PART FIVE
REPAIR INSTRUCTIONS

NOTE: Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service Forces will be reported on W.D., A.G.O. Form No. 468 (Unsatisfactory Equipment Report); by Army Air Forces, on Army Air Forces Form No. 54 (unsatisfactory report). If either form is not available, prepare the data according to the sample form reproduced in figure 68.

SECTION IX
THEORY OF EQUIPMENT

73. THEORY OF OPERATION.

The theory of operation of Camera PH-330-(*) is identical for all models in this series. Essentially, Camera PH-330-(*) is a device for intermittently driving film and exposing successive frames during intervals when the film is at rest behind the lens. The process as a whole involves three basic operations: the feeding of film to the exposure aperture, the exposure of film at the aperture, and the rewinding of the exposed film after leaving the aperture. The process is accomplished inside the camera by a mechanism which feeds, carries, positions, and takes up the film during operation, and regulates the intervals of motion and rest. The camera also embodies lenses which form the image, filters which control the relative brightness of colors in the subject, a diaphragm which controls the volume of light at the exposure aperture, a shutter which regulates the period of exposure, viewing devices which aid in determining the framing and composition of the picture, and a tripod which supports the camera. In Cameras PH-330-G, -F, -H, and -J, further provision for driving the camera mechanism is furnished by an electric motor.

a. Specifically, the picture-taking process involves the following operations. Film is drawn from the feed spool by the feed sprocket (fig. 26) and fed to the intermittent mechanism. A shuttle equipped with two teeth (fig. 45 (21)) which engage the sprocket holes on one side of the film, conveys the film over the aperture for exposure, frame by frame. The movement of the shuttle is controlled by a cam (fig. 46 (11c)) actuated by a train of gears and coupled with either the spring drive or the electric motor drive. The pressure plate (fig. 43 (18)) holds the film stationary in the aperture for the moment of exposure, when the open segment of the rotating shutter (figs. 43 (9) and 46 (11a)) passes directly in front of it at a designated speed, exposing the film to the light. The shuttle teeth then re-engage the sprocket holes of the next frame and pull it down into position for the next exposure.

b. While the unexposed film is being drawn into position by the shuttle teeth, the opaque segment of the shutter is completing a rotation before the aperture, excluding light from the film. Both the shuttle action and the rotary action of the shutter are synchronized by a single gear, permitting light to enter the camera only when the film is stationary, and interrupting the light when the film is in motion. The shutter revolves once for each complete cycle of the shuttle teeth, while the operating speed, or number of frames exposed per second, is regulated by a friction controlled governor mechanism (fig. 51 (24)). The film is drawn down into the lower film chamber after exposure and engaged by the take-up sprocket. It then is rewound on the take-up spool by the take-up spindle.

c. The function and operation of all other basic parts of Camera PH-330-(*) has been described in parts one and two of this manual. An analysis of optical theory embodied in the optical components of this camera is not within the scope of this manual. For particulars, consult TM 1-219, Basic Photography.

SECTION X
TROUBLE SHOOTING

74. GENERAL.

Equipment performance check lists (pars. 59 and 60) have already been given, tabulating various visual and operational indications of normal performance while Camera PH-330-(*) is in use. The corrective measures recommended in the table relate only to minor failures of equipment which can be remedied by simple adjustment of parts which are themselves unimpaired. The trouble shooting chart which immediately follows, provides a table of specific equipment defects which may or may not be corrected by adjustment, but which represent in all cases the failure of a part to discharge its function adequately.

75. TROUBLE CHART.

Trouble	*Probable cause*	*Remedy*
Spring motor cannot be wound.	Main drive spring broken.	Replace (pars. 94g and h and 101).
	Winding device broken.	Repair or replace.
Driving machanism does not run (without film).	Dirt particles in mechanism.	Dismantle camera, clean, oil.
	Buck tooth gears improperly adjusted.	Repair (par. 96g).
	Insufficient oil.	Lubricate (figs. 35, 36, and 37).
Driving machanism does not run (threaded).	Film incorrectly threaded.	Check loops, channel, and sprocket teeth (par. 38).
	Accumulated dirt or emulsion on gate or aperture plate.	Clean film channel (fig. 26).
Driving mechanism does not run (with magazine attached).	Magazine mounted or loaded incorrectly.	See loading and mounting instructions (pars. 55 and 56).
	Film threaded incorrectly.	See threading instructions (par. 57).
Driving mechanism does not run smoothly (with magazine).	Driving spring belt kinked, too tight, or too loose.	Adjust belt. Replace if kinked badly.
Driving mechanism does not run (with motor attached).	Spring motor not wound down. Operating lever not locked in ON position.	Correct (par. 54a).
	Current supply switch in OFF position.	Switch ON.
	Incorrect power source.	Check electric current designation.
	Motor improperly mounted to camera frame.	See mounting instructions (par. 54).
	Power cable assembly plug or receptacle damaged.	Locate and repair.
	Battery dead.	Recharge or replace.
Pictures in faulty focus, or no pictures at all.	Lens (shooting) left in viewing position.	Rotate turret arm to bring lens into shooting position.
Picture incorrectly framed.	Alignment gauge left in viewing position.	Refer to par. 52.

Trouble	*Probable cause*	*Remedy*
	No correction made for parallax.	Refer to caution in par. 49c.
Field of view obstructed when using viewfinder.	Long focal length lens interferes with viewfinder.	Use auxiliary viewfinder.
Picture obstructed.	Wrong lens complement.	Remove interfering lens.
Film loses loop.	Incorrectly threaded.	See threading instructions (par. 38). Make sure sprocket holes are engaged by shuttle teeth. Check number of sprocket holes in loop.
	Film clearance improperly adjusted.	Adjust as needed (par. 110b).
	Shuttle broken or intermittent mechanism worn.	Repair or replace (par. 88g).
Film light-struck (without magazine).	Film loaded or unloaded in bright light.	Load in subdued light.
	Camera door not securely latched.	Check latches.
	Camera door sprung.	Check edges for light leak.
Film light-struck (with magazine).	Magazine covers not securely fastened.	Fasten securely.
Film scratched.	Aperture plate gritty or dirty.	Clean aperture plate.
	Aperture plate or pressure plate nicked or damaged.	Repair, polish, or replace.
	Overlong loop in threading.	Shorten loop.
Pictures not in sharp focus.	Lens focusing scale incorrectly set for distance of subject from camera.	Check focus for each take.
	Lens has been taken apart and incorrectly reassembled.	Refer to higher echelon repair.
	Lens seat out of adjustment.	Check depth.
	Slippage of focusing collar.	Tighten focusing lens clamp knob.
Picture blurred or fuzzy.	Lens or filter element covered with dirt, oil, or moisture.	Clean as directed.
Pictures unsteady.	Camera not held steady.	Hold camera steady.
	Intermittent mechanism worn.	Repair.
	Tripod or tripod elements jarred.	Check all locking devices.
	Incorrect panning technique.	Rehearse pan before shooting.
	Incorrect threading, film loops too large or too small.	See threading instructions.

SECTION XI
REPAIR

76. GENERAL REPAIR: REQUIRED SERVICE TOOLS.

Standard repair tools required for the service, inspection, and repair of Camera PH-330-(*) include a Strobotac, surface blocks, gauges, indicators, and micrometers. The following tools are specifically required for adjusting and testing operations:

Signal Corps stock No.	*Manfacturer's No. (Bell and Howell)*	*Description*
8P9-46	S-5142-N1, 2, 3	Gauge: aperture alignment three-variable; especially adapted to gauge aperture alignment to film transport. Part of Camera Tool Equipment PH-404 and Tool Set PH-434.
8P9-22	S-4893-F1-B	Fixture: main drive spring installation. Part of Camera Tool Equipment PH-404 and Tool Set PH-434.
8P9-34	S-5376-F1, 2, 3, 6	Fixture: winding and unwinding main drive spring; full set five units. Part of Tool Set PH-434.
8P9-98	S-4860-N4, 5, 8, 9	Micrometer: with tools especially adapted to measure focal length. Part of Camera Tool Equipment PH-404 and Tool Set PH-434.
8P9-144	S-8074-F2, N5, 6, 7	Tools: governor adjusting gauges; six-variable. Parts of Tool Set PH-434.
8P9-174	S-8681-F1	Wrench: pin wrench to adjust recoil tension on feed spindle. Part of Camera Tool Equipment PH-404 and Tool Set PH-434.

77. INSPECTION BEFORE DISASSEMBLY.

Before disassembling the camera for repair, check the condition of the mechanism to determine the extent of repairs needed. All camera running speeds should be checked with film in the mechanism, and test runs should be made for later study.

a. Speed Checks.

(*1*) Check each speed of the camera to determine whether the governor requires adjustment or replacement when the camera is disassembled. In many cases when the speeds are slow or fast, the re-marking of a new speed dial is all that will be required.

(*2*) Among the variety of methods possible for checking camera running speeds, the use of a Strobotac is the most accurate and feasible. The Strobotac timing chart for ordinary climatic conditions follows:

Speed (fps)	8	12	16	24	32	48
Shutter (rpm)	480	720	960	1440	1920	2880
Plus or minus allowance	10%	10%	5%	5%	5%	5%

(*3*) A rough speed check also can be made by counting off the film footage run during a certain time interval. This check should be made with the camera loaded because film drag will slow up the operation slightly. The footage dial should register a 30-foot film run in the following times at the following operating speeds:

60 sec	8 fps
40 sec	12 fps
30 sec	16 fps
20 sec	24 fps
15 sec	32 fps
10 sec	48 fps
7½ sec	64 fps

b. Photo Test. Make a test with a short strip of unexposed film, focusing the lens by calibration on a measured distance. If the image on the developed film is not sharply focused, the depth of the lens mount (distance from the lens seat to the film plane) may need correction or readjustment. Use a depth micrometer to measure this distance, following the procedures outlined in paragraph 110a(5). If the depth as measured is correct, the lens itself may be off calibration. To adjust the

focus of the lens, use one of the following procedures.

(*1*) Remove the lens from the lens seat. Rotate the lens forward and remove it from the outer focusing mount. Inspect the inner focusing mount and the outer focusing mount for dirt which might obstruct the accurate seating of the lens. Replace the lens in the camera and make another test. If the test indicates that the calibration of the lens is inaccurate, the following methods may be used to correct the lens. On those lenses which have a setscrew positioning the focusing mount on the lens proper, remove the setscrew. Unscrew the focusing mount from the lens, being careful not to put pressure on the diaphragm ring. The correction for the positioning of the lens on the focusing mount may now be made either by inserting shims between the focusing mount and the lens to extend the lens position, or by machining the front circumference of the focusing mount to retract the lens. The amount of extension or retraction required can best be determined by testing the lens on a lens footage calibration fixture.

(*2*) When such equipment is not available, the following method may be used. Lock the lens in the lens seat and focus by calibration on a target at a measured distance. Make a reference mark on the focusing mount of the lens. Revolve the lens slightly counterclockwise. Make an index point opposite the reference mark on the focusing mount. Run several frames through the camera at this setting. Again revolve the lens slightly counterclockwise and make a second reference mark. Continue this procedure until a series of exposures has been made over an approximately 15-degree revolution of the lens in the focusing mount. Develop and examine the film under a microscope or magnifying glass and note the sharpest exposure. Insert shims between the lens mount and lens to position the lens at the reference mark indicated. If none of these exposures produce a sharp image on the test film, remove the focusing mount and take it down approximately 0.005 inch on the front circumference. Repeat the test procedure as described, shimming the lens as required.

(*3*) On Camera PH-330-G, a visual test for accuracy of lens focus may be made by means of the prismatic viewfinder. Place the camera on a tripod and rotate the lens in position before the prismatic viewfinder. Focus the lens as sharply as possible on a very distant object. Examine the focusing calibration. If critical focus is achieved with the lens extended beyond the infinity point, that is, toward 50-foot calibration, the position of the lens in the focusing mount will require extending by means of shims, as described in subparagraph (2) above. Again remove the lens from the lens seat and rotate the turret into intermediate position, leaving the aperture of the prismatic viewfinder accessible. Hold the lens before the prismatic viewfinder. Note the sharpness of focus obtainable in comparison with the focus previously visible. If a sharper focus is obtainable with the lens held by hand before the prismatic viewfinder, the focusing mount will require adjustment to retract the position of the lens, as in subparagraph (2) above.

c. Running Test. Run a 100-foot roll of test film through the camera to check the operation of the take-up spindle, sprockets, and shuttle mechanism. For proper operation, the size and shape of the film loop should be maintained intact throughout, and the film should wind tightly on the take-up spool. Listen for any irregularities in the action of the spring and camera mechanism during the film run.

78. DISASSEMBLY OF CAMERA MECHANISM: GENERAL.

The disassembly which follows pertains specifically to Camera PH-330-G, unless otherwise indicated. With the exception of parts used in Cameras PH-330-A, -H, and -J (par. 113), all camera parts comprising Camera PH-330-(*) are involved in the disassembly of Camera PH-330-G. Consequently, all characteristic stages of camera disassembly are here represented. Disassembly procedure involving features not furnished with certain models (turrets, turret viewfinders, etc.) obviously will not apply to those models.

a. Basic Disassembly Units. The camera mechanism is composed of four distinct disassembly units: the head assembly, the front mechanism plate assembly, the train of gears, and the spring motor.

(*1*) The head assembly consists of the intermittent movement shutter, and the lens turret.

(*2*) The front mechanism plate assembly

consists of the film sprockets, feed and take-up spindles, and film gate. The front plate is held securely to the back mechanism plate by screws and studs, and to the camera frame as a whole by four retaining screws.

(*3*) The train of gears on the back mechanism plate are separated from the film chamber by the front mechanism plate (fig. 48 (16)).

(*4*) The spring motor, which supplies the film driving power, is separated from the gears by two plates; a thin, brass plate known as the spring motor graphite retaining plate (fig. 49 (1)), and the back mechanism plate, complete with bearings and studs (fig. 49 (5)).

b. Removal of Basic Units. To render the driving gears more accessible for cleaning and repair, the front mechanism plate may be removed from the camera frame without removing the spring motor. Conversely, if the main drive spring is to be cleaned or repaired, the entire mechanism, including spring motor, driving gears, and front mechanism plate, may be removed from the camera frame as a unit.

79. DISMANTLING CAMERA FOR REPAIR: GENERAL.

To dismantle the camera it is always necessary to remove the camera head and spider lens turret (fig. 43). Since the stop pawl (figs. 43 (10) and 46 (12)) is located in the head, removal of the head frees the mechanism and permits it to operate to the end of its capacity run. At this point, the buck tooth (idler mechanism stop) gears (figs. 51 (13) and 48 (13)) engage and stop the mechanism while there is still power in the main drive spring (fig. 50 (9)).

80. LOCKING CAMERA MECHANISM: GENERAL.

To prevent the camera from running down, the mechanism must be locked before the camera head is removed. The extent to which the mechanism is to be dismantled will determine the procedure for locking the mechanism. Three locking procedures are possible.

a. Method Number One. This method is to be employed when the head assembly alone is to be removed from the camera, and the gearing mechanism inside the camera is not to be disturbed.

(*1*) Press the operating lever.

(*2*) Allow the camera to run until it comes to a standstill at the end of its run.

b. Method Number Two. This method is to be employed when the head assembly and the front mechanism plates are to be removed, giving direct access to the driving gears. The spring motor is left undisturbed.

(*1*) Press the operating lever, allowing the camera to operate until it stops at the end of its run.

(*2*) Press the buck tooth (idler mechanism stop) gear (fig. 51 (13)) out of position. This should be done with a small screwdriver through the opening in the front mechanism plate. While the gear is still disengaged, press the operating lever and again run the camera until it comes to a full stop. This operation permits the spring to fully uncoil within the camera frame.

(*3*) Proceed to dismantle the camera. Remove the camera head and front mechanism plate. Do not remove the back mechanism plate and the spring motor.

c. Method Number Three. This method is to be employed when the camera is to be dismantled entirely and both front and back mechanism plates and spring motor are to be removed.

(*1*) Wind the spring motor to capacity.

(*2*) Press the buck tooth gear out of position as directed in subparagraph b(2) above. While the gear is disengaged, turn it until the long buck tooth is visible.

(*3*) With the buck tooth gear still disengaged, tap the operating lever until the long tooth of the gear is engaged in the shallow space in the main drive shaft stop gear (fig. 51 (1)). This engagement must be on the camera head side of the line of center of the two gears.

(*4*) Release the pressure on the buck tooth gear and press the starting lever to make sure that the mechanism is locked.

(*5*) Proceed with the dismantling of the camera.

81. REMOVING MOTOR WINDING DEVICE (SEMI-PERMANENT).

a. Ratchet Winding Key.

(*1*) To remove the ratchet winding key (fig. 12 (1)), place a screwdriver or similar

instrument between the camera frame and the key. Pry the key out of its socket.

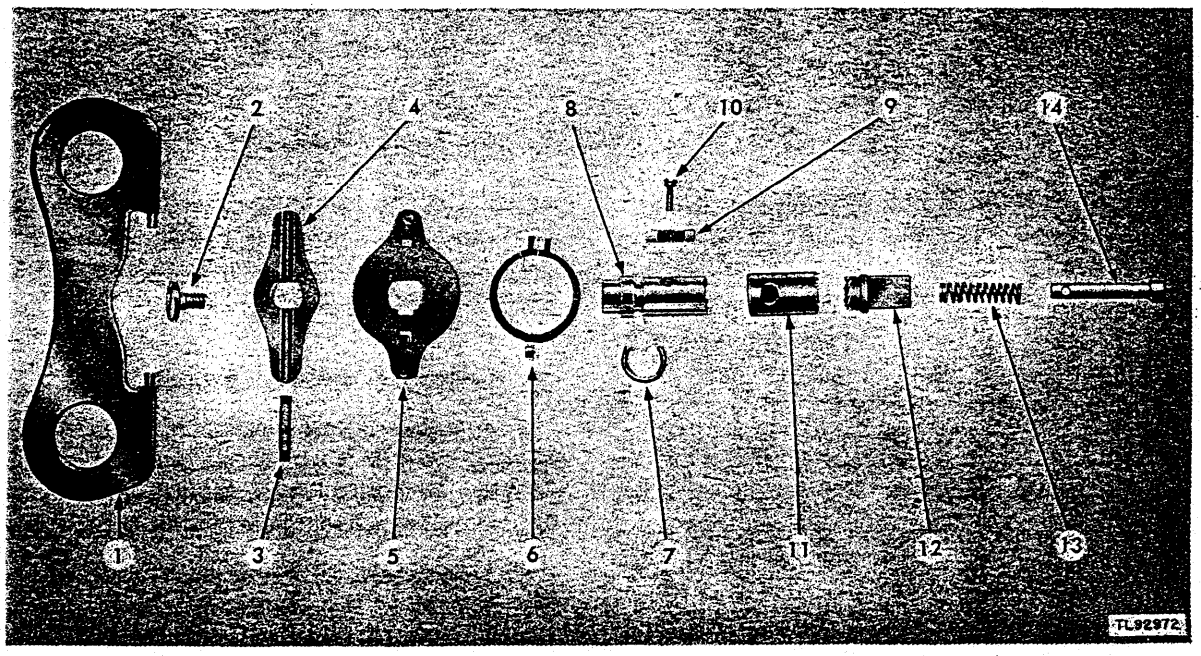
(*2*) To disassemble the ratchet winding key, remove the setscrew and the bow plate (fig. 38 (2) and (4)). Remove the clamp spring and the key lock spring (fig. 38 (5) and (6)) from the clamp spring assembly. Be careful not to lose the uncoupling cam (fig. 38 (3)) which lies in the slot on the bow plate. Remove the key shaft setscrew (fig. 38 (10)) from the winding key shaft, the ratchet, the main stud, the compression spring, and the uncoupling sleeve (fig. 38 (8), (12), (14), (13), and (11)) in the order named.

(*3*) To assemble the winding key after cleaning and repair, place the flanged end of the uncoupling sleeve (fig. 38 (11)) in the slot on the shaft (fig. 38 (8)) and slide it into place. Slip the compression spring (fig. 38 (13)) on the shaft and insert it into the ratchet (fig. 38 (12)). Press the parts together so that the holes are aligned, and fasten with the setscrew (fig. 38 (10)). Lay the uncoupling link (fig. 38 (9)) in the slot on the shaft end and fasten it with the retaining ring (fig. 38 (7)). Place the uncoupling cam (fig. 38 (3)) in position and engage the slot with the end of the cam. Cover the assembly with the clamp spring (fig. 38 (5)) and fasten it to the end of the assembled key shaft with the winding key setscrew (fig. 38 (2)).

NOTE: The ratchet winding key should be disassembled only when it is necessary to replace the compression spring, the winding key shaft setscrew, the key lock spring, the ratchet, or the main stud (fig. 38 (13), (10), (6), (12), and (14)). If other parts of the winding key need replacing, the entire key (Signal Corps stock No. 8A430A/K1) should be replaced.

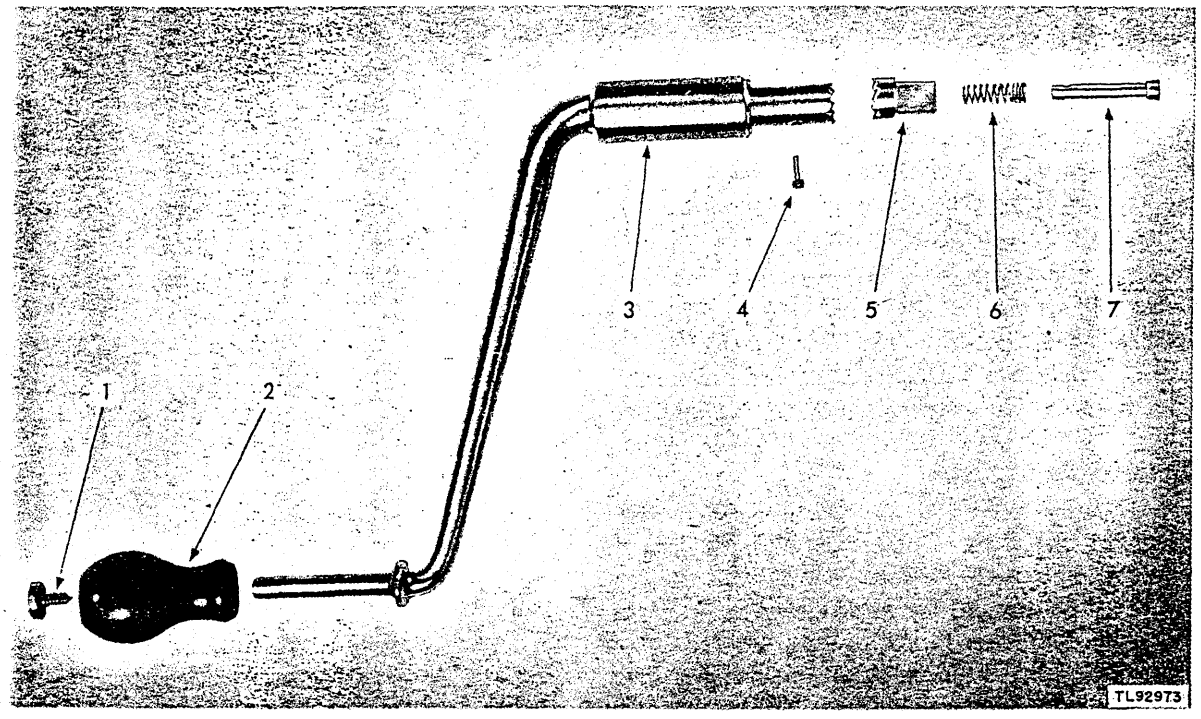
b. Geared Winding Crank.

(*1*) To remove the geared winding crank (fig. 12 (4)) attached to Camera PH-330-A (bombspotter model) and Camera PH-330-H, rotate the crank counterclockwise, or back-



1. Winding key handle
2. Winding key setscrew
3. Uncoupling cam
4. Bow plate
5. Clamp spring
6. Key lock spring (8A430A/51)
7. Retaining ring
8. Winding key shaft
9. Uncoupling link
10. Winding key shaft setscrew (8P10-932)
11. Uncoupling sleeve
12. Ratchet (8P10-1334)
13. Ratchet actuating compression spring (8P10-1030)
14. Main stud (8P10-712)

Figure 38. Disassembly, ratchet winding key, Cameras PH-330-A and -H.



1. Crank handle retaining screw (8P10-927)
2. Crank handle (8P10-214)
3. Ratchet crank arm
4. Ratchet gear retaining shaft pilot screw (8P10-932)
5. Ratchet (8P10-1334)
6. Ratchet actuating spring (8P10-1030)
7. Ratchet retaining shaft

Figure 39. Disassembly, ratchet winding crank, Camera PH-330-G.

ward, unscrewing it from the camera frame.

(*2*) For disassembly of the winding gear housing after removal of the geared winding crank assembly (fig. 41 (1)), remove the four gear housing retaining screws and the gear housing assembly plate (fig. 41 (2) and (3)). Pull the gear and key assembly drive gear, the retaining spring, and the crank holder (fig. 41 (4), (5), and (6)) from their positions on the housing plate. Remove the spring winding gear and key assembly, and the winding gears housing gasket (fig. 41 (7) and (8)) from their places on the camera frame.

(*3*) Assemble the winding gears and housing assembly by reversing the procedure outlined in subparagraph (2) above.

NOTE: The ratchet winding key (fig. 12 (1)) can be used with these models by detaching the geared winding crank as directed above and pushing the key into place with a sharp rap of the hand until it clicks with the mechanism and holds.

c. Other Hand-winding Devices. All other hand-winding devices are readily detachable and attachable for use. They should be disassembled only to replace a broken or damaged part. See figure 40 for the disassembly of the hand crank and figure 39 for disassembly of the ratchet winding crank.

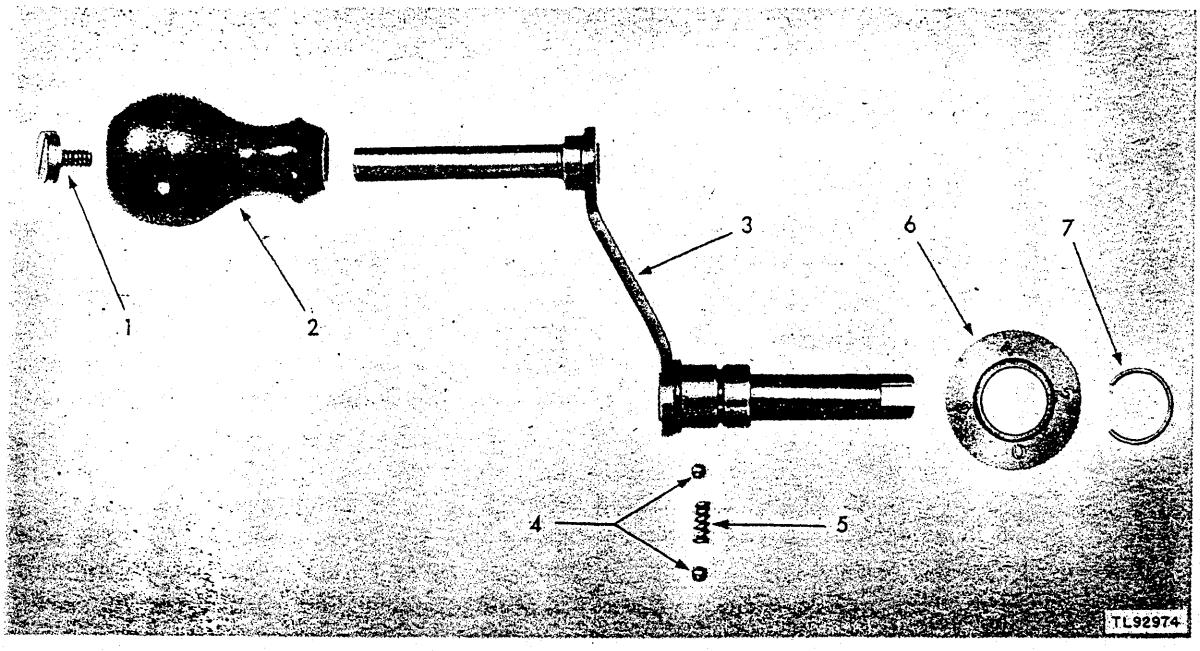
82. CAMERA HEAD: GENERAL.

a. Camera Head Parts. The camera head consists of the lens turret, the camera head casting, the shutter, and the intermittent film-driving mechanism (shuttle and shuttle cam).

b. Inspection of Parts During Disassembly. Failure of the camera to function may be due to dirt particles or small pieces of film lodged between the shuttle cam and the shuttle (fig. 46 (9) and (11)), or to lack of oil on these parts. Examine the camera carefully during disassembly to ascertain the cause of the trouble.

83. CAMERA HEAD: REMOVING TURRET.

a. Lock the mechanism (par. 80a).



1. *Hand crank handle retaining screw (8P10-927)*
2. *Hand crank handle (8P10-214)*
3. *Crank assembly*
4. *Crank assembly lock ball (2 ea.) (8P10-42)*
5. *Hand crank compression spring (8P10-1037)*
6. *Hand crank dial (8P10-481)*
7. *Hand crank dial locking spring (8P10-1053)*
8. *Hand crank assembly (entire) (8P10-480)*

Figure 40. Disassembly, hand crank, Cameras PH-330-G and -H.

b. Remove the turret post dust cap (fig. 42 (1)) by unscrewing it counterclockwise.

c. Remove the lens turret lock knob (fig. 42 (2)) by turning counterclockwise.

d. Remove the retaining screw (fig. 42 (5)). Do not lose or misplace the bearing and thrust ring or the tension spring (fig. 42 (6) and (7)). Lift the turret casting intact (fig. 42 (9)) from the turret post (fig. 46 (25)). Turn over the turret. Remove the spacer and the three locking balls (fig. 42 (8) and (10)) from inside the turret.

84. CAMERA HEAD: DISASSEMBLING TURRET.

a. Unscrew the two lens focusing lock bracket screws (fig. 42 (19)) on each lens mount seat. Remove the lens focusing lock bracket and the focusing lock clamp screw and knob assembly (fig. 42 (18) and (20)) from the casting.

b. The turret lens (with pin) key assembly (fig. 42 (16)) is held to the casting by two retaining screws (fig. 42 (17)). Remove the screws and the assembly.

c. Remove the lens mount lock lever screw (fig. 42 (13)) from the lens mount. Then lift from the casting the unit composed of the lens mount lock lever, the lens mount lock lever compression spring, and the lens mount locking pins (fig. 42 (12), (11), and (14)).

85. CAMERA HEAD: REMOVING CAMERA HEAD CASTING.

a. Remove the two head retaining screws (long) (fig. 43 (12)) from the front of the head casting. Remove the head retaining screw (short) (fig. 43 (13)) on the inside of the film chamber immediately above the aperture plate.

NOTE: In disassembling the governor-in-the-head model (Camera PH-330-A, fig. 18) the fourth head retaining screw must be removed from the camera head casting (fig. 44).

b. With the film gate open, carefully push the camera head casting assembly out by pressing with the fingers against the aperture plate

(fig. 43 (18)) until the plate is free of the camera housing.

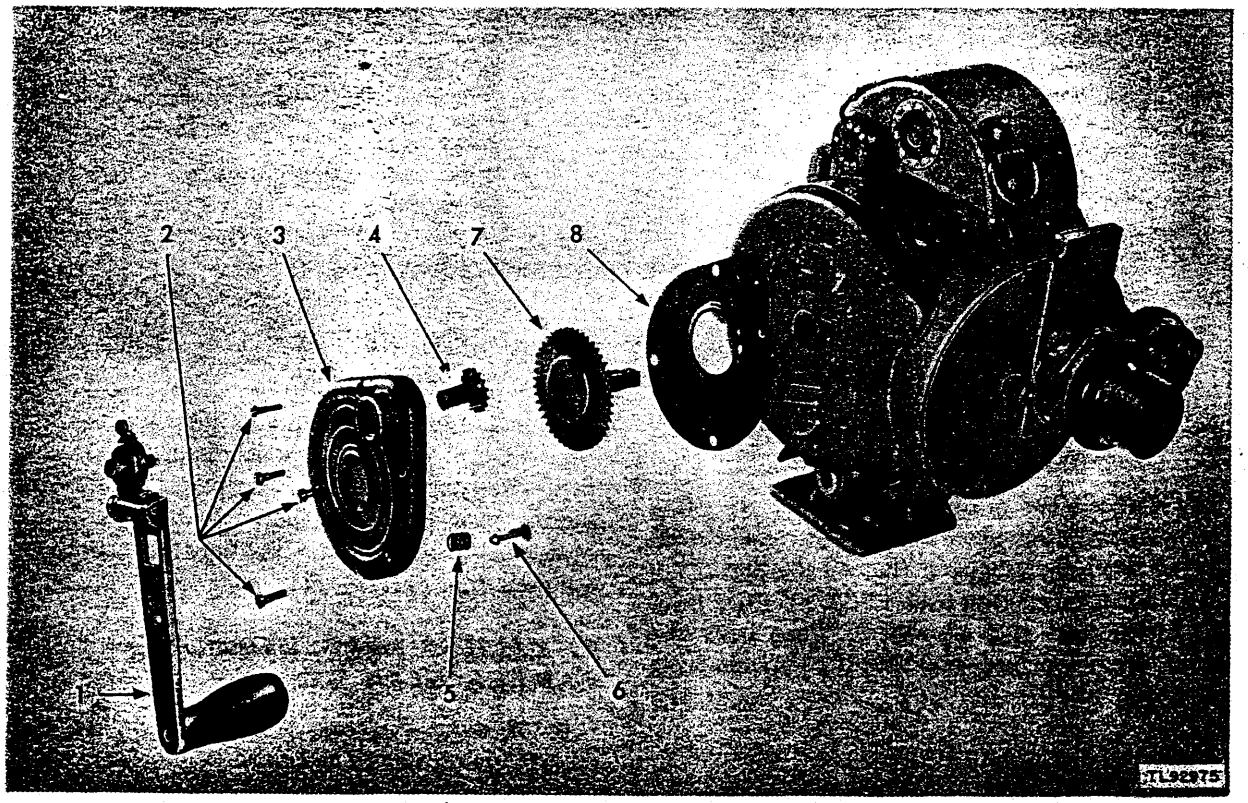
86. CAMERA HEAD: DISASSEMBLY.

a. Shuttle. To remove the shuttle (fig. 34 (8)), loosen the two large dowel pin retaining screws (fig. 43 (6)). Lift the shuttle and the two dowel pins (fig. 43 (7)) from their place in the head casting.

b. Shutter and Cam Assembly. To remove the shutter and cam assembly (figs. 46 (11) and 43 (9)), place the head casting over a hole on a block with the shutter face up. Drive the shuttle cam spindle (fig. 46 (21)) down and out of the head casting until the shutter and cam assembly can be lifted from its position. Note the shuttle cam thrust washer (fig. 46 (10)) beneath the shutter, and make certain that it is in place when the mechanism is reassembled. Note also that the shutter and cam assembly is staked in one piece. Do not dismantle this assembly. Replace it as a unit, making sure that any shims underneath the shutter are accounted for in the reassembly.

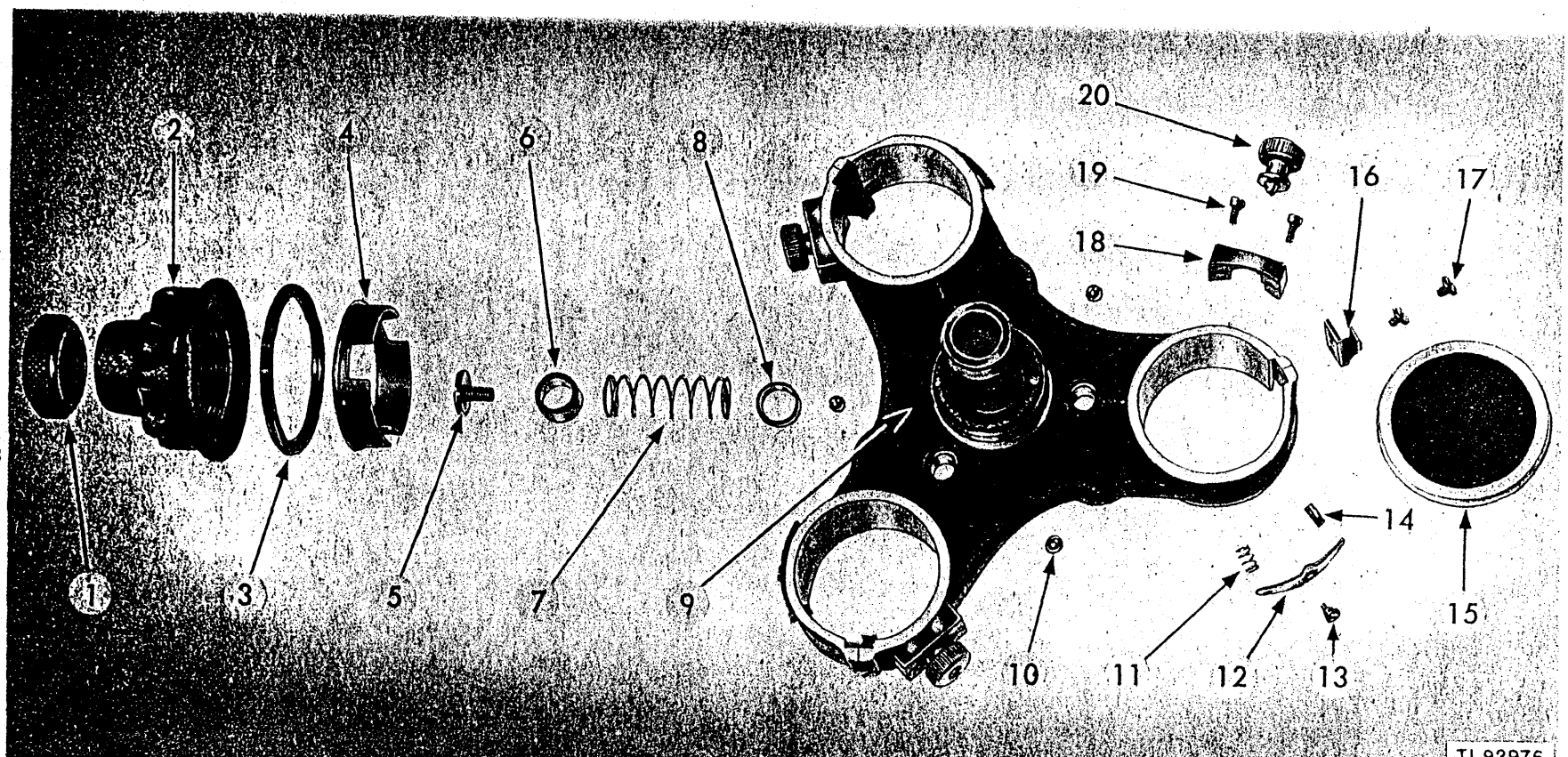
c. Governor-in-the-head, Camera PH-330-A. The removal of the shutter and cam assembly on older models of Camera PH-330-A permits access to the complete governor assembly (fig. 44). The procedure for removing this type of governor is described below.

(*1*) Remove the governor bearing shaft dust plug (fig. 45 (10)) from the governor (fig. 45 (6)). If the governor does not lift out easily, set the brake arm (fig. 45 (2)) to the highest speed: this adjustment brings the governor brake arm felt pad brake (fig. 45 (3))



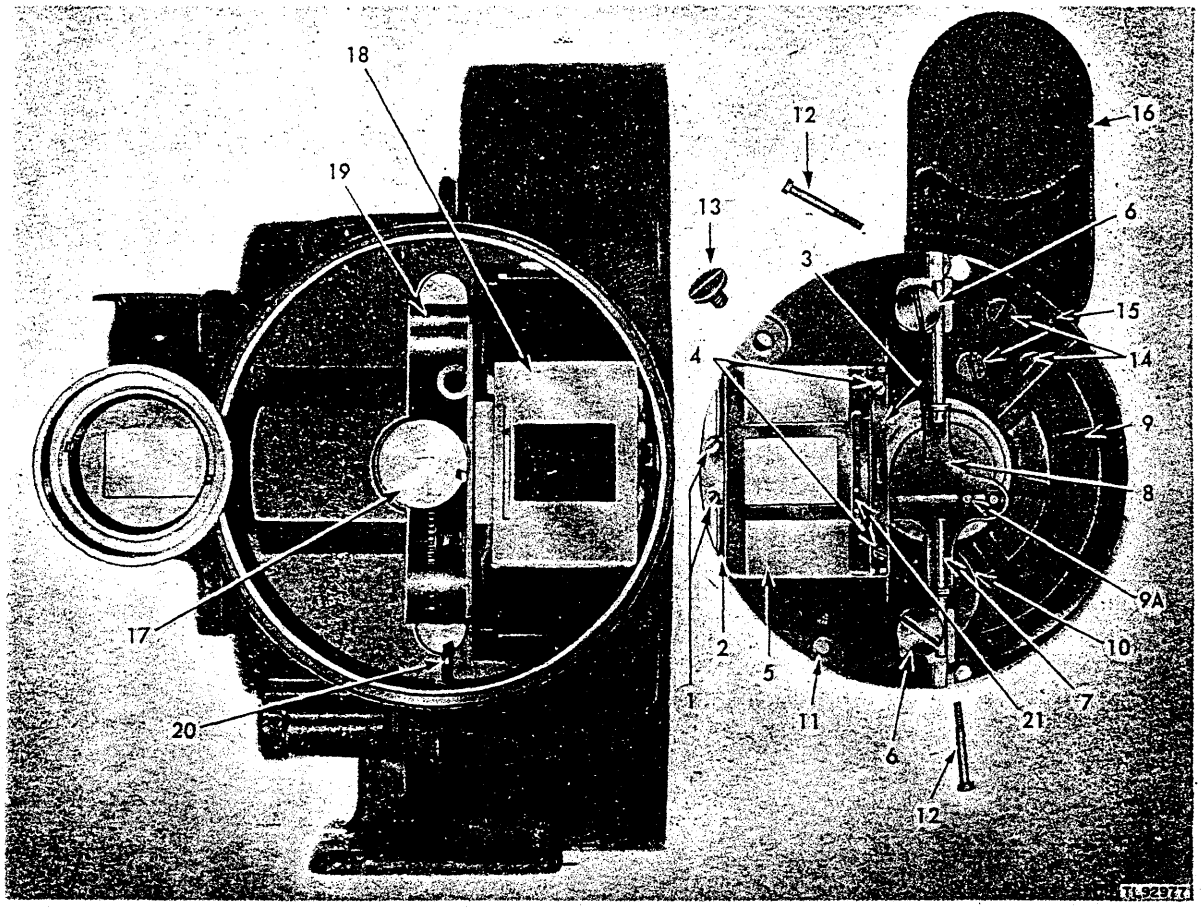
1. Geared winding crank assembly (8P10-2650)
2. Winding gears housing retaining screws (4 ea.) (6L6632-6-1.3P)
3. Winding gears and bearing insert housing (8P10-2670)
4. Winding gear and key assembly drive gear (8P10-2686)
5. Winding crank holder retaining spring (8P10-2775)
6. Winding crank holder (8P10-2698)
7. Spring winding gear and key assembly (8P10-2685)
8. Winding gears housing gasket

Figure 41. Disassembly, winding gears and housing, with geared winding crank, Camera PH-330-H.



1. *Turret post dust cap (8P10-344)*
2. *Lens turret lock knob*
3. *Lens turret clamp ring retainer nut (8P10-717)*
4. *Lens turret clamp ring (8P10-855)*
5. *Lens turret retaining screw (8P10-907)*
6. *Lens turret bearing thrust screw (8P10-886)*
7. *Lens turret tension spring (8P10-1144)*
8. *Lens turret spacer (8P10-1000)*
9. *Turret casting (8P10-1237)*
10. *Turret locking balls (8P10-48)*
11. *Lens mount lock lever compression spring (8P10-165)*
12. *Lens mount lock lever (8P10-680)*
13. *Lens mount lock lever screw (8P10-908C)*
14. *Lens mount locking pin (8P10-700)*
15. *Lens mount cap (8P10-1344)*
16. *Lens (with pin) key assembly (8P10-19)*
17. *Lens (with pin) key assembly retaining screw (8P10-900)*
18. *Lens focusing lock bracket (8P10-90)*
19. *Lens focusing lock bracket screws (8P10-922)*
20. *Lens focusing lock clamp screw and knob assembly*

Figure 42. Disassembly, spider turret, Camera PH-330-G.



1. *Aperture plate retaining screw (small) (8P10-919)*
2. *Film tension rail (8P10-844)*
3. *Film guide rail (8P10-462)*
4. *Aperture plate retaining screws (large) (8P19-904)*
5. *Aperture plate, (sound) (8P10-766)*
6. *Shuttle dowel pin retaining screw (8P10-930)*
7. *Shuttle dowel pin (2) (8P10-310)*
8. *Shuttle (8P10-970)*
9. *Shutter and cam assembly (8P10-964)*
9A. *Shutter and shuttle drive dowel pin (8P10-309)*
10. *Stop pawl (8P10-742)*
11. *Stop pawl pivot dowel pin (8P10-311)*
12. *Head retaining screws (long) (8P10-912)*
13. *Head retaining screw (short) (8P10-928)*
14. *Turret post retaining screws (3) (8P10-926)*
15. *Turret post locating pin (8P10-313)*
16. *Turret arm rear cover*
17. *Shuttle cam pin driving shaft (8P10-946)*
18. *Pressure plate (8P10-382)*
19. *Main drive spring retainer stud (8P10-1205)*
20. *Stop pawl operating lever (8P10-551)*
21. *Suttle teeth*

Figure 43. Assembly, camera head, Camera PH-330-G, front view with head removed.

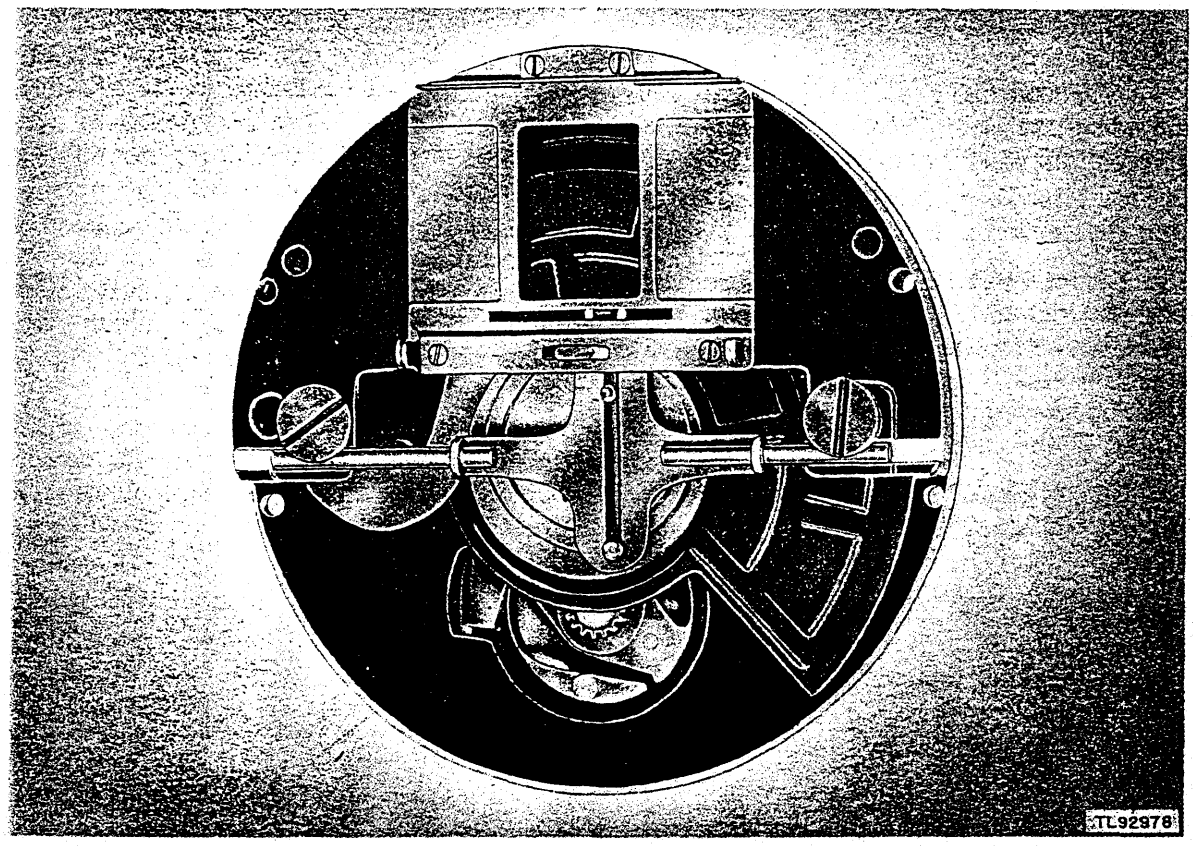


Figure 44. Assembly, camera head, Camera PH-330-A (governor-in-the-head).

away from the governor and permits its easy withdrawal. Note the position of the governor brake arm tension washer and the two thrust shims (fig. 45 (4), (7), and (8)). Be sure they are correctly replaced in reassembly.

(*2*) Remove the retaining screw (fig. 45 (5)) from the governor brake arm (fig. 45 (2)). Lift off the tension washer (fig. 45 (4)) and slide the brake arm out from under the brake arm actuating cam and lever (fig. 45 (1)). Remove the actuating cam and lever.

(*3*) Adjust the governor speeds as directed in paragraph 96 1.

d. Stop Pawl. To remove the stop pawl (figs. 46 (12) and 43 (10)) drive the stop pawl pivot dowel pin (figs. 46 (15) and 43 (11)) out of position from the inside of the head casting. Proceed to disengage the stop pawl from the stop pawl operating lever assembly (fig. 50 (10)) and pull it out of the casting.

e. Further Stop Pawl Disassembly. Further disassembly of the stop pawl mechanism can be accomplished only after the aperture plate has been removed. The following disassembly procedure should be attempted only when it is necessary to replace broken or damaged parts:

(*1*) With a sharp tool or knife, force the stop pawl actuating spring dowel pin (fig. 46 (16)) out of position toward the inside of the casting.

(*2*) Remove the actuating spring (fig. 46 (17)) from the casting.

(*3*) Remove the stop pawl guide (fig. 46 (14)) by removing the retaining screw (fig. 46 (13)) which holds the guide to the casting.

f. Aperture Plate. Remove the aperture plate only when absolutely necessary, since replacement demands critical alignment with special tools. If the tools are available and the plate must be removed, proceed as follows:

(*1*) Remove the two small retaining screws (figs. 46 (1) and 43 (1)). Note carefully the position of the film tension rail spring (fig. 46 (2)) located on a slot in the casting directly beneath the plate.

(*2*) Remove the two large retaining screws

(figs. 46 (6) and 43 (4)) from the other side of the plate.

(*3*) Lift the film guide rail (fig. 46 (5)) from one side of the plate. From the opposite side of the plate, lift the film tension rail (fig. 46 (3)).

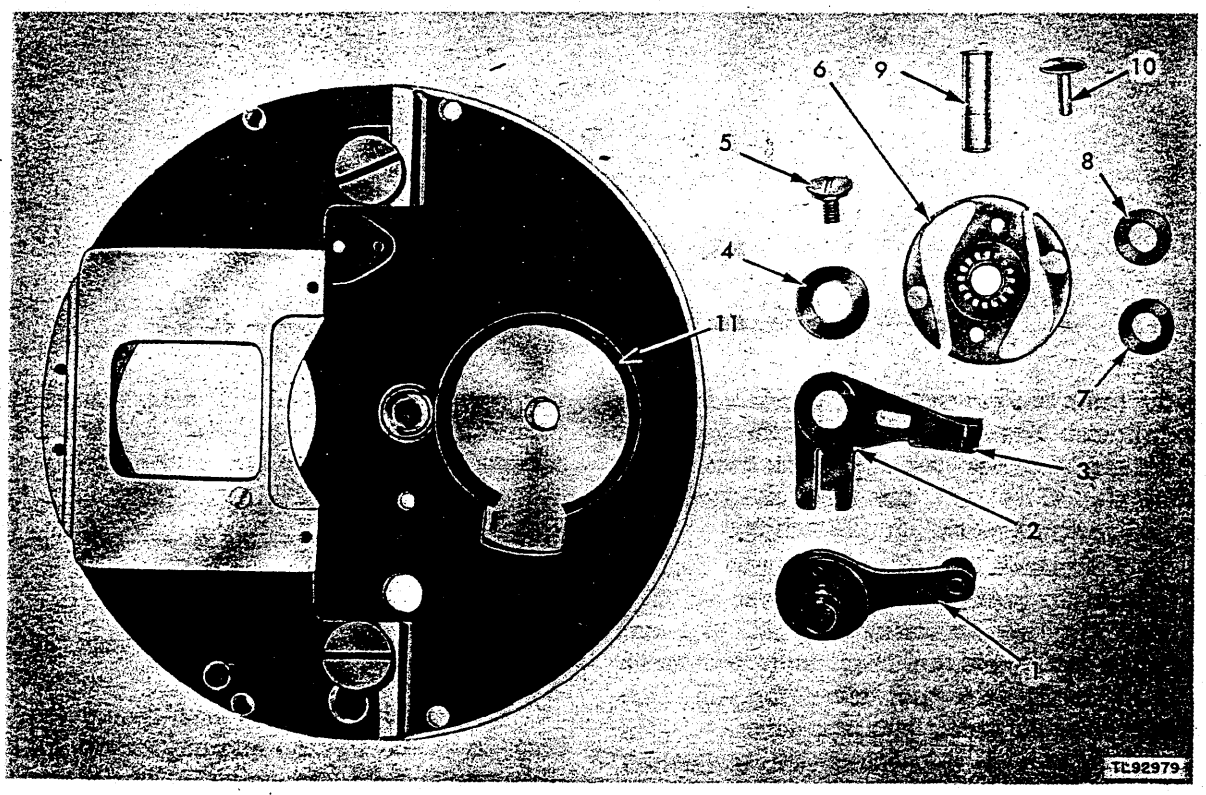
(*4*) Lift the aperture plate (fig. 46 (4)) from the slot in the film tension rail.

g. Turret Pilot Pin. Removal of the turret pilot pin (fig. 46 (23)) is not necessary in the course of the routine repair job. If removal of the pin is desired, unscrew the turret pilot pin retaining screw (fig. 46 (24)) and pull the guide pin out of the casting.

h. Turret Post. The turret post should not be disturbed unless it is necessary to replace a broken or damaged part. Since the turret post (fig. 46 (25)) and the turret arm rear cover (fig. 46 (27)) are attached to the front turret plate by the same three screws (fig. 46 (28)), the post must be removed if replacement of the turret arm rear cover is necessary.

(*1*) The turret post is set exactly perpendicular to the plane of the aperture plate surface. If the post is not critically aligned during reassembly, the lenses will not be in focus when the turret is rotated to bring each lens to the photographic position.

(*2*) To remove the turret post and the turret arm rear cover, unscrew the three retaining screws from the inside of the turret front plate.



1. Governor brake arm actuating cam and lever
2. Governor brake arm
3. Governor brake arm felt pad brake
4. Governor brake arm tension washer
5. Governor brake arm retaining screw
6. Governor (8P10-420)
7. Governor thrust shim
8. Governor thrust shim
9. Governor bearing shaft
10. Governor bearing shaft dust plug
11. Felt lining pad brake

Figure 45. Disassembly, camera head, Camera PH-330-A (governor-in-the-head).

87. CAMERA HEAD: CLEANING AND LUBRICATION.

Before reassembling the camera head, thoroughly clean and lubricate the parts of this unit with dry-cleaning solvent (SD). In the course of the assembly, apply a thin coat of oil to all the working parts with special preservative lubricating oil (PS).

88. CAMERA HEAD: ASSEMBLY.

a. Turret Pilot Pin. If the turret pilot pin (fig. 46 (23)) was removed in the disassembly, replace it in position on the casting and fasten it with the turret pilot pin retaining screw (fig. 46 (24)).

b. Stop Pawl Guide. Replace the stop pawl guide (fig. 46 (14)) on the casting and secure it with the retaining screw (fig. 46 (13)).

c. Stop Pawl Operating Lever. Place the stop pawl operating lever (fig. 50 (10)) in the slot in the edge of the camera head casting and push it in as far as possible. Move the lever forward slowly to engage the stop guide until the holes through the casting and the operating lever are aligned with each other. In this position, insert the stop pawl pivot dowel pin (fig. 46 (15)) into the hole of the casting and drive it through the hole of the stop pawl. The purpose of the guide is to eliminate side play in the lever. Replace the stop pawl actuating spring and the actuating spring dowel pin (fig. 46 (17) and (16)) in the slot of the casting.

d. Turret Post. Set the turret arm rear cover (fig. 46 (27)) into place on the camera head casting. Place the turret post (fig. 46 (25)) in position and fasten it with the three retaining screws (fig. 46 (28)) which extend through the front mechanism plate, through the turret arm rear cover, and into the turret post.

e. Checking Alignment of Turret Post.

(*1*) It is important that the turret post be exactly perpendicular to the plane of the aperture plate surface (fig. 46 (4)).

(*2*) To check the alignment, temporarily set the aperture plate into place over the aperture. Clamp the camera head to an angle plate as shown in figure 58, and use a universal test indicator as illustrated. There should be no variation in reading at either extremity of the surface near the base of the post. If the turret post is perpendicular, replace the head casting.

f. Shutter and Cam Assembly.

(*1*) Place a drop of special preservative lubricating oil (PS) on the shuttle cam spindle (fig. 46 (21)) in the center of the head casting. Slip the shuttle cam thrust washer (fig. 46 (10)) over the spindle.

(*2*) The thrust washer acts as a bearing surface and regulates the snugness of fit of the shuttle and cam, and the height to which the shuttle teeth will project through the aperture plate channel. Satisfactory adjustment may require the use of a thicker thrust washer, or two washers. This can be determined only by trial and test.

(*3*) Slip the shutter and cam assembly (fig. 46 (11)) over the spindle. If the spindle was forced out of the casting in the disassembly of the camera, drive it back into place with a mallet.

(*4*) To inspect the shutter and cam assembly, hold the stop pawl (fig. 46 (12)) forward and revolve the shutter several times to make sure that it turns freely.

g. Shuttle.

(*1*) Inspect the shuttle (fig. 43 (8)) for evidences of wear. Slight grooves in the shuttle teeth may be stoned out. If the bearing surfaces are worn unevenly, replace this part.

(*2*) Replace the shuttle dowel pins (fig. 43 (7)) in the holes in the shuttle. Lay the shuttle and pins in place over the shuttle cam (fig. 46 (11C)), installing the pins in the grooves on the casting. Adjust the dowel pins to guide the shuttle through its complete movement. The dowel pins must be spread far enough apart so that they will not interfere with the movement of the shuttle at either the upper or lower phase of its stroke.

(*3*) Tighten the two fillister-head shuttle dowel pin retaining screws (fig. 46 (7)).

(*4*) Rotate the shutter to determine whether it revolves easily and drives the shuttle properly.

(*5*) Place a drop of special preservative lubricating oil (PS) on each of the dowel pins and on the cam.

(*6*) Align the aperture plate tempcra ily over the aperture. Check the height at which

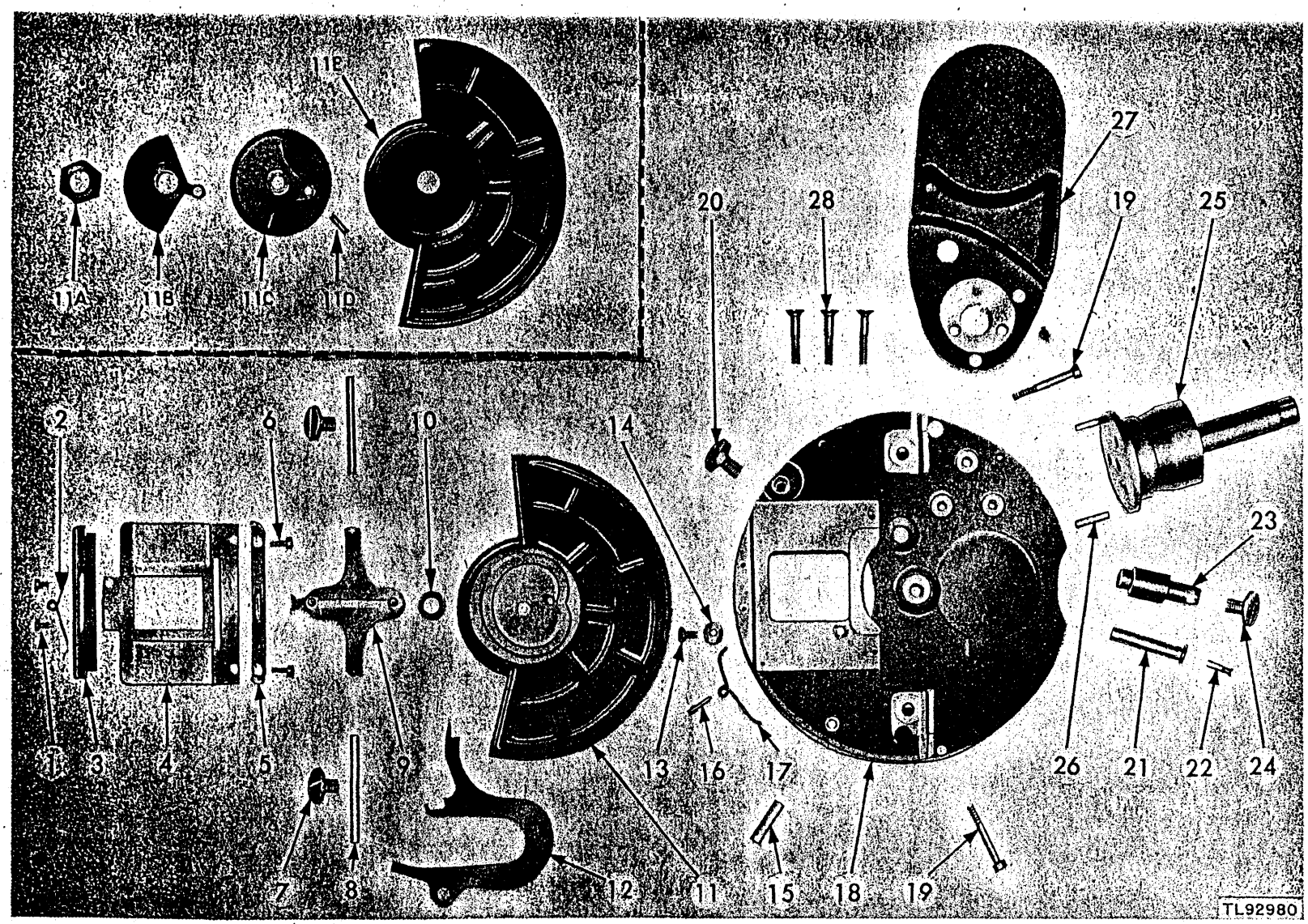


Figure 46. Disassembly, camera head mechanism, Cameras PH-330-A, -G, and -H, showing shutter and cam disassembly.

the shuttle teeth project through the channel in the aperture plate. A height permitting the teeth to engage the film sprocket holes is ample. If the shuttle teeth lie too low in the channel, use a thicker shim underneath the cam. If the teeth ride too high, use a thinner shim. Do not try to adjust the position of the shuttle by filing the casting grooves in which the shuttle dowel pins are bedded.

h. Aperture Plate: Inspection and Cleaning. Examine the aperture plate with a magnifying glass, if available, for any nicks or scratches on the polished surface. A light buffing will sometimes eliminate minor abrasions. Do not attempt to polish any pits or scratches flawing its surface, since any change in the thickness of the aperture plate will effect the accuracy of focus of the camera. If the plate is nicked or marred seriously, replace this part. Clean the aperture plate scrupulously with a dry cloth before reinstalling. Remove any remaining emulsion accumulations with a toothpick moistened with dry-cleaning solvent (SD) as authorized.

i. Aperture Plate: Installation.

(*1*) Slip the aperture plate into the recess of the film tension rail (fig. 46 (3)) with the beveled side of the rail facing inward. Place the film tension rail in position on the camera head casting (fig. 46 (18)).

(*2*) Lift the aperture plate sufficiently to place the film tension rail spring (fig. 46 (2)) into the slot directly beneath the outer side of the aperture plate. This may require the use of a pointed tool.

(*3*) Replace the two smaller retaining screws (fig. 46 (1)) in the aperture plate, on the side which seats the film tension rail. Place the film guide rail (fig. 46 (5)) in position on the other side of the aperture plate, and insert the two larger retaining screws (fig. 46 (6)). Do not tighten the screws until the aperture has been adjusted.

j. Aperture Plate: Adjustment. The aperture plate must be critically adjusted, so that the picture frame line is in correct alignment with respect to the film perforations.

(*1*) Use the aperture alignment gauge S-5142-N1, 2, 3, (Signal Corps stock No. 8P9-46). This is a three-variable gauge (par. 76). If the aperture must be adjusted for sound

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1. *Aperture plate retaining screw (small) (8P10-919)*
2. *Film tension rail spring (8P10-1090)*
3. *Film tension rail (8P10-844)*
4. *Aperture plate, sound (8P10-766)*
5. *Film guide rail (8P10-462)*
6. *Aperture plate retaining screws (large) (8P10-904)*
7. *Shuttle dowel pin and/or turret pilot pin retaining screw (8P10-930)*
8. *Shuttle dowel pin (8P10-310)*
9. *Shuttle (P810-970)*
10. *Shutter cam thrust washer (8P10-1304)*
11. *Shutter and cam assembly (8P10-964)*

11A. *Shutter (8P10-958) (8P10-309)*

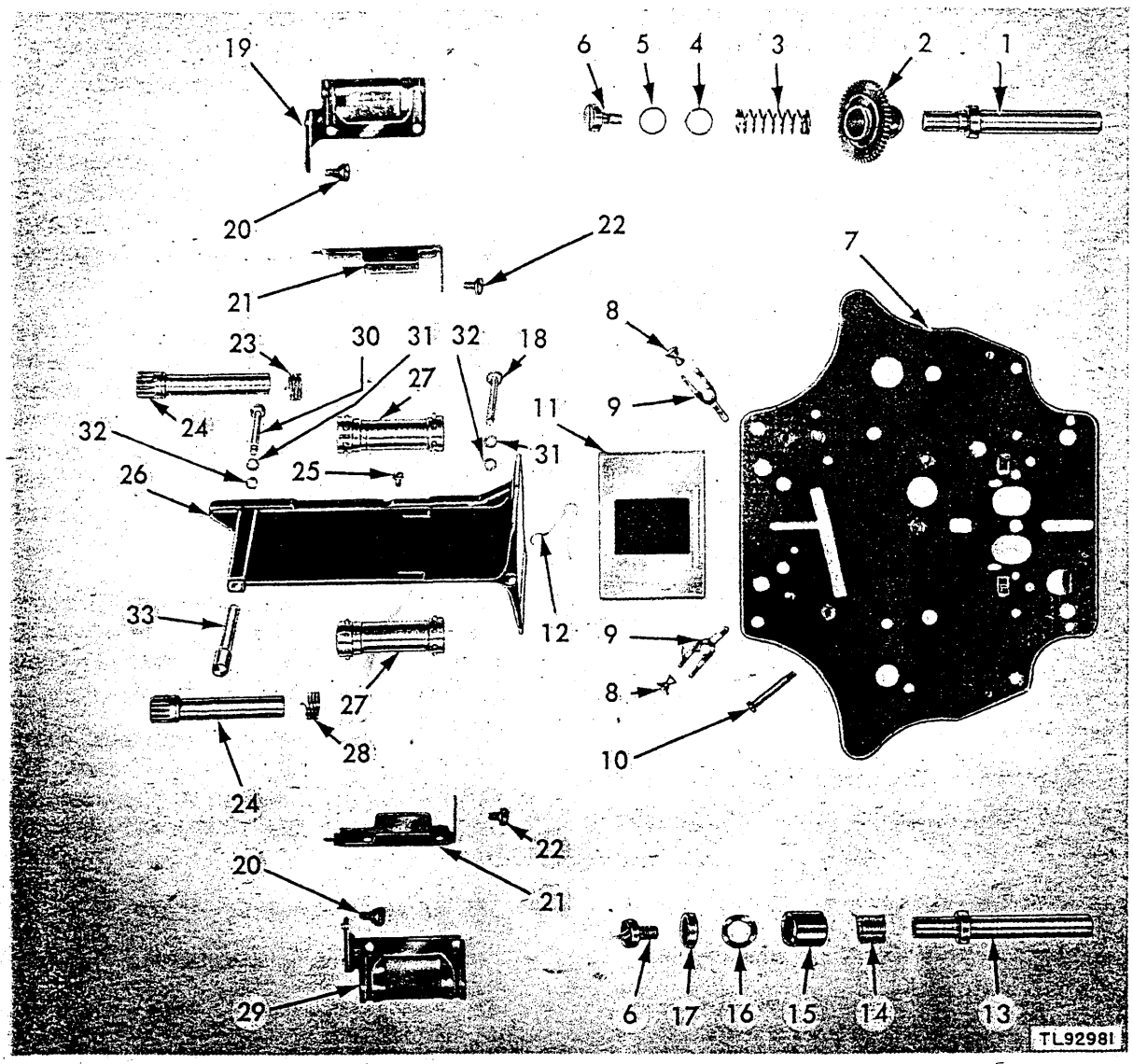
11B. *Shutter and shuttle drive dowel pin*

11C. *Shuttle cam*

11D. *Shutter counterbalance (8P10-232)*

11E. *Shutter and balance retainign nut (8P10-724)*

12. *Stop pawl (8P10-742)*
13. *Stop pawl guide retaining screw*
14. *Stop pawl guide (8P10-468)*
15. *Stop pawl pivot dowel pin (8P10-311)*
16. *Stop pawl actuating spring dowel pin (8P10-312)*
17. *Stop pawl actuating spring (8P10-1120)*
18. *Camera head (Camera PH-330-G only) (8P10-488)*
19. *Head retaining screw (short) (8P10-912)*
20. *Head retaining screws (long) (8P10-928)*
21. *Shuttle cam spindle (8P10-1012)*
22. *Shutter cam spindle oil hole plug (8P10-808)*
23. *Turret pilot pin (Camera PH-330-G only) (8P10-754)*
24. *Shuttle dowel pin and/or turret pilot pin retaining screw (Camera PH-330-G only) (8P10-930)*
25. *Turret post (Camera PH-330-G only) (8P10-814)*
26. *Turret post locating dowel pins (Camera PH-330-G only) (8P10-313)*
27. *Turret arm rear cover (Camera (PH-330-G only)*
28. *Turret post retaining screws (Camera PH-330-G only) (8P10-926)*



1. *Take-up spindle (8P10-1018)*
2. *Take-up spindle gear (8P10-320)*
3. *Take-up spindle tension spring (8P10-1150)*
4. *Take-up spindle friction key washer (8P10-1322)*
5. *Take-up spindle friction washer (8P10-1243)*
6. *Feed or take-up spindle retaining screw (8P10-916)*
7. *Front mechanism plate (8P10-778)*
8. *Film guard hole plug (8P10-796)*
9. *Film guard or plug retaining spring (8P10-1042)*
10. *Feed spool spindle return adjustment screw (8P10-894)*
11. *Pressure plate (8P10-382)*
12. *Pressure plate spring (8P10-1126)*
13. *Feed spindle (8P10-1006)*
14. *Feed spindle return spring (8P10-1102)*
15. *Feed spindle spring housing (8P10-1054)*
16. *Feed spindle friction washer (8P10-557)*
17. *Feed spindle friction collar (8P10-153)*
18. *Gate arm retaining stud, front (8P10-1199)*
19. *Lower sprocket guide shoe (8P10-1168)*
20. *Sprocket guide shoe retaining screw (8P10-906)*
21. *Sprocket guard (2 ea.) (8P10-1175)*
22. *Sprocket guard oil screw (2 ea.) (8P10-913A)*
23. *Left-hand torsion spring; (for take-up sprocket) (8P10-1224)*
24. *Sprocket gear (2 ea.) (8P10-1162)*
25. *Gate arm lock screw (1 ea.) (8P-10-901)*
26. *Gate arm (8P10-376)*
27. *Film sprocket, upper and lower (8P10-1156)*
28. *Right-hand torsion spring (for feed sprocket) (8P10-1225)*
29. *Upper sprocket guide shoe (8P10-1169)*
30. *Gate arm retaining stud (rear) (8P10-1198)*
31. *Gate arm retaining stud tension washer*
32. *Gate arm retaining stud tension spring (8P10-1108)*
33. *Gate lock stud (8P10-1187)*

Figure 47. Disassembly, front mechanism plate (top), Cameras PH-330-A, -G, and -H.

film, attach gauge S-5142-N3 to gauge S-5142-N1. If the aperture must be adjusted for silent film, attach gauge S-5142-N2 to gauge S-5142-N1. Hold the parts together with locating pins and screw. The variables of the gauge are interchanged and form a block when attached.

(*2*) All four retaining screws which hold the aperture plate should be loose. Lay the gauge block on the camera head as shown in figure 57, so that the block fits into the opening in the aperture plate. When the block is firmly seated, move the shutter counterclockwise until it is against the stop pawl (fig. 46 (12)). Holding the shutter against the pawl, slide the gauge block toward the turret arm rear cover. Tighten the aperture plate screws.

89. CAMERA HEAD: INSTALLATION.

a. Camera Head Assembly.

(*1*) Engage the slot in the face of the shuttle cam drive shaft (fig. 49 (17)) with the shutter and shuttle drive dowel pin (figs. 43 (9A) and 46 (11B)) on the shuttle cam (fig. 46 (11C)). Carefully replace the head assembly on the camera frame. Push it into position, making sure that the drive pin continues to engage the slot in the driving disk gear.

CAUTION: The shutter must not scrape against any part of the casting and must revolve easily.

(*2*) When the head assembly is fully seated, secure it with the short head retaining screw (fig. 46 (20)) which is inserted from inside the film chamber, and the two longer head retaining screws (fig. 46 (19)) which extend through the head from the front and engage in the camera frame.

b. Turret: Lens Mount Seat Check and Adjustment.

(*1*) A sprung turret may be repaired by locking it in a vise between wood blocks, with the affected arm extending from the vise. Insert a round fiber or wooden rod into the lens seat opening in such a way that necessary leverage is obtained. Twist or bend the turret arm as necessary by slow degrees. Check the progress of the work frequently on the alignment plate until all three lens seats make equal contact with the plate.

(*2*) If the turret jig is available, an alternate method of straightening a sprung turret is to place the turret on the post of the turret jig. Then gauge the position of each lens mount seat, using a universal test indicator (fig. 59) from at least three points on the circumference of each lens seat. Readings should not vary more than 0.0005 inch. Leave the turret on the jig, inserting a fiber or wooden rod into the lens seats to make the necessary correction.

c. Turret: Installation.

(*1*) Place the lens turret assembly (fig. 42) over the turret post (fig. 46 (25)). Insert the three turret locking balls (fig. 42 (10)) between the post and the turret casting (fig. 42 (9)). Slip the spacer (fig. 42 (8)) over the turret post.

(*2*) Place the tension spring and the bearing thrust ring (fig. 42 (7) and (6)) inside the turret and over the turret post. Press the retaining screw (fig. 42 (5)) down against the ring and the tension spring to allow the threads to engage. Tighten the retaining screw.

(*3*) Screw the elements of the lock lever (fig. 42 (11), (12), (13), and (14)), the lens (with pin), a key assembly (fig. 42 (16) and (17)), and the focusing lock assembly (fig. 42 (18), (19), and (20)) into place on the lens mount seats. Replace the turret post dust cap (fig. 42 (1)).

(*4*) Adjust for camera depth (par. 110a).

(*5*) Adjust for film clearance (par. 110b).

90. CAMERA FRAME: GENERAL.

a. The camera frame (figs. 50 and 51) is comprised of the following basic units:

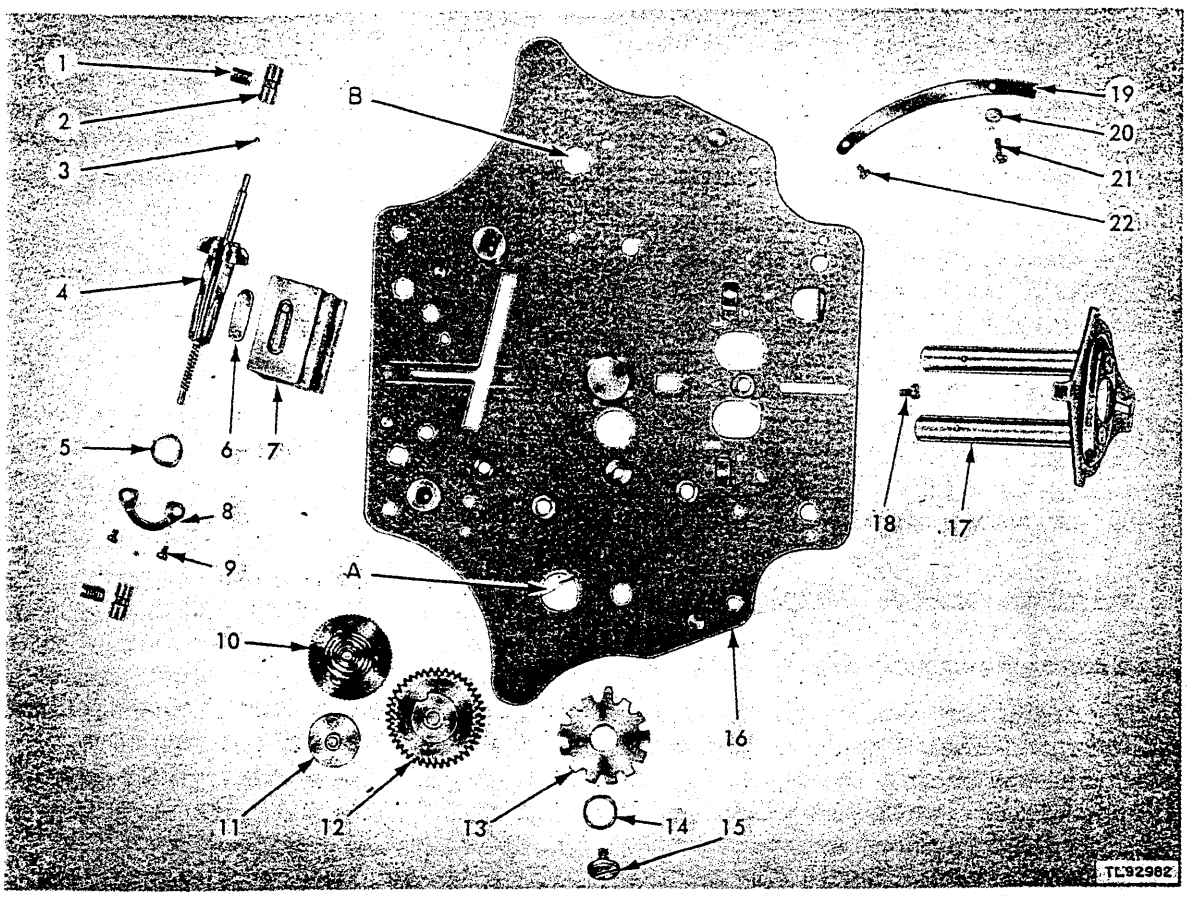
(*1*) The front mechanism plate assembly, consisting of the feed and take-up sprockets, feed and take-up spindles, and film gate.

(*2*) The train of gears on the back mechanism plate assembly.

(*3*) The spring motor.

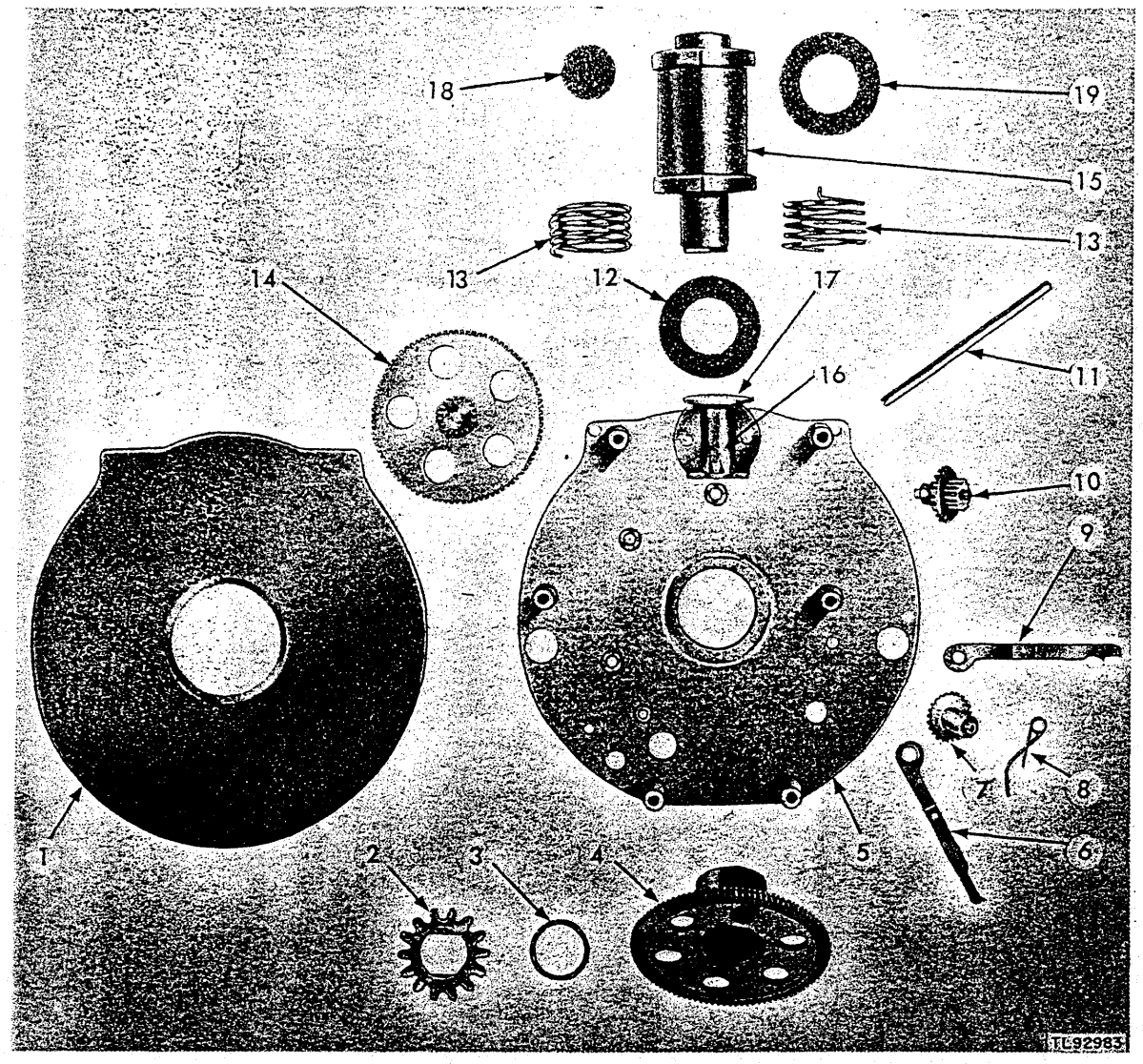
(*4*) The crank-motor gear-coupling housing, and the operating lever assembly on the outer camera frame.

b. Before the entire mechanism can be removed from the camera frame, it is necessary to remove the crank-motor gear-coupling housing and the crank-motor gear-coupling assembly. This is not necessary when only the front mechanism plate is to be removed.



1. *Governor worm shaft bearing set-screw (8P10-934)*
2. *Governor worm shaft bearing (8P10-72)*
3. *Governor worm shaft bearing ball (8P10-17)*
4. *Governor end worm shaft assembly (8P10-426)*
5. *Governor worm shaft flexture control washer (8P10-1261)*
6. *Governor worm shaft housing pressure spring (8P10-1084)*
7. *Governor worm shaft housing (8P10-504)*
8. *Governor worm shaft flexture control washer retaining collar 8P10-147)*
9. *Flexture control washer retaining collar screw (8P10-896)*
10. *Governor drive worm gear and ratchet spring assembly (8P10-36)*
11. *Worm gear and ratchet spring oiler assembly (8P10-438)*
12. *Worm gear and take-up spindle drive gear assembly*
13. *Buck tooth idler mechanism stop gear (8P10-405)*
14. *Buck tooth stop gear spring (8P10-1114)*
15. *Buck tooth stop gear retaining screw (8P10-925)*
16. *Front mechanism plate complete with studs and bearings (8P10-778)*
17. *Sprocket carrier assembly (8P10-1181)*
18. *Gate arm lock screw (8P10-901)*
19. *Governor connecting link (8P10-171)*
20. *Governor connecting link spacer (8P10-994)*
21. *Governor connecting link screw (long) (8P10-911)*
22. *Governor connecting link screw (short) (8P10-909)*

Figure 48. Disassembly, front mechanism plate (bottom), Cameras PH-330-A, -G, and H.



1. *Spring motor graphite retaining plate (8P10-202)*
2. *Main drive shaft stop gear (8P10-408)*
3. *Main drive geat split retaining ring (8P10-874)*
4. *Main drive gear assembly (8P10-396)*
5. *Back mechanism plate with bearings and studs (8P10-760)*
6. *Footage dial ratchet pull pawl (8P10-736)*
7. *Footage ratchet pawl actuating cam and gear (8P10-394)*
8. *Footage dial ratchet pawl tension spring (8P10-1138)*
9. *Footage dial ratchet lock pawl (8P10-730)*
10. *Second compound gear assembly (8P10-159)*
11. *Main drive spring retainer stud (8P10-1205)*
12. *Back mechanism plate felt packing washer (8P10-1267)*
13. *Main drive shaft clutch spring (8P10-1132)*
14. *First compound gear and pinion assembly (8P10-13)*
15. *Main drive hub shaft (8P10-952)*
16. *Shuttle cam pin driving disc gear (8P10-402)*
17. *Shuttle cam drive shaft (8P10-946)*
18. *Felt hub shaft pad grease seal (8P10-1286)*
19. *Hub shaft grease felt retaining washer (8P10-1280)*

Figure 49. Disassembly, back mechanism plate, Cameras PH-330-A, -G, and -H.

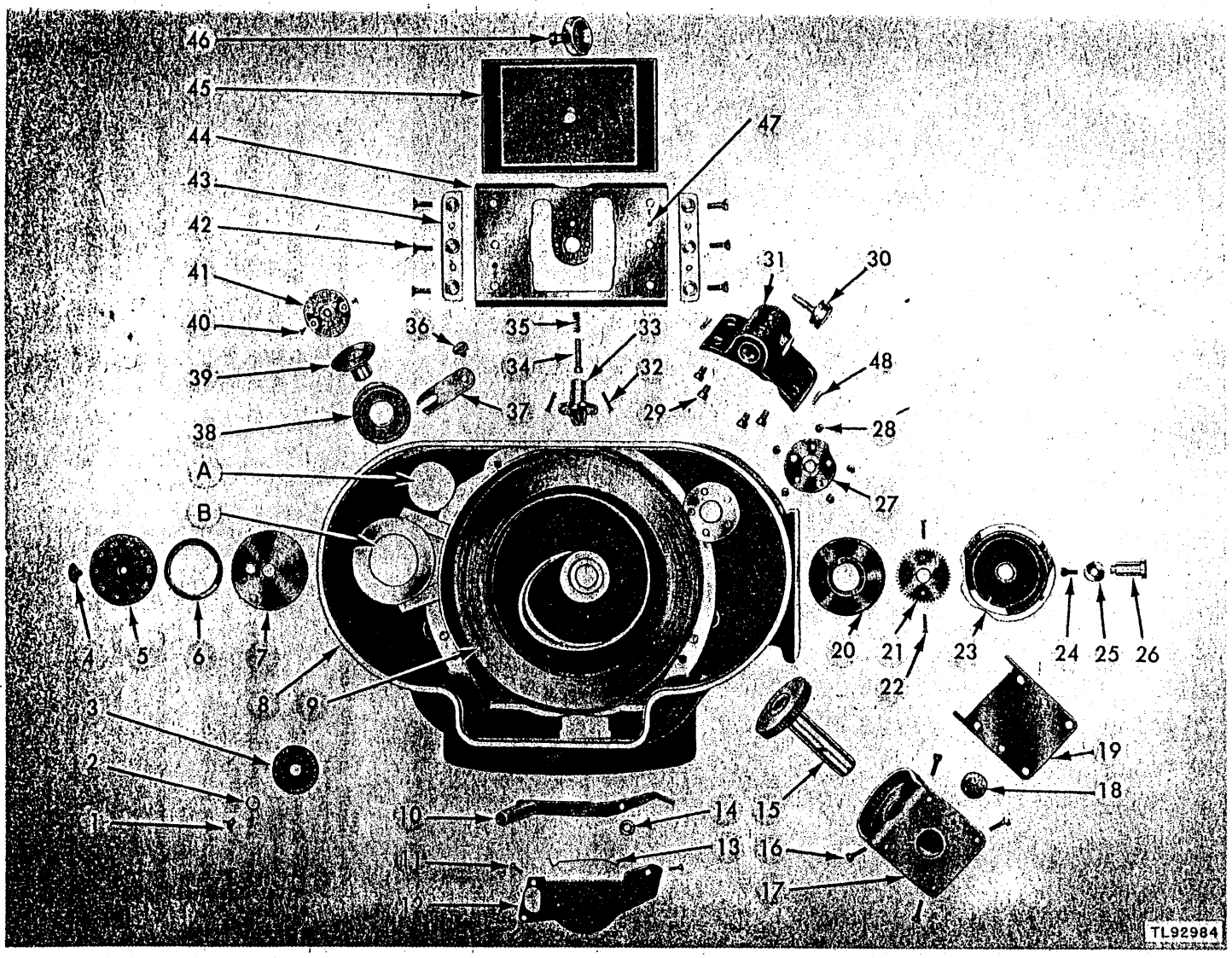


Figure 50. Disassembly, camera frame, Camera PH-330-G.

91. CAMERA FRAME: REMOVING CRANK-MOTOR GEAR-COUPLING HOUSING.

a. Unscrew the four retaining screws (fig. 50 (16)) and pull the housing free of the camera frame. Remove the crank-motor gear-coupling assembly (fig. 50 (15)) from the housing. Lift the gear and coupling housing gasket (fig. 50 (19)) from the housing.

b. Do not disassemble the gear assembly. Where necessary, replace it with a new assembly.

92. CAMERA FRAME: REMOVAL AND DISASSEMBLY OF FOOTAGE DIAL.

a. The footage dial ratchet pull pawl and the footage dial ratchet lock pawl (fig. 51 (29) and (32)) cannot be removed for replacement or adjustment until the front plate assembly has been removed from the camera frame. Instructions for removal of the plate are given in paragraph 95.

b. To remove the footage dial (fig. 50 (5)), grasp the dial firmly with the fingers and remove the retaining screw (fig. 50 (4)) which extends through the ratchet wheel (fig. 50 (7)) and screws into the footage dial. When the screw is withdrawn, remove the ratchet wheel. Push

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1. *Relative exposure indicator retaining screw (8P10-895)*
2. *Relative exposure indicator friction spring (8P10-1048)*
3. *Relative exposure indicator speed dial (8P10-256)*
4. *Footage dial retaining screw (8P10-913)*
5. *Footage dial (8P10-238)*
6. *Footage dial friction washer (8P10-1255)*
7. *Footage dial ratchet wheel (8P10-850)*
8. *Camera frame casting*
9. *Main drive spring (8P10-1072)*
10. *Stop pawl operating lever assembly (8P10-551)*
11. *Operating lever cover retaining screw*
12. *Operating lever cover (8P10-196)*
13. *Operating lever spring (8P10-1078)*
14. *Operating lever washer*
15. *Crank-motor gear-coupling assembly (8P10-395)*
16. *Crank-motor gear-coupling housing retaining screws (8P10-921)*
17. *Crank-motor gear-coupling housing (8P10-510)*
18. *Crank-motor gear-coupling oiling felt (8P10-78)*
19. *Crank-motor gear-coupling housin gasket (8P10-370)*
20. *Magazine belt drive pulley (8P10-826)*
21. *Magazine belt drive pulley gear (8P10-326)*
22. *Drive pulley and gear retaining screws (8P10-908)*
23. *Magazine belt pulley assembly housing (8P10-498A)*
24. *Pulley retaining screw (8P10-924)*
25. *Pulley spacer washer (8P10-1292)*
26. *Magazine pulley gear stud (8P10-1193)*
27. *Pulley and gear assembly bearing (8P10-274)*
28. *Pulley and gear assembly bearing retaining screws (8P10-892)*
29. *Camera frame motor mounting bracket retaining screws (8P10-915)*
30. *Motor bracket lock screw (8P10-694)*
31. *Camera frame motor mounting bracket (8P10-84)*
32. *Magazine valve lever assembly screws (8P10-917)*
33. *Magazine valve lever assembly (8P10-1221)*
34. *Magazine valve plunger push pin (8P10-840)*
35. *Magazine valve plunger compression spring (8P10-1036)*
36. *Governor speed control mount spring retaining screw (8P10-923)*
37. *Governor speed control mount retaining spring (8P10-1096)*
38. *Governor speed dial knob (8P10-177)*
39. *Governor speed control mount (8P10-250)*
40. *Governor speed dial retaining screws (8P10-918)*
41. *Governor speed dial (8P10-244)*
42. *Magazine attachment plate side bar retaining screws (8P10-914)*
43. *Magazine attachment plate side bar (8P10-982)*
44. *Magazine attachment plate (8P10-784)*
45. *Magazine attachment plate cover (G) (8P10-189)*
46. *Magazine attachment plate cover retaining screw (8P10-931)*
47. *Magazine attachment plate dowel pins (8P10-304)*
48. *Camera frame motor mounting bracket dowel pins (8P10-301)*

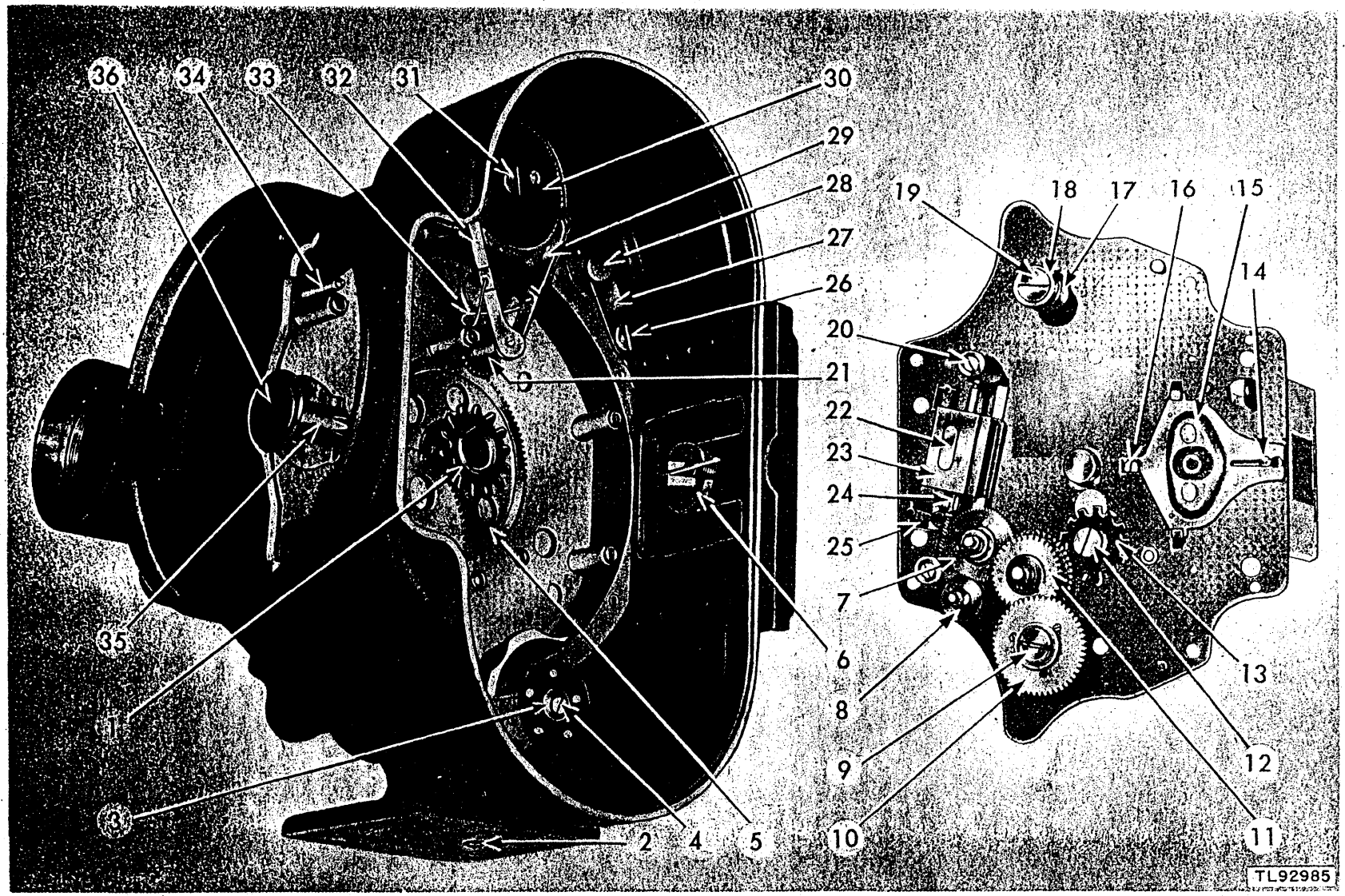

Figure 51. Camera mechanism exposed, Cameras PH-330-A, -G, and -H.

the footage dial with its friction washer (fig. 50 (6)) away from the camera frame, and remove both dial and washer.

93. CAMERA FRAME: INSPECTION, LUBRICATION, AND ASSEMBLY OF FOOTAGE DIAL.

a. Inspection. Inspect the ratchet teeth for evidences of wear. If they have been worn to roundness and do not function properly, replace the ratchet gear. If the teeth are not too badly worn, they may be repointed by careful filing.

b. Lubrication. Clean the ratchet wheel with authorized dry-cleaning solvent (SD). Apply a small amount of special lubricating grease (GL) underneath the ratchet wheel.

c. Assembly. To assemble the footage dial, replace the friction washer and the footage dial in position on the outside of the opening in the casting (fig. 50B). Replace the ratchet wheel (fig. 50 (7)) on the inside of the camera frame and fasten with the footage dial retaining screw (fig. 50 (4)). Turn the dial to make sure that it revolves freely but not too loosely.

94. CAMERA FRAME: REMOVING COMPLETE MECHANISM.

a. Follow the preliminary camera locking procedure (method number three) as outlined in paragraph 80c.

b. Remove the crank-motor gear-coupling housing (fig. 50 (17)) following the procedure outlined in paragraph 91.

c. Remove the pressure plate (fig. 43 (18)) to avoid marring its highly polished surface.

d. Remove the four fillister-head retaining screws that hold the mechanism to the camera frame. Remove the feed reel spindle return

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1. *Main drive shaft stop gear (8P10-408)*
2. *Tripod socket threaded insert (8P10-516)*
3. *Pulley spacer washer (8P10-1292)*
4. *Pulley retaining screw (8P10-924)*
5. *Main drive gear assembly (8P10-396)*
6. *Magazine valve lever assembly with push pin and spring (listed separately)*
7. *Governor drive worm gear and ratchet spring assembly (8P10-36)*
8. *Governor drive worm gear and ratchet spring oil assembly (8P10-438)*
9. *Feed or take-up spindle retaining screw (8P10-916)*
10. *Take-up spindle gear (8P10-320)*
11. *Worm gear and take-up spindle drive gear assembly*
12. *Buck tooth stop gear retaining screw (8P10-925)*
13. *Buck tooth (idler mechanism stop, gear (8P10-405)*
14. *Gate arm retaining stud, front (8P10-1199)*
15. *Sprocket carrier assembly (8P10-1181)*
16. *Gate arm lock screw (8P10-901)*
17. *Feed Spindle spring housing (8P10-1054)*
18. *Feed spindle friction collar (8P10-153)*
19. *Feed or take-up spindle retaining screw (8P10-916)*
20. *Governor worm shaft bearing set-screw (8P10-934)*
21. *Footage ratchet pawl actuating cam and gear (8P10-394)*
22. *Governor worm shaft housing pressure spring (8P10-1084)*
23. *Governor worm shaft housing (8P10-504)*
24. *Governor worm shaft assembly (8P10-426)*
25. *Film guard or plug retaining spring (8P10-1042)*
26. *Governor speed control mount spring retaining screw (8P10-923)*
27. *Governor speed control mount retaining spring (8P10-1096)*
28. *Governor speed control mounting (8P10-250)*
29. *Footage dial ratchet pull pawl (8P10-736)*
30. *Footage dial ratchet (8P10-850)*
31. *Footage dial retaining screw (8P10-913)*
32. *Footage dial ratchet lock pawl (8P10-730)*
33. *Footage dial ratchet pawl tension spring (8P10-1138)*
34. *Main drive spring retainer stud (8P10-1205)*
35. *Shuttle cam pin driving disk gear (8P10-402)*
36. *Shuttle cam drive shaft (8P10-946)*

adjustment screw (fig. 47 (10)). Remove the long governor connecting link retaining screw (fig. 48 (21)). Then remove the governor connecting link spacer washer (fig. 48 (20)) underneath the link itself.

e. Before removing the inner mechanism from Cameras PH-330-F, -G, -H, and -J, remove the magazine attachment plate cover, the magazine valve lever assembly under the plate, and the take-up pulley assembly housing (fig. 50 (45), (33), and (23)).

(*1*) The magazine attachment plate cover is removed by unscrewing the magazine attachment plate cover retaining screw (fig. 50 (46)). If it becomes necessary to remove the magazine attachment plate itself (fig. 50 (44)), unscrew the six magazine attachment plate side bar retaining screws (fig. 50 (42)) located underneath the plate cover.

(*2*) The magazine valve lever assembly is removed from inside the camera housing by unscrewing the two screws (fig. 50 (32)).

(*3*) The take-up pulley assembly housing is removed by unscrewing the pulley retaining screw (fig. 50 (24)) and removing the magazine take-up pulley spacer washer (fig. 50 (25)). The magazine belt drive pulley gear and the magazine belt pulley assembly housing (fig. 50 (21) and (23)) can then be disengaged from the camera casting on the outer side.

f. The mechanism is now ready for removal from the camera. Grasp the gate arm (fig. 47 (26)) and carefully lift the entire mechanism from the interior of the camera frame.

g. Place the safety retaining ring (fig. 61) around the main drive spring. Remove the main drive spring, following the procedure below.

> **NOTE:** The removal of the main drive spring requires the use of several Bell and Howell special tools. If these implements are not available, work with great care, because serious injury is possible if the powerful spring is not under control.

(*1*) Use the special spring motor installation fixture S-4893-F1-B (Signal Corps stock No. 8P9-22) shown in figures 60 and 62, to control the spring while it is being removed from the hub shaft and the spring retainer stud (fig. 49 (15) and (11)).

(*2*) Holding the winding crank, unlock the mechanism by depressing the buck tooth (idler mechanism stop) gear (fig. 51 (13)) with a screwdriver. Wind the spring with a hand cranking tool (fig. 60) until the ends of the spring may be conveniently removed from the hub and the pin with a screwdriver or other suitable instrument. When the ends of the spring are disengaged from both the hub and the pin, use the hand crank to unwind the spring until it is tight within the retaining ring. When the spring is firmly encircled by the retaining ring, remove the spring entirely from the fixture and the mechanism.

h. Uncoil the main drive spring, using the following procedure:

(*1*) Use the special spring motor winding and unwinding fixture S-5376-F1-B (Signal Corps stock No. 8P9-34) shown in figure 61, to control the spring while it is being unwound after it has been removed from the mechanism, and while it is being wound, prior to re-installation on the hub.

(*2*) Remove the hand cranking tool from the fixture and place the main drive spring over the main drive hub. Then replace the cranking tool and engage the looped or crimped end of the spring into the hook (fig. 61A) on the end of the arm of the fixture.

(*3*) Unwind the spring slowly until it is completely uncoiled. Remove the cranking tool. Then remove the spring from the fixture.

95. CAMERA FRAME: REMOVING FRONT MECHANISM PLATE.

The front mechanism plate (fig. 48 (16)) may be removed intact with its mechanism, giving access to the driving gears and governor, without removing the entire mechanism and spring motor from the camera frame. The procedure is outlined below.

a. Lock the mechanism, using method number two, as described in paragraph 80b.

b. Remove the four fillister-head retaining screws that hold the mechanism to the camera frame. Remove the six retaining screws that fasten the front mechanism plate, the driving gears, and the back mechanism plate (fig. 49 (5)) firmly together. Remove the feed reel spindle return adjustment screw (fig. 47 (10)) using wrench S-8681-F1 (Signal Corps stock No. 8P9-174). Disconnect the governor connecting link (fig. 48 (19)) from the governor speed dial located on the camera frame by re-

moving the long governor connecting link retaining screw and the governor connecting link spacer washer (fig. 48 (21) and (20)).

c. Grasp the gate arm (fig. 47 (26)) and carefully lift the front mechanism plate from the camera frame, taking care that the main drive spring retainer stud (figs. 43 (19) and 49 (11)) is not moved from its position on the back mechanism plate (fig. 49 (5)). It may be necessary to raise the front plate slightly with a screwdriver and tap the retainer stud back into place.

d. The governor drive worm gear and ratchet spring assembly, the governor gear and ratchet spring oiler assembly, and the governor worm gear and take-up spindle drive gear assembly (fig. 48 (10), (11), and (12)) come out readily with the front mechanism plate when it is lifted out of place.

96. CAMERA-FRAME: DISASSEMBLING FRONT MECHANISM PLATE.

a. Feed Sprocket.

(*1*) The upper or feed sprocket assembly consists of a sprocket (fig. 47 (27)), an upper sprocket right-hand torsion spring (fig. 47 (28)), an upper sprocket guide shoe (fig. 47 (29)), and a second compound gear assembly (fig. 49 (10)). It is geared to the mechanism and feeds the film to the intermittent shuttle mechanism (fig. 43 (8)).

(*2*) To remove the sprocket, the gate arm (fig. 47 (26)) must be in the open position. Remove the sprocket guard oil screw (fig. 47 (22)), permitting the sprocket guard (fig. 47 (21)), the sprocket, the sprocket gear (fig. 47 (24)), and the upper sprocket right-hand torsion spring (fig. 47 (28)) to be lifted from the spindle.

b. Take-up Sprocket.

(*1*) The disassembly of the take-up sprocket is similar to the procedure for disassembly of the feed sprocket, except for the presence of a left-hand torsion spring in the take-up assembly.

(*2*) Except for the left-hand torsion spring and the lower sprocket guide shoe (fig. 47 (23) and (19)), the numbering of parts is identical with the parts of the feed sprocket assembly.

c. Sprocket Guide Shoes.

(*1*) Locate the retaining screws (fig. 47 (20)) which hold the upper and lower (feed and take-up) sprocket guide shoes in place on the front mechanism plate.

(*2*) Remove the shoes by loosening these screws.

d. Gate Arm Assembly.

(*1*) With sprockets and guide shoes removed and with the gate arm in the closed position (fig. 24), remove the lock screw (fig. 51 (16)) from the under side of the front plate. Move the gate arm forward as far as it will go and lift it from the mechanism plate.

(*2*) Slide the sprocket carrier shaft assembly (fig. 51 (15)) back as far as it will go and separate it from the front mechanism plate.

(*3*) The pressure plate spring (fig. 47 (12)) is easily removed from inside the casting with long nosed pliers. Using a drift punch, push out the front gate arm retaining stud and the gate arm retaining stud tension spring (fig. 47 (18) and (32)).

(*4*) Lift out the rear gate lock stud (fig. 47 (33)) which is in position at the base of the gate arm. Extract the rear gate arm retaining stud, the tension spring, and the tension washer (fig. 47 (30), (32), and (31)).

(*5*) Do not disassemble the sprocket-carrier assembly (fig. 51 (15)). If necessary, replace this part with a new one.

e. Feed Spindle.

(*1*) The feed spindle assembly is composed of a friction washer, a friction collar, a return spring, a feed reel spindle, and a spring housing (fig. 47 (16), (17), (14), (13), and (15)). The recoiling action of the spindle takes up any slack in the film which may occur when the mechanism is stopped.

(*2*) Place the assembly in a smooth jaw vise, tightening the vise clamp only enough to hold the assembly firmly. Remove the retaining screw (fig. 47 (6)) from the end of the feed spindle.

(*3*) Lift the friction collar and the friction washer from the assembly.

(*4*) Lift the spring housing far enough to free the return spring from the spindle shaft. Remove both spring and housing. Lift the feed spindle from the mechanism plate.

f. Take-up Spindle.

(*1*) The take-up spindle assembly is composed of a friction washer, a friction key washer, a tension spring, a gear, and a take-up spindle (fig. 47 (5), (4), (3), (2), and (1)).

(*2*) Place the assembly in a smooth jaw vise, tightening the vise clamp only enough to hold the assembly firmly. Remove in sequence the take-up spindle friction washer, the key washer, the tension spring, the spindle gear, and the spindle itself.

g. Buck Tooth (Idler Mechanism Stop) Gear.

(*1*) The buck tooth (idler mechanism stop) gear (fig. 51 (13)) meshes with the main drive shaft stop gear (fig. 51 (1)) and is equipped with 13 teeth. One tooth, longer than the others, is known as a buck tooth. The gear is free to turn until the buck tooth meshes with the notching of the main drive shaft stop gear. This engagement stops the mechanism when the full footage of film has been run, and while there is still ample power in the spring to maintain speed.

(*2*) The buck tooth gear is assembled on a stud on the underside of the front mechanism plate and is held in position by a stop gear spring and a retaining screw (fig. 48 (14) and (15)). To detach the buck tooth gear, remove both the screw and the spring.

h. Light (Film Guard Hole) Plug.

(*1*) Locate the two film guard hole plugs (fig. 47 (8)) on the front mechanism plate near the governor worm shaft housing (fig. 51 (23)).

(*2*) Remove the guard hole plugs by slipping the film guard springs (fig. 47 (9)) from the groove around the end of the guard post on the under side of the mechanism plate.

i. Governor and Worm Shaft Assembly: Removal.

(*1*) The governor and worm shaft assembly (fig. 48 (4)) which regulates the speed of the camera within the alotted range of the model is critically aligned by the manufacturer and should not be disassembled unless absolutely necessary. Special fixtures are required to reassemble and adjust this part of the mechanism.

(*2*) The worm gear is an integral part of the governor assembly (fig. 48 (4)). The assembly is mounted on bearings, with bearing balls at each end (fig. 48 (2) and (3)). The speed-governing springs and weights are in turn mounted on the shaft itself and must be accurately adjusted. The governor worm shaft housing (fig. 48 (7)) is linked to the governor speed dial: the housing is slid back and forth by the rotation of the dial, changing the flexing length of the springs on which the weights are mounted. When in motion, the whirling of the worm shaft assembly throws the weights outward until they touch the inside of the housing. Control of the camera operating speed is obtained by regulating the length of the springs to which the weights are attached, and by changing the inside diameter of the housing proper.

(*3*) To disengage the governor and worm shaft assembly, loosen the governor bearing setscrew (fig. 48 (1)) located in the center of the stud (fig. 51 (20)) at the worm gear end of the shaft assembly, under the front mechanism plate. Pull the lower governor worm shaft bearing (fig. 48 (2)) halfway out of the stud. Lift the governor and worm shaft assembly free of the two studs which hold its bearings. Avoid disturbing the position of the bearing at the opposite end of the shaft, or it will be difficult to obtain a critical meshing of gears during reassembly.

j. Governor Assembly: Disassembly.

(*1*) To disassemble the governor assembly proper, remove the two retaining collar screws (fig. 48 (9)) that hold the governor worm shaft flexure control washer retaining collar (fig. 48 (8)) to the governor housing.

(*2*) Remove both the collar and the collar washer (fig. 48 (5)) and withdraw the governor worm shaft assembly.

k. Governor Assembly: Reassembly.

(*1*) When inspection and cleaning have been completed, assemble and align the retaining collar and the flexure control washer (fig. 48 (8) and (5)) on the housing (fig. 48 (7)).

(*2*) Insert the governor and worm shaft assembly (fig. 48 (4)) into this assembled portion so that the governor weights are inside the housing, while the worm gear end of the assembly extends through the washer.

(*3*) Replace the two bearing balls (fig. 48 (3)) in the governor worm shaft bearing (fig. 48 (2)).

(4) Insert the shaft end (not the worm gear end) of the governor and worm shaft assembly into this bearing.

(5) Place the two bearing balls into the other bearing and insert it into the other governor bearing retainer stud. The geared end of the shaft is now held in position.

CAUTION: The governor worm shaft bearing balls are easily lost. Replace the same number of balls into the bearings as were removed.

(6) Make sure that the shaft rotates freely. An end play of only several thousandths of an inch is permissible.

l. Governor and Work Shaft Assembly: Adjustments.

(1) Check the alignment of the two governor worm shaft bearing studs located on the under side of the upper mechanism plate by inserting gauge S-7807-N5 through the holes in both posts (fig. 65).

(2) Check the distance of the weights from the shafts, using gauge S-8074-N5 (fig. 65). The tip of the gauge should just clear the weights.

(3) If the weights are not equally distant from the shafts, it may be necessary to bend them individually. Insert tool S-8074-F2 under the weight and slightly bend it outward from the shaft. Do not insert the tool too deeply under the weight, since this may cause the spring to break.

(4) If the weights are not placed far enough from the shaft as gauged with tool S-8074-N5, use tools S-8074-N6 and S-8074-N7 (fig. 65) to spread the weights. When the cone-shaped tool S-8074-N6 is pressed inward, it will spread all four weights equally. Care should be taken so that they are not spread too far.

(5) Examine the governor and worm shaft assembly carefully to determine whether the governor drive worm gear and ratchet spring assembly (fig. 48 (10)) is too loose on the worm gear shaft.

(6) The retaining collar (fig. 48 (8)) on the end of the governor worm shaft housing (fig. 48 (7)) must be precisely positioned, so that it does not interfere with the governor springs. Use tools S-8094-F3 and No. S-8094-F4 (fig. 65). The spring is set so that it clears the gauge S-8094-F3. Tighten the two screws which hold the spring in place.

97. CAMERA FRAME: DISASSEMBLING BACK MECHANISM PLATE GEARS.

a. The removal of the front mechanism plate makes visible the driving mechanism gears which are set in bearings on both the front and back mechanism plates. Note the respective gear positions as the gears are being removed (fig. 51). Note that the governor drive worm gear and ratchet spring oiler assembly, the worm gear and take-up spindle drive gear assembly, and the governor drive worm gear and ratchet spring assembly (fig. 51 (8), (11), and (7)) are positioned together on the **front** mechanism plate.

b. To disassemble the **back** plate gear mechanism, proceed as follows:

(1) Lift the first compound gear and pinion assembly and the second compound gear assembly (fig. 49 (14) and (10)) off the back mechanism plate.

(2) Remove the footage ratchet pawl actuating cam and gear (figs. 49 (7) and 51 (21)) and the main drive shaft stop gear (figs. 49 (2) and 51 (1)).

(3) Pull out of place the footage dial ratchet pull pawl (figs. 49 (6) and 51 (29)) and the footage dial ratchet lock pawl (figs. 49 (9) and 51 (32)), along with the footage dial ratchet pawl tension spring (figs. 49 (8) and 51 (33)).

(4) To remove the main drive gear split retaining ring (fig. 49 (3)), pressure with a screwdriver may be needed. Press on the main drive hub shaft (fig. 49 (15)) and remove the shaft from the back plates.

(5) Lift the main drive gear assembly (figs. 49 (4) and 51 (5)) free of the mechanism. Remove the main drive shaft clutch springs (fig. 49 (13)) from the main drive hub shaft (fig. 49 (15)). Note that one end of this double spring fits into a slot in the hub shaft.

NOTE: The shuttle cam pin driving disk gear (figs. 49 (16) and 51 (35)) is driven by the second compound gear assembly (fig. 49 (10)), and in its turn, drives the shutter and the shuttle. Both the shuttle driving disk gear and the shuttle cam drive shaft (figs. 49 (17) and 51 (36)) are riveted to the back mechanism plate and should not be removed.

98. CAMERA FRAME: BACK MECHANISM PLATE GEAR ASSEMBLY.

Wash and clean all gears and the back mechanism plate thoroughly. Remove the hardened

shellac from the brass surface of the spring motor graphite retaining plate (fig. 49 (1)). Inspect all gear teeth and repair or replace gears as necessary. Proceed to reassemble the gears on the back mechanism plate, in the order named below.

a. Main Drive Gear Assembly.

(*1*) Place the main drive gear assembly (fig. 49 (4)) in position on the top side of the back mechanism plate.

(*2*) Turn the plate over and place the main drive shaft clutch springs (fig. 49 (13),) on the slots of the main drive gear assembly. Do this by first screwing one spring into the other, so that their coils are correctly matched and aligned. Insert the bent-over end of one spring in one slot on the hub shaft, and the end of the other spring in the other shaft slot.

(*3*) Place the main drive hub shaft (fig. 49 (15)) over the main drive shaft clutch spring and engage it with the ends of the spring.

(*4*) Turn the mechanism plate over and press the main drive gear assembly and the main drive hub shaft firmly together. Replace the main drive gear split retaining ring (fig. 49 (3)).

b. First Compound Gear and Pinion Assembly.

(*1*) Note that this gear (fig. 49 (14)) engages the main drive gear assembly (fig. 51 (5)) and the crank-motor gear-coupling assembly (fig. 50 (15)), and in turn drives the second compound gear assembly (fig. 49 (10)) and the worm gear and take-up spindle drive gear assembly (fig. 51 (11)).

(*2*) Place a drop of oil on the pinion shaft and then replace the first compound gear and pinion assembly in the bearing on the back plate. Turn the gear several times to make sure that it engages the main drive gear assembly and drives the shuttle cam pin driving disk gear (fig. 49 (16)).

c. Second Compound Gear Assembly.

(*1*) Note that this gear (fig. 49 (10)) is driven by the first compound gear and pinion assembly and in turn drives the shuttle cam pin driving disk gear, engaging the geared ends of the film sprockets in the sprocket shaft carrier assembly on the front mechanism plate.

(*2*) Place a drop of oil (PS) on the gear shaft and insert the gear in the bearing hole directly adjacent to the shuttle cam pin driving disk gear (fig. 49 (16)). Turn the second compound gear assembly several times to make sure that the gear and teeth mesh properly.

d. Footage Ratchet Pawl Actuating Cam and Gear.

(*1*) Note that this gear (fig. 49 (7)) is driven directly by the main drive gear assembly (fig. 49 (4)) and through the action of an eccentric (fig. 56 (7)) operates the footage dial ratchet lock pawls (fig. 49 (9) and (6)).

(*2*) Place a drop of oil (PS) on the gear shaft and insert the shaft in the opening of the back mechanism plate.

(*3*) The lock pawl and the pull pawl (fig. 49 (9) and (6)) may be placed on the footage ratchet pawl actuating cam and gear just before the front mechanism plate is placed in position on the rear mechanism plate. The footage dial ratchet pawl tension spring (figs. 49 (8) and 51 (33)) connects both pawls. Note that the pawls are not identical and make sure that they are correctly replaced in their respective positions.

e. Main Drive Shaft Stop Gear.

(*1*) Note that this gear (figs. 51 (1) and 49 (2)) is placed on the main drive hub shaft (fig. 49 (15)) and meshes with the buck tooth (idler mechanism stop) gear (fig. 51 (13)) located on the front mechanism plate. It is free to turn until the shallow space between any two of the teeth engages the longer buck tooth of the buck tooth gear.

(*2*) Turn the shuttle cam pin driving disk gear (fig. 51 (35)) several times to make sure that all gears rotate and are properly meshed.

(*3*) Place a few drops of oil (PS) on the felt hub shaft pad grease seal (fig. 49 (18)) located on the inside of the main drive hub shaft (fig. 49 (15)).

(*4*) The worm gear and take-up spindle drive gear assembly, the governor drive worm gear and ratchet spring assembly, and the worm gear and ratchet spring oiler assembly (fig. 48 (12), (10), and (11)) mesh together and are assembled on the front mechanism plate. Do not try to assemble the mechanism plates with the worm gear and take-up drive gear assembly in position on the back plate.

99. CAMERA FRAME: FRONT MECHANISM PLATE GEAR ASSEMBLY.

Clean all parts in dry-cleaning solvent (SD). Examine the sprocket teeth, gears, and other moving parts for wear or damage. Repair or replace as necessary and assemble the front plate mechanism, using the procedure described below.

a. Governor and Worm Shaft Assembly. For speed adjustment of all models of Camera PH-330-(*), except the governor-in-the-head model, Camera PH-330-A, proceed according to the instructions below. For adjustment of the governor-in-the-head camera, refer to subparagraph b below.

(*1*) Inspect the governor and worm shaft assembly parts (fig. 48 (4)). Measure the distance between the shaft and each of the weights. The measurement normally is 1/64 inch, and each of the four weights should be equally distant from the shaft.

(*2*) If the camera speed is too fast, the weights may be too close to the shaft. They must then be spread equally and at the same time. Adjust the weights as required, using the special tools and procedures outlined in paragraph 96. If the speeds are too slow, bend the governor weights closer to the shaft.

(*3*) Place a drop of oil (MO) on the worm shaft assembly and a few drops on the oil retaining felt in the worm gear and ratchet spring oiler assembly (fig. 48 (11)).

(*4*) Insert the governor and worm shaft assembly through the worm shaft housing (fig. 48 (7)). Place the governor housing pressure spring (fig. 48 (6)) in the recess in the governor housing. Place the entire unit in position on the underside of the front mechanism plate, so that the rail on the underside of the housing rides in the slot in the plate.

(*5*) Insert the plain end of the worm shaft assembly (fig. 48 (4)) in the upper governor bearing post and hold the worm end of the shaft in line with the lower governor bearing post. Insert the bearing (fig. 48 (2)) in the lower post and over the worm shaft itself. Lock it in place with the setscrew (fig. 48 (1)), keeping play of the shaft at a minimum.

(6) Move the governor housing back and forth to make sure that it slides freely during operation.

b. Governor-in-the-head Worm Shaft: Speed Adjustments. For speed adjustments of the governor-in-the-head camera, refer to the instructions below. Note that the felt lining of the governor shell (fig. 45 (11)) acts as a high speed control brake. A felt pad controlled in the governor brake arm (fig. 45 (3)) acts as a low speed brake.

(*1*) To reduce a high speed, replace the worn felt lining in the governor shell with new felt. If this does not decrease the speed sufficiently, remove the felt lining, place a paper shim beneath it, and replace the lining.

(*2*) To reduce a low speed, replace the felt pad in the governor brake arm or bring it outward toward the governor by means of paper shims.

(*3*) Further adjustment affecting high and low speeds can be made by bending the governor leaves (fig. 45 (6)) inward or outward. Be careful not to break the leaves, and make sure that all leaves are bent equally. Camera vibration can result from unequally bent leaves.

(*4*) The entire speed range can be accelerated by partially or wholly removing the weights inside the governor.

(*5*) Minor speed adjustments can be made by shifting the governor brake arm stop pins (fig. 45 (2)).

c. Buck Tooth (Idler Mechanism Stop) Gear: Installation.

(*1*) Place a drop of oil (PS) in the buck tooth gear stud on the under side of the front mechanism plate. Insert the buck tooth gear (fig. 51 (13)) in the stud.

(*2*) Slip the buck tooth stop gear spring (fig. 48 (14)) over the retaining screw (fig. 48 (15)) and fasten the gear into place with the retaining screw.

d. Take-up Spindle: Installation.

(*1*) Insert the take-up spindle (fig. 47 (1)) through the opening in the front mechanism plate. Place the tension spring (fig. 47 (3)) in the take-up spindle gear (fig. 47 (2)).

(*2*) Slip the take-up spindle friction key washer and the take-up friction washer (fig. 47 (4) and (5)) over the tension spring, so that the key of the washer fits into the slot of the gear shaft.

(*3*) Replace the feed or take-up spindle

retaining screw (fig. 47 (6)) and tighten. Turn the spindle several times to make sure that it rides freely.

e. Feed Spindle: Installation.

(*1*) Insert the feed spindle (fig. 47 (13)) through the appropriate spindle opening (fig. 48B) in the mechanism plate.

(*2*) Place the feed spindle return spring (fig. 47 (14)) over the spindle shaft and fit the bent-in end of the spring in the shaft slot.

(*3*) Place the spring housing (fig. 47 (15)) over the shaft and spring. With the aid of tweezers, pull the protruding end of the spring out and insert it in the slot cut into the edge of the housing.

(*4*) Replace first the friction washer (fig. (16)) and then the friction collar (fig. 47 (17)) over the spindle shaft. Holding the spindle in a smooth jaw vise, insert the spindle retaining screw (fig. 47 (6)), and tighten.

(*5*) After the camera has been completely assembled, adjust the spindle recoil tension. For instructions concerning adjustment, refer to paragraph 110e.

f. Gate Arm Installation.

(*1*) Place the sprocket carrier assembly (fig. 48 (17)) in position on the under side of the front mechanism plate. Slide it under the two holding flanges on the plate.

(*2*) Place and hold the gate arm (fig. 47 (26)) in position on the top side of the front mechanism plate. Press the front gate arm retaining stud (fig. 47 (18)) through the hole at the forward end of the slot in the carrier assembly and on through the hole in the front end of the arm. Move the arm back to engage the two notches in the head end of the stud with the slot in the shaft carrier assembly.

(*3*) Replace the rear gate arm retaining stud (fig. 47 (30)) in the same manner.

(*4*) Press the gate lock stud (fig. 47 (33)) into place in the rear end of the gate arm.

(*5*) Move the gate arm slowly until the screw hole in the back of the shaft carrier assembly is visible. Insert and tighten the gate arm lock screw (fig. 48 (18)).

g. Feed Sprocket: Installation.

(*1*) Place the feed sprocket right-hand torsion spring (fig. 47 (28)) on the sprocket gear (fig. 47 (24)). Engage one end of the spring with the slot in the shaft and then slip the sprocket (fig. 47 (27)) over the gear shaft, so that the protruding end of the torsion spring fits into the slot in the sprocket.

(*2*) Insert the positioning point of the sprocket guard (fig. 47 (21)) in the slot in the front plate, with the right-angled end over the sprocket. Fasten with the sprocket guard oil screw (fig. 47 (22)).

h. Take-up Sprocket: Installation.

(*1*) Assemble the take-up sprocket in the same manner as the feed sprocket.

(*2*) Note that the torsion spring of the take-up sprocket (fig. 47 (23)) assembly is left-hand wound.

i. Film Guard Hole Plugs: Installation.

(*1*) Insert the film guard hole plugs (fig. 47 (8)) through the holes in the mechanism plate. Slip the forks of the film guard or plug retaining springs (fig. 47 (9)) around the lower ends of the guard posts on the under side of the front mechanism plate, so that they engage in the grooves and hold the posts in an upright position.

(*2*) Check the clearance of the retaining springs. Make sure that they do not interfere with the governor and do not cover up any of the openings in the mechanism plate.

100. CAMERA FRAME: FRONT MECHANISM PLATE INSTALLATION.

a. Place the worm gear and take-up spindle drive gear assembly (fig. 48 (12)) in the bearing hole on the under side of the front mechanism plate: the larger of the two gears should be in position nearest the plate. Place a small amount of special lubricating grease (GL) on the gear pivot to help hold the gear in position.

b. The governor drive worm gear and ratchet spring assembly (fig. 48 (10)) meshes with the worm gear and take-up spindle drive gear assembly and the worm shaft of the governor (fig. 48 (4)). Place a small amount of grease (GL) on the gear pivot. Place the gear assembly on the mechanism plate.

c. Place the worm gear and ratchet spring oiler assembly (fig. 48 (11)) in position on the mechanism plate. Place a few drops of oil (PS) on the lubricator felt, and a small amount of grease (GL) on the pivot.

d. Rotate the gears on the front several times to make sure that they mesh properly.

e. Place a few drops of oil (PS) on the gear bearings on both mechanism plates and on the governor worm shaft assembly.

f. Place a small amount of grease (GL) on the governor worm shaft housing pressure spring (fig. 48 (6)) and set it in the recess of the governor housing, with the concave side down. To help hold the gears in position, move the governor housing back against the governor worm gear. Make sure that the footage dial ratchet pull pawl and lock pawl (fig. 49 (6) and (9)) are correctly mounted. Tilt the back mechanism plate as much as possible to retain gears in position. Grasping the gate arm (fig. 47 (26)) of the front mechanism plate, carefully fit the front plate over the back plate so that the gear shafts of all the gears match and are seated in their respective bearing holes or studs in the opposite plate.

g. To help seat the gear shafts in the respective bearings, use a pointed tool or turn the shuttle cam pin driving disk gear (fig. 49 (16)) several times to revolve the gears. When the gears are properly seated in the mechanism plate bearings, revolve the take-up spindle several times to make sure that all gears are correctly meshed and turning freely.

h. Join the mechanism plates securely with the six mechanism top plate retaining screws.

101. CAMERA FRAME: MAIN DRIVE SPRING INSTALLATION.

a. Insert the main drive spring retainer stud (fig. 49 (11)) in the hole on the back mechanism plate so that the shoulder of the stud rests on the front mechanism plate.

b. Place the spring motor graphite retaining plate (fig. 49 (1)) in position on the back mechanism plate.

c. Make sure that the main drive spring (fig. 50 (9)) is clean and free of oil and grease. To clean, securely attach one end of the spring to a work bench. Stretch the spring to its full length and wipe it with a cloth soaked with oil (PS). Then wipe the spring with a dry cloth.

d. Wind the spring by hand, to the point where it may be placed in fixture S-5376-F (Signal Corps stock No. 8P9-34) as shown in figure 61. Engage the hook A, with the crimped end of the spring. With the crank, continue winding the spring to the point where the safety retaining ring may be placed around the coiled spring. Make sure that the spring is expanded sufficiently to rest against the retaining ring. Remove the hand crank and lift the spring and safety retaining ring from the fixture.

e. Place the spring in position on the under side of the back mechanism plate. Place the looped or crimped end of the spring over the main drive spring retainer stud (fig. 49 (11)).

f. Place the entire mechanism and spring in fixture S-4893-F1-B (Signal Corps stock No. 8P9-22) as shown in figure 60. Lock the fixture arm in position over the spring and the hub. Insert the ratchet winding crank in the mechanism and engage the spring with the hub. Wind the spring so that the retaining ring can be removed. Unwind the spring slowly until it is completely uncoiled.

g. When the spring is completely unwound, place approximately one quarter teaspoon of lubricating flake graphite (GFS) between each coil or leaf of the spring, as shown in figure 62. Be sure to lubricate each leaf with graphite.

h. After graphite has been placed between each coil of the spring, wind the spring until it is tight. Allow the spring to unwind slowly until the long tooth of the buck tooth (idler mechanism stop) gear (fig. 48(13)) passes by the opening in the front mechanism plate. Press the buck tooth gear out of position with a screwdriver. Permit the spring to unwind again until the shallow space between the teeth of the main drive shaft stop gear (fig. 49 (2)) appear in the opening. Engage the long buck tooth of the buck tooth gear in the shallow space of the main drive shaft stop gear, thus locking the mechanism.

i. Remove the mechanism from the fixture. As a safety precaution, place the retaining ring around the spring until the mechanism is to be replaced in the camera frame.

102. CAMERA FRAME: COMPLETE MECHANISM AND SPRING MOTOR INSTALLATION.

a. Before placing the mechanism and spring motor into the camera frame, remove all old shellac from around the shoulder of the casting

1. *Focusing magnifier eyepiece ring*
2. *Focusing magnifier eyepiece lens*
3. *Focusing magnifier eyepiece lens barrel*
4. *Focusing magnifier eyepiece barrel*
5. *Focusing magnifier eyepiece pilot screw (8P10-936)*
6. *Focusing magnifier prism case*
7. *Focusing magnifier prism clamp screw*
8. *Focusing magnifier prism clamp*
9. *Focusing magnifier prism retaining plate*
10. *Focusing magnifier prism retaining plate screw*
11. *Focusing magnifier prism*
12. *Focusing magnifier prism retaining ring (8P10-856)*
13. *Prism assembly retaining ring setscrew (8P10-933)*
14. *Focusing magnifier retaining screw (8P10-929)*
15. *Focusing magnifier mounting (8P10-714)*
16. *Focusing magnifier mount dowel pin (8P10-299)*
17. *Focusing magnifier mount compression spring (8P10-1151)*
18. *Focusing magnifier ground glass locating ring (8P10-875)*
19. *Focusing magnifier ground glass (8P10-420)*
20. *Focusing magnifier mask (for sound film) (8P10-988)*
21. *Focusing magnifier ground glass retainer ring (8P10-876)*

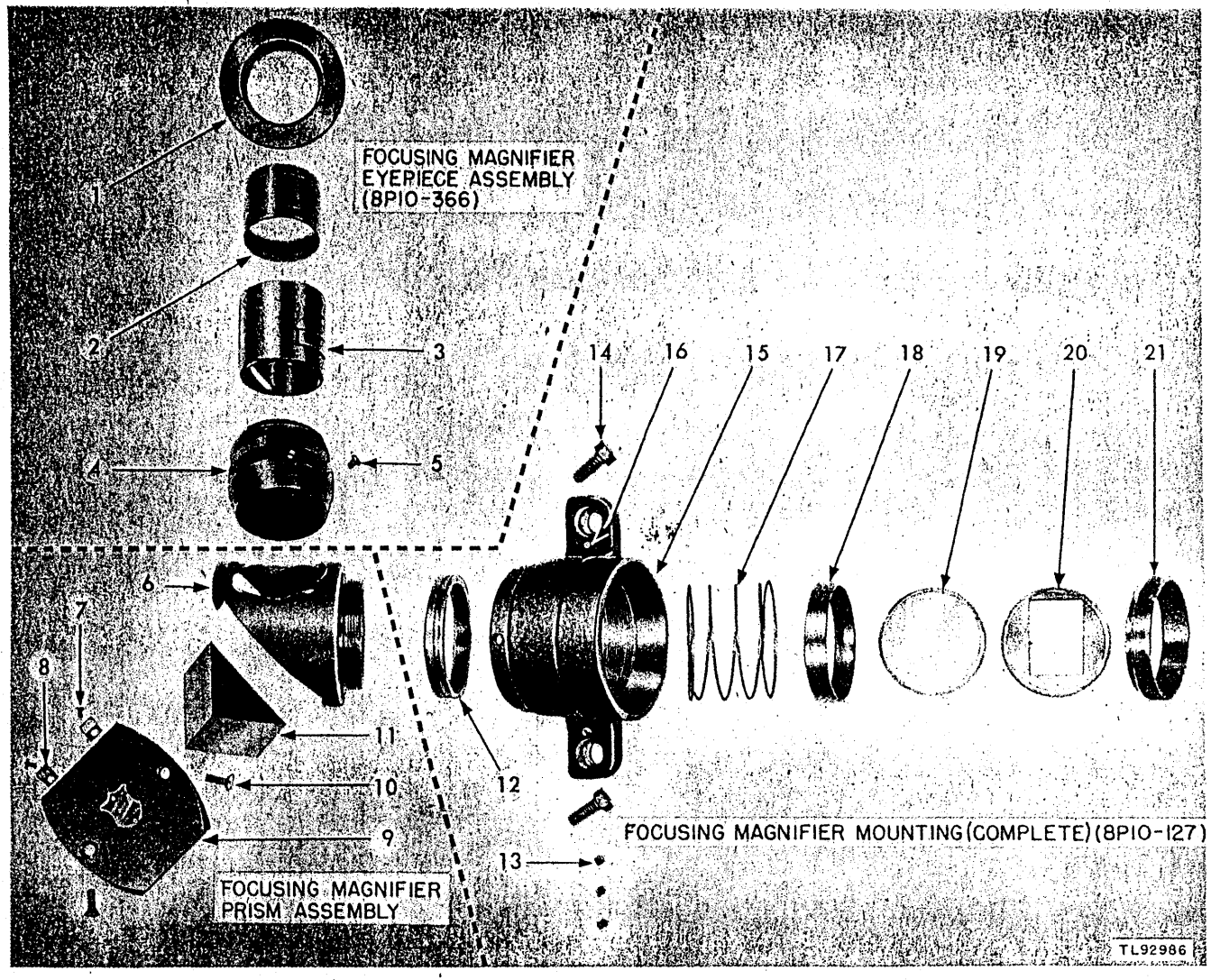

Figure 52. Disassembly, prismatic focusing magnifier, Camera PH-330-G.

with dry-cleaning solvent (SD). Clean the inside of the camera frame thoroughly. Be sure the shellac is removed from the spring motor graphite retaining plate (fig. 49 (1)).

b. Apply fresh, white, bleached, orange, gum shellac around the shoulder of the casting. This acts as a seal, preventing graphite from reaching the driving gears or film chamber. Replace the back mechanism plate felt packing washer.

c. Remove the safety retaining ring from the main drive spring. Grasp the gate arm and carefully lower the mechanism into the camera frame.

d. Place the footage dial ratchet lock pawl, the pull pawl, and the pawl tension spring (fig. 49 (9), (6), and (8)) in position on the footage dial ratchet (fig. 51 (30)).

e. Press the mechanism down firmly in the casting. Replace the four mechanism retaining screws that hold the mechanism to the camera frame, and fasten them securely.

f. Place the magazine valve lever assembly (fig. 50 (33)) in position and fasten down with two magazine valve lever assembly screws (fig. 50 (32)). Replace the magazine attachment plate cover and the plate cover retaining screw (fig. 50 (45) and (46)).

g. Replace the magazine belt drive pulley gear and the magazine belt pulley assembly housing (fig. 50 (21) and (23)) on the outside of the camera frame at the lower left side. Fasten in place with the magazine belt take-up pulley spacer washer (fig. 51 (3)) and the take-up pulley retaining screw (figs. 50 (24) and 51 (4)).

h. To link the governor with the governor speed dial, place one end of the governor connecting link (fig. 48 (19)) in position on the back of the governor speed dial. Replace the long governor connecting link screw and the spacer washer (fig. 48 (21) and (20)). Place the opposite end of the governor connecting link in position over the governor worm shaft housing (fig. 51 (23)) and fasten with the short connecting link screw (fig. 48 (22)). The speed dial should turn easily and should move the worm shaft housing back and forth.

103. CAMERA FRAME: CRANK-MOTOR GEAR-COUPLING HOUSING: INSTALLATION.

a. Insert the crank-motor gear-coupling assembly (fig. 50 (15)) in the crank-motor gear-coupling housing (fig. 50 (17)).

b. Insert the crank-motor gear-coupling housing gasket (fig. 50 (19)) and place the gear and housing in position on the camera frame. Fasten into place with the four gear and coupling housing retaining screws (fig. 50 (16)).

104. CAMERA FRAME: RELATIVE EXPOSURE INDICATOR DISASSEMBLY AND ASSEMBLY.

a. Remove the relative exposure indicator retaining screw and the relative exposure indicator friction spring (fig. 50 (1) and (2)). Lift the speed dial (fig. 50 (3)) from the camera frame. The relative exposure lens stop indicator dial is staked to the camera frame and cannot be removed.

b. To assemble the exposure indicator, replace the friction spring and the speed dial in position on the frame and fasten it down with the retaining screw.

105. CAMERA FRAME: GOVERNOR SPEED DIAL DISASSEMBLY AND ASSEMBLY.

a. To remove the governor speed dial (fig. 50 (41)) without dismantling the camera, remove the oval head speed dial retaining screws (fig. 50 (40)) that hold the dial to the speed control mount (fig. 50 (39)).

b. To remove the entire unit from the camera frame, remove the governor speed control mount spring retaining screw (fig. 50 (36)) located on the inside of the frame alongside the dial. To separate the speed control mount, the speed dial, and the speed dial knob (fig. 50 (39), (41), and (38)), slip the governor speed control mount retaining spring (fig. 50 (37)) from the grooved shaft of the speed control mount.

c. Place a drop of oil (PS) on the shaft of the dial mount.

d. To assemble the governor speed dial, insert the dial mount in the dial knob (fig. 50 (38)). Insert the dial knob through the appropriate opening (fig. 50A) in the camera frame. Fit the control mount retaining spring (fig. 50 (37)) in the groove around the end of

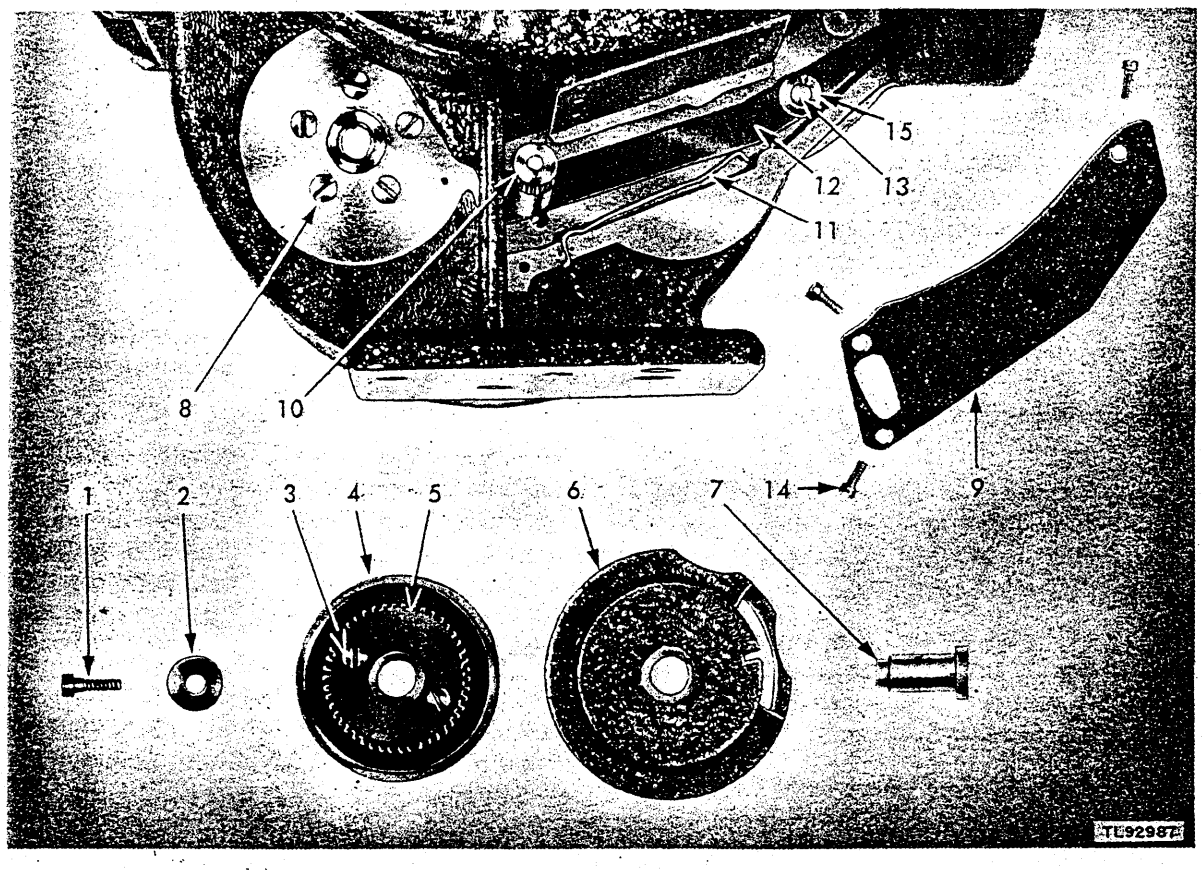

Figure 53. Disassembly, operating lever and lock, and magazine belt drive pulley, Camera PH-330-G.

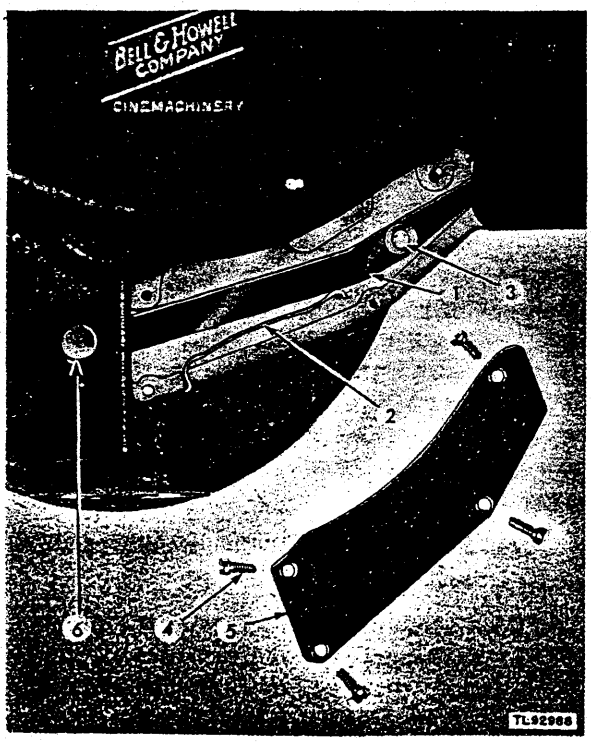

Figure 54. Disassembly, operating lever, Camera PH-330-A.

Key to figure 54

1. *Stop pawl operating lever and lock assembly (8P10-556)*
2. *Lever actuating spring*
3. *Stop pawl operating lever pivot dowel pin*
4. *Lever cover retaining screw (4 ea.)*
5. *Operating lever cover*
6. *Operating lever lock*

Key to figure 53

1. *Pulley retaining screw (1 ea.) (8P10-924)*
2. *Pulley spacer washer (1 ea.) (8P10-1292)*
3. *Pulley gear retaining screws (2 ea.) (8P10-908)*
4. *Magazine belt drive pulley (8P10-826)*
5. *Pulley gear*
6. *Pulley assembly housing (8P10-498A)*
7. *Pulley gear stud (8P10-1193)*
8. *Pulley bearing disk retaining screw (5 ea.) (8P10-892)*
9. *Operating lever cover (8P10-196)*
10. *Operating lever lock (p/o No. 12)*
11. *Operating lever actuating spring (8P10-1078)*
12. *Stop pawl operating lever assembly (8P10-551)*
13. *Stop pawl operating lever pivot dowel pin*
14. *Operating lever cover retaining screw (3 ea.)*
15. *Stop pawl operating lever pivot dowel pin washer*

Key to figure 55

1. *Pulley retaining screw (1 ea.) (8P10-924)*
2. *Pulley spacer washer (1 ea.) (8P10-1292)*
3. *Pulley gear retaining screw (2 ea.) (8P10-908)*
4. *Magazine belt drive pulley (8P10-826)*
5. *Pulley gear*
6. *Pulley assembly housing (8P10-498A)*
7. *Operating trigger assembly (8P10-2725)*
8. *Pulley bearing disk retaining screw (5 ea.) (8P10-892)*
9. *Cover retaining screw (3 ea.)*
10. *Operating lever cover (8P10-196)*
11. *Lever actuating spring (8P10-1078)*
12. *Stop pawl operating lever (8P10-2726)*
13. *Stop pawl operating lever pivot dowel pin*
14. *Stop pawl operating lever pivot dowel pin washer*

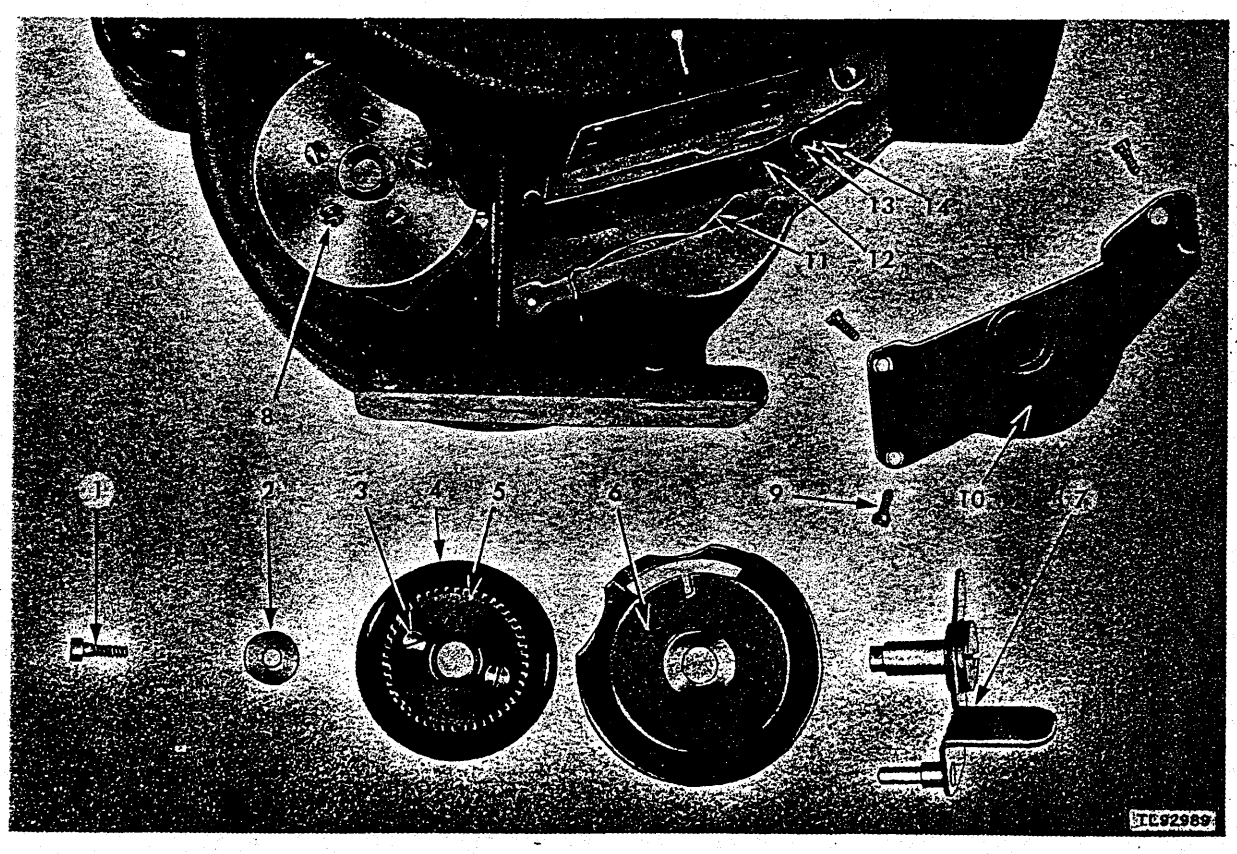

Figure 55. Disassembly, operating trigger, and magazine belt drive pulley, Camera PH-330-H.

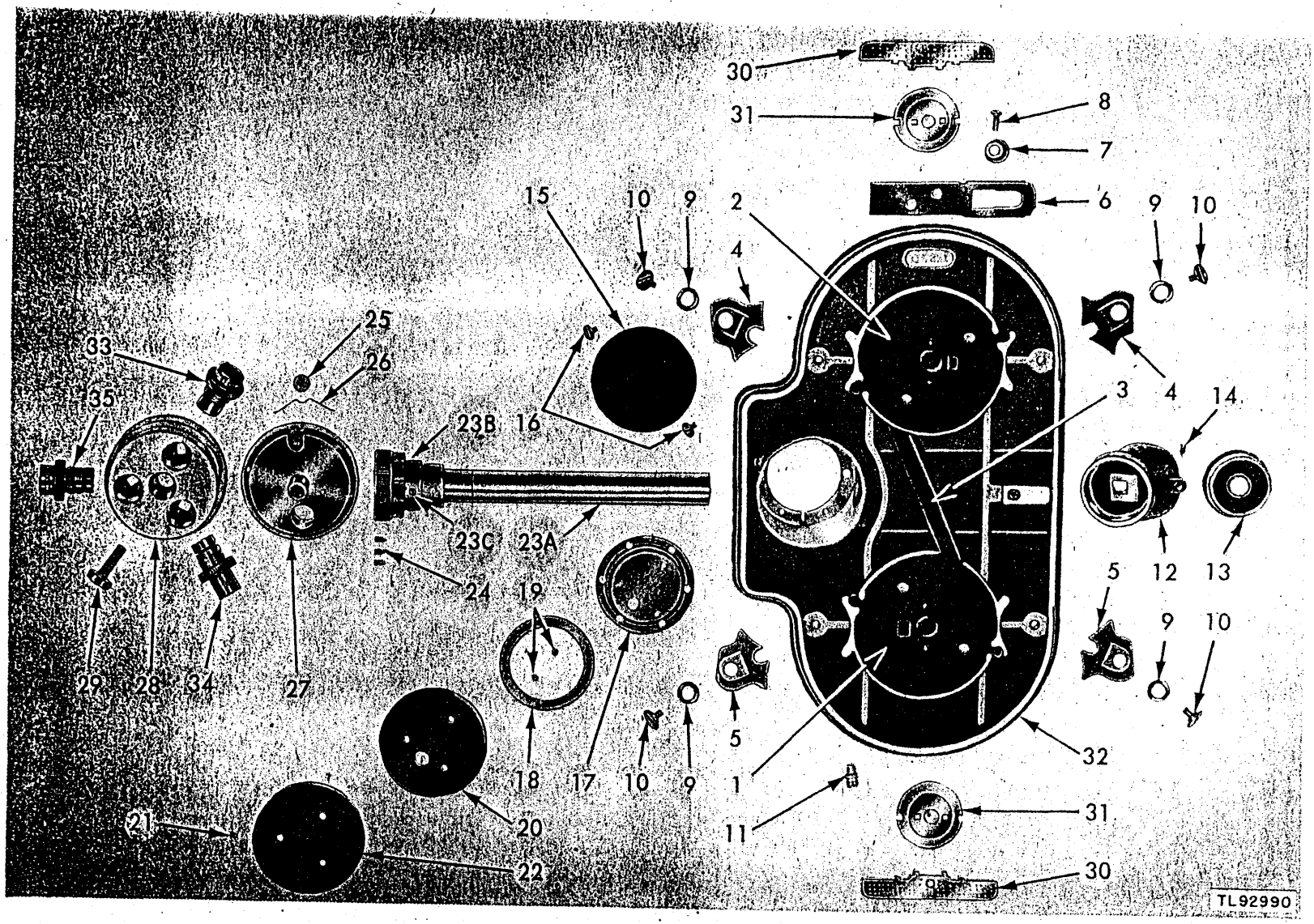

Figure 56. Disassembly, door and turret viewfinder, Cameras PH-330-G and -H.

the dial mount. Fasten the spring to the frame with the retaining screw (fig. 50 (36)). Turn the dial knob several times to see that it revolves freely.

106. CAMERA FRAME: PRISMATIC FOCUSING MAGNIFIER DISASSEMBLY AND ASSEMBLY.

The complete disassembly of the prismatic focusing magnifier as shown in figure 52 will not be necessary, since only the parts numbered in sequence from 12 to 21 are available for replacement. The focusing magnifier carried on all recent models of Camera PH-330-G consists of three component assemblies: an eyepiece assembly, a prism assembly, and a mounting (complete) (fig. 52). The first two assemblies named are supplied intact, as units, and are not to be disassembled; all parts of the focusing magnifier mounting (complete), however, are replaceable, and may be disassembled for cleaning and inspection.

a. To disassemble the focusing magnifier, unscrew the mount retaining screws (fig. 52 (14)) that hold the magnifier to the camera frame, and remove the magnifier in-tact. Unscrew the eyepiece assembly (fig. 52) from the prism assembly (fig. 52). Remove the three prism assembly retaining ring setscrews (fig. 52 (13)) that hold the prism retaining ring (fig. 52 (12)) to the focusing magnifier mounting (fig. 52 (15)). Remove the retaining ring from the prism assembly by turning the ring counterclockwise. Make a reference mark on the ground glass retaining ring and on the inside of the viewfinder. Unscrew the ground glass retainer ring (fig. 52 (21)) from the mount. Remove the sound film mask, the ground glass, the ground glass locating ring, and the compression spring (fig. 52 (20), (19), (18), and (17)) from the magnifier mount. Clean the ground glass disk thoroughly.

b. To assemble the focusing magnifier, fasten the eyepiece assembly to the prism assembly. Replace the prism retaining ring (fig. 52 (12)) on the threaded mount of the prism assembly and screw it into position by turning clockwise. Fit the magnifier mounting (fig. 52 (15)) over the prism assembly retaining ring and fasten securely with the three setscrews (fig. 52 (13)). Insert the magnifier mount compression spring (fig. 52 (17)) in place in the mount. Replace

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1. *Latch cam (upper) (8P10-540)*
2. *Latch cam (lower) (8P10-539)*
3. *Latch cam link (8P10-115)*
4. *Door latch (upper) (2 ea.) (8P10-293)*
5. *Door latch (lower) (2 ea.) (8P10-292)*
6. *Magazine valve lever push bar assembly (8P10-832)*
7. *Gate arm back lash adjustment eccentric (8P10-350)*
8. *Gate arm back lash adjustment eccentric screw (8P10-902)*
9. *Camera door cam latch washer (8P10-1310)*
10. *Door cam latch retaining screw (8P10-913B)*
11. *Auxiliary viewfinder tube mounting stud (6L31126-35CR)*
12. *Offset viewfinder eyepiece casting and assembly complete (8P10-820)*
13. *Offset viewfinder eyepiece prism holder retaining ring (8P10-868)*
14. *Offset viewfinder eyepiece casting setscrew (8P10-903)*
15. *Viewfinder drum hole cover (8P10-208)*
16. *Viewfinder drum hole cover screw (8P10-910)*
17. *Viewfinder dial attaching plate (8P10-791)*
18. *Viewfinder ball index pressure spring (8P10-1066)*
19. *Viewfinder lock ball (8P10-42)*
20. *Viewfinder dial disk (8P10-280)*
21. *Viewfinder dial disk screw (3 ea.) (8P10-893)*
22. *Viewfinder dial (8P10-268)*
23. *Viewfinder tube (positive) consisting of:*
    A. Tube
    B. Turret mount bushing
    C. Turret mount bushing setscrew
24. *Viewfinder turret setscrew (6L18504-1-1.312)*
25. *Viewfinder turret indexing roller (8P10-888)*
26. *Viewfinder turret indexing roller spring (8P10-1152)*
27. *Viewfinder turret mount (8P10-715)*
28. *Viewfinder turret and mask assembly*
29. *Viewfinder turret retaining screw (6L7040-8-1.3CR)*
30. *Camera door latch cam key (8P10-103)*
31. *Camera door latch cam hub (8P10-102)*
32. *Camera door (8P10-7)*
33. *Lens, viewfinder (8A4446)*
34. *Lens, viewfinder (8A4445)*
35. *Lens, viewfinder (8A4441)*

the ground glass locating ring, the ground glass disk, and the sound film mask (fig. 52 (18), (19), and (20)) in the magnifier mount, in the order named. Screw parts into position with the ground glass retainer ring (fig. 52 (21)), tightening the ring to the point where the reference mark on the ring coincides with the mark on the interior of the viewfinder housing. Mount the magnifier assembly in-tact in the camera frame by fastening with the two large magnifier mount retaining screws (fig. 52 (14)).

107. CAMERA FRAME: TURRET DUST COVER DISASSEMBLY AND ASSEMBLY.

a. Instead of a prismatic focusing magnifier, some older models of Camera PH-330-E are fitted with a turret dust cover screwed into the side of the camera frame in the position of the magnifier. The cover is removed by removing the two retaining screws.

b. To replace the turret dust cover, fit the plate over the two dowel pins in the camera frame casting and fasten it into place with the two retaining screws.

108. CAMERA FRAME: OPERATING LEVER AND LOCK DISASSEMBLY AND ASSEMBLY.

a. The operating lever and lock assembly can be removed only after the crank-motor gear-coupling assembly and the assembly housing (fig. 50 (15) and (17)) have been removed. To remove the stop pawl operating lever assembly (fig. 53 (12)), unscrew the three retaining screws (fig. 53 (14)) and lift up the operating lever cover (fig. 53 (9)). Insert a small screwdriver between the lever and the casting and lift the lever off the casting. To remove the lever in Cameras PH-330-A and -H, punch out the stop pawl operating lever pivot dowel (figs. 54 (3) and 55 (13)) from the opposite side of the camera frame, and draw the lever assembly out of the aperture in which it rests. The operating lever actuating spring (fig. 53 (11)) is staked on the camera frame and should not be removed unless it is necessary to replace the part.

b. To assemble the operating lever and lock, insert the stop pawl operating lever assembly and the operating lever stud (fig. 53 (12) and (13)) in position on the casting. Check the operation of the lever to see that it functions with a slight spring action. Place the lever cover in position and fasten it with the three retaining screws.

c. The basic operating lever assembly and disassembly procedure for all models of Camera PH-330-(*) and all types of lever-actuating devices is alike, except for a slight difference in nomenclature and the presence of four lever cover retaining screws (fig. 54 (4)) in Camera PH-330-A. The illustrations in figures 53, 54, and 55 are self-explanatory.

109. CAMERA FRAME: CAMERA DOOR DISASSEMBLY AND ASSEMBLY.

a. Turret Viewfinder. Do not disassemble the viewfinder unless it is out of order or its parts are broken. Ordinary repair of the camera door will consist of replacing a door latch and removing the eyepiece, the viewfinder tube, the turret mount, and the turret and mask assembly. These operations should be accomplished without disturbing the viewfinder drum hole cover, the viewfinder dial attaching plate, the viewfinder ball index pressure spring, the viewfinder dial disk, or the viewfinder dial (fig. 56 (15), (17), (18), (20), and (22)). These parts are shown in detailed disassembly in figure 56 only to make clear the complete components of this assembly; they need not be removed.

(*1*) To disassemble the viewfinder for routine cleaning and repair, unscrew the eyepiece casting (fig. 56 (12)) from the camera frame. Unscrew the eyepiece prism holder retaining ring (fig. 56 (13)) for cleaning. Grasp the viewfinder assembly at the side of the camera door plate, near the turret mount and the turret and mask assembly (fig. 56 (27) and (28)). Turn the entire assembly counterclockwise, taking care not to wrench the viewfinder tube (fig. 56 (23)) in any way that would jar the optical alignment in the tube. The three assembly elements named above should come out as a single assembly unit. Remove the three viewfinder turret setscrews (fig. 56 (24)) at the base of the viewfinder tube. Unscrew the retaining screw (fig. 56 (29)) and remove the viewfinder turret mount and the viewfinder turret and mask assembly (fig. 56 (27) and (28)). Remove the viewfinder lenses (fig. 56 (33), (34), and (35)) from the three openings in the turret and mask assembly. Clean the

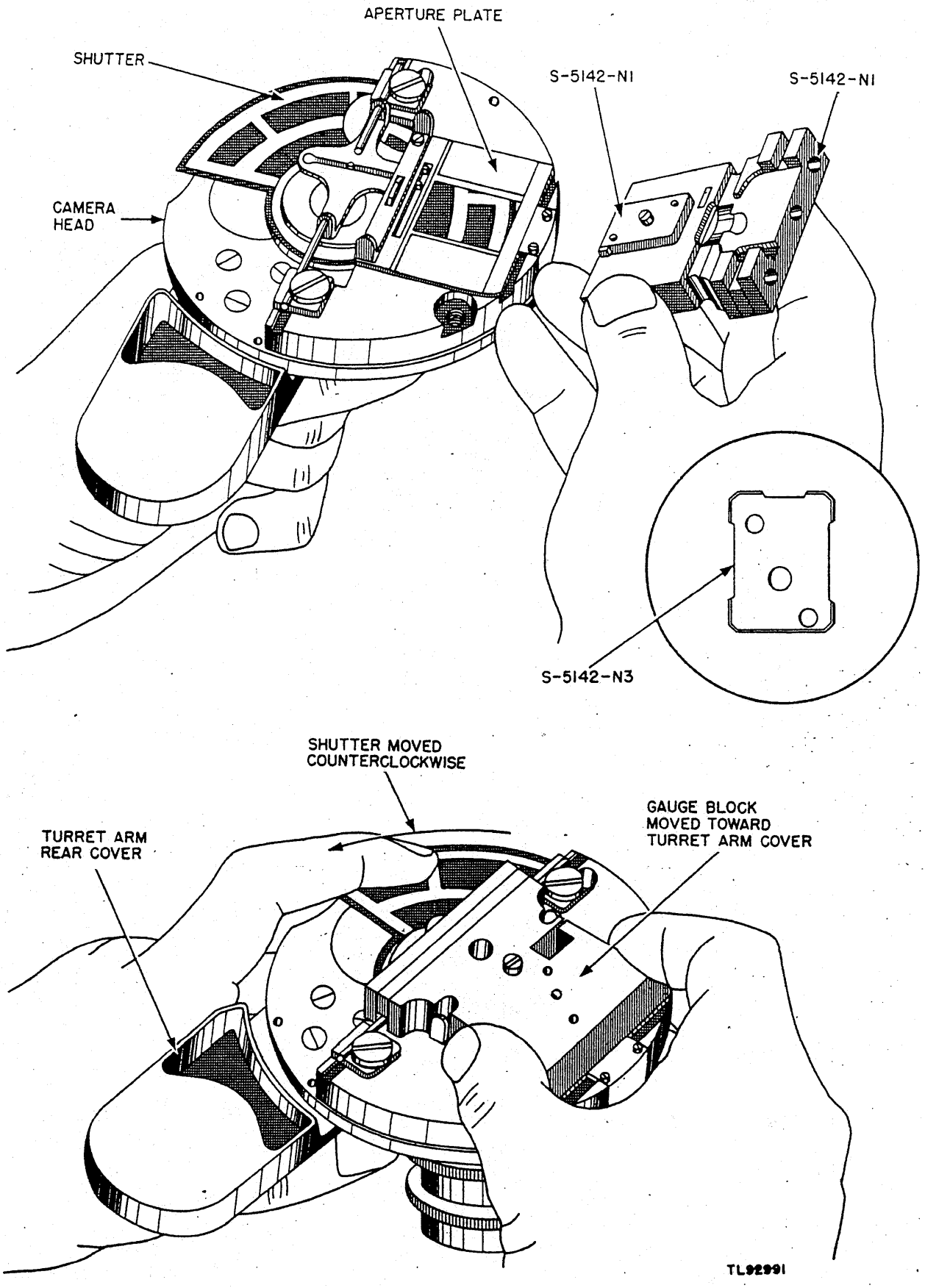


Figure 57. Adjusting aperture plate, Camera PH-330-G.

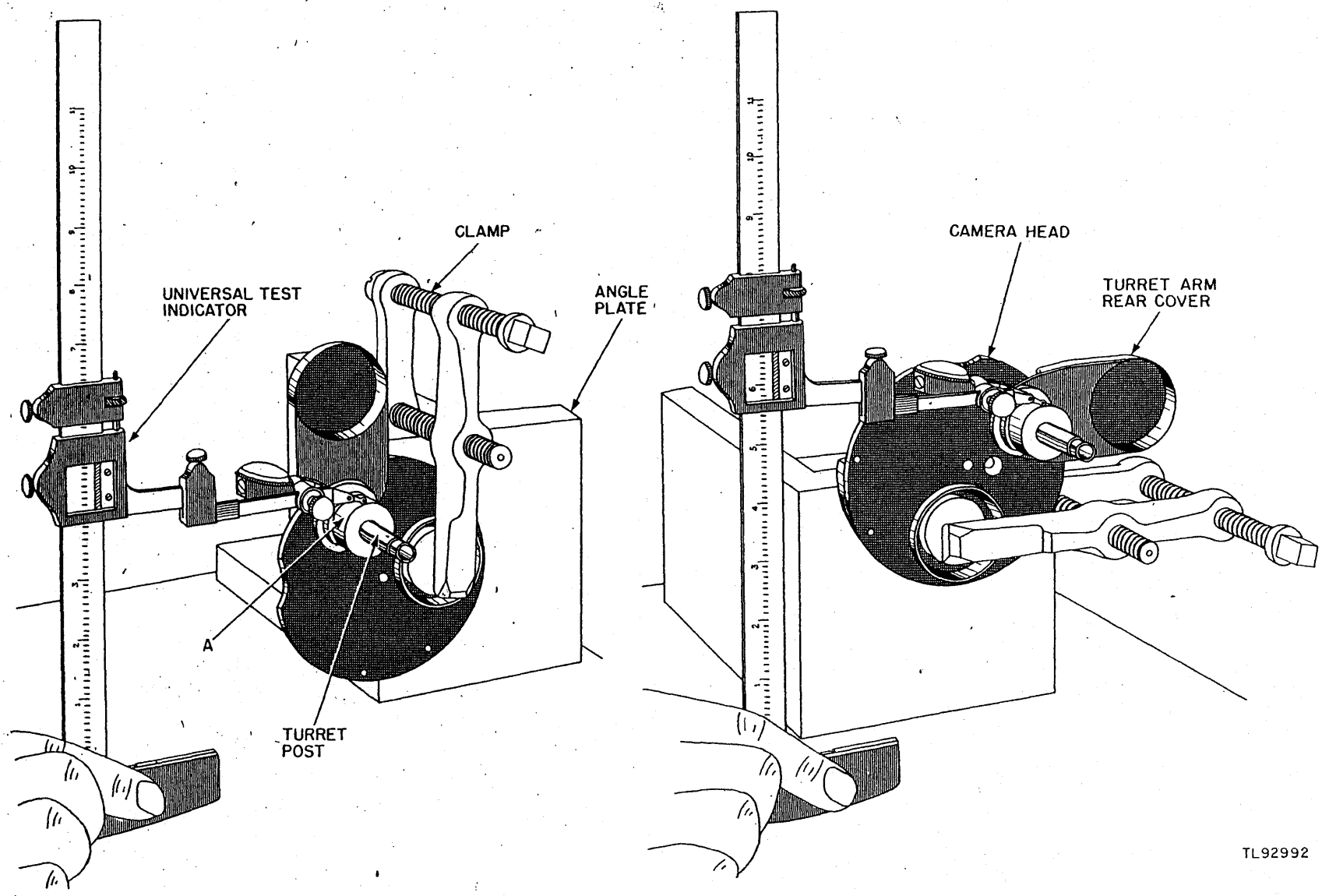


Figure 58. Adjusting turret post, Camera PH-330-G.

viewfinder lenses with a lintless cloth or with lens cleaning tissue.

(*2*) To assemble the turret viewfinder, replace the turret mount (fig. 56 (27)) in position on the base of the viewfinder tube (fig. 56 (23)). Fasten with the three setscrews (fig. 56 (24)). Seat the viewfinder turret and mask assembly (fig. 56 (28)) on the turret mount and screw them into place with the retaining screw (fig. 56 (29)). Mount the viewfinder lenses on the turret and mask assembly. Insert the combined viewfinder tube assembly into the viewfinder chamber in the camera door, until the base of the finder tube is flush with the side of the door plate and the opposite end of the tube is in position for the eyepiece at the opposite end of the door plate. Screw the eyepiece ring (fig. 56 (13)) into the eyepiece casting assembly (fig. 56 (12)) and mount the eyepiece assembly on the viewfinder tube. The offset eyepiece casting is held in place with a setscrew (fig. 56 (14)).

(*3*) The viewfinder turret and mask assembly (fig. 56 (28)) should be checked for alignment with the camera door plate after assembly. Make sure that the finder tube is tight in the casting; then release the setscrews (fig. 56 (24)) sufficiently to allow the turret mount and mask assemblies (fig. 56 (27) and (28)) to move freely but not too loosely. Place the camera door on a flat surface or block, with the outer door latch side up. Place a 90° angle so that the base of the angle is plane with the surface of the block and the straight edge is aligned vertically with the outer circumference of two turret objective openings in the turret and mask assembly. If the finder lenses are in place on the turret and mask assembly, the angle should be aligned with the outer circumference of the lenses. Fasten the turret mask and mount assemblies into place securely with the setscrews at this alignment. Check the alignment again by sighting through the finder.

b. Camera Door Latch Mechanism. Disassemble the door latch mechanism only when it is necessary to replace broken or damaged parts. Do not disassemble parts staked together.

(*1*) The camera door assembly consists of two latch cam keys (fig. 56 (30)) that move the latch cam hubs and upper and lower latch cams (fig. 56 (3), (1), and (2)). Disassemble the cams with a drift punch. The two latch cam assemblies engage the upper and lower door latches (fig. 56 (4) and (5)). They are linked together by a latch cam link (fig. 56 (3)) which engages and disengages the cover latches.

(*2*) To disassemble the door latches (fig. 56 (4) and (5)) drive the stakings out with a

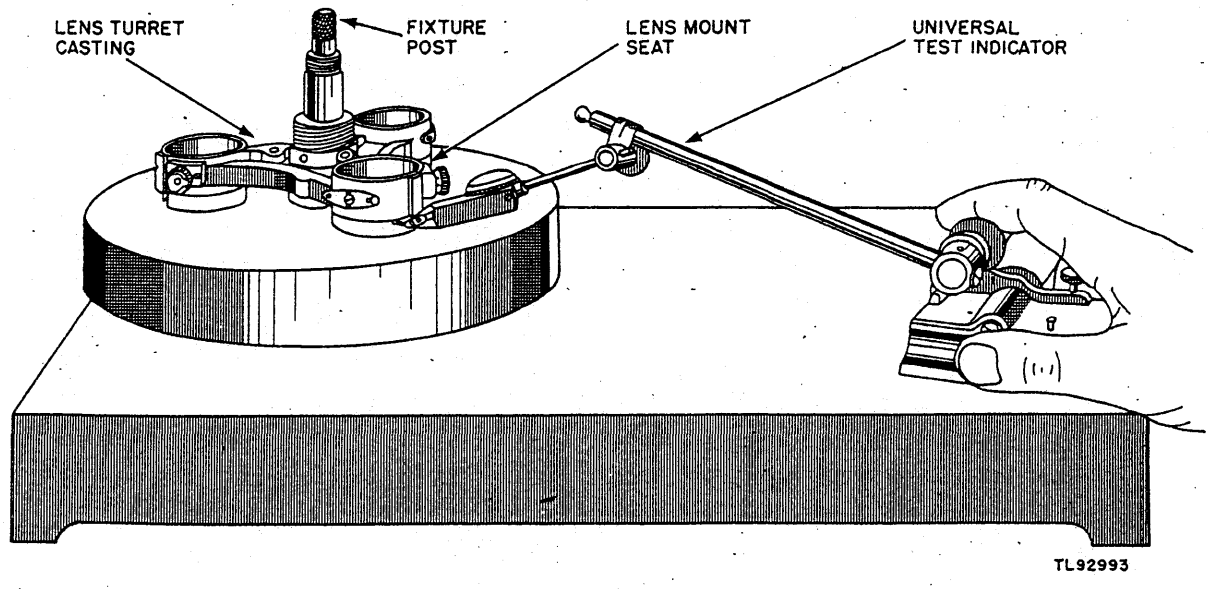


Figure 59. Adjusting turret lens mount seats, Camera PH-330-G.

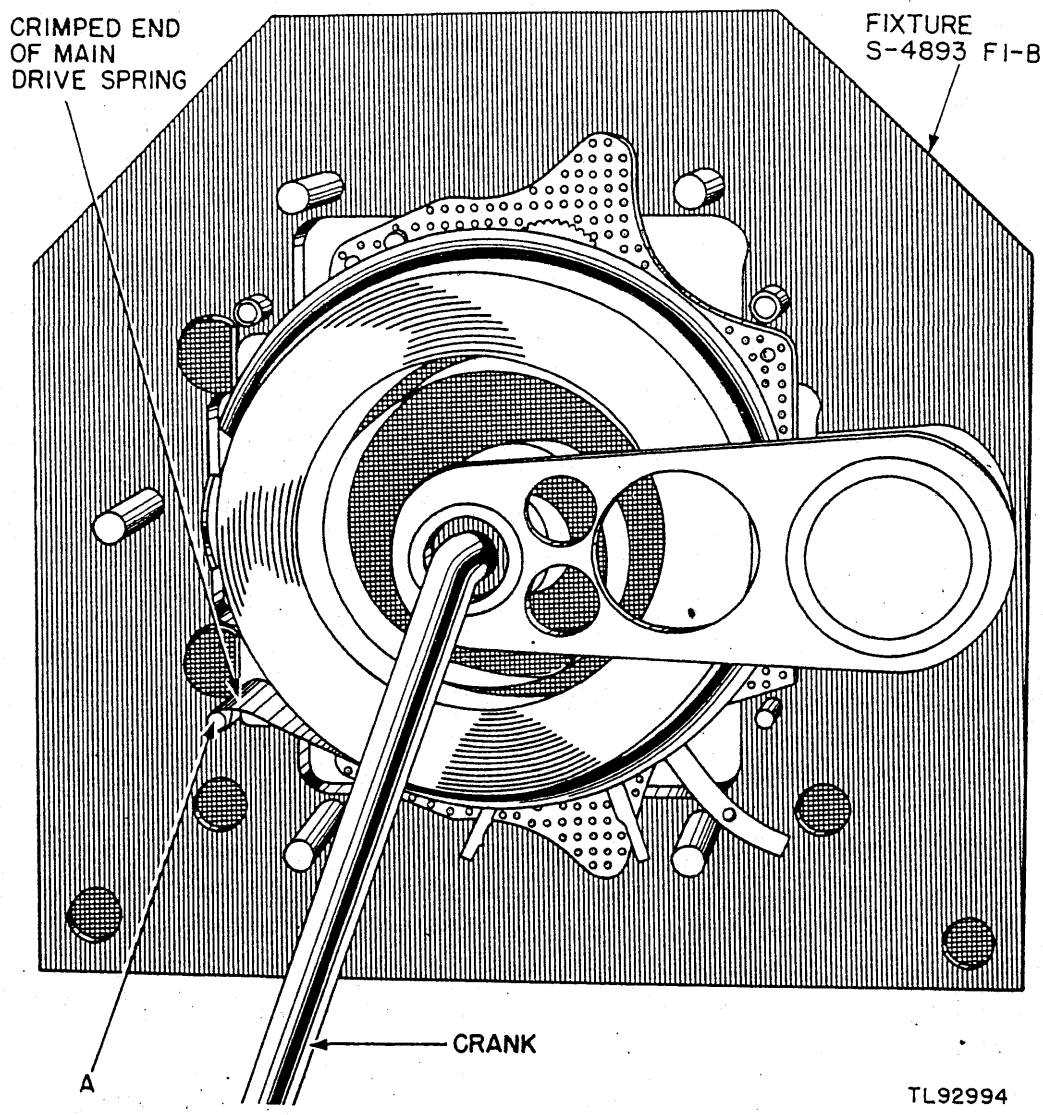


Figure 60. Installing main drive spring, Camera PH-330-(*).

drift punch. Lift the latch cam assemblies, the hub, and the latch keys (fig. 56 (1), (2), (31), and (30)) free of the cover casting. Unscrew the door latch screws (fig. 56 (10)) and remove the upper and lower door latches (fig. 56 (4) and (5)). Note the position of the camera door cam latch washers (fig. 56 (9)).

(*3*) To assemble the upper latch cam (fig. 56 (1)), lay the latch cam link (fig. 56 (3)) in place on the inside of the camera door. Lay the upper latch cam in place and engage it with the latch cam link. Hold the parts in position. Insert the lower latch cam (fig. 56 (2)) from the outside, through the opening in the door. Place the latch cam key (fig. 56 (30)) in position, so that the riveted ends protrude through both the hub and the cam. Stake the parts together, leaving no play, but permitting the parts to turn freely.

(*4*) To assemble the lower latch cam (fig. 56 (2)), repeat the process described in subparagraph (3) above.

(*5*) To assemble the door latches, secure the two upper latches (fig. 56 (4)) in position with the two door latch screws (fig. 56 (10)). Place the door latch tension washer (fig. 56 (9)) between the latch and the screw. Install the two lower door latches (fig. 56 (5)) in the same manner.

c. Gate Arm Adjustment. The gate arm back lash adjustment eccentric (fig. 56 (7)) holds the camera gate closed when the door is

on the camera. It is held in place by a screw (fig. 56 (8)). For further details see paragraph 110c.

d. Camera Door Reassembly. When the camera door mechanism has been installed on the door plate, place the door on the camera frame, fit into position, and close with latches. Examine the fit of the door plate around the edges. Door plates which have been bent can be fitted by tapping into shape with a fiber mallet.

110. CAMERA PH-330-(*): FINAL ADJUSTMENTS.

a. Adjustment of Camera Depth (fig. 64).

(*1*) Remove the turret from the camera and clean thoroughly of all dirt which might obstruct the proper seating of the turret on the camera head. Remove the dogs which are attached to each lens seat by two screws. Place the turret on an alignment plate. Examine carefully to determine whether all three lens seats are in contact with the surface of the plate. If not, the turret is sprung and will require repair or replacement (par. 89b).

(*2*) Check the turret post to make sure that it is perfectly perpendicular to the camera head (par. 88e).

(*3*) Clean the turret post and the apertures in the camera head. Replace the turret and tighten the lock knob. Insert a 0.0005 feeler gauge at the point where the lens seat rests on the aperture in the camera head. The feeler gauge should not go. If the feeler gauge does go, scrape or file to remove any high spots on the rear circumference of the lens seat. Check each lens seat similarly.

NOTE: If the turret does not seat properly and easily, loosen the three head retaining screws and make sure that the head is not twisted in the camera frame.

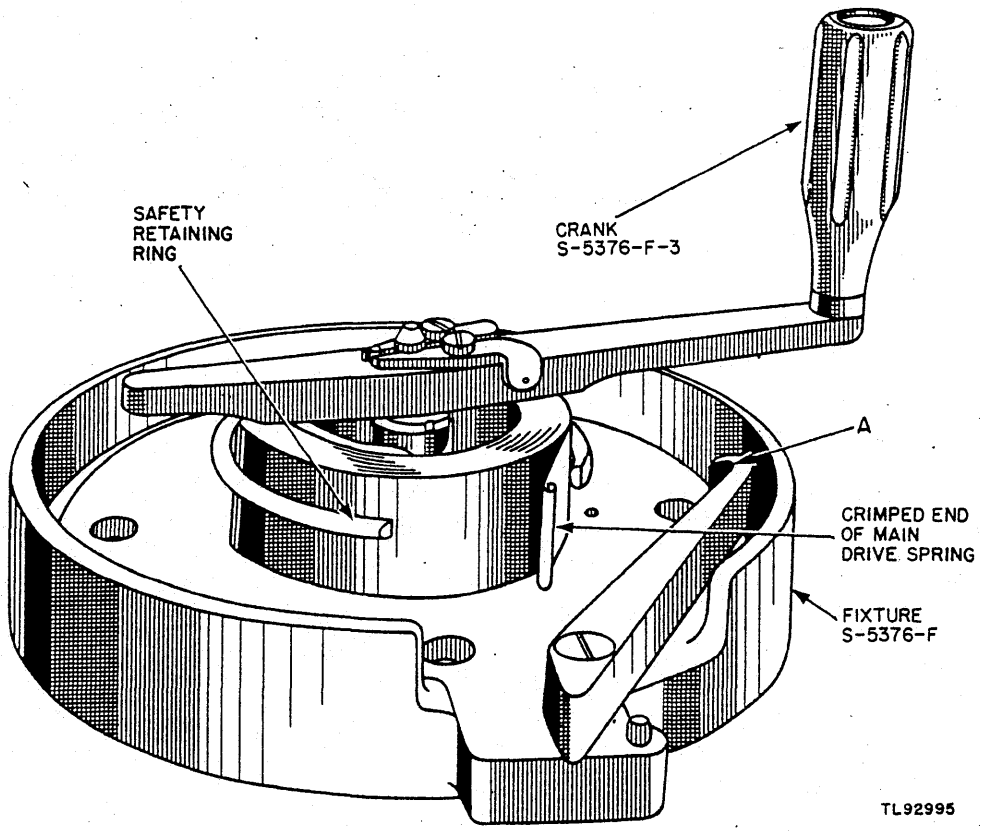


Figure 61. Coiling main drive spring, Camera PH-330-(*).

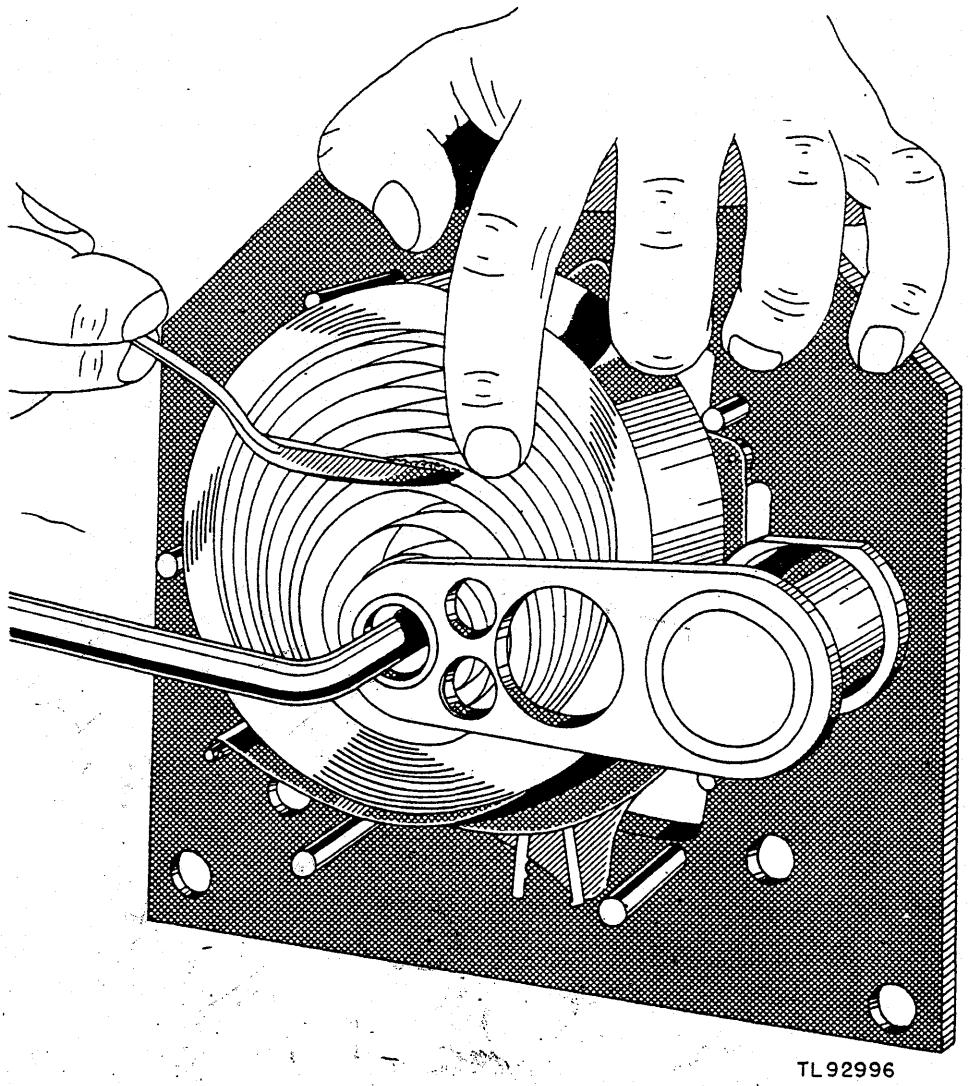


Figure 62. Graphiling main drive spring, Camera PH-330-(*).

(*4*) With a depth micrometer, measure the depth of the lens seats (the distance from the lens seat to the film plane). The depth should read 1.5 inches with a plus or minus tolerance of 0.0005 inch.

(*5*) To measure the depth, use the tools listed under Signal Corps stock No. 8P9-98. These include a steel plate S-4860-N-8-9 (fig. 64A), a lens seat gauge, S-4860-B-N-4 (fig. 64C), and a depth micrometer S-4860-B-N-5 (fig. 64B). Use these tools to obtain a micrometer reading. Be sure to subtract the thickness of the steel plate and the lens seat gauge from the actual micrometer reading. Each lens seat should be checked at three different points on the front circumference of the mount seat. To assure an accurate micrometer reading, make certain that the gauge and micrometer are free of dust.

(*6*) Carefully file the front circumference of the lens seats until the same depth reading is obtained (±0.0005 inch) from each lens seat.

(*7*) If the micrometer reading on all lenses is less than 1.5 inches minus the tolerance margin of 0.0005 inch, correct the reading by adjusting the aperture plate with shims placed beneath the aperture.

(*8*) The last adjustment of the turret,

which is made after the turret alignment and the depth of each lens seat have been checked, is made on the prismatic viewfinder. Use a micrometer to measure the distance between the lens seat and front surface of the ground glass. Tighten or loosen the ground glass retaining ring until correct reading (1.5 inches ±0.0005 inch) is obtained.

b. Adjustment of Film Clearance.

(*1*) The film clearance is the distance between the aperture plate and the pressure plate (fig. 43 (5) and (18)) when the gate is in the closed position. A clearance of 0.008 inch plus or minus 0.001 inch is allowed.

(*2*) Permit the mechanism to run down, so that the shuttle teeth (fig. 43 (21)) are retracted and behind the aperture plate.

(*3*) Place a steel plate 0.016 inch thick, approximately 1⅜ inch wide, and 2.5 inches long, between the aperture plate and the pressure plate. Close the gate.

(*4*) With a 0.006-inch feeler "go" gauge S-5762-N-2 and -3, check the distance between the pressure plate flange and the back surface of the gate arm casting (fig. 47 (26)) at points A indicated on figure 63. Note that only one side is shown in the illustration; points A on both sides of the pressure plate should be tested. The feeler "go" gauge should slide into the space easily.

(*5*) With a 0.008-inch "no go" gauge (fig. 63), follow the same procedure at the four points indicated in subparagraph (4) above.

(*6*) If the 0.006-inch gauge cannot be inserted freely between the pressure plate flange and the gate arm casting, the film clearance is too tight. Bend the flanges sufficiently to allow the gauge to enter freely.

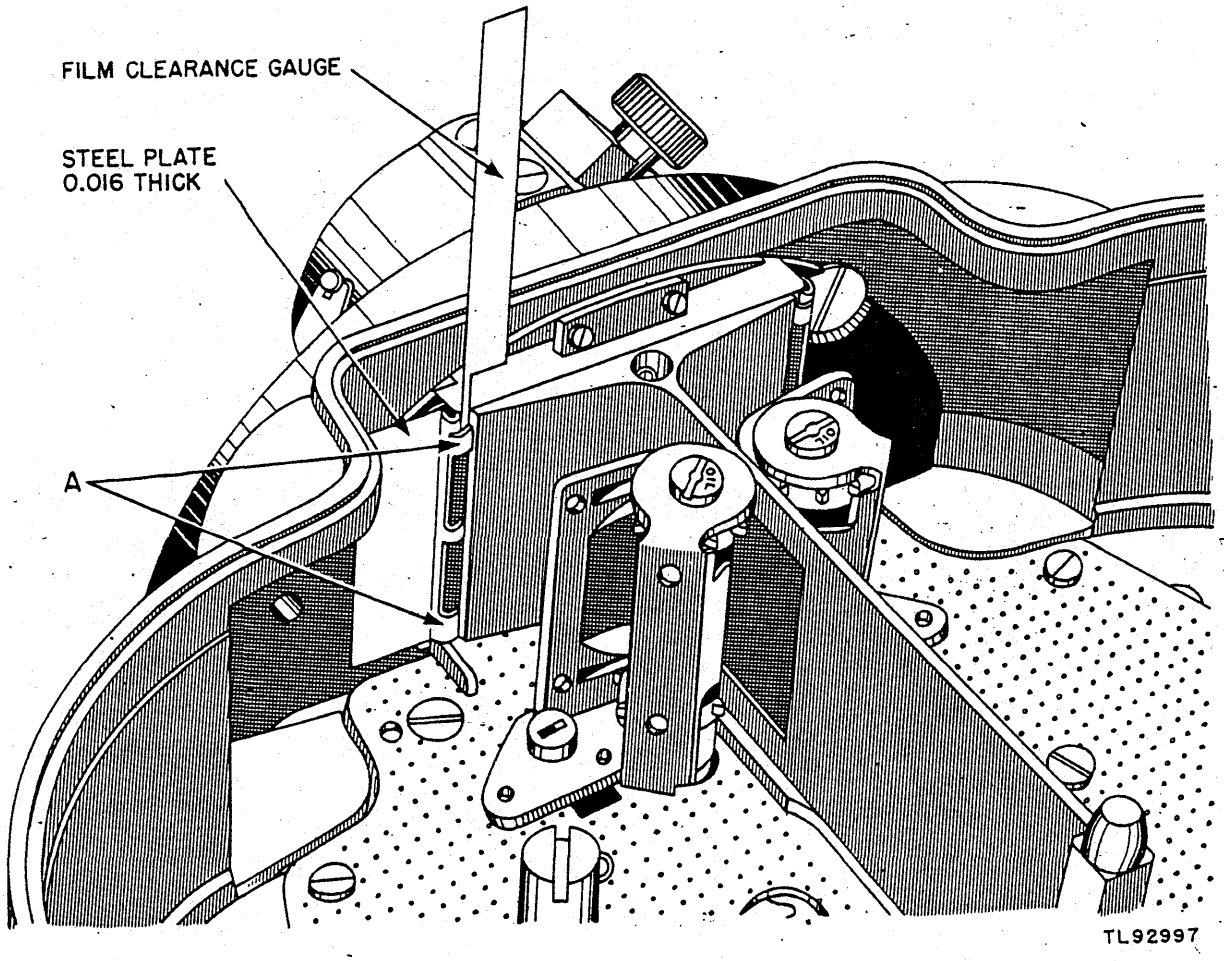


Figure 63. Checking film clearance, Camera PH-330-(*).

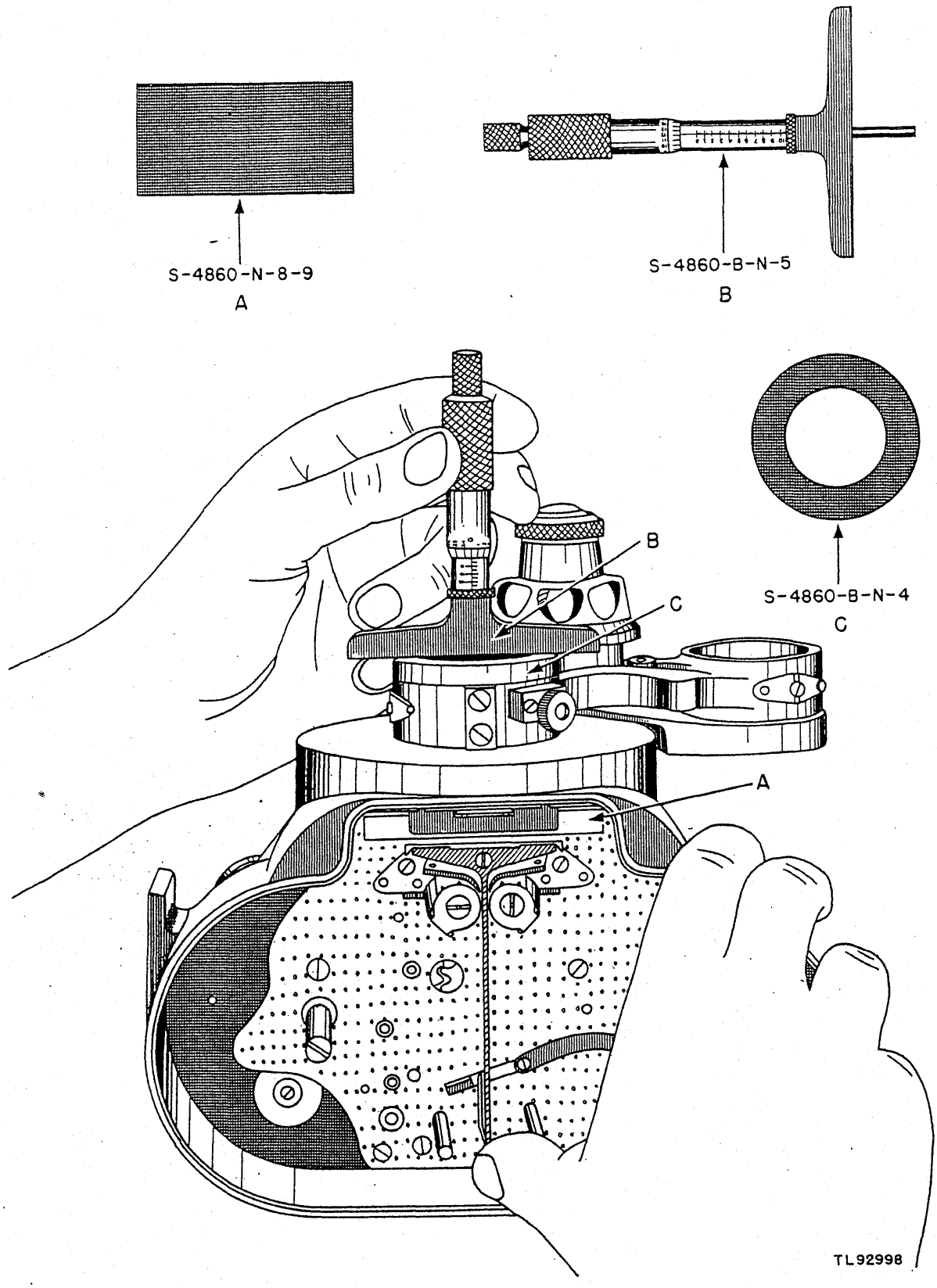


Figure 64. Measuring camera depth, Camera PH-330-G.

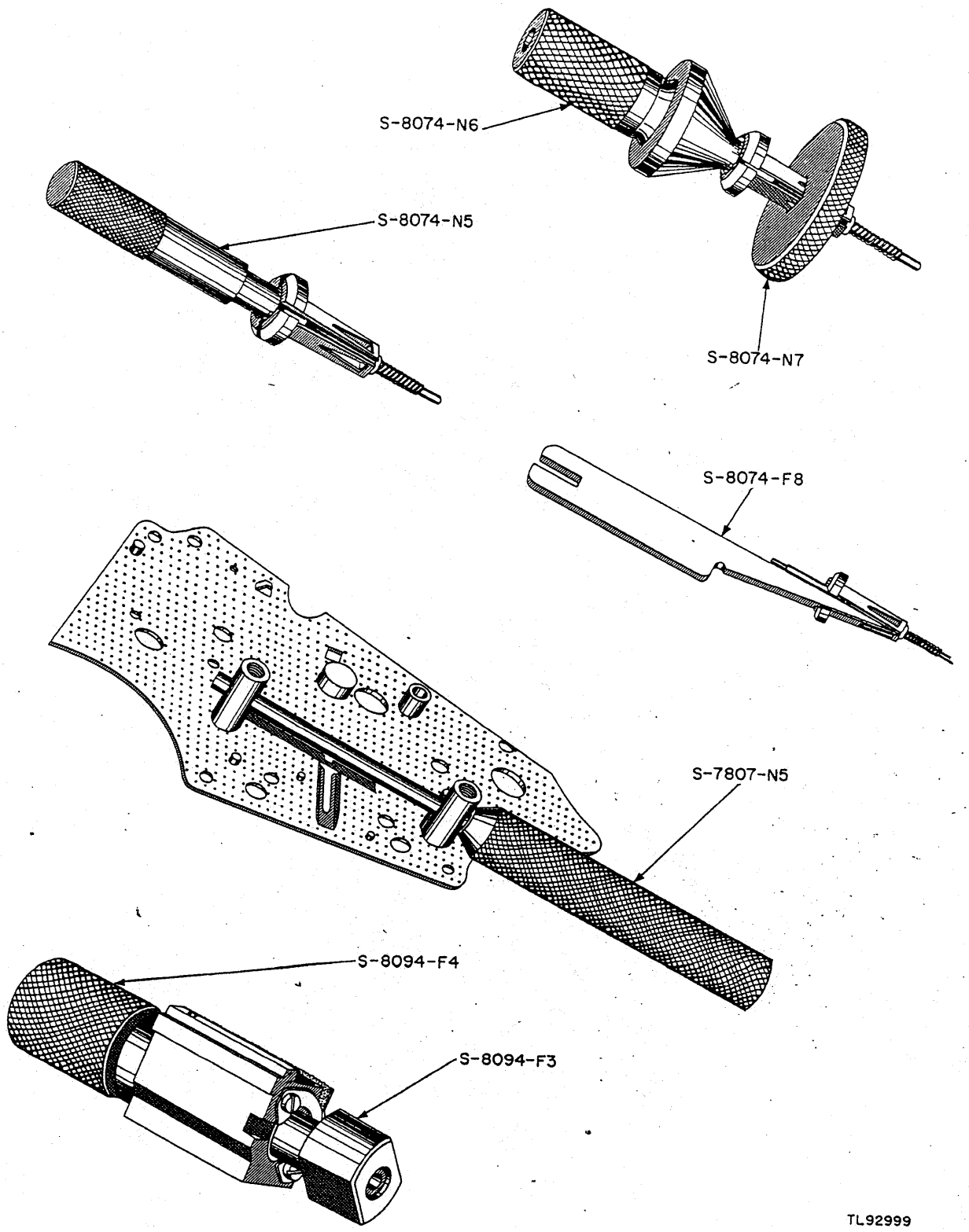


Figure 65. Governor adjusting tools, Camera PH-330-G.

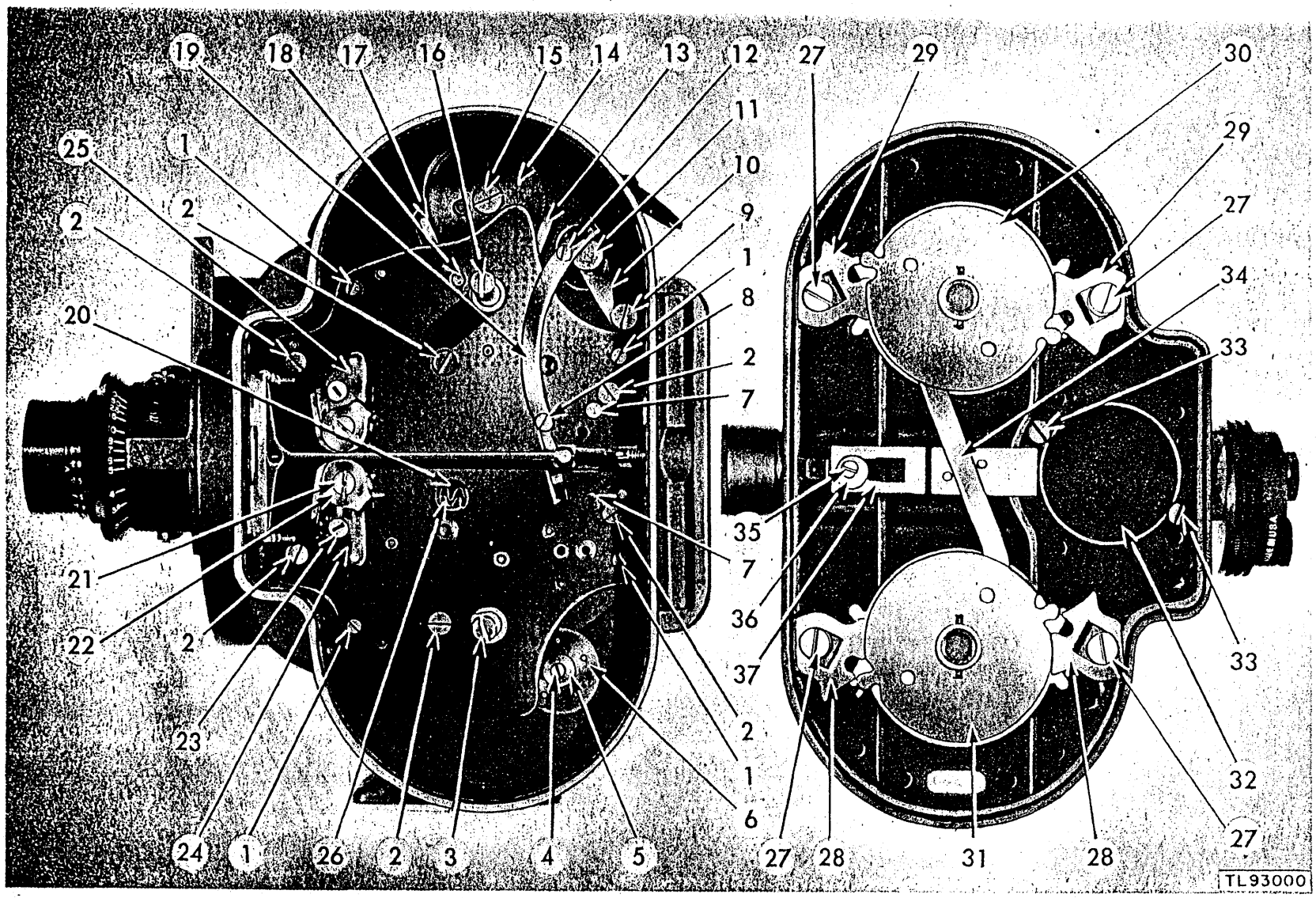


Figure 66. Camera and camera door, inside view, Camera PH-330-H.

(7) If the 0.008-inch "no go" gauge moves loosely at any one of the four points measured, bend the flange close to the back of the plate to make the correct adjustment.

(8) Correct adjustment of the film clearance is extremely important. The clearance must be equal over the area of the gate plate and should be gauged at each of the four points specified. Remove the pressure plate for adjustments and bend the flanges by tapping them lightly with a hammer.

CAUTION: Be careful not to mar or scratch the highly polished surface of the pressure plate in any way, since damage to the film emulsion will result.

c. Adjustment of Gate Arm Eccentric.

(1) The gate arm back lash adjustment eccentric (figs. 56 (7) and 66 (36)) prevents the opening of the gate while the camera is in operation and the door is in place. To check, open the gate about 1/8 inch, or less, replace the camera door, and turn the camera door latch to the CLOSED position. Remove the camera cover and press forward on the gate arm. If the gate arm can be moved forward, the eccentric requires adjustment.

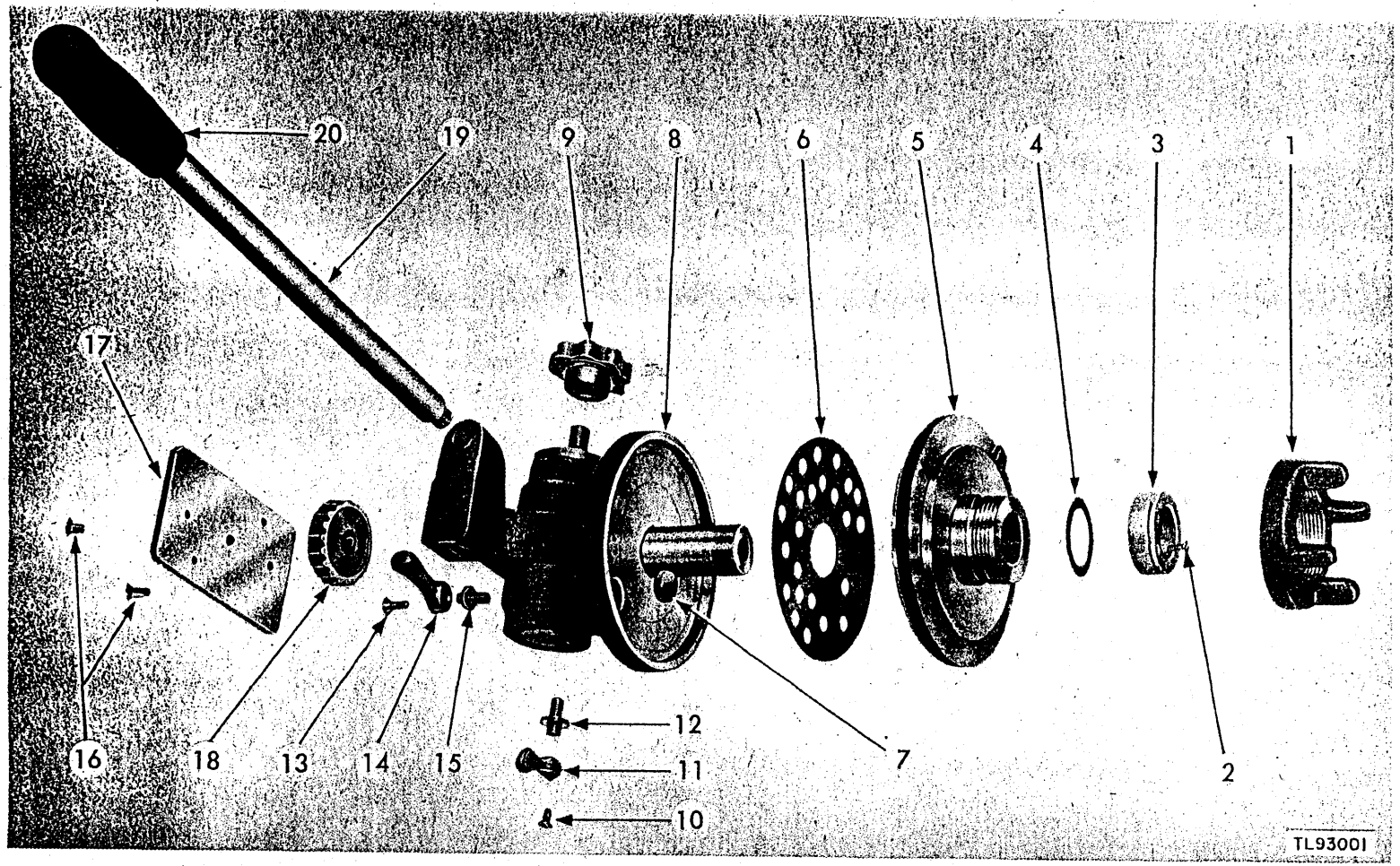
(2) To alter the adjustment, loosen the gate arm back lash adjustment eccentric screw (fig. 56 (8) and 65 (35)). Revolve the eccentric to bring the thicker side slightly toward the camera head. Tighten the screw.

(3) To check the adjustment, repeat the procedure described in subparagraph (1) above until the adjustment is satisfactory.

d. Adjustment of Buck Tooth (Idler Mechanism Stop) Gear.

(1) The adjustment of the buck tooth gear (fig. 48 (13)) is checked by a trial run of film footage. Wind the motor fully and set the footage dial at 0. Press the operating lever and run the camera until it stops. Check the footage

1. *Mechanism-plate-to-frame retaining screw (4) (8P10-902)*
2. *Front mechanism plate to rear mechanism plate retaining screw (6X8P10-920)*
3. *Take-up reel spindle (8P10-1018)*
4. *Magazine belt take-up pulley bearing stud retaining screw (8P10-924)*
5. *Magazine belt take-up pulley spacer washer (8P10-1292)*
6. *Magazine belt drive pulley pivot bearing (8P10-274)*
7. *Film guard hole light plug (2) (8P10-796)*
8. *Governor connecting link retaining screw (short) (8P10-909)*
9. *Governor speed control mount spring retaining screw (1) (8P10-923)*
10. *Speed control mount retaining spring (8P10-1096)*
11. *Governor control mounting (8P10-250)*
12. *Governor connecting link retaining screw (long) (1) (8P10-911)*
13. *Footage dial ratchet pull pawl (8P10-736)*
14. *Footage dial ratchet (8P10-850)*
15. *Footage dial retaining screw (1) (8P10-913)*
16. *Feed reel spindle (8P10-1006)*
17. *Footage dial ratchet lock pawl (8P10-730)*
18. *Feed reel spindle return adjustment screw (8P10-894)*
19. *Governor connecting link (8P10-171)*
20. *Main drive shaft stop gear (8P10-408)*
21. *Sprocket retaining oil screw (2) (8P10-913A)*
22. *Sprocket guard (2) (8P10-1175)*
23. *Sprocket guide shoe retaining screw (2) (8P10-906)*
24. *Sprocket guide shoe (lower) (8P10-1168)*
25. *Sprocket guide shoe (upper) (8P10-1169)*
26. *Idler mechanism stop gear (buck tooth) (8P10-405)*
27. *Camera door cam latch retaining screw (4) (8P10-913B)*
28. *Lower door latch (2) (8P10-292)*
29. *Upper door latch (2) (8P10-293)*
30. *Upper latch cam (1) (8P10-540)*
31. *Lower latch cam (1) (8P10-539)*
32. *Viewfinder drum hole cover (8P10-208)*
33. *Viewfinder drum hole cover retaining screw (2) (8P10-910)*
34. *Latch cam link (8P10-115)*
35. *Gate arm back lash adjustment eccentric retaining screw (1) (8P10-902)*
36. *Gate arm back lash adjustment eccentric (8P10-350)*
37. *Magazine valve lever push bar assembly (8P10-832)*



1. *Retaining nut thumbscrew*
2. *Adjusting nut lockscrew*
3. *Adjusting nut, knurled*
4. *Adjusting nut washer*
5. *Friction center piece*
6. *Friction plate, fiber*
7. *Pressure block*
8. *Head casting assembly*
9. *Vertical panning nut*
10. *Vertical pressure adjusting lever retaining screw*
11. *Pressure adjusting lever for vertical panning*
12. *Vertical pressure adjusting lever bushing*
13. *Horizontal panning pressure adjusting lever retaining screw*
14. *Horizontal panning pressure adjusting lever*
15. *Horizontal panning pressure adjusting lever bushing*
16. *Adapter plate retaining screws*
17. *Camera base adapter plate*
18. *Tripod and camera coupling knob screw assembly*
19. *Panning handle*
20. *Panning handle rubber grip*

Figure 67. Disassembly, tripod head, Tripod PH-520/U.

dial to determine the number of feet the camera has run.

(2) One full winding of the spring motor should permit a film run of 46 to 49 feet.

(3) To adjust the mechanism so that the camera will run for 46 to 49 feet on one complete winding, the position of the long buck tooth gear must be reset.

(4) The film run, as has been noted already, is stopped by the meshing of the long tooth of the gear with the shallow notching of the main drive shaft stop gear (fig. 51 (1)). A movement of one tooth of the drive gear in either direction shortens or lengthens the film run by 3 feet.

(5) To adjust for footage, press the buck tooth gear out of position. Wind the spring motor, tap the operating lever until the required number of teeth pass the buck tooth of the buck tooth gear. Release the gear.

(6) Wind and run the motor to capacity and check the footage. If further adjustment is required, repeat the operations described above.

e. Adjustment of Feed Spindle.

(1) The recoil of the feed spindle takes up whatever film slack occurs when the camera mechanism stops. The feed spool spindle return adjustment screw (fig. 47 (10)) joins the front and back mechanism plates and controls the amount of recoil. The adjustment of the screw tightens or separates the plates, varying the pressure of the spindle tension spring (fig. 47 (3)), and regulating the spindle recoil.

(2) With a special tool which engages the two holes in the return adjustment screw head (fig. 47 (10)), make the required adjustment. Turning the screw in a clockwise direction will increase the tension; turning in a counterclockwise direction will decrease the tension.

(3) Place an empty film spool on the feed spindle. To test for correct adjustment, release the spool. It should recoil one and a half turns.

(4) Repeat the operations described above as necessary.

f. Replacement and Calibration of Governor Speed Dial.

(1) Disassembly of the camera usually renders the original dial speed markings inaccurate. A new governor speed dial must be calibrated and installed on the camera.

(2) For determination of camera speeds, see paragraph 77a.

(3) After installing the governor speed dial (fig. 50 (41)), transfer the speed readings by notching the appropriate portion of the dial with a sharp tool, exactly opposite the index mark on the speed dial knob (fig. 50 (38)).

111. CAMERA PH-330-(*): FINAL TESTS.

a. Load the camera in a darkroom with a short length (4 to 6 feet) of negative film.

b. With the camera on a tripod, photograph a building or some other stationary object out of doors.

c. Process the film and examine it for scratches, sharpness of image, and fogging. Check with the trouble chart (par. 75) for probable cause and remedies.

d. Run a 100-foot test roll of film through the camera several times to make sure that the camera is functioning properly. The film running test should be made at different camera running speeds and with the camera door in place. Simulate actual operating conditions by starting and stopping the camera occasionally, manipulating the turret, and otherwise checking each of its functions.

112. UNSATISFACTORY EQUIPMENT REPORT.

a. When trouble in equipment used by Army Ground Forces or Army Service Forces occurs more often than repair presonnel feel is normal, War Department Unsatisfactory Equipment Report, W.D., A.G.O. Form No. 468 should be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D. C.

b. When trouble in equipment used by Army Air Forces occurs more often than repair personnel feel is normal, Army Air Forces Form No. 54 should be filled out and forwarded through channels.

c. If either form is not available, Form No. 468 (fig. 68) may be reproduced, filled out, and forwarded through channels. When Army Air Forces Form No. 54 is required but unavailable, reproduce Form No. 468 and forward it through channels in accordance with directions on Form No. 468.