# Film-Tech

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**SERVICE INSTRUCTIONS**

# FILMOSOUND PROJECTORS

## DESIGNS 384,385,398 and 399

CONSUMER PRODUCTS GROUP

BELL & HOWELL

GENERAL SERVICE DEPT.
7100 McCORMICK ROAD
CHICAGO, ILLINOIS 60645

PART NO. 70311 PRINTED IN U.S.A. REVISED AUGUST 1959

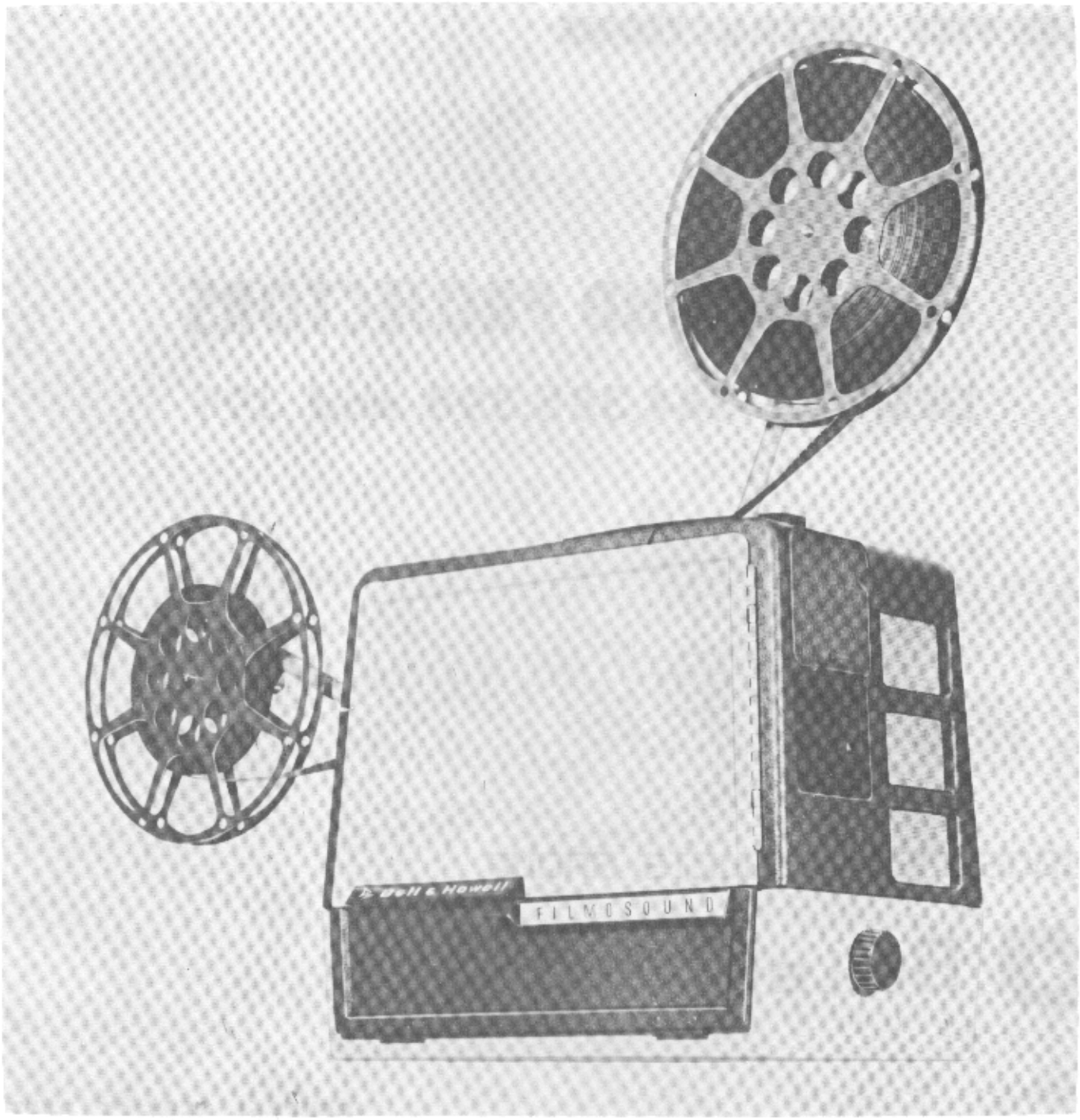



Figure A. Bell & Howell Filmosound Projector

# Introduction

GENERAL.

This manual contains service instructions for 16mm Filmosound Projectors bearing design numbers 384A, 385C, 385K, 398A, 399E, 399K and 399AV. All units are equipped with a factory-sealed lubrication system.

Due to the similarity of these designs, much of the material contained herein applies to all six 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:

| Code Letter | Design No. |
|---|---|
| A | 385C |
| B | 399E |
| C | 384A |
| D | 385K |
| E | 398A |
| F | 399K |
| G | 399AV |

Paragraph headings or titles of Illustrations not suffixed with a design code, contain information applicable to all six models. Headings or titles suffixed with a letter or letters in parenthesis indicate that this material applies only to the specific design to which the code letters apply.

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

Adjustments to the loopsetter and heat filter, used on Design 399AV projectors, will be found in the Final Test section, page 27.

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. Where the code column has been left blank, the part applies to all models.

LUBRICATION.

Whenever a lubricant is called for, it is essential that the specified lubricant be used.

NOTE

The Manufacturer will not accept any responsibility for the performance of 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.

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.

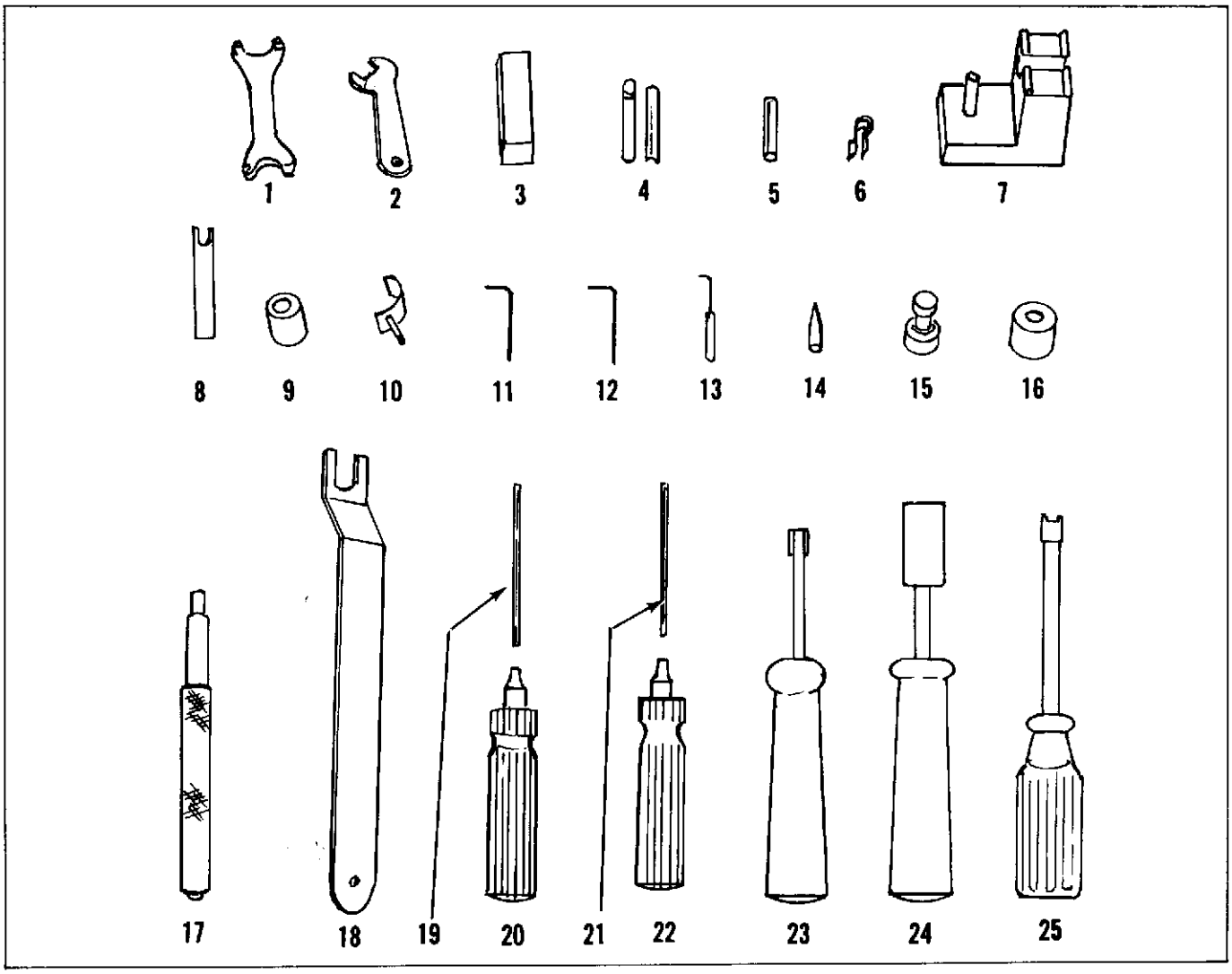



Figure B. Special Service Tools

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

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

# Disassembly Procedure

NOTE

Disassembly procedures are keyed and cross-referenced to the exploded views located in the Parts Catalog section of this book. The exploded views can be folded outward beyond the edge of the book so that text and illustrations can be 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 the power plug from the two prong rear amplifier connector and the exciter lamp plug from the top of the amplifier.
b. 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).
c. 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.

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), or support bracket (7B) and two screws (7A), 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) and 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 bushing (4), compression spring (4A), 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 screw (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 remove 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) from the projector.

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) and sprocket shaft lubricator (27A). The washer (28) and upper gear (29) will come out as the shaft is removed. Remove the lower shaft in the same manner and catch another washer (28) and the sprocket worm wheel assembly (30) 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 C. 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. 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 the 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 intermixed. 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.

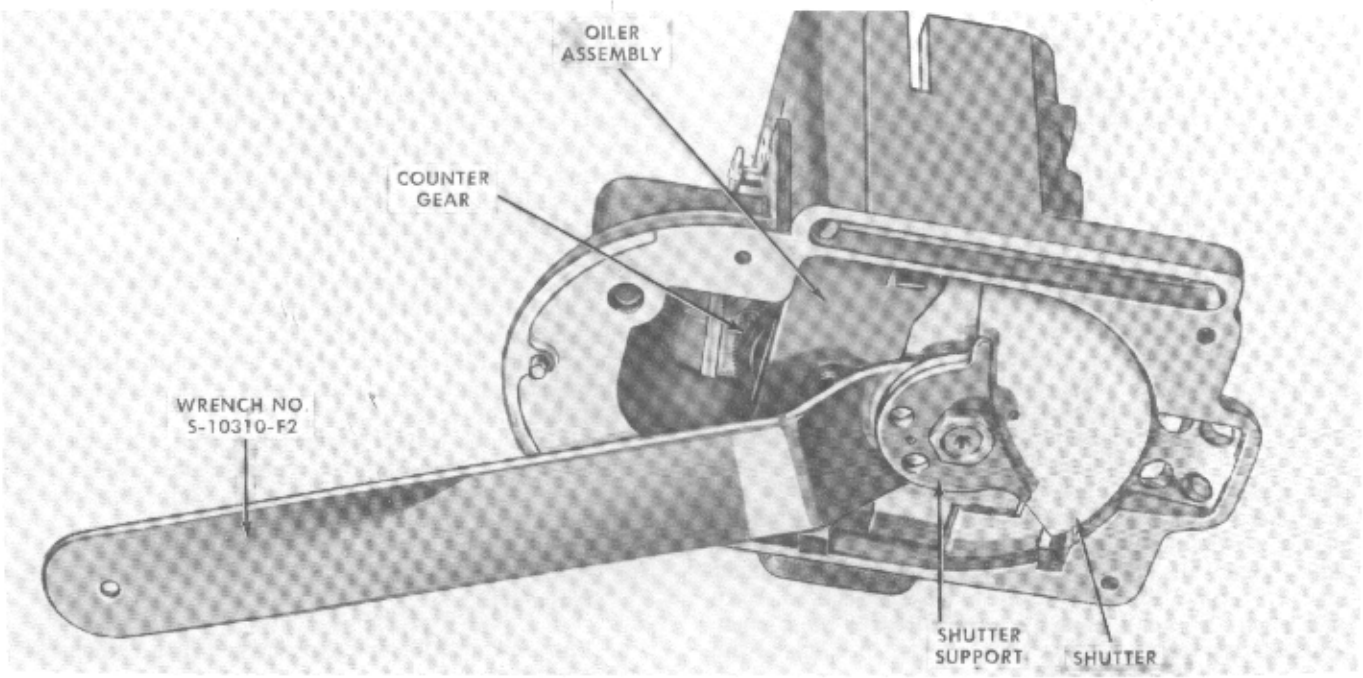



Figure C. Removing Shutter with Tool No. S-10310-F2

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 shoulder screw (10A), spring (10B) and 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.

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 remove screw (6). Remove clutch cover (7) and bronze washer (8), taking care not to dislodge the spring (9) or steel balls (11).

b. Note how the parts indexed 9 through 12 are 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) or (13A) 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 plug button (24) is used to plug the grease packing hole in the governor cap (25).

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

a. Insert tool No. S-19028-F4 (23, figure B) 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 D, 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 (10), but be careful not to lose the three governor brushes (11) which may pop out as the governor is removed.

c. Remove the four screws (16) which attach the motor brush holder housing (17) and remove the radial bearing (12) and washer (18).

d. Unscrew the brush caps (13) and remove the motor brush springs (14) and motor brushes (15). Then tap out the spring pin (19) and remove the blower fan (20).

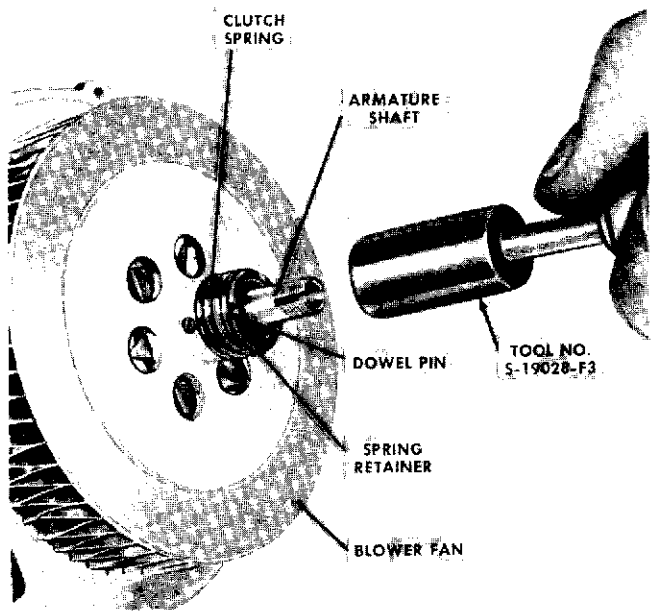



Figure D. Using Tool No. S-19028-F3

**CAUTION**

Do not permit the armature to slip forward during the disassembly procedure. If the armature should catch on the resistor clamp (27) or springs (27A), the windings may become damaged.

e. Remove the armature (23) from motor housing and disassemble the radial bearing (22) and spring (21) from the armature shaft. Unscrew the field retaining nuts (24) and carefully lift out the stator assembly (25).

f. (CODE A and B). Remove screw (26) and lift out the resistor clamp (27) and resistor (28).

g. (CODE C, D, E, F). Release the three springs (27A) and lift out the circular resistor (28A). Disconnect the capacitor leads from the brush holder terminals and withdraw the leads and strain relief bushing (29) from the brush holder housing. Remove the two screws (30) and capacitor (31).

9. LAMPHOUSE. (See figure 9.)

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

b. Unscrew the fillister head screws (2) 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), and a second condenser lens (16) from 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. Howeyer, 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). Remove the complete stabilizer assembly (3) from the shaft. 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 (45) unless absolutely necessary. If necessary for replacement, loosen the set screw (43) and withdraw the optical slit assembly. Take care that the plug (44) which bears against the optical slit assembly does not fall out.

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

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

b. Unscrew the fillister head screw (28) and remove the hex nut (29) and cable clamp (30). Unscrew two shorter fillister head screws (31) and dismount the snubber assembly as a unit. Remove the one fillister head screw (32) and separate the snubber shaft (33), spring (34), bearing (35), retaining plate (36) and the bracket and roller (37).

c. Unscrew one idler roller stud (38) to remove the idler roller (40) and spacer (39). Remove four Phillips head screws (41) and two brackets (42).

12. SOUND DRUM AND SHAFT REMOVAL. (See figure 11.)

**CAUTION**

Extreme care must be taken during removal of parts (10) and (11). Follow directions carefully, making certain that the flange on the shaft (11) does not strike optical slit.

a. Remove three screws (1) and lift off the grounding plate (2), grounding contact (3) and spring (5).

b. At the front of the sound head casting, remove three screws (6), the single hex nut (7) and cable clamp (8). The sound shaft now is loose in the sound head casting.

c. Carefully pull the shaft (11) partially out of the sound head casting. Then tilt the flywheel end of the shaft upward to permit removal of the retaining rings (4), radial bearing (12) bowed retaining ring (9) and flywheel (10). Withdraw the sound shaft from the sound head.
d. If necessary, remove the four screws (13) and lift out the exciter lamp socket (14).

13. SOUND HEAD ELECTRICAL PARTS.

NOTE

Electrical parts need not be removed unless obviously in need of replacement. Note that electrical parts peculiar to CODE A and B projectors are illustrated in figure 11 (items 16 through 40), while those peculiar to CODE C, D, E and F projectors are illustrated in figure 11A.

a. When electrical parts are removed, be sure to mark each wire and its connecting point to aid in reassembly.
b. When switches are removed, identify each by its nameplate nomenclature to insure proper re-installation.

14. AMPLIFIER. (See figure C.)

a. Normally the replacement of tubes and the 1.25 ampere fuse is the only disassembly necessary.
b. To remove tubes, simply pull them straight up from the sockets, taking care not to damage tube pins, particularly on miniature tubes.
c. The knobs on the front panel are secured with setscrews. The microphone jack is secured with a check nut.
d. To gain access to internal parts of the amplifier, unscrew four sheet metal screws, from the bottom and remove the base plate assembly. Take care not to pull the leads which are solder grounded to a terminal on the inside of the base assembly.

15. 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.

16. 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).
b. (Code C, D, E, F). Remove screw (7J) and twist the cover (7K) slightly to disengage the return spring (7H) from lock pin (7L). Lift off the cover and the return spring.
c. Remove the screw (3, for Code A, B projectors or 7D, for Code C,D, E, F projectors) and lift out the rewind gear (4). Unscrew the hex nut (5) and the bearing retaining ring (6). Remove the nineteen steel balls (8), take-up pulley assembly (7) or (7C) and nineteen more steel balls (8) from the take-up arm assembly (9). Be careful not to lose any of the steel balls.
d. 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 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.
e. 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.
f. 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).
g. (Code C, D, E, F). To disassemble the take-up spindle pulley assembly (7C), support the reel end of the spindle in a "Vee" block and use a straight punch to drive out the roll pin (7G). Separate the reel clip (7F) from the spindle.

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

NOTE

Items (2) through (11) in figure 14 are applicable to Code A, B, D and F projectors. Items 15A and 15B are applicable only to Code C and E projectors.

a. Unscrew the clutch cover screw (1) and remove the cover (2) and bronze washer (3). Carefully remove the three steel balls (4), clutch cam (5) and clutch ball retainer (6).
b. Lift the pulley (7), with bearing rollers (8), the shim or shims (9) and the spindle washer (10) from the reel spindle (13). The same number of shims (9) must be installed during reassembly of the reel arm.
c. Remove split retaining washer (11) and disassemble the reel spindle (13) and washers (12 and 14) from the front reel arm.
d. Unscrew the bearing retainer (15) and press the bearing (16) from the front reel arm. When servicing Code C, D, E, F projectors, be careful not to lose the spring (15A) and plunger (15B) as the bearing is withdrawn.

# Cleaning and Lubrication

18. 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 Optikleen 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.

19. SOUND HEAD AND OPTICAL SLIT.

Clean the front and rear lens elements of the optical slit assembly (49, figure 10) with lens tissue wrapped around a toothpick. Apply Optikleen 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.

20. 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.

21. MECHANISM PARTS.

Any part other then 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.

22. LUBRICATORS AND STORAGE PADS.

a. THIS IS EXTREMELY IMPORTANT. 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 naptha 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.

# Reassembly Procedure

23. GENERAL.

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

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

NOTE

Items (2) through (11) in figure 14 are applicable to Code A, B, D and F projectors. Items 15A and 15B are applicable only to Code C and E projectors.

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) and 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).

25. 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 on the take-up pulley shaft. Secure the gear with the screw (3, for Code A, B projectors).

d. (Code C, D, E, F). Place a film of oil on plunger (7E) and insert plunger down into take-up pulley (7C). Attach rewind gear (4) in place with screw (7D). Install pin (7L) and attach spring (7H) to cover (7K) with screw (7I). Engage the pin (7L) with the keyhole in spring (7H). Rotate the cover slightly to lock it in position and install screw (7J).

e. 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.

f. 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.

g. 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.

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

i. 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.

j. 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.

k. Latch the lock lever (16). For Code C, D, E, F projectors, swing the reel clip (7F) to open position and check to be sure that pin (7L) releases latch (16). See figure E for assembled view.

26. 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).

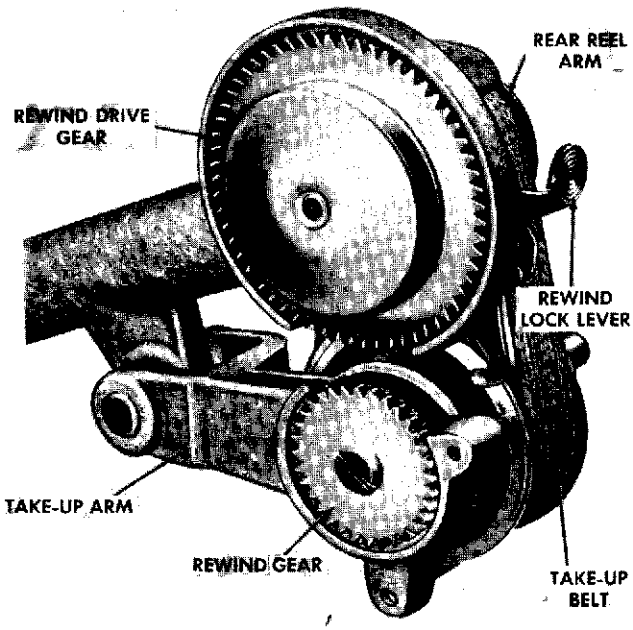



Figure E. Take-up Arm and Lock Lever Assembled

27. SOUND HEAD ELECTRICAL PARTS.

NOTE

Sound head electrical parts peculiar to Code A and B projectors are illustrated in figure 11 (items 16 through 40), while those peculiar to Code C, D, E, F projectors are illustrated in figure 11A. Refer to the projector wiring diagrams, figures F and G, for proper wiring connections during reassembly. Only unusual features of reassembly are discussed in the following paragraphs.

a. Make certain that each switch is installed in its proper location, as indicated by the identifying marking made during disassembly. The switch locating discs (33, figure 11 and 17, figure 11A) are installed so that the inner key engages the slot in the threaded shaft of the switch and the bent ear enters the small hole in the casting.

b. When electrical components have been reinstalled, check the wiring carefully to make certain that all connections have been properly and securely made.

28. SOUND DRUM AND SHAFT. (See figure 11.)

a. Carefully guide the bearing and shaft assembly (11) into its opening in the sound head casting. Tilt the inner end of the shaft upward and hold firmly while installing the flywheel (10), spring retaining washer (9), radial bearing (12) and retaining ring (4).

NOTE

Make certain that the spring retaining washer (9) holds the flywheel securely. Slippage or non-rotation of the flywheel can cause flutter.

b. With the sound shaft assembled and in place, install the three fillister head screws (6) to secure the front end of the shaft to the sound head casting. Note the cable clamp (8) and hex nut (7) to be installed on the inner end of one of these screws. Assemble the spring (5) and grounding contact (3) and install the grounding plate (2) with the three screws (1).

c. Check all sound head wiring against the wiring diagram for the projector being repaired (figure F or figure G).

29. SOUND SPROCKET AND SNUBBER ROLLERS. (See figure 10.)

a. Fasten two sound head brackets (42) to the sound head with four Phillips binding head screws (41). Attach the spacer (39) and idler roller (40) with the idler roller stud (38).

b. Insert the snubber shaft (33) through the snubber spring (34), bearing (35), and retaining plate (36) so the spring ends engage the mating holes in the shaft (33) and bearing (35). Fasten the bracket and roller assembly (37) to the snubber shaft with the fillister head screw (32).

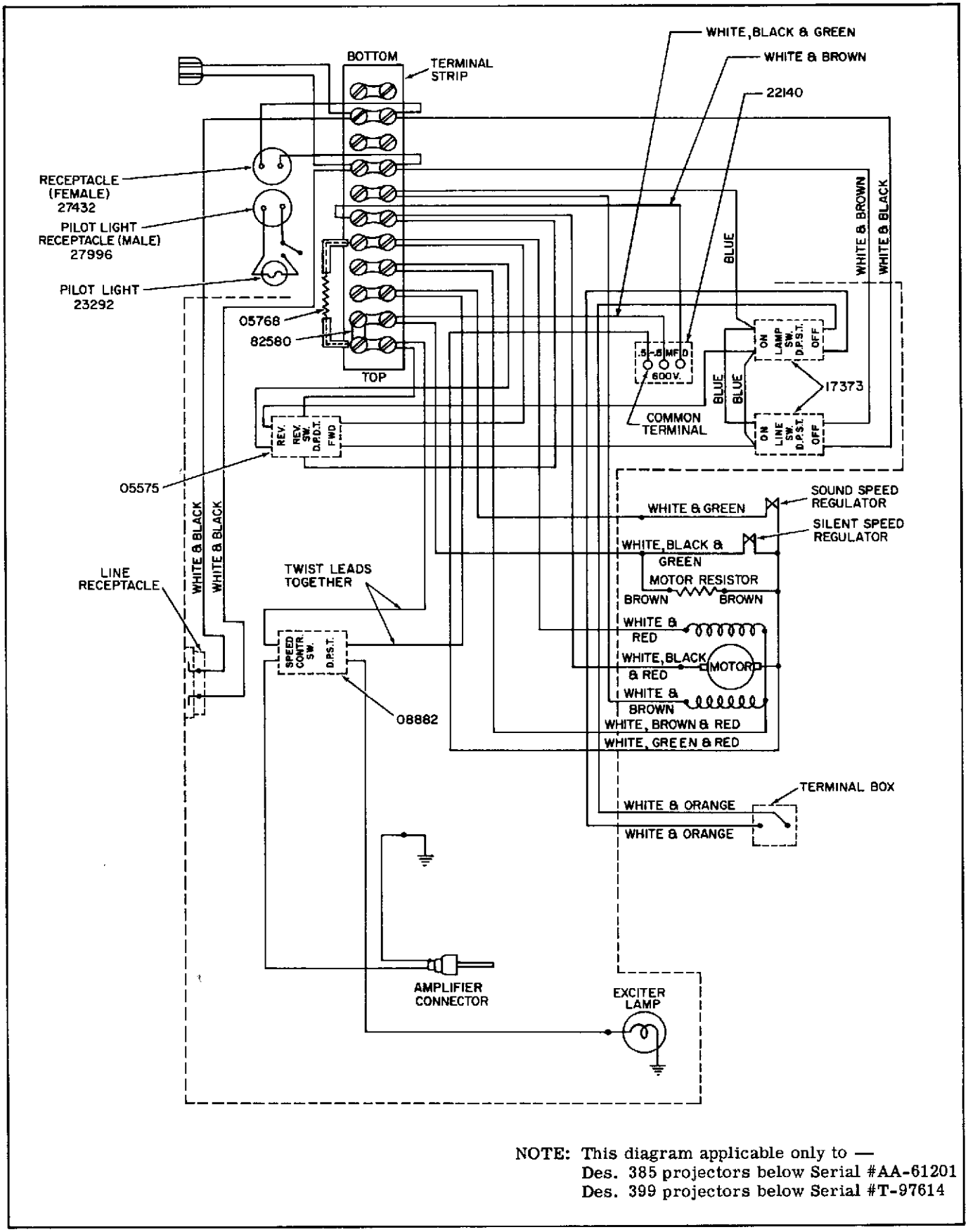
c. Mount this assembled unit with the fillister head screws (28 and 31). Attach the cable clamp (30) to the longer screw (28) with the hex nut (29) so that the clamp supports and secures the harness for the interlock relay.

d. 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.

e. To adjust the snubber assembly, proceed as follows: Loosen the three attaching screws (28 and 31) and leave them loose while making the adjustment. Turn the snubber bearing (35) 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 (28 and 31). 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.

f. 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.

g. A felt washer is located inside the sprocket (21). To avoid damaging it, use tool No. S-15177-F3 (14, figure B). Saturate the felt washer with B & H oil. Assemble the sprocket shaft lubricator (27A) into the drilled hole in the sprocket shaft (27). Insert the sprocket shaft (23) into the sound head, assembling the sprocket driving gear (25) and washer (24) to it as it passes through the pocket in the sound head. Tighten the set screw (22) against the flat surface of the shaft just enough to keep the shaft




NOTE: This diagram applicable only to —
Des. 385 projectors below Serial #AA-61201
Des. 399 projectors below Serial #T-97614

Figure F. Wiring Diagram for Design 385 and 399 Projectors (see NOTE in illustrations)

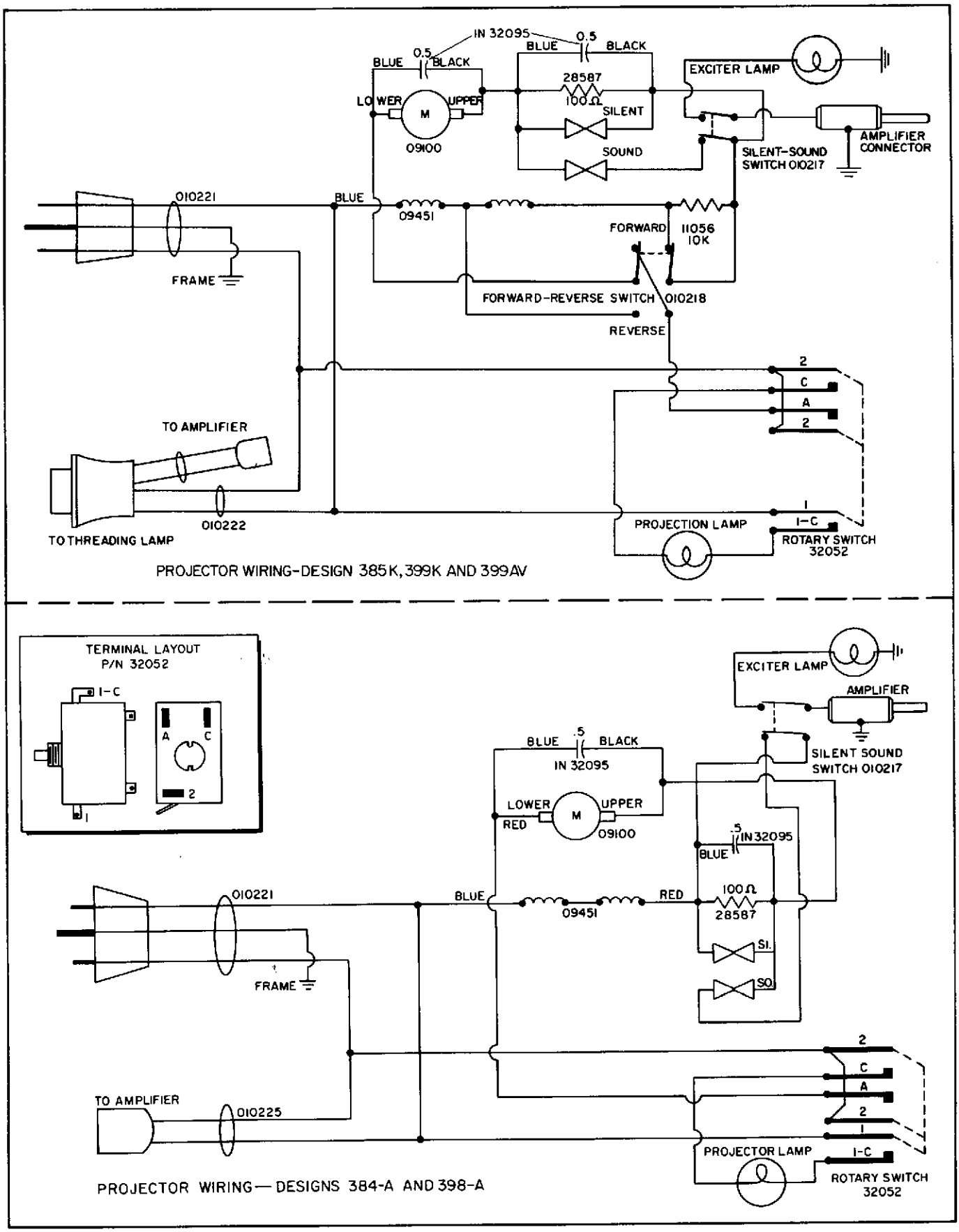



Figure G. Wiring Diagram for Design 384A, 398A and latest 385 and 399 Projectors

from turning but not so tight as to keep the shaft from being adjusted in or out. Assemble the film guide (27) to the sound head with the fillister head screws (26) 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 O. 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 (22) securely at this time. Remove tools.

h. Slip tool No. S-15177-F3 (14, figure B) onto the end of the sprocket shaft. Slide the sprocket (21) 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 (20). The sprocket, sprocket shaft and driving gear should now be positioned correctly. Remove tool from shaft.

i. Use tool No. S-15638-N6 (10, figure B) to adjust the film guide clearance as follows: Loosen the screws (26) and insert the clearance tool between the sprocket and the film guide as shown in figure Q. The tool will fit over the sprocket in only one way. Press the film guide down against the tool and tighten the screws (26). Remove the clearance gage.

j. Insert tension washer (19) and spring (18) into the sprocket guard (17) and attach all of these parts to the sprocket shaft with fillister head screw (16).

30. 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 (5) 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 the cap (2) and tighten the set screw (1). For adjustment of the stabilizer assembly, see paragraph 45.

e. If the optical slit assembly (45) 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 (44) and screw in the set screw (43). Adjustment of the optical slit assembly must be made after reassembly of the projector as described in paragraph 46.

31. 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.

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

a. Assemble the resistor (28) or (28A) and clamp (27) or springs (27A), depending on the model of projector being serviced. Fasten the resistor in place within the motor housing (32), being careful not to damage the resistor. Then carefully install the stator (25) onto the studs (24A) within the housing and secure it in place with the retaining nuts (24).

**CAUTION**

During the installation of the armature (23), step b following, do not permit the armature to slip forward in the motor housing and come in contact with the resistor clamp (27) or springs (27A) as this may cause damage to the windings.

b. Slip the armature spring (21) and bearing (22) onto the armature shaft, and carefully insert the armature (23) into the motor housing. Permit just enough of the armature shaft to project through the front of the housing so that the blower fan (20) can be installed.

c. Aline the holes in the blower fan hub and armature shaft, and install the spring pin (19).

d. (Code C, D, E, F only). Secure capacitor (31) to brush holder housing (17) with screws (30). Insert the capacitor leadwires through the hole in the brush holder housing, securing the leads with the strain relief bushing (29), and connect the leadwires to the brush holder terminals.

e. Install the washer (18) and radial bearing (12)

on the armature shaft. Assemble the brush holder housing to the motor housing with the screws (16).

f. Insert the motor brushes and springs (14 and 15) into the brush holder. Be sure that the curvature of the brushes matches the curvature of the armature. Screw in the motor brush caps (13).

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 D 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 43.

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

a. Lubricate the bearings before reassembling them. Insert the retaining ring (23), ball bearing (22) and retaining ring (21) into the governor cap (25). Insert the shaft (20) through the ball bearing. Reach in from the opposite side of the governor cap and press the retaining pin (19) into the hole provided 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) or (13A). 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) with a pair of long nosed pliers.

34. 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 temporarily.

b. The set screw (4) is used to adjust the fire shutter and should not be removed or turned unless the fire shutter requires an adjustment after reassembly. See paragraph 43 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 jiggling around and causing possible damage to the hooked lip. Remove the tape when assembling the blower housing to the motor housing.

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

CAUTION

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

a. Replace the same quantity 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 (30).

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. 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).

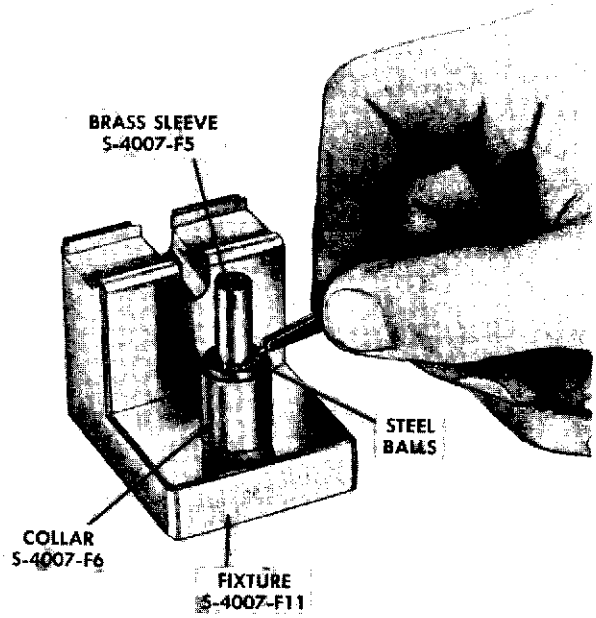



Figure H. Shuttle Shaft Reassembly, Step 1

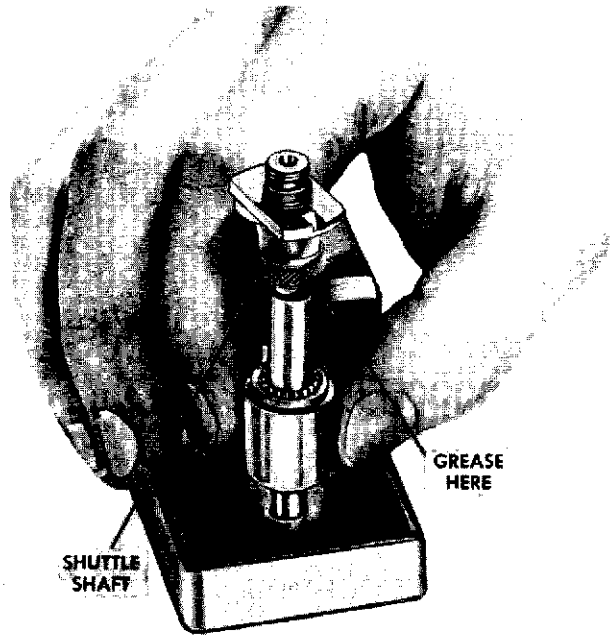



Figure I. Shuttle Shaft Reassembly, Step 2

c. In order to reassemble shafts (22 and 13), steel balls (23 and 14) and felts (24 and 15) correctly and easily, the following directions should be read and followed carefully. Figures H through L will help by illustrating the various steps.

d. 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 H. Do not grease steel balls. Then place the counter gear and shaft assembly (22) inside the brass sleeve in the same manner as shown in figure I 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.

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

f. Take one of the quills No. S-4007-F14 (4, figure B) and place it in the jig as shown in figure J. 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

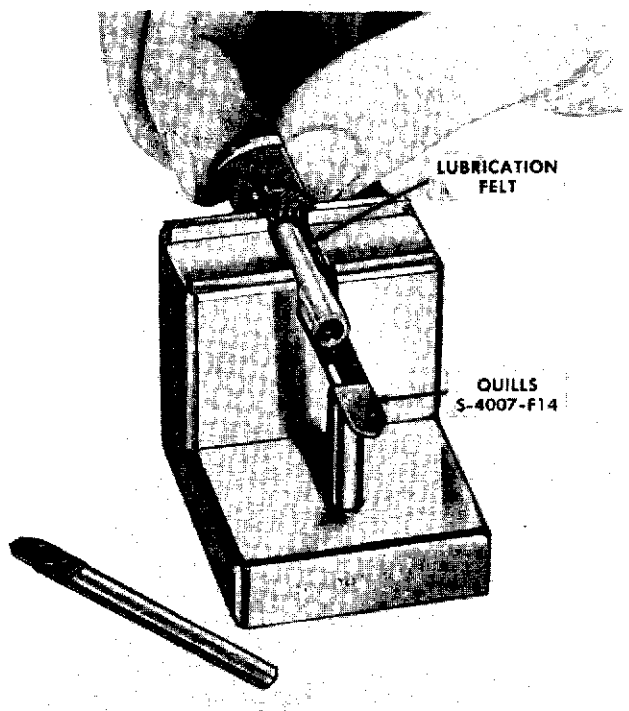



Figure J. Shuttle Shaft Reassembly, Step 3

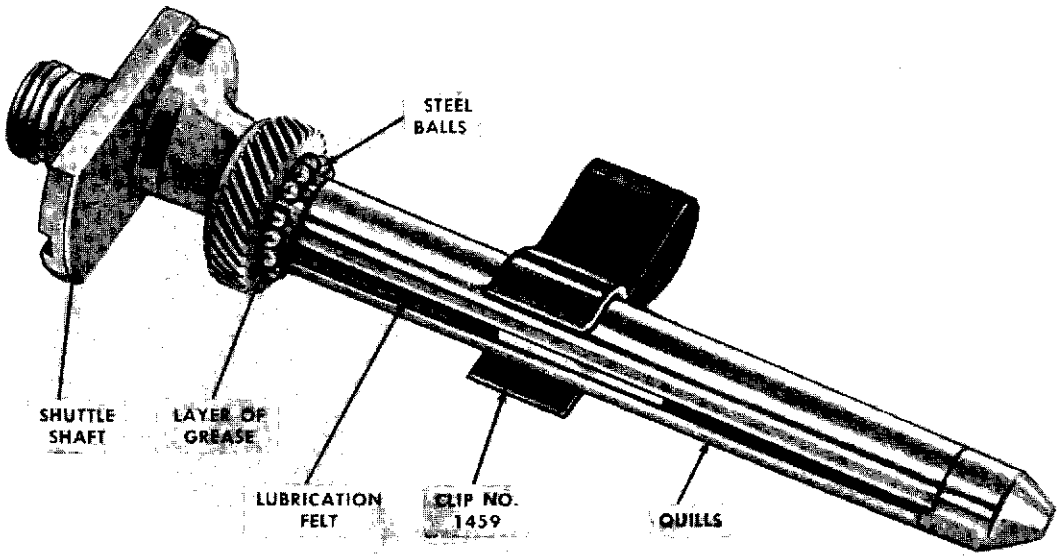



Figure K. Shuttle Shaft Reassembly, Step 4

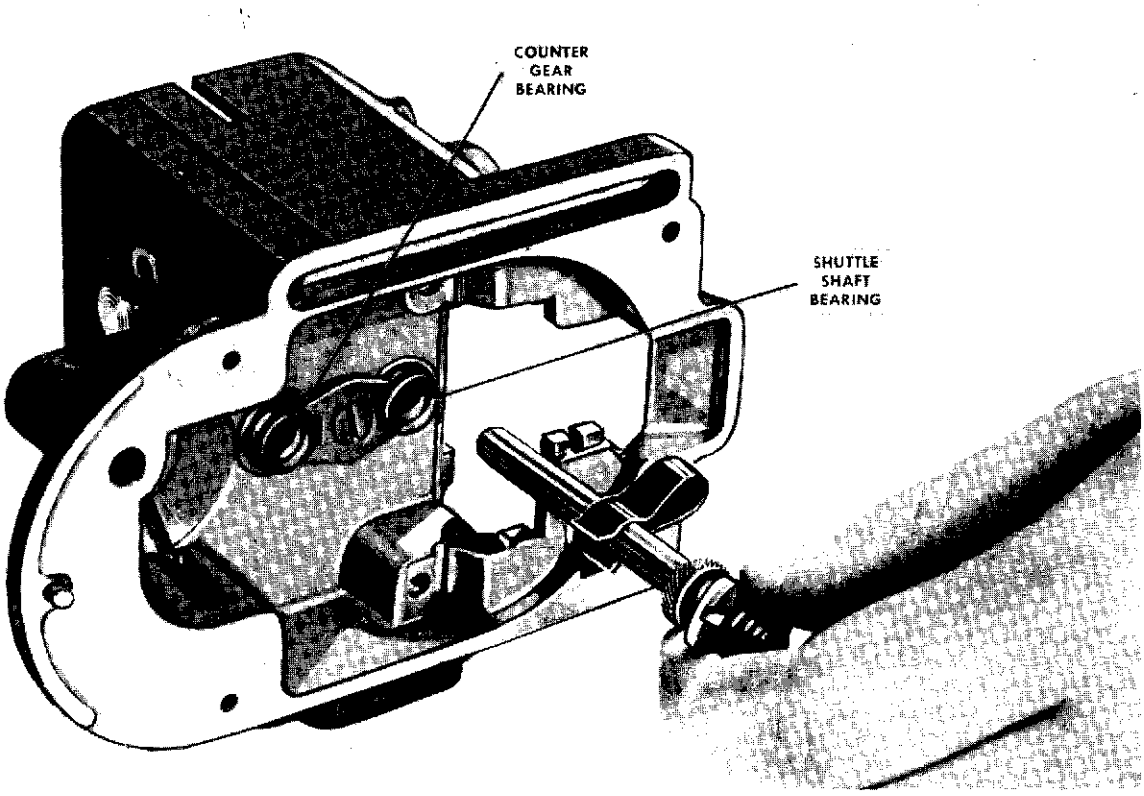



Figure L. Shuttle Shaft Reassembly, Step 5

in figure J. 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.

g. 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 K, 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 L. 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.

h. 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 and shaft should now be securely and correctly positioned and there should not be any end play present whatsoever.

i. Place the worm extension (17) on the shaft and up against the worm (20). Secure it to the shaft with the set screws (16).

j. 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 H through L 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 M. 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 M should be exactly true.

k. 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).

l. The shuttles are made of 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, be sure to use a shuttle having the same number as the one removed.

m. Assemble the two sections of oiler assembly (4 and 5) together. Press oiler assembly into place and secure it with fillister head screws (7).

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

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.

o. 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 C to engage the shuttle shaft collar and then draw the hex nut (1) on tight with an open end wrench. Figure N illustrates the rear of the gear case when properly assembled.

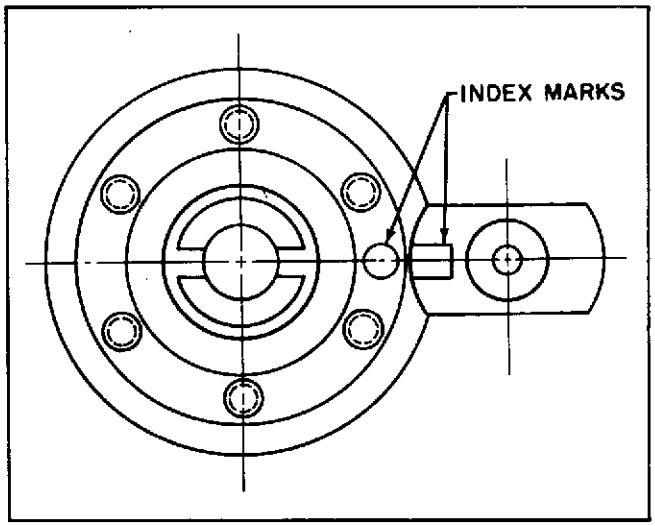



Figure M. Shuttle Shaft and Counter Gear Alinement

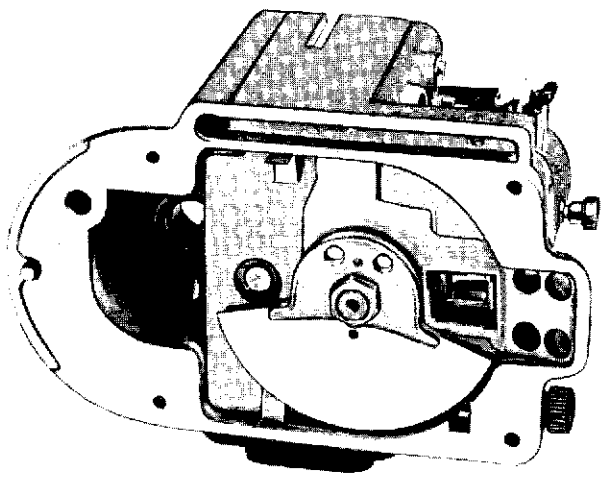


Figure N. Rear View of Gear Case Assembled

36. 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 (±0.005) of an inch. GO-NO GO gage No. S-4529-N4 (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 or remove shims (29, figure 5) as necessary to bring shuttle teeth out to the proper height.

f. When the shuttle teeth project too far through the aperture plate, even without shims (29), 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 38d. Assemble 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. Assemble sprocket shaft lubricator (27A) into sprocket shaft (27). 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 O. 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) when the shaft is properly adjusted. Remove the special tools.

k. Before reassembling the sprockets (8), saturate the felt washers which are located inside 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. The sprocket hub 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 P. 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

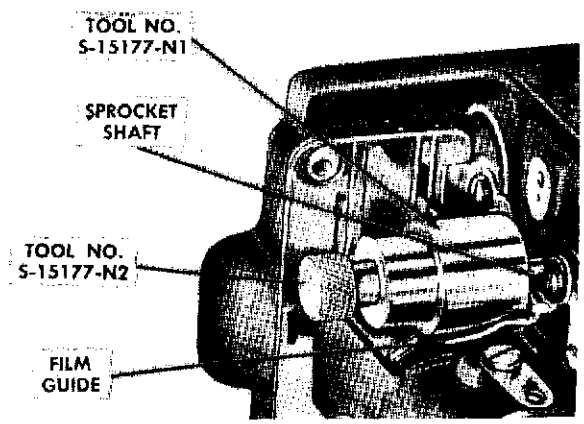



Figure O. Sprocket Shaft Adjustment

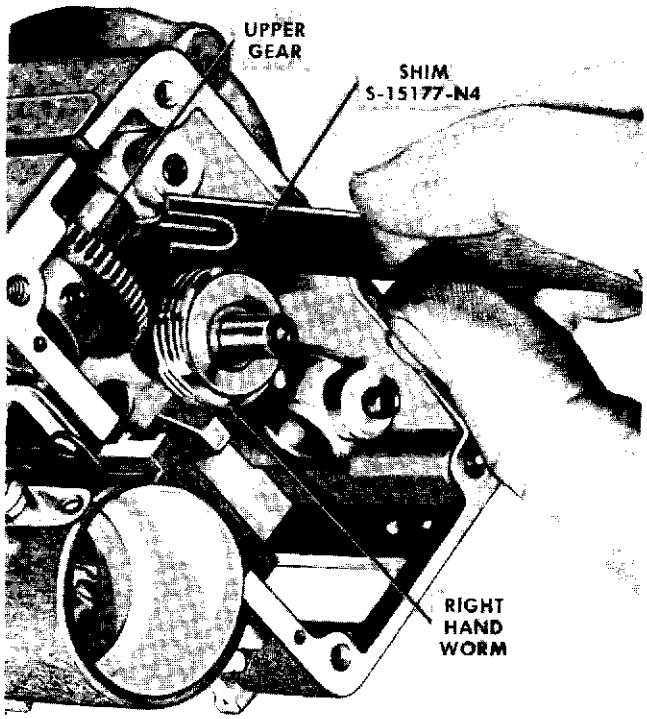



Figure P. Adjusting Clearance with Special Shim

(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 Q. 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 R for a view of the gear case interior assembled.

37. 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 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

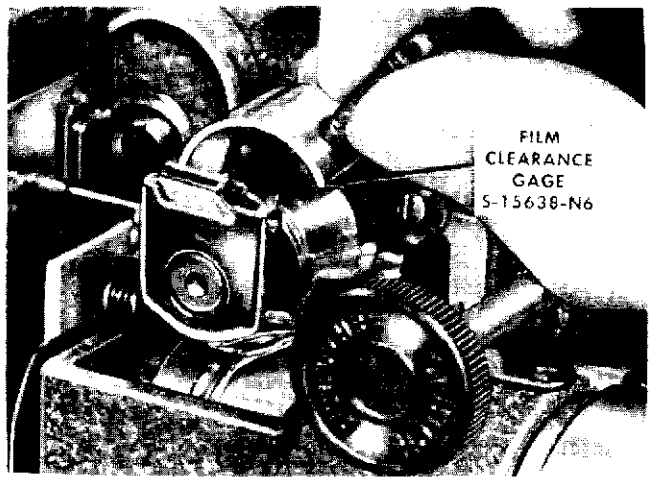



Figure Q. Adjusting Film Clearance

(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.

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

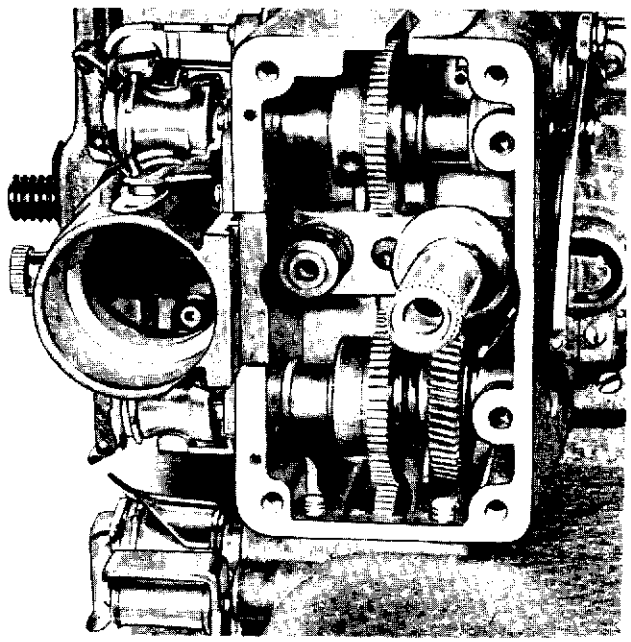


Figure R. Components Installed in Gear Case

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.

38. PRESSURE PLATE. (See figure 3.)

a. Insert the lower screw (3) through the spacer (5), pressure plate yoke (6) and compression spring (4A) and screw it into the pressure plate (7). Assemble the spring (2) and spring cup (1) between the head of the screw and the outer ear of the pressure plate yoke.

b. Insert the upper screw (3) through the spacer (5), pressure plate yoke (6) and bushing (4) and screw it into the pressure plate (7). Assemble the spring (2) and spring cup (1) between the head of the screw and the outer ear of the yoke.

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 travel. If it is, no adjustment of 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 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 40 for this adjustment.

39. PROJECTOR FINAL ASSEMBLY (See figure 2.)

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

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

c. When assembling the gear case (14) to the blower housing (17), 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. For Code A, B projectors, secure the complete assembly to the sound head casting with the Sems screws (7) and the screw and washer combinations (8). For Code C, D, E, F projectors, secure the assembly with the support brackets (7B), bracket screws (7A) and the screw and washer combinations (8).

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

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

a. The pressure plate position adjustment has already been explained in paragraphs 38c through 38f. The pressure adjustment can only be made after gear case has been securely fastened to blower housing and all attaching screws securely tightened. The pressure adjustment is made as follows:

b. Close the lens carrier in toward 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 the hex head portion of eccentric bushing (20), noting 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 eccentric bushing securely.

e. Check adjustment after the set screw has been

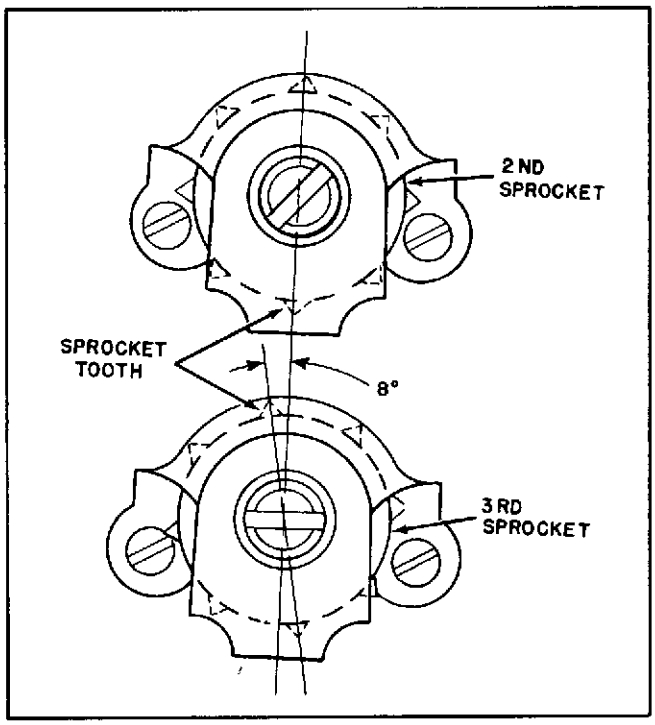



Figure S. Proper Synchronization of Second and Third Sprockets

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.

41. 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 S. This adjustment is easily made with the use of a special tool like the one shown in figure T. The left-hand side of this figure gives the dimensions of the tool which can be made from any 1/16-inch stock of steel, aluminum or bakelite.

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

e. Rotate the projector mechanism by hand (turn the rubber knob, figure 3, index 8) until one of the

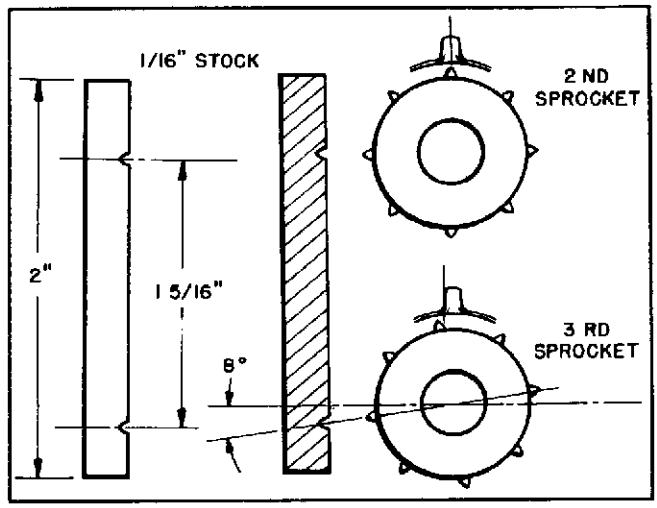



Figure T. Improvised Tool for Obtaining Proper Sprocket Synchronization

teeth on the second sprocket is in the vertical as shown in figure T, 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 gage 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 gage. With the gage still in the teeth, push the third sprocket into position.

g. Replace the sprocket guards over the sprockets as outlined in paragraph 36, step o.

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

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

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 U.) 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

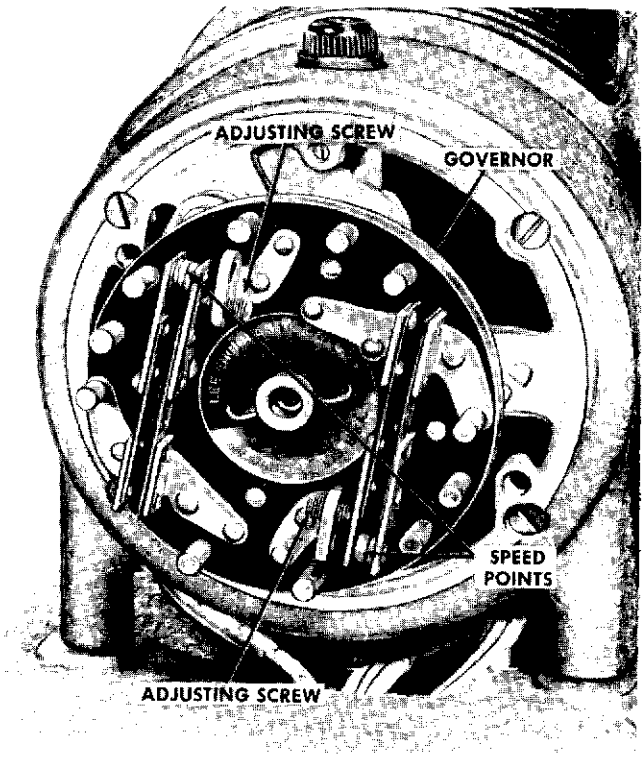



Figure U. Adjusting Governor Speed

increase or decrease the control point gaps, the speed can be either decreased or increased. Adjust until the correct speed is obtained for both sound and silent operation.

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

a. The proper clutch lever 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 (28), figure 3. 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). 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.

44. 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. Place the amplifier next to the projector and case. Connect cables as follows: (1) Connect the exciter lamp plug to the receptacle on top of the amplifier; (2) Connect the power plug to the two prong receptacle on the rear of the amplifier.

c. Install the amplifier (7) with four knurled head screws (6).

45. STABILIZER ROLLER ADJUSTMENT.

a. The stabilizer assembly must be correctly adjusted to obtain the best sound production. Make an endless loop of "buzz track" sound film and thread it through the sound 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 alinement of the plain and flanged stabilizer rollers. Misalinement of the stabilizer rollers may cause uneven film tracking around the sound drum.

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 of the film through the projector and the movement of the plain roller to its operating position should be in 2-1/2 seconds. If it is not, the torsion spring (5, figure 10) must be replaced.

46. 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 45) must be done for correct slit scanning across the sound track befor 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 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 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.

# Trouble Shooting

| TROUBLE | PROBABLE CAUSE | REMEDY |
|---|---|---|
| 1. Projector motor does not run, lamp does not light, and amplifier does not operate. | a. Current supply cord not making proper contact with power outlet. | a. Check and make certain that all cords are properly connected and making good contact. |
| | b. No current at supply outlet. | b. Check outlet with ordinary lamp. |
| | c. Open circuit in line cord. | c. Check with another cord known to be good. |
| | d. Line switch defective. | d. Replace defective switch. |
| 2. Lamp lights but motor doesn't run. | a. Motor brushes sticking or worn. | a. Remove brushes and clean out brush holders. If brushes are worn to less than 1/8 inch in length, replace them. |
| | b. Dirt in governor contacts. | b. Remove governor cap and clean governor breaker points. |
| 3. Motor and amplifier operating but lamp does not light. | a. Lamp burned out. | a. Replace lamp. |
| | b. Lamp switch not turned on. | b. Check switch to see that it is in ON position. |
| | c. Lamp switch burned out. | c. Replace defective switch. |
| 4. Speed varies or projector runs too fast. | a. Motor brushes worn. Governor points pitted or dirty. | a. Replace brushes when worn to less than 1/8 inch in length. File points or replace governor. |
| 5. Edge of aperture opening uneven and fuzz projecting into picture area. | a. Dirt in aperture opening. | a. STOP PROJECTOR. Lightly but thoroughly clean edges of aperture opening with aperture brush or pipe cleaner. |

| TROUBLE | PROBABLE CAUSE | REMEDY |
|---|---|---|
| 6. Picture not sharp on screen. | a. Lens or condenser elements may be dirty, oily, or finger-spotted. | a. Use lens tissue and thoroughly clean surfaces of lens and condenser elements. If all dirt cannot be removed in this manner, lens-cleaning fluid should be wiped on the lens surface and followed by a thorough cleaning with lens tissue. |
| | b. Loose elements in projection lens. | b. Tighten lens retainers. |
| | c. Film loops too short. | c. Rethread. |
| 7. Picture not framed. | a. Framer knob or lever improperly adjusted. | a. Turn framer knob or lever until picture is properly framed. |
| | b. Film out of frame. | b. Adjust framing until frame line is close to perforation center. |
| 8. Film does not wind on rear-reel arm. | a. Fabric belt on rear-reel arm slips. | a. Remove belt and thoroughly clean in dry cleaning solvent. Turn belt inside out or, if necessary, replace with new belt. |
| | b. Spring belt which runs from governor cap to the pulley on take-up arm may be stretched, kinked, oily, or worn. | b. Slipping may be temporarily corrected by thoroughly cleaning spring belt with dry cleaning solvent. However, if belt is stretched or kinked, it should be replaced with a new one. |
| | c. Spindle in rewind position. | c. Disengage gears. |
| | d. Take-up reel bent. | d. Use a good reel. |
| 9. Rear-reel arm assembly binds or jerks. | a. Spring take-up belt stretched, kinked, oily, or worn. | a. Wash belt with dry cleaning solvent or replace. |
| | b. Fabric take-up belt worn or oily. | b. Wash belt with dry cleaning solvent or replace. |
| 10. Film loses loops and picture unsteady. | a. Torn or chipped perforations in film. | a. Check film carefully and eliminate injured film. |
| | b. Poorly made splice. | b. Resplice film. |
| | c. Too much clearance between sprocket and film guide. | c. Film guide bent. Adjust to two film thicknesses by bending, or loosen screws and reset clearance. |
| | d. Sprocket guard out of adjustment. | d. Replace spring or tighten retaining screw. |
| | e. Shuttle does not protrude far enough through aperture plate or stroke is insufficient. | e. Shuttle mechanism and/or aperture plate must be replaced or readjusted. |
| 11. Film scratched. | a. Dirt or emulsion accumulation in film channel or around sprockets and guards. | a. Brush away as much of the free dirt as possible. Remove dust with brush or syringe. Clean with dry cleaning solvent (SD). |

| TROUBLE | PROBABLE CAUSE | REMEDY |
|---|---|---|
| | b. Worn film-handling parts such as aperture plate, gate plate, film guards, rollers. | b. Replace worn parts. |
| 12. Safety shutter sticks or operates sluggishly. | a. Dirt or oil on shutter. | a. STOP PROJECTOR. Use round camel's hair brush and clean through condenser opening. Use cleaning fluid if necessary. |
| 13. Poor illumination. | a. Line voltage lower than lamp voltage rating. | a. Use lamps with voltage rating equal to voltage of line supply. |
| | b. Lamp old, black, and almost ready to burn out. | b. Use new lamp. |
| | c. Lamp inserted crooked in lamphouse. | c. Insert lamp in lamphouse properly and screw cap up snugly. |
| | d. Safety shutter does not rise. | d. See whether safety shutter sticks. (Trouble No. 12) |
| | e. Condensers and lens dirty or oil covered. | e. Clean all lens elements thoroughly. |
| | f. Reflector mirror tarnished. | f. Polish or replace reflector mirror. |
| 14. No sound. | a. Burned out exciter lamp. | a. Replace exciter lamp. |
| | b. Amplifier not turned on. | b. Check position of amplifier switch. |
| | c. Fuse blown. | c. Replace fuse. |
| | d. Defective tube or tubes in amplifier. | d. See that all tubes are in their correct sockets. Test each tube and replace all defective ones. |
| | e. Speaker cable not plugged in at both ends. | e. Check all cable connections. See that they make proper contact. |
| | f. Pin jack between amplifier and exciter lamp may not be connected. | f. Make certain the pin jack is properly connected and makes good contact. |
| | g. Speed switch in SILENT position. | g. Move switch to SOUND position. |
| 15. No sound, exciter lamp lights. | a. Volume control not advanced sufficiently toward the high position. | a. Check position of volume control and gradually advance to high position. |
| | b. Film incorrectly threaded. | b. Check threading. |
| | c. Absence of sound record on film. | c. Remove the film; turn on the amplifier. Turn the volume control to high position. Pass a card swiftly back and forth between the sound lens and the sound drum. If a loud thumping sound is heard from the speaker, the equipment is operating properly and the lack of sound would be due to the film. |

| TROUBLE | PROBABLE CAUSE | REMEDY |
|---|---|---|
| | d. Defective tubes or photoelectric cell. | d. Test all tubes and photoelectric cell. Replace defective ones. |
| | e. Exciter lamp damping shield not aligned. | e. Adjust damping shield so that opening in shield is in line with lens of optical slit. |
| 16. Inadequate volume. | a. Volume control not advanced far enough. | a. Advance volume control until sufficient volume is obtained. |
| | b. Poorly made or dirty film. | b. Compare with sound from film known to be clean and with adequate volume. |
| | c. Foreign matter obstructing optical sound system. | c. Clean optical sound system according to instructions. |
| 17. Unsatisfactory sound quality. | a. Speed switch set in silent position. | a. Turn switch to SOUND position. |
| | b. Speed slow, fast or uneven. | b. See paragraph 42. |
| | Defective tubes. | Replace with new tubes. |
| | c. Incorrect exciter lamp being used. | c. Lamp filament must be at right angles to glass envelope. |
| | d. Dirt or foreign matter on optical system. | d. Clean according to instructions. |
| | e. Sound drum binds. | e. Check for flywheel interference during rotation. |
| | f. Film has improper traction around sound drum. | f. Rethread film. |
| | g. Optical sound system out of adjustment. | g. Check and adjust (paragraph 46). |
| 18. Amplifier fuse blows. | a. Shorted tube or tubes. | a. Check and replace defective tubes. |
| | b. Amplifier connected to direct current. | b. Connect amplifier to voltage designated on plate at amplifier socket. Be sure power supply is AC. |

# Final Test

47. 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.

48. FILM RUNNING TESTS.

a. Make an 18-inch loop of new film, thread it through the mechanism with emulsion side to gate shoe and turn on the motor switch.
b. Allow it to run through the projector 250 times.
c. Remove the film and inspect it for scratches. If scratches are evident, they are probably caused by emulsion which has gathered on the pressure plate. Clean the pressure plate as described in paragraph 20 and repeat the test, using new film.
d. If scratches are again evident on the film, examine aperture plate and pressure plate for scratches. There must not be any scratches on either of the plates. Replace the plates if necessary.
e. Upon completion of reassembly and all necessary adjustments, a sound film should be run through the projector in order to check the mechanical and sound operation. Use a film known to be in good condition and possessing a good sound track.

49. HEAT FILTER CLEANING AND REPAIR. (Design 399AV only). Heat filter parts for the Design 399AV projector are illustrated in the inset in figure 6, parts catalog section of the book.

a. Routine filter cleaning can be accomplished without removing the filter from the projector. Remove the relay condenser assembly (9, figure 6), condenser assembly (2, figure 2) and projector lens (3, figure 2). Then disengage the clutch and rotate the manual knob, if necessary, until the shutter clears the aperture.
b. Double an ordinary pipe cleaner and, at a point approximately 5/16 inch back from the fold, bend out a "foot" at an angle of 15 to 20 degrees. Dip this foot (which will serve as a swab) in alcohol and insert it through the opening for the condenser assembly (2, figure 2). Start at the top of the filter glass and move the swab gently back and forth, gradually progressing downward to the bottom of the glass. If necessary, wash the swab in alcohol and repeat the process. To clean the front surface of the filter glass, the swab must be inserted into the opening for the relay condenser (9, figure 6).
c. To remove the heat filter parts for replacement, remove the gear case and blower housing as instructed in paragraph 2. Spread the ends of the link (1A, figure 6) and disengage link from filter assembly (1F). Separate the crank (1B) from the link. Remove screw (1C) and lift out the assembled pivot (1D) and filter assembly (1F) and the mounting plate (1E).

CAUTION

The filter elements should not be removed from their housing unless absolutely necessary to clean interior glass surfaces. The bent-over tongs must be pried up carefully and all parts separated. Clean all parts with alcohol and dry thoroughly before reasembling. Be extremely careful not to bend or dent the retainer in any way, since such distortion may impede expansion of elements.

d. Reassemble all parts in reverse order of disassembly. Centrally locate the heat filter assembly with respect to the relay condenser (9, figure 6) before tightening the screw (1C).

50. LOOPSETTER CLEANING AND ADJUSTMENT. (Design 399AV only). See figure 4, Parts Catalog section.
a. To remove the loopsetter, loosen the screw (21) which holds the lower film tension clip (21) and the adjacent screw (9) which holds the lower film guide (10). This will permit the loopsetter assembly (31) to be removed.
b. Only the spring (31B) and screw (31A) are replaceable. If the cam (31C) and/or spindle (31D) are damaged, the complete assembly must be replaced. To remove the spring, hold the round head of the spindle firmly with a pliers and remove the screw.
c. Wash all parts in alcohol, dry them thoroughly, and reassemble parts. Make sure that the cam (31C) revolves freely on the spindle (31D) and that the spring is positioned so that it bears evenly against the flat on the cam hub. Do not lubricate the spindle.
d. Slip the loopsetter assembly up into approximate position and tighten the film tension clip retaining screw (21) just enough to hold the assembly in place. Turn the rubber manual knob at the front of the gear case until one tooth of the lower sprocket is on an imaginary line drawn from center of sprocket to center of spindle. Place a strip of film in the film channel and close the film gate.
e. Rotate the cam (31C) counterclockwise and check for clearance between cam and the bottom edge of the film pressure plate. If necessary, adjust the loopsetter to provide 0.008 to 0.015 inch clearance. Rotate the cam clockwise and check to make certain that the cam just clears the closest sprocket tooth. Tighten both retaining screws (9 and 21, figure 4) securely.

f. Thread the projector with film and check the loopsetter operation by pulling out (enlarging) the lower loop and observing film loop restoration. If the restored loop is too short, the loopsetter is placed too high. If the restored loop is too long, the loopsetter is placed too low. Readjust, if necessary, maintaining proper clearances (step e).

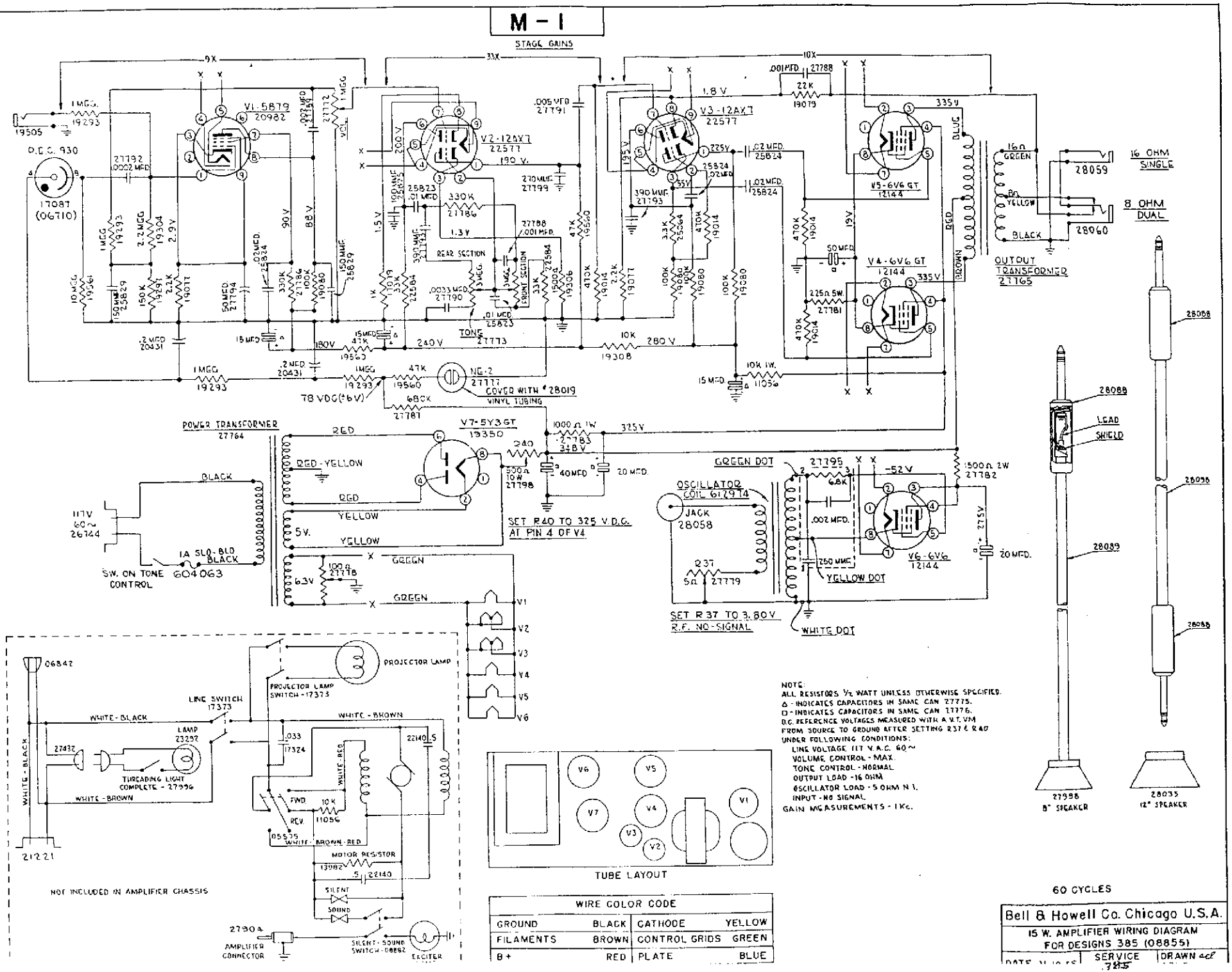
51. FINAL INSPECTION.

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. 18).
b. Inspect and clean the sound head and optical slit (par. 19).
c. Inspect and clean all film handling parts (par. 20).
d. Check snubber roller adjustment (par. 29, steps d through f).
e. Check height of shuttle teeth (par. 36, steps c through f).
f. Check film guide adjustment (par. 36n).
g. Check shuttle teeth stroke (par. 38).
h. Check pressure plate adjustment (par. 40).
i. Check clutch lever and fire shutter adjustment (par. 43).
j. Check sprocket synchronization (par. 41).
k. Check running speeds (par. 42).
l. Check stabilizer roller adjustment (par. 45).
m. Check optical slit adjustment (par. 46).
n. Be certain that film tests have been made.
o. Check operation of reel arms.
p. See that all screws and nuts are secure, and that amplifier is installed properly (par. 44).
q. Check operation of tilt mechanism.

# M - 1

STAGE GAINS










TUBE LAYOUT

| WIRE COLOR CODE | | | |
|---|---|---|---|
| GROUND | BLACK | CATHODE | YELLOW |
| FILAMENTS | BROWN | CONTROL GRIDS | GREEN |
| B+ | RED | PLATE | BLUE |

NOTE:
ALL RESISTORS ½ WATT UNLESS OTHERWISE SPECIFIED.
Δ - INDICATES CAPACITORS IN SAME CAN 27775.
□ - INDICATES CAPACITORS IN SAME CAN 27776.
D.C. REFERENCE VOLTAGES MEASURED WITH A V.T. VM FROM SOURCE TO GROUND AFTER SETTING R37 & R40 UNDER FOLLOWING CONDITIONS:
LINE VOLTAGE 117 V.A.C. 60~
VOLUME CONTROL - MAX.
TONE CONTROL - NORMAL
OUTPUT LOAD - 16 OHM
OSCILLATOR LOAD - 5 OHM N.I.
INPUT - NO SIGNAL
GAIN MEASUREMENTS - 1Kc.

60 CYCLES

Bell & Howell Co. Chicago U.S.A.

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