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Service instructions for Filmosound Projectors Design 641/642/643 644/652

This reprint service manual should also be used for the [illegible] projector designs 8D643, 8D644, 8D652, 8D655. Parts catalogue and amplifier circuit diagrams for the [illegible] projectors can be made available upon receipt of order.

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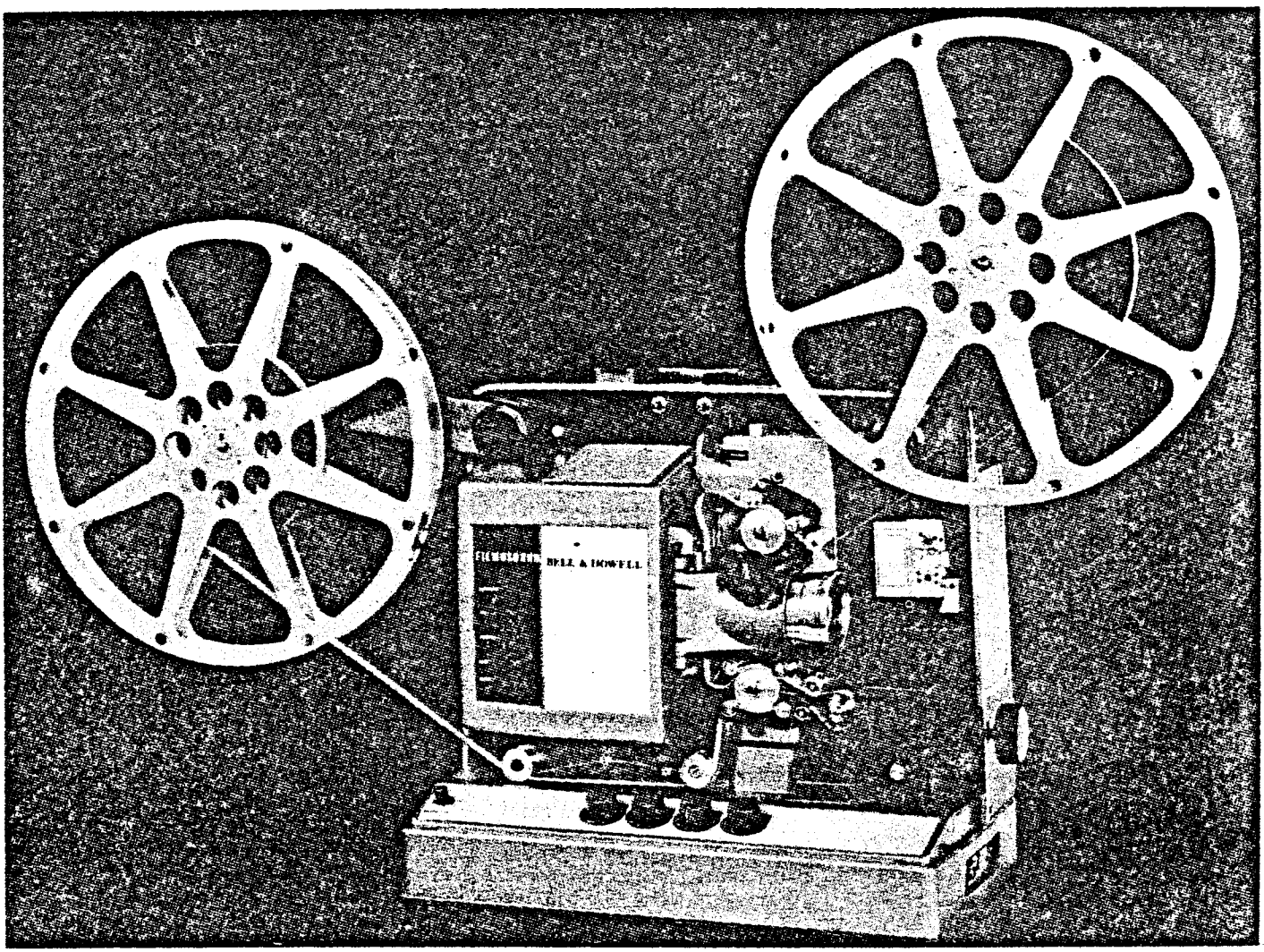

Model 642 Filmosound Projector

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IMPORTANT

The castings for the Models 641 and 642 Projectors are magnesium. Adhere to standard shop practices when machining or drilling castings.

This manual has been prepared specifically to assist Service Agents in the repair of the Bell and Howell Models 641 and 642 Projectors. Information contained in this manual should in no way be interpreted as the manufacturing specification.

INTRODUCTION

GENERAL

This manual has been prepared to aid in servicing the Bell & Howell Design 641 and 642 Filmosound 16-mm motion picture projectors. An illustrated Parts Catalogue is included at the rear of the manual to identify replacement parts and to aid the service engineer in the disassembly and reassembly of the projector.

All parts in Parts Catalogue illustrations are indexed, as much as possible, in a suggested order of disassembly, and with attaching parts immediately preceding those parts which they attach. Where disassembly and reassembly procedures are quite obvious, no attempt has been made to elaborate on removal or installation instructions. When making specific projector repairs and replacements, the service engineer must use his own judgement in eliminating unnecessary steps of procedure.

Before proceeding with repairs, refer to the Fault Finding guide for possible causes and remedies of specific customer complaints.

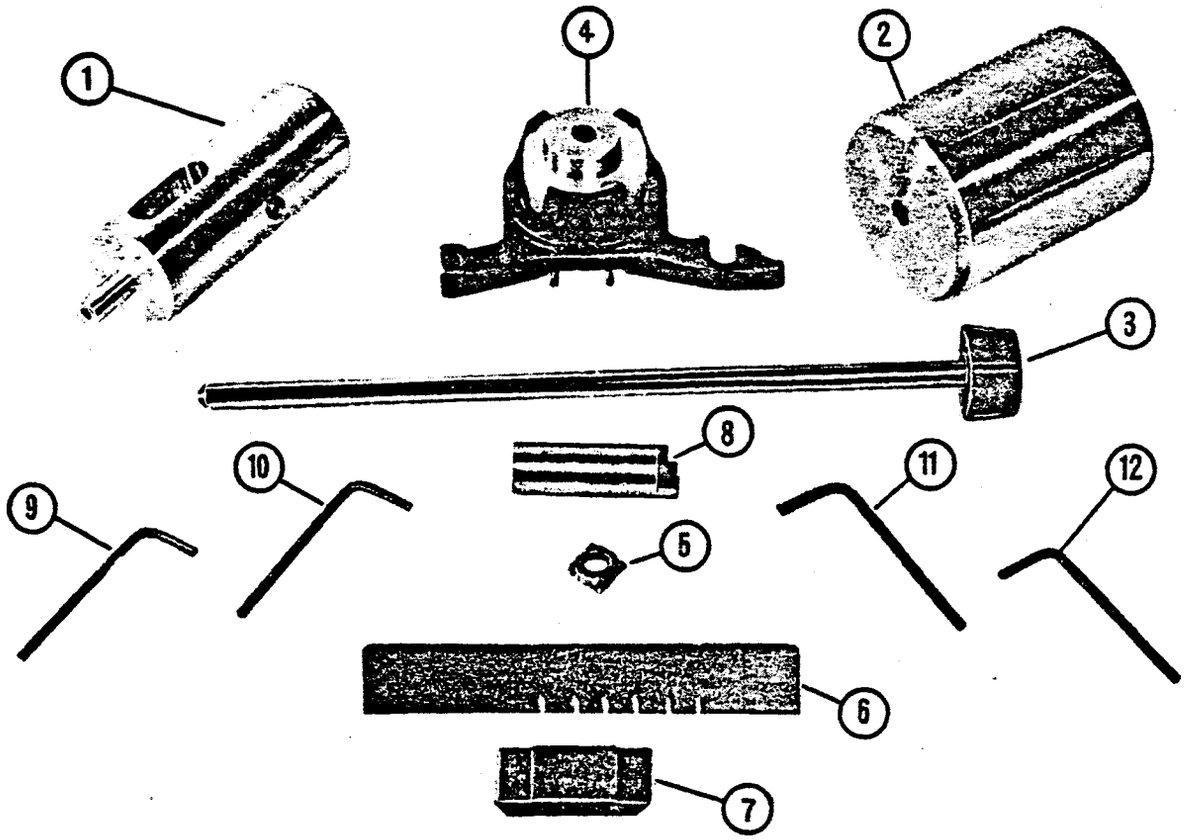

Figure A. Special Service Tools

INDEX NO.	TOOL NO.	NOMENCLATURE	TOOL APPLICATION
1	SER-550-2-N5	Lamp Plug	)
2	SER-550-2-N1	Lens Plug	)
3	SER-550-2-N2	Alignment Rod	) Alignment of optical
4	SER-550-2-N4	Condenser Plug	) system
5	SER-550-2-N3	Aperture Plug	)
6	SD-550-N1	Stroke Gauge	Measurement of shuttle stroke
7	SER-550-6-N1	Shuttle Height Gauge	Check shuttle protrusion
8	SER-550-8-N1	Alignment Tool	Sound Drum & Light Pipe adjustment
9	KEA 332	2BA Angle Allen Key	
10	KEA 564	3BA Angle Allen Key	
11	KEA 116	4BA Angle Allen Key	
12	KEA 050	6BA Angle Allen Key	

NOTE: Tools illustrated in Figure B, are identified by the index numbers in this key.

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16 mm Filmosound Projector

DESIGN 641 and 642

SERVICE INSTRUCTIONS

SECTION 1

GENERAL CLEANING, LUBRICATION
AND FAULT FINDING GUIDE

CLEANING AND LUBRICATION

1. CLEANING

During periodic maintenance of the projector, the transport mechanism should be removed and thoroughly cleaned. Brush or blow out all large particles of dirt. Wash all moving parts except oil impregnated bearings with any good petroleum solvent. Wash oil impregnated bearings and the pull-down cams with naptha. Wash the cam oilers in naptha and replace if not thoroughly cleaned by washing. As soon as parts have been washed and dried, coat with a light film of the specified lubricant.

2. LUBRICATION

a. General Unless otherwise specified, apply one or two drops of oil (Shell Clavus No. 27) to all shafts, sleeve bearings and sliding parts before assembly. Place felt pads in a shallow container of specified oil until saturated; then allow to drain before installation.

b. Lubrication of Specific Parts See the following table for lubrication of specific parts and lubricant to be used.

LUBRICATION CHART

PARTS TO BE LUBRICATED	TYPE OF LUBRICANT	SPECIFICATION
Shuttle pivot bearings	Grease	Shell Alvania No. 2
Pull-down cam, oil storage pads and shoes	Oil	Esso Turbo-Oil P-16
Shuttle guides and guide bearings	Oil	Shell Clavus No. 27
In-out cam and follower	Grease	Shell Alvania No. 2
All rollers and spindles	Oil	Shell Clavus No. 27
Tilt rack, pinions and reel arm gears	Grease	Shell Alvania No. 3
Machined surfaces of castings (non-bearing)	Oil	Shell Ensis Fluid 260
Nylon gears	Grease	Shell Alvania No. 2

FAULT FINDING GUIDE

3. MISCELLANEOUS TROUBLES AND REMEDIES

TROUBLE	PROBABLE CAUSE	REMEDY
a. Nothing runs	Damaged power cable	Repair or replace cable
	Loose connections	Repair
	Fuse blown	Replace fuse
b. Motor hums but does not run	Starting circuit open or shorted	Repair loose or transposed connections Replace starting capacitor Replace starting relay
c. Motor runs but mechanism does not run	Drive belt off pulley	Reinstall belt
	Motor or driven pulley loose on shaft	Position pulley and tighten setscrews
	Damaged belt	Replace belt
	Animation clutch spring broken (Des. 642 only)	Replace spring
d. Rewind does not operate	Rewind clutch not engaging	Adjust (para.48)
	Rewind clutch slipping	Adjust (para.48)
e. Take-up does not operate	Clutch balls or spring lost	Replace
f. Feed spindle does not revolve in reverse	Dirt in feed spindle clutch	Clean
	Clutch balls or spring lost	Replace
g. Gate will not lock	Latch spring set too close to lens mount stop	Adjust
h. Shuttle runs but sprockets do not revolve	Animation clutch spring broken or lost (Des. 642 only)	Replace
i. Short lamp life	Line voltage in excess of lamp voltage	Use lamp of correct voltage
	Blower belt off pulley	Replace
	Dirt in blower	Clean
j. Speed changer does not work	Knob or shifter crank loose	Tighten setscrews
	Shifter out of position	Adjust shifter

FAULT FINDING GUIDE (Cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
k. Speeds slow	Binding in mechanism	Free binding condition
	Slipping belt	Clean or replace
l. Runs at speed between 16 and 24 F.P.S.	Pulleys out of line	Realign
	Belt shifter out of adjustment	Adjust
	Belt shifter toggle spring broken	Replace
	Power line frequency other than 50 cycles	Use proper voltage and frequency
m. Solenoids buzz	Plungers not seating (Des. 642 only)	Adjust (para.46c and 47b)

4. PICTURE TROUBLES AND REMEDIES

TROUBLE	PROBABLE CAUSE	REMEDY
a. Film jump	Damaged film	Replace or repair
	Loose shuttle	Tighten (para. 43d)
	Dirty gate	Clean
	Damaged or lost pressure shoe spring	Replace
	Pressure shoe misaligned	Realign
	Incorrect shuttle stroke	Adjust (para. 43e)
b. Double image	Incorrect shuttle stroke	Adjust (para. 43e)
	Excessive shuttle protrusion	Adjust (para. 43c)
c. Weave	Sticking edge guide	Clean
	Side tension spring lost	Replace
	Fixed edge guide out of position	Reposition
d. Poor illumination	Optics out of line	Realign (para. 42)
	Fire shutter sticking	Free solenoid or linkage (para. 47)
	Front condenser reversed	Reassemble correctly

FAULT FINDING GUIDE (Cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
e. Poor focus	Dirty lens	Clean
	Dirty aperture	Clean
	Warped film	Recondition or replace
	Projector lens mount out of line	Realign (para. 45)
	Pressure shoe spring lost	Replace
	Bent pressure shoe	Replace
	Pressure shoe out of line	Realign
f. Frame line creeps	Framer eccentric loose	Align and tighten (para. 43f)
g. Insufficient framing	Framer eccentric out of adjustment	Adjust (para. 43f)
h. Trailer ghost	Shutter incorrectly timed	Reassemble properly

5. FILM TRANSPORT TROUBLES AND REMEDIES

TROUBLE	PROBABLE CAUSE	REMEDY
a. Loss of loops	Damaged film	Repair or replace
	Inadequate shuttle protrusion	Adjust (para. 43c)
	Inadequate or excessive shuttle stroke	Adjust (para. 43e)
	Pressure shoe spring lost	Replace
	Pressure shoe mounting plate screws loose	Tighten
	Sprocket shoes out of line	Realign (para. 44)
	Sprocket shoe locks not closing	Clean or adjust
	Sprocket drive gear loose on shaft	Retime and tighten
	In-out bracket spring broken	Replace
b. Shuttle operates but sprockets do not revolve	Animation clutch spring broken or lost (Des. 642 only)	Replace
c. Lower loop not restored	Loop restorer stroke too short	Adjust (para. 52b)
	Loop restorer does not engage restorer cam	Adjust (para. 52b)

FAULT FINDING GUIDE (Cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
d. Film rubs on loop restorer arm	Restorer arm out of position	Reposition (para. 52b)
e. Excessive film slap	Damaged film	Recondition or replace
	Dirty gate	Clean
	Pressure shoe rubbing on edge guides	Realign
	Incorrect shuttle stroke	Adjust (para. 43e)
f. Animation clutch does not operate (Des. 642 only)	Open circuit	Repair
	Solenoid plunger set too high or too low	Adjust
	Stop pawl clearance excessive	Adjust (para. 46a)
g. Animation clutch stops sprocket but shuttle pulls film (Des. 642 only)	Insufficient shuttle retraction	Adjust (para. 46b)
h. Splices jam in sprocket shoes	Bad splices	Replace
	Sprocket shoes set too close	Adjust (para. 44)

6. SOUND SYSTEM TROUBLES AND REMEDIES

TROUBLE	PROBABLE CAUSE	REMEDY
a. Projector runs, valves do not light	Loose connection	Repair
	Valve burnt out	Replace
b. Valves light, exciter does not light	Exciter lamp cable disconnected	Connect cable
	Wrong exciter lamp used	Replace with correct lamp
	Damaged oscillator valve	Replace
	Projector switch open or leads disconnected	Replace switch or connect leads

FAULT FINDING GUIDE (Cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
c. Valves and exciter light, but no sound	Speaker jack disconnected	Connect leads
	Speaker jack switch open	Repair or replace jack
	Photo-diode cable disconnected	Connect cable
	Photo-diode cable leads reversed	Connect to proper terminals
	Damaged valves	Replace
	Photo-diode out of line	Realign (para. 49b)
	Dirt on end of light pipe	Clean
	Wrong exciter lamp used	Replace with correct lamp
d. Low volume	Damaged valves	Replace
	Wrong exciter lamp used	Replace with correct lamp
	Photo-diode out of line	Realign (para. 49b)
	Dirt on light pipe or slit	Clean
	Slit misaligned	Realign (para.49d)
	Buzz track misaligned	Realign (para. 49e)
e. Distortion at all volume levels	Wrong exciter lamp used	Replace with correct lamp
	Output valves damaged	Replace
f. Crackling noises	Damaged valves	Replace
	Sound drum earthing spring loose, bent or lost	Repair or replace
	Buzz track out of line	Realign (para. 49e)
g. Wow or flutter	Guide roller sticking	Clean
	Guide roller spring broken, unhooked or lost	Repair or replace
	Film edge guide (sound head) out of line	Realign (para. 49e)
	Loose flywheel	Tighten
	Damaged sound drum bearing	Replace
	Soundhead assembly wrongly positioned	Realign
	Dirt causing guide roller arm pivot bearing to bind	Clean and polish

FAULT FINDING GUIDE (Cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
g. (Cont'd)	Photo-diode or exciter cable rubbing against flywheel	Reposition
	Chip or dirt in take-up sprocket gear teeth	Remove
	Loop restorer stroke is too short or restorer set too low	Adjust (para. 52b)
	Stabiliser arms out of balance	Adjust (para. 49c)
	Sprocket guard roller sticking	Clean
h. Clicking noises	Dirt on sound drum	Clean
	Sound drum earthing spring loose, bent or lost	Repair or replace
i. High frequencies fade (jumps focus)	Warped film	Recondition or replace
	Film edge guide (sound head) out of line	Realign (para. 49e)
	Dirt on sound drum	Clean

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THE

BELL & HOWELL

16mm Filmosound Projector

DESIGN 641 and 642

SERVICE INSTRUCTIONS

SECTION 2

DISASSEMBLY PROCEDURE

DISASSEMBLY PROCEDURE

7. GENERAL INSTRUCTIONS

a. Remove breakable items (optical parts, lamps, etc.) before proceeding with projector repairs. Wrap such items in tissue paper to protect them from damage.

b. When removing riveted parts for replacement, the old rivet must be drilled out with a drill equal to, or slightly smaller than the diameter of the rivet to be installed.

8. DISASSEMBLING FIGURE 1 PARTS

Remove the parts, as necessary, in their indexed order of disassembly. When removing the reel arms, note carefully the manner in which the clutch parts (29 to 43) are installed. Be careful not to lose the steel balls. The escutcheon (55) is self-adhesive.

Design 642 only: To remove the animation button (54), and the switch (53) the amplifier must first be removed as instructed in paragraph 11.

9. DISASSEMBLING FIGURE 2 PARTS

Insert a 1/16 in. punch through the hole in the sound drum shaft housing and into the hole in the shaft. Hold the shaft firmly while loosening the sound drum nut (49).

10. DISASSEMBLING FIGURE 3 PARTS

Remove the parts, as necessary, in their indexed order of disassembly noting the following special precautions.

Note carefully the installation of the motor and belt shifter parts (43 to 57) before disassembling parts for replacement.

11. REMOVING FIGURE 4 PARTS

Remove parts, as necessary, in their indexed order of disassembly. Before removing the amplifier (25) note that it is necessary to disconnect the ten leads from the tag board, also the exciter lamp lead, the photo-diode lead and the speaker lead at the speaker end. The amplifier can then be withdrawn after removal of the four screws (23).

12. DISASSEMBLING FRONT REEL ARM

Remove Figure 5 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Be careful not to damage the teeth of the nylon gears (20) and (21) during disassembly.

b. Unless necessary for replacement, needle bearings (32), (36) and (37) should not be pressed out.

13. DISASSEMBLING REAR REEL ARM

Remove Figure 6 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Be careful not to lose springs (1) and (19).

b. Unless necessary for replacement, needle bearings (6) and (30) should not be pressed out.

c. Be careful not to damage the teeth of the nylon gears (12) and (13) during disassembly.

14. DISASSEMBLING LAMPHOLDER

Remove Figure 7 parts, as necessary, in their indexed order of disassembly.

15. DISASSEMBLING LAMPHOUSE

Remove Figure 8 parts, as necessary, in their indexed order of disassembly.

16. DISASSEMBLING SOUND HEAD

Remove Figure 9 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Do not remove the optical slit assembly (6) unless in need of replacement or cleaning.

b. The sound drum shaft (22) must be handled carefully to avoid damage to the drum. To remove, loosen the clamping screw (18) in the holder (19). Loosen the set screws (20) and (21) and press the shaft from the sound head housing. As the shaft is withdrawn, note the manner in which the light pipe (24) and retainer (23) are installed in the slot of the sound drum shaft.

c. Note the manner in which the springs (30) and (36) are engaged before removing the related parts.

17. DISASSEMBLING FIGURE 10 PARTS

Remove Figure 10 mechanism assembly parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Prise out the hinge pins (1) with a wire cutter or similar implement to free the lens carrier.

b. When removing the speed change knob parts (5 to 10 inclusive) note the manner in which the spring (9) is installed.

c. Remove the three screws (16) and washers (17), two retaining rings (18) and the clutch lever shaft (19) to free the outboard bearing assembly (20) and rewind clutch lever (21). As the clutch lever is removed, the rewind button (22) and spring (23) will be released.

d. When the sprocket assemblies (37) and (38) are removed, be careful not to damage the sprocket teeth.

18. DISASSEMBLING FIGURE 11 PARTS

Remove Figure 11 mechanism assembly parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Note carefully the manner in which the overcentre springs (7) are installed before removing related parts.

b. When the screw (8) is loosened, the assembled cam follower support (9 to 12 inclusive) can be withdrawn from the restoring arm (13). Do not disassemble the cam follower support assembly unless the parts are in need of replacement.

19. DISASSEMBLING FIGURE 12 PARTS

Remove Figure 12 mechanism assembly parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Be careful not to bend the blades of the shutter (10) during disassembly.

b. The shuttle link bearings (14) are secured in place within the notches of the shuttle arms (15) and should not be pressed out. Also, do not remove the ball and stud assemblies (18) from the shuttle arms (15).

c. Inspect the pull-down cam followers (16) for wear. These followers, or shoes, can be turned end for end or reversed if they appear badly worn.

d. The felt wicks (20) should be pressed from the pull-down cam (19) and replaced with new wicks if they appear unusually dirty. New wicks should be lubricated as instructed in paragraph 2.

e. Note that the upper forked end of the shuttle arm plate (33) engages the framer knob shaft (35). The framer knob and shaft unscrews from the casting.

f. Items 36 to 45 inclusive are used

only in the Design 642 projector. When disassembling these parts, note the manner in which the torsion spring (38) is engaged.

20. DISASSEMBLING FIGURE 13 PARTS

Remove Figure 13 mechanism assembly parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Except for the worm gear (36), items 1 to 17 and 23 to 38 inclusive are used only in the Design 642 projector.

b. The animation clutch bracket assembly can be freed by removing the two screws (1 and 2), lock washers (3), round nut (4), flat washer (5) and adjustment bracket (6). Before disassembling the clutch bracket assembly note carefully the manner in which the parts are assembled.

c. Remove the retaining ring (18), screws (19) and bearing loading spring (20). Loosen the set screw (21) in the loop restoring cam (39) and force the bearing (22) from its seat by pressing the camshaft (42) in that direction. With the bearing (22) removed, shift the camshaft (42) to the right until the clutch parts (23 to 40 inclusive) can be removed. Be sure to note the manner in which the clutch parts are assembled.

21. DISASSEMBLING LENS CARRIER

Remove Figure 14 parts, as necessary, in their indexed order of disassembly, and wrap the pressure plate (6) in tissue paper to prevent damage to the film contact surfaces.

22. DISASSEMBLING SPROCKET GUARDS

Remove Figure 15 parts, as necessary, in their indexed order of disassembly. All sprocket guard assemblies are identical except that the upper guard for the lower sprocket has a slightly different configuration in the plate.

23. DISASSEMBLING APERTURE PLATE

Remove Figure 16 parts, as necessary, in their indexed order of disassembly. Wrap these parts in tissue paper to prevent damage to the film contacting surfaces.

24. DISASSEMBLING FIRE SHUTTER (DESIGN 642 ONLY)

Remove Figure 17 parts, as necessary, in their indexed order of disassembly. The retaining prongs, or ears, must be carefully straightened to free the heat filter (5).

25. DISASSEMBLING WORM GEAR (DESIGN 642 ONLY)

Remove Figure 18 parts, as necessary, in their indexed order of disassembly.

26. DISASSEMBLING BLOWER

The two halves of the blower housing (8, Figure 19) are assembled with eyelets (6) and (9) which are staked over. If disassembly is necessary, the eyelets must be discarded and new ones used in reassembly. Also note that the bronze bearings (17) in either housing are secured with retaining rings (15).

27. AMPLIFIER REPAIR

Amplifier replacement parts are illustrated and listed in Figures 20 to 23 inclusive. Check the amplifier, referring to the amplifier schematic wiring diagram for proper resistances, voltages and capacitances.

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BELL & HOWELL

16mm Filmosound Projector

DESIGN 641 and 642

SERVICE INSTRUCTIONS

SECTION 3

REASSEMBLY PROCEDURE

REASSEMBLY PROCEDURE

28. GENERAL INSTRUCTIONS

a. When the reassembly procedure includes the staking of rivets or similar parts, all staking and riveting should be done in the early stages of reassembly to avoid damage to other parts. Be sure to support the main casting solidly when riveting or staking.

b. Parts which require lubrication are listed in paragraph 2 (b). Lubricate sparingly and wipe away excess lubricant with a clean cloth. Use only the specified lubricants. During assembly, place a drop of oil in each tapped hole to facilitate screw installation.

c. The following component assemblies require no adjustment and can be reassembled by reversing the disassembly procedure.

Worm Gear Assembly, Figure 18 (Design 642 only).

Fire Shutter Assembly, Figure 17 (Design 642 only).

Aperture Plate Assembly, Figure 16.

Sprocket Guard Assembly, Figure 15.

Lens Carrier Assembly, Figure 14.

Lamphouse Assembly, Figure 8.

Lampholder Assembly, Figure 7.

29. REASSEMBLING THE BLOWER (Figure 19)

Reassemble the blower in reverse order of disassembly, noting the following special precautions.

a. Insert the bearings (17) and washers (16) into the housings and press the retaining rings (15) in until they snap into the ring grooves.

b. Install the collar (4) so that the shaft (14) has a barely perceptible amount of end play (0.002 to 0.005 inch).

c. After the blower housings have been assembled with the eyelets, loosen the set screw (12) through the blower opening and shift the blower wheel (13) until it is accurately centred between the inner surfaces of the housings.

30. REASSEMBLING THE MECHANISM (Figure 13)

Note - Items 1 to 17, 23 to 34, 37 and 38 are used only in Design 642 projectors. When reassembling Design 641 projectors, disregard all references to those parts.

a. (641 and 642). Press the bearing (22) into the mechanism housing. Install the bearing (41) onto the camshaft until it is seated against the shoulder of the shaft. Install the retaining ring (18) onto the camshaft with the convex side of the ring away from the bearing (41).

b. (642 only). Assemble the animation clutch bracket parts (7 to 17). Attach the clutch bracket assembly with screws (1 and 2) and washers (3). Install the shuttle adjustment bracket (6), washer (5) and round nut (4); then press down on the bracket assembly with the fingers and tighten the screws (1) and (2) securely.

c. (642 only). Assemble the bushings (37) into each of the three holes in the worm gear (34). Assemble the bearing assembly (33) to the worm gear so that the ears of the bearing assembly are in line with the notches in the worm gear. Assemble the two shoulder pins (30) into the bearing assembly. Insert the ears of the clutch yoke (31) through the slots in the bearing assembly, and press the pins (30) in to engage the holes in the clutch yoke ears. Install the spring (32) over the protrusion of the clutch yoke and into the hole in the bearing assembly. Assemble

the bearing (28) and trigger (29) to the bearing assembly.

Note - When assembling Design 641 projectors, only the cam (39) and worm gear with the hub and setscrew (35 and 36) are installed on the camshaft. Actual camshaft installation procedure is the same.

d. (642 only). Apply a light film of grease to the bearing hole in the cast arm of the mechanism housing and insert the unthreaded end of the camshaft through the bearing hole. Install the cam (39), washer (38) and assembled worm gear parts (step c) over the end of the camshaft. Assemble the spring (24) over the hub of the driven clutch (25), spreading the legs of the spring so that they straddle the bent ear of the clutch. Insert the hub of the driver clutch (23) into the hub of the driven clutch, spreading the legs of the spring still further until one of the lugs of the driver clutch is straddled. Install the washer (27) and assembled clutches onto the camshaft. The driver clutch must fit over the flats of the camshaft in such a manner that the bent ear of the driven clutch is parallel with the flat for the loop restorer cam (39).

e. (642 only). Insert the free end of the camshaft into the bearing (22) and press the camshaft in place until the bearing (41) is seated. Install the two retaining rings (26). Check to make certain that the actuating ear of the clutch yoke (31) extends past the inside edge of the strike (16). Adjust by bending this ear as necessary.

f. Secure the bearing loading spring (20) with screws (19). Install the large retaining ring (18) over the camshaft and into the groove in the housing. The convex side of the retaining ring must be against the bearing.

g. (641 and 642). Insert a 0.15 inch feeler gauge between the loop restoring cam (39) and the cast arm of the mechanism housing. Press against the cam to hold the feeler gauge against the cast arm, and tighten the setscrew (21) against the flat in the camshaft. Remove the feeler gauge. Screw the rewind adjustment stud (45) down into place so that the top of the stud is approximately 1/16 inch below the surface of the housing.

31. REASSEMBLING THE MECHANISM (Figure 12)

Note - The clutch parts (36) to (45) are used only in the Design 642 projector. When servicing 641 projectors, disregard reference to these parts.

a. Assemble the bearing support (12) to the shuttle arm plate (33) so that the nylon pads face one another. Thread in the support to the full length of its thread. Install the framer knob and shaft (35) so that the prongs of the shuttle arm plate framing arm can be engaged with the groove in the framer shaft. Secure the plate (33) to the cast arm of the mechanism housing with screws (30), washers (31) and round nuts (32). The flatted portion of the nuts (32) must fit into the notches of the plate.

b. Assemble the in-out cam (23) to the in-out bracket assembly (24) so that the nylon pad of the cam follower (28) will ride against the polished surface of the cam. Install this assembled group over the end of the camshaft and fasten the bracket assembly to the mechanism housing with two screws (21) and washers (22).

c. At this point, refer to Figure 11 and install the aperture plate (15) with the screws (14). Adjust the aperture plate as instructed in paragraph 42, step 'a'. Then return to Figure 12 and continue with the reassembly procedure.

d. Check the ball and stud assemblies (18) to make certain that the locking hexagon nuts (17) are tightened. Press the link bearings (14) into the notches at the front of each shuttle arm. Assemble the cam followers (16), burr side down, into the notched centre section of each shuttle

arm (15). Insert the front end of the upper shuttle arm between the two phenolic guide shoes of the bracket assembly (24) until the ball of item (18) rests in the socket of the nylon pad on the shuttle arm plate. Hold temporarily in place with a rubber band. Hang the shuttle (13) in the slot of the shuttle arm so that the shuttle teeth extend through the slot in the aperture plate and back toward the camshaft.

e. Insert the front end of the lower shuttle arm between the two phenolic guide shoes of the bracket assembly (24). Engage the slot of the arm with the shuttle (13) and rest the ball of item (18) in the socket of the nylon pad on the shuttle arm plate. Saturate the oiler wicks (20) with oil and insert the wicks into the pull-down cam (19). Position the in-out cam (23) so that the tongue on the unpolished side of the cam rests in the slot in the shoulder of the camshaft. Install the pull-down cam (19) onto the camshaft so that the groove nearest the oiler wicks fits over the protrusion of the in-out cam (23). Temporarily install the shutter nut (8). Tighten the bearing support (12) just enough to hold all parts securely in place. Then remove the rubber band from around the shuttle arm.

Note - At this point, adjust the shuttle as instructed in paragraph 43 and the clutch (Des. 642 only), as instructed in paragraph 46, steps 'a' and 'b'.

f. Remove the shutter nut (8). Install the fibre washer (11) over the camshaft and up against the pull-down cam so that the slot in the washer is aligned with the slot in the cam. Assemble the shutter (10) to the camshaft and install the counterbalance weight (9) so that the pin of the weight enters the slots in the shutter and pull-down cam. Install the nut (8) so that its shoulder enters the centre hole in the weight (9) and tighten the nut securely, holding the end of the camshaft with an open-end wrench.

g. (642 only). Assemble the grommets (42) into the bracket (41). Install the retaining ring (36) into the groove nearest the end of the shaft (37), and assemble the bracket (45), stop pawl (39) and remaining retaining ring (36) onto the shaft. Attach the clutch stop (44) and bracket (45) loosely to the cast arm of the mechanism housi with screws (43). Install the torsion spring (38) and mounting bracket (41) to the shaft. The spring must be hooked to the stop pawl (39) and bracket (41) in such a manner that the stop pawl will be spring-loaded against the clutch stop. Secure the bracket (41) with screws (40). Loosen the screws (43) slightly and adjust the clutch stop (44) to obtain 0.010-inch clearance between the stop pawl (39) and the trigger (29, Figure 13). It may be necessary to rotate the worm gear until the trigger is positioned below the stop pawl.

h. Slip the rounded end of the heat baffle (7) under the shutter and secure the baffle with screws (3). Install the pulley (2) on the camshaft and tighten the set screws (1). Secure the fire shutter assembly (5) of the Design 642 projector or support bracket (6) of the Design 641 projector with two screws (3). The speci screw (4) is the lower supporting post fo the condenser lens assembly (item 3, Figure 2). Install this screw. Then refer to Figure 13 and install the screw (46), holder (47), washer (48) and spring (49) that make up the upper supporting post.

32. REASSEMBLING THE MECHANISM (Figure 11)

a. Assemble the stop screw (19) the mechanism housing until only one thread is visible. Attach the eccentric anchor (6) to the housing with the screw (5). Insert the shaft of the loop restoring arm (13) through the housing and install the assembled cam follower support (12) onto the shaft. Tighten the screw (8) finger tight. Install the springs (7). One spring must fit through the rectangular opening in the cam follower, under the bottom of the loop restorer shaft, and over the tor of the eccentric anchor hub. The other spring must fit into the notch at the lower end of the cam follower, over the top of

the loop restorer shaft and below the underside of the eccentric anchor hub. Loosen the screw (5) and rotate the eccentric anchor until the cam follower (11) barely touches the cast arm of the mechanism housing. Then tighten the screw (5) securely. The loop restorer must be adjusted as outlined in paragraph 52.

b. Install the sprocket guards (3) and (4) with the screws (1). Do not tighten the screws. Fasten the lens carrier catch (18) in place with the screw (16) and washer (17). The sprocket guards and lens carrier catch will be adjusted in subsequent procedures.

33. ASSEMBLING THE MECHANISM (Figure 10)

a. Assemble two retaining rings (8) to the belt shift crank (10), and insert the long end of the crank into the opening in the housing. Install the end of the spring (9) with the least amount of coils over the end of the crank and the opposite end over the spring anchor post. The large centre coil of the spring must project toward the rear edge of the housing. Secure the spring to the crank and anchor the post with two more retaining rings (8).

b. Install the thrust washer (39) over the shaft of the upper sprocket assembly (37) and insert the sprocket shaft through the bearing hole in the housing until the shaft protrudes about 1/8 inch from the rear of the housing. Install the tension washer (36) and sprocket gear (35), aligning either set screw (34) with the flat on the sprocket shaft. Carefully mesh the sprocket gear with the worm gear; then slide the shaft through the sprocket gear until the sprocket rests against the bearing in the housing. Tighten both set screws (34). Install the take-up drive sprocket (31) on the sprocket shaft, and tighten the set screws (30).

c. Install the rewind button (22) and spring (23). Depress the button while assembling the rewind clutch lever (21) to the mechanism. The small forked end engages a groove in the button shaft; the large forked end encircles the sprocket shaft. Install the spline driver (29) on the sprocket shaft with the spline fitting through the forked end of the clutch lever and meshing with the drive sprocket (31). Install the spring (28), washer (27), retaining rings (25) and rewind drive sprocket (26). Install the timing belt (24) over the rewind drive sprocket (26). Assemble the outboard bearing assembly (20) onto the sprocket shaft and install the clutch lever shaft (19) and retaining rings (18). Secure the outboard bearing assembly to the mechanism housing with the three screws (16) and washers (17).

d. Refer to Figure 13 and turn the rewind adjusting stud (45) in or out to obtain 0.010-inch clearance between the rewind clutch lever (21, Figure 10) and the spline driver (29, Figure 10). Then tighten the set screw (44, Figure 13) securely against the adjusting stud. Remove the paper backing from the new rewind nameplate (43, Figure 13) and press the nameplate in place.

e. Assemble the thrust washer (39) onto the lower sprocket assembly (38) and insert the sprocket shaft through the bearings in the mechanism housing. Install the tension washer (36) and sprocket gear (35) onto the shaft, meshing the teeth of the sprocket gear with the worm gear. Tighten the set screws (34) securely so that the sprocket shaft turns freely but without noticeable end play. Attach the upper sprocket guards (41) and (33) with the screws (40) and (32). Adjust all sprocket guards as instructed in paragraph 44.

f. Install the roller post (15). Press the nylon bearings (14) into the roller (13) and assemble the roller to the post with the screw (11) and washer (12). Install the speed change knob (6) onto the belt shift crank (10), and hold the knob against the mechanism housing while tightening the set screw (5). Hold the knob firmly and push the spring (9) toward the sprocket

gear; then hold the spring in this position and switch the knob to the SILENT setting.

g. Hold the lens carrier (4) between the hinge bosses of the mechanism housing. Insert the washers (2) and (3) between the lens carrier hinge ears and mechanism housing hinge bosses and press the hinge pins (1) into place. The lens carrier catch installed in paragraph 32, step 'b', must be adjusted as necessary to permit the lens carrier to be opened freely; yet must hold the carrier firmly against the stop screw (19, Figure 11) in the closed position.

34. REASSEMBLING THE SOUND HEAD (Figure 9)

Reassemble the sound head parts in reverse order of disassembly, noting the following special precautions.

a. Apply a light film of oil to all roller shafts before installing the rollers. Do not over-lubricate.

b. Assemble the light pipe (24), retainer (23) and sound drum shaft (22) loosely before inserting the shaft into the sound head housing. The set screw (20) bears against the retainer (23), while two set screws (21) secure the sound drum shaft.

c. Refer to paragraph 49 for all sound head adjustments to be performed.

35. REASSEMBLING REAR REEL ARM (Figure 6)

Reassemble the rear reel arm parts in reverse order of disassembly, noting the following special precautions.

a. Make certain that all gear teeth are meshing properly (without binding, but with no obvious looseness).

b. Lubricate all gear teeth sparingly with grease, and check the gear action before installing the reel arm cover, (9).

36. REASSEMBLING FRONT REEL ARM (Figure 5)

Reassemble the front reel arm parts in the reverse order of disassembly, noting the following special precautions.

a. Make certain that all gear teeth are meshing properly (without binding, but with no obvious looseness).

b. Lubricate the gear teeth sparingly with grease, and check the gear action and clutching action before installing the reel arm cover (3).

37. REASSEMBLING THE PROJECTOR (Figure 4)

Reassemble Figure 4 parts in the reverse order of disassembly, except as noted in the following special precautions.

a. When reassembling the transformer (14) and amplifier (25) it should be noted that the various leads should be connected to the tag boards by matching the colours.

b. After the tilt mechanism is installed, rotate the knob (30) to retract the tilt bar (18) up against the base.

c. Do not tighten the blower screws (8) until the rear mechanism plate parts are assembled and the blower pulley can be aligned with the motor pulley.

38. REASSEMBLING THE PROJECTOR (Figure 3)

Reassemble Figure 3 parts in the reverse order of disassembly, noting the following special precautions.

a. Slip one ear of the bracket (44) onto the belt shifter (51). Position the stop (55) between the ears of the bracket (44) so that the set screw (54) is accessible through the centre hole in the bracket. Assemble the stop and bracket onto the belt shifter. Then assemble the bar bracket (53) to the belt shifter and tighten the set screw (52)

enough to hold. Insert the spring (45) between the stop (55) and the stop bracket (44) aligning the holes in the spring and the bracket. Temporarily put this assembly aside until the assembled mechanism (57, Figure 2) has been installed (step 'b', following).

b. Refer to Figure 2. Press the four resilient mounts (56) into the projector main plate. Fasten the mechanism assembly (57) in place with screws (54) and washers (55).

c. Refer to Figure 3. Position the bar bracket (53) over the belt shift crank of the mechanism assembly. Attach the assembled shift lever parts to the mechanism assembly with two screws (43). Do not install the reel arm lock plunger parts (items 38 to 41) until the reel arms have been installed.

d. After installing the motor mounting brackets (59), assemble the pulley (57) to the motor shaft with the set screw (56). Install the belt (50) over the small diameter of the mechanism assembly pulley and thread the free loop of the belt through the belt shifter (51). Engage the other end of the belt with the motor pulley (57). Hook the large belt (42) between motor and blower pulleys and install the motor, positioning the grooves of the motor cushion supports (48) in the brackets (59). Then install the motor bracket straps (46).

e. Install the idler assemblies (32 and 35), but do not tighten the attaching screws at this time.

f. (642 only). When assembling the clutch solenoid (11) install one collar (2), tapered end up, onto the clutch rod. Insert the rod through the stop pawl (39, Figure 12) before securing the solenoid with the screws (10). Assemble the spring (3) and the remaining collar (2), tapered end down, onto the rod. Set the lower collar so that the solenoid plunger protrudes approximately 3/16 inch from the solenoid and tighten the set screw (1). Adjust the upper collar so that the distance from the top of the upper collar to the bottom of the lower collar is approximately 7/8 inch, and tighten the set screw (1).

39. REASSEMBLING THE PROJECTOR (Figure 2)

Reassemble Figure 2 parts in the reverse order of disassembly, noting the following special precautions.

a. All wiring connections are as illustrated in Figure 24 (641 projector) or Figure 25 (642 projector).

b. The end of the earthing spring (48) must apply tension to the end of the sound drum shaft. Bend the spring if necessary.

c. After installing the pilot light bracket (26) and lamphouse assembly (24), adjust the pilot light bracket so that the contour of the lamphouse matches with the mechanism housing and the lamphouse opens and closes without binding. If necessary, adjust the lamphouse latch (9, Figure 8) so that the lamphouse is held securely against the projector main plate.

d. Install the knobs (14) so that there is approximately 1/32-inch clearance between the knob and nameplate.

e. Perform the optical alignment procedure outlined in paragraph 42.

40. REASSEMBLING THE PROJECTOR (Figure 1)

Reassemble Figure 1 parts in reverse order of disassembly, noting the following special precautions.

a. Assemble the washer (50) over the spline of each reel arm and install the reel arms to the main plate. Install the lock disc (47) over the spline of the front reel arm so that the small notch in the outer circle of the disc is at approximately the 10 o'clock position (when viewing the rear of the main plate). Install the lock disc (47)

over the spline of the rear reel arm so that the small notch is centred at the 3 o'clock position. Install the speed nuts (46) over the reel arm bearings with the convex side of the nuts away from the main plate. Press the speed nuts in place.

b. Assemble the reverse take-up sprocket (43) and washers (44) and (45) onto the front reel arm shaft. Install the retainer (42) with the formed legs out, over the reel arm shaft and into the counterbore of the sprocket. Assemble the clutch cam (41) against the retainer so that the three notches in the cam straddle the three legs of the retainer. The shallow end of the notches must point in a counter-clockwise direction. Rotate the cam counterclockwise against the legs of the retainer and insert a steel ball (40) between each of the three pairs of legs on the retainer. Insert the spring (39) into the radial slot of the cam so that the spring tends to rotate the cam in a clockwise direction. Install the rewind sprocket (37) and collar (36) onto the reel arm shaft so that the tongue of the collar enters the groove of the sprocket. Insert a 0.003 inch shim stock between the washers (45) and (44). Press all parts together and tighten the set screws (35). Remove the shim stock.

c. Assemble the rear reel arm parts in a manner similar to the front reel arm parts (step 'b') except that the shallow end of the notches in the cam (31) should point in a clockwise direction and the spring (29) must be installed so that it tends to rotate the cam in a counterclockwise direction.

d. Refer to Figure 3. Install the reel arm lock plungers (41) springs (40) and brackets (39) with screws (38). The narrow portion of each lock plunger bar must rest on the flange of the reel arm lock discs. The groove in each bracket (39) must straddle the narrow portion of the bar.

e. Install the timing belt over the small sprocket of the mechanism assembly, around the large sprocket of the front reel arm, and around the reel arm sprocket. Adjust the roller tension as instructed in paragraph 50.

f. Perform all necessary adjustments and alignments as directed in the Adjustment section.

THE

BELL & HOWELL

16 mm Filmosound Projector

DESIGN 641 and 642

SERVICE INSTRUCTIONS

SECTION 4

ADJUSTMENTS

ADJUSTMENTS

Warning - Many of the procedures listed in this section require operation with the rear cover removed. To avoid shock hazards, disconnect the power and discharge the motor starting capacitor, when not required.

41. INTRODUCTION

The adjustments listed in this section are those which either require special tools, are of such nature as to require tolerances or sequential adjustments not readily determinable by inspection or which differ radically from service procedures applicable to prior Filmosound designs. Routine adjustments such as those applicable to sliding fits, bearing clearances and endplay (within normal shop practices) have not been listed. All special tools required to perform adjustment procedures are illustrated in Figure A.

42. OPTICAL ALIGNMENT (See Figure B) (Proceed in sequence listed)

A. Aperture Plate

Remove the projection lens, condenser lens, projection lamp and pressure shoe assembly. Turn the mechanism until the shutter is opened. Loosen the two screws (14, Figure 11) enough to permit free movement of the aperture plate. Tip the projector over on its back, open the lens mount and insert the aperture plug (SER-550-2-N3) into the aperture opening. Close the lens mount and insert the lens plug (SER-550-2-N1) into the lens mount.

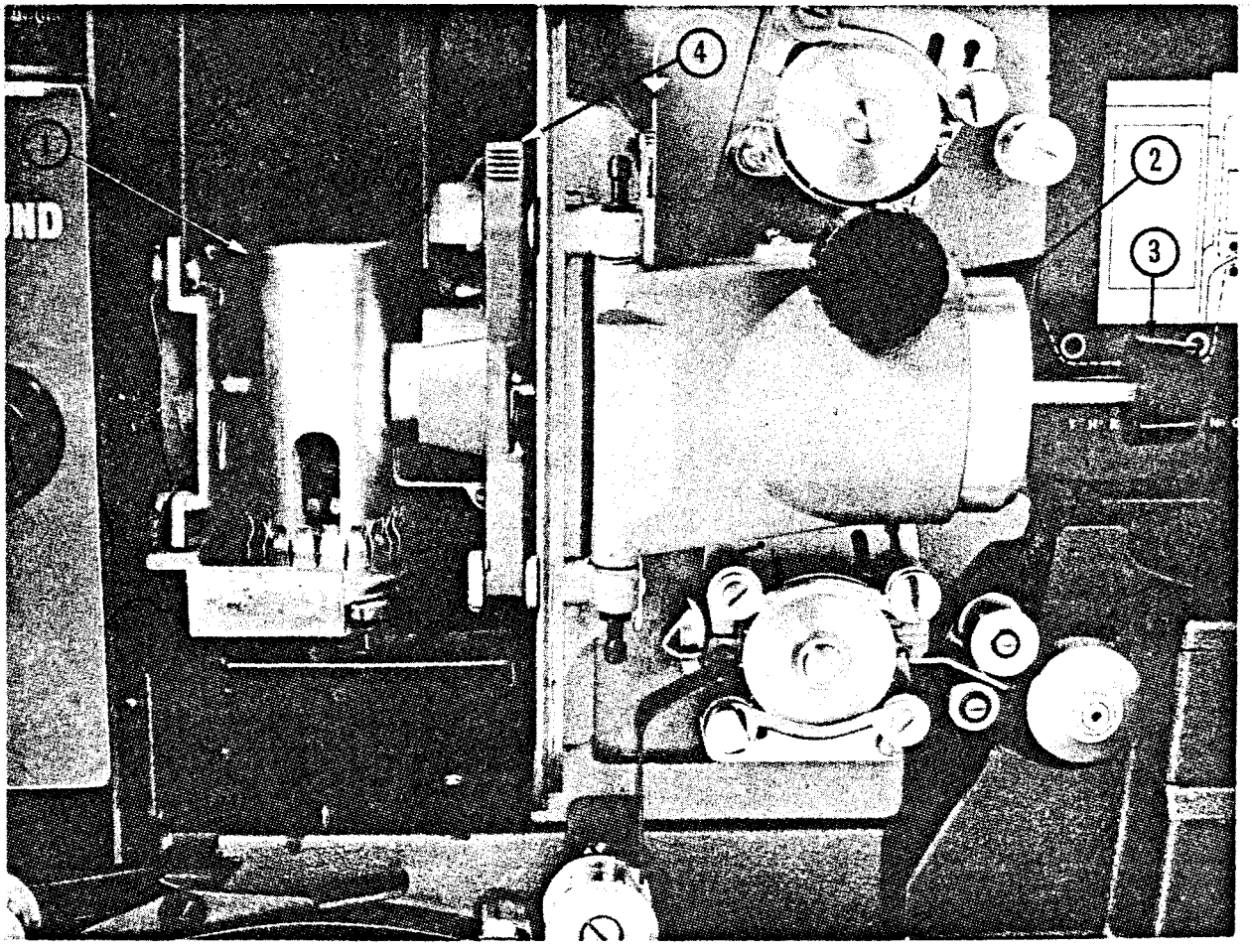


Figure B. Optical Alignment Adjustment

Insert the alignment rod (SER-550-2-N2) into the hole in the lens plug. Lower the rod carefully and shift the aperture plate as required until the rod enters the hole in the aperture plug. Tighten the aperture plate retaining screws securely.

B. Condenser Lens Assembly

Withdraw the alignment rod, if necessary, so that the end of the rod will not interfere with the installation of the condenser plug. Install the condenser plug (SER-550-2-N4) on the condenser lens holder mounting screws. Carefully push the alignment rod through the hole in the condenser plug. If the rod strikes the top or bottom of the hole, tighten or loosen the screw (46, Figure 13) as required, to bring the plug into alignment with the rod.

Note - Due to overhung suspension, the plug may shift slightly from side to side as the rod is inserted. This is not of any importance.

C. Lamp Socket

Tip the projector forward onto its base. Loosen the two screws (9, Figure 2) which hold the lampholder assembly to the main frame. Insert the lamp plug (SER-550-2-N5) into the projection lamp socket and rotate the plug until the hole lines up with the alignment rod. Push the rod through the hole in the plug. Place the thumb under the lamp socket mounting casting and the second finger on top of the lamp plug. Push the mounting upward until the socket bears evenly against the base of the plug. Slide the complete holder assembly forward along the rod until the lamp plug comes in contact with the condenser plug. Insert a screwdriver through the slot in the lamp plug and tighten the lampholder retaining screw until resistance is noted. Remove the screwdriver and tighten the retaining screw at the rear of the lampholder; then tighten the screw which is accessible through the slot in the lamp plug.

D. Final Check

Slide the alignment rod back and forth in the alignment plugs. Since the rod is a lapped fit in the holes, light resistance should be felt. Make sure that the lamp plug does not rise in the socket. If the rod binds, determine the point of binding and relocate the mis-aligned part. Tip the projector over on its back and remove the alignment rod with the plugs. Be careful not to lose the aperture plug. Install the pressure shoe assembly and visually centre in the aperture plate before tightening the retaining screws.

43. INTERMITTENT ADJUSTMENTS (See Figure 12)

A. Shuttle Tooth Side Clearance

When the shuttle is at the centre of its stroke, clearance between the sides of the shuttle teeth and the edge of the shuttle slot in the aperture plate should be approximately 0.009 inch. Use a feeler gauge. If the clearance varies from top to bottom of the shuttle and is less than 0.005 inch at either end, the aperture plate is probably out of alignment (see paragraph 42a). The side clearance is related to the stroke; therefore, make sure that the stroke is correct (see paragraph 43e). If the clearance is inadequate, it is probable that a link bearing (14) is missing. It is possible though not very probable that a ball and stud assembly (18) could have slipped on a shuttle arm (15).

B. Guide Shoe Clearance

Proper clearance between the guide shoes (26) and the bearing in the shuttle arm is approximately 0.001 inch. If the shuttle slides freely between the guides and a 0.002 inch feeler cannot be inserted between the bearing and guide at any point in the stroke, the clearance is satisfactory. If the clearance is excessive, loosen the retaining screws (25) and move the guide (26) toward the shuttle arm bearing to obtain proper clearance.

Caution - Do not set the guide snug against the bearing as this would decrease the life of the pivot bearings and cam.

C. Shuttle Tooth Protrusion

If the transport mechanism has been removed from the main frame, turn the mechanism drive pulley until the shuttle is near the mid-stroke and the notched hole in the shutter blade (10) is aligned with the access hole in the fire shutter mounting plate (5). If the transport mechanism is assembled to the main frame, remove the condenser assembly, lamp-holder assembly (10, Figure 2), and pulley shield (12, Figure 2). The access hole in the fire shutter mounting plate can now be reached through the lamphouse. After turning the drive pulley to align the notched hole in the shutter with the access hole, insert the short end of a 6BA Allen Key and engage the in-out cam follower screw. Open the film gate and check the shuttle tooth protrusion with the height gauge (SER-550-6-N1). If the "NO-GO" step passes over the shuttle tooth, turn the cam follower screw counterclockwise to increase the protrusion. If the "GO" step will not pass over the tooth, turn the follower screw clockwise to decrease the protrusion.

D. Fit of Shuttle to Pull-Down Cam

Remove the blower belt and the projection lamp. Insert a wrench in the screw in the top shuttle arm pivot. Run the projector at sound speed, without film, and tighten the screw just enough to stop the tapping noise produced by the cam shoes on the pull-down cam, then tighten the screw 1/8 to 1/4 turn. If in doubt about the source of the noise, loosen the screw until the shuttle hammer is pronounced, then tighten down to reduce this noise. After making the adjustment, disconnect the projector from the power source, discharge the motor starting capacitor and disengage the drive belt. Turn the drive pulley by hand through one complete revolution. The load will normally increase slightly as the stroke starts. If the shuttle is tight during the stroke but loose and noisy during the backstroke, check for a missing shuttle link bearing (14).

Caution - Do not tighten the shuttle more than is specified to remove the cam noise. Excessive tightening of the shuttle in an attempt to load the mechanism for the purpose of reducing the other noises will reduce the life of the cam and cam shoes.

E. Shuttle Stroke

The normal shuttle stroke (vertical travel of the shuttle teeth) is 0.3025 inch.

(1) Procedure for Measuring Shuttle Stroke

To check the shuttle stroke lay the projector on its back and open the lens carrier. Turn the mechanism until the shuttle teeth start to protrude through the aperture plate at the beginning of the downward stroke. Place the stroke gauge (SD-550-N1) into the film channel so that the slots in the edge of the gauge register over the shuttle teeth. Slowly turn the mechanism and the movement of the shuttle will slide the gauge along the aperture plate until at the bottom of the stroke the shuttle teeth withdraw below the plate. Continue turning the mechanism until the shuttle teeth again start to protrude through the aperture plate. Observe carefully, as the teeth rise, whether they strike the gauge as they come through. If so, adjust in the following manner.

(2) Procedure for Adjusting Shuttle Stroke

Loosen the two screws (30, Figure 12) just enough to permit movement of the shuttle arm plate (33).

When adjusting Design 642 projectors, it will be necessary to remove the two screws (43) and permit the clutch stop (44) and bracket (45) to drop to expose the screws (30).

(a) To lengthen the stroke, move the shuttle arm plate (33, Figure 12) toward the pull-down cam.

(b) To shorten the stroke, move the shuttle arm plate assembly away from the pull-down cam.

(c) After adjusting the stroke, recheck the shuttle tooth side clearance as instructed in paragraph 43a, and readjust if necessary.

Caution - Do not attempt to eliminate film slap by setting the stroke outside the established tolerances. This will produce double image and/or jump with films having different shrink or stretch.

F. Framing Adjustment

Thread the projector with film having a proper frame line position. Project the film and turn the framing knob from one limit to the other. If at one limit a frame-line is not visible, loosen the nut on framing eccentric, located at the top of the shuttle arm plate assembly (33, Figure 12) and turn the eccentric until the frame-line appears. Hold the eccentric while tightening the nut. Check the adjustment by again turning the framing knob from limit to limit while observing the picture. When the eccentric is properly adjusted, either frame-line can be projected and movement of the film should be approximately equal at the top and bottom of the framer travel.

44. SPROCKET SHOE ADJUSTMENT

Loosen the two screws which hold the sprocket shoe assembly to the mechanism. Place two thicknesses of film on the sprocket and close the shoe. Lightly press the shoe against the film and shift the shoe sideways, if required, to ensure full and even bearing of the shoe against the film. Tighten the retaining screws.

Note - If the shoe does not bear evenly against the film through the whole contact area, jamming at splices or pull-through (with 100 foot reels) may be encountered.

45. LENS MOUNT ADJUSTMENT

Angular relationship between the projection lens mount and aperture plate is controlled by the lens mount stop screw (19, Figure 11). Thread the projector with roll title or target film having sharp images in the corners and project a picture approximately 30 inches high onto a matt surface.

Note - The projector must be square with the screen. Focus the picture and compare the resolution of the two sides of the image when viewed from a distance of approximately twice the width of the picture. If one side appears to be soft, refocus to sharpen that edge of the picture and note whether the lens is moved toward or away from the aperture. For example, if the image at the right hand edge of the screen is soft until the lens is moved toward the aperture, then the lens stop screw is set too far forward and should be turned clockwise.

Caution - This adjustment is critical. The lens stop screw should be turned only a few degrees between tests for sharpness.

46. ANIMATION CLUTCH ADJUSTMENTS (Design 642 only)

A. Clearance Between Stop Pawl and Trigger

Correct clearance between the stop pawl (39, Figure 12) and trigger (29, Figure 13) is 0.010 to 0.015 inch. Adjust by loosening the screws (43, Figure 12) and

moving the stop (44, Figure 12) up or down, as required, to establish the correct clearance.

B. Shuttle Retraction (See Figure 13)

Depress the stop pawl and turn the mechanism by hand until the clutch latches. Check to make sure that the clutch stop engages the stop retainer on the rear end of the retainer by approximately 0.040 in.

(1) Loosen the Allen nut (4) at the upper rear corner of the slide bar, and slide the bracket (6) toward the shuttle until the shuttle teeth are retracted below the level of the aperture rails. Tighten the nut.

(2) Adjust the setscrew (7) at the front end of the slide bar bracket so that the slide bar assembly (13) clears the end of the setscrew by 0.080 to 0.082 inch.

(3) Turn the mechanism manually until the clutch engages and the clutch yoke (31) is in line with the strike (16). Loosen the screw (14) and move the strike (16) until the clearance between the yoke and strike is 0.040 inch.

(4) Loosen the screw in the adjusting bracket (6). Insert 0.040 inch feeler gauge between the bracket and the ear on the clutch yoke (31). Push the bracket against the gauge and tighten the retaining screw.

C. Solenoid Linkage (See Figure 3)

Loosen the setscrews (1) so that the collars (2) slide freely on the link of the solenoid (11). With the clutch stop pawl disengaged, lift the solenoid plunger by means of the link until the top of the plunger extends approximately 3/16 inch out of the top of the solenoid frame. Slip the lower collar up against the bottom of the stop pawl and tighten the setscrew. Hold the lower collar against the bottom of the stop pawl and depress the upper collar just enough to provide sufficient compression of the spring (3) to prevent rattling. Tighten the setscrew in the upper collar. Start the projector and check the operation of the clutch. If the solenoid is sluggish in pull-in, the plunger is set too high. If the solenoid produces a buzzing noise, the plunger is either set too high or the spring (3) is compressed too much. If the plunger seats and the stop pawl is not fully engaged, the plunger is set too low or the spring (3) is not sufficiently compressed.

47. FIRE SHUTTER ADJUSTMENTS (See Figure 4) (Design 642 only)

A. Linkage Clearance

Check that the fire shutter rod (5) clears both drive belts. To adjust, loosen the two retaining screws (6) and shift the solenoid (7) to provide adequate clearance, then tighten the retaining screws (6) securely.

B. Alignment

Open the film gate and turn the mechanism pulley until the interrupter shutter clears the aperture. Loosen the two screws (6) which secure the solenoid (7) to the bracket. Place the thumb of the right hand against the outer end of the solenoid plunger. Press the solenoid against the plunger. While looking straight into the aperture, position the solenoid so that the fire shutter covers the aperture; then tighten the screw (6) at the outer end of the solenoid bracket enough to hold the solenoid in place. Release the solenoid plunger and trip the rocker arm several times to make sure that the plunger slides freely in the solenoid. Tip the solenoid if necessary to free the plunger, then tighten both the retaining screws (6) securely. Recheck the clearance between the rod (5) and the drive belts.

48. REWIND CLUTCH ADJUSTMENTS (See Figure 1)

The rewind clutch should be adjusted to produce a supply spindle torque of $5\frac{1}{2}$ to 6 in.-oz. when the rewind button is depressed. Use the standard reel and spring balance method of measuring torque. The clutch is adjusted by means of a hexagon nut on the outer end of the clutch (37). Tighten the nut to increase the torque. Loosen to decrease the torque.

49. SOUND HEAD ADJUSTMENTS

Warning - If for any reason the Photo-diode or its cable is removed, it is essential upon reassembly that the positive and negative connections are not transposed. The screening of the coaxial lead must always be connected to the Photo-diode wire identified by a green spot at the base of the diode. Failure to observe this precaution will result in damage to the diode.

A. Removal

Due to the ease with which the head can be removed and the greater accessibility thereby obtained, time will be saved by removing the head if major work is required.

(1) Remove the projection lens assembly from the projector. Wrap the lens in tissue paper.

(2) Disconnect the photo-diode and exciter lamp cable from the amplifier and release the cables from their retaining clips.

(3) Remove the earthing spring (48, Figure 2). Insert the end of an Allen wrench or short steel pin in the hole in the sound drum bearing housing directly behind the flywheel until the wrench or pin drops through the hole in the sound drum shaft. Remove the flywheel retaining nut (49, Figure 2) and flywheel (50, Figure 2).

(4) With a sharp pencil, draw a line on the main frame where the front edge of the soundhead meets the frame. This will provide a reference mark when reassembling.

(5) Take out the three screws (51) and (52, Figure 2) which tap into the soundhead from the rear of the main frame, and carefully withdraw the soundhead.

B. Light Pipe and Photo-Diode

Caution - Do not scratch the light pipe. Clean only with Lens Cleaning Fluid.

(1) Remove the exciter lamp (4, Figure 9) loosen the clamping screw (5) and withdraw the optical slit (6). Insert the tool into the optical slit clamping boss as shown in Figure C. Note the proper position of the light pipe and sound drum as set by the tool. Tighten the sound drum housing setscrews (21, Figure 9) and the light pipe setscrew (20) and remove the tool. Reinstall the optical slit (6).

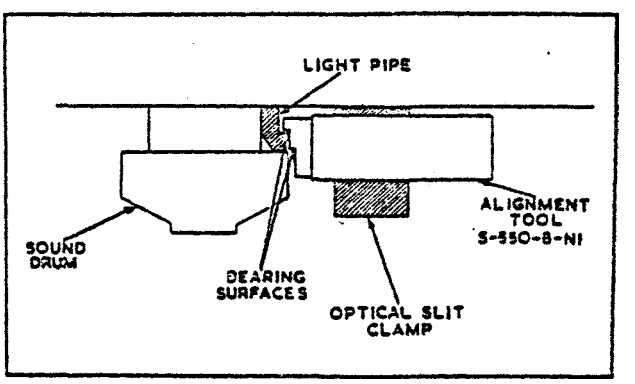


Figure C.
Adjusting Light Pipe and Sound Drum

(2) The position of the photo-diode is critical with respect to the pipe. To adjust, connect a 16-ohm, 10-watt resistor and output meter to the speaker jack. Thread the projector with constant frequency

film (preferably 400 CPS). Remove the flywheel and loosen the two screws (9, Figure 9) which hold the photo-diode assembly (10, Fig. 9) to the holder (19, Fig. 9).

(3) Start the projector and adjust the volume control to a convenient level. Position the photo-diode for maximum output; then tighten the retaining screws.

C. Tension Rollers (See Figure 9)

The arms upon which the rollers (28 and 29) are mounted, are linked by a torsion spring (36). Therefore, the roller arms move as a pair. The counterbalance spring (30) offsets the weight of the rollers and arms. Place the soundhead on a level surface and move the roller arms (as a set) to various positions. If the spring tension is incorrect, the roller arms will not remain in the position in which they are placed. If the roller arms swing downward, loosen the retaining screw for the anchor (32) and move the anchor downward until the weight of the arms is counterbalanced. If the roller arms move upward, move the anchor upward to reduce the counterbalancing force.

D. Optical Slit Assembly (See Figure 9)

(1) Loosen the clamping screw (5). If the slit does not slide freely in the holder, insert the bit of a small screwdriver in the slot in the clamp and wedge the clamp open to free the slit assembly. Thread the projector with optical setting film, Part No. 53377 and connect 16-ohm, 10-watt load resistor and output meter to the speaker jack.

Note - A pair of hairpin tongs approximately 6 inches long and formed with the ends turned inward and tapered to engage the holes in the end of the slit barrel are very useful in adjusting the slit. They can be made from 1/16 inch diameter silver steel rod or music wire.

(2) Set the volume control at approximately the '5' position and start the projector. Move the slit toward or away from film, as required, to obtain an output reading. Rotate the slit to obtain the peak reading and simultaneously move in or out until maximum output is obtained. If the film was threaded with the emulsion toward the slit, move the slit toward the film until output drops $1\frac{1}{2}$ to 2DB. If the emulsion is toward the sound drum, move the slit away from the film to obtain $1\frac{1}{2}$ to 2DB drop in output. Tighten the slit clamping screw.

E. Buzz Track Adjustment (See Figure 9)

Lateral position of the film in the soundhead is controlled by the flanged roller (28) and edge guide screw (25). Unless the adjustment has been disturbed, it is not probable that the edge guide screw (25) will require resetting. Thread the projector with buzz track film and adjust the volume control to a suitable listening level. Turn the positioning sleeve (8) to move the flanged roller laterally.

Note - There are two types of buzz track in use. On one, the track spacing exceeds the length of the scanning beam. This track can be positioned so that little or no signal is reproduced. On the other type of track, spacing is less than the length of the beam. This track should be positioned so that both tones are reproduced at approximately the same volume level. If after adjustment of guide roller position, signal levels cannot be balanced (or eliminated on wide track), or level of tones fluctuates, adjust the edge guide screw (25) to clear up the condition. If the edge guide screw is far out of adjustment, turn it clockwise until it clears edge of film, adjust the rollers and then set the guide screw to stop side weave of film.

50. TIMING BELT IDLER ADJUSTMENT

Belt tension is not critical, although excessive tension will reduce belt life. Set the rewind belt idler so that the midpoint of the slack side of the belt can be pushed inward approximately 1/8 inch by light pressure. Set the take-up belt idler so that the belt can be pushed down against the motor relay mounting bracket by light pressure.

51. PROJECTOR SPEED CHECKS

The speed of the projector is not adjustable. Therefore, speed checks are primarily for the purpose of determining that the equipment is operating properly and as a means of detecting excessive mechanism loads, damaged drive belt or similar conditions.

A. Methods of Measurement

Various devices and procedures can be used to check projector speed. The most common ones are as follows.

(1) Photocell and Frequency Meter. Used to measure the number of interruptions of the projection beam per second, pulses per second are then converted to the projector speed. This method is quite practical if a quantity of equipment is handled.

(2) "Strobotac" or similar strobe light. Usually synchronized with the interrupter shutter or shuttle. The shutter makes one revolution per frame. The shuttle makes one stroke per frame.

(3) Tachometer (preferably having a speed range with a maximum speed of 150-200 RPM). Used to measure RPM of sprocket.

(4) Timed Loop. Make a loop of exactly 120 frames. At sound speed the splice will pass the aperture 12 times per minute ± the permissible variation in speed and the timing error.

B. Speeds at 240 Volts 50 CPS

(1) Sound Speed

Shutter - 1440 RPM ± 2%
Sprocket - 102.86 RPM ± 5%

(2) Silent Speed

Shutter - 960 RPM ± 5%
Sprocket - 68.6 RPM ± 5%

52. LOOP RESTORER ADJUSTMENTS

A. Test Film

Since the film is transported by means of the sprocket holes and the shuttle and sprockets are synchronized by the gear train, there will always be the same number of frames in the lower loop, when the shuttle is at top of stroke position. The size of the loop, however, is dependent upon the actual length of the film in the loop. If the film is either stretched or shrunk, the size of the loop will change. This possible variation in the size of the loop, due to film condition must be recognized and allowance made for it in adjusting the loop restorer. Therefore, it is necessary to measure the stretch or shrinkage of the piece of film which is to be used in adjusting the loop restorer in order that the adjustment can be made with the highest possible degree of accuracy. Proceed as follows:

(1) Count 40 frames of film and mark the first and last sprocket holes.

(2) Place the trailing edge of the first sprocket hole at one end of a 12 inch steel rule.

(3) Smooth the film along the rule. Do not apply more than 2 to 3 oz. tension to the film as this might produce an erroneous measurement.

(4) If there is zero shrinkage in the film, the trailing edge of the last

sprocket hole will register exactly with the end of the rule.

(5) If the leading edge of the last sprocket hole registers with the end of the rule, the film has approximately 0.4% shrinkage. Since the variation is usually linear, a film which had shrunk half the height of a sprocket hole would have approximately 0.2% shrinkage.

(6) If the trailing edge of the last sprocket hole overshoots the end of the rule, the film is stretched. Generally you will find that the film will have some shrinkage. If the film is shrunk more than 0.5% (height of 1-1/4 sprocket holes), do not use for adjustments.

B. Adjustments (See Figure 11)

(1) Loosen the retaining screw (5) and rotate the adjusting cam (6) so that the end of cam follower (11) clears the end of the restorer cam by approximately 0.015 inch.

Note - If the cam follower strikes casting before proper clearance is obtained, move the cam away from the casting.

(2) Thread the projector with film of known shrinkage. Turn framer to the maximum counterclockwise position. Turn the mechanism by hand until the shuttle has engaged perforations at top of the stroke but the stroke has not begun.

(3) Loosen the screw (8) which holds the cam follower support bracket (12) to shaft.

(4) Position the loop restorer (13) as follows:

(a) Film shrinkage 0 to 0.2%: set restorer 0.015 to 0.020 inch above loop.

(b) Film shrinkage 0.2% to 0.5%: set restorer 0.010 to 0.012 inch above loop.

(5) After establishing the correct clearance, tighten the screw (8) securely.

(6) Turn the mechanism by hand until the lobe of the restorer cam is on top dead-centre.

(7) Push the cam follower (11) forward until it passes under the cam. If the end of the follower does not clear the cam by 0.018 to 0.020 inch, loosen the two screws (9) and move the follower downward to establish the correct clearance.

(8) Turn the mechanism by hand until the shuttle reaches the end of stroke. Open the gate and pull out the loop.

(9) Hold the film lightly against the aperture and turn the mechanism to restore the loop. Observe the shuttle teeth as they re-enter the perforations. Adjust as follows:

(a) If the bottom edge of the shuttle teeth does not clear the bottom edge of the sprocket holes, move the cam follower upward.

(b) If the top edge of the shuttle teeth does not clear the top edge of sprocket holes, move the cam follower downward.

(10) Run the projector and check the operation either by pulling out the lower loop or opening and closing the gate. After the loop has been restored, place the tip of finger on the top of the restorer and check for pulse at loop frequency. If a pulse is detected, increase the restorer clearance as instructed in Step (4) (a), preceding.

THE

BELL & HOWELL

16mm Filmosound Projector

DESIGN 641 and 642

SERVICE INSTRUCTIONS

SECTION 5

AMPLIFIER DATA

AMPLIFIER PART NO. 026641

The amplifier used in the Model 641 projector has a rated output of 6 watts and a rated load impedance of 16 ohms. It is designed to accept signals from either a Photo-diode or a microphone. The insertion of the microphone jack automatically disconnects the photo cell circuit. The sensitivity has been arranged to give an adequate gain margin over that required to obtain the full power output from a fully modulated film. A single tone control is provided which gives a lift variable from 0 to about + 8 D.B. at 10 K.C.

The first stage uses the pentode section of a triode pentode valve type 6BR8. The anode load resistor of this stage is very high (1.5 megohms) and the anode current is very small. This stage is worked under what are known as "starvation conditions" and although this does restrict the signal handling capacity it also allows a very large voltage gain to be obtained. The screen supply for this first stage is derived from the cathode of the following stage which is the triode section of the 6BR8. The anode of the first stage is directly coupled to the grid of the second stage which is used as a phase splitter. This phase splitter is of the conventional split load type, one output valve deriving its drive from the anode and the other from the cathode.

The output stage is a conventional push-pull stage employing two EL 84 valves. Negative feed-back is taken from the secondary of the output transformer and fed back to the cathode of the first stage. The tone control is in the feed-back circuit and is effective by operating on the frequency characteristic of the feed-back signal.

The power for the exciter lamp is supplied by an R.F. oscillator which employs a cathode coupled Hartley circuit. The exciter lamp is rated at 6 volts 1 amp and is operated with approximately 5 volts to it in order to increase its life. The lamp voltage may be varied by means of a resistor (VR3) in the screen circuit of V4 the oscillator valve. The power for the amplifier and the oscillator is provided by means of a double wound transformer, the primary winding of which also acts as an auto transformer to supply the correct voltage for the projector motor. The anode supply is rectified by means of an EZ 81 rectifier valve.

Physical Features of the 641 Amplifier

The three amplifier valves, the oscillator and rectifier valves are all mounted on one printed circuit board. This board is of thick material and ruggedly constructed to prevent damage due to handling and transit. All heavy components have been kept off the printed board in order to ensure reliability with rough handling. The mains transformer is mounted away from the amplifier and is situated in the projector just beneath the motor. The servicing of this amplifier can, in most instances, be performed without the removal of the amplifier from the projector. The chassis has been kept shallow for this purpose. The photo cell employed for reading the signal from the optical sound track of the film is a Germanium Diode. Because the Germanium Photo-diode used in the soundhead works into a lower load impedance than the Caesium-Silver photo cells previously used, the input impedance of the amplifier is relatively low. This lower impedance and the somewhat greater signal level obtained from the Photo-diode (about 10 D.B.) leads to comparative freedom from noise pick-up troubles and consequently an improved signal to noise ratio.

The 641 projector is fitted with a 6" x 4" elliptical speaker connected across the output. A 16 ohm resistor is connected in parallel to limit the power fed into it. This internal speaker is automatically

disconnected when an external speaker is plugged into the output socket.

The photo cell and microphone inputs are provided with a single volume control. The tone control is provided with just one control for lifting the treble.

General Information

Sensitivity

Mic. Socket Min. 40mV Max. 2 volts.
Mic. Socket Input Impedance - High.

Power Output

6 watts.
Signal - Noise Ratio (Unweighted)
Better than 50db.

Frequency Response

(Dependent on Tone Control Setting).

Mic. 50 - 10 Kc/s
Optical 50 - 7 Kc/s

Output Impedance to match 16 ohms.

AMPLIFIER PART NO. 026642

The amplifier used in the Model 642 projector has a rated output of 15 watts and rated load impedances of 16 ohms and 8 ohms. It has two independent input stages, one for the Photo-diode used in the projector soundhead, and the other for the signal from a high impedance microphone or similar device.

The input sensitivity of the photocell channel is such as to provide a gain margin of at least 12 dB over that required to obtain full output from a fully modulated soundtrack.

The microphone channel sensitivity is sufficient to provide for satisfactory operation from microphone part number 026758 and others with similar characteristics.

A record player with an output not exceeding 200 mV may be fed into the microphone input.

Because the Germanium Photo-diode used in the soundhead works into a lower load impedance than the Caesium - Silver photocells previously used, the input impedance of the amplifier is relatively low. This lower impedance and the somewhat greater signal level obtained from the photo-diodes (about 10 dB) lead to comparative freedom from noise pick-up troubles and consequently an improved signal/noise ratio.

A low noise pentode (type EF 86) is used in a conventional circuit for the photo cell amplifier V1, with feed-back applied by means of an un-bypassed Cathode resistor. The signal from this stage is fed to the grid of another EF 86 (V3) together with the signal from the microphone input amplifier (V2) which is also a conventional resistance capacity coupled amplifier using an EF 86 valve. Independent volume controls are provided for the photocell and microphone amplifiers (VR. 1 and VR. 2 respectively) and the two signals are combined in the resistance mixer in the grid circuit of V3. The component values in this circuit are so chosen as to provide proper independence of the two volume controls.

This voltage amplifier stage (V3) is also a conventional resistance coupled amplifier, using an EF 86 with feed-back applied by means of an un-bypassed Cathode resistor, and is used to amplify the signal to such a level that a twin tone control of the conventional resistance capacitance type may be used between it and the next amplifier stage. The fourth stage uses the first half of a double triode. This is the first valve in the feed-back loop of the output stages, and its output is fed to the grid of the other half of the double triode which acts as a phase splitter in a conventional split load circuit. The output stage uses a pair of EL 84 valves in push-pull, one of these receiving its signal from the anode of V4B, the other from the cathode of V4B. This output stage is not quite conventional and requires some explanation as to its exact mode of working.

In conventional output stages, the bias is chosen so that under full drive conditions the stage is capable of giving reasonably undistorted output from a continuous sine wave signal. This however means that under small signal conditions and quiescent conditions the bias is slightly less than is necessary and hence the anode current is greater than necessary, also the distortion is not as low as it could be. In order to ensure an adequate output at full drive the anode to anode load is chosen to be higher than optimum for the minimum distortion at low signal levels. By departing from conventional operating conditions, output stages can be designed to give the best performance for speech and music, but at some sacrifice in the ability to obtain full power output from a continuous sine wave. A study of normal programme material of speech and music

will show that full power output is demanded only for very short periods of time and that the average level of the programme requires very low power, usually less than 1/10th of full power output. If then the output stage is designed so that the bias is maintained at a fixed level for a period longer than that during which the demand for full power output occurs, the bias may be set at a higher value than in a conventional amplifier and the anode to anode load may also be reduced. Such an output stage will then give the best possible performance for lower signal levels and will also give satisfactory performance at full drive for short periods. The output stage cathode bypass condensers will maintain the bias voltage at a steady value and the smoothing condenser will maintain the HT at a steady value for a short period provided that the time constants of these circuits are properly chosen. An output stage operating in this way is said to be working under 'low loading conditions'. It has the advantages of (a) low distortion, (b) longer valve life, (c) lower HT drain.

A further improvement in performance may be obtained at high signal levels by feeding back positive bias to the grids of the output valves in order to overcome the increased negative bias produced by the increase in anode current through the cathode resistors, which occurs under large signal conditions. This can be quite simply done by means of a rectifying system connected across the secondary of the output transformer. By suitable selection of the charge and discharge time constants of this DC feed-back circuit the advantages of low loading may be maintained with the added advantage of lower distortion and greater power output at full drive from continuous sine wave signals. This circuit has been employed in the 642 with the result that it can be claimed that for speech and music the output power is in excess of 15 watts and the output from a steady sine wave signal is in excess of 14 watts over the frequency band of the amplifier.

In the 642 amplifier the normal negative feed-back signal is taken from the secondary of the output transformer and fed back to the cathode of V4A.

The power for the exciter lamp is supplied by an R.F. oscillator which employs a cathode coupled Hartley circuit. The exciter lamp is rated at 6 volts, 1 amp and is operated with approximately 5 volts applied to it in order to increase its life. The lamp voltage may be varied by means of a resistor (VR5) in the screen circuit of V7 the oscillator valve. The power for the amplifier and the oscillator is provided by means of a double wound transformer, the primary winding of which also acts as an auto-transformer to supply the correct voltage for the projector motor. The anode supply is rectified by means of an EZ81 rectifier valve.

Physical Features of the 642 Amplifier

The 642 amplifier employs two major printed circuit boards. These boards are constructed of a thick printed circuit material and the dimensions are such that the boards are stiff and rugged. All heavy components are mounted on the metal chassis so that these boards should not suffer from the defects sometimes experienced with printed circuits, such as cracks in circuitry and in board materials, due to handling and transit. The low signal stages V1, 2 and 3, are mounted on one board and V4, 5, 6, 7 and 8, are mounted on the second board. The chassis containing these boards has been kept shallow in order to facilitate servicing. Space has been provided to permit the subsequent conversion of 642 projectors into magnetic playback and magnetic record and playback machines. Various controls are mounted directly onto the chassis and are easily accessible for service. The servicing of this amplifier can, in most instances, be done without removing it from the projector. The 642 projector is fitted with a 6" x 4" elliptical speaker connected across the 8 ohm output. A 16 ohm resistor is connected in parallel to limit the power fed

into it. This internal speaker is automatically disconnected when an external speaker is plugged into the output sockets.

Controls

The photocell and microphone stages are provided with separate volume controls. The Twin Tone controls provide means of lifting or cutting bass and treble independently.

General Information

Sensitivity

Mic. Socket Min. 8mV Max. 200mV.
Mic. Socket Input Impedance - High.

Power Output

15 watts (Speech and Music)
14 watts (Continuous Sine Wave)
Signal - Noise Ratio (Unweighted)
Better than 65dB

Frequency Response

(Dependent on Tone Control Setting).

Mic. 50 - 10 Kc/s
Optical 50 - 7 Kc/s

Output Impedance to match 8 ohms or 16 ohms.

THE

BELL & HOWELL

16mm Filmosound Projector

DESIGN 641 and 642

SERVICE INSTRUCTIONS

SECTION 6

SPARE PARTS LISTS
AND ILLUSTRATIONS

All Orders for Spares must bear
Model Number, Part Number and Description

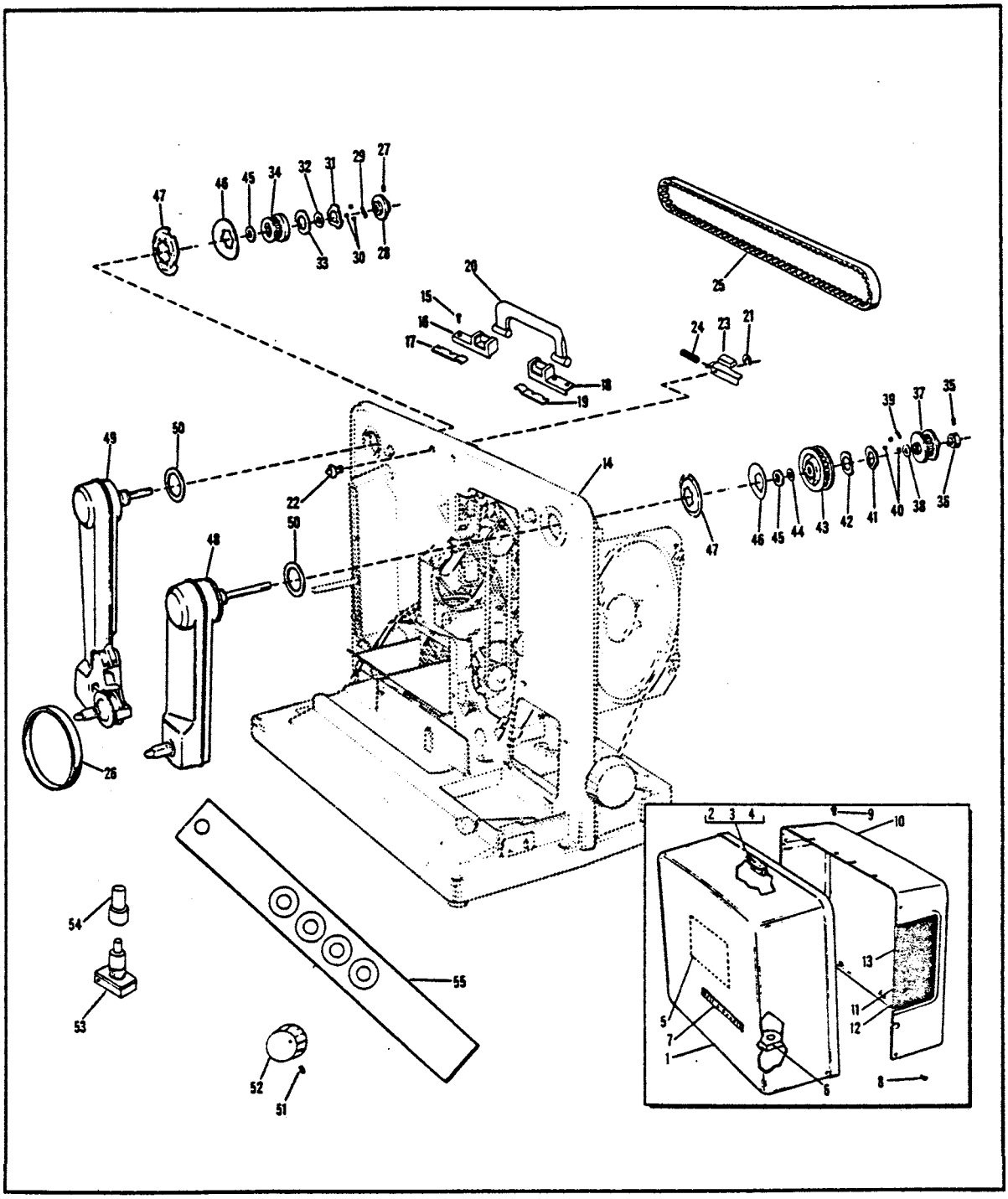


Figure 1. Filmosound Projector Main Plate Exploded (Sheet 1)

Figure 1

PROJECTOR MAIN PLATE

Key No.	Description	Part No. 641	Part No. 642
1	Cover Assembly, Front (includes items 2 to 7 inclusive)	026667	026784
2	Screw, Cover latch plate	33388	*
3	Speed Nut, Cover latch plate	33390	*
4	Plate, Latch	33383	*
5	Plate, Operating instructions	59076	59077
6	Spares Holder	026792	*
7	Nameplate, Bell & Howell	58971	*
8	Screw, Rear cover attaching	33388	*
9	Screw, Rear cover attaching	58962	*
10	Cover Assembly, Rear (includes items 11 to 13 inclusive)	026774	*
11	Guard, Rubber (ventilation grille)	33494	*
12	Gasket, Speaker	33384	*
13	Grille, Ventilation	09946	*
14	Moulding, Main plate	400476	*
15	Screw	33392	*
16	Bracket, Rear Handle	58639	*
17	Spring, Rear Handle	58641	*
18	Bracket, Front Handle	58640	*
19	Spring, Front Handle	58642	*
20	Handle	52226	*
21	Ring, Retaining (cover latch stud)	33299	*
22	Stud, Cover latch	33301	*
23	Lever Assembly, Cover release	026720	*
24	Spring, Release lever	33302	*
25	Belt, Take-up timing	31342	*
26	Belt, Take-up	24047	*
27	Setscrew, Rear reel arm bearing	24049	*
28	Bearing, Rear reel arm	09772	*
29	Spring, Clutch cam	10750	*
30	Ball, Steel	5238	*
31	Cam, Clutch	31338	*
32	Washer, Nylon	31237	*
33	Retainer, Clutch ball (rear arm)	31351	*
34	Sprocket Assembly, Rear arm	09771	*
35	Setscrew, Front reel arm collar	24049	*
36	Collar, Front reel arm	31345	*
37	Sprocket Assembly, Rewind	09770	*
38	Washer, Nylon	31237	*
39	Spring, Clutch cam	10750	*
40	Ball, Steel	5238	*
41	Cam, Clutch	31338	*
42	Retainer, Clutch ball (front arm)	31346	*
43	Sprocket Assembly, Reverse take-up	011183	*
44	Washer, Nylon	31237	*
45	Washer, Brass	31372	*
46	Speed Nut, Reel arm	33436	*
47	Disc, Reel arm lock	31358	*
48	Arm Assembly, Front (see Figure 5 for breakdown)	026585	*
49	Arm Assembly, Rear (see Figure 6 for breakdown)	026583	*
50	Washer, Bronze	31370	*
51	Screw, Knob attaching	33348	*
52	Knob	58525	*
53	Switch, Animation		58956
54	Button		58493
55	Escutcheon	59078	59079

* indicates that the part is used on both Models.

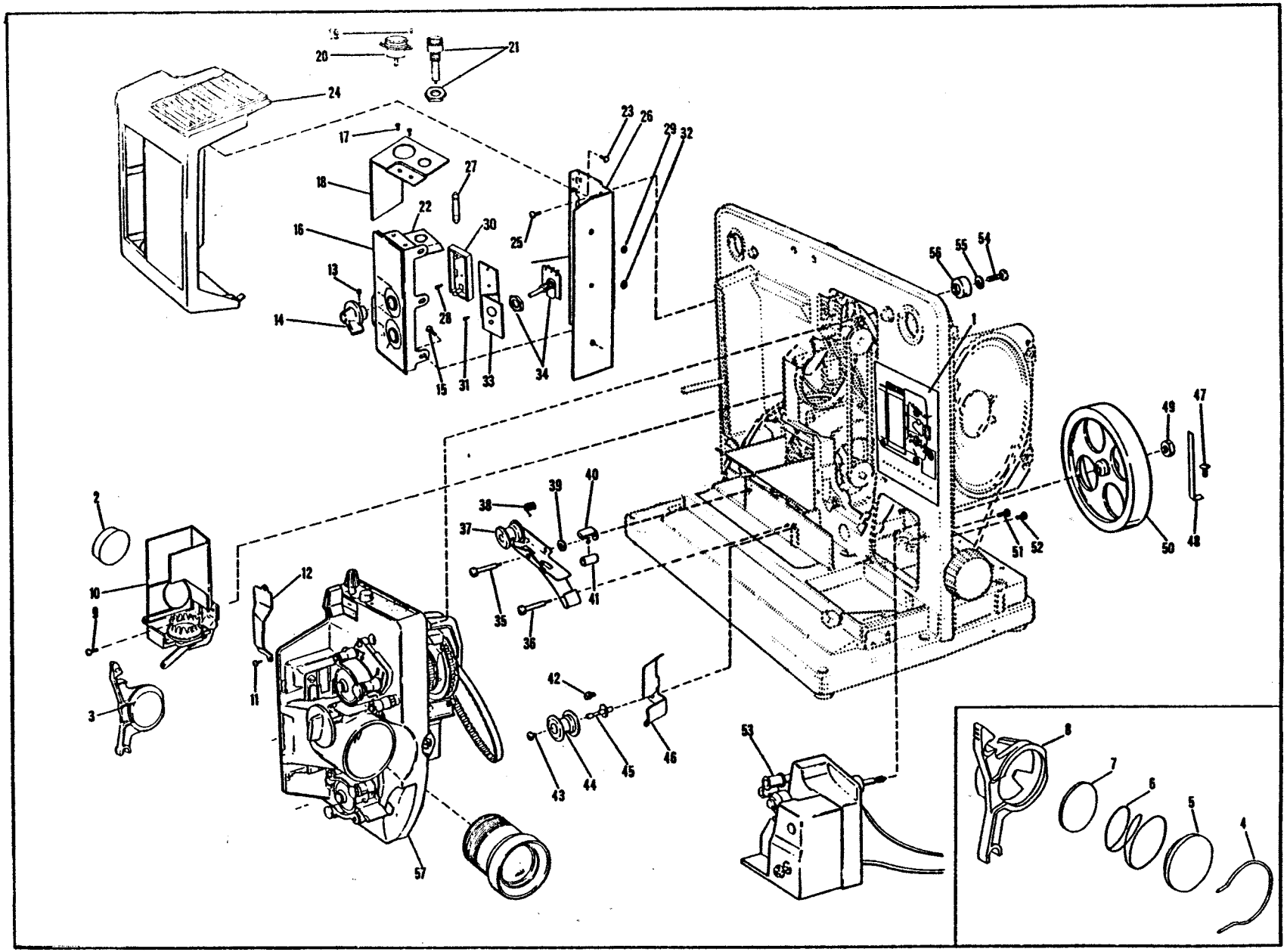


Figure 2. Filmosound Projector Main Plate Exploded (Sheet 2)

Figure 2

PROJECTOR MAIN PLATE (Cont.)

Key No.	Description	Part No. 641	Part No. 642
1	Nameplate, Threading guide	34780	*
2	Reflector	200455	*
3	Condenser Lens Assembly	09811	*
4	Spring, Condenser retaining	31583	*
5	Lens, 2nd. condenser	200454	*
6	Spring, Condenser	31584	*
7	Lens, 1st. condenser	200453	*
8	Housing, Condenser lens	31582	*
9	Screw, Projection lampholder attaching	31930	*
10	Lampholder Assembly, Projection (see Figure 7 for breakdown)	026830	*
11	Screw, Pulley shield attaching	30164	*
12	Shield, Pulley	31340	*
13	Setscrew, Projector control knob	620899	*
14	Knob, Projector control	09846	*
15	Screw, Switch nameplate	31943	*
16	Nameplate Panel	026691	026760
17	Screw, Bracket retaining	31697	*
18	Bracket, Voltage selector	58599	*
19	Rivet	58914	*
20	Voltage Selector	57572	*
21	Fuse Holder	58523	*
22	Insulation, Voltage selector	59154	*
23	Screw, Lamphouse attaching	30164	*
24	Lamphouse Assembly (see Figure 8 for breakdown)	026917	*
25	Screw, Bracket attaching	59075	*
26	Bracket Assembly	026916	*
27	Lamp, Pilot	58532	*
28	Screw	58470	*
29	Nut	58529	*
30	Holder, Pilot lamp	58531	*
31	Screw		58584
32	Nut		56389
33	Bracket, Switch mounting		58867
34	Switch, Selector		58628
35	Stud, Snubber roller	31632	*
36	Screw, Film guide	34809	*
37	Snubber Roller Assembly	09805	*
38	Spring, Snubber roller	31644	*
39	Washer, Plain	31634	*
40	Detent, Snubber roller	31633	*
41	Tubing, Extruded	33487	*
42	Screw, Film guide attaching	59080	*
43	Screw, Idler roller	605222	*
44	Roller, Idler	09747	*
45	Shaft, Idler roller	31915	*
46	Guide, Film	34842	*
47	Screw, Earthing spring	31049	*
48	Spring, Earthing	59023	*
49	Nut, Flywheel	31476	*
50	Flywheel	31592	*
51	Screw, Sound head attaching (rear)	31491	*
52	Screw, Sound head attaching (front)	31491	*
53	Sound Head Assembly (see Figure 9 for breakdown)	026815	*
54	Screw, Mechanism assembly attaching	31492	*
55	Washer, Steel	31243	*
56	Mount, Resilient	31219	*
57	Mechanism Assembly (see Figure 10 for breakdown)	011168	011169

* indicates that the part is used on both Models.

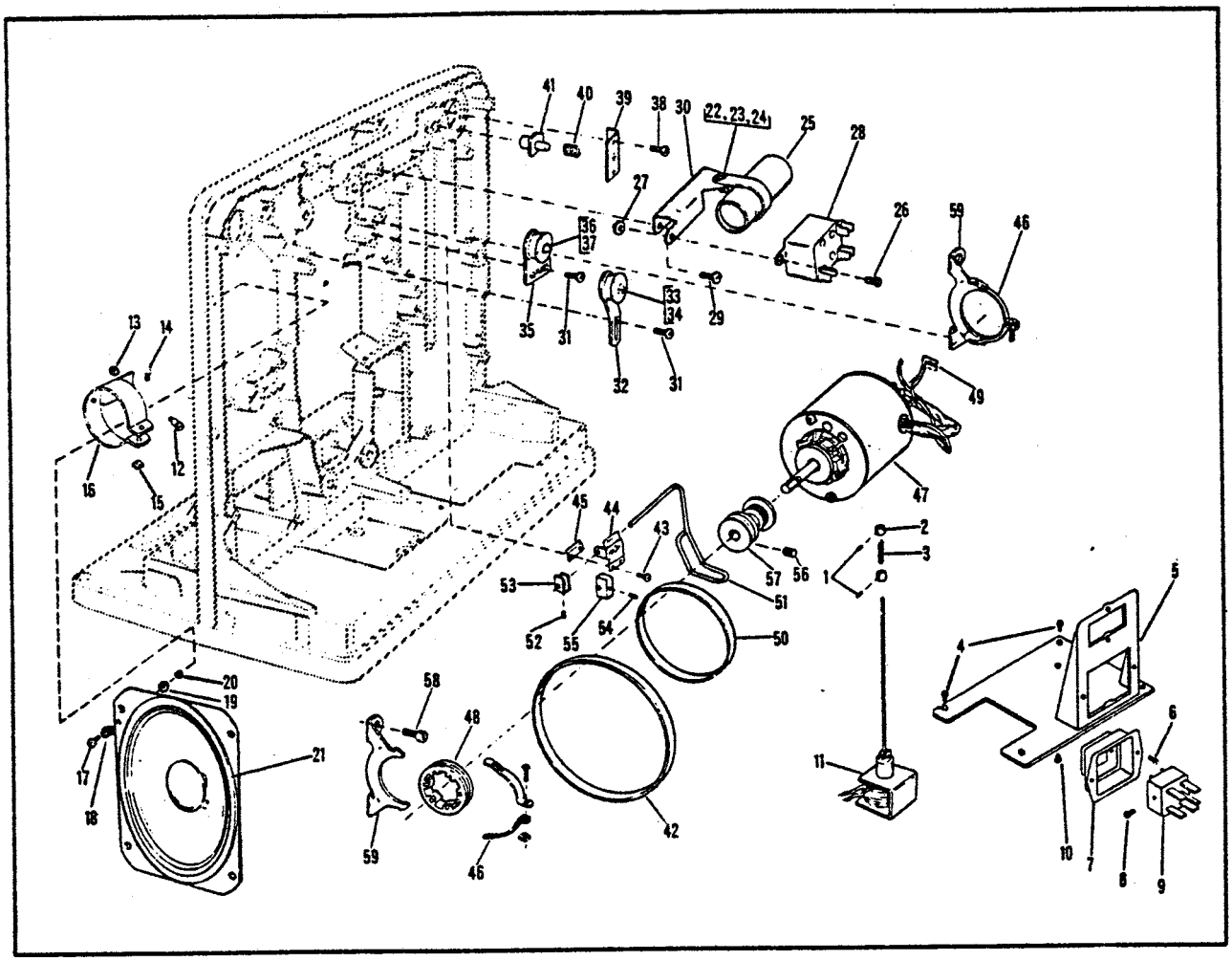


Figure 3. Filmosound Projector Main Plate Exploded (Sheet 3)

Figure 3

PROJECTOR MAIN PLATE (Cont.)

Key No.	Description	Part No. 641	Part No. 642
1	Setscrew, Collar		56152
2	Collar, Clutch rod		31481
3	Spring, Clutch rod		31482
4	Screw, Socket bracket	31049	*
5	Bracket, Socket mounting	58656	*
6	Screw, Plug holder attaching	31049	*
7	Holder, Plug	50090	*
8	Screw, Plug attaching	50025	*
9	Plug	50027	*
10	Screw, Clutch solenoid		31943
11	Solenoid and Rod Assembly, Clutch		026913
12	Screw	59060	*
13	Grommet	56303	*
14	Screw	50851	*
15	Nut	2843	*
16	Bracket, Speaker	58597	*
17	Screw, Speaker mounting	59059	*
18	Grommet	56316	*
19	Washer	52470	*
20	Nut, Push-on	58529	*
21	Speaker Assembly	59164	*
22	Screw, Starting capacitor	31928	*
23	Nut, Hexagon	601190	*
24	Clamp, Starting capacitor	31503	*
25	Capacitor, Starting	58570	*
26	Screw, Motor relay	31697	*
27	Nut, Hexagon	601190	*
28	Relay, Motor	31267	*
29	Screw, Relay bracket	31049	*
30	Bracket, Relay	31914	*
31	Screw, Idler assembly attaching	31049	*
32	Idler Assembly (includes items 33 and 34)	09768	*
33	Ring, Retaining	614240	*
34	Roller, Idler	611107	*
35	Idler Assembly (includes items 36 and 37)	09769	*
36	Ring, Retaining	614240	*
37	Roller, Idler	611107	*
38	Screw, Lock bracket	31493	*
39	Bracket, Reel arm lock	31232	*
40	Spring, Reel arm plunger	31231	*
41	Plunger Assembly, Reel arm lock	09888	*
42	Belt, Blower	59130	*
43	Screw, Bar stop bracket	31550	*
44	Bracket, Bar stop	31919	*
45	Spring, Belt shift	31921	*
46	Strap, Motor bracket (includes screw and nut)	31265	*
47	Motor Assembly, Drive (includes items 48 and 49)	026904	*
48	Support, Cushion (motor)	70345	*
49	Terminal, Flag snap-on	32093	*
50	Belt, Flat	31341	*
51	Shifter, Belt	31339	*
52	Setscrew, Bar bracket	33348	*
53	Bracket, Bar	31343	*
54	Setscrew, Belt shift stop	31909	*
55	Stop, Belt shift	31920	*
56	Setscrew, Motor pulley	80591	*
57	Pulley, Motor	31334	*
58	Screw, Motor bracket	31690	*
59	Bracket, Motor mounting	59263	*

* indicates that the part is used on both Models.

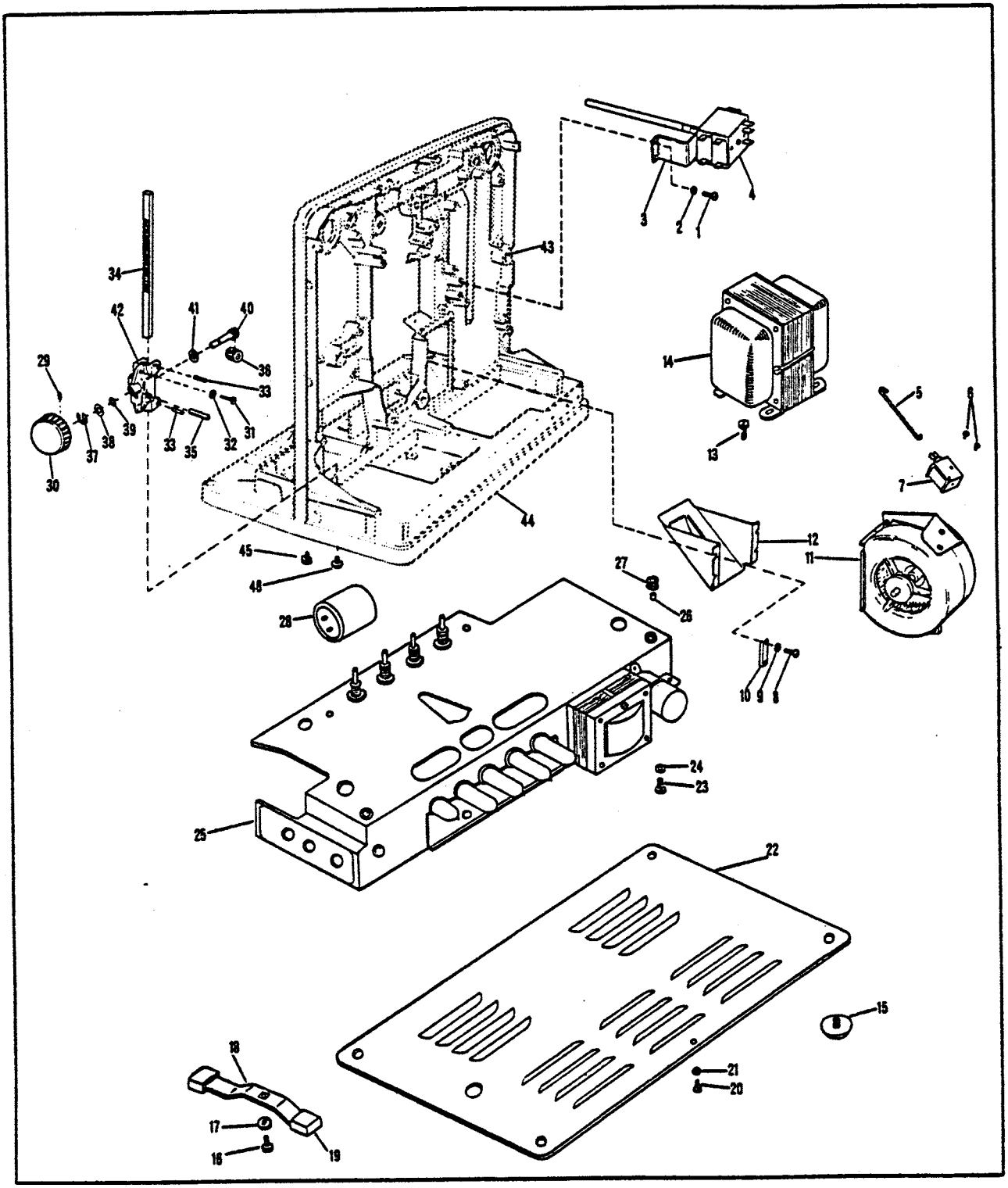


Figure 4. Filmosound Projector Main Plate Exploded (Sheet 4)

Figure 4

PROJECTOR MAIN PLATE (Cont.)

Key No.	Description	Part No. 641	Part No. 642
1	Screw, Switch bracket	600803	*
2	Washer, Lock	24436	*
3	Bracket, Rotary switch	58598	*
4	Switch, Rotary	58443	*
5	Rod, Fire shutter		59261
6	Screw, Solenoid retaining		58949
7	Solenoid and Rod Assembly (includes item 5)		026896
8	Screw, Blower bracket	31499	*
9	Washer, Lock	14175	*
10	Bracket, Blower	31692	*
11	Blower Assembly (see Figure 19 for breakdown)	09762	026892
12	Deflector, Air	011174	*
13	Screw, Transformer attaching	31493	*
14	Transformer Assembly	026829	026828
15	Foot, Rubber	026736	*
16	Screw, Tilt bar	31699	*
17	Washer, Lock	52047	*
18	Bar Assembly, Tilt (includes item 19)	09802	*
19	Foot, Rubber	31561	*
20	Screw	31499	*
21	Washer	14175	*
22	Baseplate	58106	*
23	Screw, Amplifier retaining	31694	*
24	Washer	22659	*
25	Amplifier Assembly	026641	026642
26	Spacer	58468	*
27	Grommet	58467	*
28	Condenser		58866
29	Setscrew, Tilt Knob	24084	*
30	Knob, Tilt	09807	*
31	Screw, Tilt mechanism	31694	*
32	Washer, Lock	25266	*
33	Pin, Spring	31567	*
34	Rack, Tilt	31559	*
35	Pin, Spring	31568	*
36	Pinion, Tilt	31565	*
37	Ring, Retaining	21736	*
38	Washer, Flat	31039	*
39	Washer, Spring	34822	*
40	Gear, Tilt worm	31564	*
41	Washer, Flat	31039	*
42	Housing, Tilt	31563	*
43	Plate, Main	58417	*
44	Base Assembly, Projector	026866	026805
45	Screw, 8-32 x 1/2"	31491	*
46	Screw, 8-32 x 3/8"	31930	*

* indicates that the part is used on both Models.

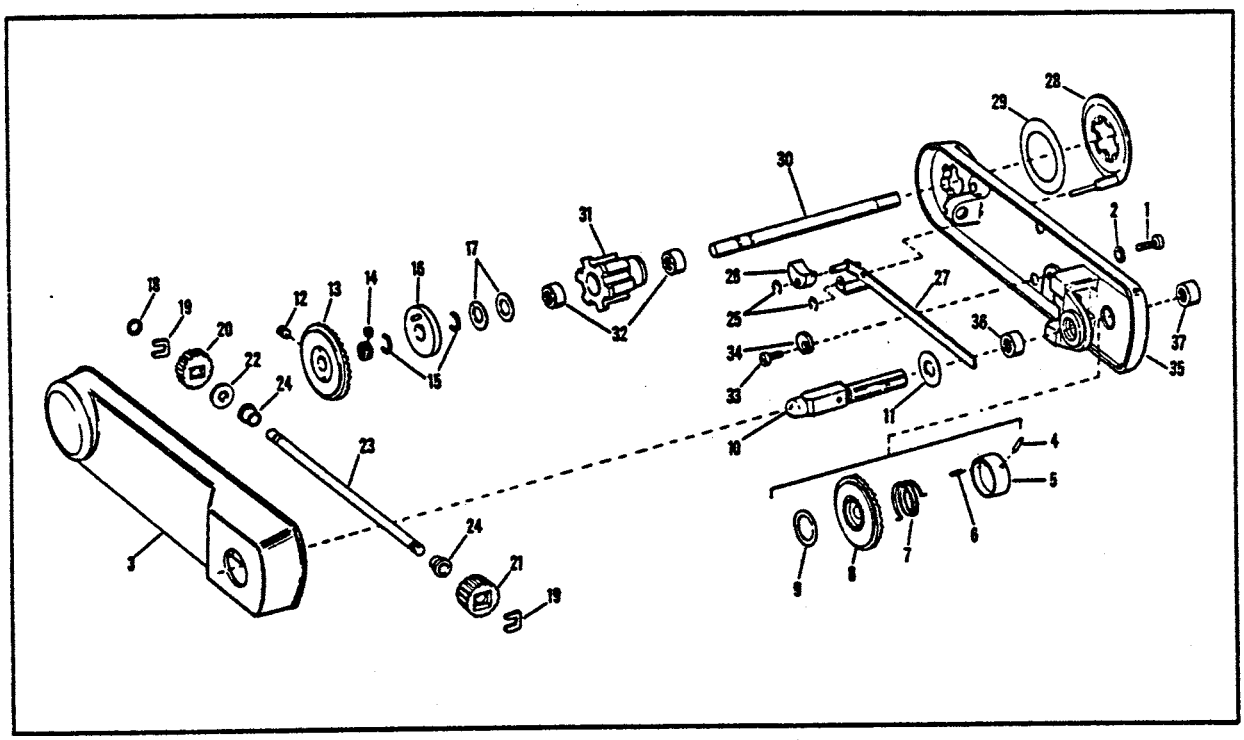


Figure 5. Front Reel Arm Assembly

Figure 5

FRONT REEL ARM ASSEMBLY

Key No.	Description	Part No. 641	Part No. 642
-	Reel Arm Assembly, Front	026585	*
1	Screw, Reel arm cover	24270	*
2	Washer, Lock	14175	*
3	Cover, Front reel arm	31361	*
4	Pin, Spring	31366	*
5	Collar, Feed spindle	31363	*
6	Pin, Drive	31365	*
7	Spring, Torsion	31364	*
8	Gear Assembly, Lower	09776	*
9	Washer, Brass	31371	*
10	Spindle Assembly, Feed	09774	*
11	Washer, Steel	59246	*
12	Setscrew, Upper gear	58355	*
13	Gear Assembly, Upper	09754	*
14	Spring, Clutch	31369	*
15	Ring, Clutch disc retaining	24903	*
16	Disc Assembly, Clutch	09779	*
17	Washer, Brass	31372	*
18	Ring, Retaining	31245	*
19	Clip, Gear retaining	31241	*
20	Gear, Spur (lower)	33385	*
21	Gear, Spur (upper)	31239	*
22	Washer, Steel	31243	*
23	Shaft, Drive	31360	*
24	Bearing, Nylon	31236	*
25	Ring, Retaining	17639	*
26	Shoe, Friction	31367	*
27	Bracket Assembly, Friction shoe	09778	*
28	Disc Assembly, Spline bearing	09777	*
29	Washer, Bronze	31370	*
30	Shaft, Front reel arm	31356	*
31	Bearing Assembly, Splined (including items 32)	09752	*
32	Bearing, Needle	31911	*
33	Screw, Eccentric stop	24021	*
34	Stop, Eccentric	31368	*
35	Arm and Bearing Assembly, Front (including items 24, 36 & 37)	026639	*
36	Bearing, Needle	31911	*
37	Bearing, Needle (closed end)	31375	*

* indicates that the part is used on both Models.

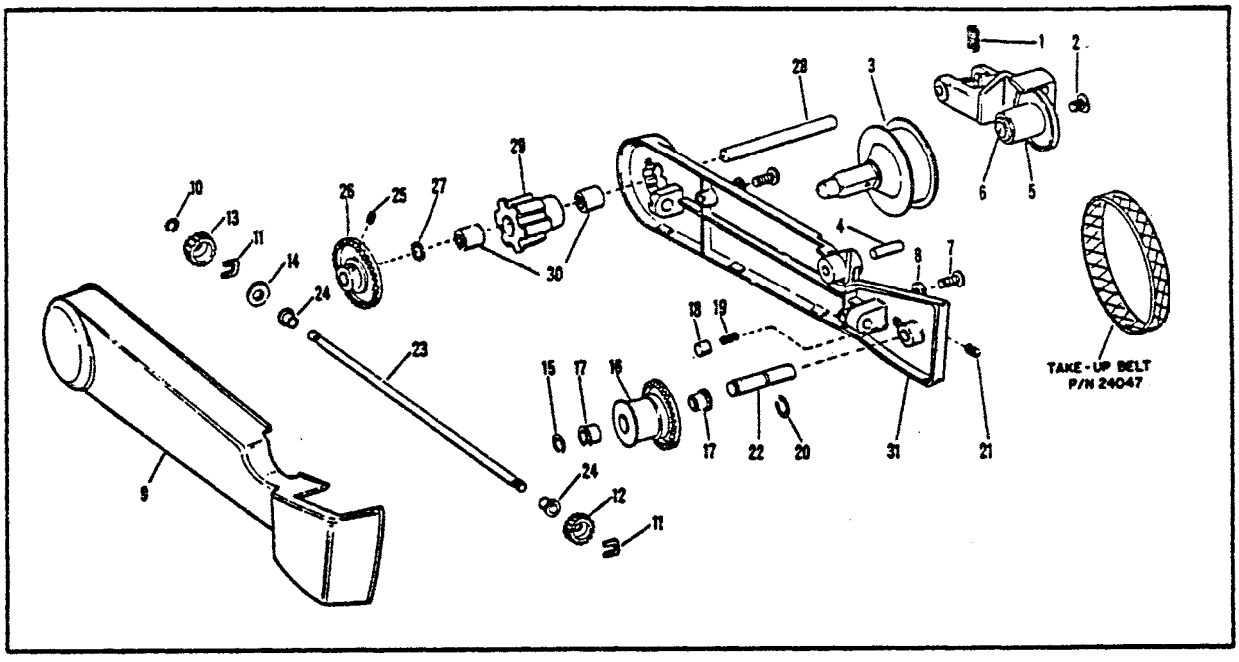


Figure 6. Rear Reel Arm Assembly

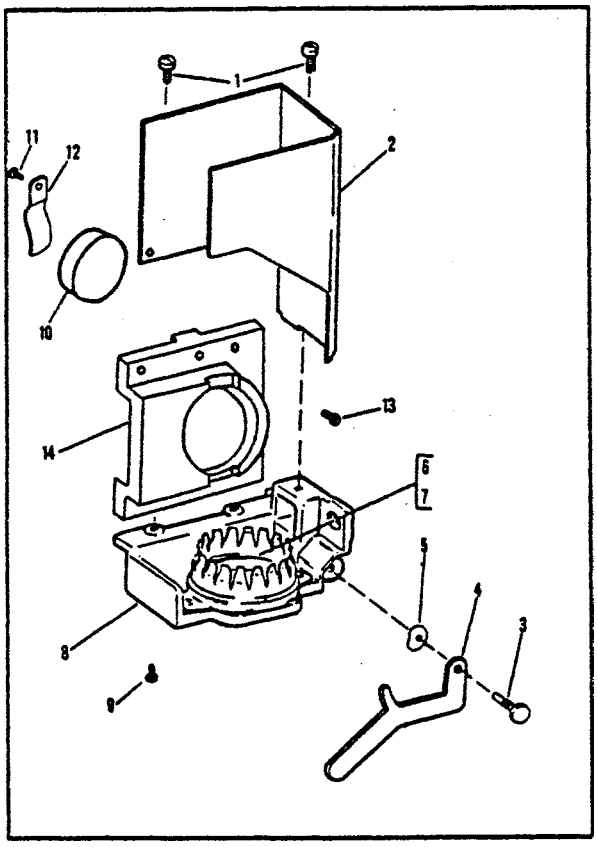


Figure 7. Projection Lampholder Assembly

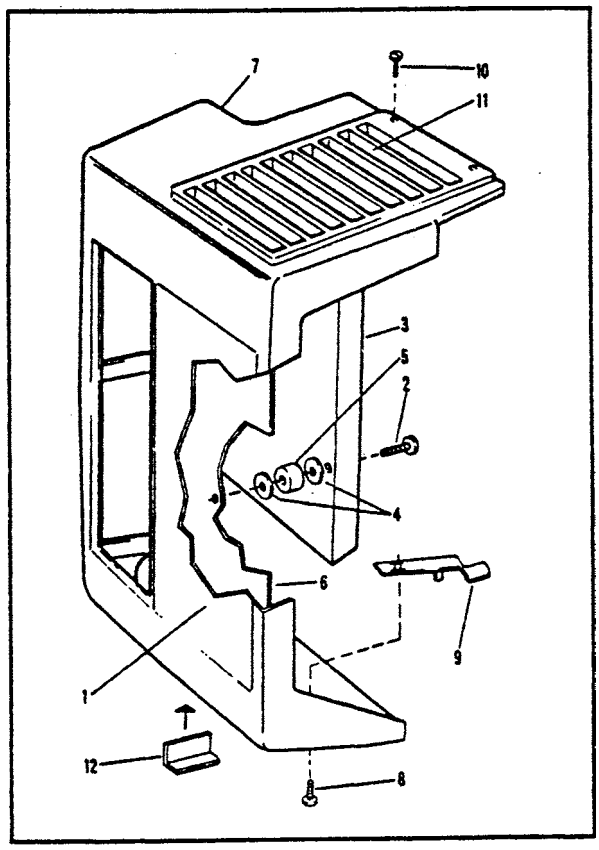


Figure 8. Lamphouse Assembly

Figure 6

REAR REEL ARM ASSEMBLY

Key No.	Description	Part No. 641	Part No. 642
-	Reel Arm Assembly, Rear	026583	*
1	Spring, Tension (take-up arm)	31240	*
2	Screw, Socket head	58354	*
3	Spindle and Pulley Assembly, Take-up	09753	*
4	Pin, Take-up Arm	24043	*
5	Arm Assembly, Take-up (includes item 6)	026678	*
6	Bearing, Needle	31911	*
7	Screw, Reel arm cover	24270	*
8	Washer, Lock	14175	*
9	Cover, Rear reel arm	31251	*
10	Ring, Retaining (spur gear)	31245	*
11	Clip, Gear retaining	31241	*
12	Gear, Spur	31239	*
13	Gear, Spur	31239	*
14	Washer, Steel	31243	*
15	Ring, Retaining (gear assembly)	614240	*
16	Pulley and Gear Assembly	09756	*
17	Bearing, Nylon	31235	*
18	Plunger, Spring	31242	*
19	Spring, Compression	31246	*
20	Ring, Retaining	33966	*
21	Setscrew, Rewind drive shaft	58353	*
22	Shaft, Rewind drive	31234	*
23	Shaft, Drive	31238	*
24	Bearing, Nylon	31236	*
25	Setscrew, Gear Assembly	58355	*
26	Gear Assembly	09754	*
27	Washer, Brass	58725	*
28	Shaft, Rear reel arm	31233	*
29	Bearing Assembly, Splined (includes items 30)	09752	*
30	Bearing, Needle	31911	*
31	Arm, Rear	31249	*

Figure 7

PROJECTION LAMPHOLDER ASSEMBLY

-	Lampholder Assembly, Projection	026830	*
1	Screw, Heat shield attaching	31943	*
2	Baffle, Lamp	59053	*
3	Pin, Lamp release lever	31604	*
4	Lever, Lamp release	31605	*
5	Washer, Tension	31019	*
6	Rivet, Lamp socket attaching	58593	*
7	Socket, Projection lamp	56733	*
8	Bracket, Lamp socket	58438	*
-	Socket and Bracket Assembly (items 6 to 8 inclusive)	026918	*
9	Screw, Reflector holder retaining	31697	*
10	Reflector	200455	*
11	Screw, Spring attaching	31943	*
12	Spring, Reflector retaining	31603	*
13	Screw, Baffle retaining	31943	*
14	Holder, Reflector	58440	*

Figure 8

LAMPHOUSE ASSEMBLY

-	Lamphouse Assembly	026917	*
1	Nameplate	31278	*
2	Screw, Shield attaching	34812	*
3	Shield, Lamp	31933	*
4	Washer	34753	*
5	Bushing	34751	*
6	Reflector, Heat	31937	*
7	Lamphouse	58425	*
8	Screw, Latch attaching	31922	*
9	Latch, Lamphouse	09806	*
10	Screw, Drive	83234	*
11	Grille, Lamphouse	33306	*
12	Guard, Film	33488	*

* indicates that the part is used on both Models.

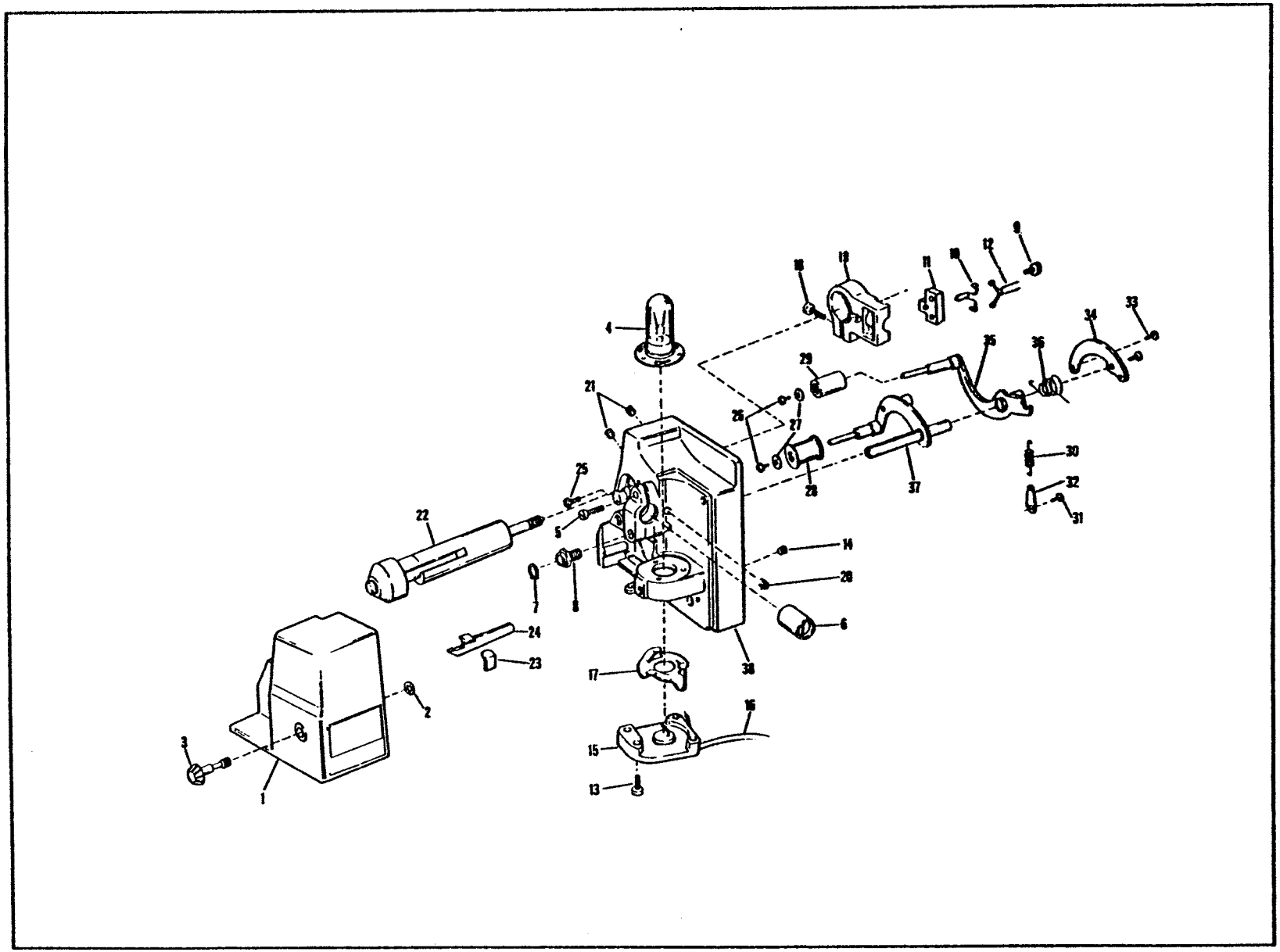


Figure 9. Sound Head Assembly

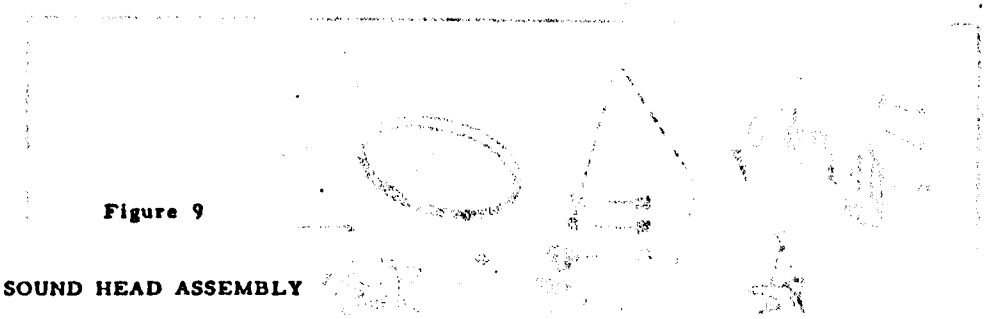


Figure 9

SOUND HEAD ASSEMBLY

Key No.	Description	Part No. 641	Part No. 642
-	Sound Head Assembly	026815	*
1	Cover Assembly, Exciter lamp	026848	*
2	Ring, Retaining	20808	*
3	Screw, Cover retaining	026914	*
4	Lamp, Exciter	31631	*
5	Screw, Optical slit clamping	24271	*
6	Optical Slit Assembly	020240	*
7	Ring, Retaining	31671	*
8	Screw, Guide roller adjusting	31630	*
9	Screw, Photocell attaching	29558	*
10	Photo Diode Assembly	026658	*
11	Support, Photo Diode	58600	*
12	Cable Assembly, Photo Diode	026772	*
13	Screw, Lamp contact attaching	31638	*
14	Setscrew, Ground lead locking	11521	*
15	Contact Assembly, Exciter lamp	09828	*
16	Leadwire Assembly, Lamp contact	026773	*
17	Ring, Lamp release	31636	*
18	Screw, Photo Diode holder clamping	301435	*
19	Holder, Photo Diode	31663	*
20	Setscrew, Light pipe locking	11521	*
21	Setscrew, Sound drum shaft locking	12636	*
22	Shaft Assembly, Sound drum	09831	*
23	Retainer, Light pipe	31669	*
24	Light Pipe	200526	*
25	Screw Assembly, Edge guide	09826	*
26	Screw, Film guide roller	30163	*
27	Washer, Steel	31674	*
28	Roller, Flanged	09834	*
29	Roller, Plain	09835	*
30	Spring, Extension	31673	*
31	Screw, Spring terminal	30164	*
32	Terminal, Spring	31675	*
33	Screw, Stabilizer arm	30164	*
34	Arm, Stabilizer	09833	*
35	Arm Assembly, Stabilizer (lower)	09832	*
36	Spring, Stabilizer arm	31672	*
37	Arm Assembly, Stabilizer (upper)	09838	*
38	Housing, Sound head	34881	*

* indicates that the part is used on both Models.

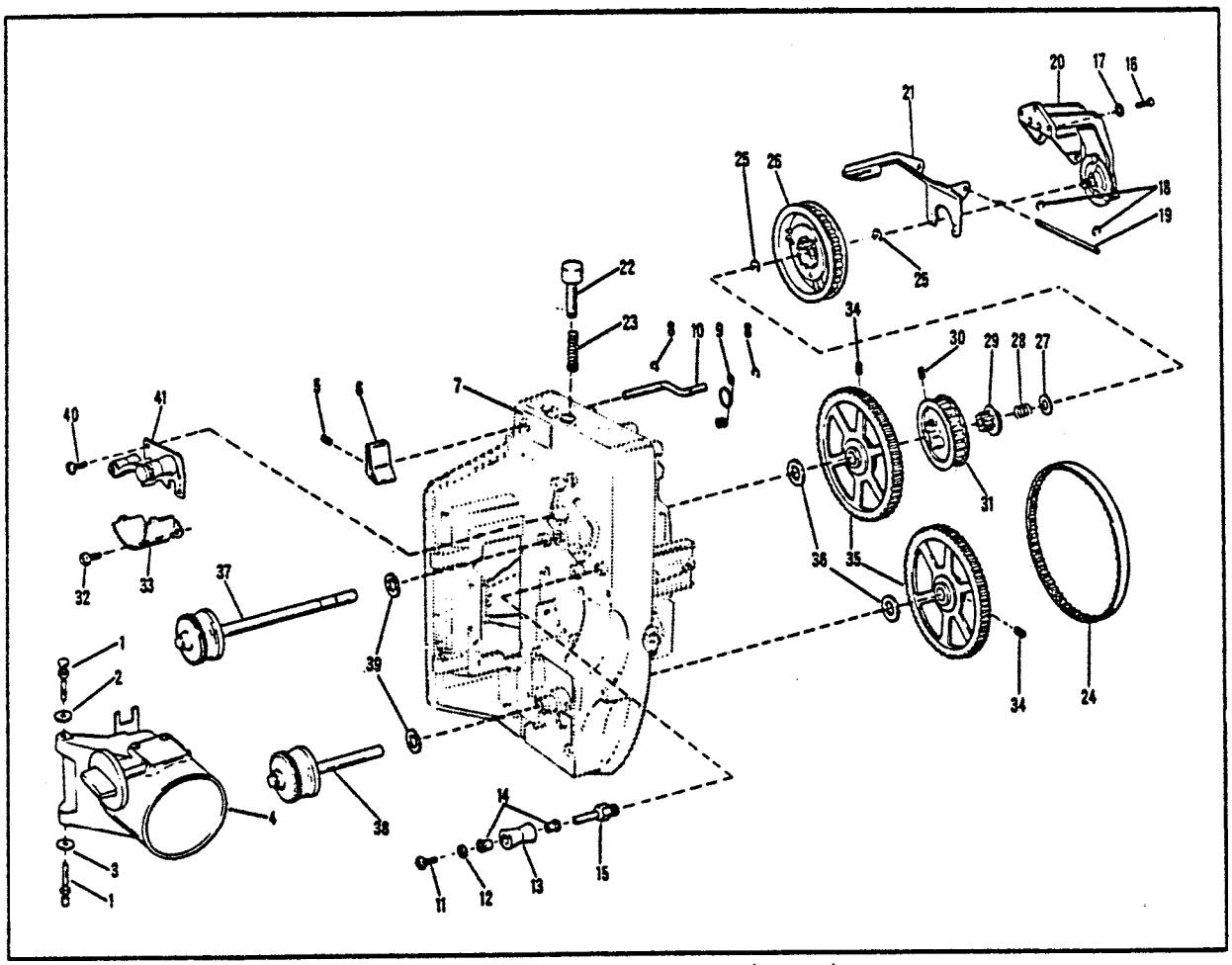


Figure 10. Mechanism Assembly (Sheet 1)

Figure 10

MECHANISM ASSEMBLY, COMPLETE

Key No.	Description	Part No. 641	Part No. 642
-	Mechanism Assembly, Complete	011168	011169
1	Pin, Hinge	31957	*
2	Washer, Spring	31019	*
3	Washer, Flat	31020	*
4	Lens Carrier Assembly (See Figure 14 for breakdown)	09714	*
5	Setscrew, Speed change knob	620899	*
6	Knob, Speed change	31964	*
7	Nameplate, Silent-Sound	31956	*
8	Ring, Retaining	31038	*
9	Spring, Belt shift lever	31012	*
10	Crank, Belt shift	31014	*
11	Screw, Guard roller	31473	*
12	Washer	34784	*
13	Roller, Sprocket guard	34825	*
14	Bearing, Nylon	31164	*
15	Post, Roller	34824	*
16	Screw, Outboard bearing	24270	*
17	Washer, Lock	14175	*
18	Ring, Retaining	17639	*
19	Shaft, Clutch lever	31045	*
20	Bearing Assembly, Outboard (includes the following parts)	09721	*
	Rivet	31906	*
	Retainer, Bearing	31121	*
	Bearing	7994	*
	Ring, Felt	31120	*
21	Lever, Rewind clutch	31041	*
22	Button, Rewind	31044	*
23	Spring, Rewind button	31042	*
24	Belt, Rewind timing	31023	*
25	Ring, Retaining	614240	*
26	Sprocket Assembly, Rewind drive	09724	*
27	Washer, Flat	31039	*
28	Spring, Compression	31040	*
29	Driver Assembly, Spline	09730	*
30	Setscrew, Take-up drive sprocket	24049	*
31	Sprocket Assembly, Take-up drive	09723	*
32	Screw, Sprocket guard	25837	*
33	Guard, Sprocket	34774	*
34	Setscrew, Sprocket gear	58355	*
35	Gear Assembly, Sprocket	09757	*
36	Washer, Sprocket tension	31015	*
37	Sprocket Assembly, Upper	09719	*
38	Sprocket Assembly, Lower	09716	*
39	Washer, Sprocket thrust	31017	*
40	Screw, Sprocket guard assembly	31551	*
41	Guard Assembly, Sprocket (See Figure 15 for breakdown)	011182	*

* indicates that the part is used on both Models.

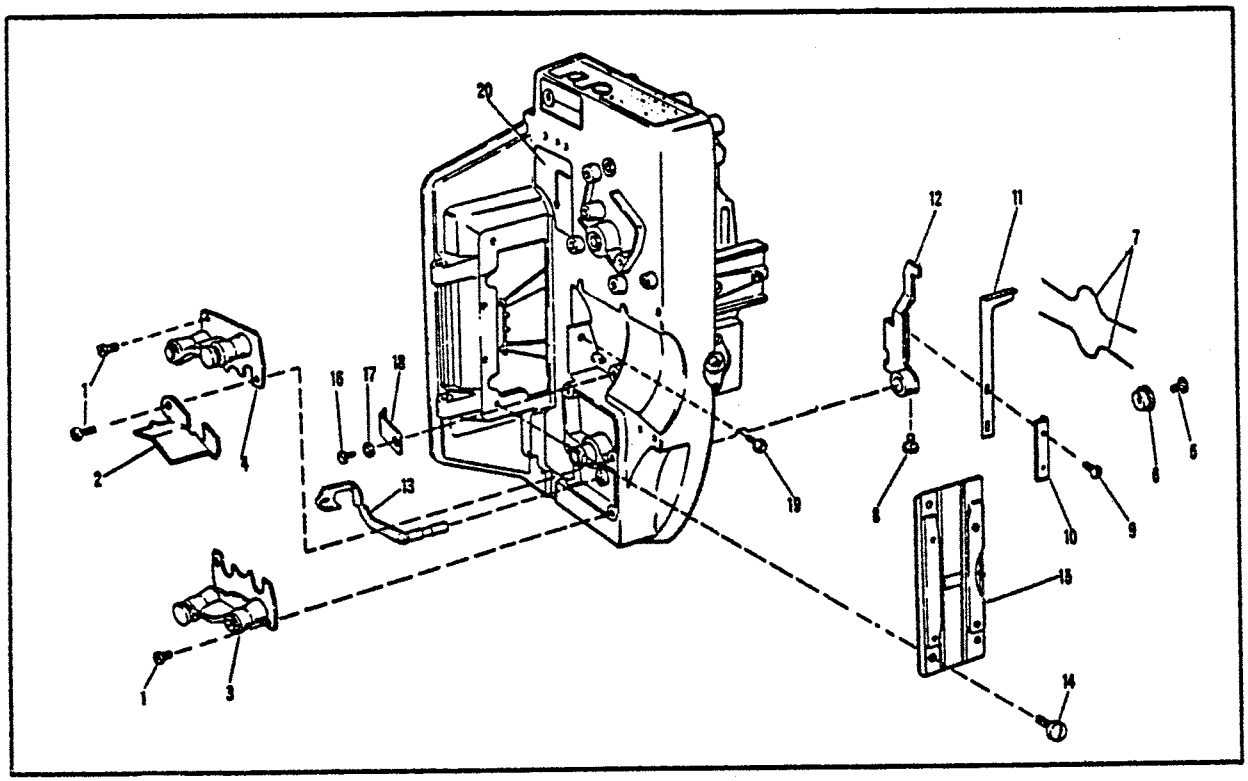


Figure 11. Mechanism Assembly (Sheet 2)

Figure 11

MECHANISM ASSEMBLY, COMPLETE (Cont.)

Key No.	Description	Part No. 641	Part No. 642
1	Screw, Sprocket guard	31551	*
2	Guide, Threading	34775	*
3	Guard Assembly, Sprocket (see Figure 15 for breakdown)	011182	*
4	Guard Assembly, Sprocket (see Figure 15 for breakdown)	011178	*
5	Screw, Eccentric anchor	31499	*
6	Anchor, Eccentric	31470	*
7	Spring, Overcentre	31469	*
8	Screw, Cam follower support	33347	*
9	Screw, Cam follower	31555	*
10	Bracket, Follower alignment	31474	*
11	Follower, Cam	31425	*
12	Support	09786	*
-	Support Assembly, Cam follower (items 8 - 12 inclusive)	09843	*
13	Arm Assembly, Restoring	09797	*
14	Screw, Aperture plate	31049	*
15	Plate Assembly, Aperture (see Figure 16 for breakdown)	026623	*
16	Screw, Lens carrier catch	31943	*
17	Washer, Lock	14175	*
18	Catch, Lens carrier	33261	*
19	Screw, Lens stop	33260	*
20	Nameplate, Threading (upper)	34776	*

* indicates that the part is used on both Models.

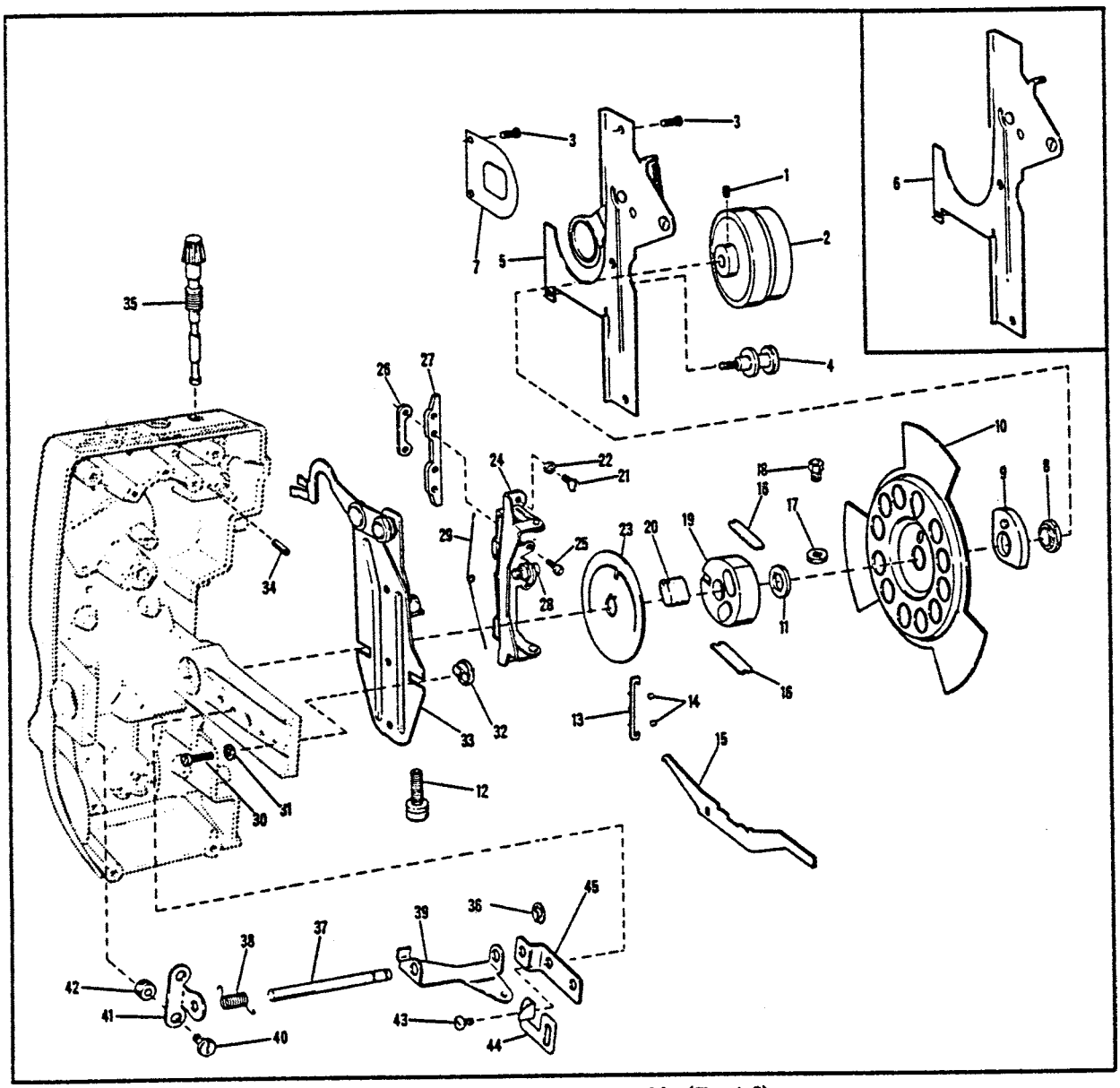


Figure 12. Mechanism Assembly (Sheet 3)

Figure 12

MECHANISM ASSEMBLY, COMPLETE (Cont.)

Key No.	Description	Part No. 641	Part No. 642
1	Setscrew, Mechanism pulley	12636	*
2	Pulley, Mechanism	31021	*
3	Screw, Fire shutter and heat baffle	31943	*
4	Screw, Condenser	31960	*
5	Shutter Assembly, Fire (see Figure 17 for breakdown)		09729
6	Bracket, Support	31154	*
7	Baffle, Heat	31022	*
8	Nut, Shutter	31005	*
9	Weight, Counterbalance	31037	*
10	Shutter, Three-blade	31004	*
11	Washer, Fibre	34797	*
12	Support Assembly, Bearing	09712	*
13	Shuttle	31557	*
14	Bearing, Shuttle link	31011	*
15	Arm Assembly, Shuttle	09706	*
16	Follower, Pull-down cam	31003	*
17	Nut, Stud assembly	31010	*
18	Ball and Stud Assembly	09703	*
19	Cam, Pull-down	33346	*
20	Wick, Cam oiler	31025	*
21	Screw, In-out bracket	31049	*
22	Washer, Lock	14175	*
23	Cam, In-out	31001	*
24	Bracket Assembly, In-out (includes items 25 - 29)	09715	09878
25	Screw, Shuttle guide shoe	30163	*
26	Shoe, Shuttle guide	31901	*
27	Plate, Cam bracket	31558	*
28	Follower, Cam	09702	*
29	Spring, In-out	31100	*
30	Screw, Shuttle arm plate	24452	*
31	Washer, Lock	14175	*
32	Nut, Round	31032	*
33	Plate Assembly, Shuttle arm	09705	*
34	Pin, Spring	98763	*
35	Knob and Shaft Assembly, Framer	09732	*
36	Ring, Retaining		20808
37	Shaft, Stop pawl		31396
38	Spring, Torsion		33258
39	Pawl, Stop		31026
40	Screw, Shoulder		24851
41	Bracket, Stop pawl shaft		31027
42	Grommet, Rubber		24852
43	Screw, Clutch stop		31049
44	Stop, Clutch		33259
45	Bracket, Bearing		31398

* indicates that the part is used on both Models.

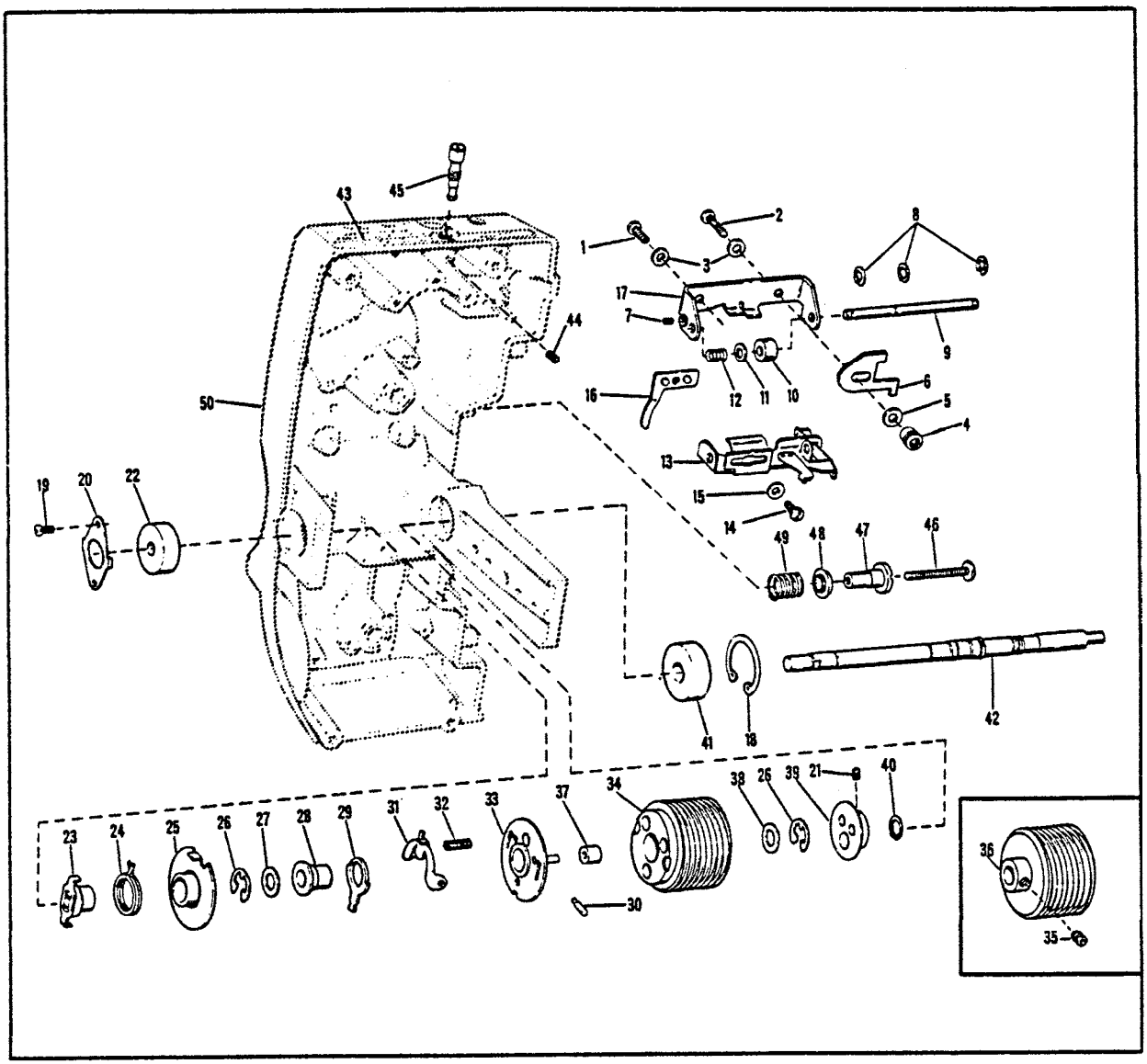


Figure 13. Mechanism Assembly (Sheet 4)

Figure 13

MECHANISM ASSEMBLY, COMPLETE (Cont.)

Key No.	Description	Part No. 641	Part No. 642
1	Screw, Clutch bracket (short)		31976
2	Screw, Clutch bracket (long)		30162
3	Washer, Lock		31977
4	Nut, Round		31397
5	Washer, Flat		31457
6	Bracket, Shuttle adjustment		31048
7	Setscrew, Slide bar adjusting		31405
8	Ring, Retaining		17639
9	Shaft, Clutch bracket		31403
10	Bumper, Slide		31399
11	Washer, Flat		31456
12	Spring, Compression		31036
13	Bar Assembly, Clutch slide		09886
14	Screw, Strike		31555
15	Washer, Flat		31451
16	Strike		31050
17	Bracket Assembly, Clutch mounting		09885
-	Bracket Assembly, Animation clutch (items 7 - 17 inclusive)		09870
18	Ring, Retaining	31009	*
19	Screw, Loading spring	31094	*
20	Spring, Bearing loading	31553	*
21	Setscrew, Loop restorer cam	31433	*
22	Bearing	31007	*
23	Clutch Assembly, Driver		09710
24	Spring, Clutch torsion		31035
25	Clutch Assembly, Driven		09711
26	Ring, Retaining		21736
27	Washer, Flat		31029
28	Bearing, Sleeve		31400
29	Trigger		31145
30	Pin, Shoulder		31149
31	Yoke, Clutch		31147
32	Spring, Compression		31148
33	Bearing Assembly		09728
34	Gear Assembly, Worm (see Figure 18 for breakdown)		09709
35	Setscrew, Worm gear	620905	
36	Gear, Worm	09852	
37	Bushing, Rubber		31031
38	Washer, Flat		31029
39	Cam, Loop restorer	31424	*
40	Ring, Retaining	31078	*
41	Bearing	31006	*
42	Camshaft	31967	31008
43	Nameplate, Framer-Rewind	31954	*
44	Setscrew, Rewind adjustment stud	58353	*
45	Stud, Rewind adjustment	31043	*
46	Screw, Condenser holder	33490	*
47	Holder, Condenser	33489	*
48	Washer, Special	31962	*
49	Spring, Condenser holder	31959	*
50	Housing Assembly, Mechanism	011165	011166

* indicates that the part is used on both Models.

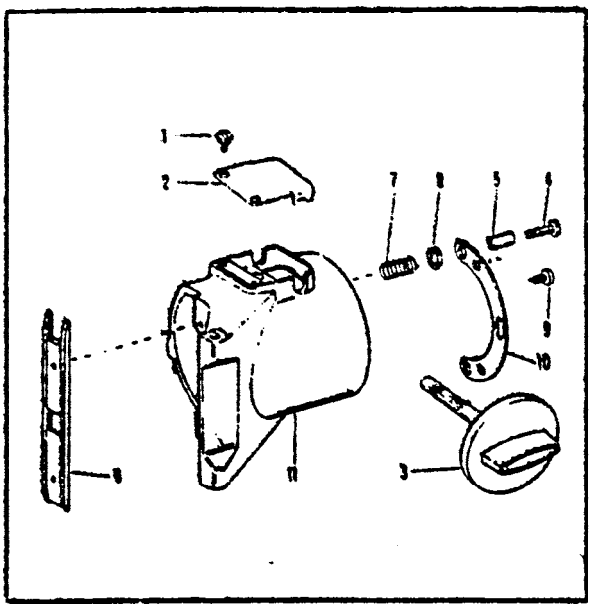


Figure 14. Lens Carrier Assembly

Figure 14

LENS CARRIER ASSEMBLY

Key No.	Description	Part No. 641	Part No. 643
-	Lens Carrier Assembly	09714	*
1	Screw, Hold-down	31094	*
2	Spring, Pinion hold-down	31093	*
3	Knob Assembly, Focus	026827	*
4	Screw, Pressure plate	31098	*
5	Bushing, Spacer	31097	*
6	Plate, Pressure	31092	*
7	Spring, Compression	31096	*
8	Washer, Flat	24366	*
9	Screw, Adjustment plate	31905	*
10	Plate, Adjustment	31095	*
11	Carrier, Lens	09707	*

* indicates that the part is used on both Models.

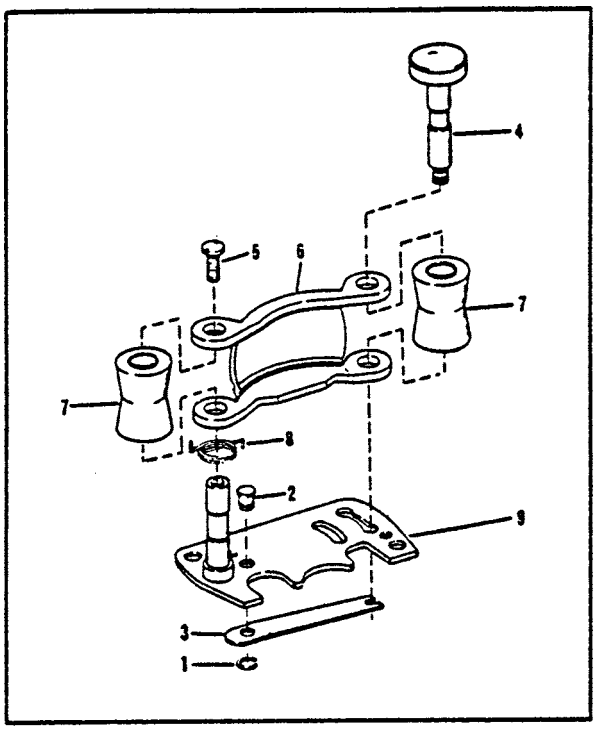


Figure 15. Lower Sprocket Guard Assembly

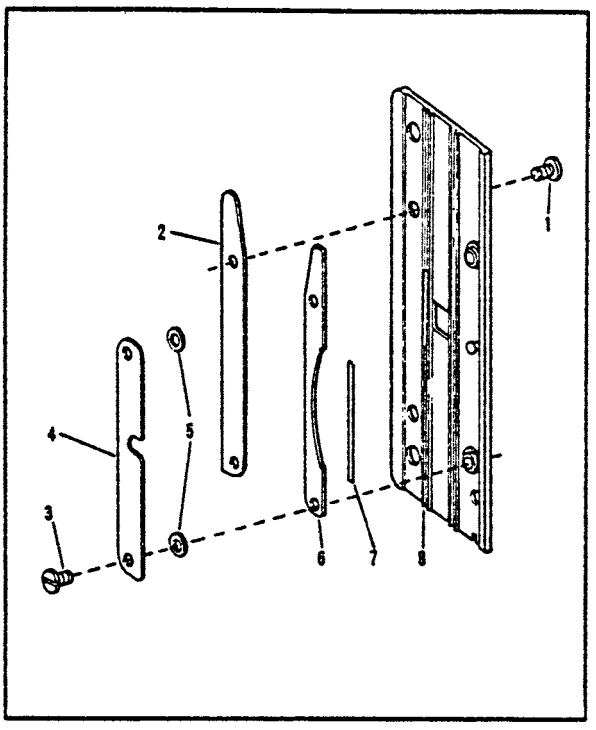


Figure 16. Aperture Plate Assembly

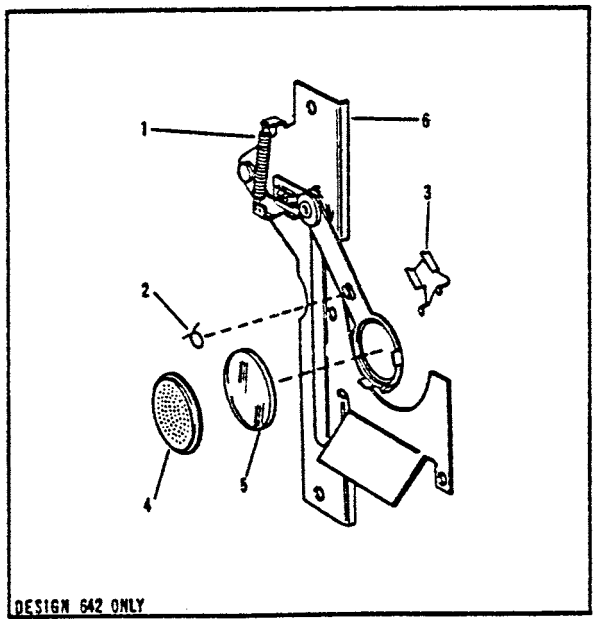


Figure 17. Fire Shutter Assembly

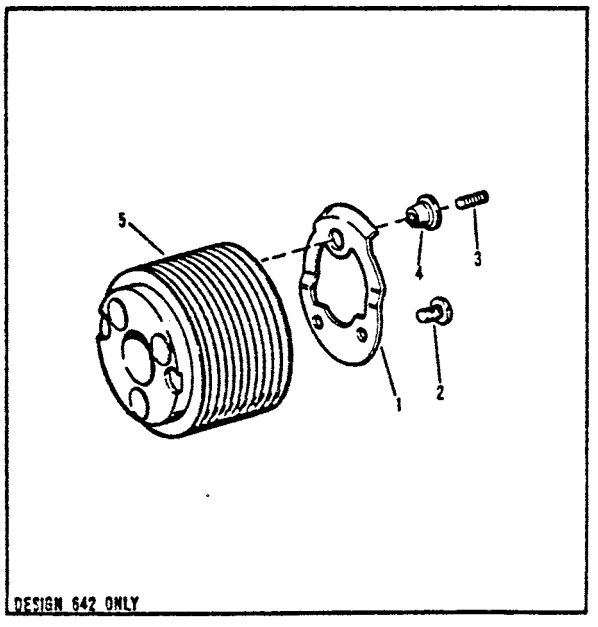


Figure 18. Worm Gear Assembly

Figure 15

SPROCKET GUARD ASSEMBLY

Key No.	Description	Part No. 641	Part No. 642
-	Sprocket Guard Assembly	011178	*
-	Sprocket Guard Assembly	011182	*
1	Ring, Retaining	17639	*
2	Stud, Shoulder	31460	*
3	Latch	31124	*
4	Stud, Detent	31165	*
5	Screw, Sprocket guard	31473	*
6	Guard, Sprocket	34762	*
7	Roller, Sprocket guard	34867	*
8	Spring	31435	*
9	Plate Assembly (for 011182 sprocket guard)	09722	*
10	Plate Assembly (for 011178 sprocket guard)	011177	*

Figure 16

APERTURE PLATE ASSEMBLY

-	Aperture Plate Assembly	026623	*
1	Screw, Guide rail	31978	*
2	Rail, Film guide	09872	*
3	Screw, Tension rail	31555	*
4	Cover, Spring retaining	34819	*
5	Washer, Spacing	10689	*
6	Rail, Film tension	09871	*
7	Spring, Side tension	31135	*
8	Plate, Aperture	026915	*

Figure 17

FIRE SHUTTER ASSEMBLY

-	Fire Shutter Assembly	09729
1	Spring, Extension	31143
2	Spring, Filter retainer	34823
3	Retainer, Heat filter glass	31153
4	Disc, Fire shutter	31407
5	Filter, Heat	200508
6	Bracket Assembly, Fire shutter	011282

Figure 18

WORM GEAR ASSEMBLY

-	Gear Assembly, Worm	09709
1	Retainer, Shuttle interlock	31081
2	Screw, Interlock retainer	30163
3	Setscrew	31083
4	Banc-Lok	31082
5	Gear, Worm	09784

* indicates that the part is used on both Models.

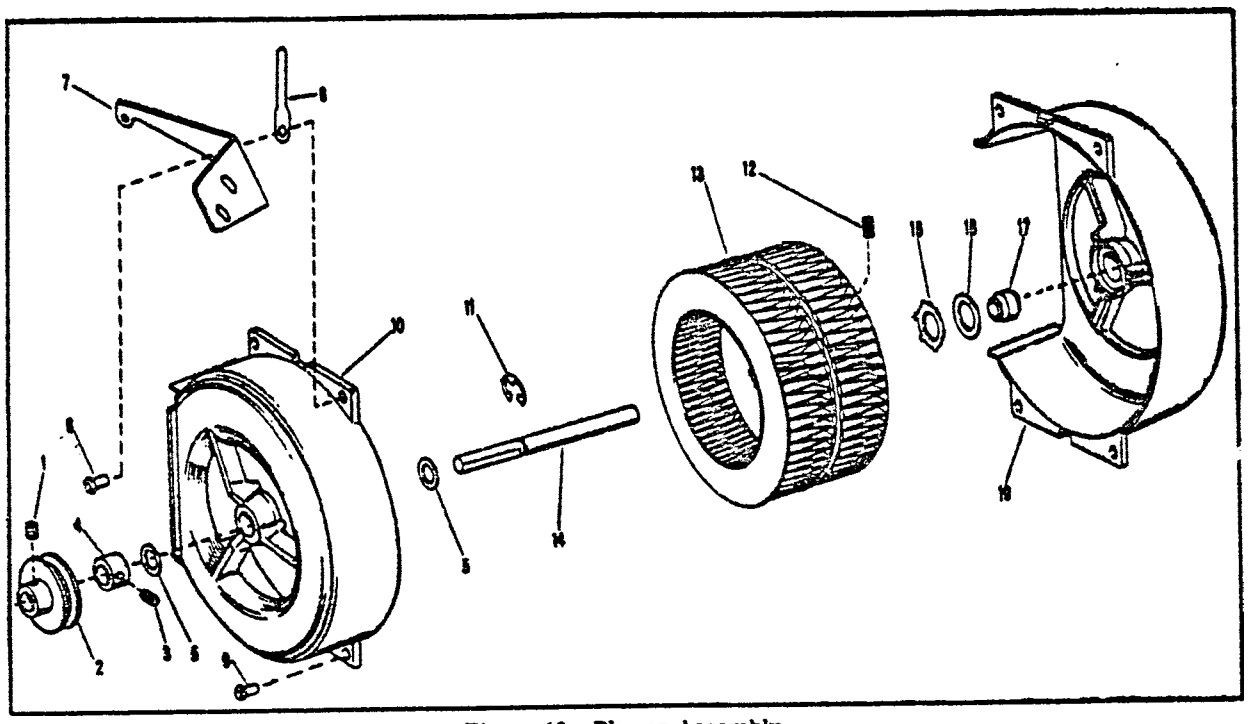


Figure 19. Blower Assembly

Figure 19

BLOWER ASSEMBLY

Key No.	Description	Part No. 641	Part No. 642
-	Blower Assembly	026892	*
1	Setscrew, Pulley	24084	*
2	Pulley, Blower	31586	*
3	Setscrew, Collar	56152	*
4	Collar, Spacing	82655	*
5	Washer, Bronze	31029	*
6	Rivet	27462	*
7	Bracket, Solenoid mounting	59257	*
8	Clamp, Leadwire	31585	*
9	Eyelet	31588	*
10	Housing, Blower fan	31948	*
11	Ring, Retaining	21736	*
12	Setscrew, Blower fan	24084	*
13	Wheel Assembly, Blower	09783	*
14	Shaft, Blower wheel	31590	*
15	Ring, Internal retaining	31589	*
16	Washer	33422	*
17	Bearing, Bronze	31587	*

* indicates that the part is used on both Models.

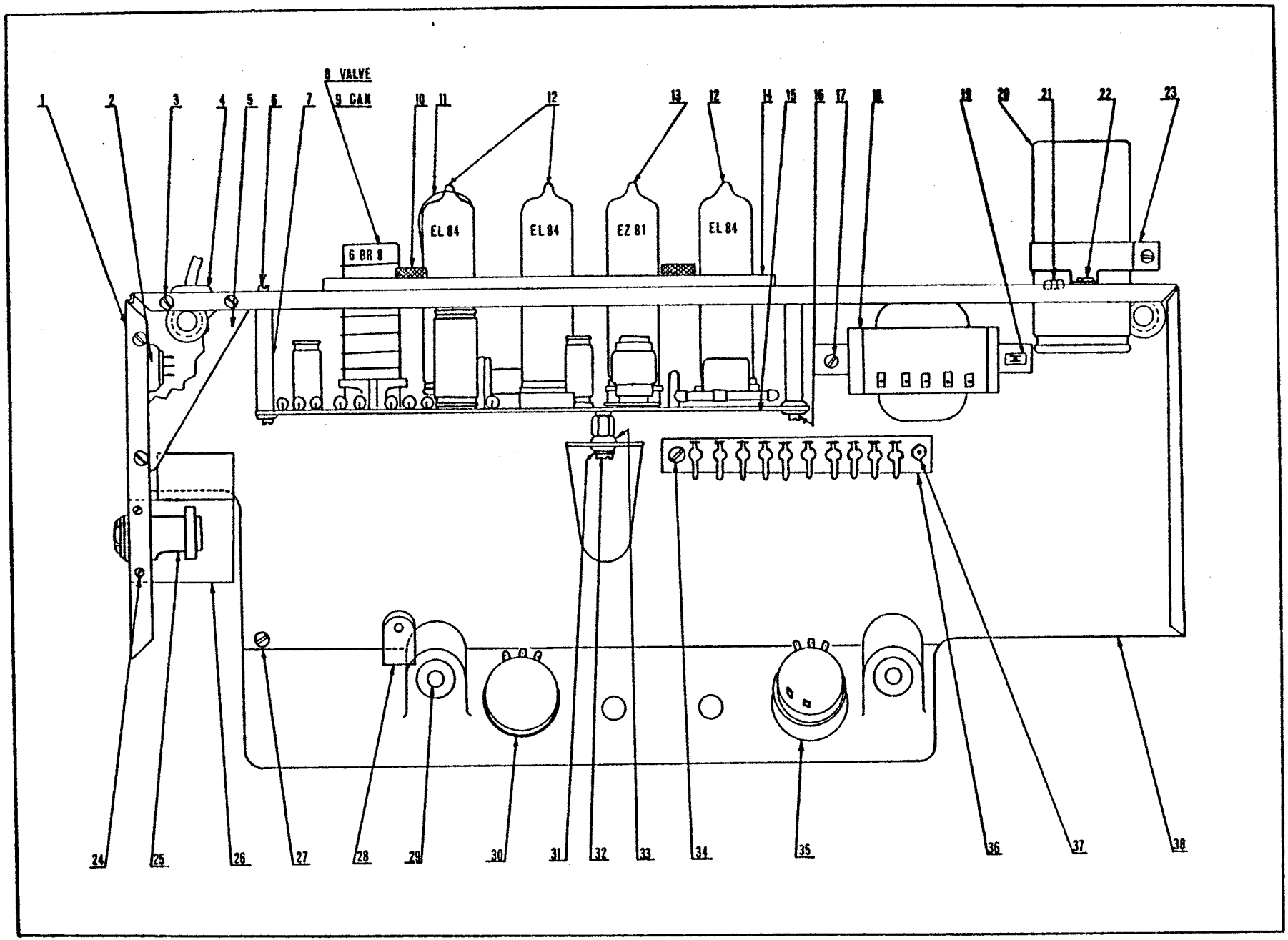
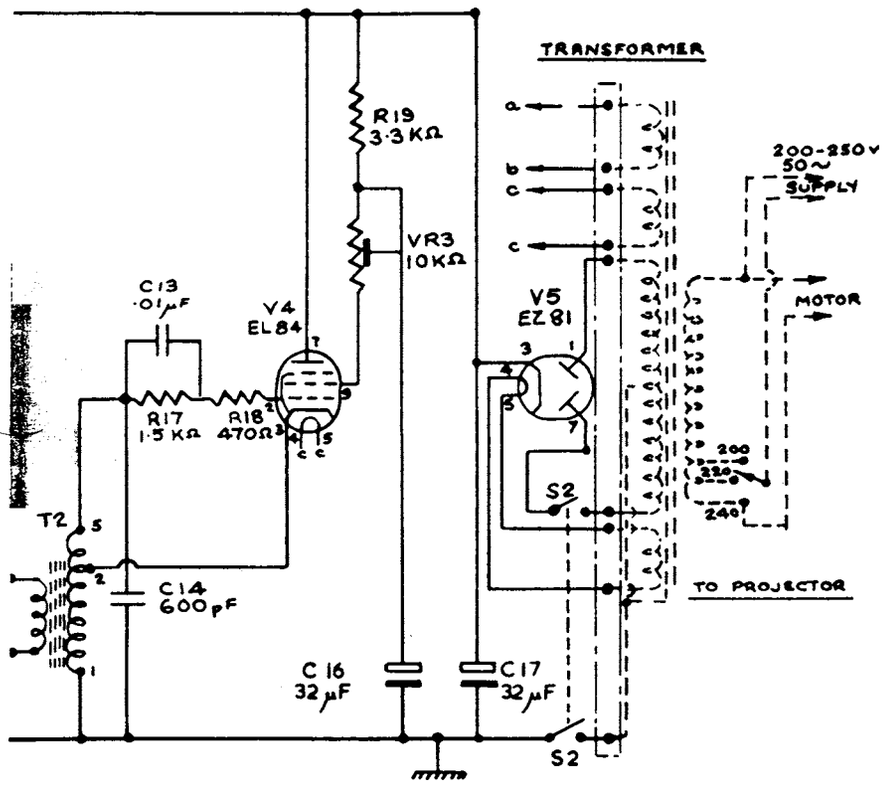


Figure 20. Design 641 Amplifier Assembly

Figure 20

641 AMPLIFIER ASSEMBLY

Key No.	Description	Part No.	Key No.	Description	Part No.
1	Nameplate, Side	58498	20	Condenser	58400
2	Socket, Speaker	58572	21	Grommet	58083
3	Screw, No. 4 x 3/16 Binder Head	56313	22	Screw, 'Self Tap'	56410
4	Grommet, (G.10)	58467	23	Clip, Condenser	58520
5	Chassis Support	59039	24	Screw, No. 4 x 3/16 Binder Head	56313
6	Screw, 4-40 Fillister Head	58470	25	Input Socket	58203
7	Support, Circuit Board	58465	26	Screen, Input Socket	58730
8	Valve, (6.B.R.8)	58446	27	Screw, 'Self Tap'	56410
9	Screening Can	56323	28	Cable Clamp	58670
10	Screw, 4-40 Knurled	58582	29	Grommet, (G.10)	58467
11	Clip, Valve Retaining	56353	30	Potentiometer	58447
12	Valve, (E.L.84)	54381	31	Washer, 3 B.A.	22659
13	Valve, (E.Z.81)	58445	32	Screw, 4-40 Shoulder	58472
14	Valve Support	58460	33	Grommet, (G.14)	19256
15	Circuit Board Assembly	026622	34	Screw, 4-40 B.H.	82982
16	Screw, Shoulder	58731	35	Potentiometer (Switch)	58449
17	Screw, 6 B.A. Ch.Hd.	56310	36	Tag Strip	58768
18	Output Transformer	026646	37	Nut, 4-40 "Oddie"	58529
19	Speed Nut	56400	38	Amplifier Chassis	026645



026641 AMPLIFIER FOR DESIGN 641

t Diagram

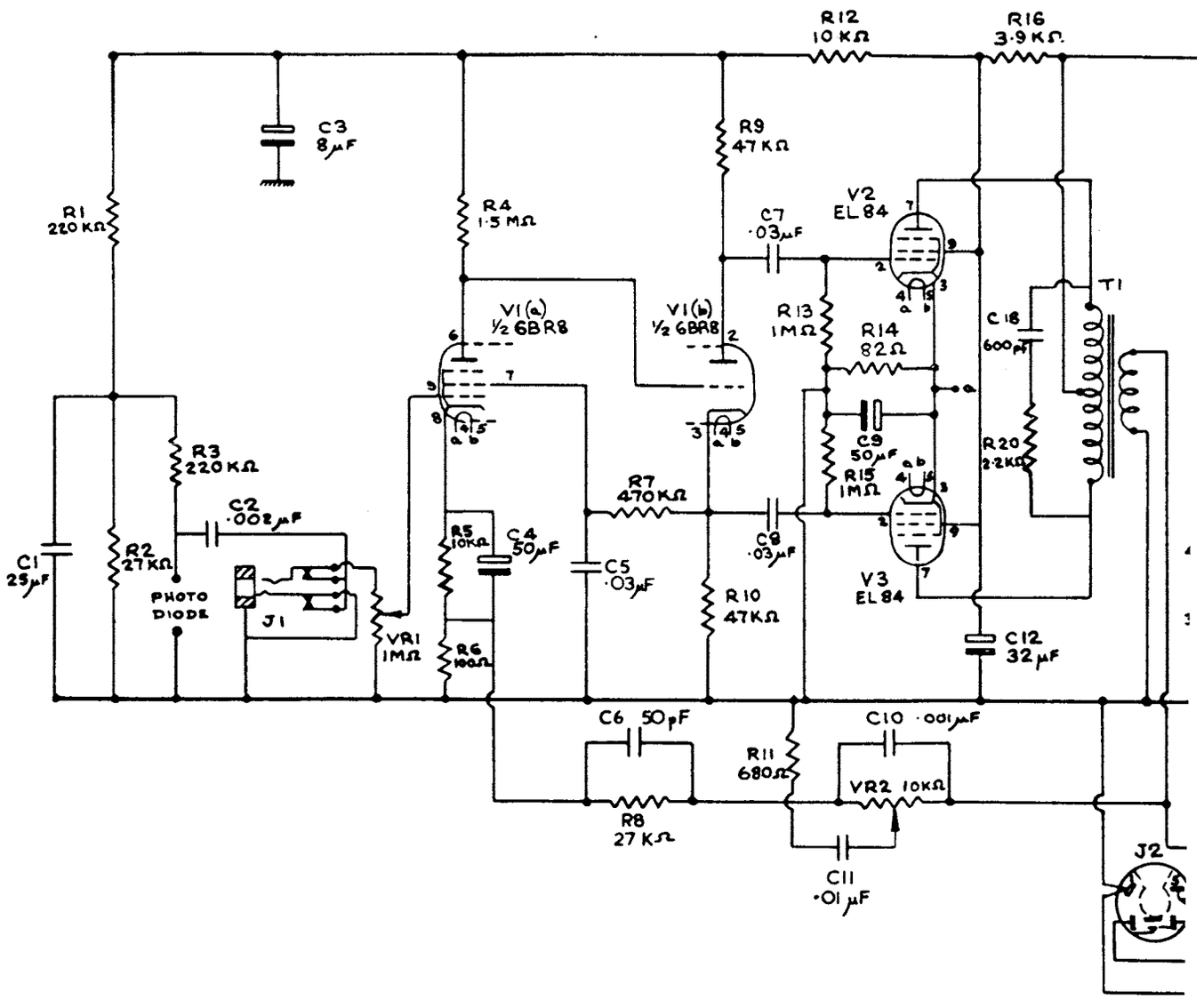


Figure 21. Design 641 Amplifier - Theoretical Circu

Figure 21

641 AMPLIFIER ASSEMBLY

Circuit Ref.	Description		Part No.
R1	Resistor	220 K ohm ± 10%	58481
R2	"	27 K ohm " 10%	58386
R3	"	220 K ohm " 10%	58481
R4	"	1.5 M ohm " 10%	58482
R5	"	10 K ohm " 20%	58483
R6	"	100 ohm " 10%	58387
R7	"	470 K ohm " 20%	58485
R8	"	27 K ohm " 10%	58386
R9	"	47 K ohm " 10%	58486
R10	"	47 K ohm " 10%	58486
R11	"	680 K ohm " 20%	58484
R12	"	10 K ohm " 20%	58483
R13	"	1 M ohm " 20%	58487
R14	"	82 ohm " 10%	58388
R15	"	1 M ohm " 20%	58487
R16	"	3.9 K ohm	58398
R17	"	1.5 K ohm ± 10%	58389
R18	"	470 ohm " 10%	58390
R19	"	3.3 K ohm	58399
R20	"	2.2 K ohm ± 20%	56378
VR1	Potentiometer	1 M ohm	58447
VR2	Potentiometer, Switch	10 K ohm	58449
VR3	Resistor	10 K ohm Pre-set	58587
C1	Condenser	.25 mfd	56374
C2	"	.002 mfd	58391
C3	"	8 mfd	58394
C4	"	50 mfd	58395
C5	"	.03 mfd	56343
C6	"	50 pf	58396
C7	"	.03 mfd	56343
C8	"	.03 mfd	56343
C9	"	50 mfd	58395
C10	"	.001 mfd	56496
C11	"	.01 mfd	57376
C12	"	32 mfd (Part of C16/17)	
C13	"	.01 mfd	56408
C14	"	600 pf	58397
C16	"	32 mfd }	58400
C17	"	32 mfd }	
C18	"	600 pf	58397
V1	Valve	6 B.R.8	58446
V2	Valve	E.L.84	54381
V3	Valve	E.L.84	54381
V4	Valve	E.L.84	54381
V5	Valve	E.Z.81	58445
T1	Output Transformer		026646
T2	Oscillator Transformer		026638
S2	D.P.S.T. Switch	See V.R.2.	
J1	Input Socket		58203
J2	Speaker Socket		58572

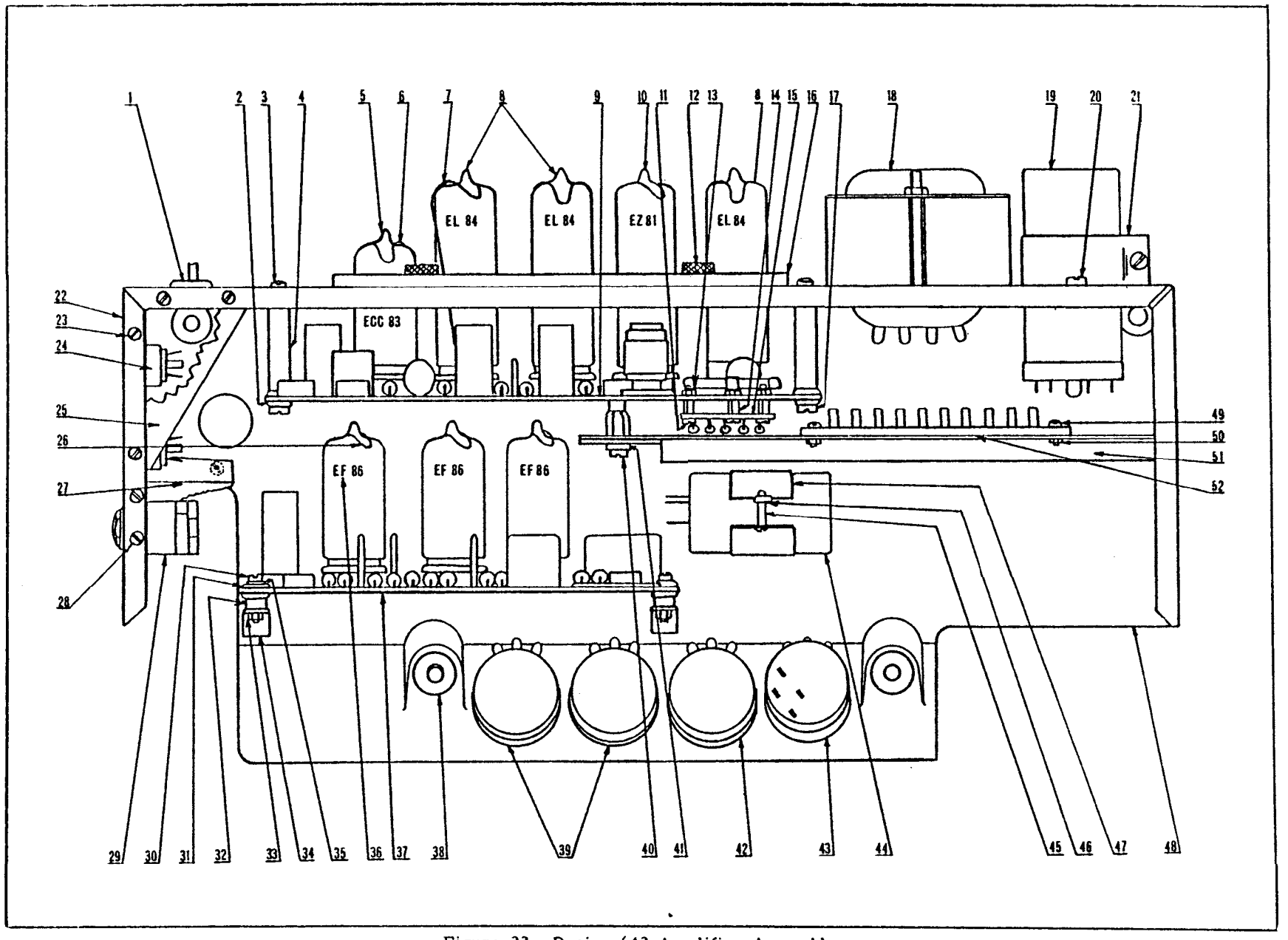
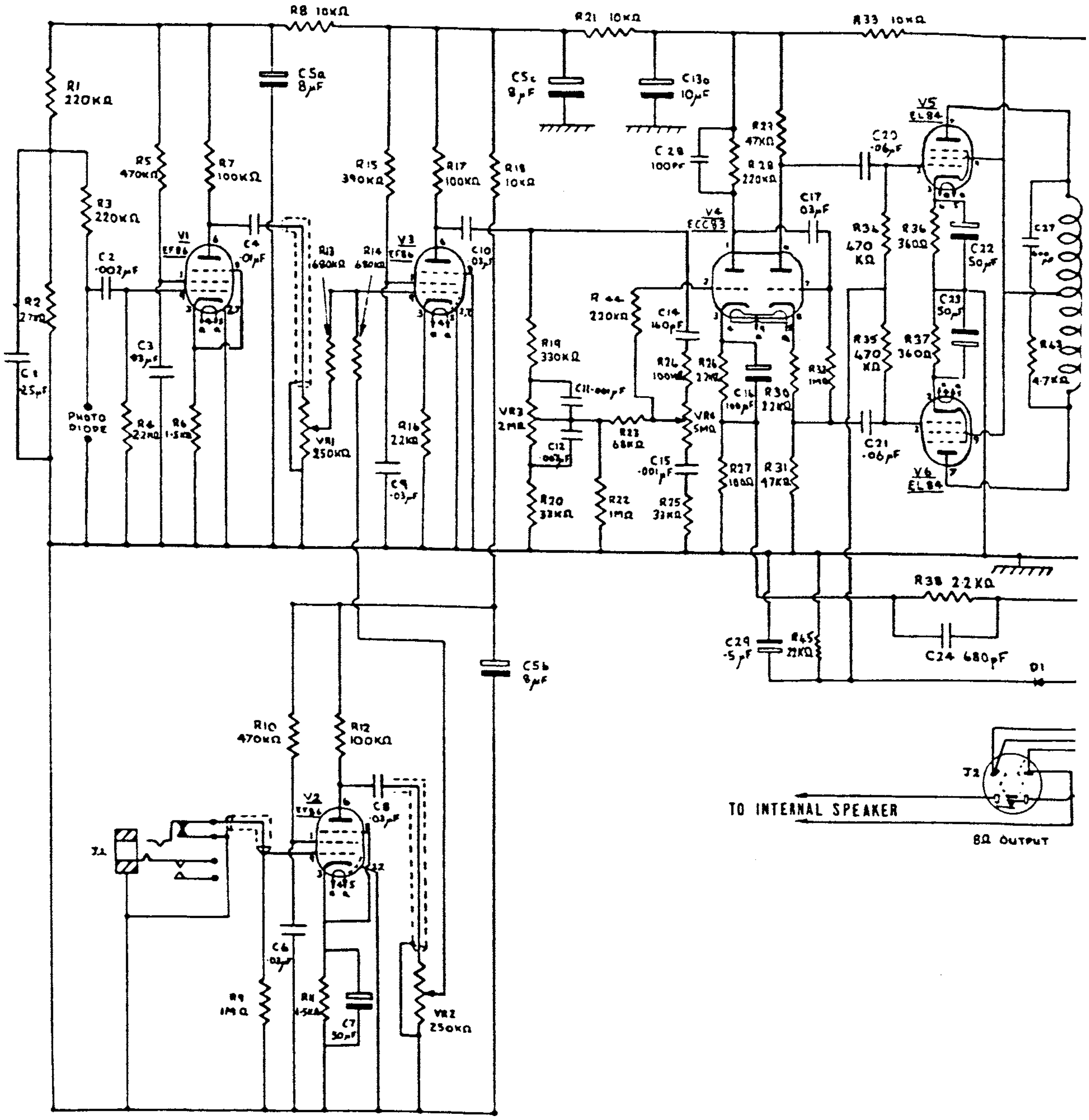


Figure 22. Design 642 Amplifier Assembly

Figure 22

642 AMPLIFIER ASSEMBLY

Key No.	Description	Part No.
1	Grommet, (G.10)	58467
2	Grommet	58732
3	Screw, 4-40 Fillister Head	58470
4	Support, Output Board	58733
5	Valve, E.C.C. 83	56320
6	Clip, Valve Retaining	56375
7	Clip, Valve Retaining	56353
8	Valve, (E.L.84)	54381
9	Output Board Assembly	026739
10	Valve, (E.Z.81)	58445
11	Screw	34812
12	Screw, 4-40 Knurled	58582
13	Nut, 4-40 "Oddie"	58529
14	Support	58283
15	Board Assembly	026903
16	Valve Support	58460
17	Shoulder Screw	58731
18	Output Transformer Assembly	026702
19	Condenser	58744
20	Screw, 'Self Tap'	56410
21	Clip, Condenser	58520
22	Nameplate	58777
23	Screw, No. 4 x 3/16 Binder Head	56313
24	Socket, Speaker	58572
25	Chassis Support	59039
26	Clip, Valve Retaining	56375
27	Screen, Input Socket	58730
28	Screw, No. 4 x 3/16 Binder Head	56313
29	Input Socket	58203
30	Screw, 4-40 Fillister Head	82968
31	Grommet	58732
32	Spacer	58740
33	Nut, 4-40 "Oddie"	58529
34	Bracket	58741
35	Washer	52470
36	Valve, (E.F.86)	56321
37	Input Board Assembly	026738
38	Grommet, (G.10)	58467
39	Potentiometer	58765
40	Screw, 4-40 Shoulder	58472
41	Grommet, (G.14)	19256
42	Potentiometer	58766
43	Potentiometer	58767
44	Condenser	58745
45	Screw, 4 x 5/8 Binder Head	56420
46	Nut, Speed	56414
47	Clip, Condenser	56422
48	Amplifier Chassis	026740
49	Screw, 4-40 Binder Head	82982
50	Nut, 4-40 "Oddie"	58529
51	Screen	58743
52	Tag Strip	58768

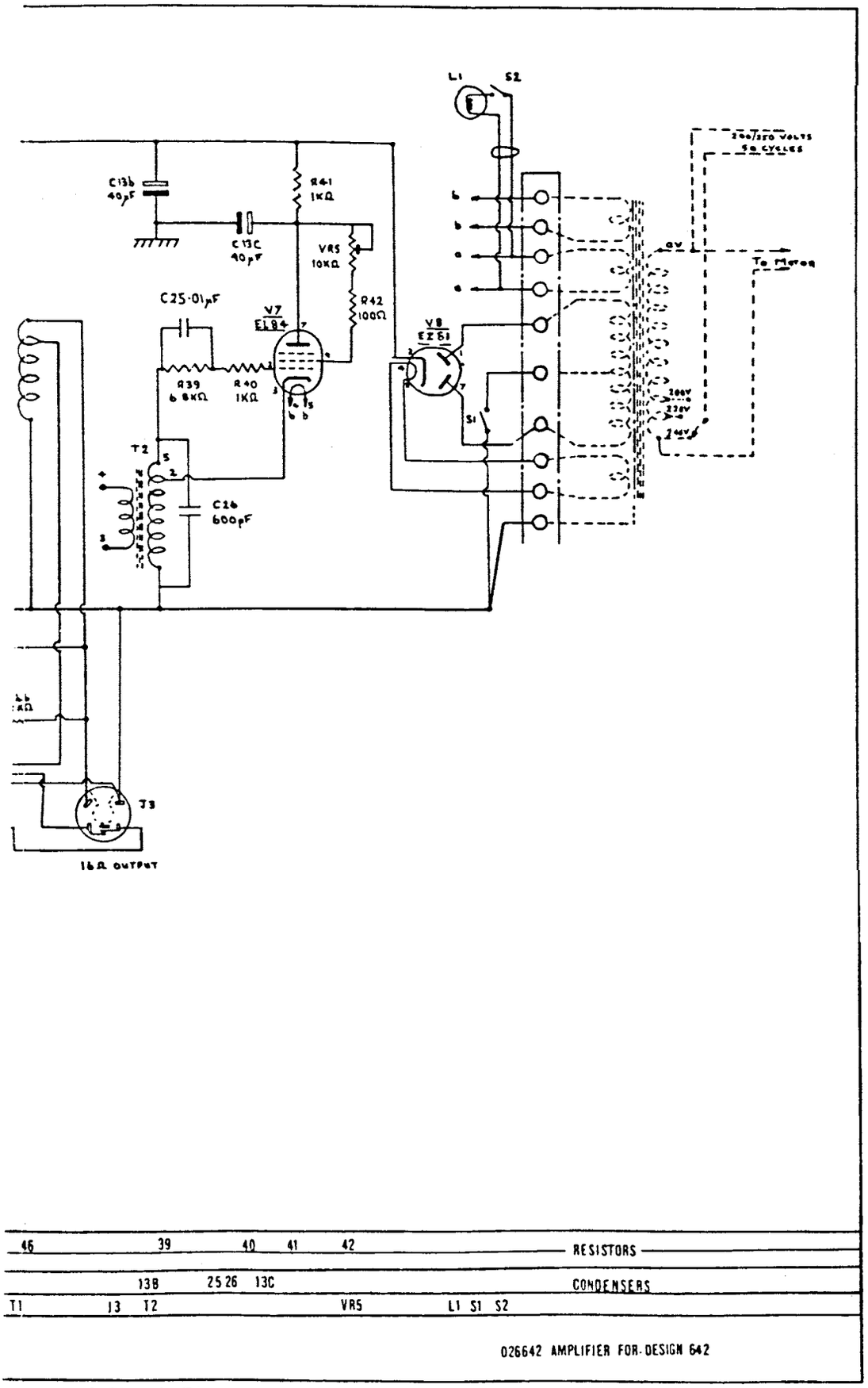


R 1 2 3 4 5 6 7 9 8 10 13 11 12 14 15 16 17 18 19 20 21 22 23 44 24 25 26 27 28 29 30 31 45 32 33 34 35 36 37 38 43

C 1 2 3 4 5A 6 8 9 10 5B 5C 11 12 13A 14 15 28 16 29 17 20 21 24 22 23 27

J1 VR1 VR2 VR3 VR4 J2 D1

Figure 23. Design 642 Amplifier - T



46	39	40	41	42	RESISTORS	
13B	25 26	13C			CONDENSERS	
T1	13	T2	VR5	L1 S1 S2		

026642 AMPLIFIER FOR DESIGN 642

heoretical Circuit Diagram

Figure 23

642 AMPLIFIER ASSEMBLY

Circuit Ref.		Description	Part No.	Circuit Ref.
R1	Resistor	220 K ohm ± 10%	58481	VR3
R2	"	27 K ohm " 10%	58386	VR4
R3	"	220 K ohm " 5%	58750	VR5
R4	"	2.2 M ohm " 20%	56417	C1
R5	"	470 K ohm " 5%	58752	C2
R6	"	1.5 K ohm " 20%	56492	C3
R7	"	100 K ohm " 5%	58753	C4
R8	"	10 K ohm " 20%	58483	C5
R9	"	1 M ohm " 20%	56380	C6
R10	"	470 K ohm " 5%	58752	C7
R11	"	1.5 K ohm " 20%	56492	C8
R12	"	100 K ohm " 5%	58753	C9
R13	"	680 K ohm " 20%	58759	C10
R14	"	680 K ohm " 20%	58759	C11
R15	"	390 K ohm " 10%	58760	C12
R16	"	2.2 K ohm " 20%	56378	C13
R17	"	100 K ohm " 20%	56386	C14
R18	"	10 K ohm " 20%	58483	C15
R19	"	330 K ohm " 10%	58755	C16
R20	"	33 K ohm " 10%	58756	C17
R21	"	10 K ohm " 20%	58483	C20
R22	"	1 M ohm " 10%	56391	C21
R23	"	68 K ohm " 10%	58757	C22
R24	"	100 K ohm " 10%	56397	C23
R25	"	33 K ohm " 10%	58756	C24
R26	"	2.2 K ohm " 20%	56378	C25
R27	"	100 ohm " 10%	58387	C26
R28	"	220 K ohm " 20%	56379	C27
R29	"	47 K ohm " 20%	56337	C28
R30	"	2.2 K ohm " 20%	56378	C29
R31	"	47 K ohm " 20%	56337	D1
R32	"	1 M ohm " 20%	56380	V1
R33	"	10 K ohm " 20%	58754	V2
R34	"	470 K ohm " 20%	59284	V3
R35	"	470 K ohm " 20%	59284	V4
R36	"	360 ohm " 5%	58763	V5
R37	"	360 ohm " 5%	58763	V6
R38	"	2.2 K ohm " 10%	56431	V7
R39	"	6.8 K ohm " 10%	58761	V8
R40	"	1 K ohm " 10%	58758	T1
R41	"	1 K ohm	58764	T2
R42	"	100 ohm ± 20%	58762	S1
R43	"	4.7 K ohm " 10%	58939	J1
R44	"	220 K ohm " 20%	56379	J2
R45	"	22 K ohm " 10%	57402	J3
R46	"	10 K ohm " 10%	59285	
VR1	Potentiometer	250 K ohm	58765	
VR2	Potentiometer	250 K ohm	58765	

Description		Part No.
Potentiometer, Switch	2 M ohm	58767
Potentiometer	5 M ohm	58766
Resistor (Pre-set)	10 K ohm	58587
Condenser	.25 mfd	56374
"	.002 mfd	58391
"	.03 mfd	56343
"	.01 mfd	56408
"	8+8+8 mfd	58745
"	.03 mfd	56343
"	50 mfd	58395
"	.03 mfd	56343
"	.03 mfd	56343
"	.03 mfd	56343
"	.001 mfd	56496
"	.007 mfd	58749
"	40+40+10 mfd	58744
"	160 pf	58748
"	.001 mfd	56496
"	100 mfd	58746
"	.03 mfd	56343
"	2x .03 mfd	56343
"	2x .03 mfd	56343
"	50 mfd	58747
"	50 mfd	58747
"	680 pf	56370
"	.01 mfd	56408
"	600 pf	58397
"	600 pf	58397
"	100 pf	56344
"	.5 mfd	59286
Diode		59282
Valve	E.F.86	56321
Valve	E.F.86	56321
Valve	E.F.86	56321
Valve	E.C.C.83	56320
Valve	E.L.84	54381
Valve	E.L.84	54381
Valve	E.L.84	54381
Valve	E.Z.81	58445
Output Transformer		026702
Oscillator Transformer		026638
On/off Switch (See VR3)		
Input Socket		58203
Speaker Socket		58572
Speaker Socket		58572

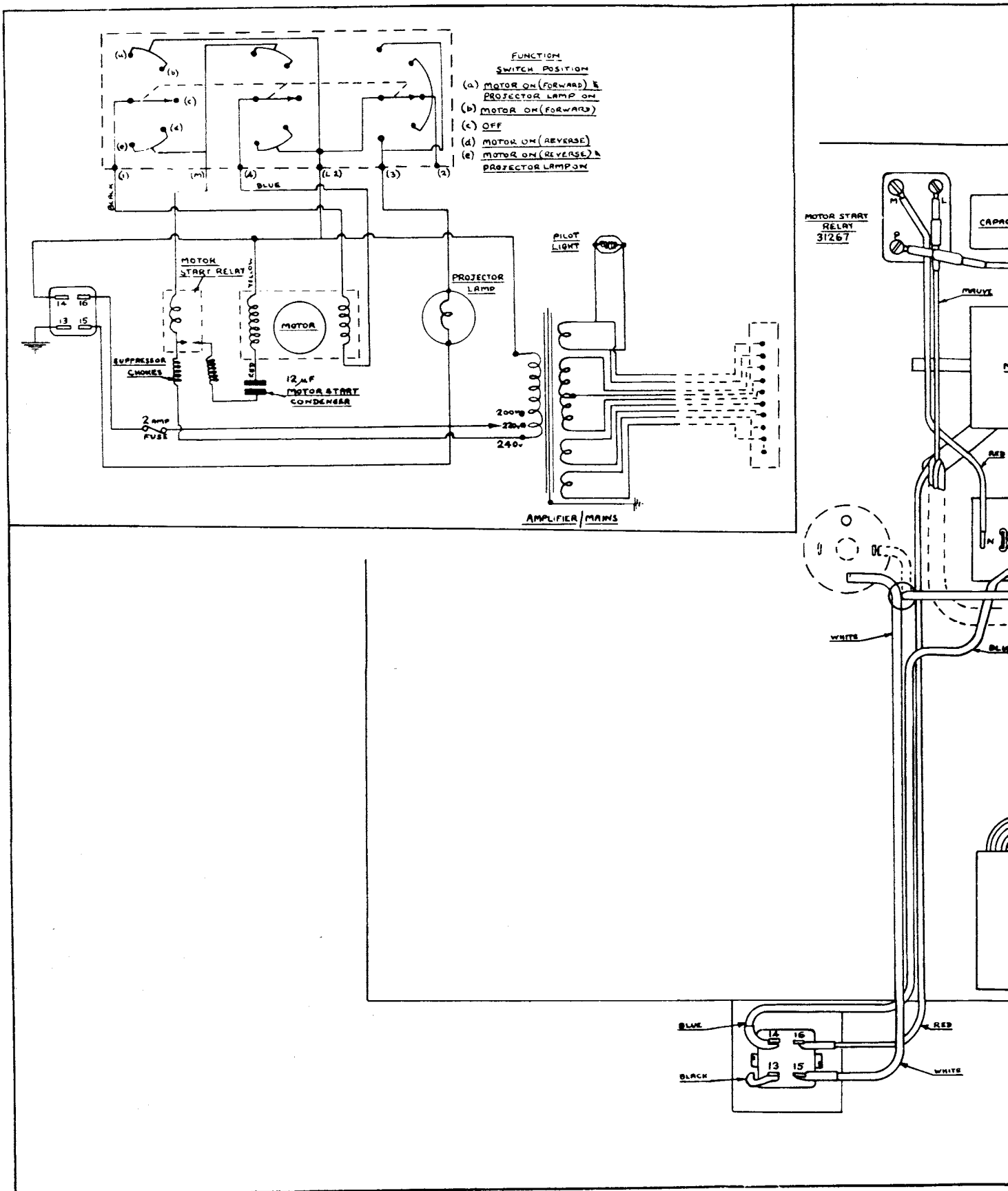
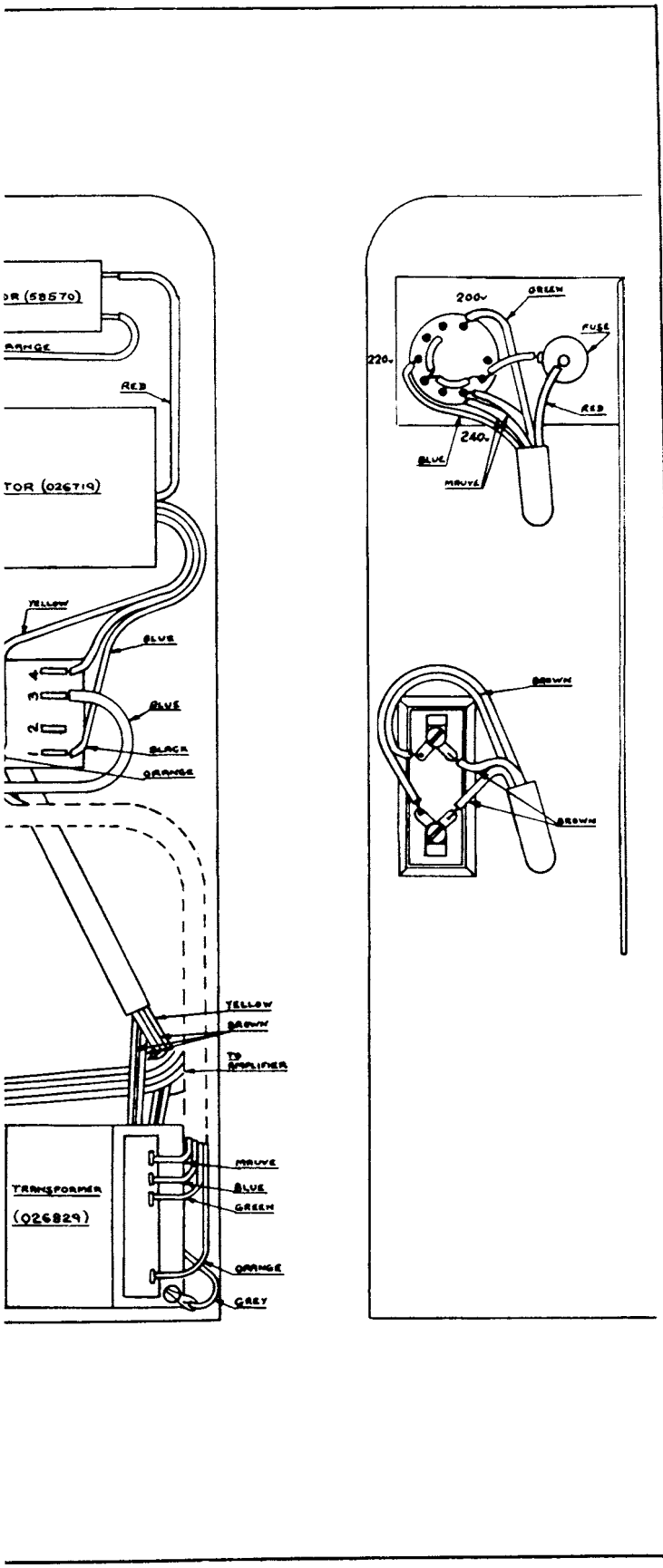


Figure 24. Design 641 Projector - Schematic Wiring Diag


OR (58570)
ORANGE
RED
TOR (026719)
YELLOW
BLUE
BLUE
BLACK
ORANGE
YELLOW
BROWN
TO AMPLIFIER
TRANSFORMER
(026829)
MAUVE
BLUE
GREEN
ORANGE
GREY
200v
GREEN
FUSE
220v
RED
240v
BLUE
MAUVE
BROWN
BROWN

am

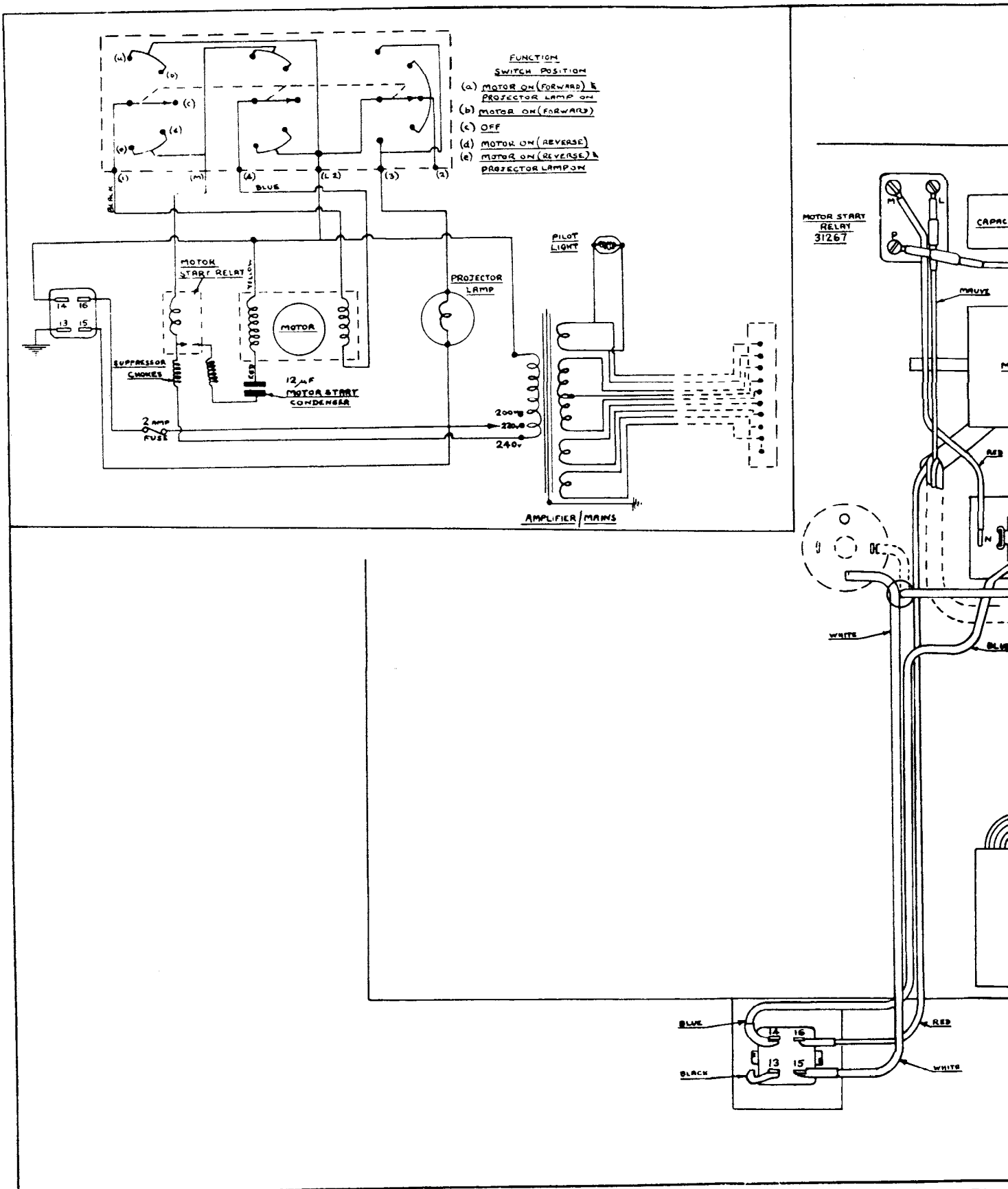


Figure 24. Design 641 Projector - Schematic Wiring Diag

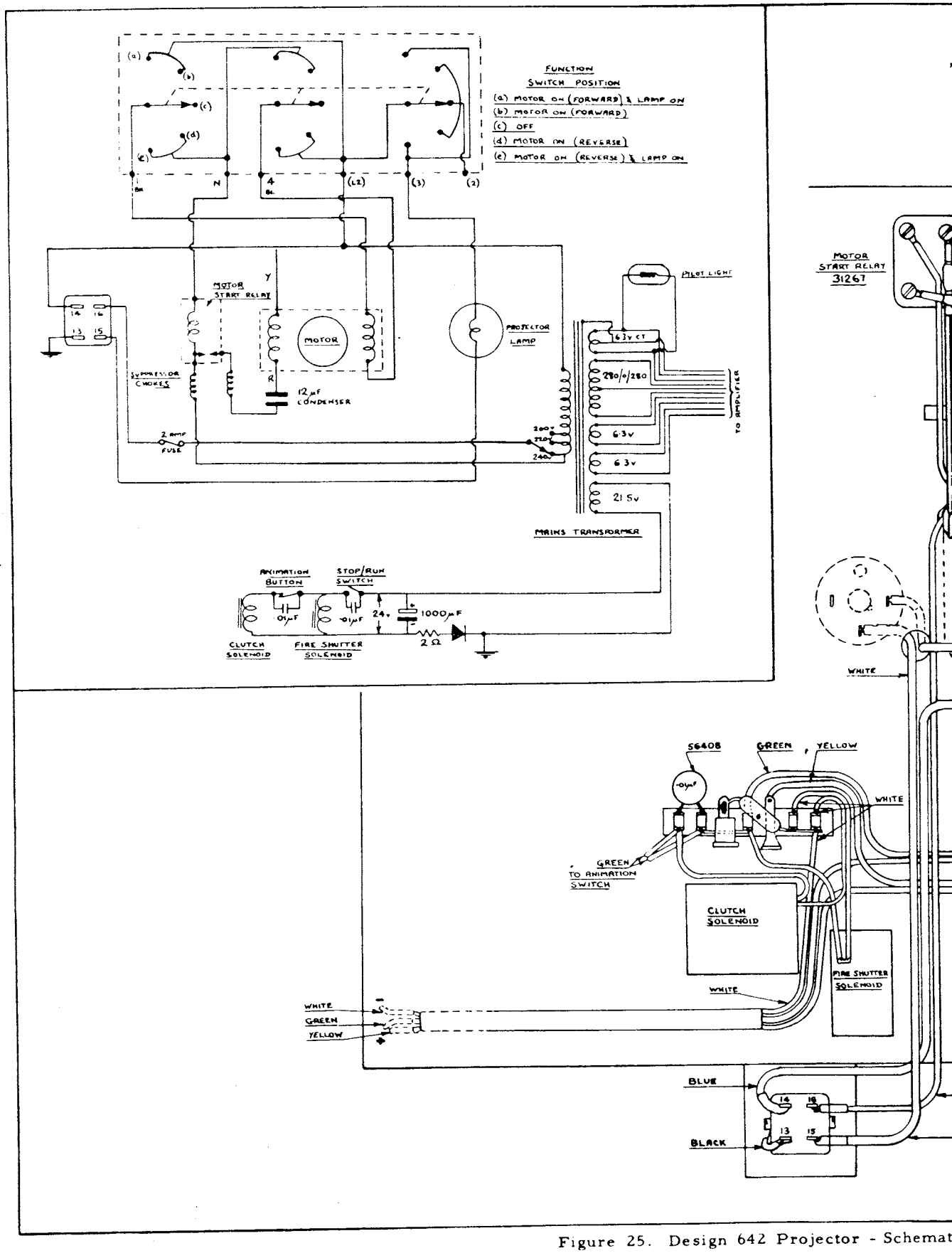
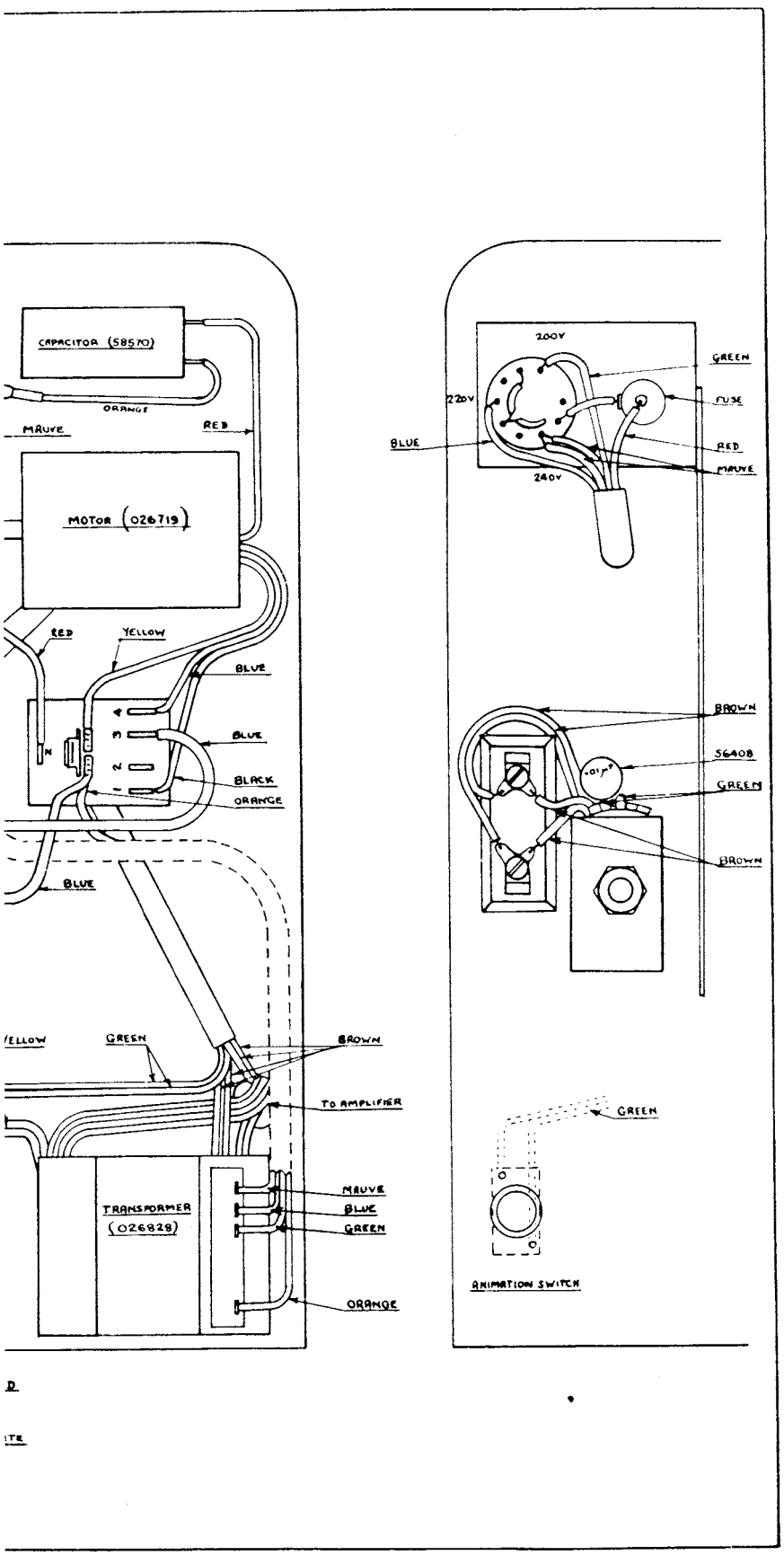


Figure 25. Design 642 Projector - Schemat



Wiring Diagram

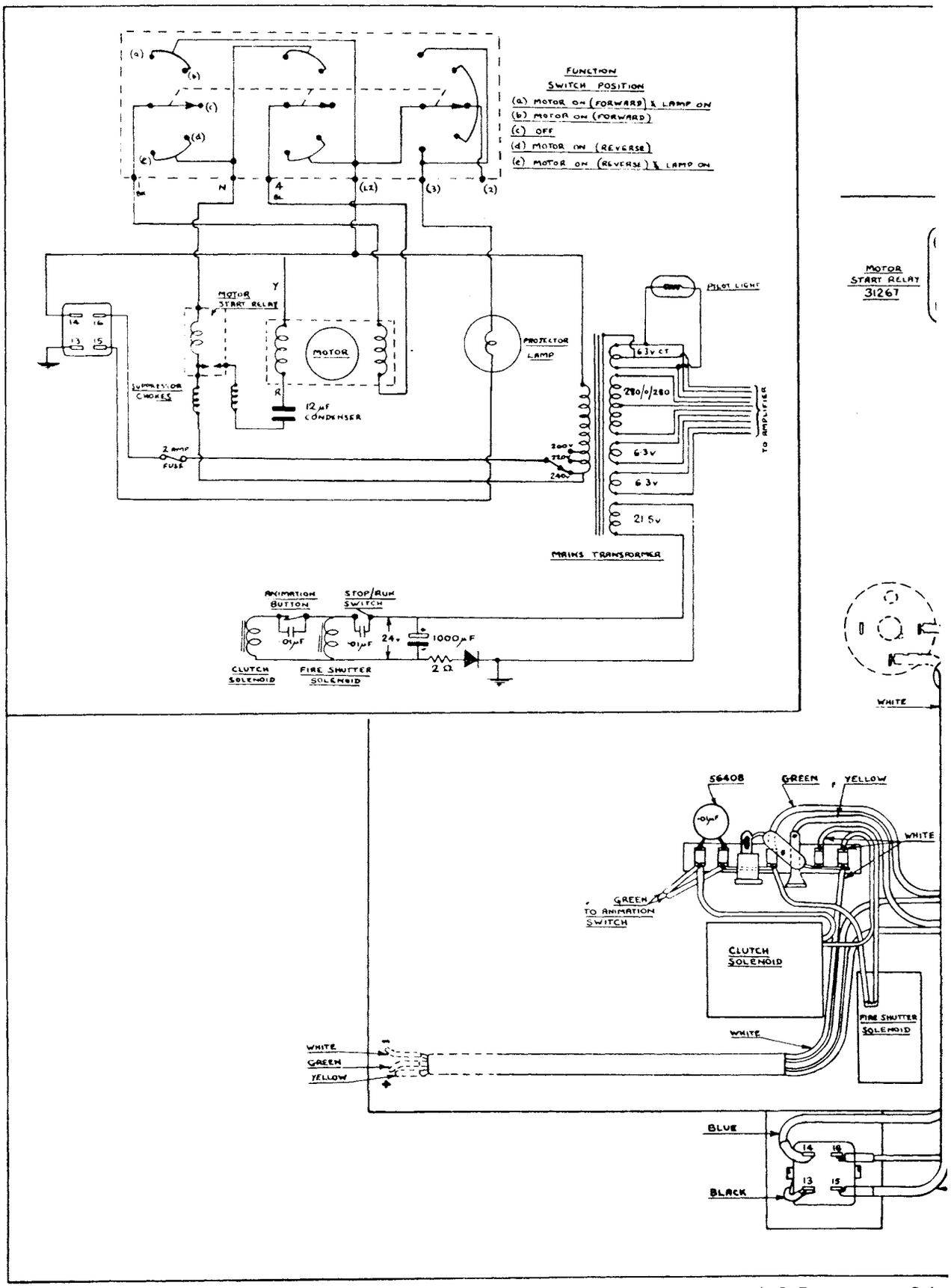


Figure 25. Design 642 Projector - Sche

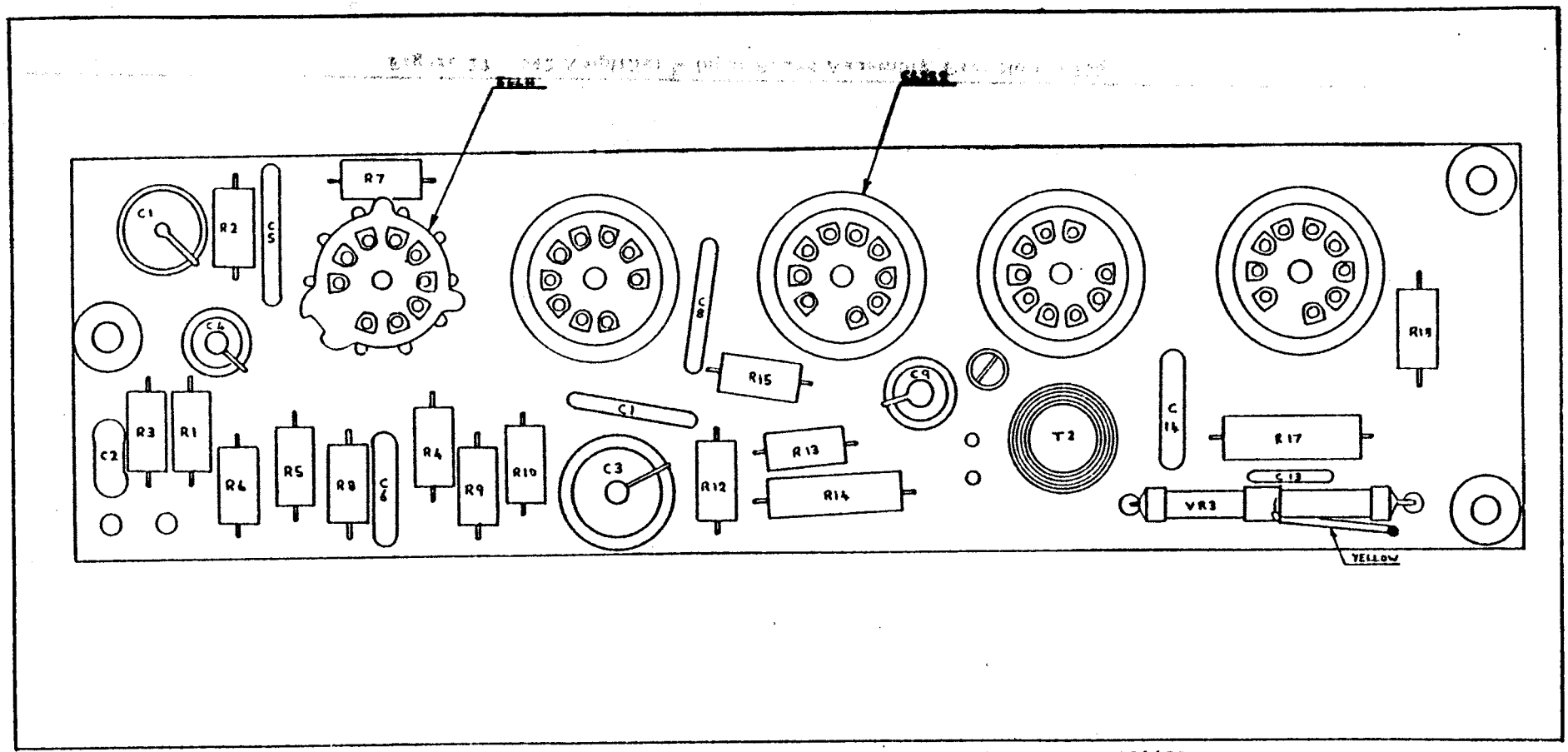


Figure 26. 641 Amplifier - Circuit Board Assembly Part No. 026622

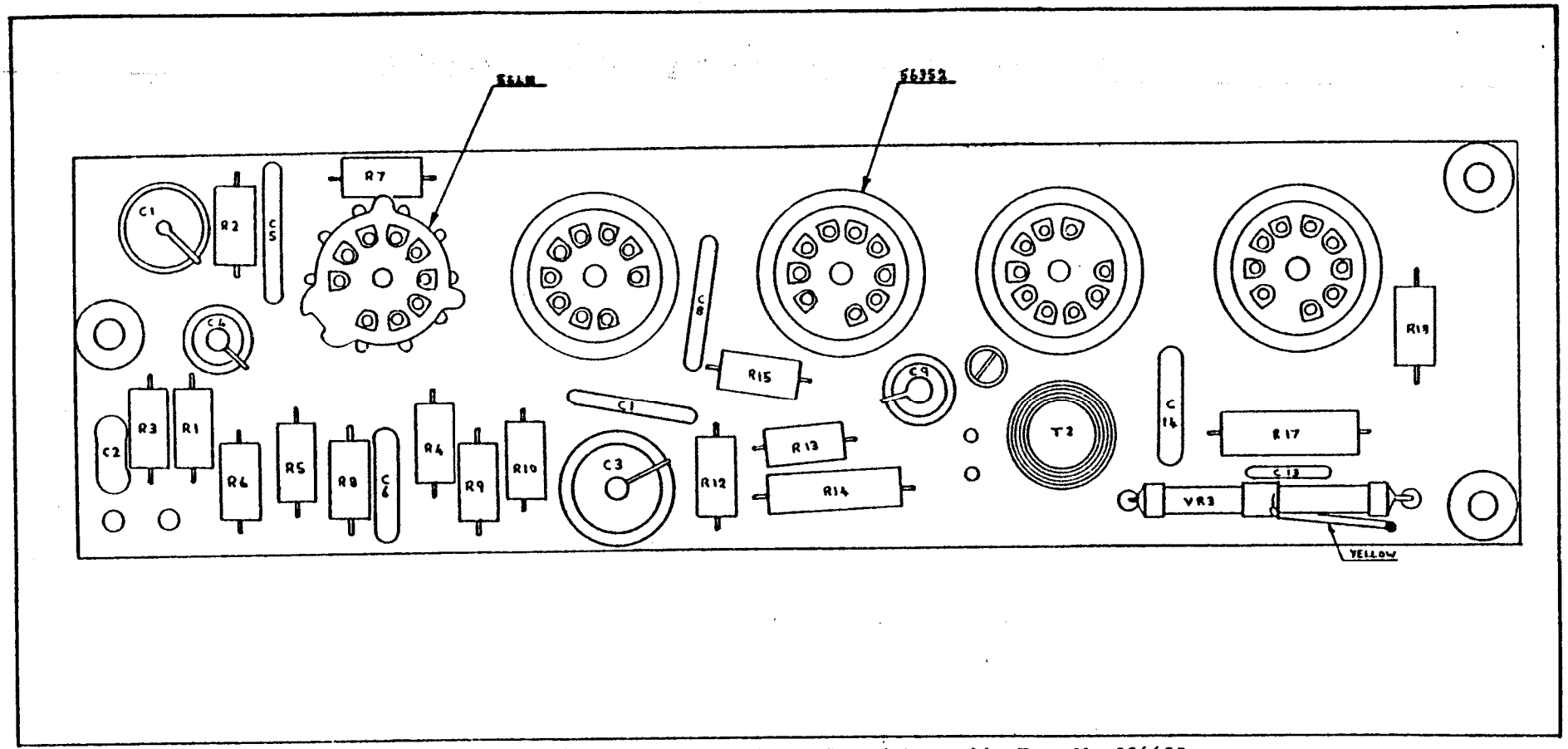


Figure 26. 641 Amplifier - Circuit Board Assembly Part No. 026622

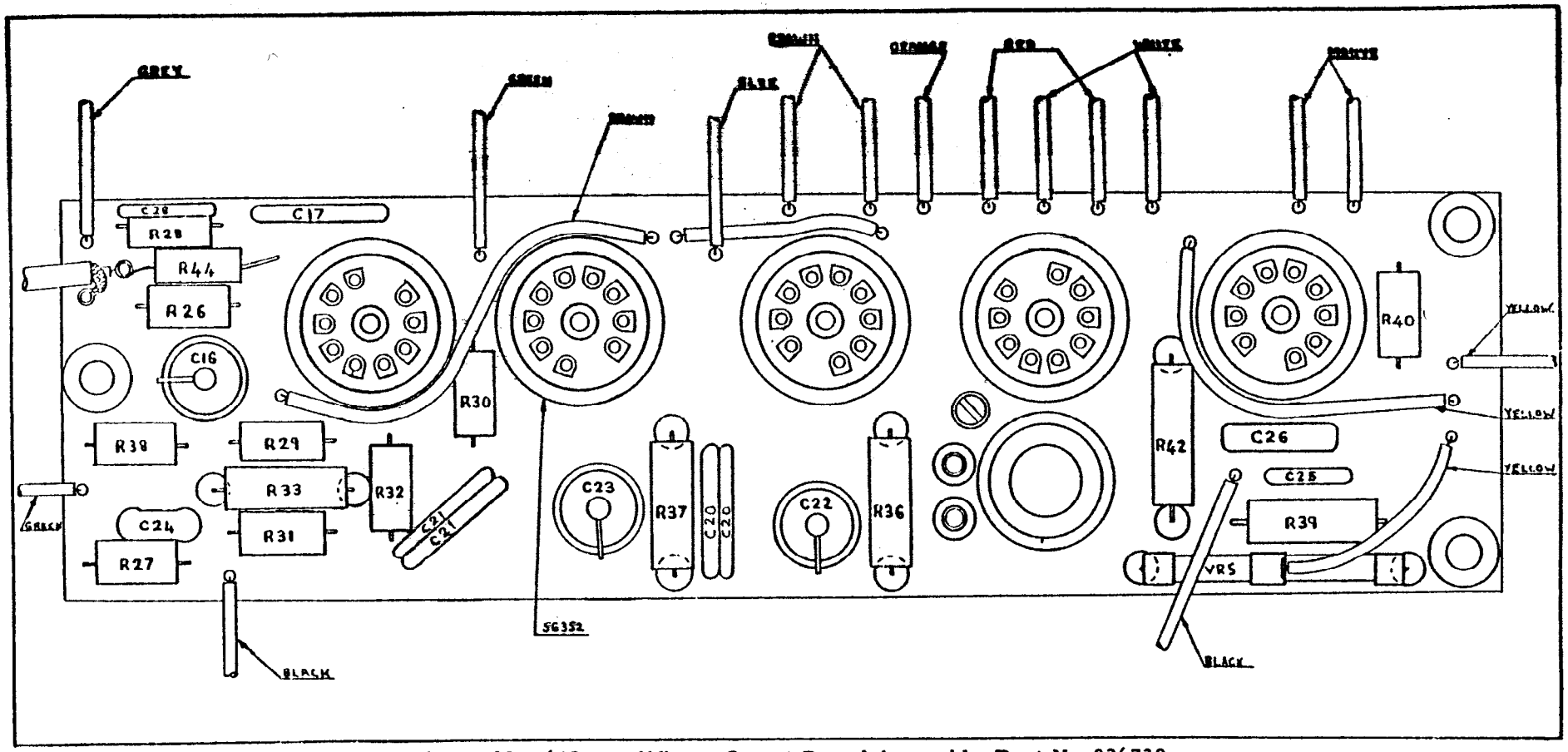


Figure 28. 642 Amplifier - Output Board Assembly Part No. 026739

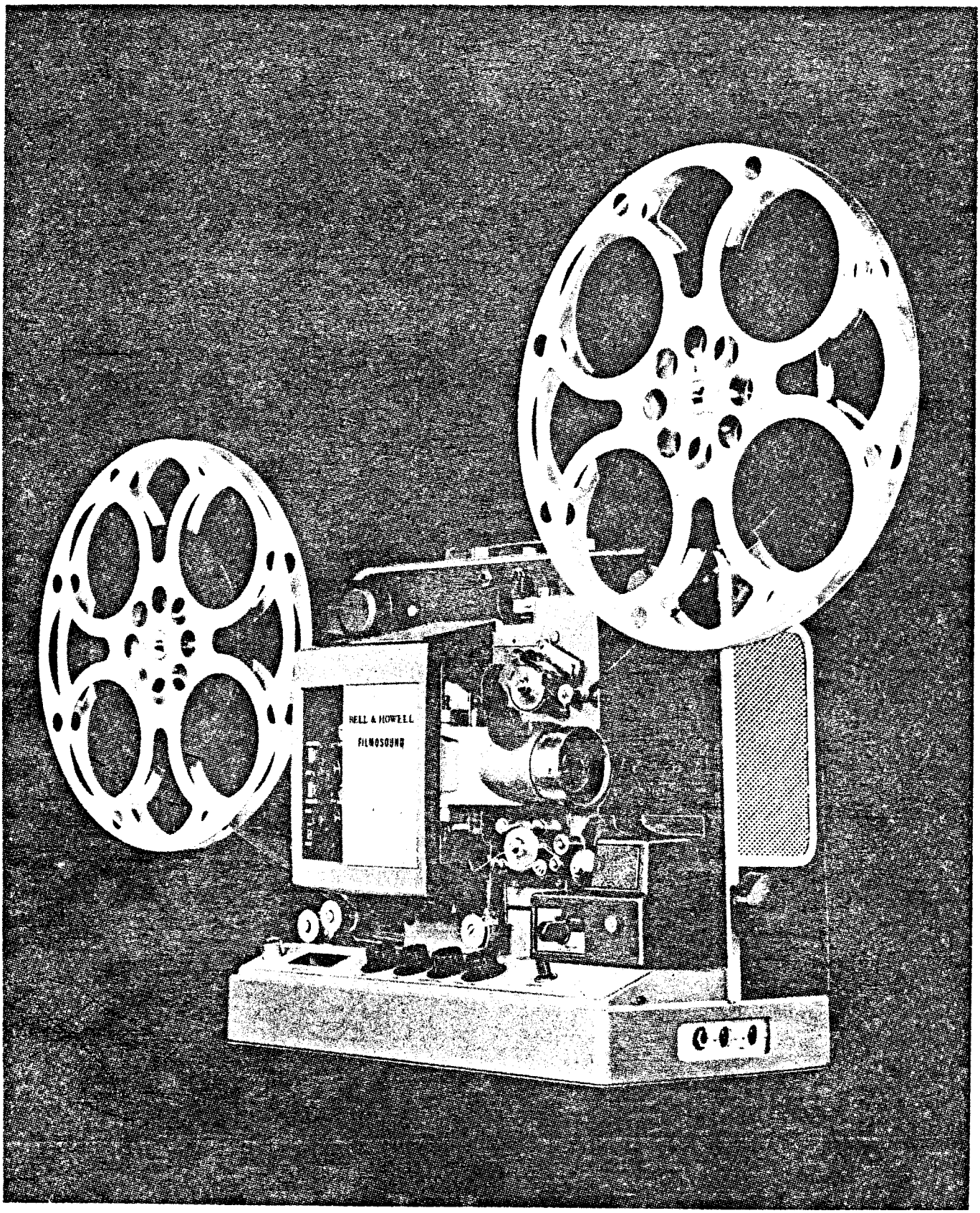
· 48A

BELL & HOWELL

DESIGNS 643 and 644

Filmosound
16 mm Projectors

SUPPLEMENTARY SERVICE INFORMATION



Model 644 Filmosound Projector

GENERAL INFORMATION

Designs 643 and 644 differ from the design 642 only in respect of the additional components and circuitry which provide facilities for the use of magnetic sound tracks.

The following information, therefore, deals only briefly with certain phases of the disassembly procedure, and further adjustments which may be found necessary during or after re-assembly. For basic instructions the service engineer is referred to the standard Filmosound service manual dealing with the 642 projector.

No attempt has been made to describe the re-assembly procedure since this is a logical reversal of the sequence of disassembly indicated in the attached illustrations, and is similar in most respects to the procedure laid down for the design 642 projector.

Theoretical and schematic diagrams of the 644 amplifier are provided, and, for design 643, the 642 circuit diagram should be studied in conjunction with the pre-amplifier circuit which is common to both models.

BELL & HOWELL

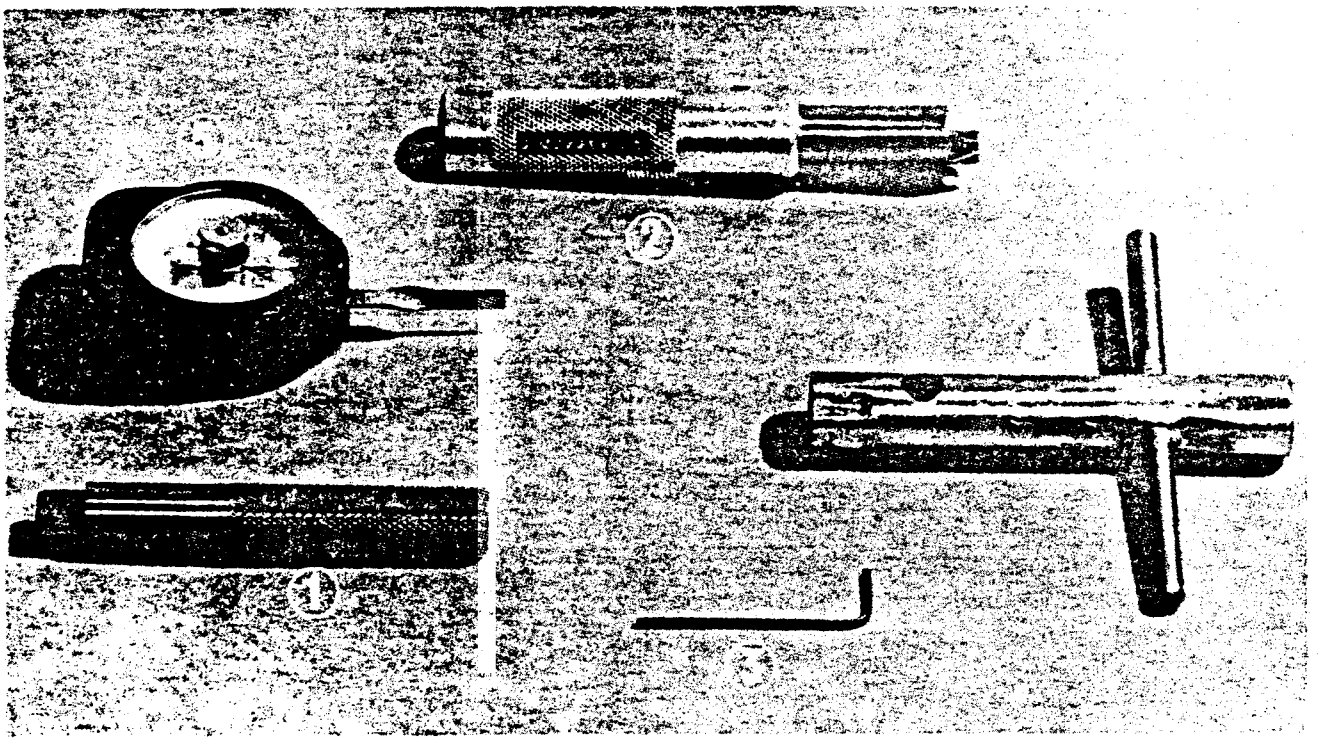
Filmosound 16 mm Projectors

DESIGNS 643 and 644

SERVICE INSTRUCTIONS

SECTION 7

SPECIAL SERVICE TOOLS, MAGNETIC FAULT FINDING GUIDE



Special Service Tools

In addition to the tools listed at the front of the Filmosound service manual, the following special tools are required for use with designs 643 and 644.

INDEX NO.	TOOL NO.	NOMENCLATURE	APPLICATION
1	027025-N2	Alignment Tool	Sound drum adjustment
2	026815-F1	Alignment Tool	Light pipe adjustment
3		Allen Key (0.035A/F)	Removal of skate assembly
4		9/16" box spanner	Removal of magnetic switch
5		Gramme gauge 0 to ± 50 Grms.	Adjustment of stabiliser arms.

MAGNETIC SOUND SYSTEM TROUBLES AND REMEDIES

TROUBLE	PROBABLE CAUSE	REMEDY
a. No Sound	Selector switch in wrong position	Adjust
	Head plug not making proper contact with contact block	Adjust
	Pre-amplifier plug disconnected from amplifier or not seating properly	Adjust or re-connect
b. Inadequate Volume	Defective valve	Replace
	Dirt on film	Clean
	Head plug not making proper contact with contact block	Adjust
	Skate moved out of position	Align
	Selector switch in wrong position	Adjust
	Faulty pre-amplifier	Repair
	Head plug mis-aligned	Adjust trackway screw
c. Poor Quality Sound	Causes shown under the heading of "Inadequate Volume". Noises such as humming, whistling etc., can result from defective valves.	
	Various defects listed on page 9 of the manual may also apply.	

BELL & HOWELL

Filmosound 16 mm Projectors

DESIGNS 643 and 644

SERVICE INSTRUCTIONS

SECTION 8

DISASSEMBLY PROCEDURE

DISASSEMBLY PROCEDURE

GENERAL INSTRUCTIONS

Carry out the procedures outlined in the manual and note the following variations which are related to the component parts concerned with magnetic operation.

DISASSEMBLING FIGURE 37 PARTS

To detach the complete sound head assembly from the main casting refer to the procedure set out in section 49 (page 36) but note that it will be necessary to disconnect the leads terminating the plug contact block from within the amplifier and one lead attached to the main casting which serves as a hum bucking coil. With design 644 also note the wafer switch secured by two screws to the bracket of the magnetic switch assembly. It is advisable to note the correct orientation of the wafer switch to ensure re-assembly in an identical manner.

The contact block (58A) may be detached from the assembly after removal of the two screws (58B). It is important to note however, that the position of the contact block assembly (58) is extremely critical and removal of this item should, therefore, be avoided.

DISASSEMBLING FIGURE 35 PARTS

Remove parts in their indexed order of disassembly.

Before removing the amplifier (25) note that it is necessary to disconnect the following leads from tagboards located in the amplifier (see Figure 40)

a) Ten leads from tagboard P4

b) Seven leads from tagboard P2

c) Two leads from tagboard P5

Before removing leads from tagboards P2 and P5 it is advisable to note the correct sequence of connection before removal. With tagboard P4 it is only necessary to match the colours of the fixed and detachable leads when re-assembling the amplifier.

In addition to the above the following leads must be disconnected.

d) Exciter lamp leads

e) Photo diode leads

f) Speaker leads

g) Main earth leads

When all leads have been detached remove the record switch attached to a bracket on the underside of the base casting by a knurled plastic nut.

The amplifier can then be withdrawn after removal of the four screws (23)

BELL & HOWELL

Filmosound 16 mm Projectors

DESIGNS 643 and 644

SERVICE INSTRUCTIONS

SECTION 9

ADJUSTMENTS

The following adjustments may be necessary in addition to those described in section 4 of the manual.

1. Light pipe and photo diode

Refer to Fig.C page 36 and carry out the procedure as described for design 642, using tools 027025-N2 and 026815 for sound drum and light pipe respectively in place of existing combined tool.

Note that the skate assembly (Fig.37) must be removed before carrying out this operation.

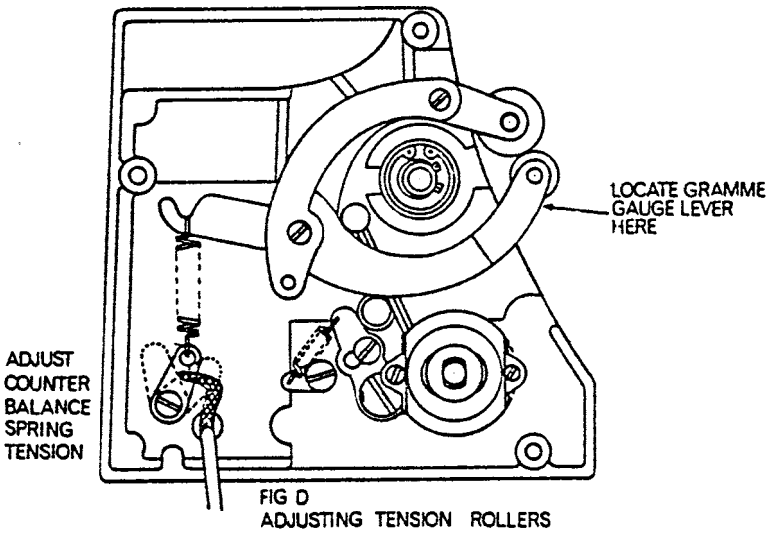


FIG D
ADJUSTING TENSION ROLLERS

2. Tension rollers (Fig. D)

If the tension rollers have been dismantled it will be necessary to re-adjust as follows. Usea sensitive gramme gauge with centre zero, 0 to ± 50 gramme dial and, with the base of the sound head level, adjust the counter balance spring to hold upper and lower stabiliser arm assemblies against the upper stop with a force of 20 ± 5 grammes.

Film protection switch (Fig. E)

Loosen the screws securing the micro-switch to the input bracket and with the blower running at full speed, set the gap between the actuator and micro-switch lever to 0.015" + 0.015". Securely tighten the screws to hold the switch in this position.

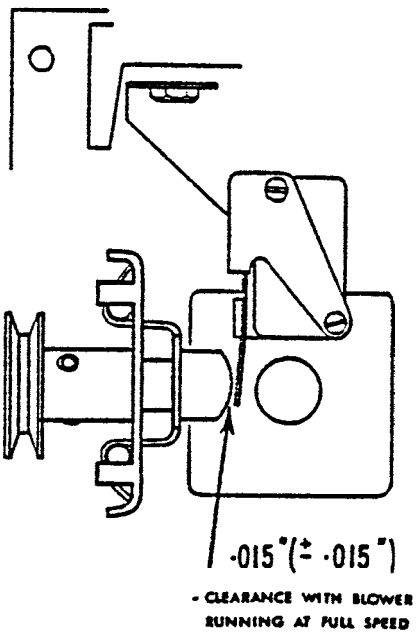


FIG.E Adjusting Film Protection Switch

Latch, Cam and spindle assembly (Fig. F)

When re-assembling the magnetic switch to the sound head, set the switch to Position 1 (fully anti-clockwise), and adjust the cam so that its flat edge rests against the skate operating lever which forms part of the spindle assembly.

The tension of the latch spring should be sufficient to provide a brisk latch recovery on operation of the magnetic switch.

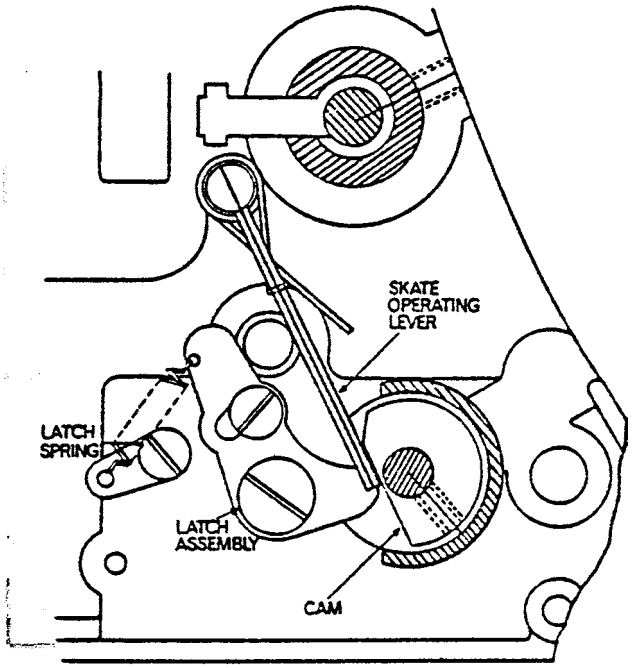


FIG F
ADJUSTING LATCH CAM AND SPINDLE ASSEMBLY

Skate (Fig. G)

Loosen the skate securing screw and the skate boss set screw.

With the edge stripe head in position lace film through the sound head.

Set the selector switch to position 1.

Hold the skate in light contact with the film and adjust the skate laterally until its contact surface is parallel with the curvature of the magnetic heads.

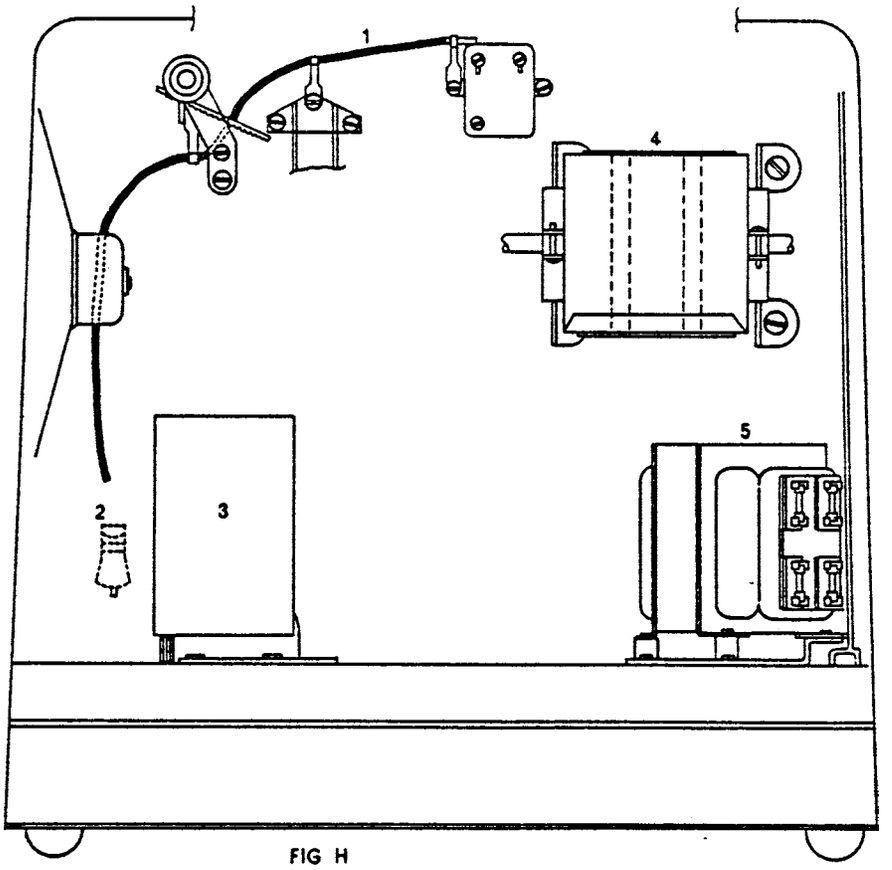


FIG H
HUM LEVEL ADJUSTMENTS

1 Hum bucking loop from head plug bracket
2 Head plug
3 Pre-amplifier
4 Motor
5 Transformer

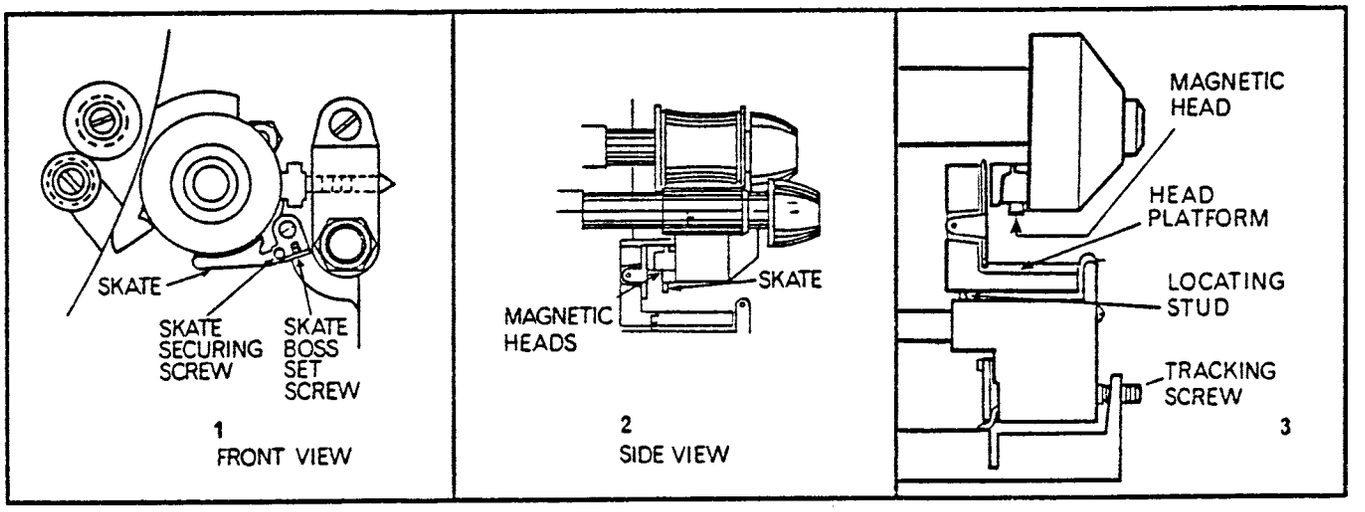


FIG G
ADJUSTING THE SKATE

Tighten the skate securing screw.

Slide the skate boss along its spindle and with the aid of a small mi-ror, visually align the skate as near to the edge of the film as possible, then tighten the skate boss set screw.

Skate pressure on the film should not be so heavy as to move the magnetic head upwards.

Note that after adjusting the skate hum bucking adjustments must be carried out as described under "Hum Level Adjustments".

Hum Level Adjustments (Fig. H)

The following three adjustments determine the hum pick up level.

1. The position of the hum bucking loop attached to the projector frame which terminates on the head plug bracket

2. The orientation of the amplifier transformer on its mounting bracket.

3. The position of the hum bucking coil located in the magnetic head plug.

If any of these components have been disturbed during disassembly it will be necessary to carry out the following adjustments.

Set the selector switch for magnetic operation. Switch on the amplifier and turn up the magnetic volume until sound is audible from the speaker.

Adjust the hum bucking loop on the projector frame for minimum hum. Loosen the screws securing the transformer to its bracket and slowly turn the transformer in either direction for minimum hum. Remove the plug cover plate and locate the hum bucking coil. Alter the position of this coil until hum is further reduced.
Repeat the sequence of adjustments until hum level is at a minimum.

Firmly secure all components in this position.

Magnetic Head Wear

As wear develops on the magnetic heads they fail to lie in contact with the magnetic stripe, resulting in loss of sound or poor quality sound.

To check for this position, lace film in the projector and switch on, then gently depress the head platform (Fig. G). This action should transmit movement to the stabilisers if the head is functioning normally. If the stabilisers are unaffected, indicating that wear exists, remove the head and carefully file the tip of the locating stud (Fig.G) at the base of the platform until the heads are in contact with the film.

Tracking adjustment

The tracking screw (Fig.G) permits adjustment of the magnetic heads in the horizontal plane in order to ensure correct head location over the width of the magnetic stripe. To adjust, thread the machine with a full track film, set the Selector Switch to position 2 and with the projector running, loosen or tighten the tracking screw as required. A small dental mirror will assist in making a visual examination to ensure that the heads are correctly aligned

BELL & HOWELL

Filmosound 16 mm Projectors

DESIGNS 643 and 644

SERVICE INSTRUCTIONS

SECTION 10

AMPLIFIER DATA

Description of 643 and 644 Amplifier Circuits

643 Amplifier

This is basically a 642 Amplifier with an added preamplifier. The preamplifier is situated behind the soundhead and plugs into the 642 Amplifier using a B7G plug.

The preamplifier consists of a two transistor circuit using Mullard A.C. 107 transistors. The first stage is operated from a low voltage (approx 3V.) to give two sensitivities to enable full track and quarter track heads to playback at approx. the same level. The value of the collector load and hence the sensitivity is determined by the type of plug fitted. Frequency correction is performed in the second transistor stage and the first stage in the main amplifier. This is achieved by a frequency selective negative feedback loop from the anode of the first valve in the main amplifier to the emitter of the second transistor in the preamplifier. The resulting frequency response gives a linear playback from film recorded to C.C.I.R. standard.

Interposed between the preamplifier and the main amplifier is the MIC socket which is wired so that the preamplifier output and the negative feedback loop is disconnected when the microphone is plugged in.

644 Amplifier

Playback System (Magnetic)

This is identical with that of the 643 except that the preamplifier switching is done with a relay.

Relays

There are two relays in the 644 amplifier, relay A which switches the input circuits and record head and relay B which switches the tone controls, amplifier output, bias/erase oscillator and record level indicator.

Record System

The record system is interlocked so that the amplifier cannot be switched to record when the Projector is stationary or running in reverse, or if the soundhead switch is in the optical position. For presetting the record level, however, the amplifier can be switched to record if the projector is switched to still picture with the motor running in the forward direction.

The amplifier is switched to record by depressing the button which supplies power to relay B from the motor circuit. Relay B then holds itself on, operates relay A, and switches on the bias/erase oscillator and record level indicator.

Relay A switches the record head into the record circuit, disconnects the preamplifier and connects the mic socket to the input board. The signal, which can either come from the mic socket or the optical channel, is amplified in the normal manner and then fed to relay B which switches it through a H.F. preemphasis network, to the output board. This network replaces the tone control circuit which is in-operative in record.

The loudspeaker is disconnected by relay B and the output is fed to the record level indicator and through a bias rejection filter to the record head.

The bias/erase oscillator is of the Hartley type and employs a double triode operating in parallel. The bias is fed via a small capacitor from the anode circuit and the erase current is fed from a low impedance secondary winding on the oscillator coil.

The oscillator frequency is approx. 62 kc/s

To cease recording, either the projector motor can be switched off or the soundhead switch turned to the Optical position.

P.A. System

If the soundhead switch is turned to the Optical position, relay A is energised and this connects the microphone socket to the input of the amplifier which can then be used as P.A. equipment.

Soundhead Switch

This controls the power supply to the relays. When switched to magnetic, it feeds power to relay B via the record button, and connects the coil of relay A to contacts on Relay B. When switched to the Optical position it disconnects power from Relay B and connects the coil of relay A to the amplifier H.T. supply.

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Filmosound 16 mm Projectors

DESIGNS 643 and 644

SERVICE INSTRUCTIONS

SECTION 11

SPARE PARTS LISTS AND ILLUSTRATIONS

Figure 32

PROJECTOR MAIN PLATE (1)

Key No.	Description	Part No.	
		643	644
1	Front Cover Assembly	026784	*
5	Plate, Instruction	59701	59619
10	Cover Assembly, Rear	026902	*
31	Cam, Clutch	35876	*
53	Switch Animation	58956	*
54	Button	58951	*
55	Escutcheon	59709	59375
56	Base Assembly, Projector	026852	027028

* Indicates parts used on both models

Parts common to design 642 are not listed

46	Collar	35811	*
	Screw	56060	*
3	Screw	59869	*
8	Screw	59926	*
9	Screw	59925	*

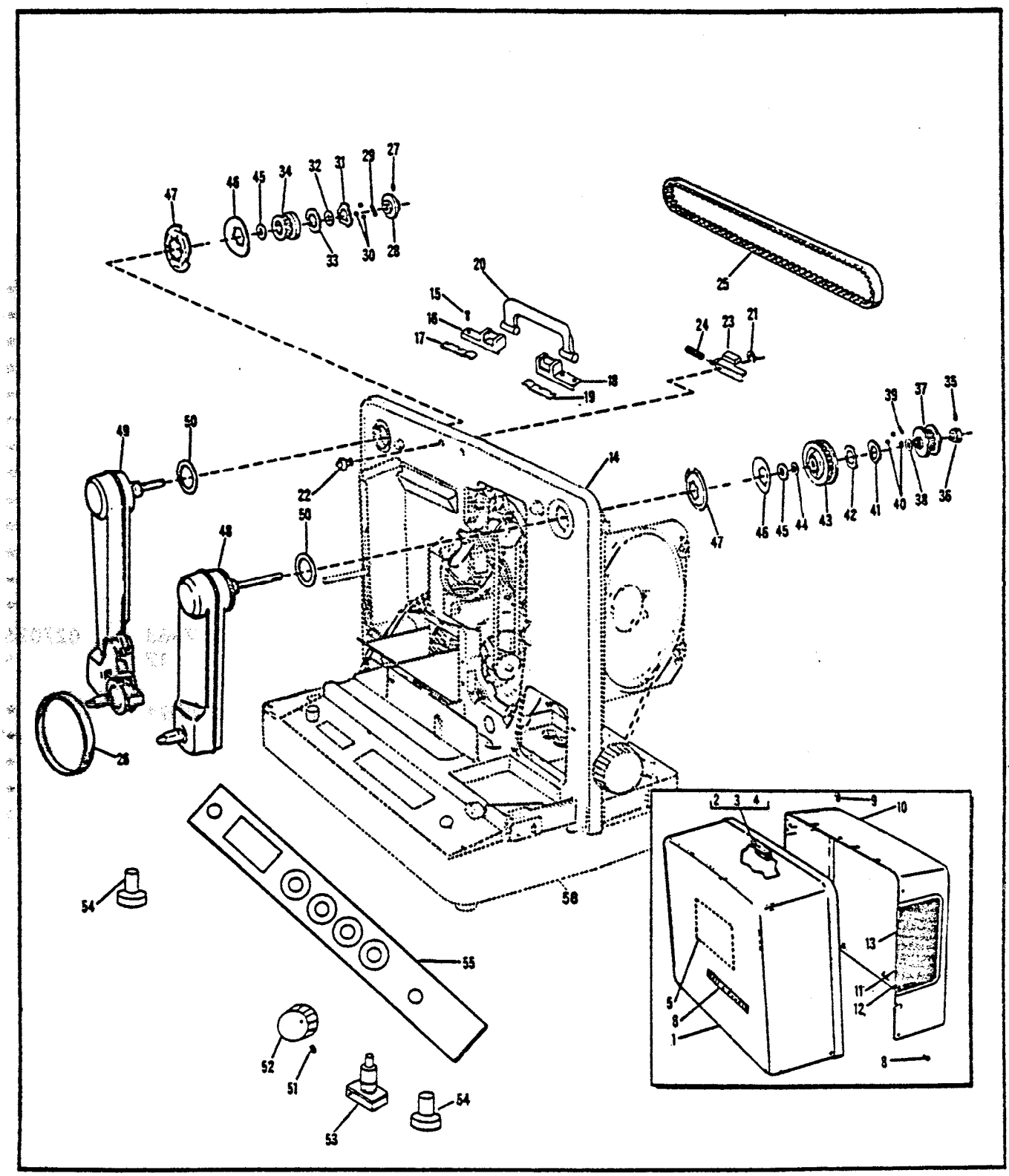


Figure 32 Filmosound Projector Main Plate Exploded (1)

Figure 33

PROJECTOR MAIN PLATE (2)

Key No.	Description	Part No. 643	Part No. 644
	Lampholders Assembly, Projection (See Fig.33A)	026830	*
35	Screw, 4-40 x 3/16 Binder Head	30164	*
35A	Handle	36035	*
36	Washer, Roller post	34784	*
37	Roller, Idler	59807	*
38	"E" Ring	97509	*
39	Shaft Assembly, Snubber Roller	011222	*
40	Spring, Snubber	35859	*
41	Retainer, Snubber Spring	35858	*
41A	Cover, Spring	35856	*
41B	Post, Snubber Roller Mounting	35860	*
41C	Washer	15563	*
41D	Stop, Snubber	59801	*
53	Sound Head Assembly	027063	027026
58	Washer	31017	*
	Snubber Assembly (Interim)	011223	*
1	Screw	605222	*
2	Washer	31634	*
3	Idler	09747	*
4	Washer, Split	20808	*
5	Shaft Assembly	011224	*
6	Spring	35859	*
7	Retainer, Spring	35858	*
8	Cover Spring	35890	*
9	Screw	31943	*
10	Washer	5563	*
11	Distance Plate	59951	*
12	Bracket and Shaft Assembly	011225	*

* Indicates parts used on both models

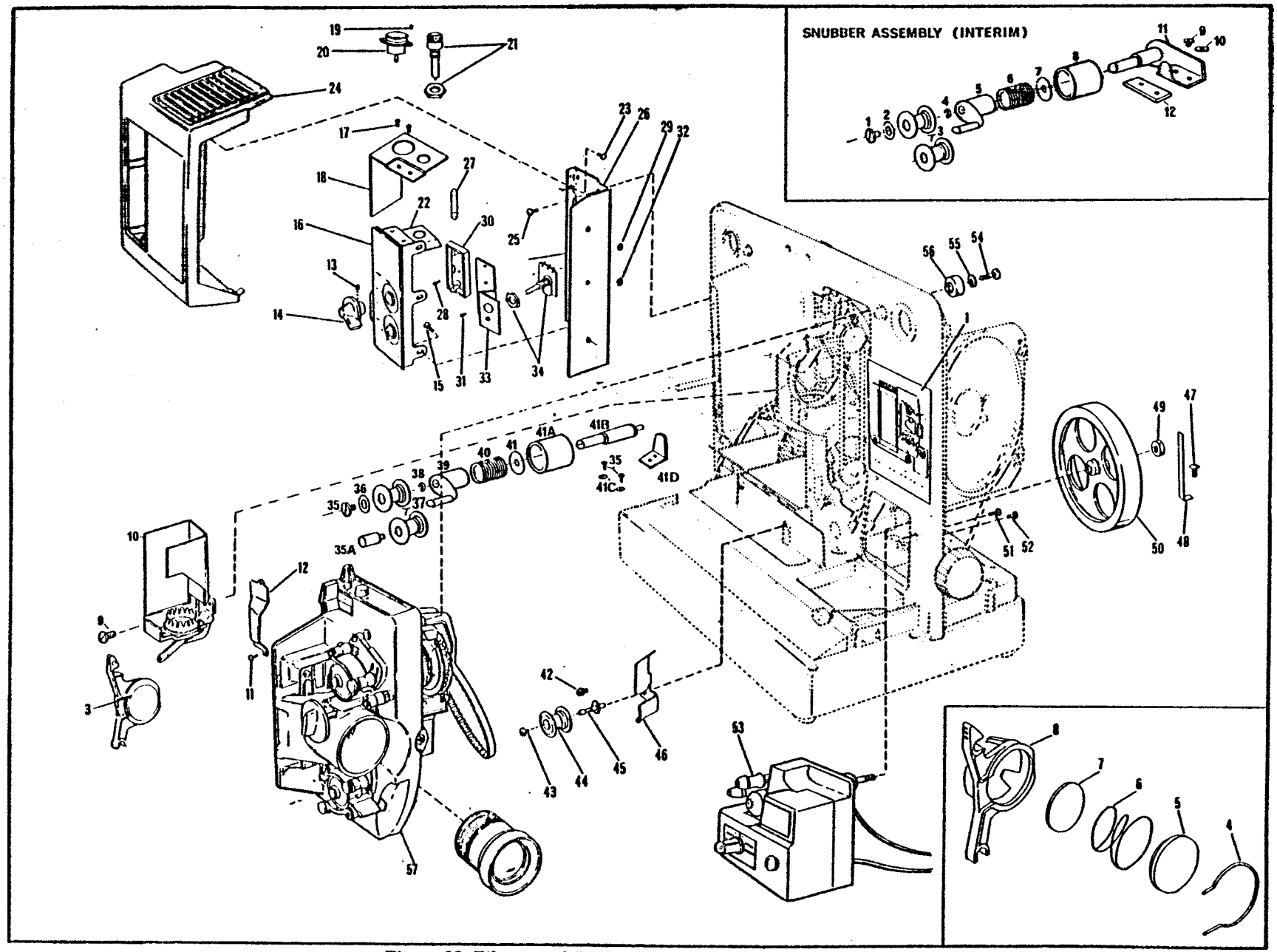


Figure 33 Filmosound Projector Main Plate Exploded (Sheet 2)

Figure 33A

PROJECTION LAMPHOLDER ASSEMBLY

Key No.	Description	Part No. 643	Part No. 644
	Lampholder Assembly, Projection	026830	*
2	Baffle, Lamp	31273	*
3	Pin, Lamp Release Lever	31604	*
4	Lever, Lamp Release	31605	*
5	Nut	24736	*

* Parts not listed are common to design 642

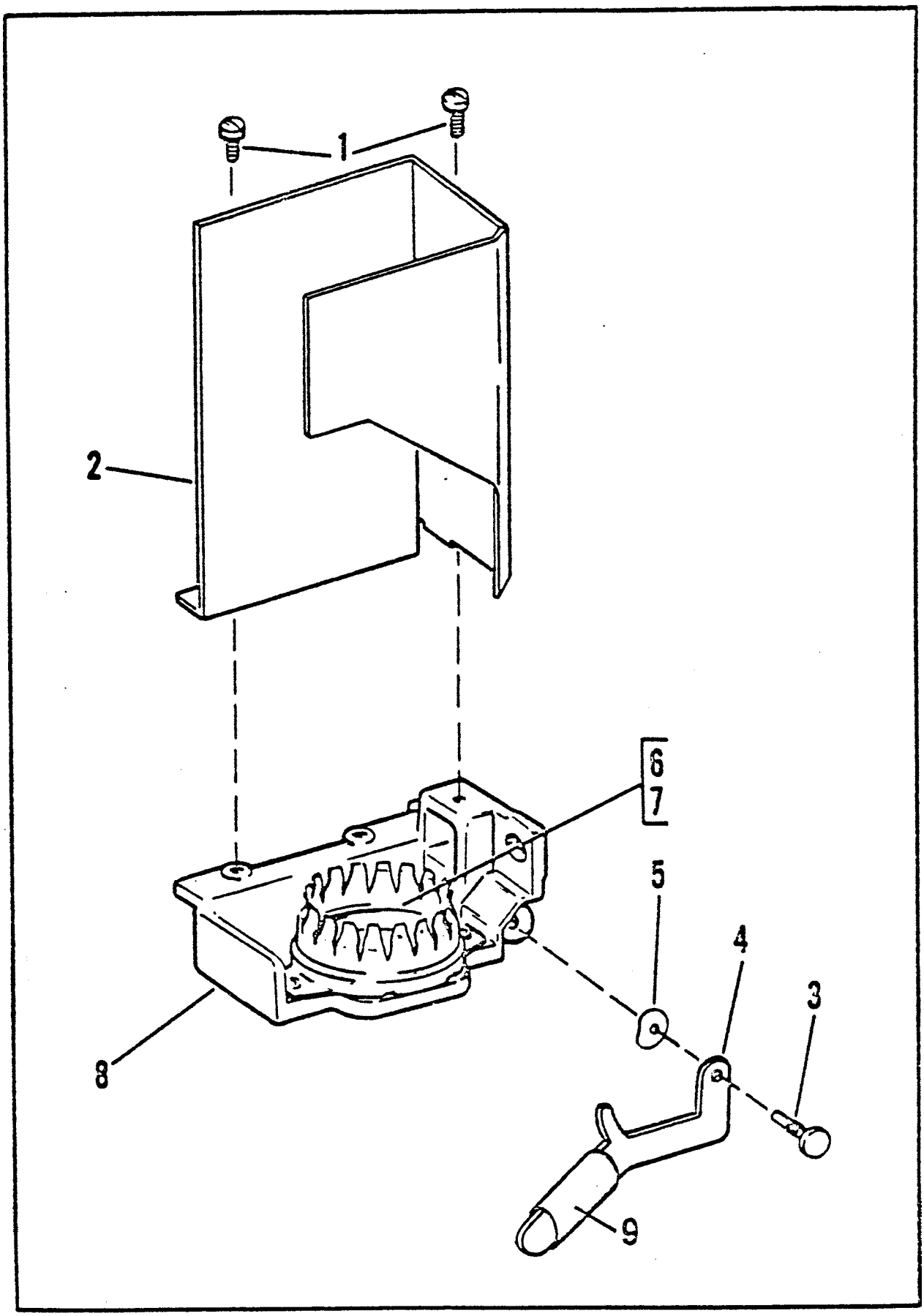


Figure 33A Projection Lampholder Assembly

Figure 34

PROJECTOR MAIN PLATE (3)

Key No.	Description	Part No. 643	Part No. 644
5	Bracket, Socket Mounting	58656	*
5A	Nut S40	58861	*
5B	Lockwasher No.6 Internal	14175	*
5C	Spacer		
5D	Screw 5-40 Pan Head	59648	*
5E	Micro-Switch Assembly	027089	*
9A	Screw	59800	*
9B	Pre-Amplifier Assembly	027041	*
10	Clip Assembly, Condenser (includes screw and nut)	58520	*
10A	Screw, 6/32 x ½ Binder Head	31928	*
10B	Spacer	82641	*
10C	Condenser	58866	*
47	Motor Assembly, Drive	026904	*
47A	Knob, Inching	59270	*
47B	Clip, Knob to Start	59281	*
47C	Cover, Inching Knob	59273	*
47D	Motor Screen	59422	*
47F	End Cap, Motor Screen	59424	*
47G	Screw	82640	*
47H	Belt, Mechanism Flat Endless	59695	*
49	Terminal, Flag Snap on	32093	*
50	Belt, Mechanism Flat Endless	59695	*
59	Bracket	027039	027040

* Indicates parts used on both models

Parts common to design 642 are not listed

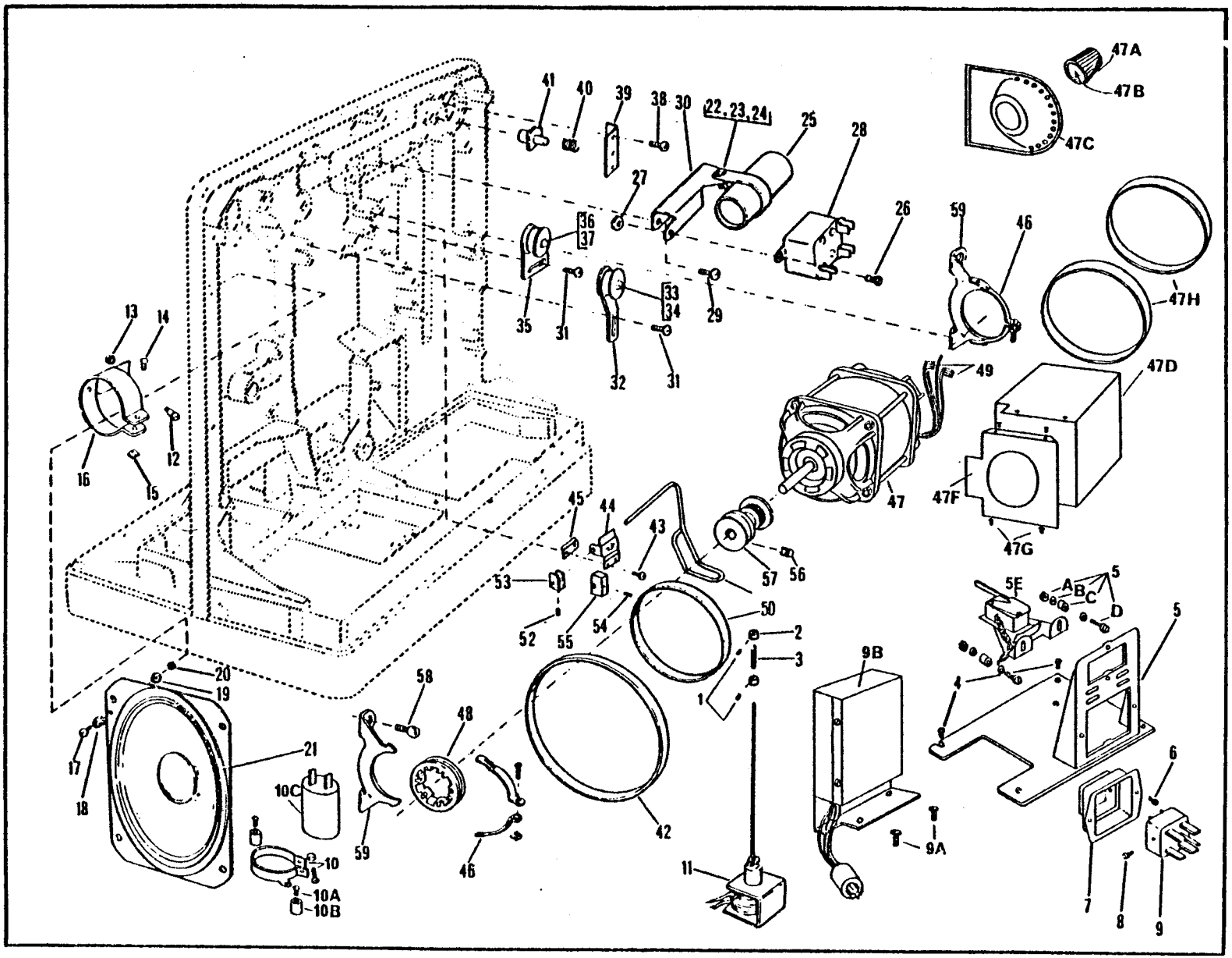


Figure 34 Filmosound Projector Main Plate Exploded (3)

Figure 35

PROJECTOR MAIN PLATE (4)

Key No.	Description	Part No. 643	Part No. 644
11	Blower Assembly	027017	*
13	Bracket, Transformer Assembly	026989	*
14	Transformer and Tags Assembly	026936	*
15	Screw	59918	*
15A	Screw	59626	*
23	Screw, Amplifier	59481	*

UNCOMMON PARTS NOT ILLUSTRATED

Description	Part No. 643	Part No. 644
Spider Assembly	027020	*
Screw	12636	*
Weight	59583	*
Blower Shaft	59586	*
Washer	34859	*
Actuator Arm	027019	*

* Indicates parts used on both models

Parts common to design 642 are not listed.

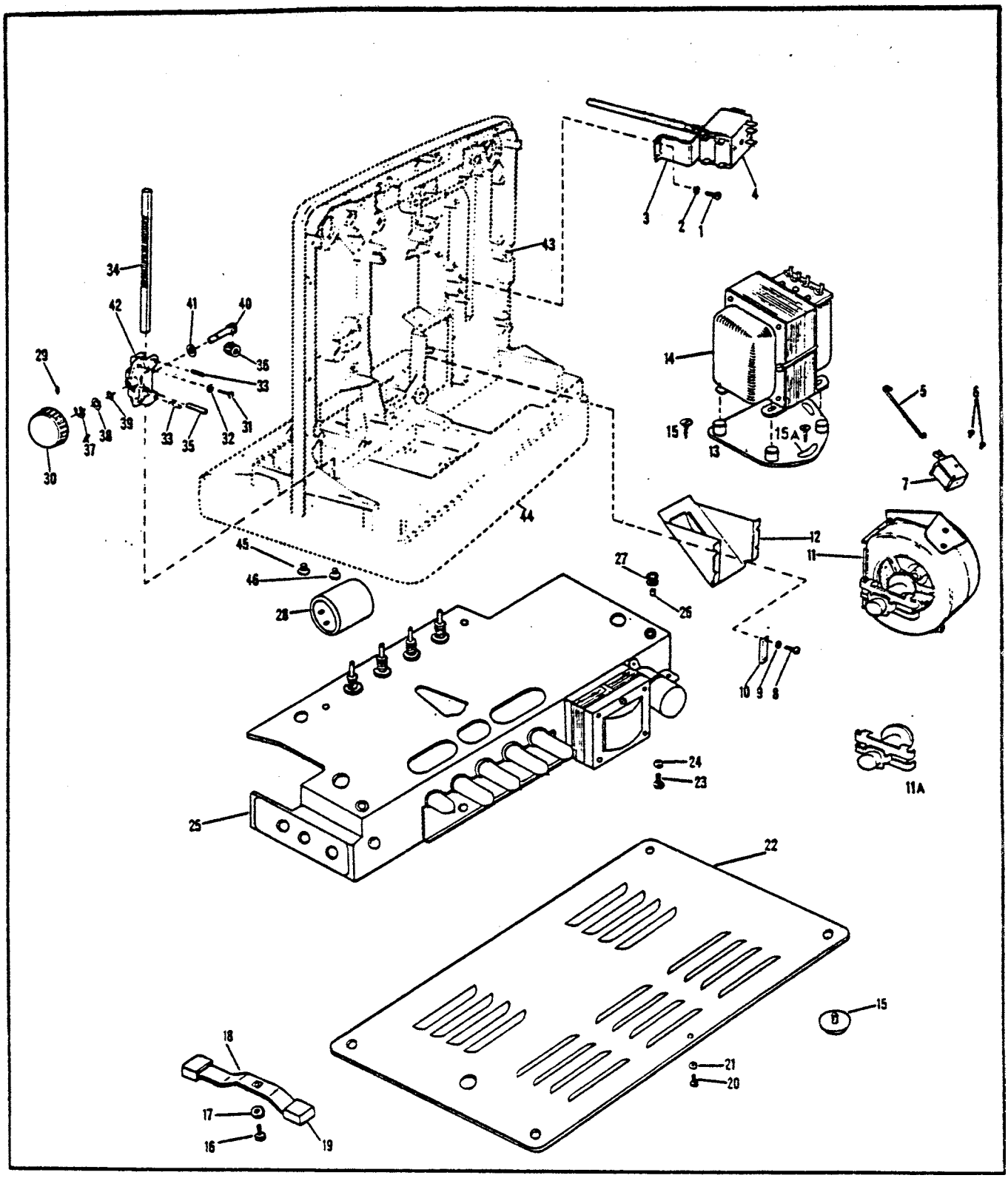


Figure 35 Filmosound Projector Main Plate Exploded (4)

Figure 36

LENS CARRIER ASSEMBLY

Key No.	Description	Part No. 643	Part No. 644
2	Spring, Pinion Hold Down	31093	*
4	Screw, Pressure Plate	31098	*
6	Plate, Pressure	34888	*
10	Plate, Adjustment	31095	*
11	Carrier, Lens	31073	*
	Lens Carrier Assembly	09707	*

* Indicates parts used on both models

Parts common to design 642 are not listed

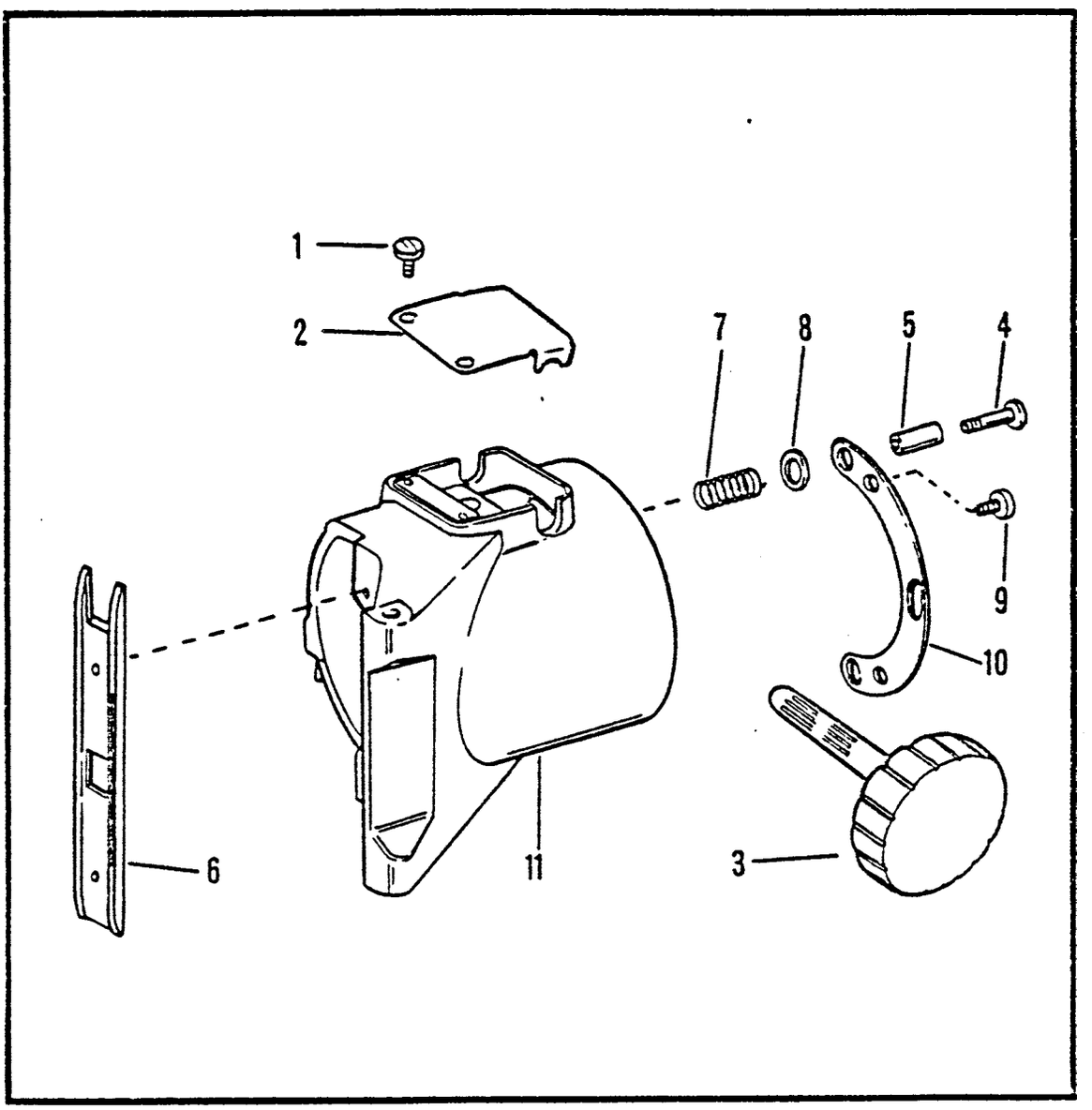


Figure 36. Lens Carrier Assembly

Figure 37

SOUND HEAD ASSEMBLY

Key No.	Description	Part No. 643	Part No. 644
	Sound Head Assembly	027063	027026
1	Cover Assembly, Exciter Lamp	027030	*
3A	Screw, Door Retaining	34837	*
3B	Door	59121	*
4A	Head Plug Assembly	027044	*
10 %	Photo Diode Assembly (includes items 10A, 10B, 10C).	027091 or 026958	*
10A @	Photo Diode	59433 or 58658	*
10B @	Support, Photo Diode	59763 or 59485	*
16	Holder, Photo Diode	59697	*
18	Screw, Sound Drum Shaft Locking	59080	*
20	Shaft Assembly, Sound Drum	026972	*
24	Screw, Guide Roller	35375	*
26	Threading Guide, Plain Roller	59504	*
27	Threading Guide Flanged Roller	59505	*
28	Screw, Flanged Roller	35376	*
36	Arm Assembly, Stabiliser (Lower)	026995	*
37	Spring, Stabiliser Arm	59553	**
38	Arm Assembly, Stabiliser (Upper)	026994	*
39	Housing, Sound head and Spigot Assembly	027024	*
40	Screw, Skate Securing	10268	*
41	Skate	59401	*
42	Set Screw, Skate Boss Securing	59613	*
43	Skate Boss	59406	*
44	Screw, Socket Head	57598	*
45	Knob	59368	*
46	Set Screw, Cam	31433	*
47	Cam	59403	*
48	Nut, Magnetic Switch Retaining (Supplied with 58929)		

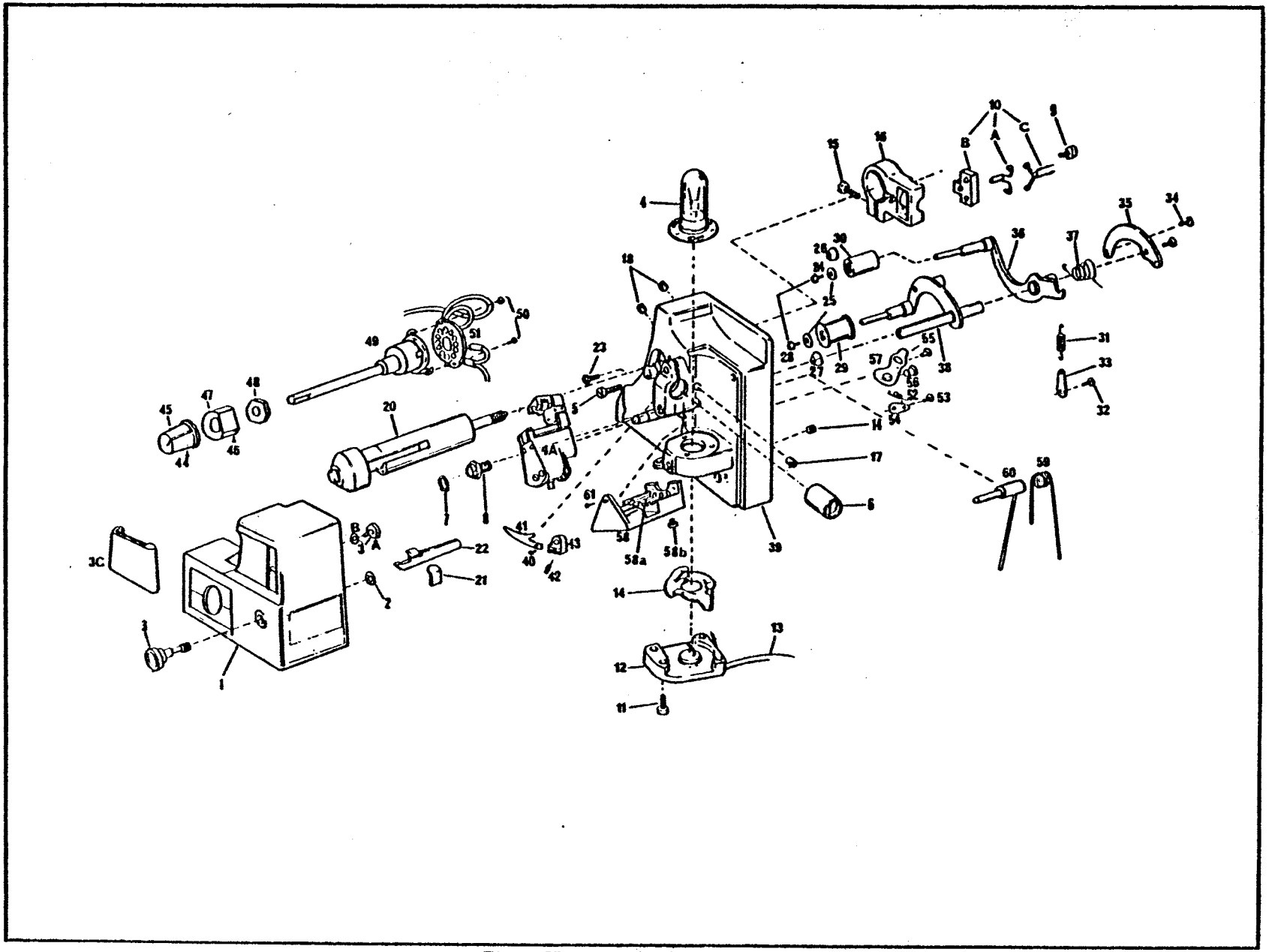


Figure 37 Sound Head Assembly

Figure 37 cont.

49	Switch, Magnetic	58929	
50	Screw, Wafer Switch Retaining (Supplied with 027012)		
51	Switch, Wafer		027012
52	Spring	59157	*
53	Screw	9175	*
54	Terminal, Lug	59614	*
55	Screw, Latch	59420	*
56	Screw, Pan Head	59415	*
57	Latch Assembly	026970	*
58	Head Contact Block Assembly	027047	*
59	Spring, Spindle	59419	*
60	Spindle Assembly	029971	*
61	Screw, Tracking	11521	*

% 027091 includes 59433. 026958 includes 58658.

@ 59763 for use with 59433. 59485 for use with 58658.

* Indicates parts used on both models

Parts common to design 642 are not listed

Figure 39

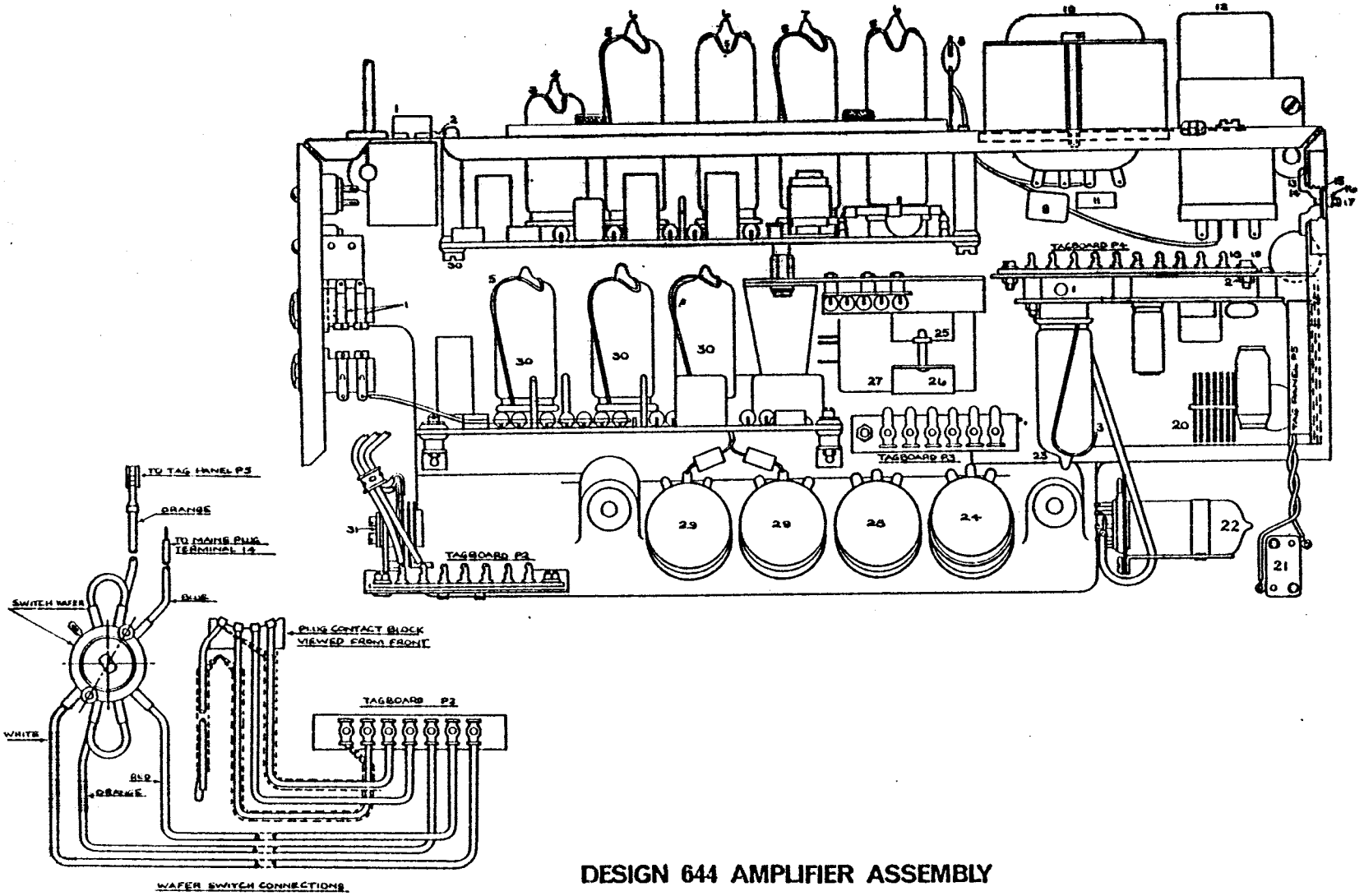
644 AMPLIFIER ASSEMBLY

Key No.	Description	Part No. 643	Part No. 644
	Clamp Assembly, Preamplifier comprising,		
	Clamp	59765	*
	Screw	56420	*
	Speed Nut	56414	*
8	Resistor R41		59927
9	Condenser R43		58397
11	Resistor R43		58939
13	Fuse F1		59722
14	Fuse F2		56845
15	Washer		14175
16	Nut 6BA		56389
17	Screw 6BA		58584
20	Relay, Recording Control		59786
21	Switch, Recording		58930
22	Valve EM84		58925
23	Valve ECC82		54219
31	Relay, Recording Playback		59773
	Tagboard P3	*	58768
	Tagboard P2	*	59433
	Tagboard P5		59362

Note Tagboard P3 is identical with the existing 642 tagboard

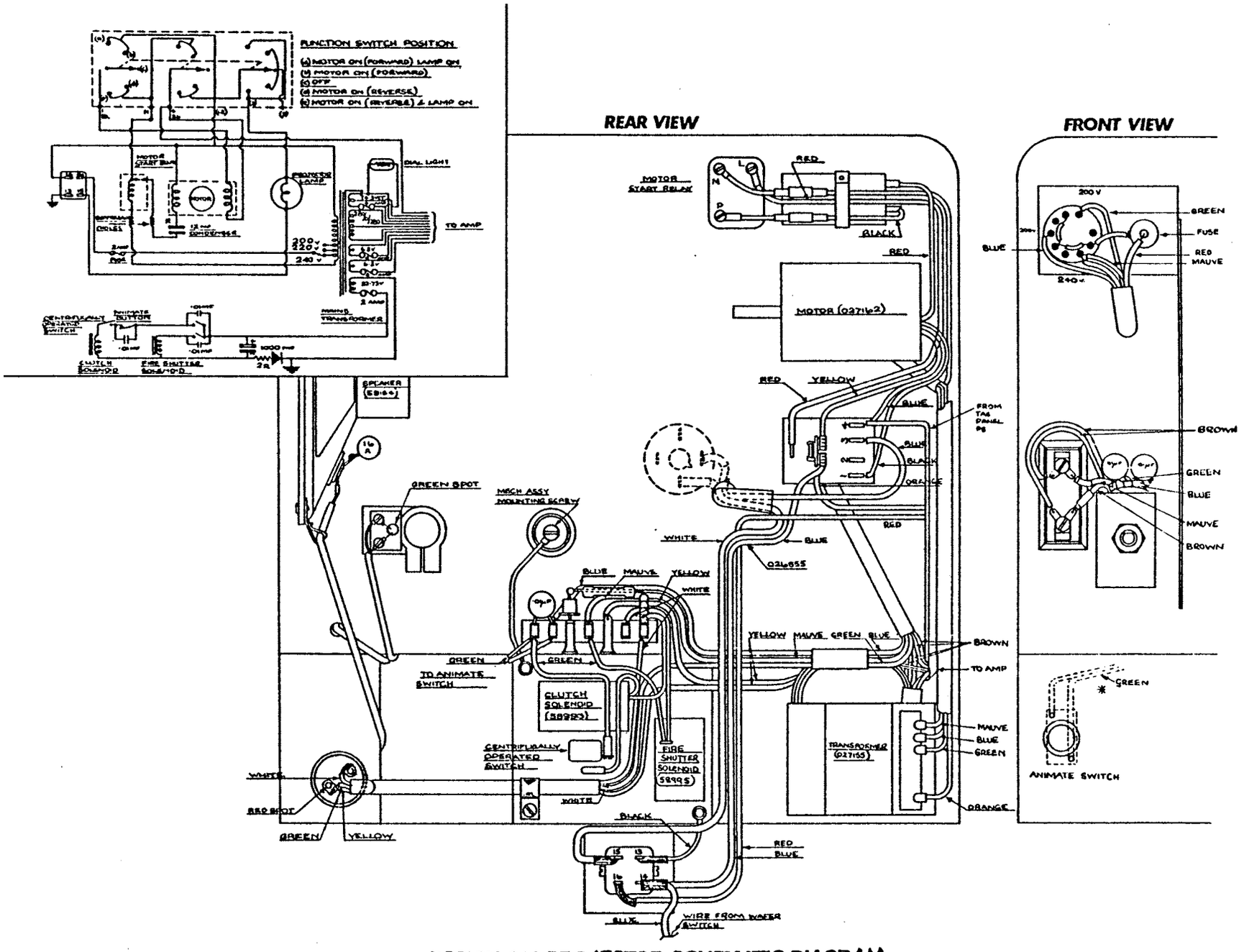
* Indicates parts used on both models

Parts common to design 642 are not listed



DESIGN 644 AMPLIFIER ASSEMBLY

Figure 39

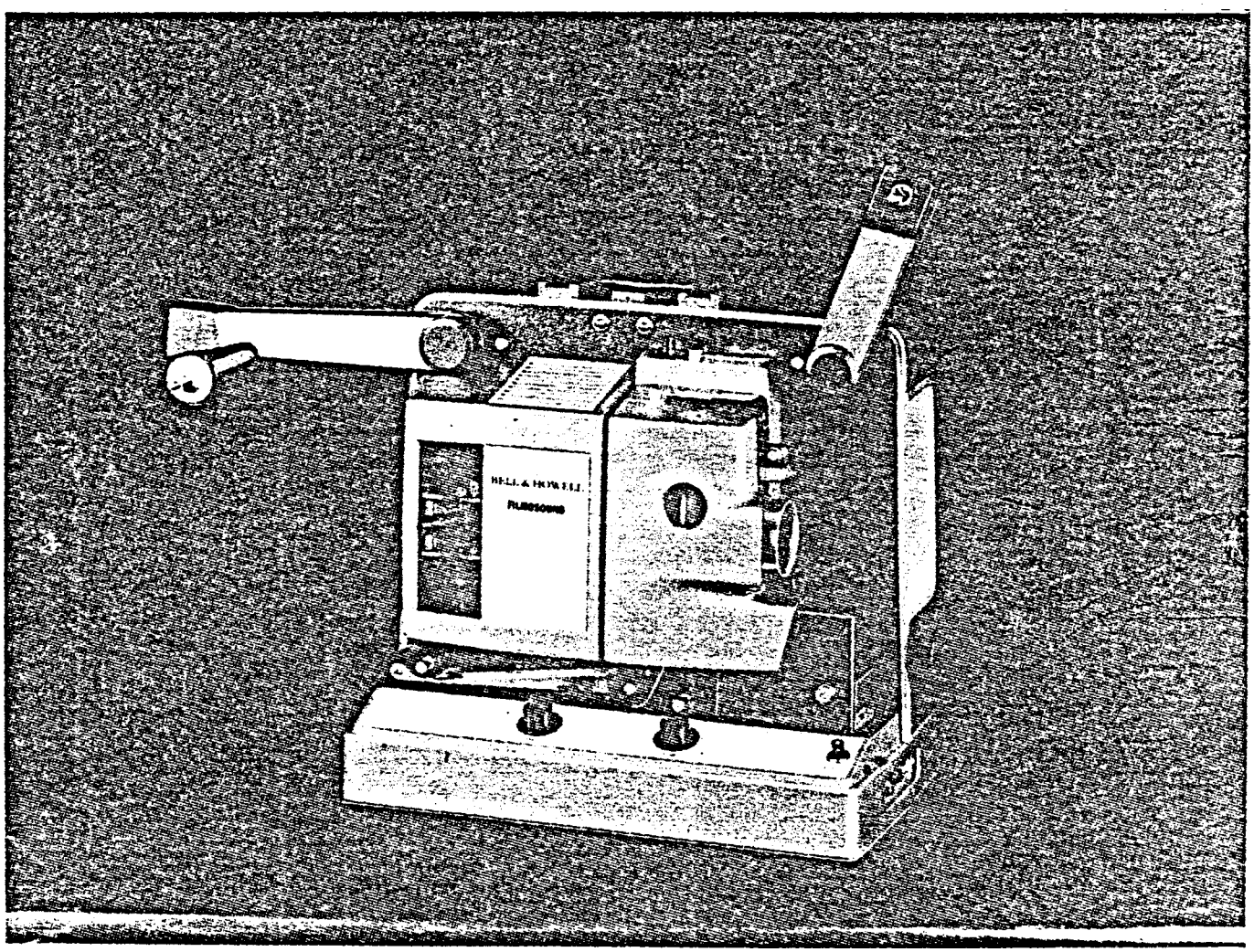


DESIGN 644 PROJECTOR SCHEMATIC DIAGRAM

BELL & HOWELL

DESIGN 652

Filmosound
16 mm Projector



Model 652 Filmosound Projector

GENERAL INFORMATION

Design 652 is basically similar in construction to design 641 and the servicing information provided for the latter design is applicable.

The following information is confined to the automatic threading mechanism and the various illustrations show only those part numbers which are not common to the 641.

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Filmosound 16 mm Projector

DESIGN 652

SERVICE INSTRUCTIONS

SECTION 13

DISASSEMBLY PROCEDURE

Disassemble parts shown in Figures 42 -45 in their indexed order and note the following precautions.

When the actuating assembly (13, Fig.44) is removed, observe the setscrew protruding up from the casting immediately below the mounted position of the actuating assembly. The height of this setscrew above the casting has been set to ensure that the auto-threading system does not lock when the actuating assembly is depressed. Do not disturb this setscrew.

Before disassembling, make a careful note of the manner in which the various springs (9, 15, 18 and 44 Fig.45) are installed. It is important that these springs be reassembled in the same manner.

Removal of parts in this illustration will necessitate the re-adjustment of the auto-threading mechanism as described later.

REASSEMBLING THE MECHANISM (Figure 45)

Install lens stop screw (67) into the housing casting until only one thread is visible. Attach lens carrier catch (65) and spacer washer (66) to casting with screws (63) and lock washer (64). The stop screw and catch will be adjusted after lens carrier is installed.

Secure the connecting link (60) and shuttle retractor (59) to the casting with screw (56) and washers (57 and 58).

Attach self-centering assembly (55) to rear of casting with screws (52) and washers (53 and 54). Assemble lever and shaft assembly (51) to casting and install washer (42) and arm assembly (50) on shaft. Tighten screw (49).

Assemble cam follower parts (48) and fasten to the arm assembly (50) with screw (45) and washers (46 and 47). Attach spring (44) to casting and hook loose end of spring over shaft of lever assembly (51).

Assemble upper loop form shaft (68) to casting and install washer (42) and upp loop form (41); tighten setscrews (35). Install upper sprocket guard plate (40). Assemble lower loop form (38) so that loop form shaft passes through guard plate and casting while upper stud of connecting link passes through holes in upper loop form. Install retaining ring (37) on connecting link stud and the threading lever (36) on end of loop form shaft. Secure the threading lever with setsc (35).
Install spring (34) so that it supplies return tension to shaft (68).

Assemble toggle lever (31) to lower sprocket guard plate (28) with retaining ring (30). Fasten guard plate to casting screws (27). Install upper film guide (29) large washer (25) lower film guide (26) and a second large washer (25) over lower bearing protruding through sprocket guard plate (28). Note that the lower stud of the connecting link (60) must pass throug a hole in the left ear of the lower film guide. Spring (15) and lower loop form (14) are then installed on this stud an secured with retaining ring (13). Leg of spring (15) must be positioned to apply proper tension to lower loop form. Install large retaining ring (24). Fasten backup bracket (23) to sprocket guard plate.

Attach auto-thread locking lever (21) and eccentric pivot (20) to casting with screw (19). Attach release spring (18) and bushing (17) to casting just above and to the left of lever (21), hooking long leg of spring behind the rear edg of lever, and handle assembly (8) and spring (9) with retaining ring (7). Install all rollers.

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Filmosound 16 mm Projector

DESIGN 652

SERVICE INSTRUCTIONS

SECTION 14

ADJUSTMENTS

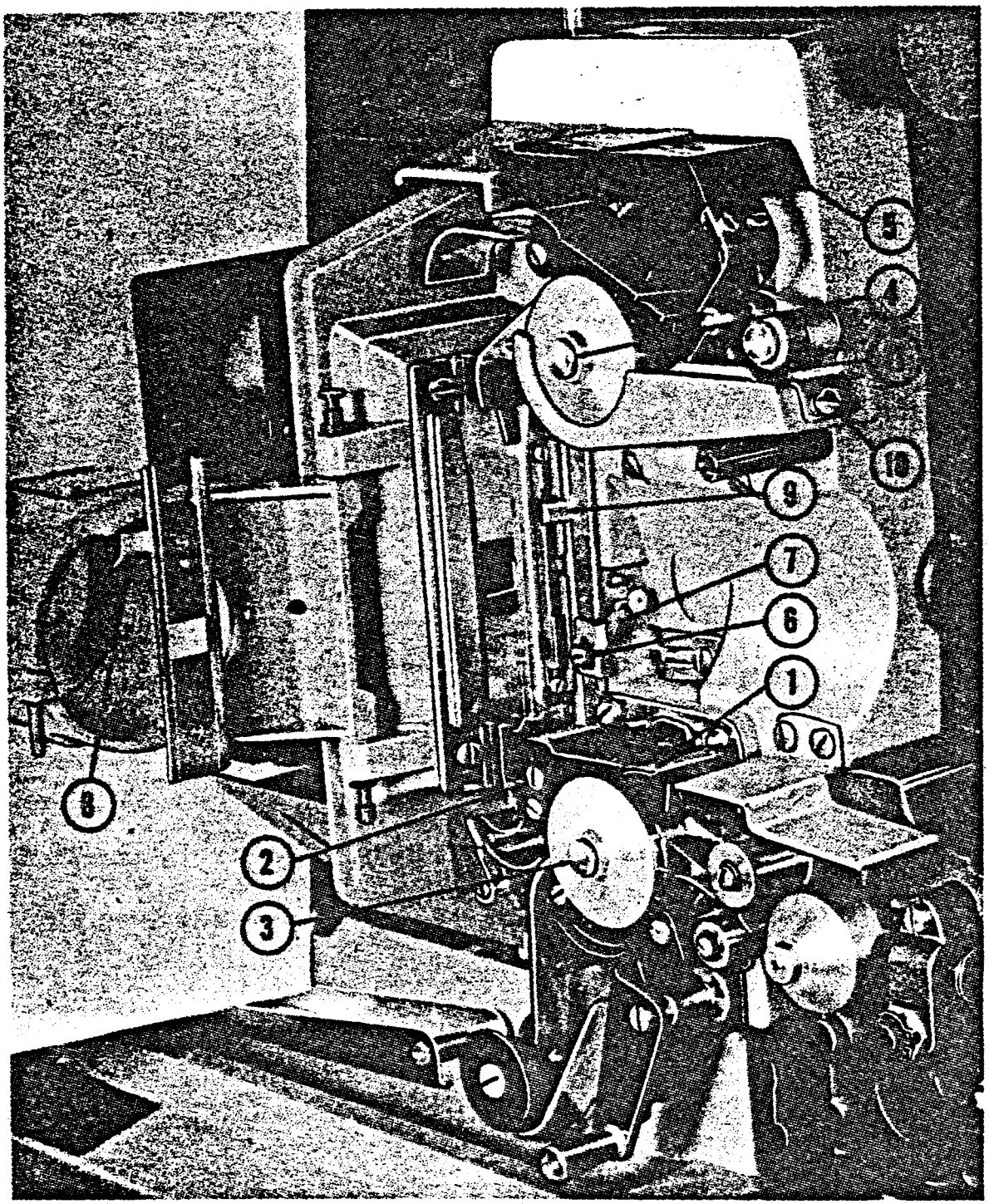


Figure J. Autoload System Adjustment Points (1)

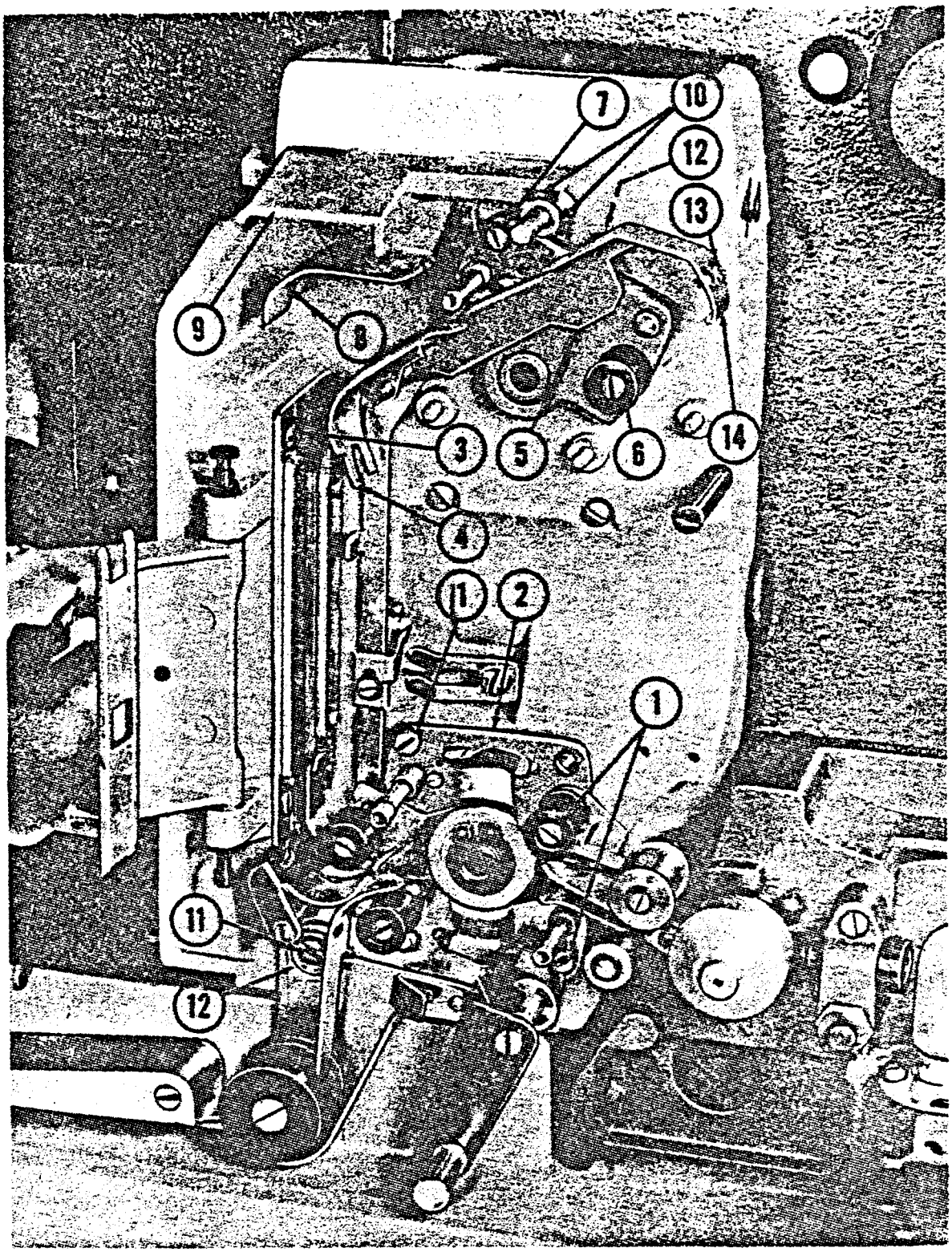


Figure K. Autoload System Adjustment Points (2)

AUTO-LOAD SYSTEM ADJUSTMENTS - GENERAL

The auto-load system consists of a series of guides and rollers which when the system is in the load position, are so located as to guide the film through the threading path. When the system is in the open position, the guides and rollers clear the film path.

When the system is in the open position, the location of the guiding parts is not critical. Therefore, adjustments to assure proper location of the guiding parts are made with the system in the load position.

The guides are connected by mechanical linkage. The system is actuated by a cocking lever at the lower end of the linkage and the movement is stopped at the top end of the linkage. The specified clearances must be checked with the system in the load position. If the need for adjustments is detected, it is important that repairman proceeds in the sequence listed in this section. The sprocket timing and the locating of the soundhead may be done without disturbing the guide adjustments.

CHECKING AND ADJUSTING THE LOADING GUIDES

Remove retaining ring that secures the actuating assembly (5 Fig.J) and lock the auto-loading system. Place a 0.015 inch feeler gauge between the film support rails of the aperture plate and the rear surface of the lower loop form assembly (4 Fig.K). This surface should touch the feeler gauge just as the heel of the loop form (5 Fig.K) strikes the shoulder on the mounting stud for the entrance guide roller (6 Fig.K). To adjust, loosen two screws (7, Fig.K) which attach the upper sprocket guard plate. Press downward on front end of loop form assembly and rotate upper sprocket guard plate until heel of loop form strikes shoulder of stud and rear surface clears aperture rails by 0.015 inch. Then tighten screws (7, Fig.K) securely.

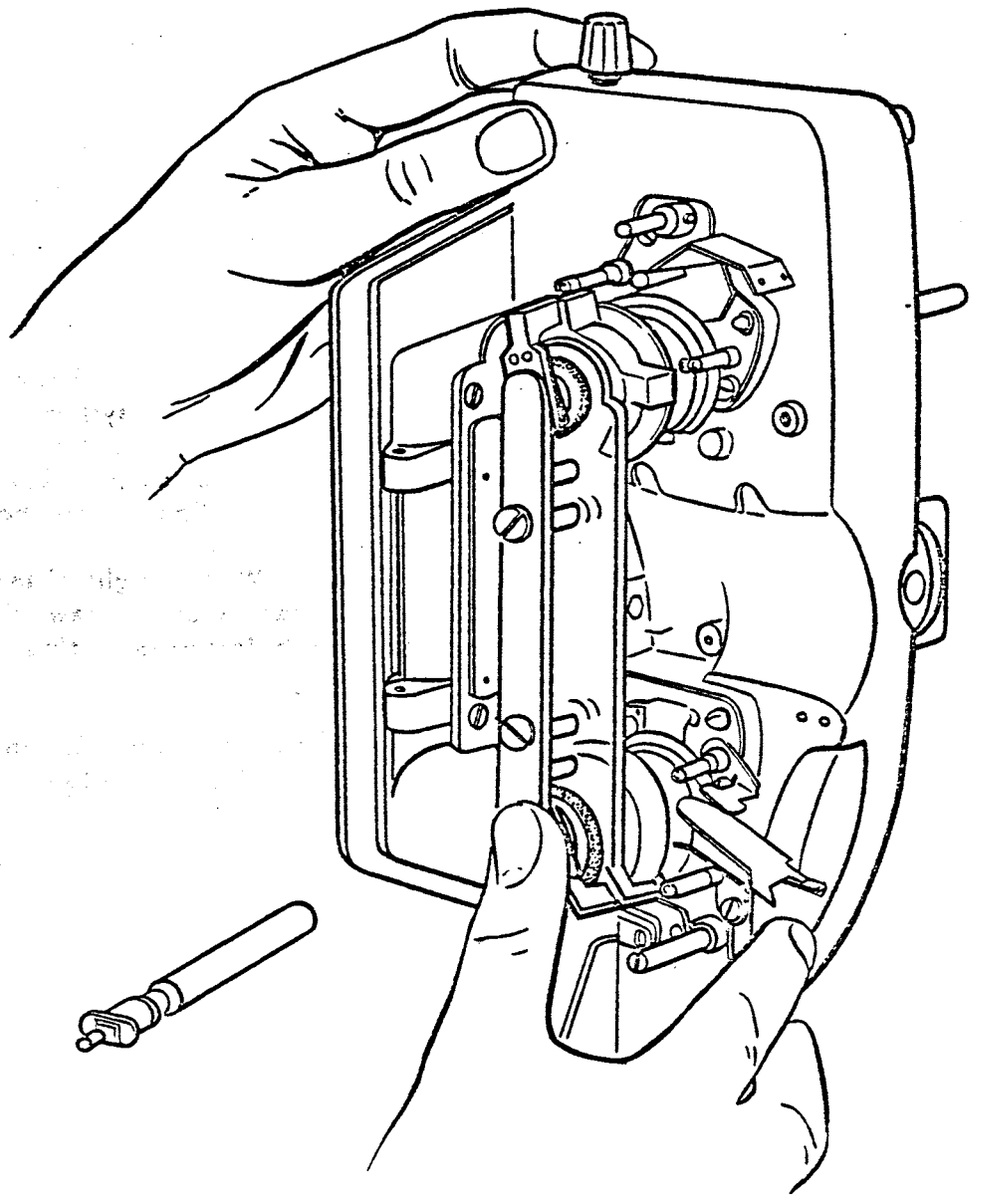


Fig. L

TIMING THE SPROCKETS

NOTE

While depressing lower loop form assembly, check to make certain that the pin in the threading lever (36 Fig.45) clears the bottom of the slot in arm of loop form shaft (68) by 1/64 inch. If pin is touching bottom of slot, loosen the screws (35) in threading lever and move lever upward to obtain the proper clearance.

Again depress the loop form assembly and check to make certain that there is 0.012 to 0.015 inch clearance between the top surface of the lower loop form (4 Fig.K) and the bottom surface of the upper loop form (8). If adjustment is required, remove the two screws which attach the hood (9). Loosen two setscrews (10) and rotate upper loop form (8) to obtain desired clearance. Tighten set-screws and re-install hood. Before tightening hood retaining screws, press hood toward rear of projector.

With the auto-load system locked and film gate open, check to make certain that the shuttle teeth do not protrude through the slot in the apeture plate. If shuttle teeth protrude, loosen screw (6 Fig.J) and carefully raise the shuttle retractor (7) until teeth are retracted; then tighten screw (6) securely. CAUTION: The top end of the shuttle retractor must not strike the casting.

Close film gate while observing to see that the film pressure does not contact the aperture plate. If pressure plate remains in contact with aperture plate, either the pressure plate lift-off ear (8 Fig.J) or the ear (9) on the threading guide linkage is bent. Reform ear, or ears, as necessary.

Loosen screw (10 Fig.J) and align the film guide (11) so that film will feed squarely to the sprocket; then retighten screw (10).

Loosen screw (11 Fig.K) lock the system and check to make sure that loop form heel (5) is bearing on shoulder of roller stud (6). If necessary rotate the eccentric pivot (12) with a pin punch until heel bears against stud shoulder. When loop form is pressed down-ward, there must be no clearance between heel and stud shoulder. Recheck clearance between rear of loop form and aperture rails. Also, make certain that end of upper loop form (8) is tangent to slightly ahead of the plane of the aperture plate film support rails.

Install actuating assembly (5 Fig.J) and press it down to make certain that system does not lock. If system locks when actuating assembly is depressed, remove the assembly and raise the setscrew protruding up from boss in casting. This setscrew acts as a stop for the actuating assembly. When height of set-screw is properly adjusted, seal setscrew with shellac or cement and re-install actuating assembly with retaining ring.

Lock the system and try inserting film in to the feed sprocket. If film slips in too freely, loosen the two screws (13 Fig.K) and move leaf spring (14) downward to increase pressure on film. If film buckles as it is inserted, move leaf spring upward to reduce pressure; then tighten screws (13)

TIMING THE SPROCKETS (Figure L)

Open the film gate and insert Tool No. S-09701-N13 into the film aperture. Then turn the mechanism in the forward run direction until the edge of the shutter blade is in contact with the pin on the end of the tool.

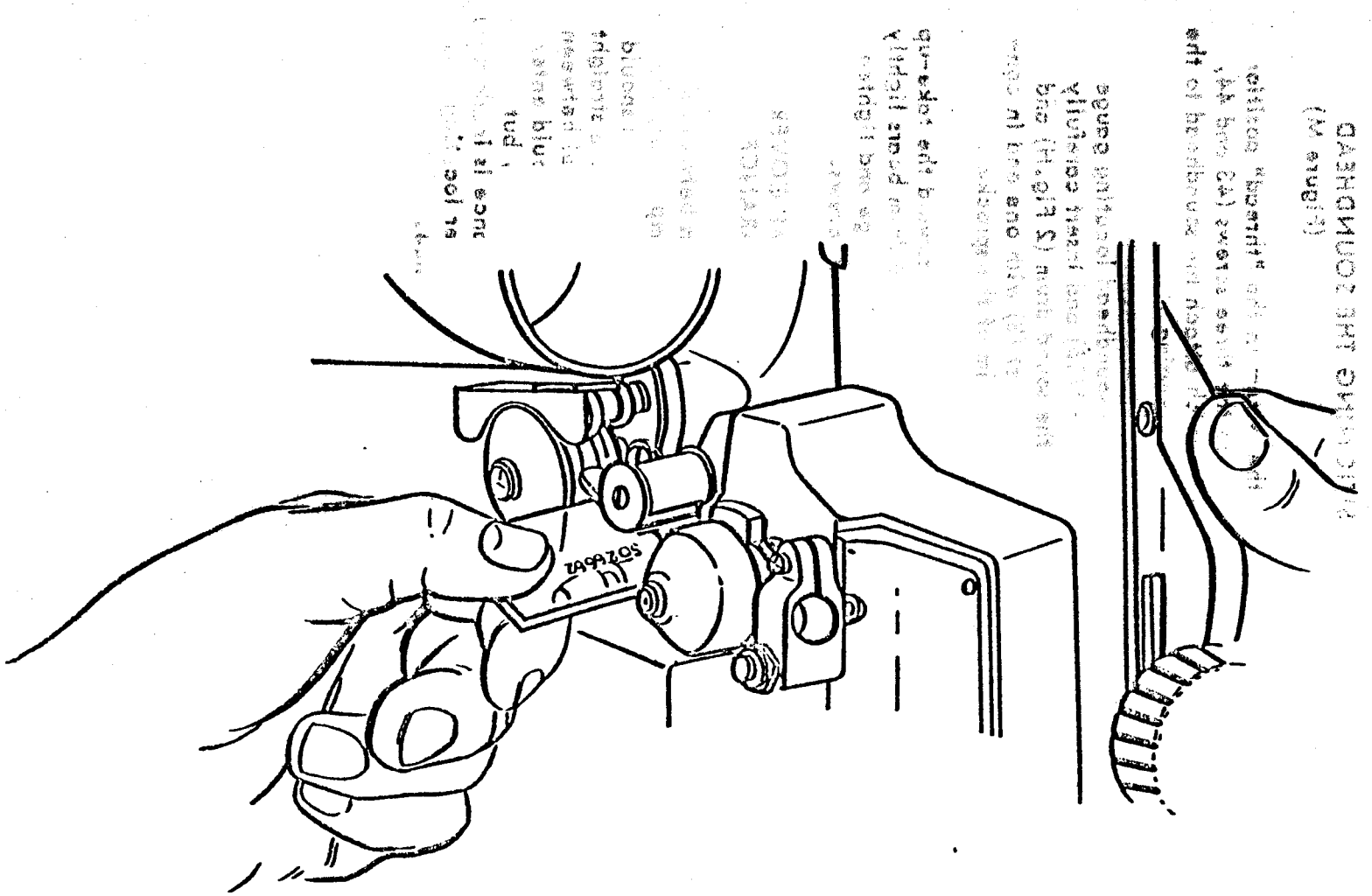


Fig.M. POSITIONING THE SOUND HEAD

Remove upper and lower sprocket guard assemblies and place the sprocket timing plate Tool No. S-09701-F21 over the sprocket hubs. Ensure that the spring loaded claws of the timing plate grip round the edge of the sprocket hubs.

To retime the feed (upper) sprocket, Remove the two sprocket setscrews to expose the inner setscrews and loosen the inner setscrews. Rotate the sprocket until the root of one of the sprocket teeth is in contact with the metal stop of the timing plate. Then tighten all four setscrews securely.

To retime the take up (lower) sprocket loosen the setscrews (38 Fig.10) in the hub of the lower sprocket gear (39) and adjust as for the upper sprocket. Then tighten gear setscrews securely.

NOTE

Sprocket shafts should have approximately 0.003 inch end play when tension washers (40 Fig.44) are completely compressed.

POSITIONING THE SOUNDHEAD (Figure M)

Lock the system in the "thread" position and loosen the three screws (43 and 44, Fig.42) which attach the soundhead to the main frame casting.

Hold the soundhead locating gauge (S-026662 - N1B) and insert carefully between the sound drum (2 Fig.H) and take up sprocket (3) with one end in contact with the rim of the sprocket.

Shift the soundhead toward the take-up sprocket until the sound drum bears lightly against the end of the gauge and tighten the soundhead attaching screws.

CHECKING EXCITER LAMP COVER CLEARANCE

Since the film must pass between the sound drum and exciter lamp cover, the clearance between these two items should be checked. Insert a 77 drill or a straight piece of 25 wire into the channel between the drum and cover. Gauge should enter the channel with slight friction, but without forcing. If clearance is inadequate straighten the exciter cover locating pins to obtain proper clearance.

BELL & HOWELL

Filmosound 16 mm Projector

DESIGN 652

SERVICE INSTRUCTIONS

SECTION 15

AMPLIFIER DATA

AMPLIFIER PART NO.027097

The amplifier used in the Model 652 projector has a rated output of 10 watts and a rated load impedance of 16 ohms. It is designed to accept signals from either a Photo-diode or a microphone. The insertion of the microphone jack automatically disconnects the photocell circuit. The sensitivity has been arranged to give an adequate gain margin over that required to obtain the full power output from a fully modulated film. A single tone control is provided which gives a lift variable from 0 to about + 8 db. at 10 k/c

The first stage uses the pentode action of a triode pentode valve type 6BR8. The anode load resister of this stage is very high (1.5 megohms) and the anode current is very small. This stage is worked under what are known as "starvation conditions" and although this does restrict the signal handling capacity it also allows a very large voltage gain to be obtained. The screen supply for this first stage is derived from the cathode of the following stage which is the triode section of the 6BR8. The anode of the first stage is directly coupled to the grid of the second stage which is used as a phase splitter. This phase splitter is of the conventional split load type, one output valve deriving its drive from the anode and the other from the cathode.

The output stage is a conventional push-pull stage employing two EL 84 valves. Negative feed-back is taken from the secondary of the output transformer and fed back to the cathode of the first stage. The tone control is in the feed-back circuit and is effective by operating on the frequency characteristic of the feed-back signal.

The power for the exciter lamp is supplied by an R.F. oscillator which employs a cathode coupled Hartley circuit. The exciter lamp is rated at 6 volts 1 amp and is operated with approximately 5½ volts to it in order to increase its life. The lamp voltage may be varied by means of a resistor (VR3) in the screen circuit of V4 the oscillator valve. The power for the amplifier and the oscillator is provided by means of a double wound transformer, the primary winding of which also acts as an auto transformer to supply the correct voltage for the projector motor. The anode supply is rectified by means of an EZ 81 rectifier valve.

PHYSICAL FEATURES OF THE 652 AMPLIFIER

The three amplifier valves, the oscillator and rectifier valves are all mounted on one printed circuit board. This board is of thick material and ruggedly constructed to prevent damage due to handling and transit. All heavy components have been kept off the printed board in order to ensure reliability with rough handling. The mains transformer is mounted away from the amplifier and is situated in the projector just beneath the motor. The servicing of this amplifier can, in most instances, be performed without the removal of the amplifier from the projector. The chassis has been kept shallo for this purpose. The photo cell employe for reading the signal from the optical sound track of the film is a Germanium Diode Because the Germanium Photo-diode used in the soundhead works into a lower load impedance than the Caesium-Silver photo cells previously used, the input impedance of the amplifier is relatively low. The lower impedance and the somewhat greater signal level obtained form the Photo-diode (about 10 D.B.) leads to comparative freedom from noise pick-up troubles and consequently an improved signal to noise ratio.

AMPLIFIER PART NO.027097

Four fuses have been fitted to protect the mains transformer from damage should a fault occur. Three of the fuses are fitted in the 6.3 volt heater supplier to the valves and the fourth as an H.T. fuse being fitted in the centre tap to the H.T. winding.

The 652 projector is fitted with a 6" x 4" elliptical speaker connected across the output. This internal speaker is automatically disconnected when an external speaker is plugged into the output socket.

The photo-cell and microphone inputs are provided with a single volume control. The tone control is provided with just one control for lifting the treble.

GENERAL INFORMATION

Sensitivity

Mic.Socket Min. 56 mv. ± 3 db
Max. 49 mv. ± 3 db

Power Output

10 watts
Signal - Noise Ratio (unweighted)
Better than 50 db.

Frequency Response

(Dependant on Tone Control Setting)

Mic. 50 - 10 Kc/s
Optical 50 - 7 Kc/s

Output Impedance to match 16 ohms.

BELL & HOWELL

Filmosound 16 mm Projector

DESIGN 652

SERVICE INSTRUCTIONS

SECTION 16
SPARE PARTS LISTS
AND ILLUSTRATIONS

Figure 42

PROJECTOR MAIN PLATE

Design 652

23	Screw, Idler Roller	30164
24	Stud, Film Guide Mounting	35861
25	Guide, Film	35852
26	Spacer	35862
27	Roller, Idler	35884
28	Handle, Snubber	36035
30	Roller, Idler	35884
31	Ring, Retaining	97509
32	Shaft Assembly, Snubber Roller	011222
33	Spring Snubber,	35859
34	Retainer, Snubber Spring	35858
35	Cover, Snubber Spring	35856
36	Post, Snubber Mounting	35860
45	Sound Head Assembly (see Fig.43)	011205
46	Screw, Cutter Attaching	31049
47	Cutter, and Pin Assembly	026655
48	Cutter Arm	58528
49	Button	59710

Parts common to design 641 are not listed

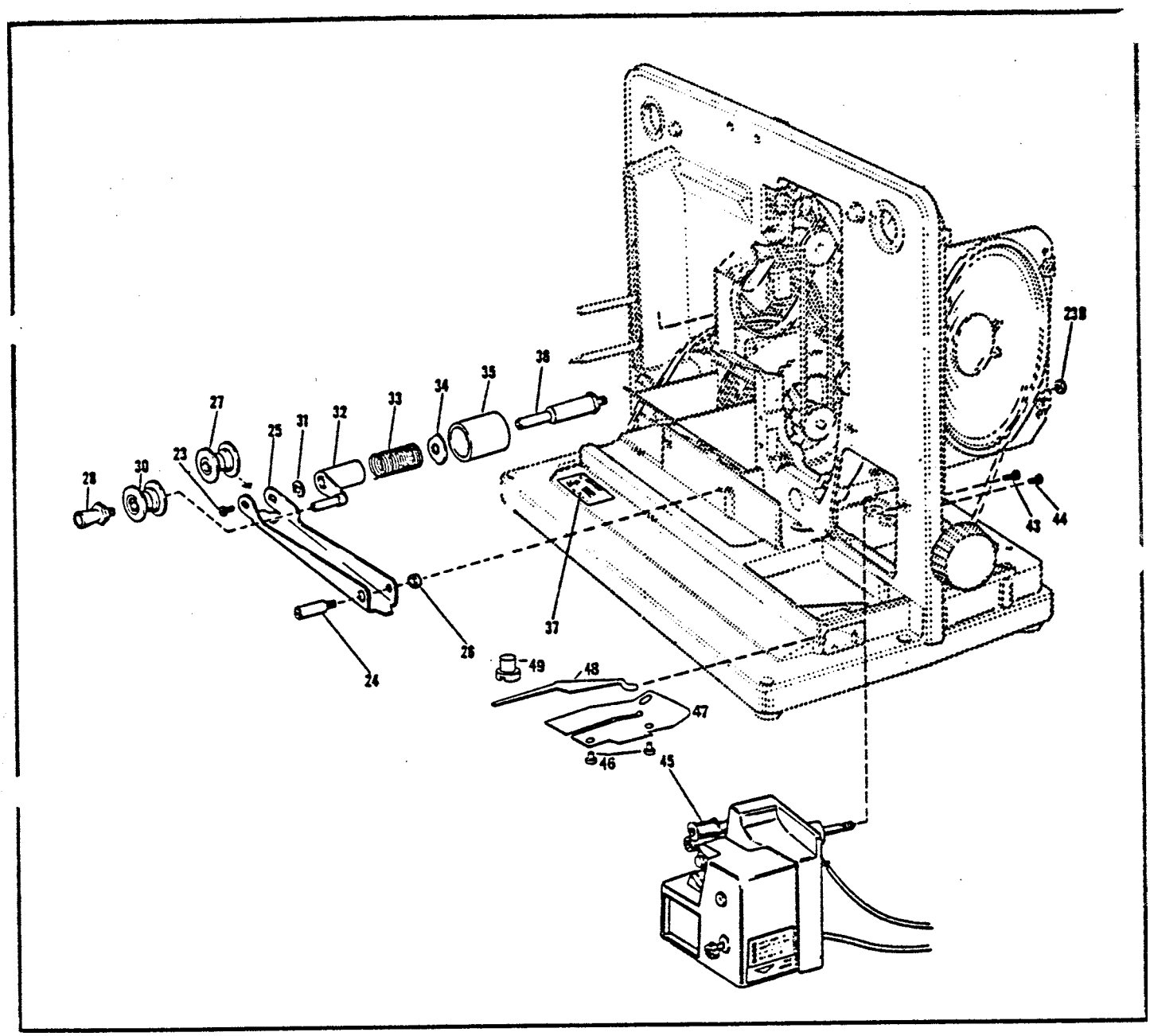


FIGURE 42

Figure 43

SOUND HEAD ASSEMBLY

Design 652

	Sound Head Assembly	011205
2	Screw, Cover Retaining	34837
4	Ruby, Indicating	34787
5	Screw, Film Guide	29526
6	Guide, Film	35823
7	Cover Assembly, Exciter Lamp	011942
7a	Nameplate, Film Cutter	31643
36	Housing Assembly, Sound Head	011943

Parts common to design 641 are not listed

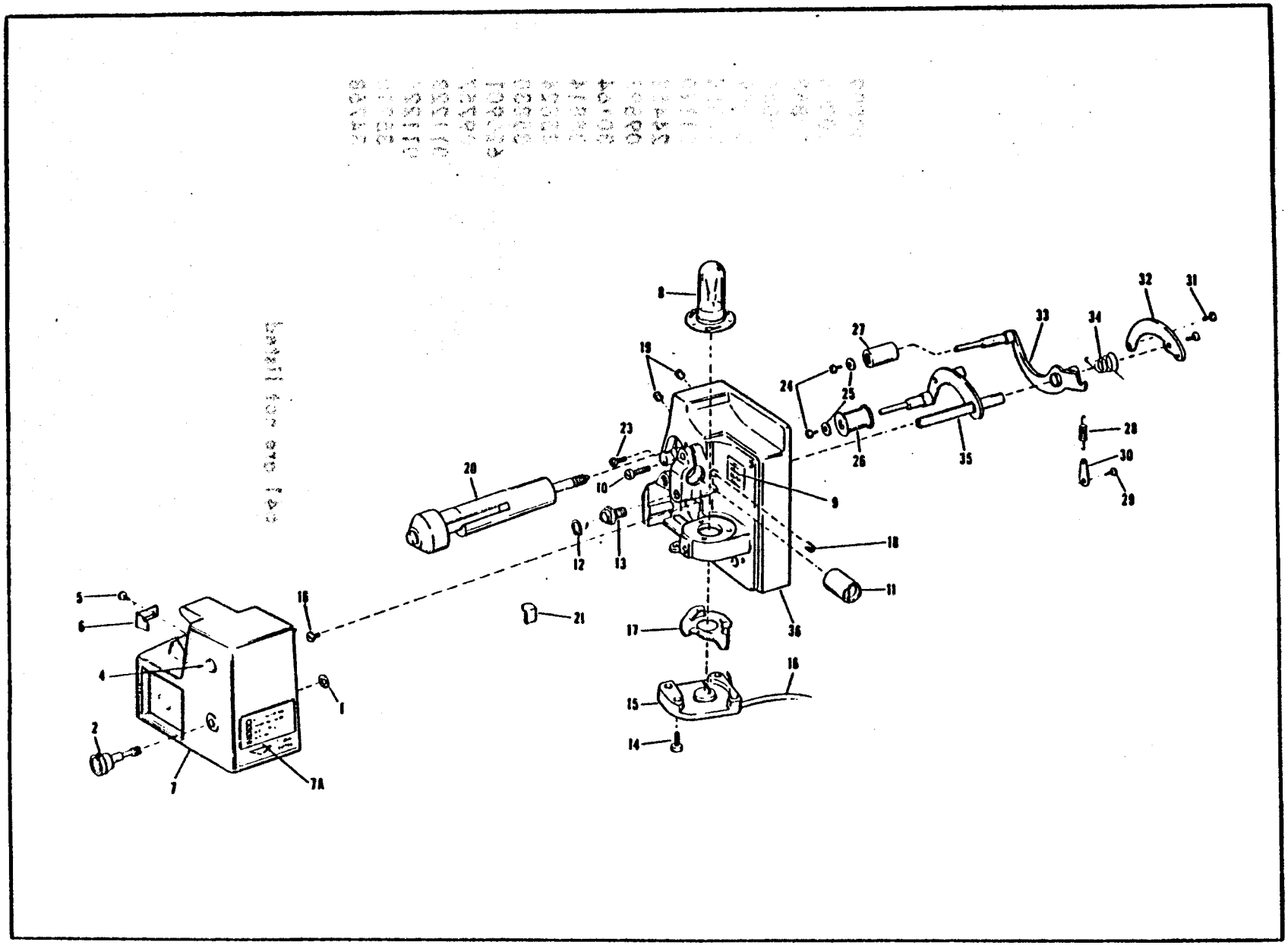


Figure 43. Sound Head Assembly

Figure 44

652 MECHANISM ASSEMBLY COMPLETE

5	Lens Carrier Assembly	09899
12	Ring Retaining	20808
13	Actuating Assembly, Spring & Button	09853
13B	Set Screw	36056
14	Screw, Hood	31049
15	Hood	33358
	Ring , Felt	31120
32	Screw, Sprocket Guard	24452
33	Guard Assembly, Sprocket (See Fig.46 for detail)	09897
34	Screw, Sprocket Guard	30164
35	Guard, Sprocket	35814
36	Roller	35824
37	Spring, Torsion	35830
38	Setscrew	620901
39	Gear Assembly, Sprocket	09757
41	Sprocket Assembly, Upper	011228
42	Sprocket Assembly, Lower	011226
43	Flange, Lower Sprocket	35910
45	Pin , Cover Stop	34768

Parts common to design 641 are not listed

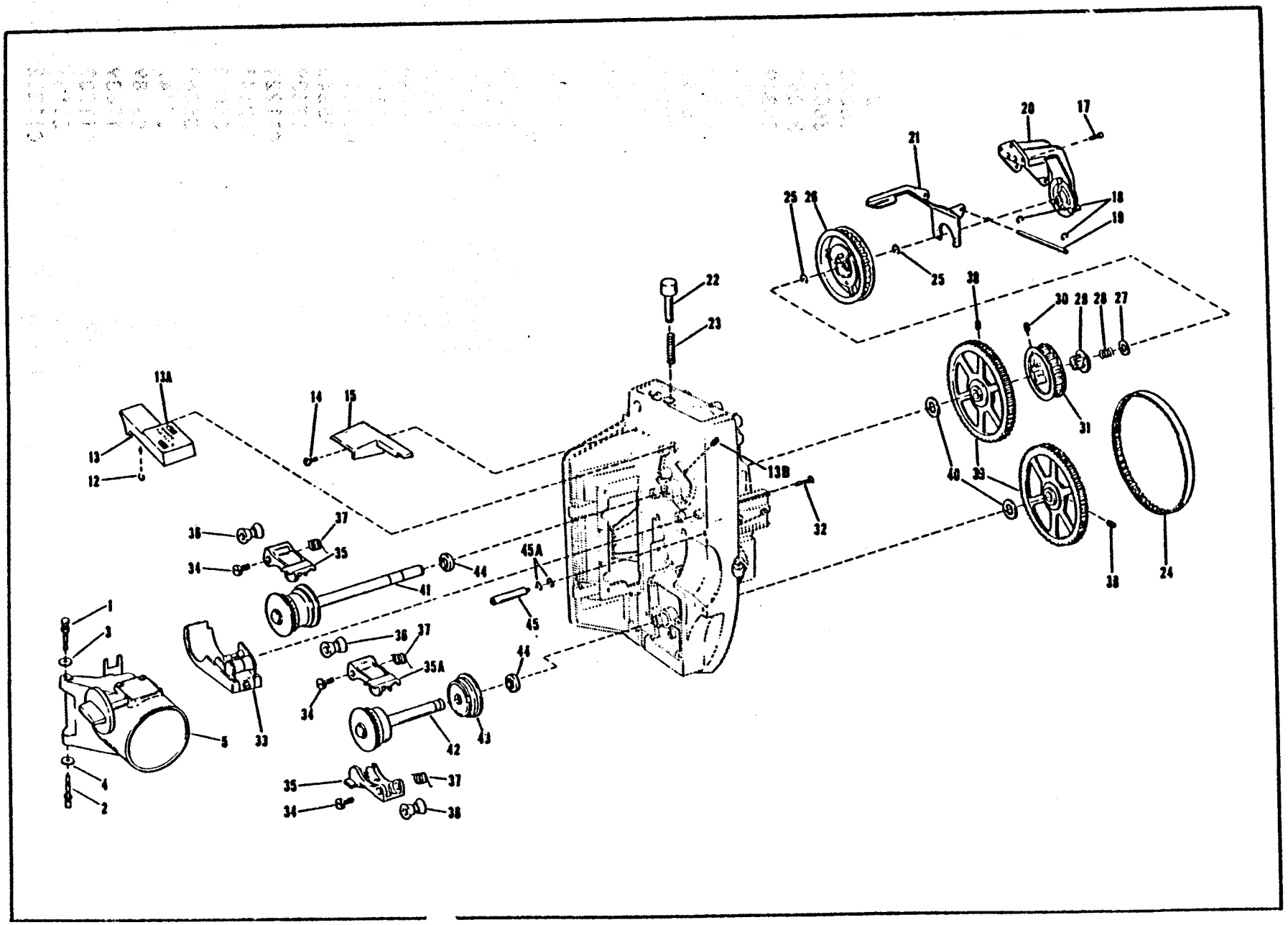
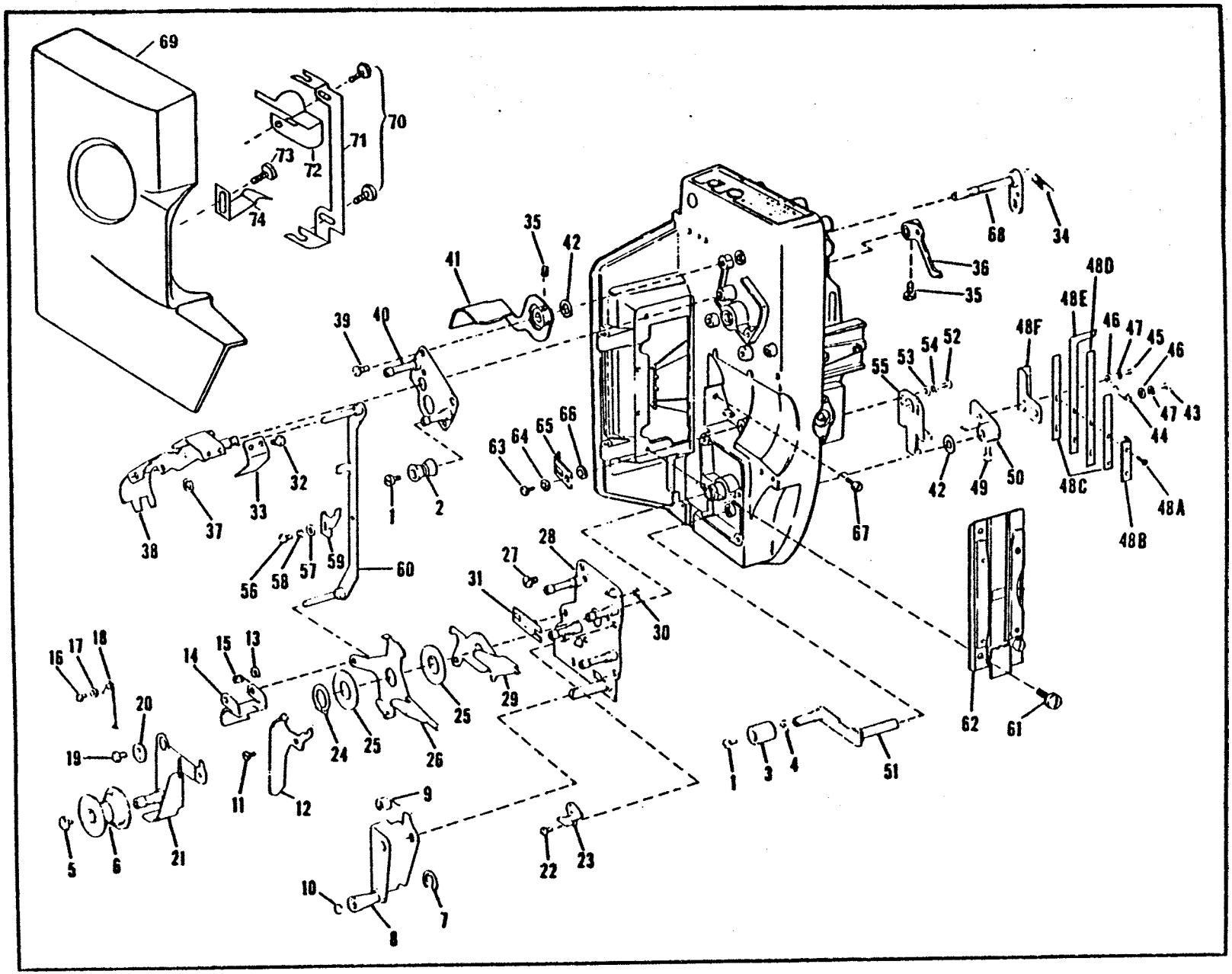


Figure 44. Mechai ı Assembly (1)

Figure 45

652 MECHANISM ASSEMBLY COMPLETE

1	Screw, Roller	30164
2	Roller, Flanged	35829
3	Roller, Plain	35840
4	Ring, Retaining	20808
5	Screw, Roller	605222
6	Roller, Idler	35885
7	Ring , Retaining	97509
8	Bracket and Handle Assembly	011245
9	Spring, Torsion	36023
10	Insert No.3	36031
11	Screw	31049
12	Guide, Film Exit	35849
13	Ring , retaining	17676
14	Form, Lower Loop	35874
15	Spring, Torsion	35838
16	Screw	30164
17	Bushing, Release Spring	35867
18	Spring, Release	35866
19	Screw	31049
20	Pivot, Locking Lever	35863
21	Lever Assembly, Auto Thread Locking	011220
22	Screw	31551
23	Bracket, Backup	35822
24	Ring Retaining	31413
25	Washer, Flat	35834
26	Guide, Film (Lower)	35850
27	Screw	31551
28	Plate Assembly, Sprocket Guard	011213
29	Guide, Film (Upper)	35846
30	Ring , Retaining	17639
31	Lever and Pivot Assembly (Toggle)	011221
32	Screw	303541
33	Spring, Leaf	36018
34	Spring,Tension	35869
35	Setscrew	33347
36	Lever, Assembly, Threading	09789
37	Ring Retaining	17639
38	Form Assembly, Lower Loop	011233
39	Screw	31551
40	Plate Assembly, Sprocket Guard (Upper	011212



Figu 45. Mechanism Assembly. (2)

652 MECHANISM ASSEMBLY COMPLETE cont.

41	Form and Hub Assembly, Upper Loop	011217
42	Washer, Flat	34878
43	Screw	31049
44	Spring Tension	36044
45	Screw	31049
46	Washer, Flat	17632
47	Washer, Lock	14175
48	Cam Follower and Support Assembly	011249
48A	Screw	31555
48B	Bracket, Follower Alignment	31474
48C	Spring, Cam Follower	36027
48D	Follower, Cam	36047
48E	Support, Cam Follower	36028
49	Screw, Hex. Head	33347
50	Arm Assembly	011250
51	Lever and Shaft Assembly	011219
52	Screw	31551
53	Washer, Flat	31020
54	Washer, Lock	31977
55	Self Centring Assembly	011248
56	Screw	31555
57	Washer, Flat	31451
58	Washer, Lock	83663
59	Retractor, Shuttle	35820
60	Link and Stud Assembly, Connecting	011218
61	Screw, Aperture Plate	31049
62	Aperture Plate Assembly (see Fig. 47)	027005
63	Screw	31049
64	Washer, Lock	14175
65	Catch, Lens Carrier	34885
66	Washer, Flat	13198
67	Screw, Lens Stop	32260
68	Shaft and Link Assembly	011214
69	Shield, Mechanism	59600
70	Screw, Bar attaching	31049
71	Bar	31610
72	Latch	31609
73	Screw, spring securing	31550
74	Spring	36069

Figure 46

Mechanism Assembly

Key No.	Description	Part No.
1	Set Screw, Pulley	12636
2	Pulley, Mechanism	59697
9	Shutter Blade	59689

Projection Lampholder Assembly (see Fig.33A)

	Blower Assembly	027168
	Pulley Blower	59535
3	Pin, Lamp Release Lever	59434
4	Lever, Lamp Release	59687
8	Bracket, Lamp Socket	59268
9	Insulator, Lamp Release Lever	59688

Parts not listed are common to design 641

	Rubazote Block	59952

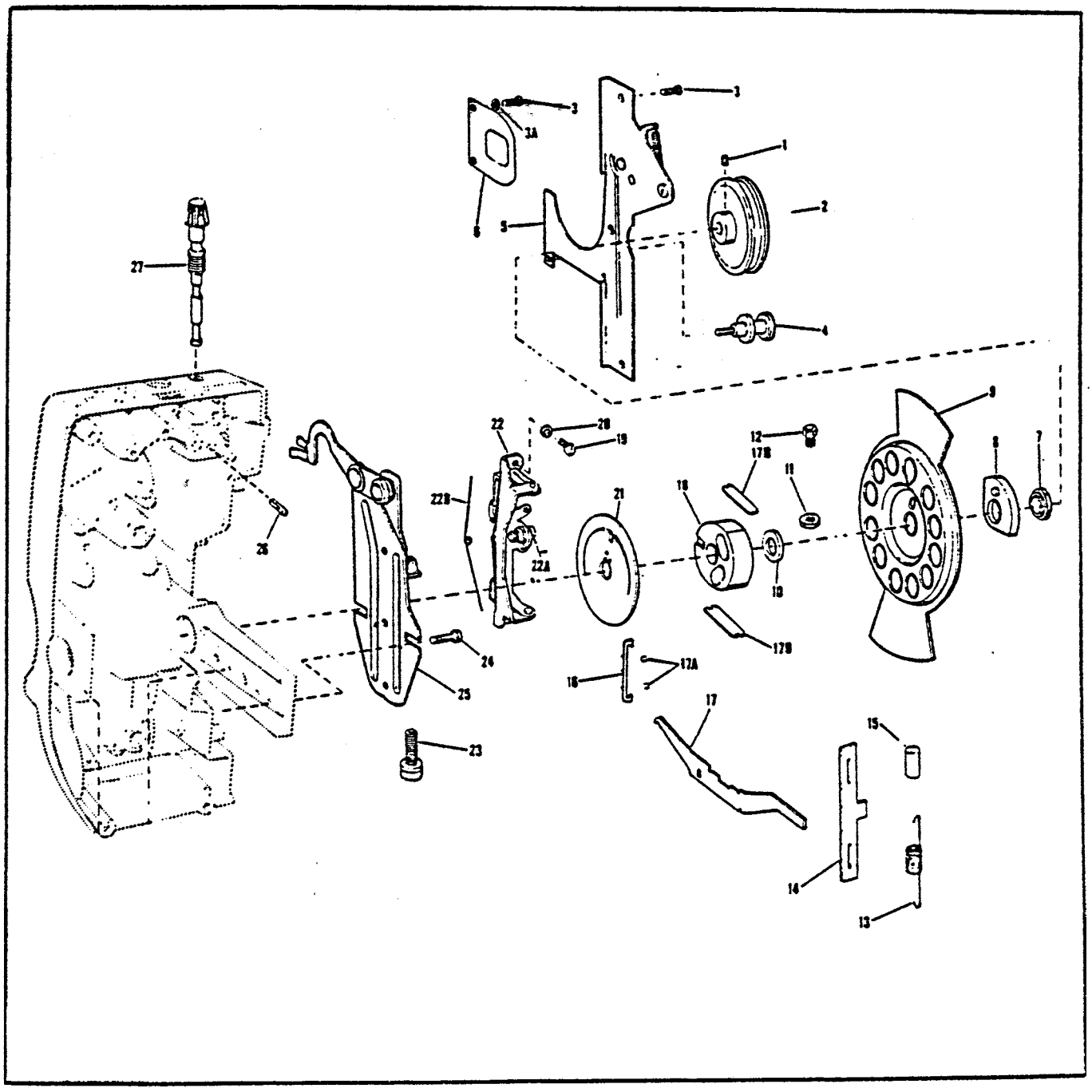


Figure 46 Mechanism Assembly (3)

Figure 47

APERTURE PLATE ASSEMBLY

Design 652

	Aperture Plate Assembly	027005
2	Rail, Film Guide	35883
4	Cover, Spring Retaining	36079
6	Rail, Film Tension	33256
8	Screw	30164
9	Nut, Hex	25042
10	Washer, Lock	24397
11	Guide, Film	36075
12	Plate, Aperture	59482

Parts common to design 641 are not listed

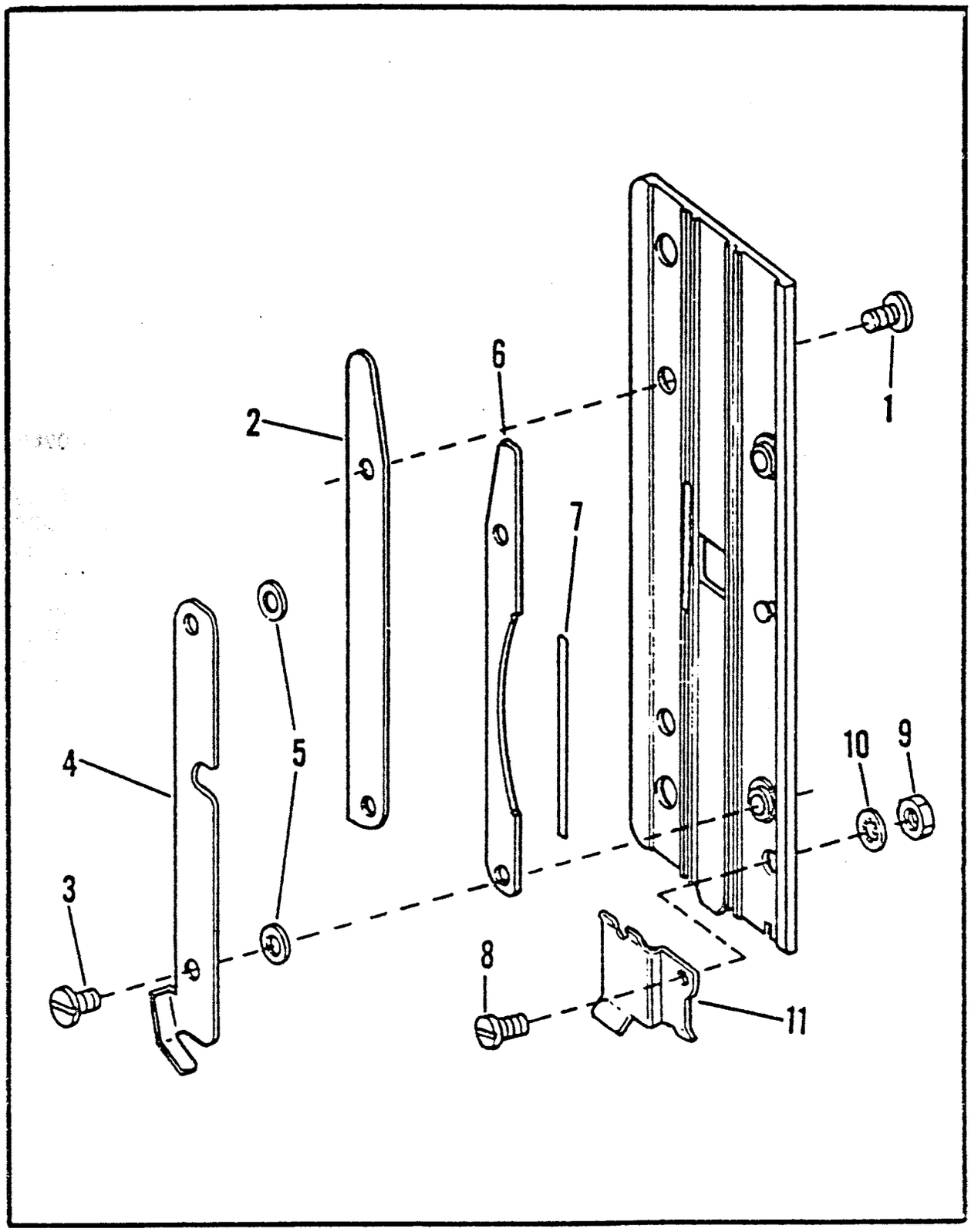


Figure 47. Aperture Plate Assembly

Figure 48

LENS CARRIER ASSEMBLY

	Carrier Assembly Lens	09899
3	Knob Assembly, Focus	09847
4	Screw, Pressure Plate	35880
5	Bushing, Spacing (Upper)	35868
6	Bushing, Spacing (Lower)	31097
8	Spring, Compression	34897
9	Lever, Pressure Plate	35819
12	Button, Stop	33309
13	Carrier, Lens	09898

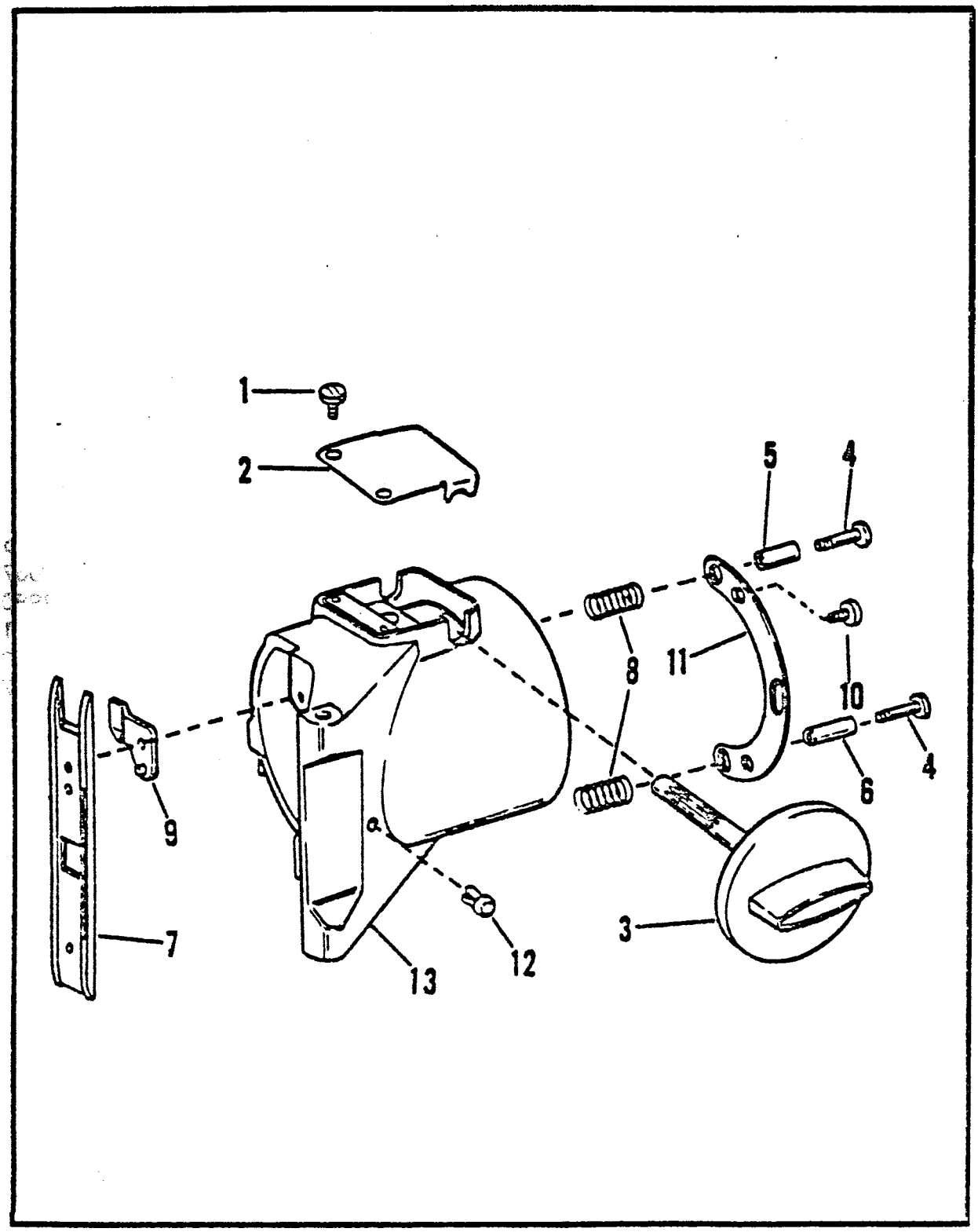


Figure 48. Lens Carrier Assembly

Figure 49

SPROCKET GUARD ASSEMBLY

	Sprocket Guard Assembly	012125
1	Ring, Retaining	27067
2	Washer,	32980
3	Roller, Feed Channel (Front)	36671
4	Guard and Shaft Assembly	09799
5	Spring	31467
6	Roller, Feed Channel (Rear)	36670
7	Roller, Steel	31466
8	Screw	31551
9	Washer	700639
10	Channel and Post Assembly	012131
11	Screw	30164
12	Strike, Cover	31963
13	Guard, Sprocket	36673

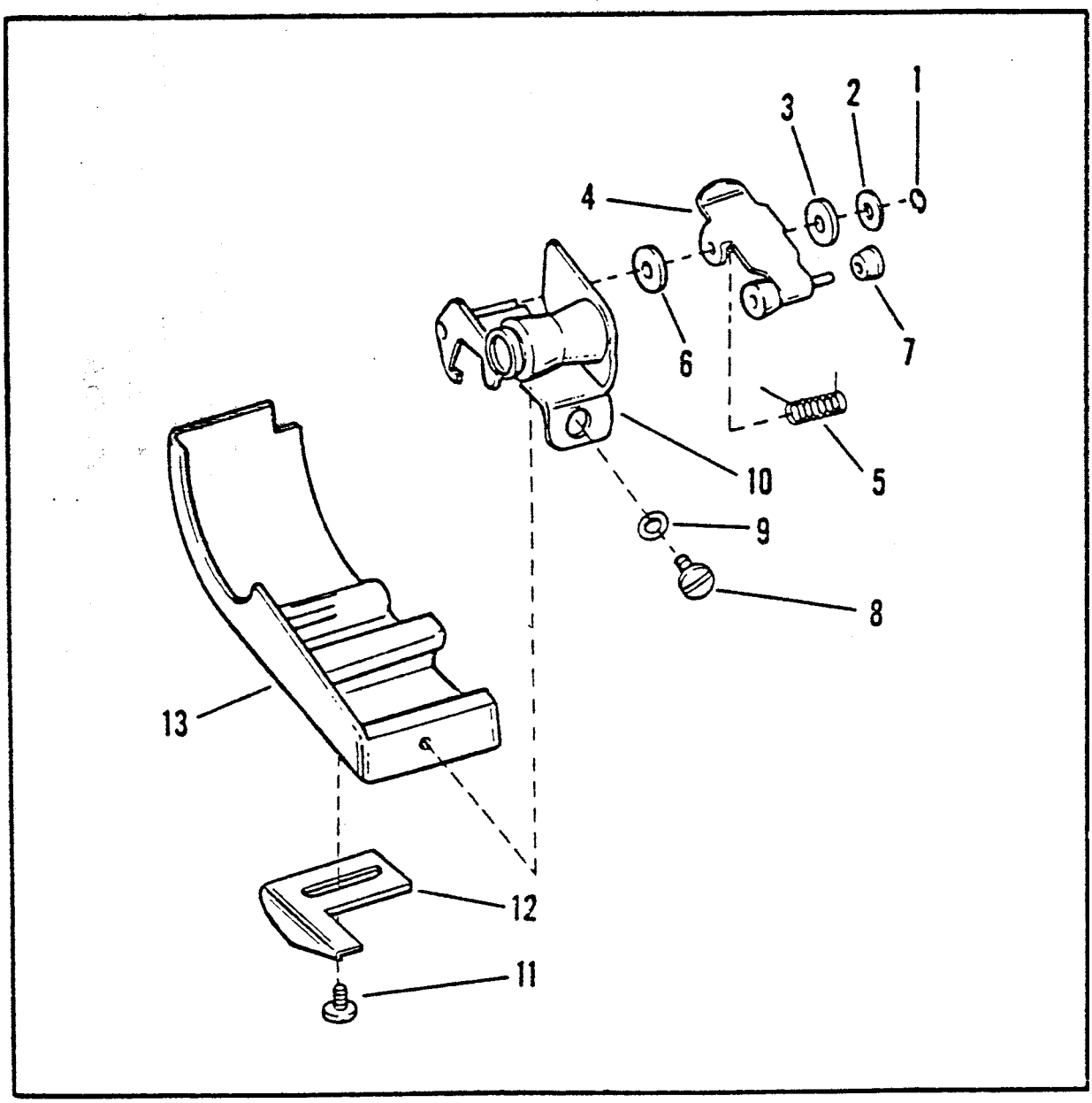
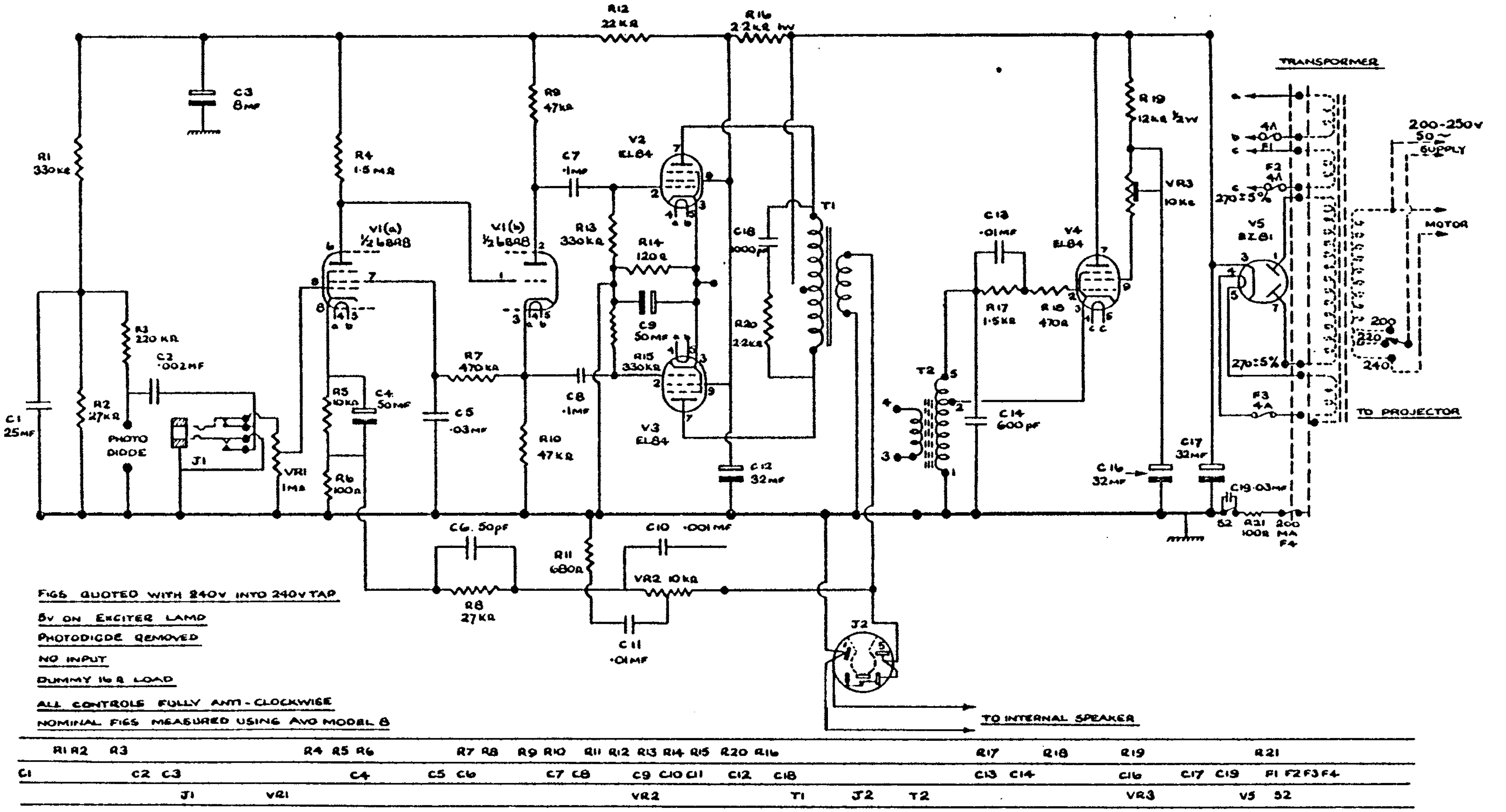


Figure 49 Sprocket Guard Assembly (Interim Design)



CIRCUIT DIAGRAM, 652 AMPLIFIER

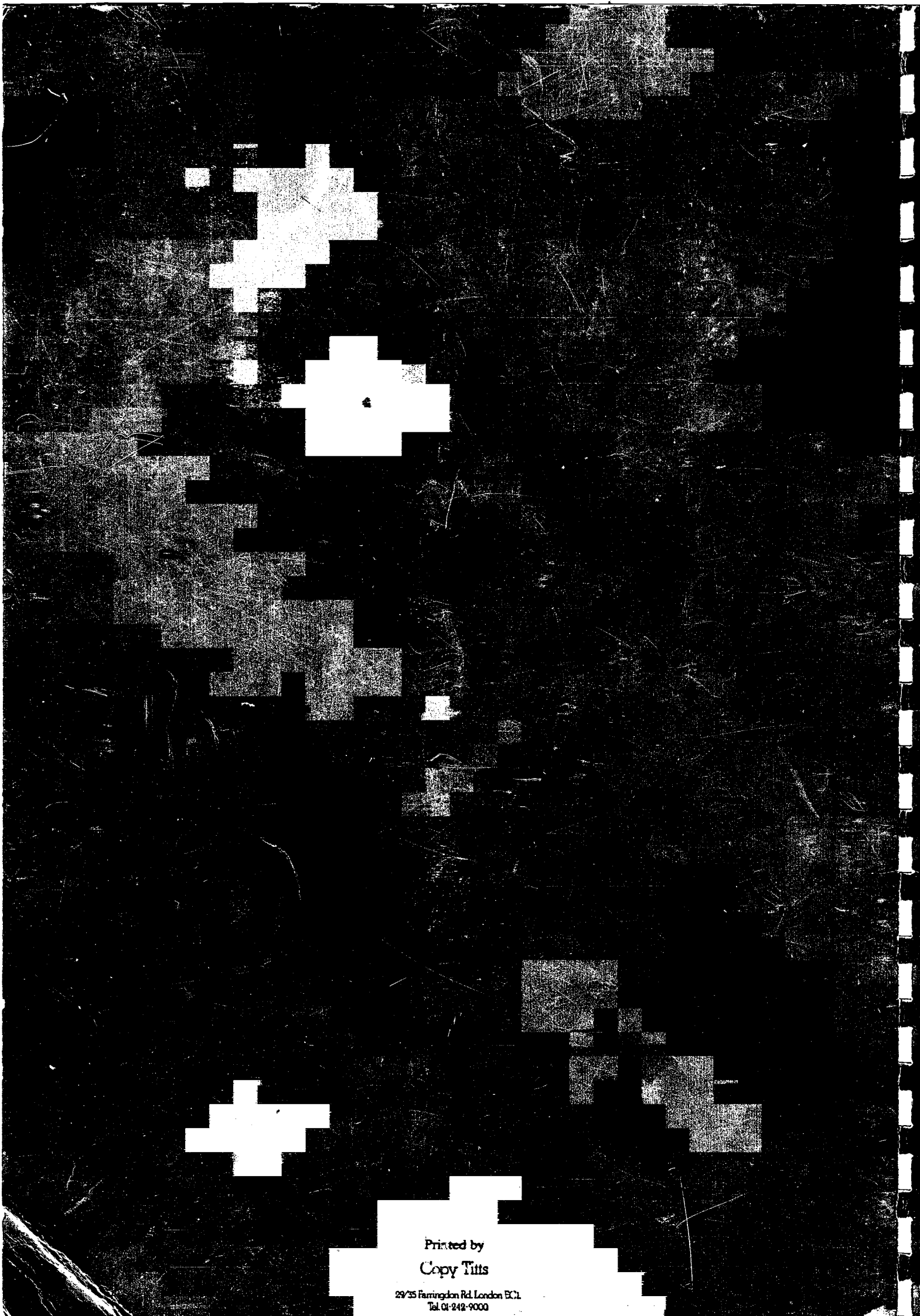
FIGURE 50

SYM:	VALUE	PART NO
R1	330K Ω (±10%)	58755
R2	27K Ω (±10%)	58386
R3	220K Ω (±10%)	56388
R4	1·5m Ω (±10%)	56377
R5	10K Ω (±20%)	56487
R6	100 Ω (±10%)	58387
R7	470K Ω (±20%)	56458
R8	27K Ω (±10%)	58386
R9	47K Ω (±10%)	56490
R10	47K Ω (±10%)	56490
R11	680 Ω (±20%)	58484
R12	22K Ω (±20%)	56331
R13	330K Ω (±20%)	57390
R14	120 Ω (±10%) ½w	59781
R15	330K Ω (±20%)	57390
R16	2·2K Ω 1w	58934
R17	1·5K Ω (±10%) w	58399
R18	470 Ω (±10%)	58390
R19	12K Ω ½w	59785
R20	2·2K Ω (±20%)	56378
R21	100 Ω 3w	59780
VR1	1m Ω LOG	58447
VR2	10K Ω LOG WITH DP SWITCH	58443
VR3	10K Ω PRE-SET	58587

SYM	VALUE	PART NO
C.1	·25μF 250vw	56374
C.2	·002 μF	58391
C.3	8 μF	58394
C4	50μF	58395
C5	·03μF	58343
C6	50pF (±2%)	58336
C7	·1μF	59435
C8	·1μF	59435
C9	50μF	59760
C10	·001μF (±10%)	56496
C11	·01μF (±25%)	57376
C12	32μF 350vw	SEEC17
C13	·01μF	56408
C14	600 PF (±10%)	58397
C15		
C16	32μF 350vw	SEEC17
C17	32μF 350vw	58400
C18	1000 PF (±10%)	59537
C19	·03μF	56343

SYM	VALUE	PART NO
V1	6BR8	58446
V2	EL84	54381
V3	EL84	54381
V4	EL84	54381
V5	EZ81	58446
T1	O/P XFMR	
T2	OSC XFMR	
S.2	DP.S.T. SWITCH	SEEVR2
J1	MIC: SOCKET	026672
J2	SPK SOCKET	58572
F1	4000 MA FUSE	59691
F2	4000 MA FUSE	59691
F3	4000 MA FUSE	59691
F4	200 MA FUSE	59722

652 AMPLIFIER ASSEMBLY



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