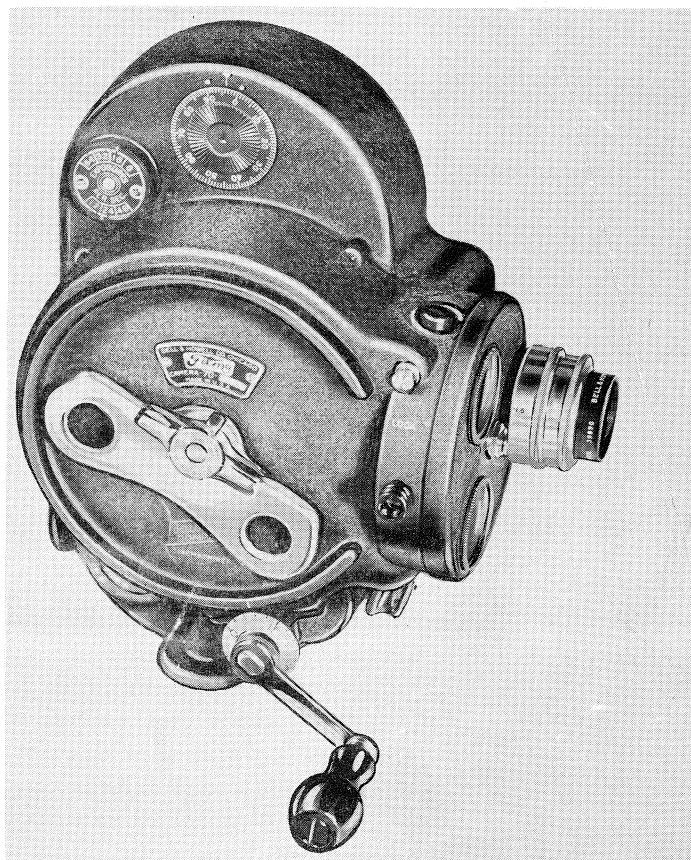
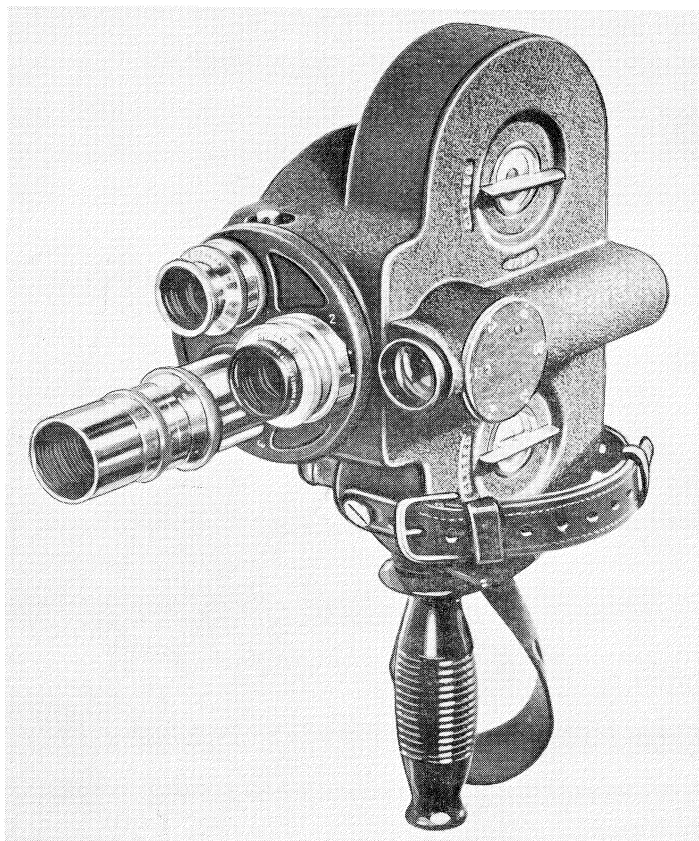


SERVICE INSTRUCTIONS

DESIGN 70 CAMERAS

DA, DL, H, DR, HR





Introduction

This instruction book has been prepared to aid the serviceman in the repair of Bell & Howell Design 70 cameras. Replacement parts for these cameras are listed and illustrated in the Parts Catalog section of the book.

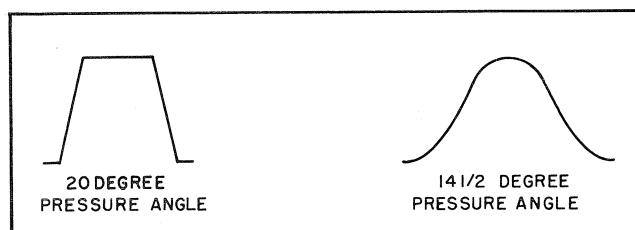
All parts in the exploded view illustrations in the Parts Catalog section are indexed in their suggested order of removal. The serviceman must use his own judgment in eliminating unnecessary steps of disassembly when making specific repairs to the camera. Special tools required for repair and adjustment are listed at the end of this section (Special Tools List), and their use is illustrated throughout the service instructions.

Note, in the parts lists, that a Usable on Code column has been provided to indicate the applicability of parts to the various camera models covered by this instruction book. When a listed part is applicable to all models, this column will be blank. When code letters are inserted in this column, the listed part is used only on the camera, or cameras, to which those

letters apply. Following is a listing of the code letters used and the corresponding camera model to which each applies:

CODE LETTER	CAMERA MODEL
A	Design 70-DA
B	Design 70-DL
C	Design 70-H
D	Design 70-DR
E	Design 70-HR

It is very important to note that cameras beginning with serial number L-98020 have been equipped with newly designed gears. These new gears have a pressure angle of 20 degrees as compared to the 14-1/2 degree pressure angle formerly used. (See accompanying sketch.) When servicing these cameras, be sure to check all gears for pressure angle. The difference can be noted by visually checking corresponding gears or by using a slide or film-strip projector to produce an enlarged profile of the gear teeth. When reassembling the camera, all worn bearings must be replaced and all gears must have the same pressure angle. Mis-matching of gears (mixing gears of both pressure angles in the same camera) will cause excessively noisy operation, excessive gear tooth wear and excessive bearing wear within a relatively short period of use.



SPECIAL TOOLS LIST

Tool No.	Tool Name
S-3972-N1	Shuttle teeth gage (horizontal alinement of aperture plate opening) (Fig. S)
S-4163-N2	Front plate assembly fixture and gage (vertical alinement of aperture plate opening) (Fig. Q)
S-5218-F2	Hand crank (use with ST-243) (Fig. C)
ST-243	Spring winding fixture (Fig. C)
S-7807-N5	Hole locating gage (for governor bearing studs) (Fig. F)
S-8074-F8	Spring setting tool (for setting governor spring) (Fig. M)

Tool No.	Tool Name
S-8074-N5	Spring distance gage (to check position of governor weights) (Fig. L)
S-8074-N6	Spreading tool (to spread all governor weights simultaneously) (Fig. N)
S-8074-N7	Spreading tool ring (to hold springs while spreading weights) (Fig. N)
S-8094-F3	Spring gaging fixture (to check and set spring on governor housing) (Fig. P)
S-8094-F4	Spring gaging fixture (Fig. P)
S-8681-F1	Driving mechanism pin wrench (Fig. A)

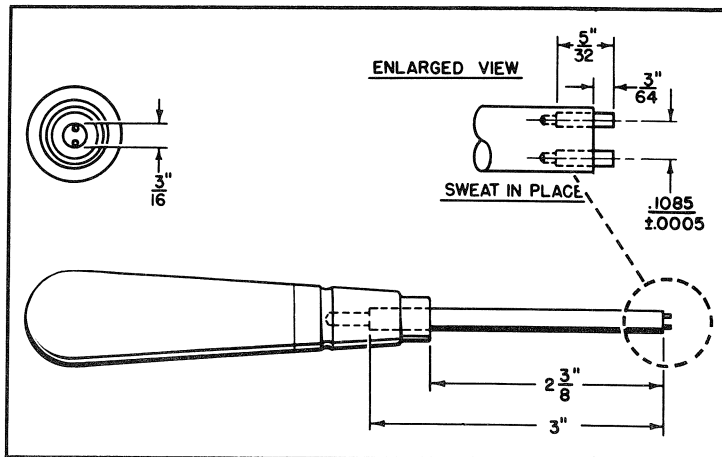


Figure A.
S-8681-F1 Driving
Mechanism Pin Wrench

We advise that the serviceman make the holding fixture illustrated in figure J. A tweezers also will prove invaluable when handling small parts. Once more we would like to stress the importance of using the proper size tools when dismantling or reassembling the camera equipment. It is also advisable to replace all screws in their respective holes after a part has been disassembled. This will avoid any mix-up of screws in reassembly, because many screws have the same diameter and threads per inch but will vary in length.

MANUAL REVISIONS.

This manual is subject to revisions which may occur from time to time whenever the Bell & Howell Company makes improved changes in design. Such revisions or additions automatically will be forwarded to the distributors for insertion in the manual. Keep your service manual up-to-date. Insert revision pages at once and place obsolete pages in the back of the manual for reference when repairing obsolete model cameras.

Disassembly Procedure

1. INSPECTION PRIOR TO DISASSEMBLY.

a. **GENERAL INSPECTION.** Load the camera with exposed film. With the camera door removed, wind the spring motor to capacity and lock the starting button in place. Check the course of the film to make certain that sprocket teeth are releasing the film smoothly and that film is winding tight on the take-up spool. Listen for unusual noises that may indicate a need for lubrication. Check the footage indicator to make certain that the dial does not stick at any point. Watch the action of the footage dial ratchet pawls, inside the camera frame, to make sure that the footage dial does not jump.

b. **CHECKING CAMERA RUNNING SPEED.** Before disassembling the camera, it is advisable to check the camera running speeds to determine whether or not the governor needs adjustment or replacement. In many cases, should it be found that speeds are slow or fast, the replacement and remarking of the speed dial may be all that is necessary. Wind the camera spring to full

capacity, and leave the winding key in an upright position so that it will revolve as the camera runs. With film in the camera, set the speed dial at the speed to be checked and press the camera starting button. The revolutions made by the winding key at the various speeds should agree with those listed in the following chart. If errors are found, the speed dial should be recalibrated after the camera has been reassembled. (Refer to paragraph 21.)

Speed	No. of Revolutions	No. of Seconds	Tolerances	
			Fast	Slow
8	5	75	6 sec	3 sec
12	6	60	6 sec	3 sec
16	6	45	5 sec	3 sec
24	6	30	3 sec	2 sec
32	7	26	3 sec	2 sec
48	6	15	2 sec	2 sec
64	7	13	2 sec	2 sec

NOTE

A more accurate method for checking the running speed is to count the shutter revolutions with a stroboscope, if such an instrument is available. Use the following chart as a guide.

Camera Speed	Shutter rpm	Tolerances (+ or -)
8	480	10%
12	720	10%
16	960	5%
24	1440	5%
32	1920	10%
48	2880	10%
64	3480	10%

c. PHOTO TEST. Make a photo test with approximately three or four feet of film. Examine this test film for sharpness in order to check the camera lens focus. Join the ends of the film to make a loop and run it through a projector to check the steadiness and proper alinement of the image. Examine the film for scratches.

d. PRE-DISASSEMBLY INSTRUCTIONS.

(1). If disassembly of camera is not to include removal of driving mechanism from camera frame, proceed as follows: Allow camera to run down, by pressing starting button, until it stops at end of run. Follow disassembly instructions from paragraph 2-a. through 5-g. only.

(2). If front mechanism plate is to be removed without disturbing back mechanism plate or drive spring, first prepare the camera as follows: Press camera starting button and allow camera to run to end of capacity. Hold idler gear in disengaged position with screw driver as shown in figure B and again allow camera to run until it stops. This will allow spring to unwind to fullest capacity within camera frame. Then proceed to disassemble camera up to and including front mechanism plate. When this procedure is followed, front mechanism plate must be removed very carefully to avoid breaking seal of back mechanism plate.

(3). If camera is to be completely disassembled, first prepare the camera as follows: Wind spring motor to capacity, remove camera cover and set camera at slowest (8) speed. Press camera starting button, and allow camera to run until the first long tooth of idler gear is completely visible in the gear opening. While holding idler gear in depressed position with screw driver, allow camera to run until the shallow space between drive gear teeth is visible in the opening. Release the idler gear so that the first long tooth is engaged in this shallow space. Press camera starting button to make certain that mechanism is locked. Then proceed with disassembly of camera.

2. WINDING KEY. (See figure 1.)

a. Pry the winding key from its socket with a screw driver or similar tool.

b. Drive out the pin (1) with a drift punch, and remove the ratchet (2) from the spring shaft.

c. Pry the retaining ring (3) from the groove in the key body. Remove the retaining collar (4) and slide off the friction clip (5), clamp spring (6) and handle plate (7).

d. Pull on the end of the spring shaft to compress the spring, and press out the uncoupling bar (8). Then tap lightly on the end of the spring shaft (9) until the plug (10), spring shaft and spring (11) come out of the key body (12).

3. HAND CRANK. (See figure 2.)

a. Remove the hand crank dial locking spring (1) and pull the dial (2) from the crank stem. Be careful not to lose the two steel balls (3) and the compression spring (4).

b. Take out the fillister head screw (5) and remove the crank handle (6) from the hand crank assembly (7).

4. CAMERA COVER ASSEMBLY. (See figure 3.)

a. The camera cover assembly consists of two latch cam keys that move the cam hubs and upper and lower latch cams to the OPEN or CLOSED positions. These keys are staked to the latch cams and can be removed only by using a drift punch. Therefore, the cover assembly should be disassembled only when necessary to replace damaged parts.

b. Unscrew the view-finder eyepiece (1) and objective lens and mount assembly (2) from the view finder.

c. Drive out the latch cam key stakings with a drift punch, and remove the keys (3), latch cam hubs (4), latch cams (5 and 6) and the latch cam link (7).

d. The upper and lower door latches (8 and 11) can be removed by taking out the four shoulder screws (9 and 12) and spring washers (10 and 13). Note the

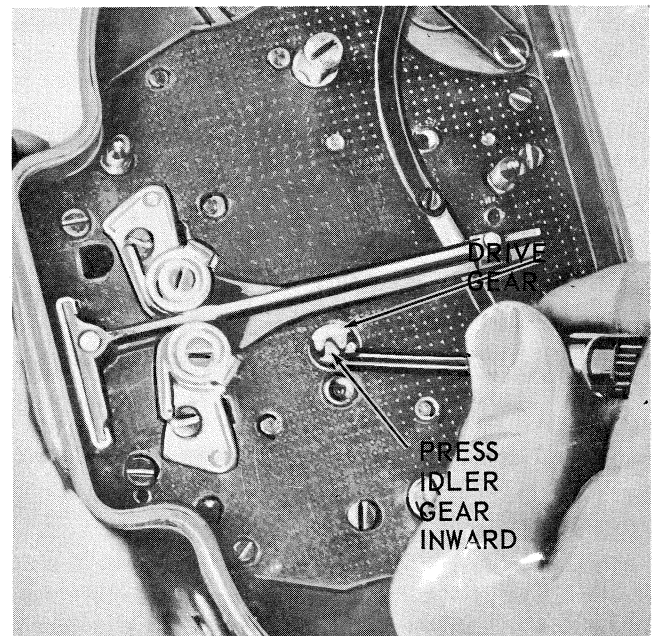


Figure B. Locking the Idler and Drive Gears

positions of the spring washers (10 and 13) before removal so that they may be reassembled in the same manner. Remove the eccentric (14) by taking out the fillister head screw (16).

e. The view-finder drum is accurately alined in assembly at the factory, and it must not be disassembled unless parts are broken or it is not operating properly. Should it become necessary to disassemble the view finder for replacement of parts, first remove the two shoulder screws (18) from inside the camera cover and lift out the turret hole cover (17).

f. Remove the three oval head screws (20) that attach the aperture dial (19) and lift off the dial and the dial seat disc (21). The view-finder aperture (22) then may be withdrawn from inside the camera cover. Be careful not to lose the shims (23 and 24) or the two steel balls (26).

NOTE

During reassembly be sure to replace same number and thicknesses of shims to insure alinement of view-finder aperture opening.

g. The index spring (24) and the indexing ring (26) are shown exploded in figure 3 for illustrating purposes only. Do not remove the ring or spring from the cover. The alinement of the indexing ring is extremely critical and requires the use of special factory alinement tools and fixtures. There is very little wear on either of these parts, and only in the case of physical damage to the camera cover or view-finder tube will they need replacement.

5. FRONT PLATE ASSEMBLY. (See figure 4.)

a. The unit of the camera known as the front plate assembly consists of the lens turret, front plate, shutter and intermittent mechanism (cam and shuttle).

b. Pry out the oil retaining plug (2) with a screw driver or knife blade. Remove the hex nut (3) and spacer (4) from the shuttle cam spindle. Revolve the turret (5) with an outward motion while cupping one hand around the front plate to catch the three indexing roller studs (6); indexing rollers (7) and compression springs (8) as the lens turret is removed.

CAUTION

Refer to paragraph 1-d for proper precautions to be taken before further disassembly is attempted.

c. The bearing plate (9) now can be lifted from the front plate. Remove the screw (10) that holds the plunger spring (11) in place, and lift out the spring and plunger (12).

d. Remove the four fillister head screws (1) that fasten the front plate assembly to the camera proper, and lift the plate assembly from the camera by pressing the thumb against the aperture plate. Keep one finger on the starting button to keep it from jumping out.

e. Remove the two screws (14) that hold the film guide rail (13) in place, and lift out the guide rail.

Remove the two screws (16) from the aperture plate (15), and the aperture plate, film tension rail (17) and guide rail tension spring (18) can be lifted out.

f. Take out the two screws (19) that hold the shuttle pins in place and lift out the shuttle (20). Be careful not to lose shuttle pins (21), bumper spring (22) or washer (23) during this operation. Lift out the stop pawl assembly (24).

g. Carefully lift the shutter and shuttle cam assembly (25) from the shuttle cam spindle (29), being very careful not to lose the shims (26 and/or 27). The dowel pin (28) need not be removed from the front plate. Do not remove the spindle and washer assembly (29) from the front plate (30) unless it is loose in the front plate casting. If such is the case, the front plate must be replaced.

6. REMOVING DRIVING MECHANISM AND DISASSEMBLING THE SPRING.

a. Before attempting to take out the driving mechanism assembly, the hand crank housing (index 25, figure 9) first must be removed by unscrewing the four screws (index 26, figure 9). The parts discussed in the remainder of this disassembly procedure are illustrated in figure 5.

b. Remove the four screws (1) that fasten the complete driving mechanism to the camera frame. Also remove the shoulder screw (2) and spacer (3) that attach the governor link (8) to the speed dial. Grasp the gate arm between thumb and forefinger, and carefully lift the driving mechanism out of the camera frame.

CAUTION

Do not attempt to remove the main driving spring from the mechanism unless a spring retaining clamp and a holding fixture (Tool No. ST-243) are available (figure C, Step 1). Be careful not to drop the mechanism so as to cause the spring to release.

c. Place the assembled mechanism within the holding fixture (Tool St-243-F1) with the driving spring facing up (figure C, Step 2), and install the spring clamp around the spring. If the clamp will not fit easily around the spring, use the handcrank (Tool No. S-5218-F2) to wind the spring more tightly.

d. Install the retaining bar (Tool No. ST-243-F2) as shown in figure C, Step 2, and lock in place with the clamp knobs. Turn the fixture over and press on the "buck tooth" gear of the mechanism (visible through an opening in the rear of the fixture). This will permit the spring to unwind until it is tight within the spring clamp. Insert the hand crank and turn it one full turn clockwise to disengage the inner end of the spring from the spring hub on the rear mechanism plate.

e. Remove the retaining bar from the holding fixture and lift the spring and clamp carefully from the rear mechanism plate. It is always advisable to wear gloves when handling the spring since the edges are very sharp. When lifting the mechanism plate from the fixture, be careful not to lose the pin

which held the outer end of the spring.

f. Place the fixture plate (Tool No. ST-243-F8) into the holding fixture as shown in figure C, Step 1, and install the collar (Tool No. ST-243-F9, spring hook (Tool No. ST-243-F11) and nut (Tool No. ST-243-F10) on the spring hook stud of the fixture as shown in figure C, Step 3. Place the fixture spring hub (Tool No. ST-243-F7) over the collar in the center of the fixture plate and lower the driving spring down over the hub, engaging the inner end of the spring with the slot in the hub.

g. Install the adapter (Tool No. ST-243-F5) on the top of the hub and the retaining bar (Tool No. ST-243-F2) on the adapter, and tighten the clamp knobs securely. Engage the spring hook with the outer end of the driving spring.

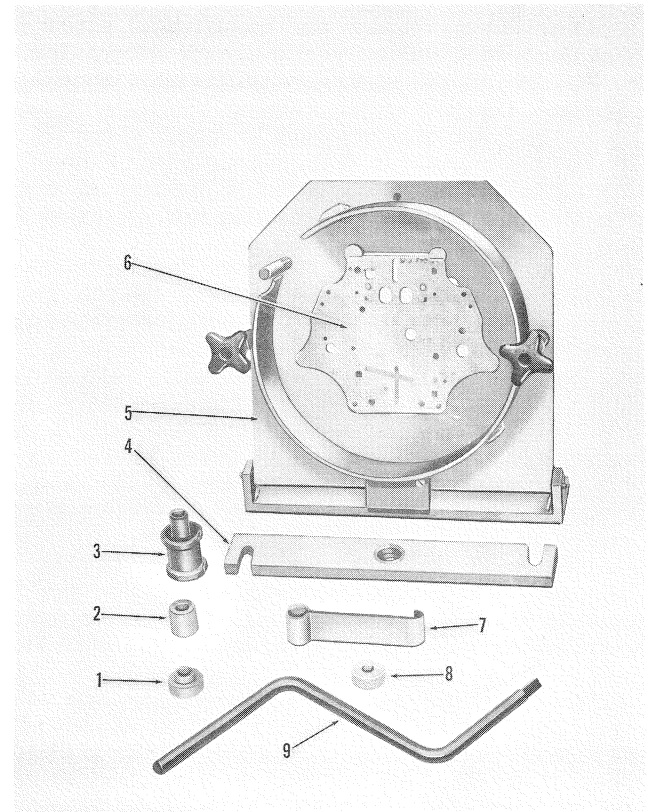
h. Use the hand crank to wind the spring until the spring clamp can be removed. Then slowly unwind the spring until it fills the drum of the holding fixture. The spring now can be pulled through the open slot in the fixture for inspection and cleaning.

i. Remove the shoulder screw (9) that fastens the governor connecting link (8) to the front plate.

7. FRONT MECHANISM PLATE ASSEMBLY.

a. Remove the fillister head screws (index 1, figure 6) that fasten the upper and lower mechanism plates

(cont'd on page 6)



- | | |
|-------------------------|----------------------|
| 1. Adapter ST-243-F5 | 5. Fixture ST-243-F1 |
| 2. Collar ST-243-F9 | 6. Plate ST-243-F8 |
| 3. Spring hub ST-243-F7 | 7. Hook ST-243-F11 |
| 4. Bar ST-243-F2 | 8. Knob ST-243-F10 |
| 9. Hand Crank S-5218-F2 | |

Figure C(Step 1). Holding Fixture, ST-243

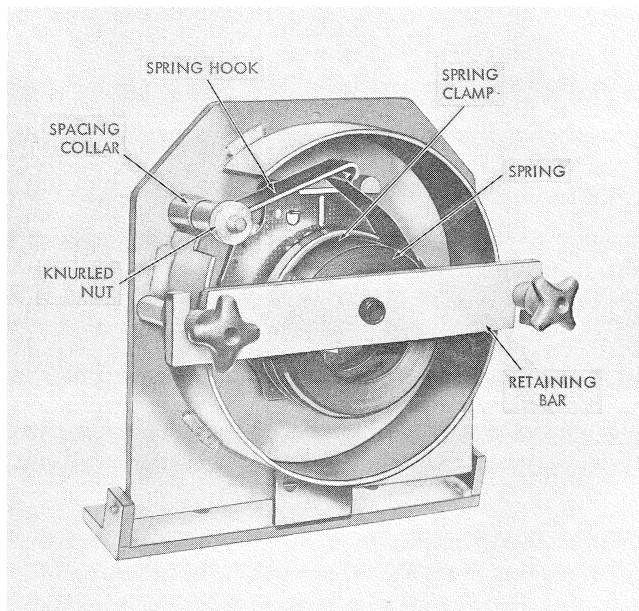


Figure C (Step 2). Mechanism and Driving Spring in Holding Fixture

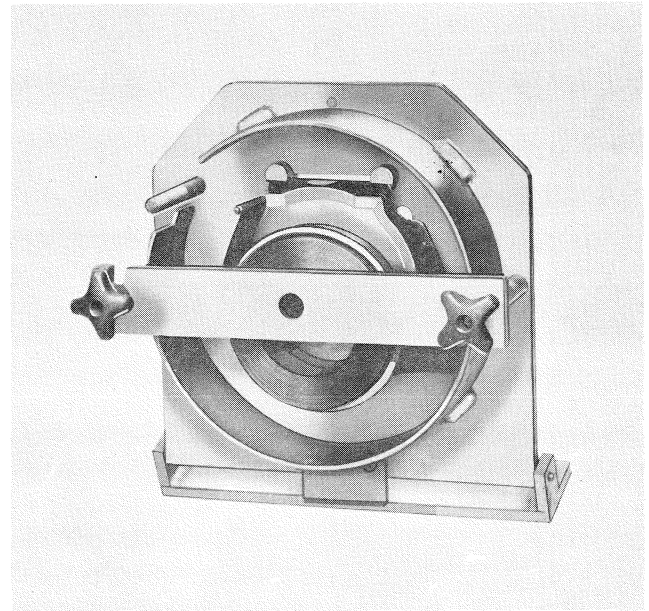


Figure C (Step 3). Spring and Clamp in Holding Fixture

together. Then remove the special head screw (2) with the S-8681 driving mechanism pin wrench (figure A) and lift off the upper mechanism plate assembly.

b. Open the gate arm. Remove the fillister head screw (4) that attaches each sprocket guard (3) to the sprockets, and lift off the guards and the shims (5). Then remove the feed sprocket (6), take-up sprocket (7), spring cover tubes (8), torsion springs (9 and 10) and sprocket gear and sleeve assemblies (11) from the film sprocket studs. The sprocket guide shoes (12 and 14) can be removed by taking out the film guide screws (13 and 15) that fastens each shoe to the front mechanism plate.

c. Remove the spring (16) which holds each of the four film guards (17) to front mechanism plate.

d. The governor and worm assembly (21), which regulates the speed of the camera within the prescribed range of eight to 64 frames per second, is critically aligned at the factory and must not be disassembled except to remove the governor assembly from the housing assembly. If either of these assemblies is damaged, it must be replaced with a new one. To remove the governor assembly, loosen the set screw (18) located in the center of the stud at the worm gear end of the governor shaft. Then back the bearing (19) halfway out of the stud, and remove the governor shaft from the opposite bearing (19). The governor assembly now may be lifted free of the two mechanism plate studs that retain its bearings. Be careful not to lose the two steel balls (20) that are housed in each bearing or the pressure spring (22) located in the recess of the governor housing.

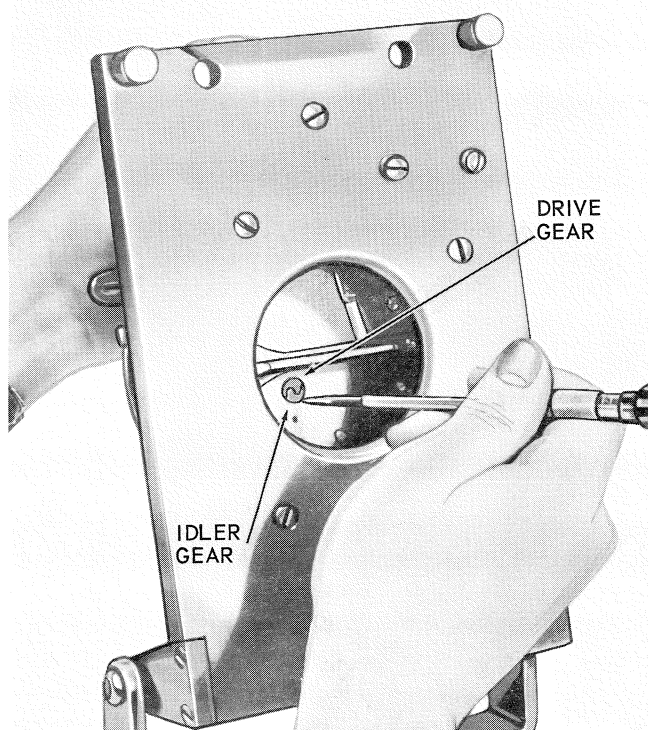


Figure D. Unlocking Idler and Drive Gears

NOTE: Figure E has been deleted.

NOTE

Do not disturb the bearing which carries the end of the shaft opposite from the worm, or great difficulty will be experienced when attempting to mesh the governor worm gear and drive gear during reassembly.

e. From the underside of the mechanism plate, take out the fillister head screw (index 2, figure 7) that holds the gate arm assembly (1) in place. The gate plate (3) can be removed from the arm by pressing on the gate arm tension pin (through opening in center of gate plate) with a pointed instrument and then sliding the plate from the arm. Be very careful not to scratch the gate plate.

f. The gate plate adjusting hex nuts (4) and set screws (5) need not be removed from the gate plate. Remove the front retaining stud (6) and rear retaining stud (9) from the gate arm, being very careful not to lose the single coil springs (7 and 10) and spacer washers (8 and 11).

g. To disassemble the feed spindle mechanism, it will be necessary to clamp the spindle in a smooth-jaw vice. Tighten the vice just enough to hold firmly. Remove the shoulder screw (12), friction collar (13), spring washer (14) and return spring (16) and housing (15) from the spindle shaft. Then remove from the vice and lift out the feed spindle (17), being careful not to lose the friction washer (18).

h. Slide the stud carrier (19) forward until it can be separated from the mechanism plate.

i. Remove the fillister head screw (20) that fastens the stop gear spring (21) and idler stop gear (22) to the mechanism plate. Bearings (23 and 24) must not be removed from the plate (25) except for replacement.

8. BACK MECHANISM PLATE ASSEMBLY. (See figure 8.)

a. With the front mechanism plate removed, it will be noted that the driving mechanism gears are set in bearings pressed into the front and back plates. All of these gears can be removed from the back plate simply by lifting them out of the bearings. As each is removed, make a mental note of its assembled position.

b. Lift the pull pawl (1), locking pawl (2) and tension spring (3) from the shaft of the eccentric shaft gear (4). Then remove the stop gear (5), intermediate spindle and gear assembly (6), governor worm gear pinion assembly (7), governor lubricating wheel assembly (8), second compound pinion assembly (9), first compound pinion and gear assembly (10) and the shaft and idler gear assembly (11).

c. Place the take-up spindle assembly in a smooth-jaw vice, and tighten just enough to hold it firmly. Remove the shoulder screw (12) and slide the two take-up friction washers (13), the key washer (14), drive shaft gear (15), and compression spring (16) from the spindle and collar assembly (17).

d. Pry the grease retaining washer (18) from inside the main drive shaft (21). Remove the split retaining ring (19) with a screw driver and lift the main driving gear (20) from the drive shaft. Press on the main

shaft (21) until it is forced out from the underside of the back mechanism plate (24). The packing washer (22) is shellacked in place and should be removed only if in need of replacement. Lift the spring (23) from the drive shaft.

9. CAMERA FRAME ASSEMBLY. (See figure 9.)

a. The critical focuser (1), critical focuser eyepiece (2) and focuser carrier (3) have been shown exploded in figure 9 only for illustrating purposes. The alignment of these parts is very critical and requires the use of special factory equipment. Do not remove them. Lift out the stop pawl push button (4) and spring (5).

b. Remove the retaining spring (6) from the stop plunger (7), and lift out the plunger and the friction spring (8). The name plate (9) need not be removed.

c. Take out the fillister head screw (11) from inside the camera frame and remove the film meter ratchet (12), dial (13) and friction washer (14). Remove the fillister head screw (16) that fastens the speed control retaining spring (15) to the inside of the camera frame and withdraw assembled governor dial (17), dial holder

(19) and speed control knob (20). The dial (17) is fastened to the holder (19) with two oval head screws (18).

d. Remove the shoulder screw (21) and lift the friction spring (22), speed dial (23) and lens stop dial (24) from the camera frame.

e. The crank housing (25), which was taken off in order to facilitate removal of the driving mechanism (paragraph 6), can be disassembled as follows: Lift the felt block (27) from the underside of the housing. Remove the housing cover (28) and press out the cranking gear and pin assembly (29).

NOTE

The bushings within the housing are reamed after assembly and must not be removed.

f. Do not remove the clamp (30) or clamp screws (31) which hold the critical focuser in place. Press out the main drive shaft bearing (32).

g. Do not remove the stop plunger bushing (33) from the camera frame unless a visual examination indicates that it is in need of replacement.

Cleaning and Repair

10. CLEANING.

- a. Wash all parts thoroughly with aromatic petroleum naptha and dry carefully with a clean, white, lint-free cloth. Old grease and oil must be completely removed.
- b. Remove the hardened shellac and old graphite from the main spring cover plate and the inside of the camera frame.
- c. Secure one end of the main spring to the work bench and stretch the spring out to its full length. Wipe the spring with a cloth dampened with light lubricating oil and dry with a clean, lint-free cloth.

11. INSPECTION.

- a. Inspect the shuttle for damage. Slight grooves in shuttle teeth may be removed with a fine polishing stone as a temporary measure. However, replacement is advisable if such damage is evident. Check the shuttle cam spindle and shuttle cam bearing surfaces for deep grooves or scratches and replace if necessary.
- b. Inspect the aperture plate through a magnifying glass, if available, for nicks and scratches. A light buffing with fine crocus cloth sometimes will remove minor abrasions. Do not attempt to polish out deep pits or scratches because changes in the thickness of the aperture plate affect the focal distance. If plate is nicked or scratched to any great extent, it must be replaced with a new one.
- c. Inspect the teeth of the cranking gear and pin assembly for damage and replace if necessary.
- d. Inspect governor worm carefully for damage. Make sure that shaft is not bent and springs are not broken. The complete governor assembly must be replaced if damage is evident.
- e. Examine all gears for broken teeth, and replace damaged parts. All gear shafts must be checked to

make certain that they are not bent.

f. Examine the camera frame and cover assembly for cracks that might admit light, and replace those items if such damage is found. Springs that have become weakened through constant use should be replaced with new ones.

g. Lay a scale across the surface of the aperture plate. If there is a bow in the plate, it may be hand-bent until straight. This must be done carefully.

12. GOVERNOR BEARING STUD ALINEMENT.

a. The two governor worm shaft bearing studs are located on the underside of the front mechanism plate. If it is necessary to replace the front mechanism plate with a new one, these studs may have to be alined.

b. Insert the hole locating gage, S-7807-N5, through the bearing holes in both studs as shown in figure F. If the gage cannot be inserted through both holes, ream out both holes with the governor stud hand-line reamer, S-7807-F7.

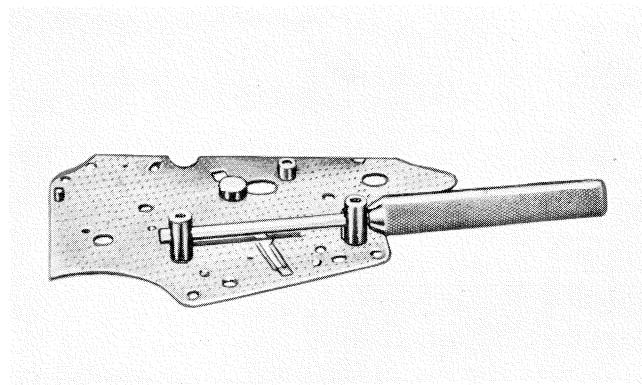


Figure F. Governor Bearing Stud Alinement

Reassembly Procedure

13. CAMERA FRAME ASSEMBLY. (See figure 9.)

- a. If the stop plunger bushing (33) was removed for replacement, press a new bushing into the camera frame (34). Install the main drive shaft bearing (32).
- b. Insert the cranking gear and pin assembly (29) into the crank housing (25), and press on the housing cover (28). Press the felt block (27) into the recess in the bottom of the crank housing. Do not install this assembled group until after the driving mechanism has been inserted into the camera frame.
- c. Place the exposure indicator friction spring (22), speed dial (23) and lens stop dial (24) on the shoulder screw (21) in that order, and turn the screw into the camera frame.
- d. Press the speed control dial holder (19) into the control knob (20), and fasten the governor dial (17) to the holder with two oval head screws (18). Insert the shaft of the dial holder through the camera frame and slip the arms of the retaining spring (15) around the groove in the shaft. Secure the retaining spring to the inside of the camera frame with the fillister head screw (16).
- e. Hold the film meter dial (13) and friction washer (14) in place against the outside of the camera frame. Place the film meter ratchet (12) on the fillister head screw (11), and thread the screw into the film meter dial from inside the camera frame. The teeth of the ratchet (12) must curve in a counterclockwise direction as shown in figure G.

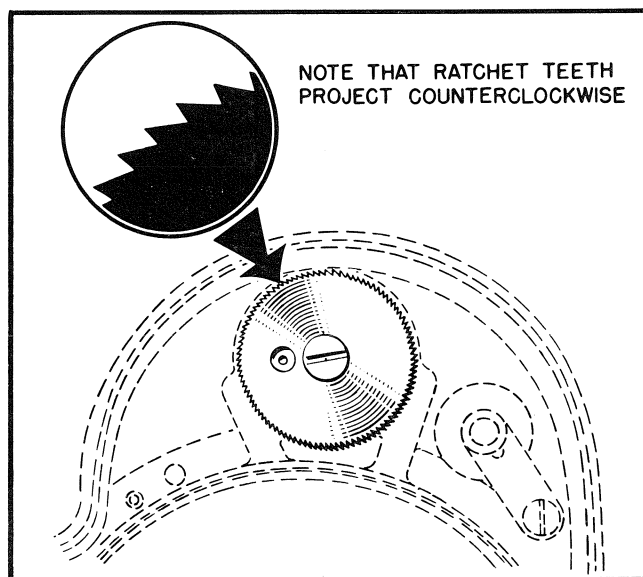


Figure G. Correct Installation of Footage Ratchet

f. Assemble the friction spring (8) and retaining spring (6) into their respective positions on the plunger (7), and insert the plunger into the stop plunger bushing (33). Be sure that the springs are carefully compressed so that the bushing is not scored. Insert the push button spring (5) and push button (4) into the push button opening. Tap the plunger (7) until the end of the plunger engages the keyway, or slot, at the end of the push button.

14. BACK MECHANISM PLATE ASSEMBLY. (See figure 8.)

- a. If the packing washer (22) was removed, apply a thin coat of orange shellac before reinstalling. Insert the hub of the main driving gear (20) through the opening in the back plate (24). Install the tension springs (23) on the gear hub. Grease the springs lightly. Insert the hub of the main drive shaft (21) through the hollow gear hub and press together until the tension spring is completely enclosed by the drive shaft collar. Then install the split retaining ring (19) around the drive shaft to lock all the parts in place. Saturate the felt washer (18) with B & H oil and press it into the opening in the gear end of the drive shaft.
- b. Insert the spring (16), key washer (14) and friction washer (13) into the take-up drive shaft gear (15). Insert the screw (12) loosely, maintaining a slight pressure on the screw head with the thumb while turning the gear until the key washer matches with the slot in the gear. Then press the screw in place, and turn the spindle and collar assembly (17) down onto the screw. Place this group in a smooth-jaw vise, and tighten the screw as tightly as possible. Test the operation of the assembly by holding the spindle and turning the gear. Then set this group aside for the time being.
- c. In order that the installation of the gears to the back plate might be more easily understood, figure H shows all gears in place. The first compound pinion gear engages the main drive gear and the hand crank gear, which in turn drives the second compound pinion assembly and the intermediate spindle and gear assembly. The second compound pinion assembly drives the intermittent mechanism and engages the geared ends of the sprockets. The intermediate spindle and gear assembly rotates both the film take-up spindle and the governor worm gear pinion assembly. The worm gear pinion drives the governor worm shaft. The governor lubricating wheel is automatic in action. Its purpose is to assure a constant film of oil to the contact surfaces of the governor worm and worm gear. The eccentric shaft gear assembly is driven directly by the main drive gear, and, through the action of an eccentric operates the footage indicator pawls. The

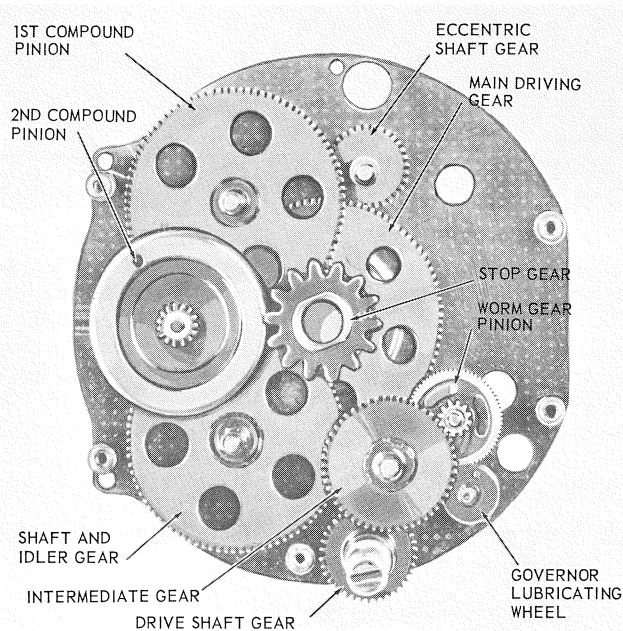


Figure H. Back Mechanism Plate Assembled

drive shaft stop gear meshes with the idler gear on the upper mechanism plate. It is free to turn until the shallow space between two of the teeth engages the long teeth of the idler gear. This action stops the motor.

d. Prepare a back plate holding fixture from a piece of wood two inches thick by five inches wide by eight inches long. (See figure J.) Place the back mechanism plate in the fixture with the main driving gear facing up and the top of the plate near the two nails.

e. Place a drop of B & H oil in the bearings of the back plate and on each gear shaft, and install the gears in the following order: shaft and idler gear assembly (11), first compound pinion and gear assembly (10), second compound pinion assembly (9), and the intermediate spindle and gear assembly (6). Lift the intermediate spindle and gear assembly enough so that the take-up spindle (assembled in 14-b, preceding) can be installed. Install the governor worm gear pinion assembly (7). Saturate the lubricator felt of the governor

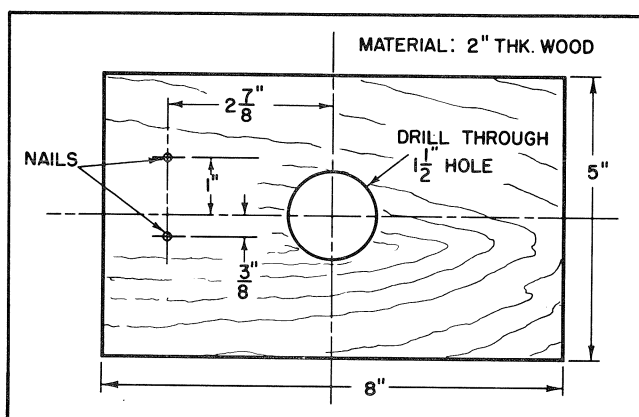


Figure J. Back Mechanism Plate Holding Fixture

lubricating wheel (8) with B & H oil, and install it on the back plate. Install the eccentric shaft gear assembly (4), and press the drive shaft stop gear (5) down on the hub of the drive shaft.

f. Install the tension spring (3), locking pawl (2) and pull pawl (1) on the shaft of the eccentric shaft gear assembly (4). Place the assembled back mechanism plate assembly in a clean spot until the front mechanism plate assembly can be assembled.

15. FRONT MECHANISM PLATE ASSEMBLY.

a. If any of the bearings (index numbers 23 and 24, figure 7) were removed for replacement, press the new ones into the front mechanism plate (25). Install idler stop gear (22) and spring (21) with the screw (20).

b. Place the stud carrier (19) into position on the underside of the front mechanism plate, and slide it forward until it is held by the two flanges, or ears, of the plate.

c. Hold the gate arm (1) in place on the front mechanism plate and press the rear retaining stud (9), with spring (10) and washer (11) installed, down through the opening in rear of gate arm until the groove in the stud can be engaged with the slot in the mechanism plate. Shift the gate arm and stud carrier just a bit toward the rear of the mechanism plate so that the rear retaining stud holds. Then press the front retaining stud (6), with spring (7) and washer (8) installed, down through the front end of gate arm until the groove in the stud engages with the slot in the stud carrier. Hold gate arm firmly and press stud carrier forward as far as it will go. Then move the gate arm back until the hole in the underside of the gate arm is visible behind the stud carrier, and install the screw (2).

d. Install the friction washer (18) over the tapped end of the spindle and collar assembly (17) and insert the tapped end through the opening in the front mechanism plate. Slide the return spring (16), return spring housing (15), spring washer (14) and friction collar (13) over the spindle shaft, and secure all parts with the shoulder screw (12). Tighten the screw firmly.

e. Insert the four film guards (item 17, figure 6) through their openings in the front mechanism plate, and slip the forked end of the film guard springs (16) around the grooves in the lower ends of the guards. Springs must not interfere with any openings in the front mechanism plate.

f. Attach the lower guide shoe (14) and upper guide shoe (12) to the mechanism plate with the film guide screws (13 and 15). Slide the spring cover tubes (8) down onto the sprocket gear and sleeve assemblies (11). Install the torsion springs (9 and 10) so that each spring fits down into the spring cover tube and end of spring fits into the recess in the gear. The clockwise-wound spring (figure K) goes with the take-up sprocket, so be sure to note with which assembly each spring was installed. Install each sprocket (6 and 7) on its respective sleeve assembly so that the bent out end of the torsion spring fits into the recess at the lower end of each sprocket. Fasten the sprocket guards (3) and shims (5) temporarily in place with the screws (4). Sprockets must be synchronized after the camera mechanism is completely assembled. (Refer to para-

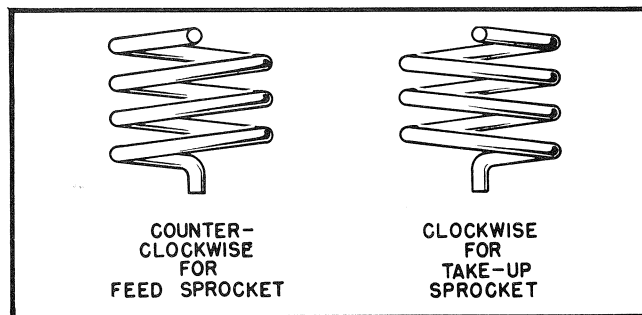


Figure K. Sprocket Gear Torsion Springs

graph 28 for synchronizing procedure.

g. Insert the plain end of the governor shaft into the bearing (19) that was not touched during disassembly, and the worm end of the shaft into the bearing (19) which was backed part way out of the bearing support. Press the latter bearing back down into the bearing support so that the long, key-like projection of the governor and worm assembly (21) fits into the slot in the front mechanism plate. Install the set screw (18) to lock the worm shaft bearing in place. Move the governor housing back and forth to make certain that it operates freely.

h. Place a drop of B & H oil on each of the bearings which retain the governor worm shaft. Apply a light film of B & H lubricating grease to spring (22) and install it in the opening in the top of governor housing. Grasp the gate arm between thumb and forefinger and place the assembled front mechanism plate carefully on the assembled back mechanism plate. It may be necessary to shift the gears slightly with a pointed tool until the gear shafts enter the proper shaft openings in the upper mechanism plate. Fasten the two mechanism plates together with the screws (1 and 2). It will be necessary to adjust screw (2) with the driving mechanism pin wrench, S-8681-F1. (Refer to paragraph 29 for feed spindle adjustment.) Then remove the assembled mechanism from the wooden fixture.

i. Turn the hub of the main drive gear (on the back mechanism plate) and check the gears for freedom of movement. Also make certain that all gears are in mesh and that they have the proper clearance in relation to other gears.

16. INSTALLING SPRING AND DRIVE MECHANISM.

a. Wind the driving spring loosely by hand until it can be placed in the drum of the holding fixture (Tool No. ST-243-F1), engaging the inner end of the spring with the hub (Tool No. ST-243-F7). Install the retaining bar (Tool No. ST-243-F2) and wind spring with hand crank until spring clamp can be installed.

b. Install spring cover plate (7, figure 5) over hub of main drive shaft and up against back mechanism plate. Lift wound spring from holding fixture and install on spring hub of mechanism plate, engaging inner end of spring with slot in hub and slipping the looped outer end of the spring over the spring retaining stud (5) in the mechanism plate. Handle spring carefully during installation.

c. Attach the lower end of the governor connecting link (8) to the governor housing with the shoulder screw (9). The tapped hole in the governor housing can be seen through the long slot in the front mechanism plate.

d. Place assembled mechanism in fixture (paragraph 6, step c), and pre-set the camera footage as follows: First, install the hand crank, S-5218-F2, and slowly and carefully wind the spring until it is tight. Remove the safety retaining ring from drive spring. Release the hand crank and count the number of complete revolutions that the hand crank makes before the drive and idler gears lock. The hand crank should make seven complete revolutions, which is equivalent to approximately 21 feet of film. If hand crank made only six revolutions, wind the spring, disengage the gears (figure G), and allow the spring to unwind until one drive gear tooth has passed by the idler gear. Then re-engage the gears. If hand crank made eight revolutions, disengage the gears and wind the spring until one tooth of the drive gear has moved back past the idler gear. Then re-engage the gears.

e. Now pre-set the speed as follows: Hook the loose end of the governor link over the pin on the timing fixture speed indicating dial. Set the dial pointer between the two notches at the high-speed end of the dial, and wind the spring slowly until it is tight. Release the hand crank. Hand crank should make seven complete revolutions in from 13 to 14 seconds. With dial pointer set between the two notches at the low-speed end of the dial, hand crank should make one complete revolution in approximately 15 seconds. If unable to obtain these speed adjustments, remove the governor and adjust it as instructed in paragraph 17. If pre-setting speeds appear to be correct, wind the spring completely, lock the idler and drive gears by engaging first long tooth of idler gear with shallow space between drive gear teeth. Then install safety retaining ring around the spring.

CAUTION

As a safety measure, it is advisable to leave the safety retaining ring around the spring until just before the driving mechanism is to be installed in the camera frame.

f. Apply a thin film of orange shellac around the shoulder of the casting. This will act as a seal to prevent the graphite from reaching the driving gears of film chamber. Spread approximately one teaspoonful of lubricating graphite around the bottom of the camera within the recess that houses the spring.

g. Remove the safety retaining ring from around the main spring, and lift the driving mechanism carefully from the timing fixture. Install the grease retaining washer (index 6, figure 5) over the end of the main drive gear hub and lubricate it lightly with a coat of B & H lubricating grease. Grasp the gate arm between the thumb and forefinger, and insert the driving mechanism carefully into the camera frame. Spread the two pawls until they straddle the film meter ratchet, and press down firmly on the driving mechanism until it is firmly seated. Check to make certain that locking

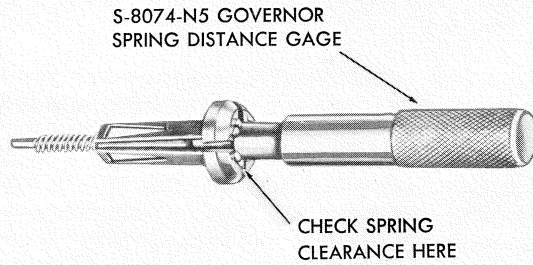


Figure L. Checking Distance of Governor Weights from Shaft

pawl operates footage dial freely. Install the driving mechanism attaching screws (index 1, figure 5) and turn them in until tight.

h. Attach the upper end of the governor connecting link to the speed control dial with the shoulder screw (index 2, figure 5) and spacer (3). The speed control dial should turn freely and should move the governor housing back and forth.

i. Install the assembled crank handle housing (index 25, figure 9) with the four fillister head screws (26). During this operation, the cranking gear must be slipped into position so that it meshes with the second compound pinion assembly of the driving mechanism.

17. ADJUSTING THE GOVERNOR

a. If the pre-setting speed check during reassembly proved unsatisfactory, it may mean that the governor springs and weights are in need of adjustment. Remove the weight carrier and shaft assembly from the governor housing, and carefully insert the governor spring distance gage, S-8074-N5, as shown in figure L. The gage should just clear the governor weights, and all four weights should be equidistant from the governor shaft.

b. If the four weights are not of equal distance from the governor shaft, it may be necessary to bend each spring individually. Insert the governor spring setting gage, S-8074-F8, under the weight as shown in figure

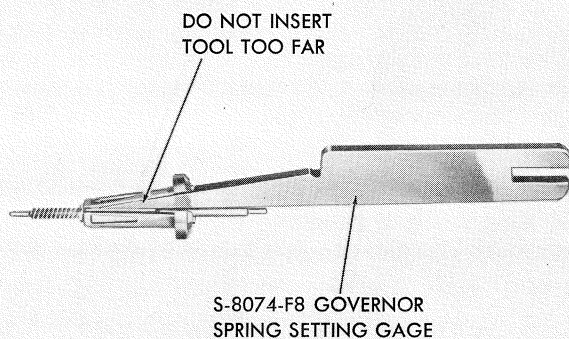


Figure M. Spreading Governor Springs Individually

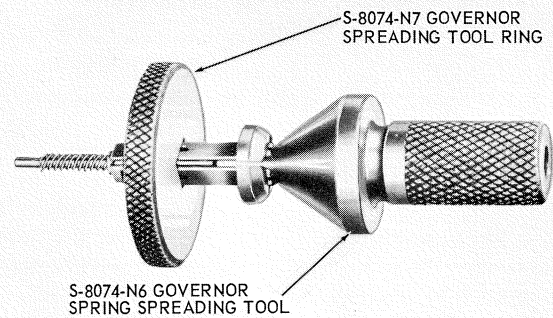


Figure N. Spreading Governor Springs Simultaneously

M and slightly bend the weight outward from the shaft. Be very careful not to insert the tool too deeply under the weight as it may cause the spring to break.

c. If none of the four weights are far enough away from the shaft, use the governor spring spreading tool, S-8074-N6, and the governor spreading tool ring, S-8074-N7, as shown in figure N. As the spreading tool, S-8074-N6, is pressed inward, it will spread all four weights equally. This must be done carefully so that the weights are not opened too far.

NOTE

Always check the weight clearance frequently with the governor spring distance gage, S-8074-N5, when spreading the weights as instructed in steps 17-b and 17-c, preceding.

d. The governor flexure control washer retainer (figure P) on the end of the governor housing assembly must be positioned very precisely so that it does not interfere with the governor springs. Install the governor spring gaging fixtures, S-8094-F3 and S-8094-F4, and loosen the retainer screws. Adjust the retainer so that it clears the S-8094-F3 gaging fixture, and tighten the retainer screws.

e. If the governor weights are too far away from the governor shaft, insert the end of a piece of steel which is 1/32 inch square under the governor springs one

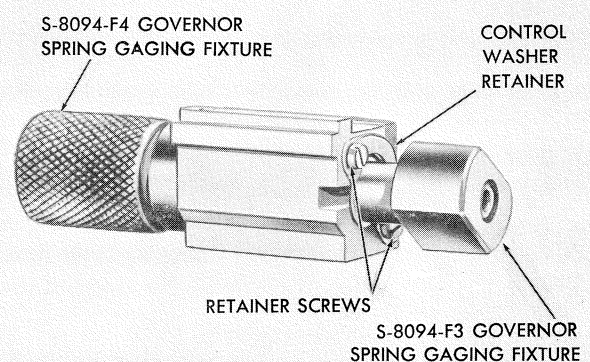


Figure P. Adjusting Control Washer Retainer

at a time. Bend each spring carefully toward the shaft, and then check the adjustment with the S-8074-N5 governor spring distance gage. Repeat the adjustment until all four weights just clear the outer circumference of the gage.

18. FRONT PLATE ASSEMBLY. (See figure 4.)

a. If the front plate and spindle were replaced, press the new spindle (29) carefully into the new front plate (30) so that the spindle washer fits down into the recess in the front plate casting. Put a drop of B & H lubricating oil on the shuttle cam spindle (29), and slip the shims (26 and 27) over the spindle. Install the shutter and shuttle cam assembly (25) on the spindle, and spin the shutter around several times to make certain that it spins freely and does not strike the front plate casting.

b. Insert the shuttle pins (21) into the openings in the shuttle (20), and install the washer (23) and then the spring (22) on the lower pin. Position the shuttle on the shuttle cam so that the dowel pins lie in the grooves in the front plate casting. Spread the pins far enough apart to allow a full shuttle stroke, and install special screws (19) to hold shuttle pins.

c. Rotate the shutter to make certain that it revolves easily and that it drives the shuttle. There should be very little play between shuttle and cam, either horizontally or vertically. However, parts should not bind, and the shuttle and cam should spin easily. If there is too much play between shuttle and cam, shims must be added - if shuttle and cam bind, remove a shim or shims.

d. Lay the aperture plate (15) temporarily in place, and check the height that the shuttle teeth project through the two parallel slots in the aperture plate. The teeth must be high enough to engage the perforations in the film. This height can be regulated by changing the thickness of the shim, or shims, under the shuttle cam.

CAUTION

Do not attempt to adjust the shuttle by filing the grooves in which the shuttle dowel pins rest.

e. Place the aperture plate (15) in the recess of the film tension rail (17), and lay both parts in approximate position on the front plate casting. Lift the outer edge of the plate just enough so that the tension spring (18) can be slipped into the recess in the casting. It may be necessary to bend the ends of the spring away from the front plate casting. Then hold the aperture plate in position and install the two screws (16) just enough to hold the plate. Position the film guide rail (13) along the opposite edge of the aperture plate, and fasten it loosely in place with the two screws (14). Now adjust the aperture plate as instructed in paragraph 19.

f. Loosen the upper dowel pin retaining screw (19) so that the upper shuttle dowel pin (21) may be moved temporarily out of position. Then slide the stop pawl assembly (24) into place so that one leg is underneath

the dowel pin and the other leg is between the aperture plate and the casting. Move the dowel pin back into position and tighten the dowel pin retaining screw.

g. Lay the camera on the work bench with the front plate opening facing up. Remove the starting button and spring temporarily from the camera frame. Inspect the front plate assembly for cleanliness, and lubricate all bearing surfaces sparingly with a very light film of B & H lubricating oil. Install the front plate assembly so that the stop pawl stud fits into the bearing brackets on the upper mechanism plate. Before pressing the front plate completely down into place, reinstall the starting button and spring and engage the stop pawl assembly. Then press the front plate down into place.

h. Install the four screws (1) that fasten the front plate to the camera casting. Install the plunger (12), plunger spring (11) and screw (10).

NOTE

Before installing the turret head, check the camera footage as instructed in paragraph 20, and adjust if necessary. Then mark the speed dial as instructed in paragraph 21.

i. Place the bearing plate (9) on top of the front plate so that the cut-out in the bearing plate is squarely over the aperture opening. Carefully insert the three springs (8) into the slots around the edge of the front plate. Place the indexing rollers (7) on the indexing roller studs (6) and insert them partially into the slots. Then lay the lens turret (5) in place on the front plate; and, while holding it firmly with one hand, press the indexing rollers and studs into the slots one at a time until the lens turret is firmly seated. Revolve the turret to make certain that the indexing rollers properly position each lens opening at the aperture. Install the spacer (4) and special nut (3) being careful not to turn the nut on too tightly. Then press in the oil retaining plug (2).

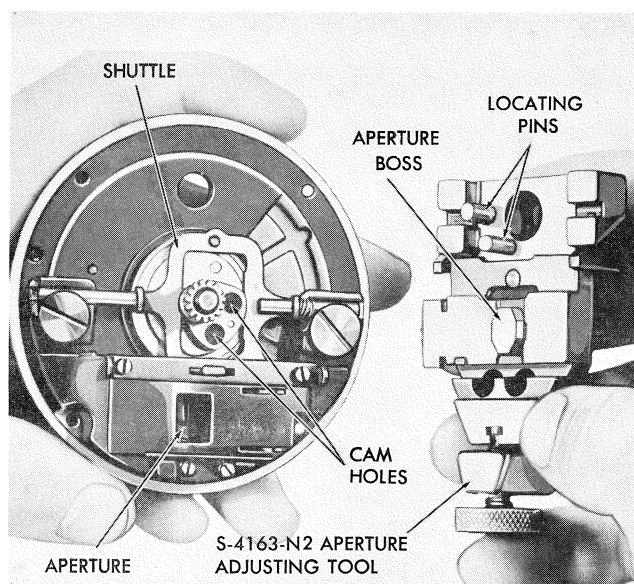


Figure Q. Inserting Gage S-4163-N2

NOTE

The turret must turn with some amount of resistance, but must not be so tight that the "snap" of the indexing rollers as they position the lens opening cannot be felt.

19. ADJUSTING THE APERTURE PLATE.

a. When correctly adjusted, the upper and lower frame lines on the film are in the exact center of the film perforations and the outer frame lines are equally distant from the edges of the film.

b. Rotate the shutter so that the two large holes in the cam are in the position shown in figure Q. Notice that the shuttle teeth are at the beginning of the stroke. Lay the aperture adjusting tool, S-4163-N2, over the aperture plate so that the two pins fit into the large holes and the aperture stud fits into the aperture opening.

c. The four screws which attach the aperture plate were left slightly loose during reassembly. Turn the knurled knob on the adjusting tool, as shown in figure R, until it is tight. This will pull the aperture plate to the correct position. Then tighten the aperture plate attaching screws slightly, and remove the adjusting tool.

d. The gage, S-3972-N1, is used to check the position of the aperture plate in relation to the shuttle stroke. With the gage positioned on the aperture plate as shown in figure S (boss on underside of gage inserted in aperture opening) and the NO GO end nearest the shuttle teeth, the shuttle teeth should just strike the gage when the shutter is rotated. When the gage is reversed so that the GO end is nearest the shuttle teeth, the teeth should just clear the gage as the shutter is rotated. It may be necessary to shift the aperture plate slightly until this condition is met. Then repeat step 19-c, preceding, and tighten down the aperture plate attaching screws securely.

20. ADJUSTING THE BUCK TOOTH GEARS.

a. The idler and drive gears are visible through the opening in the front mechanism plate just below the gate arm. The camera mechanism must be adjusted to run not less than 21 feet and not more than 23 feet on one full winding of the main drive spring. This adjustment is made by setting the teeth of the idler gear in relation to the shallow space of the drive gear.

b. Wind the spring to capacity and set the Veeder counter at zero. Press the camera starting button, and allow the camera to run until it stops. Then check the Veeder counter to see how many feet the camera has run.

c. As an example, suppose the footage dial indicates the camera run is 19 feet. Since each tooth of the drive gear represents approximately three feet, one tooth of the drive gear must be moved forward (clockwise) in order to bring the long teeth of the idler gear and the shallow space between two teeth of the drive gear to the correct locking position at the end of a 22-foot run. Turn the winding key slightly and depress the idler gear with a screw driver until the gears are

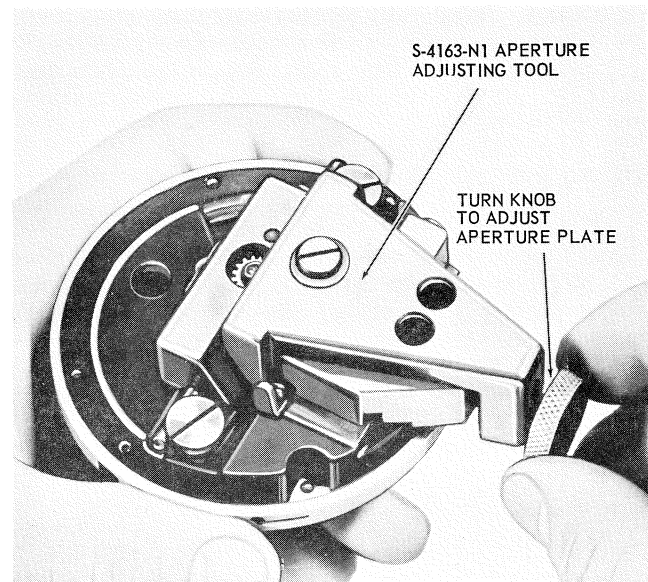


Figure R. Adjusting the Aperture Plate

disengaged; then press the starting button momentarily to allow one tooth of the drive gear to pass by. Then re-engage the gears.

d. If, for example, the footage dial should indicate that the camera run is 30 feet on one complete winding, disengage the idler gear with a screw driver and wind the spring slowly until three drive gear teeth (representing nine feet) have passed the idler gear in a counterclockwise direction. Then re-engage the gears.

e. Test the adjustment by winding the spring to capacity, setting the footage dial at zero, and allowing the motor to run down.

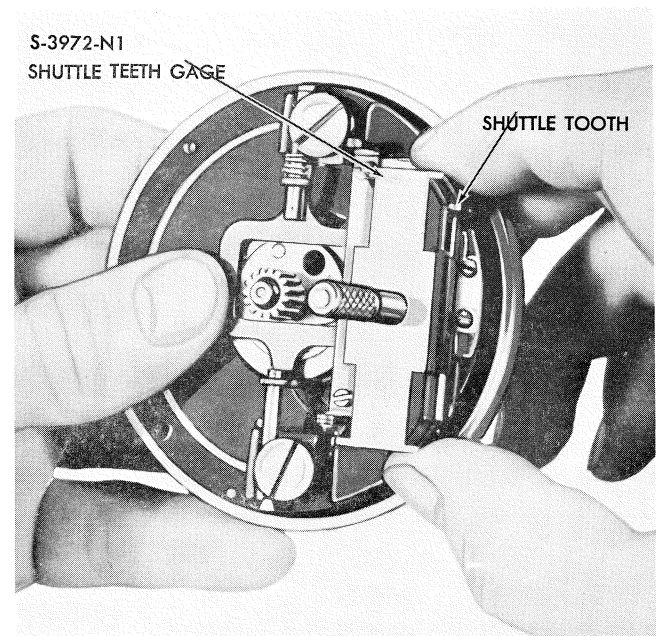


Figure S. Checking Clearance of Shuttle Teeth

21. MARKING THE SPEED DIAL.

a. Whenever the camera has been disassembled, it usually is necessary to remark the speed dial. If this is done, a new speed dial must be installed.

b. Determine the proper position of speed control of the outer dial by checking the running time as instructed in paragraph 1-a. As each speed is properly set, mark the dial with a sharp tool exactly opposite the mark on the speed control ring.

22. CAMERA COVER ASSEMBLY. (See figure 3.)

a. Place the two steel balls (25) in the holes of the indexing ring (26), and hold view-finder aperture (21) and shims (22 and 23) in place with the fingers. Then position the view-finder dial seat disc (20) and aperture dial (18) on the outside of the casting, line up the largest view-finder aperture opening with the number "20" on the aperture dial, and install the three oval head screws (19). Fasten the turret hole cover (16) in place on the inside of the cover casting with the two shoulder screws (17).

b. Fasten the eccentric (14) to the inside of the camera cover with the fillister head screw (15). This eccentric assures that the film gate is closed when the cover is on the camera and must be adjusted (paragraph 23) before camera cover is installed.

c. Lay the latch cam link (7) in place on the inside of the camera cover. Install the lower latch cam assembly (6) so that it engages the link. Hold the parts in place and insert the latch cam hub (4) through the opening in the cover from the outside. Insert the latch cam key (3) so that the riveting ends protrude through both the hub and the cam. Stake the parts together, leaving no play but allowing latch key to turn freely. Install upper latch cam assembly (5), hub (4) and key (3) in the same manner.

d. Install the upper door latch (8) and lower door latch (11) with the shoulder screws (9 and 12) and spring washers (10 and 13). Then screw the view-finder objective lens (2) and view-finder eyepiece assembly (1) into the ends of the view-finder tube. Cover assembly should not be installed until the adjustments have been made.

23. APERTURE GATE BACK LASH.

a. A small eccentric washer is located near the center of the camera cover on the inside of the door casting. Its purpose is to lock the gate in the closed position when the cover is in place so that it cannot open while the camera is in use.

b. To adjust the eccentric, open the gate approximately 1/16 inch. Install the camera cover and turn the latch key to the CLOSED position. Then remove the cover and press forward on the gate arm. If the gate arm can be moved forward, the eccentric needs adjusting.

c. Loosen the screw that holds the eccentric in place, and revolve the eccentric slightly to bring the thicker side a bit more toward the camera head. Then tighten the screw and repeat step 23-b, preceding. This procedure must be repeated until the adjustment has

been properly made. Also note that if the cover goes on with difficulty, chances are that the eccentric is not properly set.

CAUTION

If the eccentric is adjusted so that it forces the gate arm forward too tightly, it may cause the gate to pinch the film and result in binding or jamming of the camera.

24. HAND CRANK ASSEMBLY. (See figure 2.)

a. Fasten the crank handle (6) to the spindle of the hand crank (7) with the fillister head screw (5).

b. Insert the compression spring (4) and two steel balls (3) into the opening in the crank stem, and hold them with the thumb and forefinger while slipping the hand crank dial (2) up into place. Install the dial locking spring (1).

25. WINDING KEY ASSEMBLY. (See figure 1.)

a. Place a small amount of vaseline on the tip of the spring shaft (9) and the teeth of the ratchet (2) and key body (12). Insert the spring (11) and spring shaft (9) down into the key body (12), and install the plug (10).

b. Compress the spring by pulling the end of the spring shaft until the uncoupling bar (8) can be inserted through the opening in the key body.

c. Hold the handle plate (7) in position with the prongs in the key body slots, and install the clamp spring (6) and split retaining collar (4). Then slide the friction clip (5) up over the key body, and install the retaining ring (3).

d. Slide the ratchet (2) onto the lower end of the spring shaft so that the ratchet teeth engage the teeth on the key body and the hole in the ratchet is aligned with the hole in the shaft. Install the pin (1) to hold the ratchet in place.

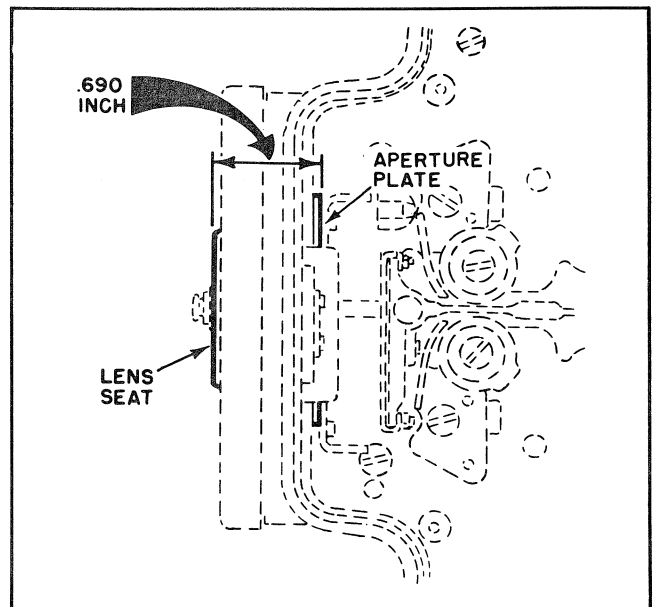


Figure T. Camera Focal Length Adjustment

26. FOCAL LENGTH ADJUSTMENT. (See figure T.)

a. The focal length of the camera is measured from the film plane (surface of the aperture plate) to the lens seat. This measurement, which can be taken with a standard one-inch micrometer, should read .690 inch plus or minus .001 inch at all points on the lens seat. The distance must be exact, because errors may cause pictures to be out of focus.

b. If the micrometer reading is less than .690 inch paper shims must be inserted under the aperture plate until the reading is correct. If the micrometer reading exceeds .690 inch, the lens seat must be accurately and carefully ground or filed to the exact dimension. Use a Number 00 mill file for this purpose. Lay the file across the lens seat and file gently with a straight, smooth movement, turning the camera frequently so that the filing can be done in all directions. Check the focal length frequently until the micrometer reading is exact from all points on the lens seat.

NOTE

When making the measurements, be sure that there are no particles of lint or dust on the aperture plate, lens seat or micrometer. Be sure to check each lens seat individually.

27. FILM CLEARANCE ADJUSTMENT.

a. The film clearance is the distance between the aperture plate and the gate plate when the film gate is in the closed position. This clearance should be .0065 inch. Allow the mechanism to run down so that the shuttle teeth are retracted and behind the aperture plate.

b. With a .0065-inch feeler gage, check the distance between the gate plate and aperture plate at the four corners of the gate plate. The feeler gage should just slide into the space without forcing.

c. Adjust the film clearance by loosening the hex nuts on the three gate plate set screws and turning the set screws in or out with an Allen head wrench until the clearance is correct. Then tighten the hex nuts securely.

28. SYNCHRONIZING THE SPROCKETS.

a. Synchronization of the sprockets must be made

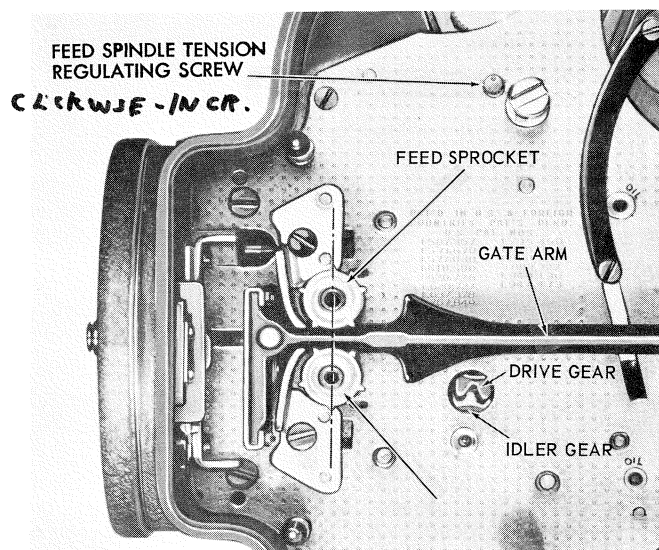


Figure U. Feed Spindle and Sprocket Adjustment

after the camera is completely assembled and with the mechanism at least partly wound so that the mechanism is stopped with the shutter in the closed position.

b. Remove the screw which holds the sprocket and guard in place. Lift the sprocket enough to unmesh the gears, and revolve the sprocket until the tooth farthest from the gate arm points away exactly at right angles to the center line of the gate arm. (See figure U.)

c. When both sprockets are properly adjusted, there will be sufficient clearance between the sprocket teeth and the gate arm (with the gate open) to permit easy film threading.

29. FEED SPINDLE ADJUSTMENT.

a. Place the film spool on the feed spindle, and turn the spool three or four complete revolutions in a clockwise direction. When released, the spool should recoil about one and one-half turns.

b. The tension on the feed spindle is regulated by turning the feed spindle tension regulating screw. Turning the screw clockwise with the S-8681-F1 drive mechanism pin wrench shown in figure A increases the feed spindle tension; turning the screw counter-clockwise decreases the tension of the feed spindle.

Final Test

30. GENERAL TEST PROCEDURE.

- a. Wind the spring motor to capacity. Press and release the starting button several times. The starting button must return to its original position each time it is released.
- b. Watch the footage dial while the camera is running. It must move only one graduation at a time.
- c. Check the tension of the speed control dial. It must have sufficient tension to prevent its being disturbed during normal handling of the camera.
- d. Rewind the spring motor to full capacity and set the footage dial at zero. Press the starting button, and allow the camera to run down. Camera footage dial must show a run of not less than 21 and not more than 23 feet. If necessary, adjust as instructed in paragraph 20.
- e. While the camera is running, note carefully any irregularities in operation such as spring jump or unusual noises which may be caused by a lack of oil.

31. FILM TEST.

- a. Load the camera with a 100-foot roll of positive film. Light struck film may be used repeatedly for testing purposes.
- b. Thread-run the entire 100-feet of film to determine that the camera functions properly when loaded. Check to see that the sprocket teeth release the film smoothly and evenly.
- c. During running of the film, check the action of take-up spool. The film must wind tight on the spool.
- d. To check the tension of the feed spindle, place a film spool on the feed spindle and turn the spool three

or four complete revolutions in a clockwise direction. When released, the spool should recoil about one and one-half turns. Adjust, if necessary, as instructed in paragraph 29.

32. PHOTO TEST.

- a. Thread the camera with a short strip of positive or negative film. Set the camera as you would normally do for taking pictures.
- b. Make a short photo test, and check the test for sharpness, film scratches and proper framing of the pictures.

33. LIGHT-LEAK TEST.

- a. Thread the camera in the usual manner with a short piece of Super XX Panchromatic film, using both the feed and take-up spools.
- b. Close the camera door securely, and lay the camera in the direct sunlight (door side up) for at least 15 minutes. Move the camera frequently so that all edges of the door are exposed to the direct sunlight.

NOTE

If it is not possible to place the camera in the sunlight, use several photo flood bulbs and expose the camera in the same manner. Make certain that the lens cap, or caps, are in place during test.

- c. Inspect the film to see whether or not it has been affected in any way by the light.

PARTS CATALOG

DESIGN 70 CAMERAS

DA, DL, H, DR, HR,

Bell & Howell

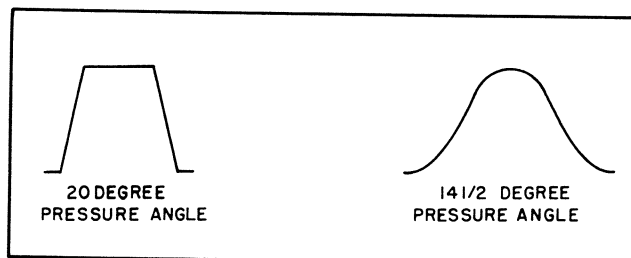
Replacement Parts

The following pages illustrate and list, by part numbers and part name, all serviceable parts of the Designs 70-DA, 70-DL, 70-DR, 70-H, and 70-HR 16-mm cameras. The illustrations themselves have a two-fold purpose: (1) They will prove an invaluable aid during the disassembly and reassembly of the camera. (2) They will help you make a more positive identification of parts when ordering replacements.

Before ordering replacement parts, check the code designation column carefully to make certain you are ordering the correct part for the particular model camera being serviced. The following code designation applies throughout this manual:

CODE LETTER	CAMERA MODEL
A	Design 70-DA
B	Design 70-DL
C	Design 70-H
D	Design 70-DR
E	Design 70-HR

It is very important to note that Design 70-DR (Code D) and Design 70-HR (Code E) cameras beginning with serial number L-98020 have been equipped with newly designed gears. These new gears have a pressure angle of 20 degrees as compared to the 14-1/2 degree pressure angle formerly used throughout the Design 70 cameras (see accompanying sketch). When servicing cameras, be sure to check all gears for pressure angle either visually, or by using a slide or film-strip projector to produce an enlarged profile of the gear teeth. Do not intermix 14-1/2 degree gears with 20 degree gears during reassembly, as this will cause excessive noise, gear tooth and bearing wear within a relatively short period of time. All gears and other replacement parts involved in this change over are plainly identified as "14-1/2° pressure angle" or "20° pressure angle" throughout the parts listings.



Comparison of Gear Tooth Pressure Angles

Lock Parts ; 18291 { #18291
#21544

Brushes for Motor 70 # 70158 - 110V
Motor Cap for Brush # 70162

70 SUPER SPEED CAMERAS

Specifications and parts common only to design G & S. Use only in conjunction with Service Manual, Part No. 70019.

Average speed 128 frames per second.

Film loops at aperture - 5 perforations visible each side.

Shuttle tooth must be protruding through aperture when threading film.

Spring run (buck tooth gears) set to 15 feet.

Camera head requires oil for every 200' film run.

Timing 15 feet in 5 seconds.

Two shuttle bumper springs, Part No. 6522, and washers, Part No. 6529, are used on shuttle pins between shuttle and the head casting pin boss. The washers locate against the head casting pin boss and the springs are between the washer and shuttle. Clip partial turn of one spring if shuttle compresses spring tight against boss.

Shuttle cam heel clearance .001 to .003.

Film gate clearance $.007 \pm .0005$.

Shutter cam, Part No. 08901.

Shutter stop, Part No. 08902.

Governor drive gear, Part No. 09333, 20 degrees, gear teeth Part No. 05072, $14\frac{1}{2}$ degree gears.

Intermediate gear, Part No. 09326, 20 degrees, gear teeth, Part No. 02602, $14\frac{1}{2}$ degrees.

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5 6 7		
WINDING KEY ASSY				
1-	07388	KEY ASSY, Winding, non-rotating	1	
-1	14479	. PIN	1	
-2	14481	. RATCHET	1	
-3	1662	. RING, Retaining	1	
-4	1092	. COLLAR, Retaining, split	1	
-5	1685	. CLIP, Friction	1	
-6	14475	. SPRING, Clamp	1	
-7	14474	. PLATE, Handle	1	
-8	14476	. BAR, Uncoupling	1	
-9	14478	. SHAFT, Spring	1	
-10	14480	. PLUG	1	
-11	14477	. SPRING, Compression	1	
-12	14482	. BODY, Key	1	
HAND CRANK ASSY				
2-	0295	CRANK ASSY, Hand (complete)	1	
-1	9419	. SPRING, Hand crank dial locking	1	
-2	9421	. DIAL, Hand crank (20 frames)	1	
-3	2569	. BALL	2	
-4	10457	. SPRING, Compression	1	
-5	21997	. SCREW, Fillister hd, No. 6-32 x 1/4 in.	1	
-6	15904	. HANDLE, Crank	1	
-7	04192	. CRANK ASSY, Hand	1	
COVER ASSY (70-DA ONLY)				
3-1	04515	EYEPIECE ASSY, Viewfinder (25-mm photo lens)	1	A
-2	04859	LENS AND MOUNT ASSY, Viewfinder objective	1	A
	0688	COVER ASSY, Camera	1	A
-3	14424	. KEY, Latch cam	2	A
-4	6215	. HUB, Latch cam	2	A
-5	04262	. CAM ASSY, Latch, upper	1	A
-6	04263	. CAM ASSY, Latch, lower	1	A
-7	6212	. LINK, Latch cam	1	A
-8	14429	. LATCH, Door, upper	1	A
-9	14430	. SCREW, Shoulder, No. 5-40.	2	A
-10	6219	. WASHER, Spring	2	A
-11	14428	. LATCH, Door, lower	1	A
-12	14430	. SCREW, Shoulder, No. 5-40.	2	A
-13	6219	. WASHER, Spring	2	A
-14	11144	. ECCENTRIC	1	A
-15	6458	. SCREW, Fillister hd, No. 5-40 x 1/4 in.	1	A
-16	6421	. COVER, Turret hole	1	A
-17	1112	. SCREW, Shoulder, fillister hd, No. 3-48.	2	A
-18	6425	. DIAL, Viewfinder aperture	1	A
-19	6423	. SCREW, Oval hd, No. 2-64	3	A
-20	6269	. DISC, Finder dial seat	1	A
-21	6424	. APERTURE, Turret viewfinder	1	A
-22	15966	. WASHER, Shim, .002-inch thick	As Req'd	A
-23	15967	. WASHER, Shim, .005-inch thick	As Req'd	A
-24	589	. SPRING, Turret index	1	A
-25	2569	. BALL, Steel	2	A
-26	584	. RING, Viewfinder turret indexing	1	A
-27	11142	. COVER, Camera	1	A

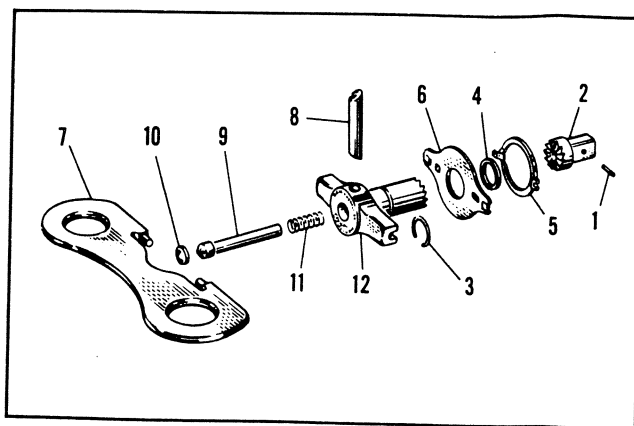


Figure 1. Winding Key Assembly - All Models

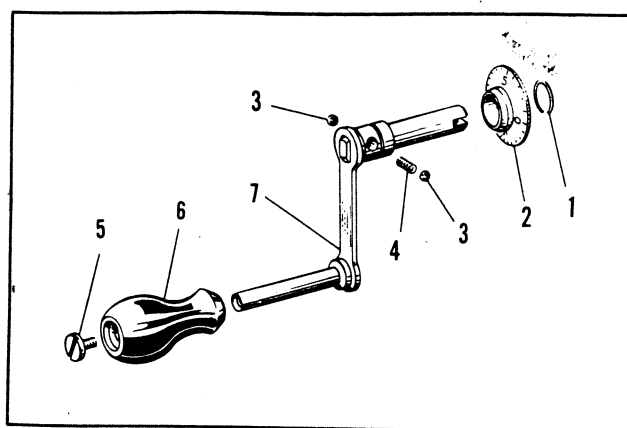


Figure 2. Hand Crank Assembly - All Models

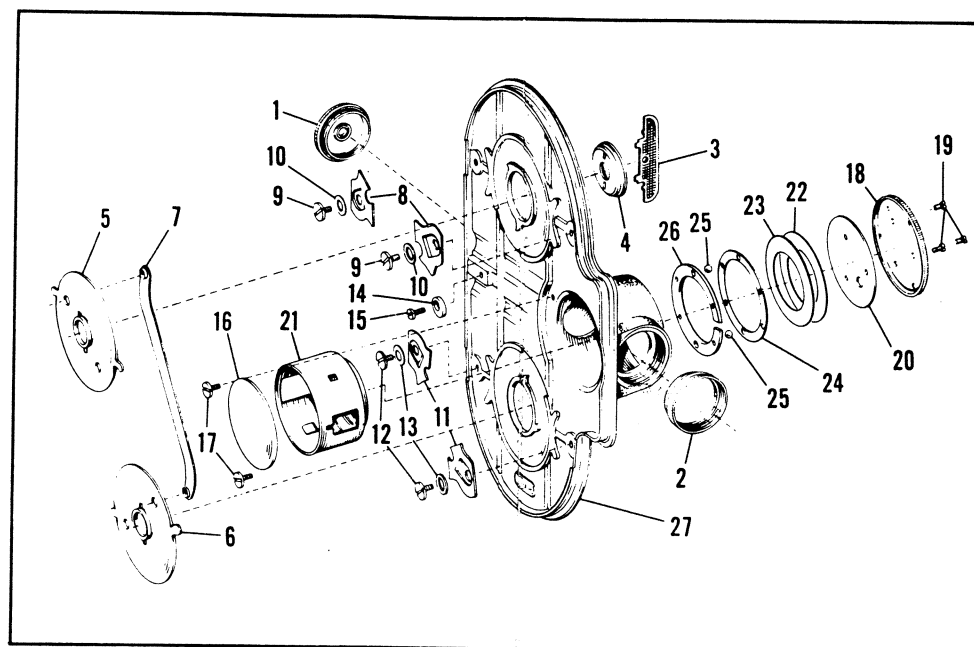


Figure 3. Camera Cover Assembly - Design 70DA only
(see figure 4 for 70DR and 70HR camera covers)

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
1	2	3 4 5 6 7		
CAMERA COVER ASSY				
4-1	11765	COVER, Lens mount	2	BCDE
-2	06684	VIEWFINDER ASSY (Includes items 4-18) . . .	1	B
-2	06929	VIEWFINDER ASSY (Includes items 4-18) . . .	1	C
-2	09020	VIEWFINDER ASSY (Includes items 4-18) . . .	1	D
-2	09029	VIEWFINDER ASSY (Includes items 4-18) . . .	1	E
-3	20549	SCREW, Viewfinder attaching.	4	BD
-3	22305	SCREW, Viewfinder attaching.	4	CE
-4	06680	. MOUNT, Eyepiece	1	BCDE
-5	06683	. TUBE ASSY, Finder (includes items 8-13) .	1	BC
-5	09027	. TUBE ASSY, Finder	1	DE
-6	20693	. SCREW, Pilot (upper)	1	BCDE
-7	20536	. SCREW, Pilot (lower)	1	BCDE
-8	06681	. . TURRET, Viewfinder	1	BC
-8A	09033	. . TURRET, Viewfinder	1	DE
-9	22006	. . SCREW, Turret	1	BC
-9	28069	. . SCREW, Turret	1	DE
-10	17891	. . WASHER, Spring	1	BCDE
-11	11775	. . SPRING, Turret indexing	1	BCDE
-12	11785	. . ROLLER, Turret indexing	1	BCDE
-13	No Number	. . TUBE, Viewfinder	1	BCDE
-14	20534 —	. CAM, Parallax correction	1	BD
-14	22306	. CAM, Parallax correction	1	CE
-15	26915	. RING, Retaining	1	BCDE
-16	5238	. BALL, Steel	1	BCDE
-17	22500	. SPRING, Compression	1	BCDE
-18	20630	. HOUSING, Viewfinder tube.	1	BC
-18	27959	. HOUSING, Viewfinder tube.	1	DE
-18A	29268	. NAMEPLATE (70-DR)	1	D
-18A	29270	. NAMEPLATE (70-HR)	1	E
-19	22304	SPACER, Viewfinder	1	C
-19	27961	SPACER, Viewfinder	1	E
-19A	27968	SCREW, Pivot	1	E
-19B	27966	WASHER	1	E
-19C	27964	GEAR, Idler	1	E
	06729	COVER ASSY (Includes items 20-34)	1	B
	06730	COVER ASSY (Includes items 20-34)	1	C
	09035	COVER ASSY (Includes items 20-34)	1	D
	09038	COVER ASSY (Includes items 20-34)	1	E
-20	14424	. KEY, Latch cam	2	BC
-20AA	27975	. KEY, Latch cam	2	DE
-21	6215	. HUB, Latch cam	2	BC
-21AA	27978	. HUB, Latch cam	2	DE
-21BB	27981	. HUB, Latch cam	2	DE
* -21A	16821	. KNOB, Clutch	1	C
* -21B	6128	. SPRING, Compression	1	C
* -21C	16822	. CLUTCH	1	C
* -21D	05222	. HUB ASSY, Latch cam	1	C
-22	04262	. CAM, Latch (upper)	1	BDE
-22	05221	. CAM, Latch (upper)	1	C
-23	04263	. CAM, Latch (lower)	1	BCDE
-24	6212	. LINK, Latch cam.	1	BCDE
-25	14429	. LATCH, Door (upper)	2	BCDE
-26	14430	. SCREW, Door latch	2	BCDE
-27	6219	. WASHER, Spring	2	BCDE
-28	14428	. LATCH, Door (lower)	2	BCDE
-29	14430	. SCREW, Door latch	2	BCDE

* NOTE: CAMERA REWIND PARTS, indexed 21A, 21B, 21C and 21D, are standard equipment on Code C cameras and can be installed on Code A and B cameras upon request and without any change in part numbers. When modifying Code D and E cameras for rewind, use cam hub assembly #09673 in place of #05222 (item 21D); all other parts (21A thru 21C) remain the same.

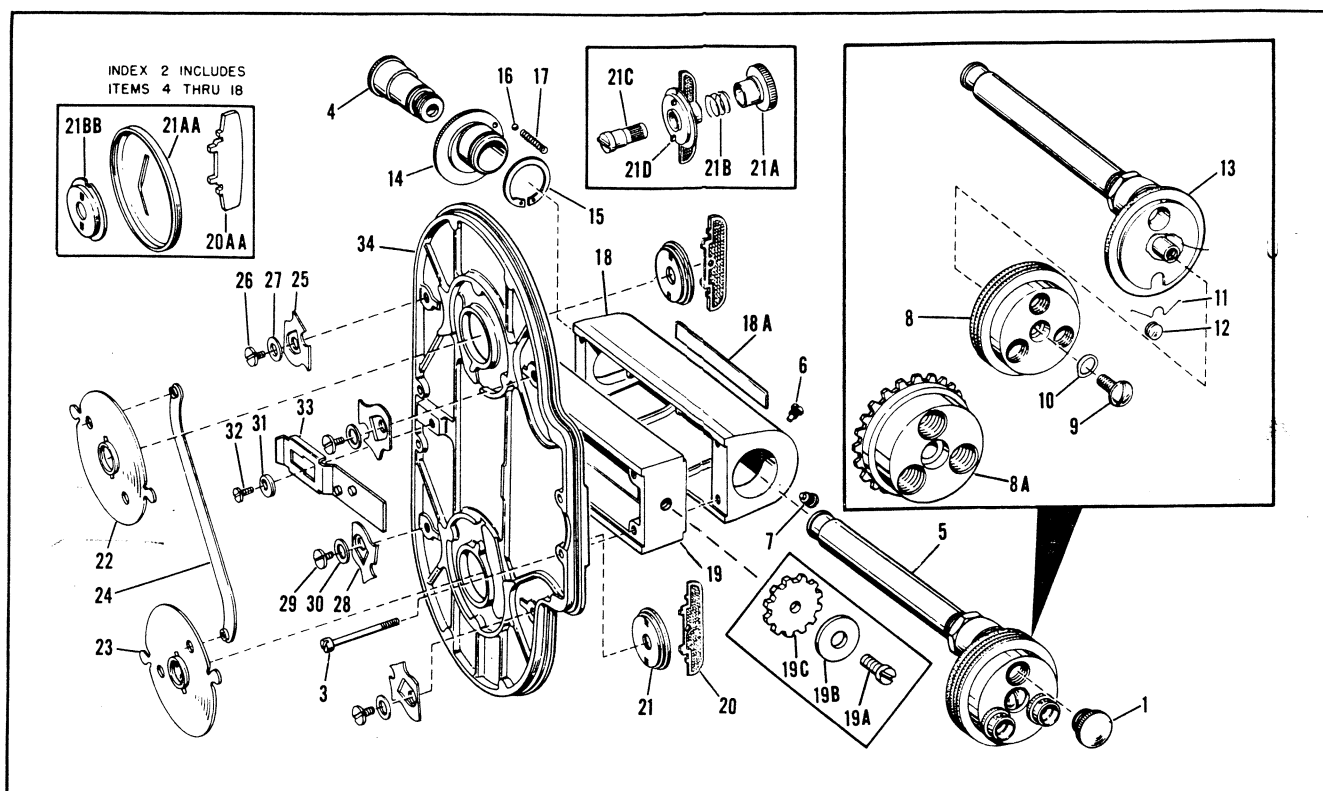


Figure 4. Camera Cover Assembly - Design 70DL, 70H, 70DR and 70HR Cameras

FIG. & INDEX NO.	PART NO.	DESCRIPTION							UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5	6	7		
4-30	6219	.	WASHER, Spring.	.	.	.	.	.	2	BCDE
-31	11144	.	ECCENTRIC	.	.	.	.	.	1	BCDE
-32	6458	.	SCREW, Eccentric.	.	.	.	.	.	1	BCDE
-33	02145	.	BAR, Push	.	.	.	.	.	1	CE
-34	22313	.	COVER, Camera.	.	.	.	.	.	1	B
-34	20674	.	COVER, Camera.	.	.	.	.	.	1	C
-34	28009	.	COVER, Camera.	.	.	.	.	.	1	D
-34	28012	.	COVER, Camera.	.	.	.	.	.	1	E

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
1	2	3 4 5 6 7		
FRONT PLATE ASSY				
5-	01220	PLATE ASSY, Front	1	A
5-	06944	PLATE ASSY, Front	1	B
5-	06947	PLATE ASSY, Front	1	C
5-	09009	PLATE ASSY, Front	1	D
5-	09014	PLATE ASSY, Front	1	E
-1	6495	. SCREW, Fil hd.	4	
-1A	25648	. WASHER, Felt, retaining	1	BCDE
-1B	25649	. WASHER, Felt lubricating	1	BCDE
-2	4491	. PLUG, Oil retaining	1	
-3	14031	. NUT, Special	1	
-4	14030	. SPACER	1	
-5	6491	. TURRET, Lens.	1	ABC
-5A	09008	. TURRET, Lens.	1	DE
-6	6380	. STUD, Turret indexing roller	3	
-7	6381	. ROLLER, Turret indexing	3	
-8	6382	. SPRING, Compression	3	
-9	6500	. PLATE, Lens turret bearing	1	
-10	6433	. SCREW, Plunger spring	1	
-11	6435	. SPRING, Plunger.	1	
-12	6434	. PLUNGER	1	
-13	6202	. RAIL, Film guide	1	
-14	21995	. SCREW, Guide rail.	2	
15	6200	. PLATE, Aperture	1	A
15	22354	. PLATE, Aperture	1	BCDE
-16	6201	. SCREW, Fil hd.	2	
-17	6199	. RAIL, Film tension	1	
-18	6198	. SPRING, Guide rail tension	1	
-19	6197	. SCREW, Shuttle pin	2	A
-19	21999	. SCREW, Shuttle pin	2	BCDE
-20	6328	. SHUTTLE.	1	A
-20	22351	. SHUTTLE.	1	BCDE
-21	5113	. PIN, Shuttle	2	
-22	16958	. SPRING, Shuttle bumper	1	
-23	6529	. WASHER	1	
-24	01219	. PAWL ASSY, Stop	1	A
-24	0671	. PAWL ASSY, Stop	1	BC
-24	08817	. PAWL ASSY, Stop	1	DE
-25	05206	. SHUTTER ASSY	1	C
-25	08818	. SHUTTER ASSY	1	ABD
-25	08819	. SHUTTER ASSY	1	E
-26	6224	. SHIM, Shuttle cam	As Req'd	
-27	16995	. SHIM, Shuttle cam	As Req'd	
-28	1954	. PIN, Dowel.	1	
-29	0681	. SPINDLE ASSY, Shuttle cam.	1	
-30	6375	. PLATE, Front	1	ABD
-30	16780	. PLATE, Front	1	CE
-31	16776	. SCREW, Stabilizer	1	CE
-32	05205	. STABILIZER ASSY.	1	CE
-32A	1375	. . WASHER, Split	1	CE
-32B	10515	. . WASHER, Friction <i>Tension</i>	1	CE
-32C	16774	. . GEAR, Stabilizer	1	CE
-32D	16772	. . FLYWHEEL, Stabilizer.	1	CE
-33	16777	. SCREW, Flat hd	2	CE
-34	16775	. PLATE, Stabilizer mounting.	1	CE

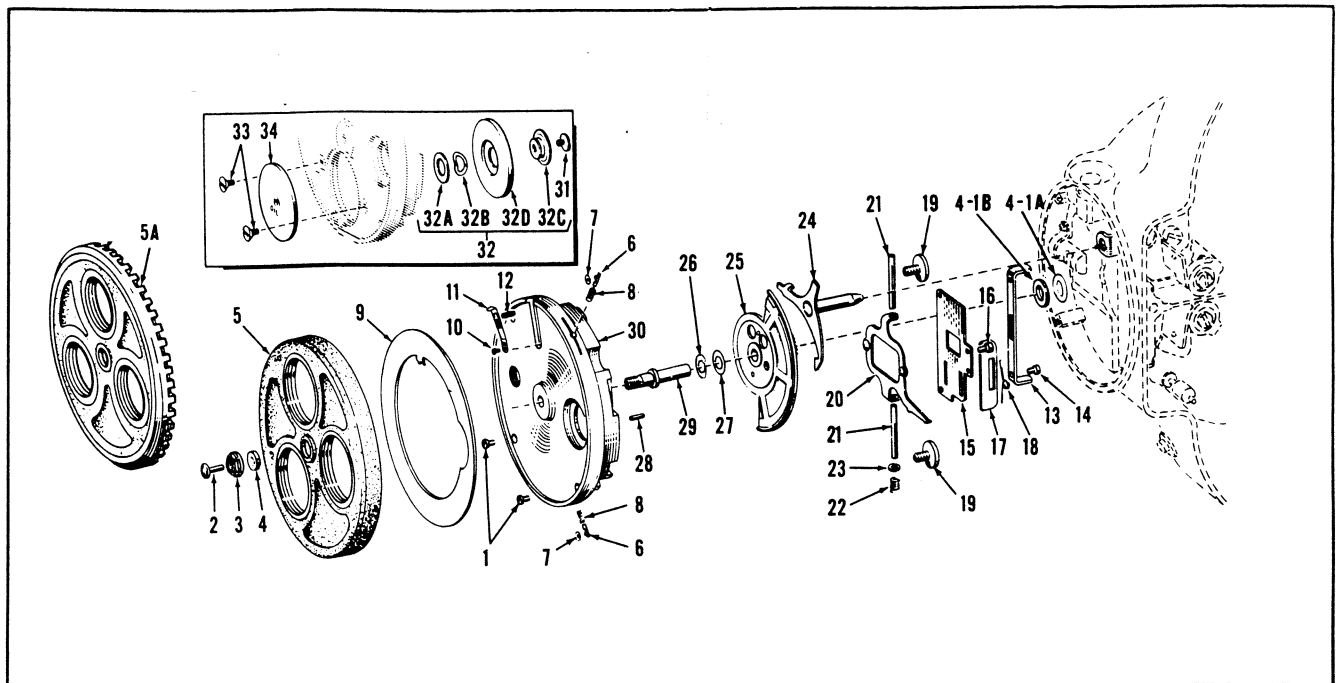


Figure 5. Front Plate Assembly

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5 6 7		
MAIN DRIVE SPRING				
6-	05652	MECHANISM ASSY, Driving	1	A
6-	06943	MECHANISM ASSY, Driving	1	B
6-	06946	MECHANISM ASSY, Driving	1	C
6-	*08824	MECHANISM ASSY, Driving	1	D
6-	*08825	MECHANISM ASSY, Driving	1	E
-1	6458	. SCREW, Mechanism attaching	4	A
-1	22003	. SCREW, Mechanism attaching	4	BCDE
-2	6401	. SCREW, Shoulder	1	
-3	6403	. SPACER, Governor link	1	
-4	6300	. SPRING, Driving	1	
-5	6118	. STUD, Motor spring retaining	1	
-6	6168	. WASHER, Grease retaining	1	
-7	6546	. PLATE, Spring cover	1	
-8	6404	. LINK, Governor connecting	1	
-9	6402	. SCREW, Shoulder	1	

*NOTE: Cameras bearing Serial No. L-98020 and higher are equipped with gears having 20° pressure angle (09373 mechanism replaces 08824; 09374 replaces 08825)

FRONT MECHANISM PLATE ASSY				
7-	05271	PLATE ASSY, Mechanism (front).	1	A
7-	*06942	PLATE ASSY, Mechanism (front).	1	BD
7-	*06945	PLATE ASSY, Mechanism (front).	1	CE
-1	21998	. SCREW, Front plate attaching	5	
-2	6456	. SCREW, Special	1	
-3	6290	. GUARD, Sprocket	2	
-4	21998	. SCREW, Sprocket guard	2	
-5	6224	. SHIM, Sprocket guard	As Req'd	A
-6	6539	. SPROCKET, Feed	1	A
-6	22353	. SPROCKET, Feed	1	BCDE
-7	6538	. SPROCKET, Take-up	1	A
-7	22352	. SPROCKET, Take-up	1	BCDE
-8	6545	. TUBE, Sprocket spring cover	2	
-9	6542	. SPRING, Feed sprocket (RH)	1	
-10	6543	. SPRING, Take-up sprocket (LH).	1	
-11	0727	. GEAR ASSY, Sprocket (14-1/2° press. angle)	2	
-11	09321	. GEAR ASSY, Sprocket (20° press. angle) . .	2	DE
-12	6166	. SHOE, Sprocket guide (upper)	1	A
-12	22356	. SHOE, Sprocket guide (upper)	1	BCDE
-13	6291	. SCREW, Sprocket guide shoe	1	A
-13	9335	. SCREW, Sprocket guide shoe	1	BCDE
-14	6167	. SHOE, Sprocket guide (lower)	1	A
-14	22357	. SHOE, Sprocket guide (lower)	1	BCDE
-15	6291	. SCREW, Sprocket guide shoe	1	A
-15	9335	. SCREW, Sprocket guide shoe	1	BCDE
-16	6282	. SPRING, Film guard	4	A
-17	6281	. GUARD, Film	4	A
-18	6370	. SETSCREW, Governor bearing	2	A
-18	22000	. SETSCREW, Governor bearing	2	BCDE
-19	6359	. BEARING, Governor worm shaft	2	
-20	6715	. BALL, Steel	4	
-21	0725	. GOVERNOR ASSY	1	
-22	6407	. SPRING, Pressure	1	

*NOTE: For cameras equipped with 20° pressure angle gears: Front Plate Assy #09348 replaces #06942 (Des. 70-DR) Front Plate Assy #09349 replaces #06945 (Des. 70-HR)

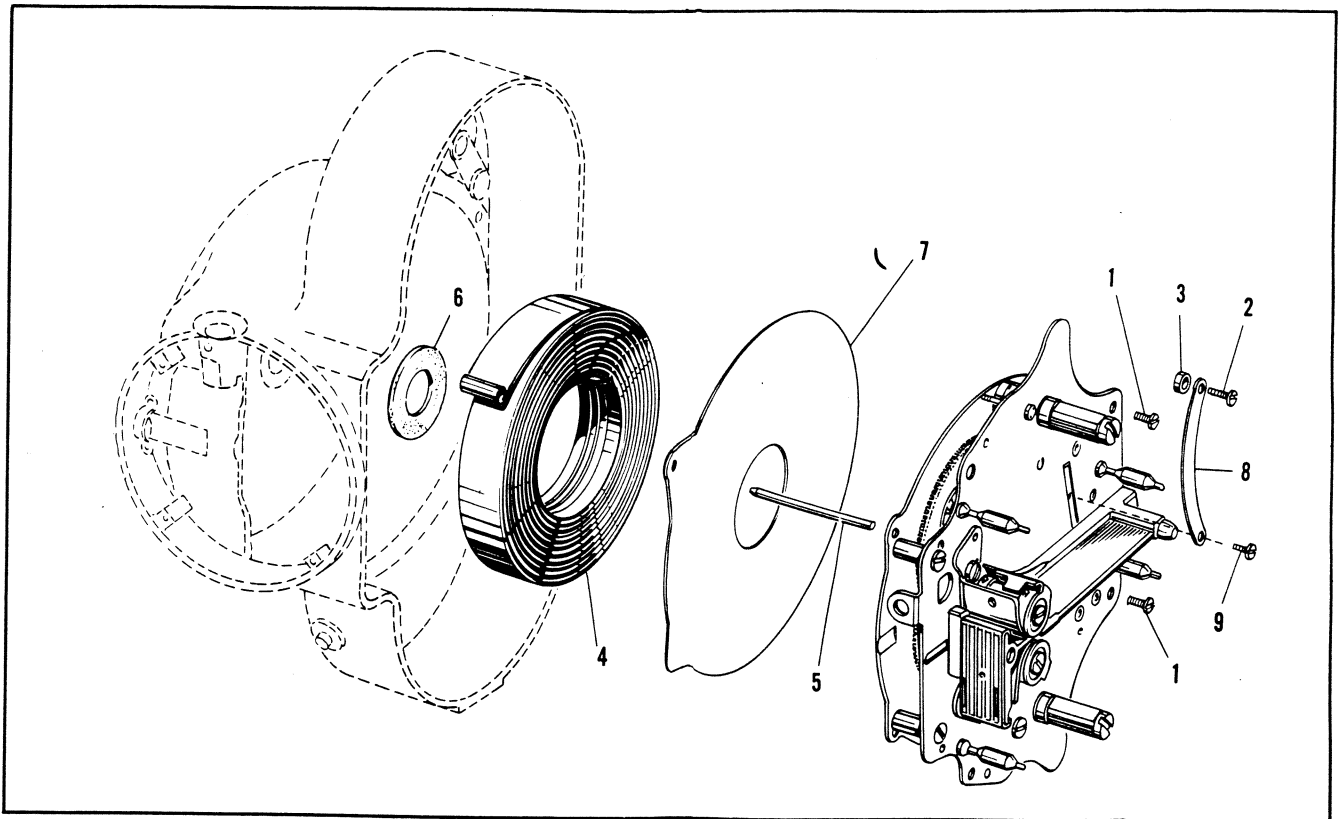


Figure 6. Main Drive Spring and Governor Link

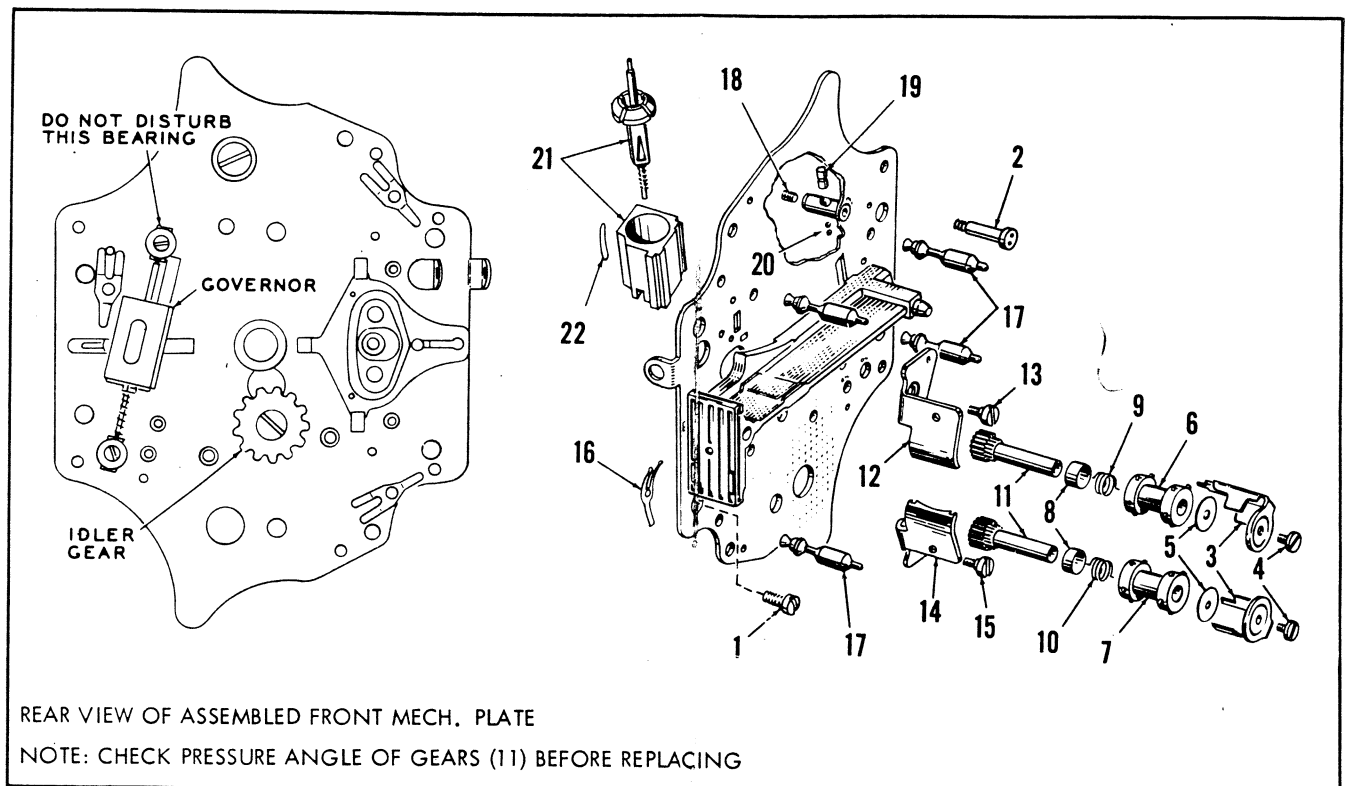


Figure 7. Front Mechanism Plate Assembly - Plate I

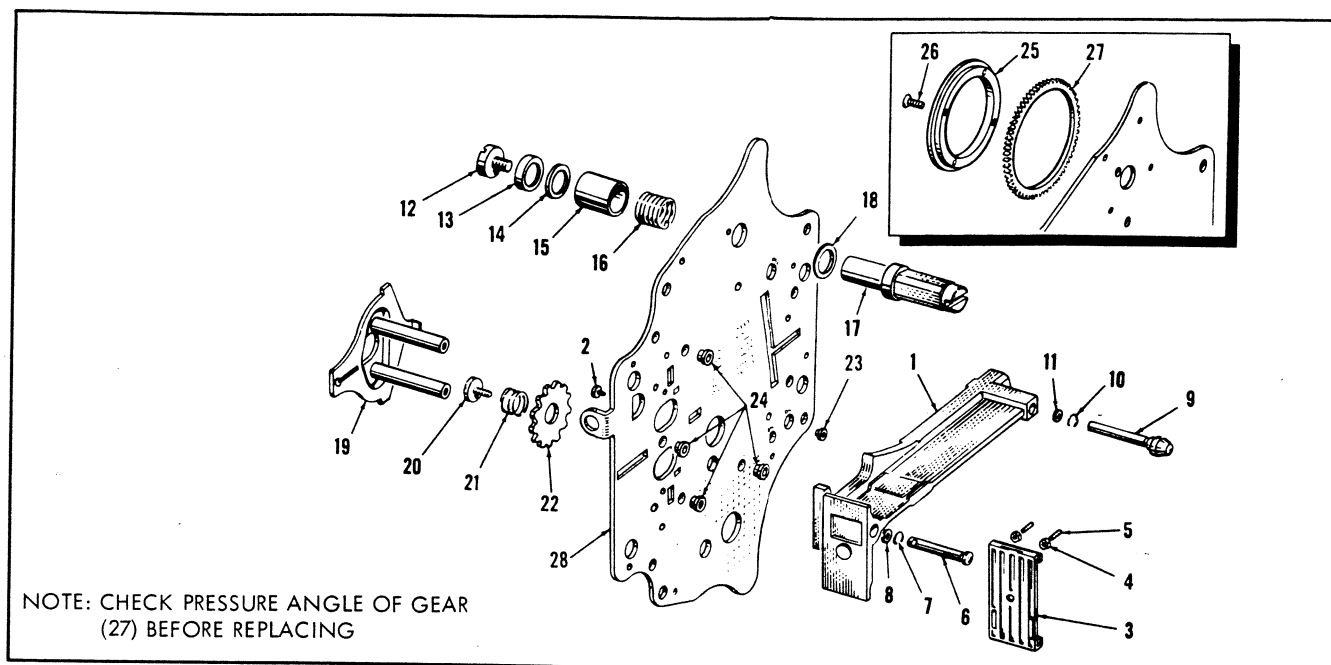


Figure 8. Front Mechanism Plate Assembly - Plate II

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5 6 7		
FRONT MECHANISM PLATE ASSY				
8-1	03480	. ARM ASSY, Gate (includes items 3-5). . . .	1	A
-1	06941	. ARM ASSY, Gate (includes items 3-5). . . .	1	BCDE
-2	7363	. SCREW, Gate arm	1	
-3	16449	. . PLATE, Film gate	1	A
-3	22355	. . PLATE, Film gate	1	BCDE
-4	15192	. . NUT, Hex	3	
-5	17934	. . SETSCREW, Headless	3	
-6	6152	. STUD, Gate retaining (front).	1	
-7	6151	. SPRING, Single coil	1	
-8	6529	. WASHER, Shim.	As Req'd	
-9	11883	. STUD, Gate retaining (rear).	1	
-10	6151	. SPRING, Single coil	1	
-11	6529	. WASHER, Shim.	As Req'd	
-12	6296	. SCREW, Shoulder	1	
-13	6416	. COLLAR, Friction.	1	
-14	24612	. WASHER, Spring.	1	
-15	6417	. HOUSING, Return spring.	1	
-16	6418	. SPRING, Feed spindle return	1	
-17	03045	. SPINDLE ASSY, Feed	1	
-18	6492	. WASHER, Friction.	1	
-19	05867	. CARRIER ASSY, Sprocket stud	1	
-20	1523	. SCREW, Stop gear	1	
-21	6128	. SPRING, Stop gear	1	
-22	6127	. GEAR, Idler stop (14-1/2° press. angle)	1	
-22	27630	. GEAR, Idler stop (20° press. angle)	1	CE
-23	6373	. BEARING, Governor drive gear	1	
-24	6112	. BEARING, Driving gear	4	
-25	16798	. RING, Idler gear retainer	1	CE
-26	8772	. SCREW, Retainer ring	4	CE
-27	16800	. GEAR, Idler (14-1/2° press. angle)	1	CE
-27	29113	. GEAR, Idler (20° press. angle)	1	E
-28	05269	. PLATE, Mechanism (front)	1	A
-28	05868	. PLATE, Mechanism (front)	1	BD
-28	05875	. PLATE, Mechanism (front)	1	CE

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
1	2	3 4 5 6 7		
BACK MECHANISM PLATE ASSY				
9-1	6164	PAWL, Ratchet pull	1	ABD
-2	6163	PAWL, Ratchet locking	1	ABD
-3	6165	SPRING, Ratchet pawl	1	ABD
-4	05076	GEAR ASSY, Eccentric shaft (14-1/2° pressure angle)	1	ABD
-4	05040	GEAR ASSY, Veeder counter (14-1/2° pressure angle)	1	CE
-4	*09006	GEAR ASSY, Eccentric and (20° pressure angle) . . .	1	D
-4	*09007	GEAR ASSY, Veeder counter (20° pressure angle) . .	1	E
-5	6149	GEAR, Stop, main drive shaft.	1	
-6	0680	SPINDLE & GEAR ASSY (14-1/2° pressure angle) . .	1	
-6	*09001	SPINDLE & GEAR ASSY (20° pressure angle)	1	DE
-7	05065	PINION ASSY, Governor (14-1/2° pressure angle) . .	1	
-7	*09332	PINION ASSY, Governor (20° pressure angle)	1	DE
-8	0698	WHEEL ASSY, Governor lubricating	1	
-9	03893	PINION ASSY, 2nd compound (14-1/2° pressure angle)	1	ABC
-9	08820	PINION ASSY, 2nd compound (14-1/2° pressure angle)	1	DE
-9	*09004	PINION ASSY, 2nd compound (20° pressure angle) . .	1	DE
-10	05071	PINION ASSY, 1st compound (14-1/2° pressure angle)	1	
-10	*09003	PINION ASSY, 1st compound (20° pressure angle) . .	1	DE
-11	05063	GEAR ASSY, Idler (14-1/2° pressure angle)	1	
-11	*09002	GEAR ASSY, Idler (20° pressure angle)	1	DE
9-	0450	SPINDLE ASSY, Take-up (includes items 12-17) . . .	1	ABD
9-	02235	SPINDLE ASSY, Take-up (includes items 12-17) . . .	1	CE
9-	*09317	SPINDLE ASSY, Take-up (includes items 12-17) . . .	1	D
9-	*09324	SPINDLE ASSY, Take-up (includes items 12-17) . . .	1	E
9-12	6296	. SCREW, Shoulder.	1	
-13	6492	. WASHER, Friction	2	
-14	6493	. WASHER, Friction (keyed)	1	
-15	6121	. GEAR, Take-up drive (14-1/2° pressure angle) . .	1	ABD
-15	02233	. GEAR, Take-up drive (14-1/2° pressure angle) . .	1	CE
-15	*27626	. GEAR, Take-up drive (20° pressure angle)	1	D
-15	*09323	. GEAR, Take-up drive (20° pressure angle)	1	E
-16	6124	. SPRING, Compression	1	
-17	03045	. SPINDLE & COLLAR ASSY.	1	
-18	6147	WASHER, Grease retaining	1	
9-	05270	PLATE ASSY, Back (includes items 19-24).	1	A
9-	05872	PLATE ASSY, Back (includes items 19-24).	1	BD
9-	05874	PLATE ASSY, Back (includes items 19-24).	1	CE
9-	*09343	PLATE ASSY, Back (includes items 19-24).	1	D
9-	*09344	PLATE ASSY, Back (includes items 19-24).	1	E
9-19	6146	. RING, Split retaining	1	
-20	05075	. GEAR, Main driving (14-1/2° pressure angle) . .	1	
-20	*09005	. GEAR, Main driving (20° pressure angle)	1	DE
-21	6144	. SHAFT, Main drive.	1	
-22	6299	. WASHER, Packing	1	ACE
-22	22218	. WASHER, Packing	1	BD
-23	12086	. SPRING, Tension.	2	
-24	05273	. PLATE & BEARING ASSY	1	A
-24	05871	. PLATE & BEARING ASSY	1	BD
-24	05873	. PLATE & BEARING ASSY	1	CE

* NOTE: Cameras bearing serial no. L-98020 and higher are equipped with gears which have a pressure angle of 20 degrees (see gear tooth comparison sketch on page 1). When in doubt, check gear tooth pressure angle. Do not install gears of different pressure angles in any one camera.

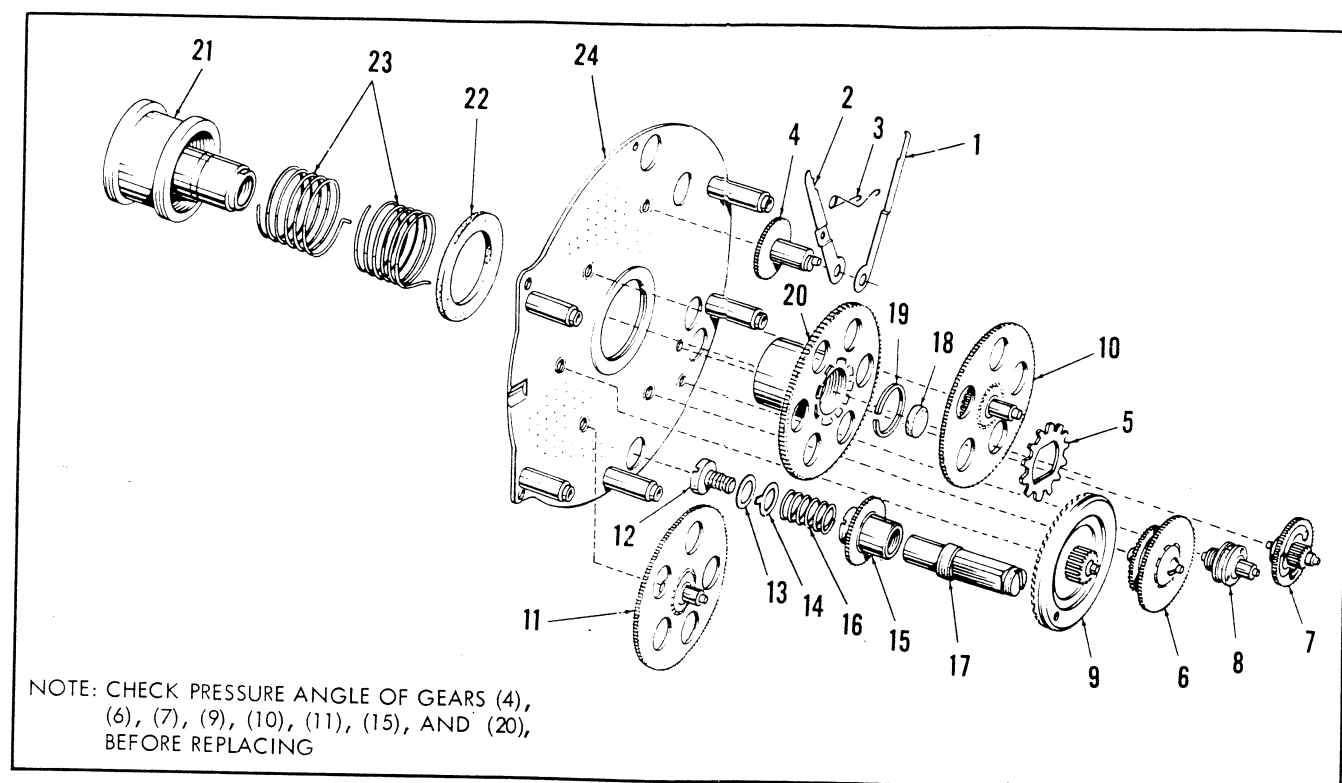


Figure 9. Back Mechanism Plate Assembly

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5 6 7		
CAMERA FRAME (DES. 70-DA, 70-DL, 70-DR)				
10-1	0730	FOCUSER, Critical	1	ABD
-2	04872	EYEPIECE, Critical focuser	1	ABD
-3	04069	CARRIER, Critical focuser	1	ABD
-4	6390	BUTTON, Stop pawl push	1	ABD
-5	6432	SPRING, Push button	1	ABD
-6	6431	SPRING, Stop plunger retaining.	1	ABD
-7	9257	PLUNGER, Push button stop	1	ABD
-8	6430	SPRING, Stop plunger friction	1	ABD
-9	21301	NAMEPLATE	1	A
-9	6438	NAMEPLATE	1	B
-10	8120	SCREW, Oval hd.	2	A
	05653	FRAME ASSY, (Includes items 11-34)	1	A
	05225	FRAME ASSY, (Includes items 11-34)	1	BD
-11	22002	. SCREW, Ratchet	1	ABD
-12	6105	. RATCHET, Film meter	1	ABD
-13	6437	. DIAL, Film meter	1	ABD
-14	6436	. WASHER, Friction.	1	ABD
-15	6398	. SPRING, Speed control retaining	1	ABD
-16	4116	. SCREW, Retaining spring	1	ABD
-17	6399	. DIAL, Governor	1	ABD
-18	25654	. SCREW, Governor dial.	2	ABD
-19	6405	. HOLDER, Speed control dial.	1	ABD
-20	6406	. KNOB, Speed control.	1	ABD
-21	10523	. SCREW, Shoulder	1	A
-22	6441	. SPRING, Friction	1	A
-23	6444	. DIAL, Relative exposure indicator	1	A
-24	16962	. DIAL, Lens stop	1	A
-25	02055	. HOUSING ASSY, Crank (for 14-1/2°	1	ABD
		press. angle cranking gear)		
-25	09322	. HOUSING ASSY, Crank (for 20° press.	1	D
		angle cranking gear)		
-26	21996	. SCREW, Crank housing	4	ABD
-27	11017	. BLOCK, Felt.	1	ABD
-28	9253	. COVER, Crank housing	1	ABD
-29	0264	. GEAR ASSY, Cranking (14-1/2° press. angle)	1	ABD
-29	09314	. GEAR ASSY, Cranking (20° press. angle).	1	D
-30	6473	. CLAMP, Critical focuser	1	ABD
-31	21994	. SCREW, Clamp.	2	ABD
-32	6102	. BEARING, Main drive shaft	1	ABD
-33	11624	. BUSHING, Stop plunger	1	ABD
-34	01235	. FRAME, Camera.	1	ABD
-35	30532	SCREW, Carrying strap.	2	ABD
-36	06398	STRAP, Carrying	1	ABD

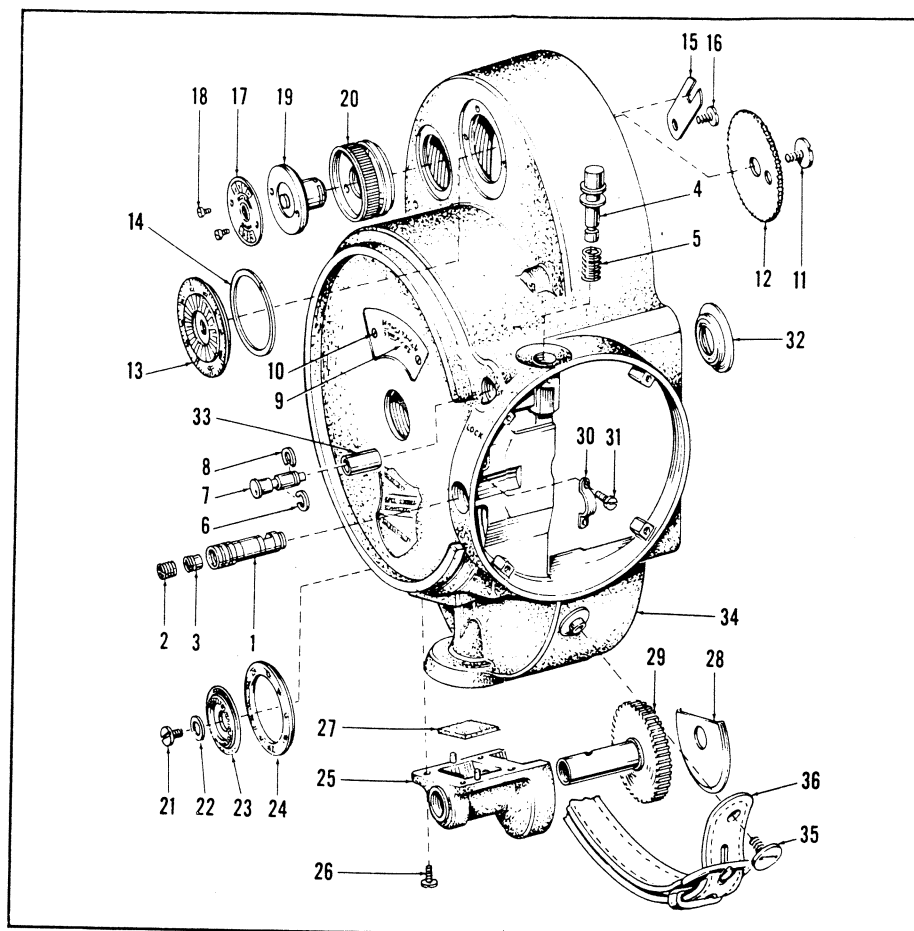


Figure 10. Camera Frame Assembly - Des. 70DA, 70DL, and 70DR
(see Figure 11 for Des. 70H Camera Frame)

NOTE: CHECK PRESSURE ANGLE OF GEAR (29)
BEFORE REPLACING

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5 6 7		
CAMERA FRAME ASSY (Des. 70-H and 70-HR)				
11-1	0730	FOCUSER, Critical	1	CE
-2	04872	EYEPIECE, Critical focuser	1	CE
-3	04069	CARRIER, Critical focuser	1	CE
-4	6390	BUTTON, Stop pawl push	1	CE
-5	6432	SPRING, Push button	1	CE
-6	6431	SPRING, Plunger retaining	1	CE
-7	9257	PLUNGER, Stop	1	CE
-8	6430	SPRING, Friction	1	CE
-9	6438	NAMEPLATE	1	C
-10	12663	SCREW, Cover	1	CE
-11	9057	COVER.	1	CE
-12	10882	SCREW, Flat hd.	2	CE
-13	05718	CRANK AND SUPPORT ASSY	1	CE
-14	21607	PIN, Push	1	CE
-15	9059	SPRING, Push pin	1	CE
-16	9227	SCREW, Knurled hd.	1	CE
-17	06398	STRAP, Carrying	1	CE
-18	30532	SCREW, Carrying strap.	2	CE
	05042	FRAME ASSY, (Includes items 19-56)	1	C
	*08927	FRAME ASSY, (Includes items 19-56)	1	E
	*09378	FRAME ASSY, (Includes items 19-56)	1	E
-19	10881	. SCREW, Flat hd	4	CE
-20	9054	. BAR, Side	2	CE
-21	9055	. PLATE, Attachment	1	CE
-22	17931	. GASKET, Attachment plate	1	CE
-23	6473	. CLAMP, Critical focuser	1	CE
-24	21994	. SCREW, Clamp.	2	CE
-25	6102	. BEARING, Main drive shaft	1	CE
-26	4116	. SCREW, Retaining spring	1	CE
-27	6398	. SPRING, Speed control retaining	1	CE
-28	6399	. DIAL, Governor	1	CE
-29	25654	. SCREW, Governor dial.	2	CE
-30	6405	. HOLDER, Speed control dial.	1	CE
-31	6406	. KNOB, Speed control.	1	CE
-32	6059	. SCREW, Gear stud.	1	CE
-33	9240	. WASHER	1	CE
-34	9237	. STUD, Gear	1	CE
-35	9235	. HOUSING, Belt.	1	CE
-36	9239	. SCREW, Drive gear	2	CE
-37	9238	. GEAR, Drive (14-1/2° pressure angle)	1	CE
-37	29106	. GEAR, Drive (20° pressure angle)	1	E
-38	9236	. PULLEY, Take-up drive.	1	CE
-39	822	. SCREW, Bearing disc	8	CE
-40	9234	. DISC, Bearing	1	C
-40	28131	. DISC, Bearing	1	E
-41	*05039	. COUNTER ASSY, Veeder (includes	1	CE
		items 43-47)		
-41	*09331	. COUNTER ASSY, Veeder (includes	1	E
		items 43-47)		
-42	16577	. SCREW, Counter assy	3	CE
-43	4489	. . PIN, Dowel	1	CE
-44	16801	. . GEAR, Veeder counter index.	1	CE
		(14-1/2° pressure angle)		
-44	29114	. . GEAR, Veeder counter index.	1	E
		(20° pressure angle)		
-45	26977	. . SCREW, Mounting plate.	4	CE
-46	28589	. . PLATE, Counter mounting	1	CE
-47	16799	. . COUNTER, Veeder	1	CE
-48	22152	. BRACKET, Motor	1	CE
-49	22026	. SCREW, Motor bracket	4	CE

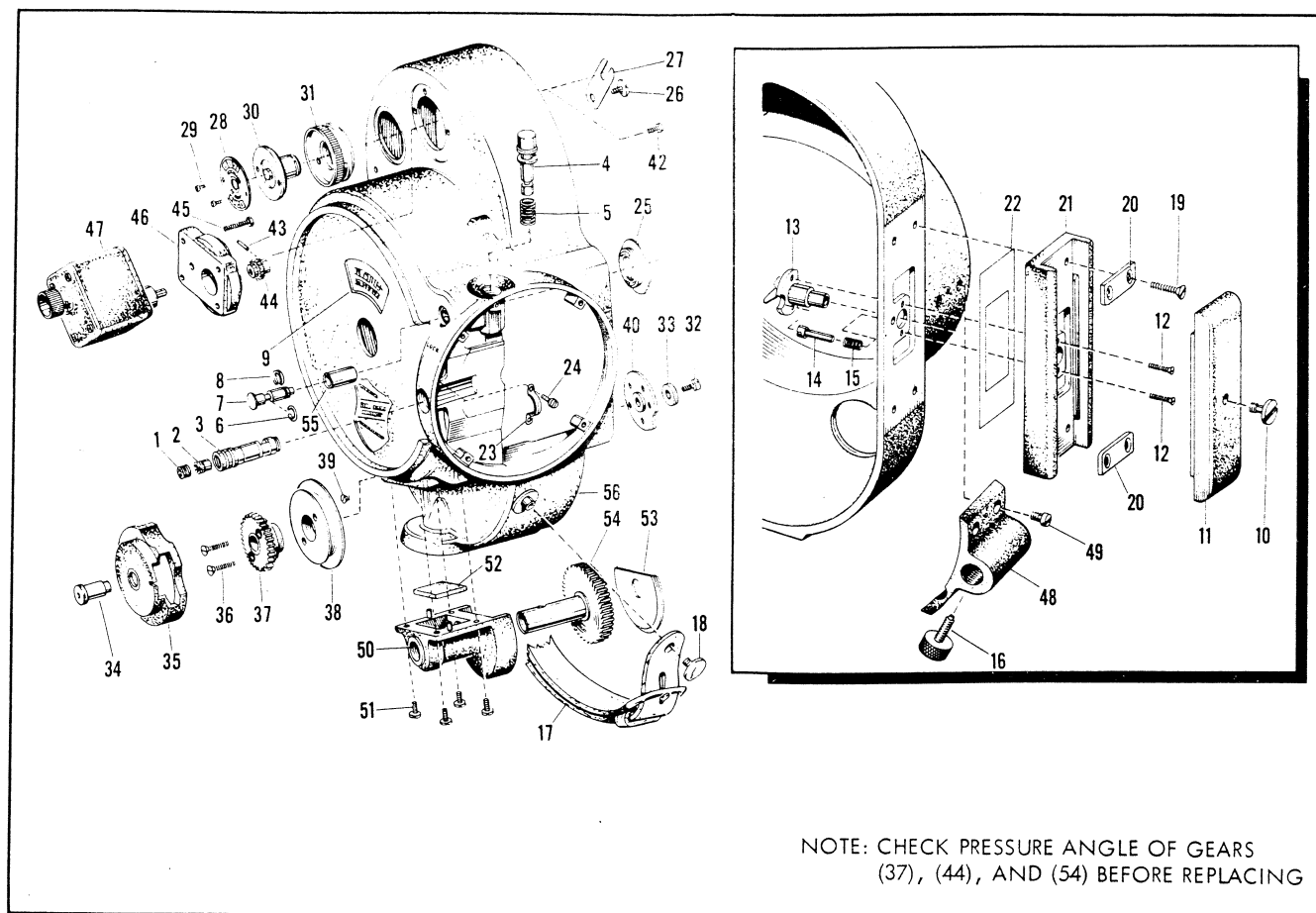


Figure 11. Camera Frame Assembly - Des. 70H and 70HR Camera

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5 6 7		
CAMERA FRAME ASSY (Des. 70-H and 70-HR) (CONT)				
11-50	02055	. HOUSING, Crank (for 14-1/2° pressure angle cranking gear)	1	CE
-50	09322	. HOUSING, Crank (for 20° pressure angle . . cranking gear)	1	E
-51	21996	. SCREW, Crank housing	4	CE
-52	11017	. BLOCK, Felt	1	CE
-53	9253	. COVER, Crank housing	1	CE
-54	0264	. GEAR, Cranking (14-1/2° pressure angle) .	1	CE
-54	09314	. GEAR, Cranking (20° pressure angle). . . .	1	E
-55	11624	. BUSHING, Stop plunger	1	CE
-56	05037	. FRAME, Camera.	1	<u>C</u>
-56	09031	. FRAME, Camera.	1	<u>E</u>

*NOTE: When ordering replacement assemblies for cameras equipped with 20° pressure angle gears Frame Assy #09378 replaces #08927 (Des. 70-HR) Counter Assy #09331 replaces #05039 (Des. 70-HR)