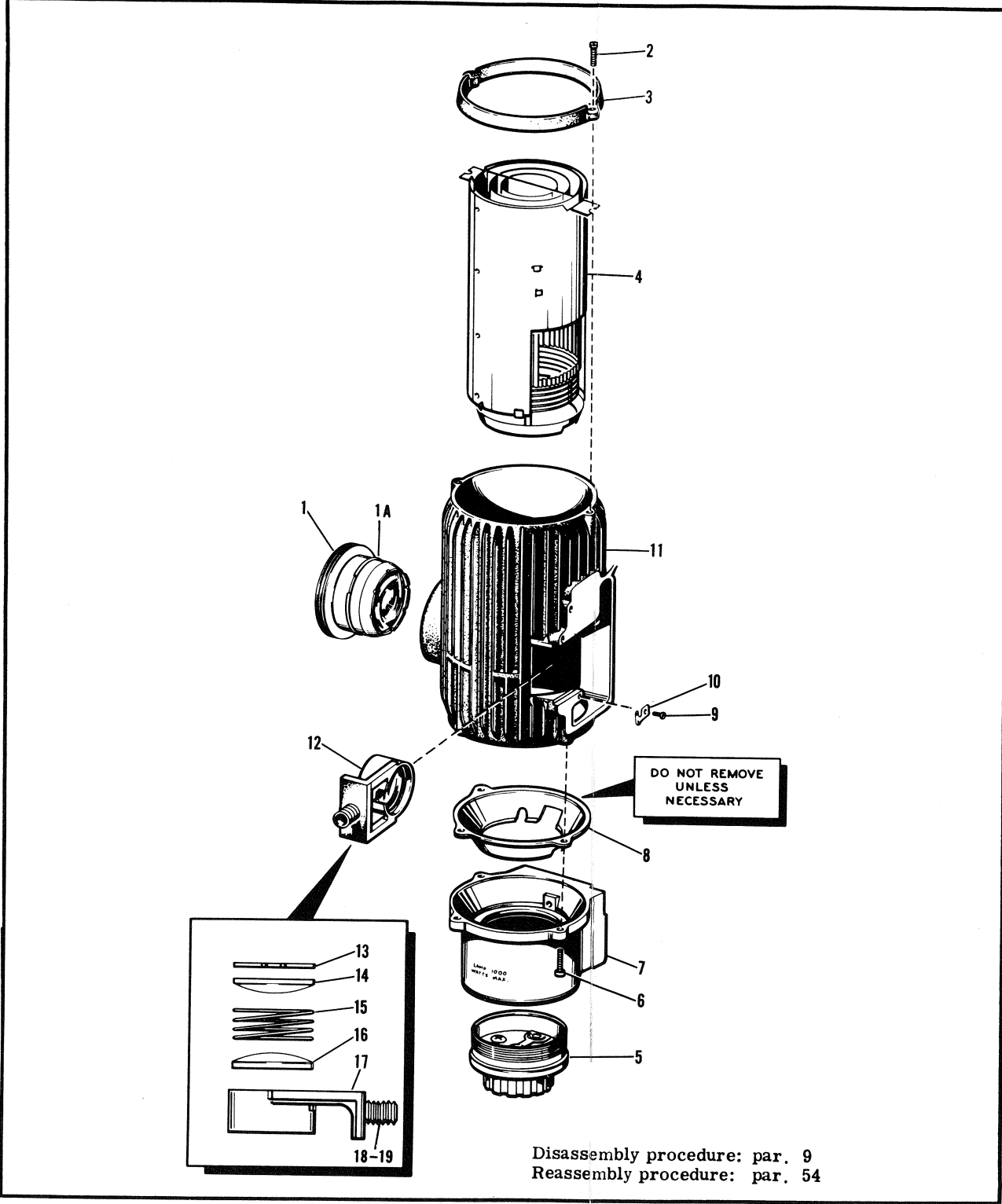


Figure 9. Lamphouse Group

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
PROJECTOR ASSEMBLY (CONT)				
10-1	21788	SCREW, headless set, cup pt, No. 4-48	1	W,X
-1	21793	SCREW, headless set, cup pt, No. 4-48	1	Y,Z
-2	21782	CAP	1	All
-3	14697	WASHER	1	W
-4	12985	SCREW, fil hd, No. 2-56	1	W,X
-5	21785	SPRING, torsion	1	W
-5	26981	SPRING, torsion	1	X,Y,Z
-6	12501	SCREW, fil hd, No. 2-56	1	W
-6	30163	SCREW, fil hd, No. 2-56	1	X,Y,Z
-7	21780	STUD, roller	1	All
-8	03688	PLAIN ROLLER ASSY	1	W
-8	08258	PLAIN ROLLER ASSY	1	X,Y,Z
-9	21779	ARM, lower, stabilizer	1	All
-10	5130	SCREW, fil hd	1	W,X
-10	30163	SCREW, fil hd	1	Y,Z
-11	21780	STUD, roller	1	All
-12	05774	FLANGED ROLLER ASSY	1	All
-13	05775	STABILIZER ARM ASSY	1	All
-14	21781	STUD, stabilizer	1	All
-15	21821	NUT, lock, 1/4-32	1	All
-16	7493	SCREW, fil hd, No. 4-40 x 3/16 in.	1	All
-17	11762	STRIPPER, film	1	All
-18	11757	SCREW, fil hd, No. 4-40	1	W,X,Y
-18	30390	SCREW, fil hd, No. 4-40	1	Z
-19	08990	SPROCKET GUARD ASSY	1	All
-20	16243	SPRING	1	All
-21	16244	WASHER, tension	1	All
-22	12481	SCREW, headless set, No. 8-32	1	W
-23	03461	SPROCKET ASSY	1	All
-24	6419	WASHER, spring	1	W
-25	13499	WASHER, spacer	1	W
-26	11268	SCREW, headless set, No. 10-32	1	All
-27	29590	SHAFT, sprocket	1	All
-27A	29589	LUBRICATOR, sprocket shaft	1	Z
-28	11147	WASHER	1	All
-29	11868	GEAR, sprocket driving	1	All
-30	30164	SCREW, fil hd, No. 4-40 x 3/16 in.	2	All
-31	11761	GUIDE, film	1	All
Not shown	25108	WASHER	-2	Y,Z
-32	1520	SCREW, fil hd, No. 5-40	1	All
-32A	*1295	SCREW, fil hd, No. 5-40	1	W
-32B	3954	NUT, hex, No. 5-40	1	X,Y,Z
-33	*8122	NUT, hex, No. 5-40	1	W
-33	3954	NUT, hex, No. 5-40	1	All
-34	*17376	CLAMP, cable	1	W
-34	19100	CLAMP, cable	1	W
-35	3914	SCREW, fil hd, No. 5-40 x 3/16 in.	2	W
10-	07213	SNUBBER ASSY (includes items 35 thru 40)	1	All
-36	21765	SCREW, fil hd, No. 5-40 x 3/16 in.	1	All
-37	23255	SHAFT, snubber	1	All
-38	23258	SPRING, snubber	1	All
-39	23256	BEARING, snubber	1	All
-40	23257	PLATE, snubber retaining	1	All
-41	09282	BRACKET AND ROLLER ASSY	1	All
-42	22740	STUD, idler roller	1	All
-43	17312	SPACER	1	All
-44	07053	IDLER ROLLER ASSY	1	All
-45	27487	SCREW, Phillips binding hd	4	All
-46	17317	BRACKET, sound head	2	All
-47	12641	SCREW, headless set, No. 10-32	1	All
-48	17362	PLUG	1	All
-49	02678	OPTICAL SLIT ASSY	1	All
10-	*05551	SNUBBER ASSY (includes items 50 thru 58)	1	W

\*Used on or with Snubber Assy, 05551 which is interchangeable with Snubber Assy, 07213.

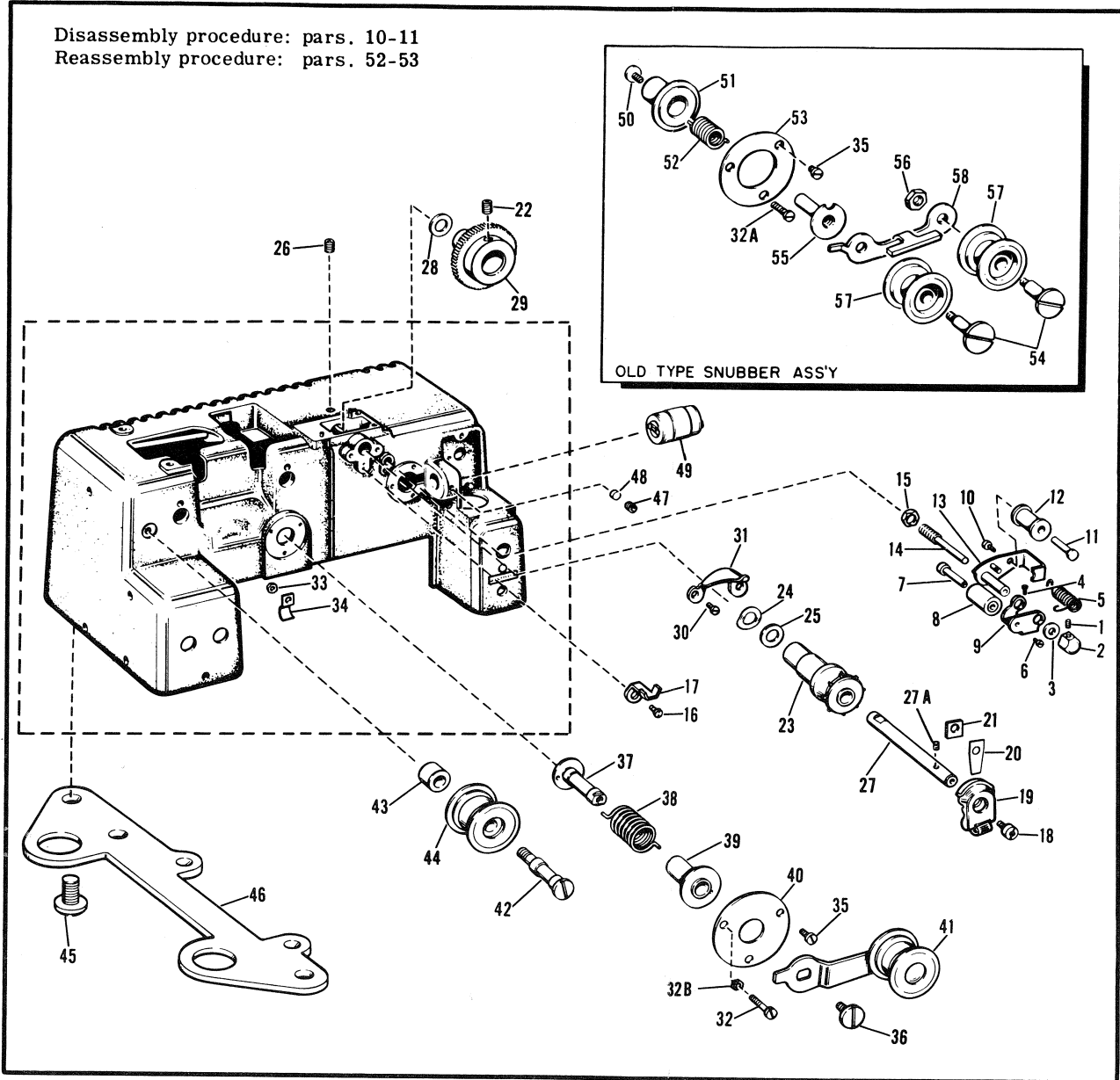


Figure 10. Sound Head Assembly (1 of 3 illust.)

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
PROJECTOR ASSEMBLY (CONT)				
10-50	*9178	SCREW, fil hd, No. 6-32	1	W
-51	*9415	BEARING, snubber	1	W
-52	*9412	SPRING, torsion	1	W
-53	*9414	PLATE, bearing	1	W
-54	*14849	STUD, snubber	2	W
-55	*17309	RETAINER, spring	1	W
-56	*12087	NUT, hex, No. 10-32	1	W
-57	*02247	ROLLER ASSY, idler	2	W
-58	*17310	LEVER, snubber	1	W

\*Used on or with Snubber Assy, 05551 which is interchangeable with Snubber Assy, 07213.

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
PROJECTOR ASSEMBLY (CONT)				
11-1	20716	SCREW, fil hd . . . . .	3	W
-1	5266	SCREW, fil hd . . . . .	3	X
-1	30162	SCREW, fil hd . . . . .	3	Y,Z
-2	13656	CAP, bearing . . . . .	1	W
-2	27845	CAP, bearing . . . . .	1	X,Y,Z
-3	13661	RETAINER, spring . . . . .	1	W
-3	27484	RETAINER, spring . . . . .	1	X,Y,Z
-4	13659	SPRING, compression . . . . .	1	W
-4	27483	SPRING, compression . . . . .	1	X,Y,Z
-5	5130	SCREW, fil hd . . . . .	2	All
-6	22685	COVER, light shield . . . . .	1	All
-7	22639	SCREW, fil hd, No. 2-56 . . . . .	1	All
-8	22638	BEARING, eccentric . . . . .	1	All
-9	22637	LEVER, detent . . . . .	1	All
-10	22640	SPACER . . . . .	1	All
-11	22641	SPRING, torsion . . . . .	1	W,X
-11	30230	SPRING, torsion . . . . .	1	Y,Z
-12	25718	SCREW, lever, No. 2-56 . . . . .	1	All
-13	08222	ROLLER ASSY, rubber . . . . .	1	W,X
-13	29417	ROLLER ASSY, rubber . . . . .	1	Y,Z
-14	25715	RING, retaining . . . . .	1	W,X
Not shown	30160	WASHER, set . . . . .	1	Y,Z
-15	25716	SPRING, torsion . . . . .	1	All
-16	08221	ARM ASSY, roller . . . . .	1	W,X
-16	09469	ARM ASSY, roller . . . . .	1	Y,Z
-17	25742	SCREW, fil hd No. 4-40 . . . . .	2	All
-18	25741	STRAP, clamp . . . . .	1	W,X
-19	25713	STUD, pivot . . . . .	1	All
-20	25660	RING, retaining . . . . .	1	W,X
-21	25714	SPRING, flat . . . . .	1	W,X
-22		BEARING AND SHAFT ASSY, sound drum (see fig. 11A) . . . . .	1	All
-23	23110	WASHER, spring . . . . .	1	All
-24	23261	FLYWHEEL . . . . .	1	All
-25	22652	SCREW, rd hd, No. 1-72 . . . . .	2	All
-26	25717	LEVER . . . . .	1	All
-27	12246	BEARING, radial, 6-mm . . . . .	1	W
-27	27239	BEARING, radial, 6-mm . . . . .	1	X,Y,Z
-28	9180	SCREW, fil hd, No. 5-40 x 11/32 in. . . . .	1	W,X
-29	1984	SCREW, oval hd, No. 6-32 x 3/8 in. . . . .	1	W,X
-29A	29194	SCREW, rd hd . . . . .	1	Y,Z
-30	05560	COVER ASSY, terminal . . . . .	1	W,X
-30	09454	COVER ASSY, terminal . . . . .	1	Y,Z
-31	17351	NUT, speed, type "J" . . . . .	1	All
-32	7363	SCREW, fil hd, No. 2-56 . . . . .	1	W
-33	22647	SCREW, pilot, No. 2-56 . . . . .	1	W
-34	19100	CLAMP, cable . . . . .	1	W,X
-35	22643	BUSHING, threaded . . . . .	1	All
-36	7856	SCREW, rd hd, No. 6-32 . . . . .	1	All
-37	9567	WASHER, lock . . . . .	1	All
-38	22644	SHIELD, relay . . . . .	1	All
-39	22679	BUTTON, relay trip . . . . .	1	W
-39	27519	BUTTON, relay trip . . . . .	1	X
-39	29287	BUTTON, relay trip . . . . .	1	Y,Z
-40	22654	SPRING, button return . . . . .	1	W
11-	08174	RELAY AND HARNESS ASSY, record interlock (includes items 41 thru 45). . . . .	1	W
-41	22645	STRIP, terminal . . . . .	1	W
-42	22650	SCREW, rd hd, No. 5-40 . . . . .	1	W,X
-42	27944	SCREW, rd hd, No. 5-40 . . . . .	1	Y,Z
-43	22642	BRACKET, relay mounting . . . . .	1	W,X
-43	29253	BRACKET, relay mounting . . . . .	1	Y,Z

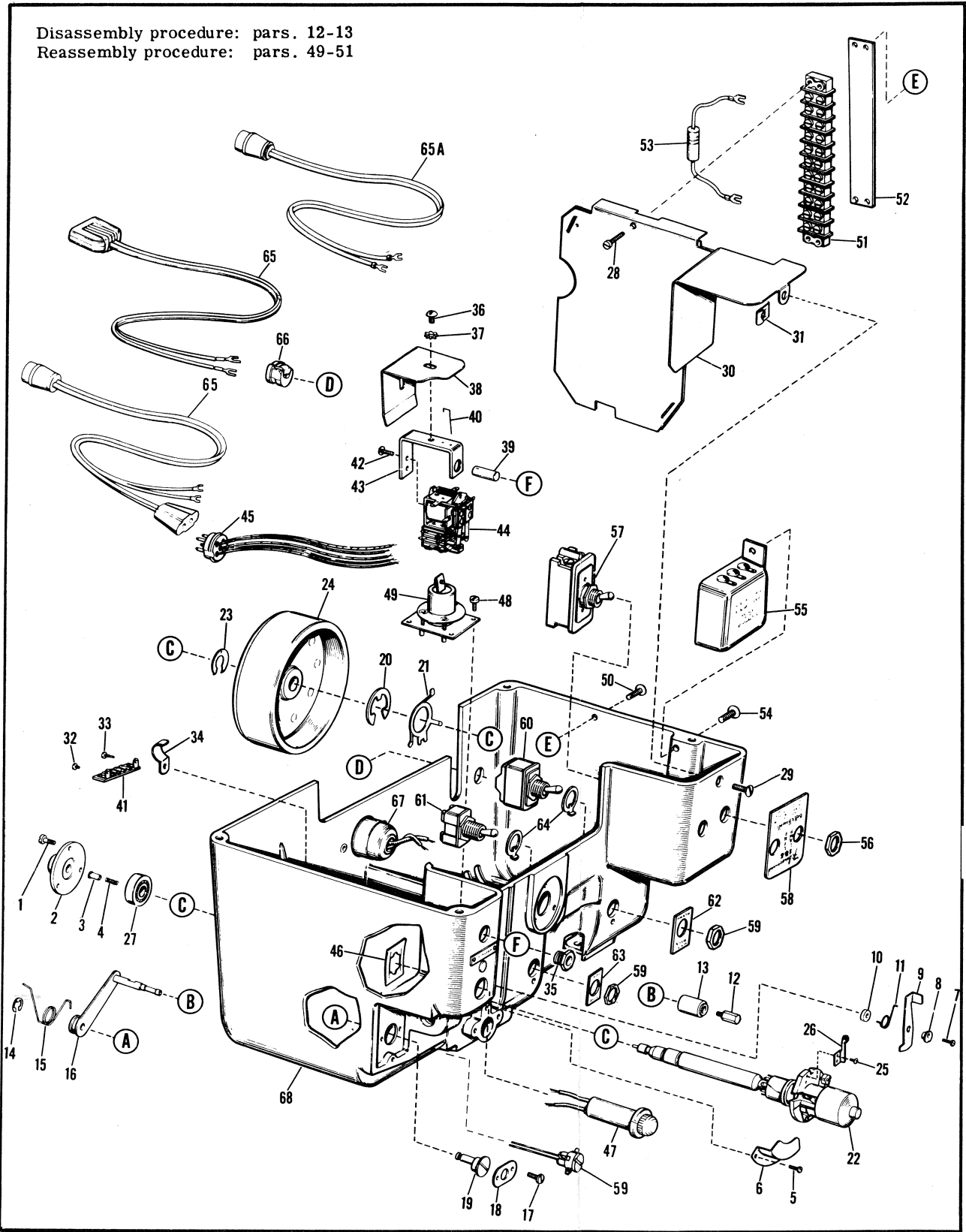


Figure 11. Sound Head Assembly (2 of 3 illust.)

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
PROJECTOR ASSEMBLY (CONT)				
11-44	25606	RELAY .....	1	W,X
-44	29252	RELAY .....	1	Y,Z
-45	22661	PLUG .....	2	W,X
-46	NPN	FASTENER, push-on (furnished as part of item 47) .....	1	All
-47	22646	LAMP, pilot .....	1	All
-48	20716	SCREW, fil hd, No. 5-40 .....	4	W
-49	17315	SOCKET, exciter lamp .....	1	All
-50	22031	SCREW, Phillips rd hd, No. 5-40 .....	2	W,X
-51	17314	STRIP, terminal .....	1	W,X
-52	21924	INSULATION, terminal strip .....	1	W,X
-53	05768	RESISTOR AND TERMINAL ASSY .....	1	W,X
-54	22032	SCREW, Phillips hd .....	2	W,X
-55	22140	CAPACITOR, 2 x 5 uf, 600 v .....	1	W,X,Y
-55	29282	CAPACITOR (for reference only, not pt of sound head) .....	1	Z
-56	NPN	NUT, check (furnished as part of item 57) .....	2	All
-57	17373	SWITCH, dpst .....	2	All
-58	22554	PLATE, name, LINE-LAMP .....	1	W
-58	28021	PLATE, name, LINE-LAMP .....	1	X,Y,Z
-59	09463	PHAZE REACTOR ASSY .....	1	Y,Z
-59	NPN	NUT, check (furnished as part of items 60 and 61) .....	2	W
-60	17365	SWITCH, dpdt .....	1	W,X
-60	29296	SWITCH, dpdt .....	1	Y,Z
-61	17363	SWITCH, two circuit .....	1	W,X
-61	29560	SWITCH, two circuit .....	1	Y,Z
-62	22691	PLATE, name, FORWARD - REVERSE .....	1	W
-62	27914	PLATE, name, FORWARD - REVERSE .....	1	X,Y,Z
-63	22690	PLATE, name, SILENT - SOUND .....	1	W
-63	27915	PLATE, name, SILENT - SOUND .....	1	X,Y,Z
-64	9121	DISC, switch locating .....	2	W,X
-65	06842	LINE CORD ASSY .....	1	W,X
-65	09551	LINE CORD ASSY .....	1	Y,Z
-65A	27432	RECEPTACLE, .....	1	W,X
-66	22464	BUSHING, strain relief .....	1	All
-67	21221	RECEPTACLE, line .....	1	All
-68	NPN	SOUND HEAD (includes other parts of sound head assy) .....	1	All

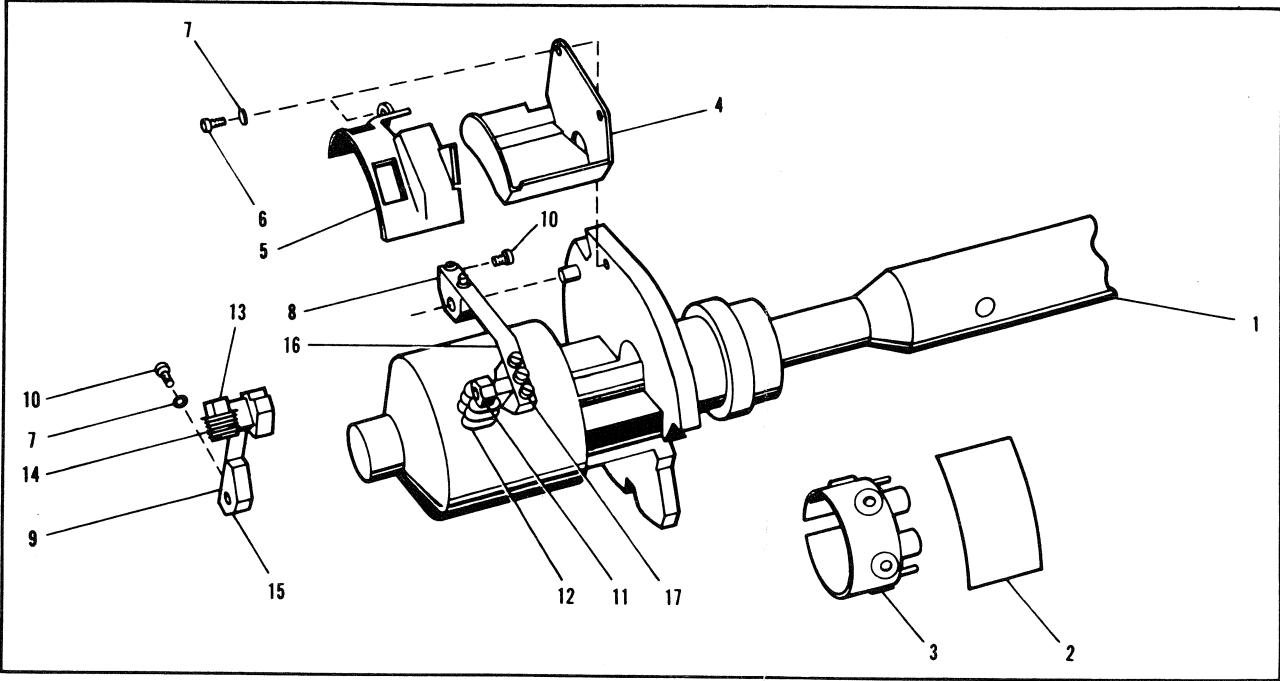


Figure 11-A. Sound Drum Bearing and Shaft Assembly (3 of 3 illust.)

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
PROJECTOR ASSEMBLY (CONT)				
11-A-1	08255	BEARING AND SHAFT ASSY, sound drum .....	1	W
-1	08783	BEARING AND SHAFT ASSY, sound drum .....	1	X
-1	09251	BEARING AND SHAFT ASSY, sound drum .....	1	Y,Z
-2	Coml	TAPE .....	1	All
-3	22623	RING, terminal .....	1	All
-4	22603	SHIELD .....	1	All
-5	22621	COVER, shield .....	1	All
-6	4080	SCREW .....	3	All
-7	22615	WASHER .....	3	All
-8	08253	ARM, HUB AND HEAD ASSY, R/P .....	1	W,X
-8	09250	ARM, HUB AND HEAD ASSY, R/P .....	1	Y,Z
-9	08254	ARM, HUB AND HEAD ASSY, erase .....	1	W,X
-9	09248	ARM, HUB AND HEAD ASSY, erase .....	1	Y,Z
-10	15617	SCREW .....	12	All
-11	07788	HEAD ASSY, R/P (pole piece) .....	1	W,X
-11	09202	HEAD ASSY, R/P (pole piece) .....	1	Y,Z
-12	08251	BOBBIN AND COIL ASSY, R/P .....	1	W,X
-12	09203	BOBBIN AND COIL ASSY, R/P .....	1	Y,Z
-13	07800	HEAD ASSY, erase (pole piece) .....	1	W,X
-13	09201	HEAD ASSY, erase (pole piece) .....	1	Y,Z
-14	08252	BOBBIN AND COIL ASSY, erase .....	1	All
-15	22609	HUB .....	4	All
-16	25985	ARM .....	2	All
Not shown	22610	TIE BAR (bobbin) .....	2	All



Fig. and Index No.	Part No.	Description	Units Per Assy	Code
PROJECTOR CASE ASSEMBLY				
12-	07347	CASE ASSEMBLY, complete	1	W
12-	04239	TILTING KNOB, complete (includes items 1 thru 8)	1	W
-1	10738	NUT, hex, 0.216-40	1	W
-2	02832	TILTING KNOB ASSY	1	W
-3	6182	WASHER, bronze	1	W
-4	11283	SPRING, blade	1	W
-5	10736	BAND, friction	1	W
-6	10739	SCREW, pilot	1	W
-7	04238	TILTING PINION ASSY	1	W
-8	03974	FRICITION CUP, complete	1	W
-9	23419	WASHER	1	W
-10	11649	SCREW, fil hd, 1/4-32	1	W
-11	8179	WASHER, lock	1	W
-12	07337	BAR ASSY, tilting foot	1	W
-13	17756	RACK, tilt	1	W
-14	02040	FOOT ASSY	4	W
-15	8179	WASHER, lock	4	W
-16	23440	SCREW, flat hd, No. 5-40	2	W
-17	23404	PLATE, door pull	1	W
-18	17302	PULL, door	1	W
-19	23414	SCREW, rd hd wood, No. 5	4	W
-20	23288	CATCH, door	2	W
-21	2148	NUT, hex, No. 8-32	4	W
-22	15563	WASHER, internal lock, No. 8	4	W
-23	23382	WASHER, spacer	1	W
-24	13550	PLATE, washer	1	W
-25	23411	POST, handle	1	W
-26	23423	POST, handle	3	W
-27	13548	PIN, handle	2	W
-28	13547	SPRING, torsion	2	W
-29	23422	HANDLE	1	W
-30	23388	PLATE, adapter	2	W
-31	23421	SCREW, Phillips binding hd, No. 6-32	8	W
-32	23260	PLATE, reel arm	4	W
12-	07286	HOLDER ASSY, front reel arm (includes items 33 thru 36)	1	W
-33	11521	SCREW, headless set	1	W
-34	13525	PIN	1	W
-35	26503	ROLLER	1	W
-36	22681	PLATE (includes pin 17752)	1	W
12-	07287	HOLDER ASSY, rear reel arm (includes items 37 thru 40)	1	W
-37	11521	SCREW	1	W
-38	13525	PIN	1	W
-39	26503	ROLLER	1	W
-40	22682	PLATE (includes pin 17752)	1	W
-41	23292	LAMP	1	W
-42	23414	SCREW, rd hd, wood, No. 5	1	W
-43	07714	RECEPTACLE ASSY, threading light	1	W
-44	23427	STRIKE, catch	1	W
-45	22362	NAIL, flat hd	2	W
12-	08767	SPEAKER AND DOOR ASSY (includes items 47 thru 50)	1	W
Not shown	21251	SPEAKER	1	W
Not shown	23406	RIVET	4	W
Not shown	17460	WASHER, connector	1	W
Not shown	17461	SLEEVE, connector	1	W
Not shown	17462	CAP, connector	1	W
Not shown	17463	CUP, connector washer	1	W
Not shown	17464	WASHER, connector	1	W
Not shown	17465	PRONG AND BASE	1	W
-46	21728	SCREW, Phillips self-tapping, No. 8	1	W
-47	21280	CLAMP, cable	1	W
-48	05717	CABLE AND CONNECTOR ASSY	1	W
-49	NPN	SPEAKER AND DOOR SUB ASSY (includes all other parts of speaker and door assy)	1	W
-50		FASTENER, dot	1	W
-51	3209	NUT, check, 5/16-18	2	W
-52	22658	WASHER, external tooth lock, 5/8 in.	1	W
-53	07018	TRANSFORMER ASSY, power	1	W
-53	09041	TRANSFORMER ASSY, power	1	X
-53	29246	TRANSFORMER ASSY, power	1	Y, Z
Not shown	25432	DOOR, blank	1	W
-54	13896	BRUSH, aperture	1	All
-55	08962	OIL CAN, with oil	1	All
-56	21898	BELT, spring	1	All

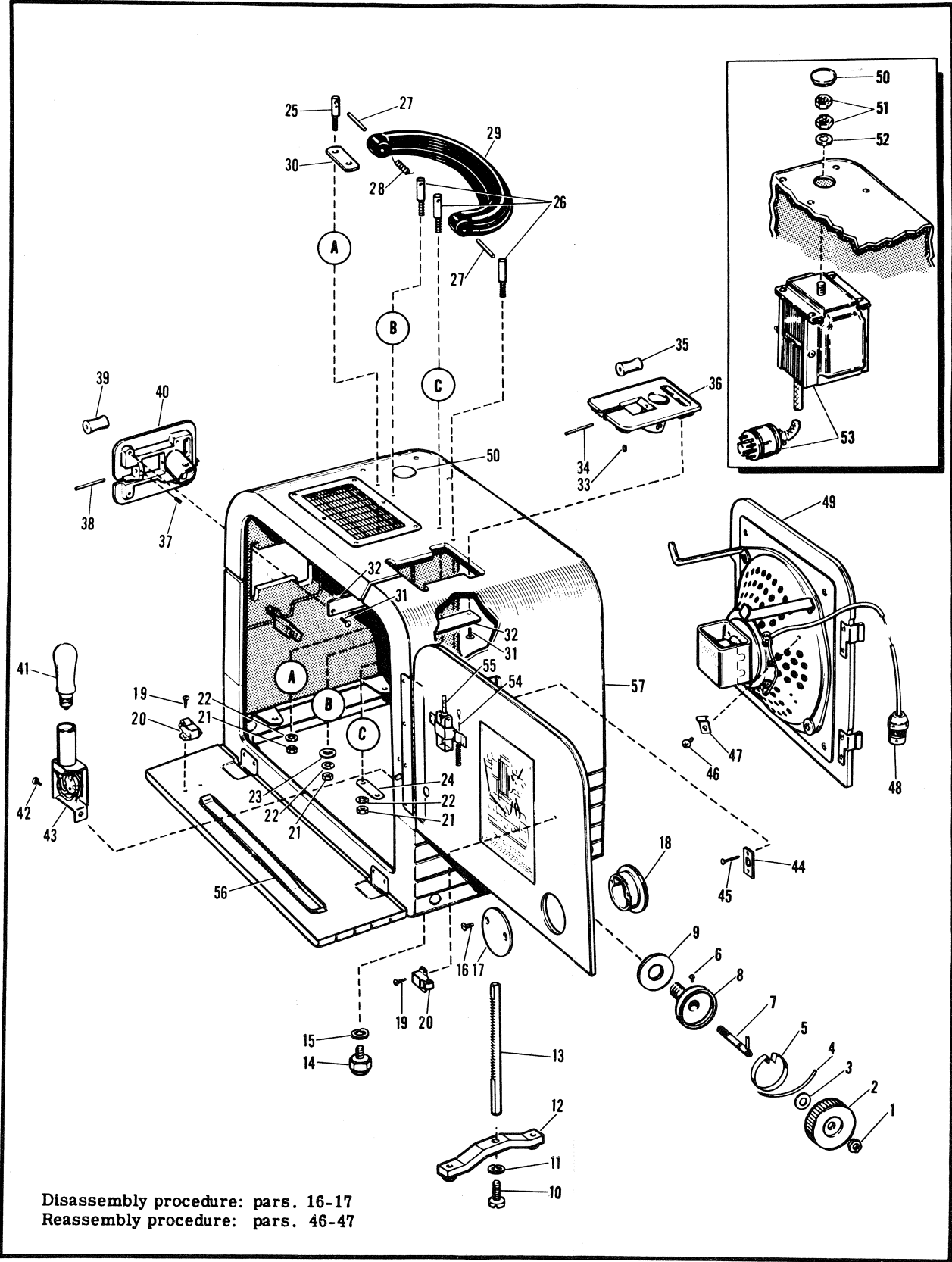


Figure 12. Case Assembly

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
12A-	09185	CASE ASSY, complete	1	X
12A-	040050	CASE ASSY, complete	1	Y,Z
-1	08883	KNOB ASSY, tilt	1	X,Y,Z
-2	22631	RING, retaining	1	X,Y,Z
-3	27908	PINION, tilt	1	X,Y,Z
-4	602416	SCREW, set, 5-40 x 1/8	1	X,Y,Z
-5	27909	SHAFT, tilt pinion	1	X,Y,Z
-6	27907	RACK, tilt	1	X,Y,Z
-7	08881	BAR ASSY, tilting foot (includes items 10 and 11) (not part of case assy)	1	X,Y,Z
-8	30178	SCREW (not part of case assy)	1	X,Y,Z
-9	8179	WASHER, lock (not part of case assy)	1	X,Y,Z
-10	27901	FOOT, rubber (not part of case assy)	2	X,Y,Z
-11	27902	BAR (not part of case assy)	1	X,Y,Z
-12	NPN	PLATE, instruction (not part of case assy)	1	X,Y,Z
-13	23288	LATCH, door	3	X,Y,Z
-14	27931	SCREW, self tapping	4	X,Y,Z
-15	08917	DOOR ASSY, case port (includes items 17 and 18)	1	X,Y,Z
-16	23414	SCREW, rd hd wood	2	X,Y,Z
-17	27949	DOOR, case port	1	X,Y,Z
-18	27950	SPRING, case port door	1	X,Y,Z
-19	08895	HOLDER ASSY, front reel arm	1	X,Y,Z
-20	08894	HOLDER ASSY, rear reel arm	1	X,Y,Z
-21	27944	SCREW, binding hd	8	X,Y,Z
-22	23260	PLATE, reel arm	4	X,Y,Z
-23	26503	ROLLER, film	2	X,Y,Z
-24	13525	PIN, roller	2	X,Y,Z
-25	11521	SCREW, set, 6-32	2	X,Y,Z
-26	27925	GRILLE, exhaust	1	X,Y,Z
-27	27945	SCREW, pan hd	4	X
-28	15563	WASHER, internal tooth lock	4	X
-29	23382	WASHER	4	X
-30	040042	HANDLE ASSY, case carrying	1	X
-31	08918	DOOR ASSY, blank	1	X,Y,Z
-31	08888	SPEAKER AND DOOR ASSY	1	X,Y,Z
-32	09425	STRAP, reel arm	2	Y,Z
-32	08529	STRAP, reel arm, front (not shown)	1	X
-32	08896	STRAP, reel arm, rear (not shown)	1	X
-33	26641	SCREW, reel arm strap	2	X
-33	26635	WASHER, reel arm strap	2	X
-34	430062	HANDLE	1	Y,Z
-35	430145	RIVET	2	Y,Z
-36	24736	NUT	2	Y,Z
-37	430097	PIN	2	Y,Z
-38	430037	BRACKET	1	Y,Z
-39	430023	POST	2	Y,Z
-40	430142	WASHER	2	Y,Z
-41	430144	SNUBBER	2	Y,Z
-42	430193	SPRING	2	Y,Z
-43	430058	SPACER	2	Y,Z
-44	430141	PLATE	2	Y,Z
-45	430088	RIVET	4	Y,Z
FOR INSTALLATION OF 29246 TRANSFORMER IN 040050 CASE				
12A-	29250	SCREW, Phillips hd	4	Y,Z
12A-	29251	WASHER	4	Y,Z
NON ILLUSTRATED ATTACHING PARTS				
12A-	27934	HINGE (for speaker door)	1	All
12A-	27935	HINGE (for speaker door)	1	All
12A-	28048	RIVET (for speaker door)	4	All
12A-	400031	DOOR PULL, lower	1	All
12A-	28538	RIVET, door pull	2	All
12A-	27933	HINGE (on speaker door)	2	All
12A-	28048	RIVET (on speaker door)	4	All

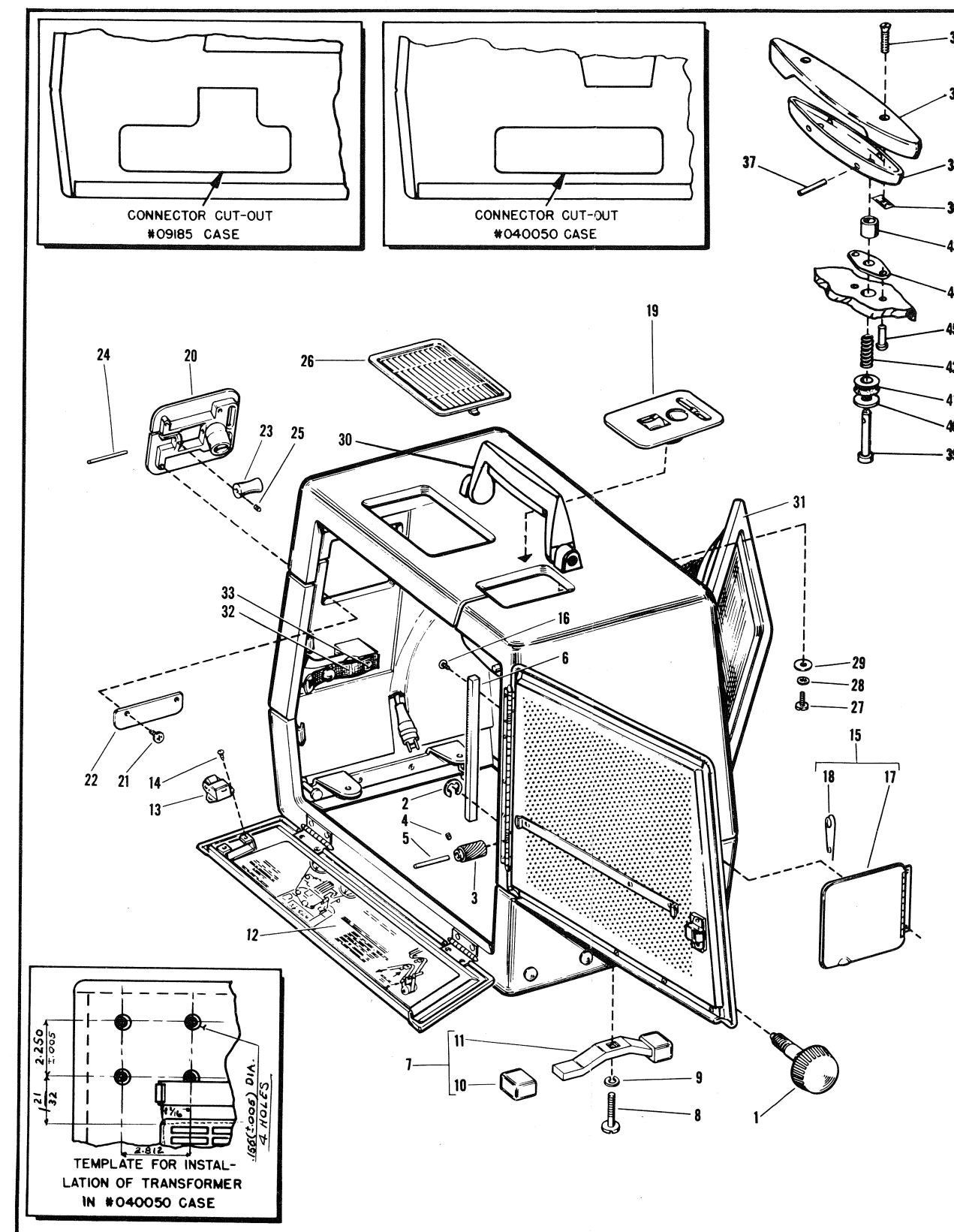


Figure 12A. Projector Case Assembly (X,Y, and Z)

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
REAR (TAKE-UP) REEL ARM				
13-1	11478	BELT, take-up . . . . .	1	All
-2	24947	SHAFT, take-up arm . . . . .	1	All
13-	08907	ARM ASSY, take-up (includes items 3 thru 9) . . . . .	1	W,X,Y
13-	09654	ARM ASSY, take-up (includes items 1 thru 6, 7C thru 7L, 8 and 9) . . . . .	1	Z
-3	9178	SCREW, rewind gear attaching . . . . .	1	W,X,Y
-4	11463	GEAR, rewind . . . . .	1	All
-5	11475	NUT, thin hex . . . . .	1	All
-6	11474	RING, bearing retaining . . . . .	1	All
-7	03447	PULLEY, take-up . . . . .	1	W,X,Y
-7C	09653	PULLEY ASSY, take-up . . . . .	1	Z
-7D	30114	SCREW, guide . . . . .	1	Z
-7E	30107	PLUNGER . . . . .	1	Z
-7F	607103	CLIP, reel . . . . .	1	Z
-7G	607106	PIN, roll . . . . .	1	Z
-7H	30108	SPRING, plunger return . . . . .	1	Z
-7I	25356	SCREW, fil hd, No. 4-40 . . . . .	1	Z
-7J	5211	SCREW, fil hd, No. 5-40 . . . . .	1	Z
-7K	30122	COVER, plunger . . . . .	1	Z
-7L	30110	PIN, lock . . . . .	1	Z
-8	5238	BALL, steel . . . . .	38	All
-9	08906	ARM, take-up . . . . .	1	W,X,Y
-9	09651	ARM ASSY, take-up compensator . . . . .	1	Z
13-	07208	ARM ASSY, reel (includes items 10 thru 20) . . . . .	1	W
13-	08909	ARM ASSY, reel (includes items 10 thru 20) . . . . .	1	X,Y,Z
-10	11462	GEAR, drive, re-wind . . . . .	1	All
-11	04523	PULLEY, drive, take-up . . . . .	1	All
-12	12129	PLUNGER . . . . .	1	All
-13	12128	SPRING, compression . . . . .	1	All
-14	16941	SCREW, knurled head . . . . .	1	W,X,Y
-14	5893	SCREW, set, No. 10-32 . . . . .	1	Y,Z
-15	11470	SCREW, lock lever attaching . . . . .	1	All
-16	03446	LEVER, rewind lock . . . . .	1	All
-17	11466	SPRING, lock lever . . . . .	1	All
-18	11472	RING, bearing retainer . . . . .	1	All
-19	11471	ROLLER, bearing . . . . .	16	All
-20	07207	ARM, rear reel . . . . .	1	W
-20	08910	ARM, rear reel . . . . .	1	X,Y,Z

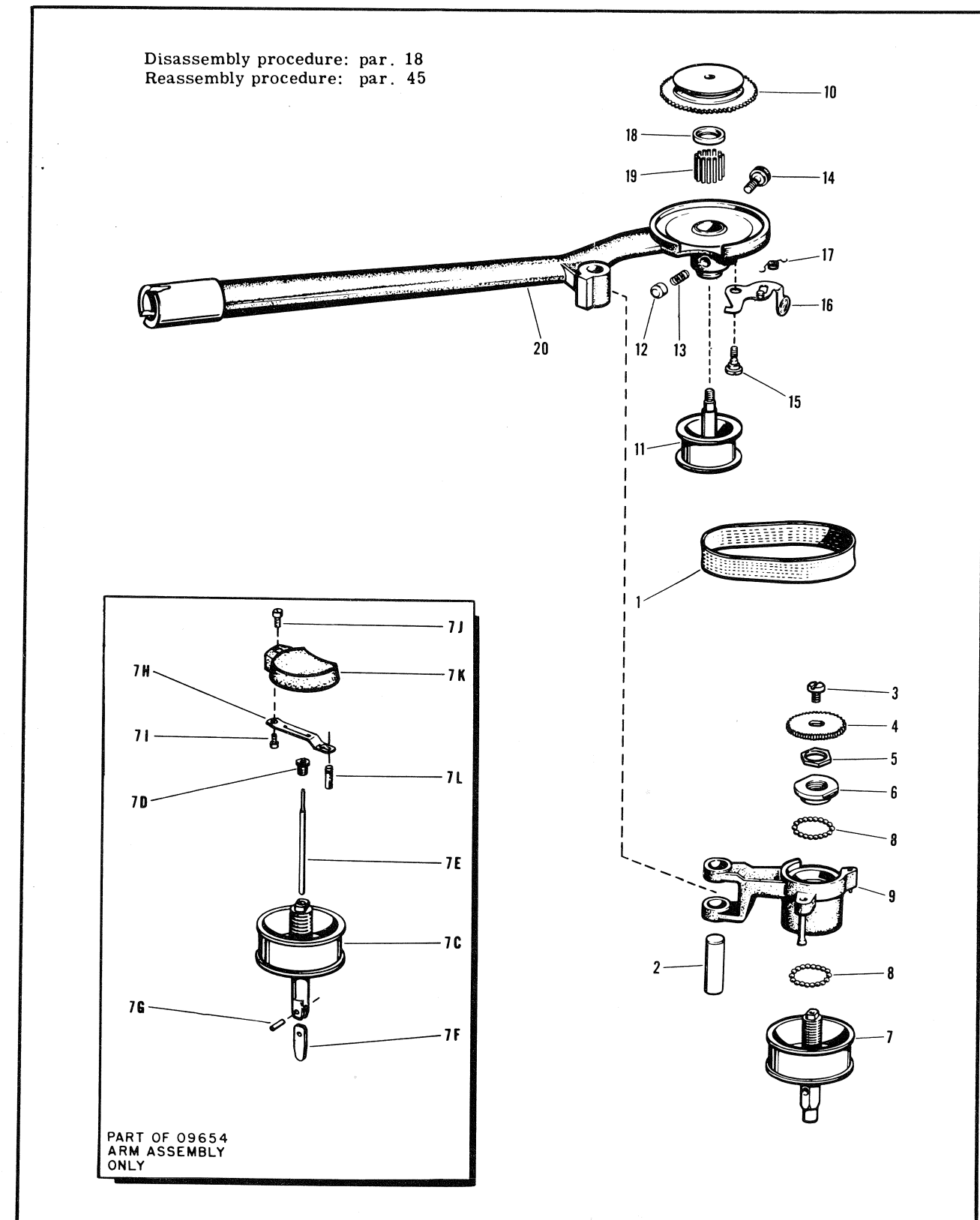


Figure 13. Rear Reel Arm

Fig. and Index No.	Part No.	Description	Units Per Assy	Code
FRONT REEL ARM				
14-1	16698	SCREW, clutch cover . . . . .	1	W,X
-1	32065	SCREW, clutch cover . . . . .	1	Y,Z
-2	12864	COVER, clutch, reel drive . . . . .	1	All
-3	15582	WASHER, bronze . . . . .	1	All
-4	5238	BALL, steel . . . . .	3	All
-5	5514	CAM, clutch . . . . .	1	All
-6	10749	RETAINER, clutch ball . . . . .	1	All
-7	11036	PULLEY . . . . .	1	All
-8	5495	ROLLER, bearing . . . . .	18	All
-9	1367	WASHER, shim . . . . .	AR	All
-10	5629	WASHER, spindle . . . . .	1	All
-11	1375	WASHER, retaining, split . . . . .	1	All
-12	17897	WASHER . . . . .	AR	All
-13	01138	SPINDLE ASSY, reel . . . . .	1	All
-14	17184	WASHER . . . . .	1	All
-15	17182	RETAINER, bearing . . . . .	1	All
-16	17183	BEARING, reel arm . . . . .	1	All
-17	23103	ARM, reel, front . . . . .	1	W
-17	27938	ARM, reel, front . . . . .	1	X,Y,Z

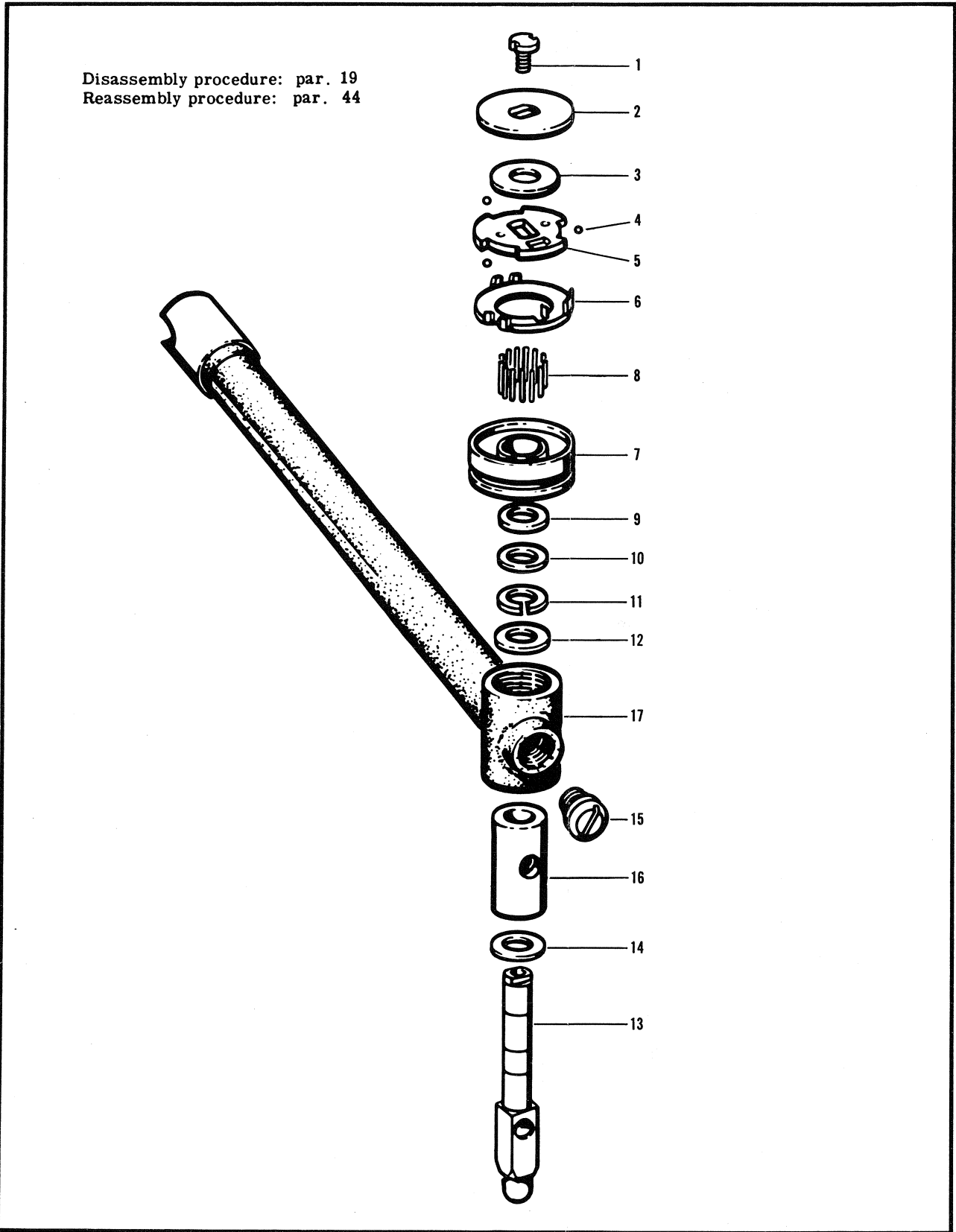
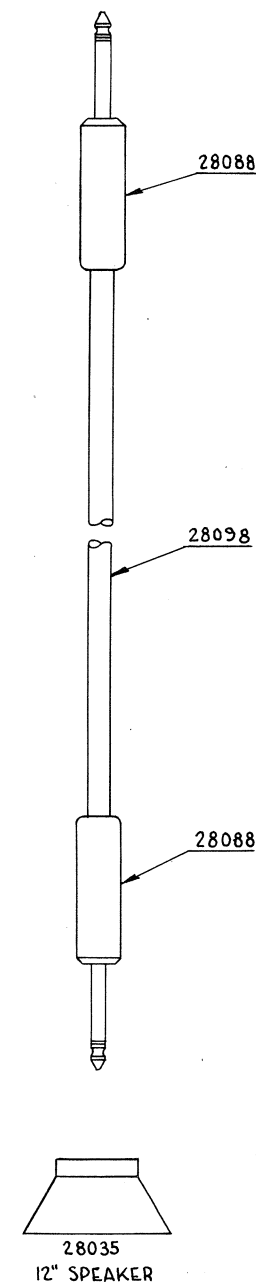
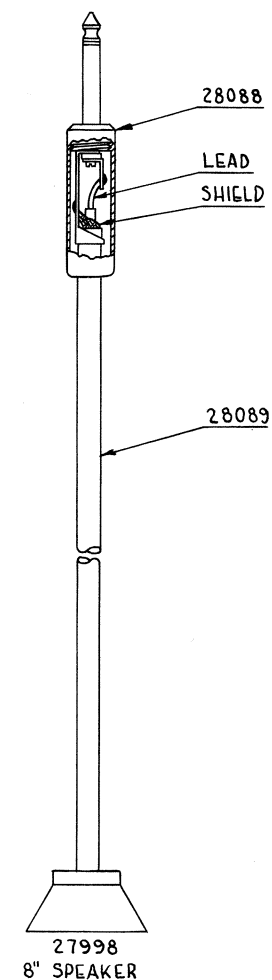
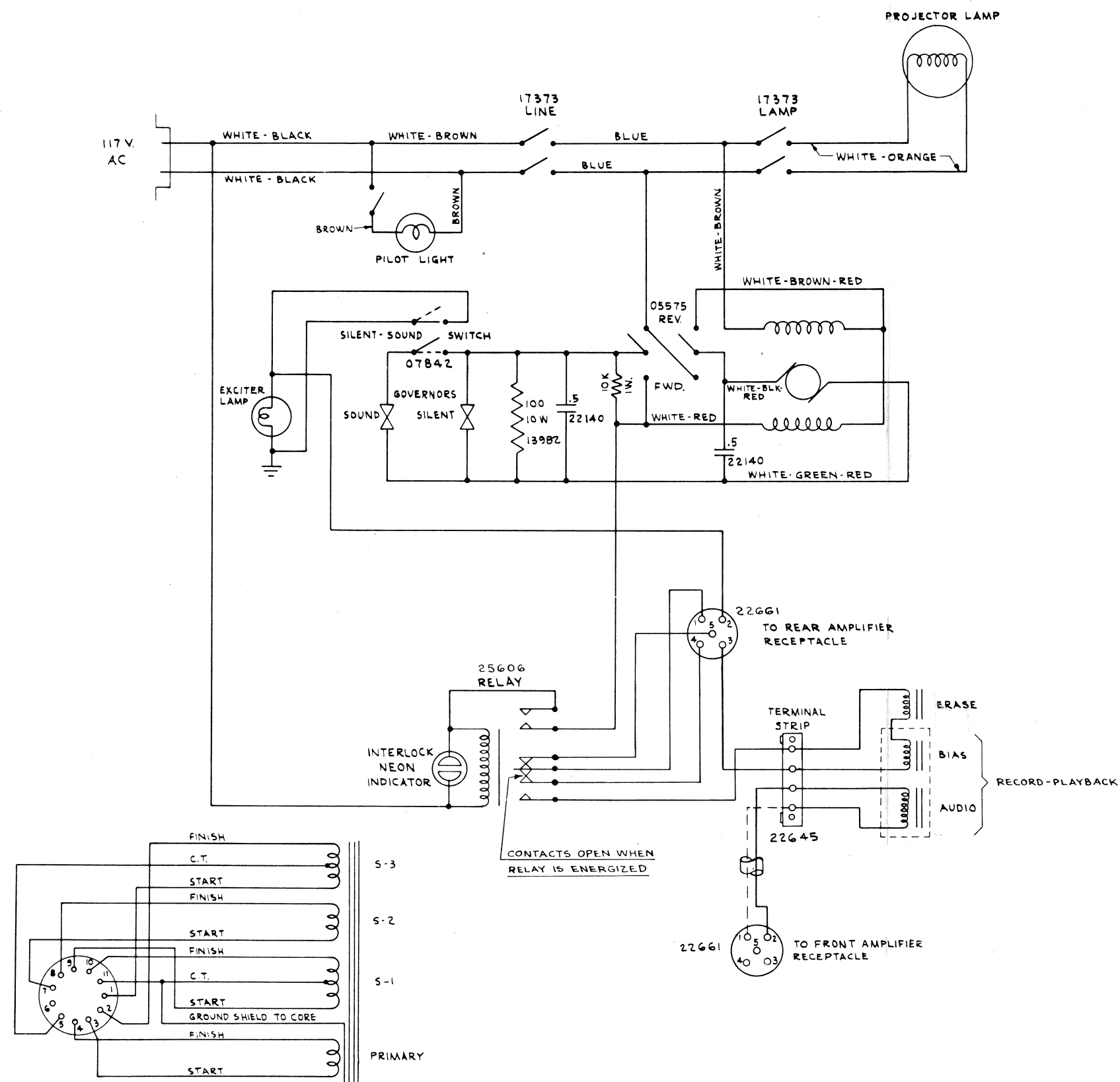


Figure 14. Front Reel Arm



22571  
TO AMPLIFIER

09041  
SUPPLIED AS A  
COMPLETE UNIT

PARTS ON THIS SHEET NOT INCLUDED IN AMPLIFIER CHASSIS

Bell & Howell Co. Chicago U.S.A.		
AMPLIFIER WIRING DIAGRAM FOR DESIGNS 302 (ALL)		
DATE 11-25-55	SERVICE DATA	DRAWN <i>ael</i> APVD. <i>L.L.</i>