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DEPARTMENT OF THE ARMY TECHNICAL MANUAL



STILL PICTURE  
CAMERA SET  
KS-4A (1)



DEPARTMENT OF THE ARMY • NOVEMBER 1954



**STILL PICTURE CAMERA SET KS-4A (1)**

	<i>Paragraph</i>	<i>Page</i>
<b>CHAPTER 1. INTRODUCTION</b>		
Section I. General.....	1, 2	3
II. Description and data.....	3-16	3-23
<b>CHAPTER 2. INSTALLATION</b> .....	17-19	24-25
<b>3. OPERATION</b>		
Section I. Controls.....	20-22	26-29
II. Operation under usual conditions.....	23-42	29-51
III. Operation under unusual conditions.....	43-45	51-53
<b>CHAPTER 4. ORGANIZATIONAL MAINTENANCE</b>		
Section I. Organizational tools and equipment.....	46, 47	54
II. Preventive maintenance services.....	48-50	54-58
III. Lubrication.....	51, 52	58
IV. Weatherproofing.....	53, 54	58-60
V. Troubleshooting at organizational maintenance level.....	55-58	60-64
<b>CHAPTER 5. AUXILIARY EQUIPMENT</b> .....	59, 60	65-66
<b>6. THEORY</b>		
Section I. Theory of between-the-lens shutter.....	61-66	67-81
II. Theory of focal plane shutter.....	67-70	81-87
III. Theory of range finder.....	71, 72	87-90
IV. Theory of optical view finder.....	73, 74	90-91
V. Theory of flash-lamp flasher.....	75-77	92-96
<b>CHAPTER 7. FIELD MAINTENANCE</b>		
Section I. Inspecting, stripping, and cleaning.....	78-80	97
II. Troubleshooting at field maintenance level.....	81-85	97-105
III. Repairs.....	86-101	105-183
IV. Final testing.....	102, 103	183-184
<b>CHAPTER 8. SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE.</b>	104-106	185-186
<b>INDEX</b> .....		187-191

The camera, equipped with an  $f/4.5$  lens, accepts a film holder or a film pack adapter for 4- by 5-inch film. The camera incorporates a focal plane shutter and a between-the-lens shutter; a rising, shifting, and tilting front; and a drop bed and double extension bellows. In addition to a focusing scale, the camera has a ground glass focusing screen, open frame optical view finders, and a range finder. Refer to paragraph 6 for a full description of the camera.

b. *Flash-Lamp Flasher and Connecting Cables* (fig. 10). The flash-lamp flasher can be mounted on the camera and connected to it by means of the shutter connecting cable and the solenoid tripper cable. The batteries that supply the power to fire the flash lamp are contained in the flash-lamp flasher.

c. *Tripod LM-15(1)*. Tripod LM-15(1) (fig. 14), supplied with this equipment, is equipped with a panhead and has a maximum height of 52 inches. Refer to paragraph 12 for full description.

d. *Reflector Assemblies and Bayonet Lamp Adapter* (fig. 10). Two reflector assemblies are supplied, one 5-inch and one 7-inch reflector assembly which can be used interchangeably with the flash-lamp flasher or with the extension lamp holder. The 5-inch reflector accepts bayonet base flash lamps and the 7-inch reflector is used for standard base flash lamps. The bayonet lamp adapter is provided to permit use of bayonet base flash lamps with the 7-inch reflector. Refer to paragraph 7c(1) and (2) for a full description of these items.

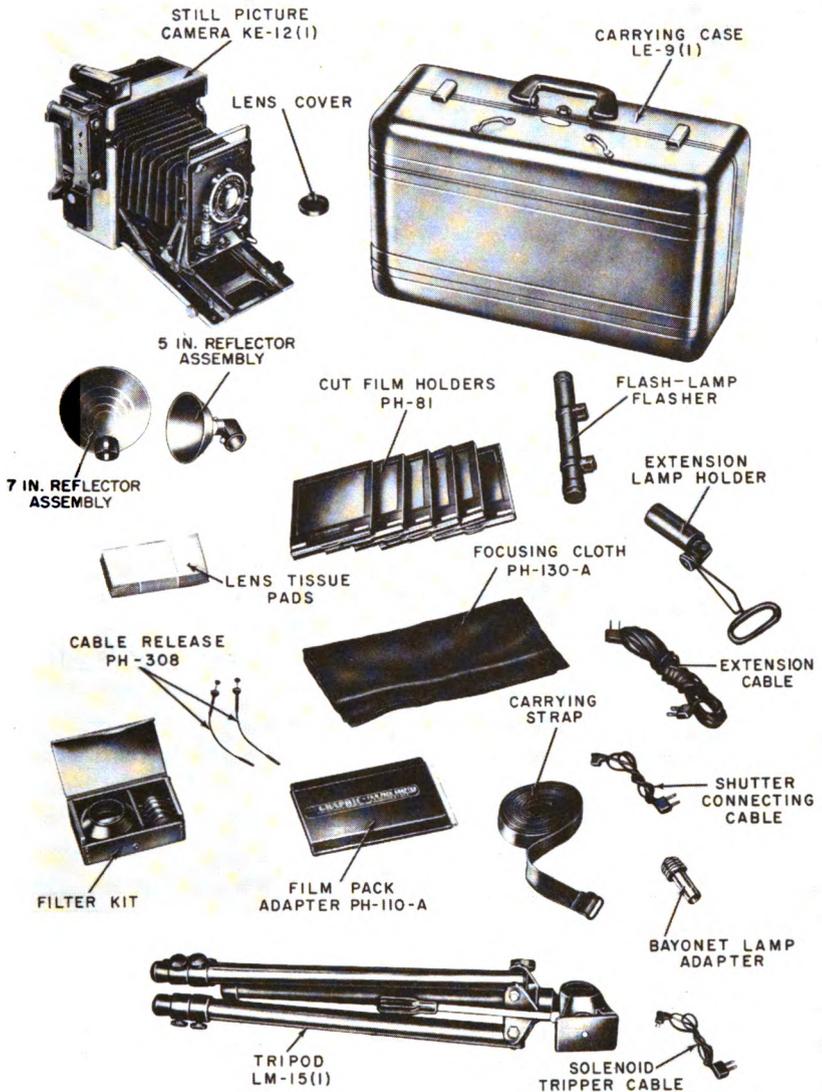
e. *Filter Kit* (fig. 11). The filter kit contains five filters and a lens shade. Refer to paragraph 9 for a full description of the equipment supplied in the filter kit.

f. *Extension Lamp Holder and Extension Cable* (fig. 10). The extension lamp holder, used for an additional flash lamp, consists of a lamp socket mounted on a spring clip by means of a universal joint. The extension lamp holder can be connected to the flash-lamp flasher through the 15-foot extension cable.

g. *Film Pack Adapter PH-110-A and Cut Film Holder PH-81* (figs. 12 and 13). The film pack adapter holds a 12-sheet, 4- by 5-inch film pack. Each of the six film holders accepts two sheets of 4- by 5-inch film.

h. *Cable Release PH-308* (fig. 2). The cable release supplied with the equipment can be attached to the cable release socket on the camera shutter and used for time exposures.

i. *Miscellaneous Components* (fig. 2). Carrying Case LE-9 (1) houses all the components shown in figure 2. The carrying strap, supplied with the equipment, permits a man to carry the packed carrying case on his back. Focusing Cloth PH-130-A can be used for viewing the ground glass focusing screen. Six pads of lens tissues are supplied for cleaning the camera lenses.



TM2352B-2

Figure 2. Still picture camera set KS-4A(1), components.

#### 4. Table of Components

The component parts of Still Picture Camera Set KS-4A(1) are listed in the chart below. Refer to figure 2 for an illustration of these parts.

Quantity	Component	Dimensions (in.)			Volume (cu. in.)	Weight (lb.)
		Height	Depth	Length		
1	Still Picture Camera KE-12 (1)	8.5	4.6	8.25	322.58	6.25
1	Flash-lamp flasher	11.0	(dia) 1.5	---	24.75	.625
1	Tripod LM-15 (1)	17.5	5.0	4.25	371.87	4.125
1	Reflector assembly, 7-inch	(dia) 7.38	---	4.1	223.32	.5
1	Reflector assembly, 5-inch	(dia) 5.38	---	5.1	147.62	.44
1	Filter kit	2.0	2.0	4.75	19.0	.625
1	Extension lamp holder	3.63	2.4	6.75	58.80	.5
1	Film Pack Adapter PH-110-A	7.25	.75	4.75	25.83	.90
6	Cut Film Holder PH-81	7.25	.63	4.75	21.70	.375
1	Bayonet lamp adapter	(dia) 1.1	---	2.5	3.03	.06
2	Cable Release PH-308	---	---	7.0	---	.03
1	Shutter connecting cable	---	---	20.0	---	.06
1	Solenoid tripper cable	---	---	20.0	---	.06
1	Extension cable	---	---	180.0	---	.354
1	Focusing Cloth PH-130-A	---	---	48.0	---	.375
6	Lens tissue pads	.1	3.1	5.0	---	.05
1	Carrying Case LE-9 (1)	14.0	8.25	21.0	---	10.56
1	Carrying strap	---	---	145.0	---	.25
1	Lens cover	(dia) 1.75	---	.44	---	.07

## 5. Common Names of Components

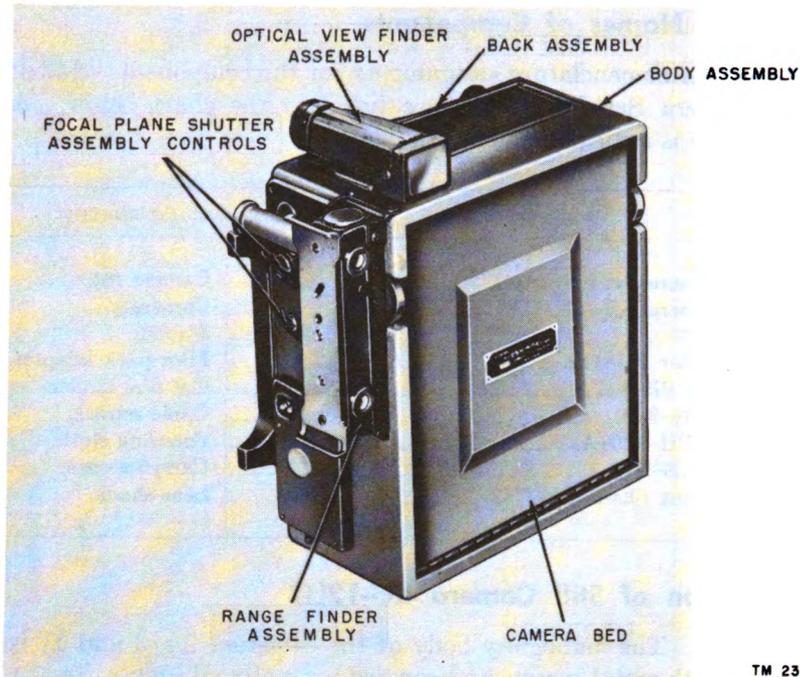
A list of the nomenclature assignments for the components of Still Picture Camera Set KS-4A(1) are listed in the chart below. A common name is indicated after each item.

Nomenclature	Common name
Still Picture Camera Set KS-4A(1)-----	Camera set.
Still Picture Camera KE-12(1)-----	Camera.
Tripod LM-15 (1)-----	Tripod.
Film Pack Adapter PH-110-A-----	Film pack adapter.
Cut Film Holder PH-81-----	Cut film holder.
Cable Release PH-308-----	Cable release.
Focusing Cloth PH-130-A-----	Focusing cloth.
Carrying Case LE-9 (1)-----	Carrying case.
Photographic Lens Shade LE-7 (1)-----	Lens shade.

## 6. Description of Still Camera KE-12(1)

*a. General.* The mahogany body of the camera (figs. 3 and 4) is reinforced with metal inserts and covered with olive-drab plastic. A lens and shutter assembly is mounted on the front of the body. A bed and carriage assembly is hinged to the bottom front of the body, and a front assembly, positioned within the body when the bed is closed, rides on the bed when the camera is set up for operation. A bellows assembly is attached to the front assembly and to an inner body frame. A focal plane shutter is inclosed within the body at the rear, with its controls located on the right of the body, together with a coupled range finder. An optical view finder is mounted on the top; a black assembly is attached to the rear of the body. An open frame view finder assembly consists of two sights—the front sight, mounted above the front assembly, and the peep sight, mounted on the back assembly (fig. 9). A lens cover is supplied to protect the lens when the camera is not in use.

*b. Body Assembly* (fig. 3). The mahogany body is reinforced with metal inserts and covered with olive-drab plastic. The focal plane shutter mechanism is located inside the camera body at the rear. The controls of this shutter are located on the outside right. The back assembly, which holds the film-holding accessories, is mounted on the rear of the body assembly. The nylon carrying strap (fig. 4) is attached to the left side of the body assembly with two metal harness loops. The brace plates, mounted inside the body assembly at the front, serve as guides and supports for the bed braces. The optical view finder is mounted on the top right and the range finder on the right side of the body. A steel bracket (fig. 5) mounted on the range finder housing holds the battery case of the flash-lamp flasher. One



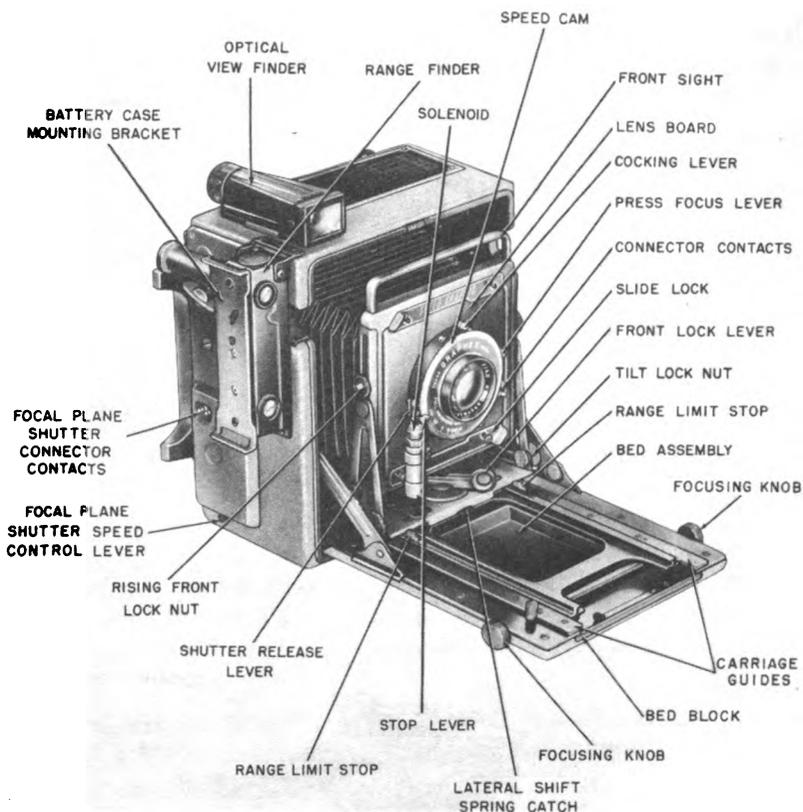
TM 2352B-3

Figure 7. Lens and shutter assembly, front view.

threaded tripod socket is located on the left side of the body (fig. 4) and a second socket is located on the bottom of the body.

c. *Lens and Shutter Assembly* (fig. 7). The camera is fitted with a 127-millimeter (mm),  $f/4.5$  anastigmatic coated Optar lens. It covers an angular field of approximately  $53^\circ$  on the long side (5 in.) of the negative and is mounted in a No. 2 Graphex synchronized shutter with an iris diaphragm that may be stopped down to  $f/32$  by means of the stop lever. The light-restricting parts of the shutter mechanism consist essentially of five blades lying between the front and rear elements of the lens. The shutter is a rim-set type which provides nine speeds from 1 to  $1/400$  second, plus *bulb* (B) and *time* (T). The shutter assembly includes a blade arrester, operated by the press-focus lever, which opens the shutter for focusing. This arrangement eliminates the necessity of resetting from a selected shutter speed to *bulb* or *time* for ground-glass focusing. Two connector contacts extend from the side of the shutter. These contacts can be connected to either a flash-lamp flasher mounted on the camera, or to an electronic flash unit triggered by electronic flashing means. A synchronization-adjusting lever at the bottom of the shutter assembly can be moved over a four-position scale to adjust the delay time of the synchronizing mechanism to meet the requirements of three different types of flash lamps. In the fourth, or OFF position, the synchro-



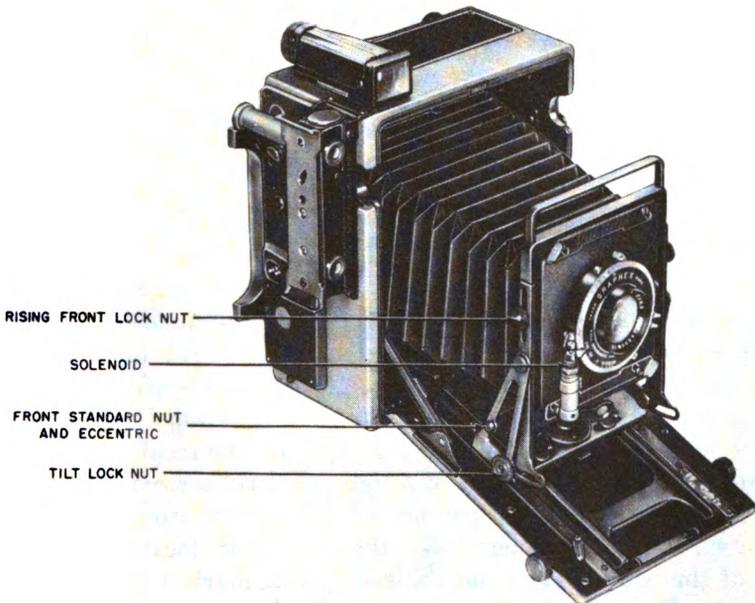


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*Figure 5. Camera, right front view.*

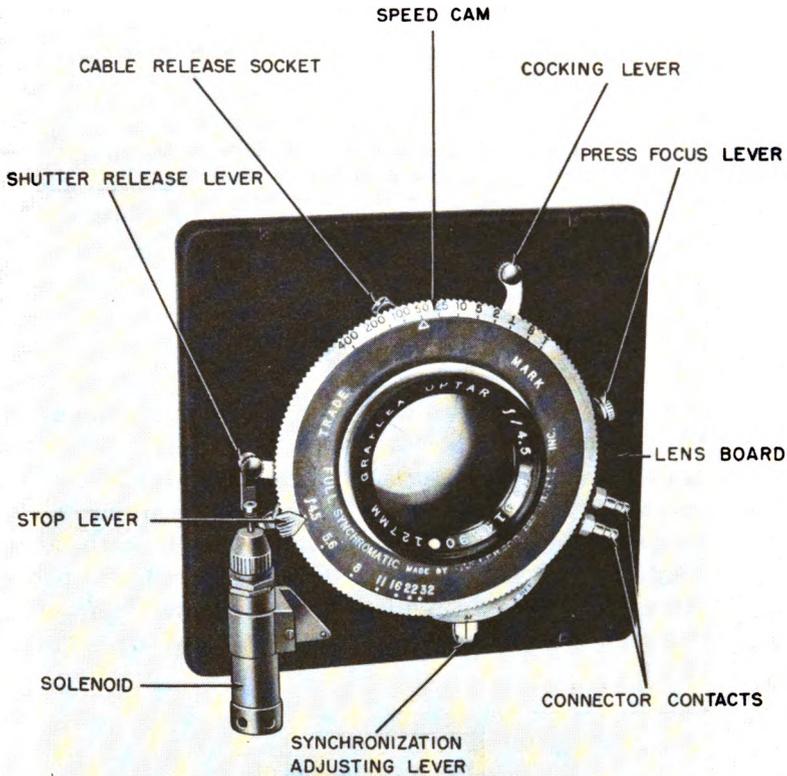
bly are controlled by a helical focusing pinion assembly operating on a rack actuated by two focusing knobs, one on each end of the bed. The semivernier focusing scale, calibrated in feet to indicate the distance from the subject to the focal plane when the subject is in focus, consists of two parts. One part is mounted on the carriage guide and the other on the bed block. Two folding range limit stops on the bed carriage hold the camera front at the correct position on the sliding carriage so that the position of the lens corresponds to the indication on the calibrated focusing scale (infinity or any distance marked on the scale). A carriage lock lever, when in its locked position, supplies enough friction to prevent the sliding carriage from slipping. The bed may be dropped below its normal position when using a wide-angle lens, or for corrective photographic adjustment of the lens. When dropped, the bed locks rigidly in position. This prevents accidental change of its position.

*e. Front Assembly* (figs. 4 and 5). The front assembly consists of a metal lens board, a metal front standard, and a front sight. The lens and shutter assembly is mounted on the lens board, which also mounts the solenoid. The lens board itself is attached to the lens board frame of the standard by two lock plates. The front sight of the open-frame view finder is in the lens board frame. The sight can be raised from the frame when needed and collapsed into the frame when not in use. This sight is used with the back peep sight to permit full-size observation of a scene of moving objects. Two knurled, rising front locknuts, used to hold the lens board frame at the desired height in the standard, are located on the sides of the standard. The lens is centered in relation to the film only when these locknuts are at the bottom of their slots. Two tilt locknuts, used to hold the lens board at the desired inclination from vertical, are on the sides of the standard. The lens is parallel to the film plane only when the tilt locknuts are at the front of their slots. The standard is locked at any desired position on the carriage (*d* above) by the front lock lever located at the base of the standard. Thus, movement of the sliding carriage moves the front standard. Directly beneath the lock lever is the lateral shift spring catch. This spring, when depressed, allows the lens board to be shifted laterally only when the front lock lever is in its unlocked position (lever straight forward). The lens



TM2352B-6

*Figure 6. Camera, right front view, bed in dropped position, bellows extended.*



TM2352B-7

Figure 7. Lens and shutter assembly, front view.

is centered in relation to the film only when the lateral shift spring catch is in the center slot in the base of the standard.

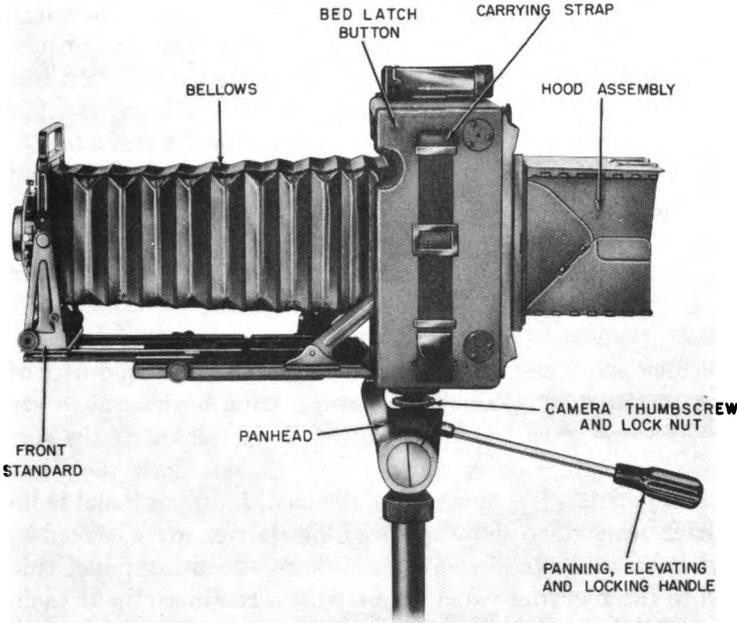
*f. Bellows Assembly* (fig. 8). The bellows is made of accordion-pleated fabric and forms a collapsible, lighttight connection between the film and the lens. It extends a maximum of 12 inches and contracts as the camera front is moved in and out for focusing. The front frame of the bellows is screwed to the lens board frame. The rear frame of the bellows is crimped to the body frame.

*g. Focal Plane Shutter Assembly* (fig. 9). The focal plane shutter, affording fast speed, consists of a lightproof rubberized cloth curtain having four rectangular openings of different widths. The shutter is housed within the camera body; the controls are located on the right side of the body. The synchronized speeds, marked in black on the indicator dial, are 1,000, 500, 250, and T (time). These three speeds are synchronized for use with standard fast peak focal plane (FP)

type flash lamps. The unsynchronized shutter speeds (marked in red) are 125, 50, 30, and O (open). Note that both sets of markings on the indicator dial are shutter speeds in terms of fractional parts of a second. The shutter speed is set by turning the shutter winding key and positioning the speed control level until the desired shutter speed appears on the focal plane shutter speed setting indicator. The exposure time is governed by the width of the curtain opening and the speed at which it travels. The focal plane shutter release lever is used for operating the focal plane shutter.

*h. Range Finder Assembly (fig. 9).* The camera is equipped with a superimposition-type range finder. The range finder extension eyepiece is located at the upper right corner of the camera body. The range finder is a mechanical-optical indicator for focusing the camera lens at any distance from infinity to 6 feet. It may be used in place of the ground-glass focusing screen in cases where fast, accurate focusing is required. A system of a fixed mirror, movable prism, cams, and levers actuated by the movement of the camera carriage, indicates correct focus by superimposed images, and out-of-focus by nonsuperimposed images.

*i. Optical View Finder Assembly (fig. 9).* The optical view finder slides into a shoe attached to the top of the camera body. The view



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**Figure 8.** Camera on tripod, left side view, bellows extended to maximum, hood assembly open.

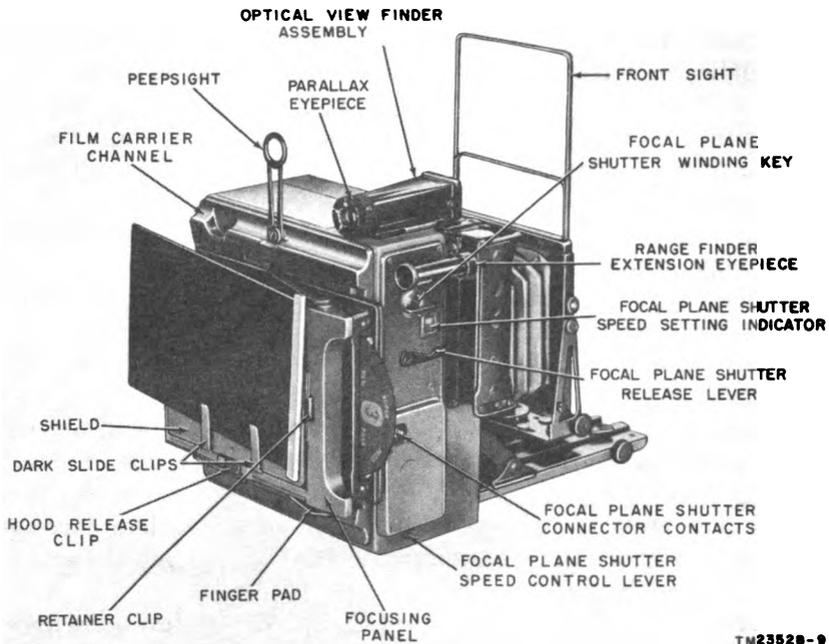


Figure 9. Camera, rear view, film pack adapter in position, dark slide removed.

finder may be removed by pressing a tab at the inside front edge of the shoe and sliding the view finder forward. When removed, it can be used as a hand viewer to aid in selecting the best camera position. The maximum field of view, as seen through the view finder, is determined by the size of the aperture of the finder. This aperture, in turn, is established by a removable mask mounted on the front lens of the view finder. The mask size corresponds with the angular field of the lens used. The mask supplied matches the lens fitted to this camera. Parallax error is corrected by a scaled, rotatable, eccentric eyepiece which has four calibrations marked on it for camera-to-subject distances of 6 feet, 8 feet, 15 feet, and infinity.

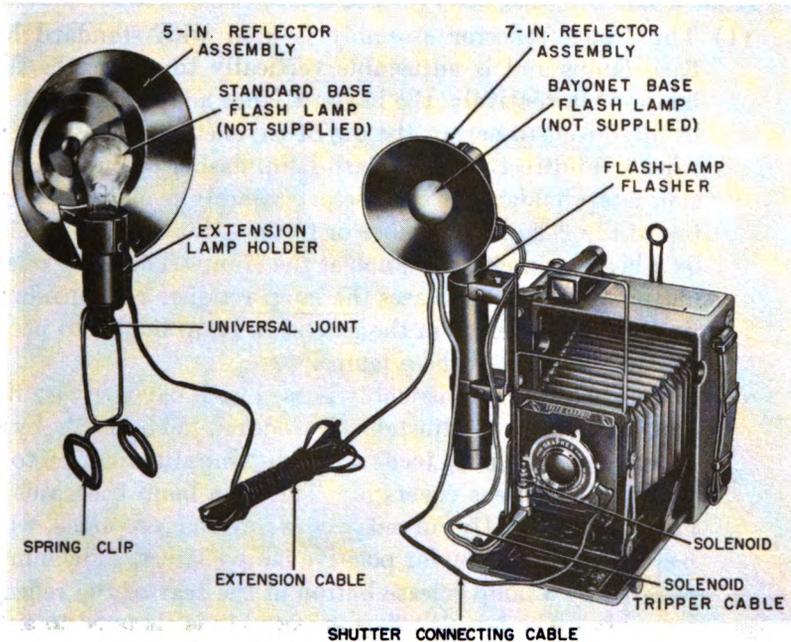
*j. Back Assembly* (fig. 9). The back assembly has a die-cast back frame which is screwed to the camera body. At the top center of this frame is a peep sight that may be swung from horizontal to vertical position for use with the front sight. Lock plates at the top and bottom of the film-carrier channel are used to lock the film-pack adapter in position. A removable, die-cast, focusing panel is hooked to the back frame by counterbalanced knee-action arms backed by coil springs. An all-metal, removable, folding, focusing-panel shield is clipped to the focusing-panel frame with a retainer clip at each side. The shield is four-sided and self-erecting. At the lower edges of the shield are two dark-slide retaining clips.

*k. Open Frame View Finder Assembly* (fig. 9). The open frame view finder consists of a pivoted rear peep sight, mounted on the top of the camera back, and an open metal frame front sight which telescopes into the lens board frame. In use, the rear peep sight is raised to a vertical position, and the front sight is pulled up and out of its housing in the lens board frame. The exact extent to which the front sight should be pulled out is governed by a footage scale stamped on one leg of the sight. This scale corrects parallax error. The open frame view finder is especially desirable when taking pictures of fast moving objects which would be difficult to follow and compose in the optical view finder.

## 7. Description of Flash Equipment (fig. 10)

The flash equipment consists of the flash-lamp flasher, an extension lamp holder, two reflector assemblies, and connecting cables.

*a. Flash-Lamp Flasher* (fig. 10). The flash-lamp flasher is basically a battery case that holds three Batteries BA-30, BA-202/UF, or equivalent, to supply current to fire the flash lamps and to operate the solenoid on the camera. The upper part of the flash-lamp flasher can support either the 5-inch or the 7-inch reflector assembly. Five standard female outlets, labeled EXTENSION, SHUTTER, BATTERY, SOLENOID, and REMOTE, are provided on the upper part of the



TM2352B-10

Figure 10. Flash equipment, connected and mounted on camera.

flash-lamp flasher. The EXTENSION outlet connects to the extension lamp holder through the 15-foot extension cable; the SHUTTER outlet connects to the camera shutter through the 20-inch long shutter connecting cable, and the SOLENOID outlet connects to the camera solenoid through the 20-inch long solenoid tripper cable. The BATTERY outlet is provided to permit connection to additional batteries, if desired. The REMOTE outlet may be used for connecting the flash-lamp flasher to an external switch or to another flash-lamp flasher. A three-position circuit selector switch on the flash-lamp flasher can be set for simultaneous operation of the camera shutter and flash lamp at either the shutter or at the flash-lamp flasher. The lamp firing switch, located directly below the circuit selector switch, is recessed to prevent accidental contact.

*b. Extension Lamp Holder (fig. 10).* The extension lamp holder is used as an auxiliary flash-lamp accessory, powered by the batteries in the flash-lamp flasher through a 15-foot extension cable. The extension lamp holder is provided for use in cases where the area to be photographed is large enough to require supplementary lighting. Either the 5-inch or the 7-inch reflector assembly can be used with this unit. The spring clip with rubber-covered jaws can be attached to convenient objects. The universal joint at the neck permits the unit to be adjusted to any angle desired.

*c. Reflectors.* Both the 7-inch and the 5-inch reflector assemblies can be used with the flash-lamp flasher and the extension lamp holder.

- (1) The 7-inch reflector assembly is used with standard base flash lamps and is adjustable vertically to center the flash lamp. Alternatively, the bayonet lamp adapter (fig. 2) can be fitted to it to permit the use of bayonet base lamps, either when used directly on the flash-lamp flasher or on the extension lamp holder. The reflector assembly is clamped to the top of the flash-lamp flasher or to the extension lamp holder by a head locking screw knob at the front. The lamp release button at the back releases the lamp retainer ring inside the flash-lamp flasher or in the extension lamp holder to permit ejection of standard base lamps.
- (2) The 5-inch reflector assembly is used with bayonet base flash lamps only. It is adjustable and locked horizontally by the reflector clamp nut to focus the flash-lamp illumination to approximate the lens coverage. The flash-lamp base pins are guided by a slightly curved groove into the receptacle, which has a spiked plunger for positive lamp contact. The lamp is released by a lamp release button at the rear of the reflector assembly. The 5-inch reflector assembly is clamped to either the flash-lamp flasher or to the extension lamp holder in the same manner as the 7-inch reflector ((1) above).

## 8. Description of Cable Release PH-308

(fig. 2)

Cable Release PH-308 consists of a spring cable encased in a 7-inch long flexible metal tube. One end is equipped with a plunger and the other end has a threaded tip which screws into the cable release socket of the shutter. The cable release permits the operation of the shutter without risk of camera movement when the camera is mounted on a tripod. It is especially useful for time and bulb exposures.

## 9. Filter Kit

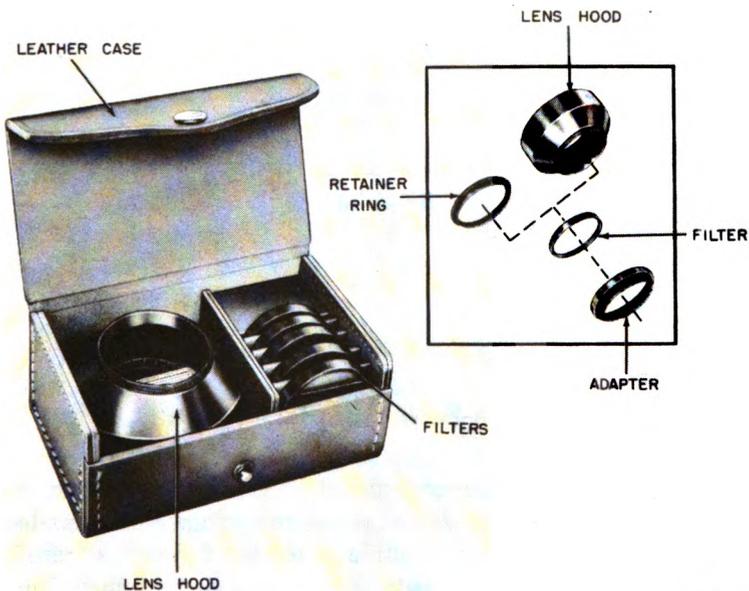
(fig. 11)

The filter kit consists of a leather case containing five filters and a lens hood assembly. The following Wratten series VI filters are included: K2 yellow, XI green, G orange, A red, and No. 1 haze. The lens hood assembly consists of a lens hood, retainer ring, and an adapter ring. The adapter ring is used to mount the lens hood or the retainer ring or both to the lens assembly. When a filter is required, either the retainer ring or the lens hood may be used to position the filter in the adapter ring.

## 10. Description of Cut Film Holder

(fig. 12)

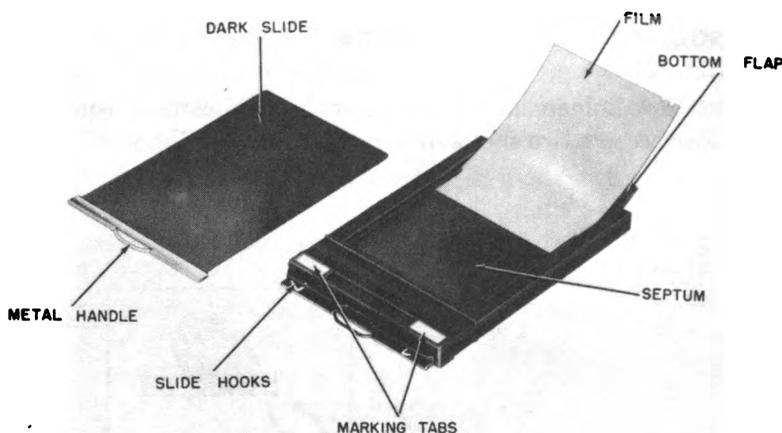
Six cut film holders are supplied with each camera equipment. Each holder accepts two sheets of 4- by 5-inch sheet film and is loaded



TM2352B-II

Figure 11. Filter kit.

at the bottom end after the dark slide has been withdrawn and the bottom hinged flap rail has been swung out. The two dark slides each have a metal-reinforced top and handle that is black on one side to indicate exposed film and silver on the other side to indicate unexposed film. The silver side also has raised dots to aid identification by touch while loading in a darkroom. Brass slide hooks prevent accidental removal of the dark slides, which slide through a light trap fitted with cloth-covered, multiple-spring fingers. There is a solid metal plate between the two septums which hold the two sheets of film. The outside edges of the film holders are ribbed, the ribbing acting as a light baffle when the holder is fitted into the camera back. Two white marking tabs are provided on each side of the film holder. Picture identification data may be written on these tabs in pencil, and subsequently erased. For further identification, a clear acetate-type tab  $\frac{3}{8}$ -inch square may be cemented into a space provided in the bottom flap. One-eighth of an inch of this tab then will project up so that a unit number or film number written or printed on it in ink will photograph on the negative.



TM2352B-12

*Figure 12. Cut film holder.*

## 11. Description of Film-Pack Adapter

(fig. 13)

The film-pack adapter is constructed of aluminum die-cast frames with a hinged metal cover. It has pressure springs and a self-locking spring cover catch. The dark slide is made of formica, reinforced with a metal handle. The adapter accepts one 4- by 5-inch film pack containing 12 sheets of film.

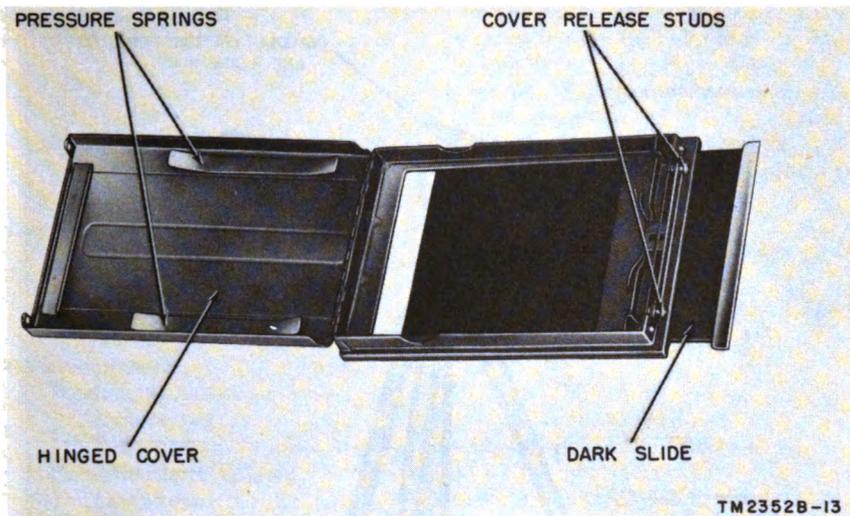


Figure 13. Film-pack adapter.

## 12. Description of Tripod

(fig. 14)

The tripod is constructed of aluminum and is painted olive drab. It consists essentially of a panhead with standard camera-mounting, knurled thumbscrew and locknut, pan handle, and a central support column. This column can be raised or lowered in a fitting to which are attached the three legs. Each leg telescopes in three sections and is equipped with a rubber foot. Knurled thumbscrews afford positive locking of each telescoping leg section and central support column. The pan handle allows positive locking of the panhead. The maximum height of the tripod is 52 inches.

## 13. Description of Focusing Cloth

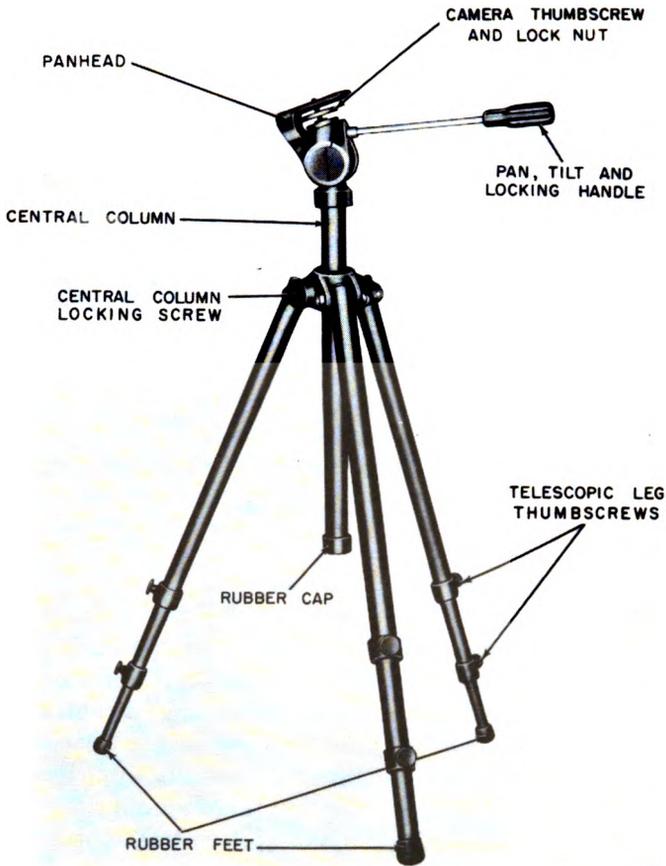
(fig. 2)

A black, lightproof focusing cloth, 45 inches square, is supplied with the equipment. The cloth is draped over the rear of the camera and the operator's head to exclude external light while focusing an image on the ground-glass screen.

## 14. Description of Carrying Case

(fig. 2)

The carrying case is constructed of reinforced aluminum, finished in olive drab, with a carrying handle on one side. There is a rubber gasket around the edge of the lid. The case is equipped with two snap-lock latches, a metal lock, and a series of metal strap harness loops through which a carrying strap may be threaded (fig. 25) so that the equipment may be carried as a back pack (fig. 26). The



TM2352B-14

Figure 14. Tripod.

felt-lined compartments inside the case, and the space inside the lid, provide storage room to accommodate all the other components of the camera set.

## 15. Technical Characteristics

Camera :

Type ----- Still, press type.  
 Film type ----- 4- by 5-inch sheet film or film pack.

Lens :

Characteristics ----- 127 mm,  $f/4.5$ , anastigmatic, antireflection coated.  
 Diaphragm openings ----- Click stop adjustment :  $f/4.5$ ,  $f/5.6$ ,  $f/8$ ,  $f/11$ ,  $f/16$ ,  $f/22$ ,  $f/32$ .

Focal range :

Normal ----- 5 to 100 feet, and infinity, lens-to-subject distance.  
 Using double extension bellows. ----- 9 inches minimum lens-to-subject distance.

**Between-the-lens shutter :**

Type-----	Synchronized, adjustable to M, X, or F lamp types. Hand- or solenoid-operated. Synchronizer equipped with OFF position.
Speed settings-----	Time (T), bulb (B), 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, 1/200, and 1/400 sec.

**Focal plane shutter :**

Type-----	Synchronized at 1/250, 1/500, and 1/1000 sec.
Speed settings-----	1/30, 1/50, 1/125, 1/250, 1/500, 1/1000 sec and time (T).

**Flash equipment :**

**Flash-lamp flasher :**

Lamp types-----	Accepts standard flash lamps.
Reflectors-----	Accepts 5- or 7-inch reflectors.

**Extension lamp holder :**

Lamp types-----	Accepts standard flash lamps.
Reflectors-----	Accepts 5- or 7-inch reflector assembly.

Filter kit-----	Lens hood, adapter retainer, and five Wratten filters (X1 green, K2 yellow, G orange, A red, No. 1 haze).
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Tripod-----	Standard, adjustable, with pan and tilt control.
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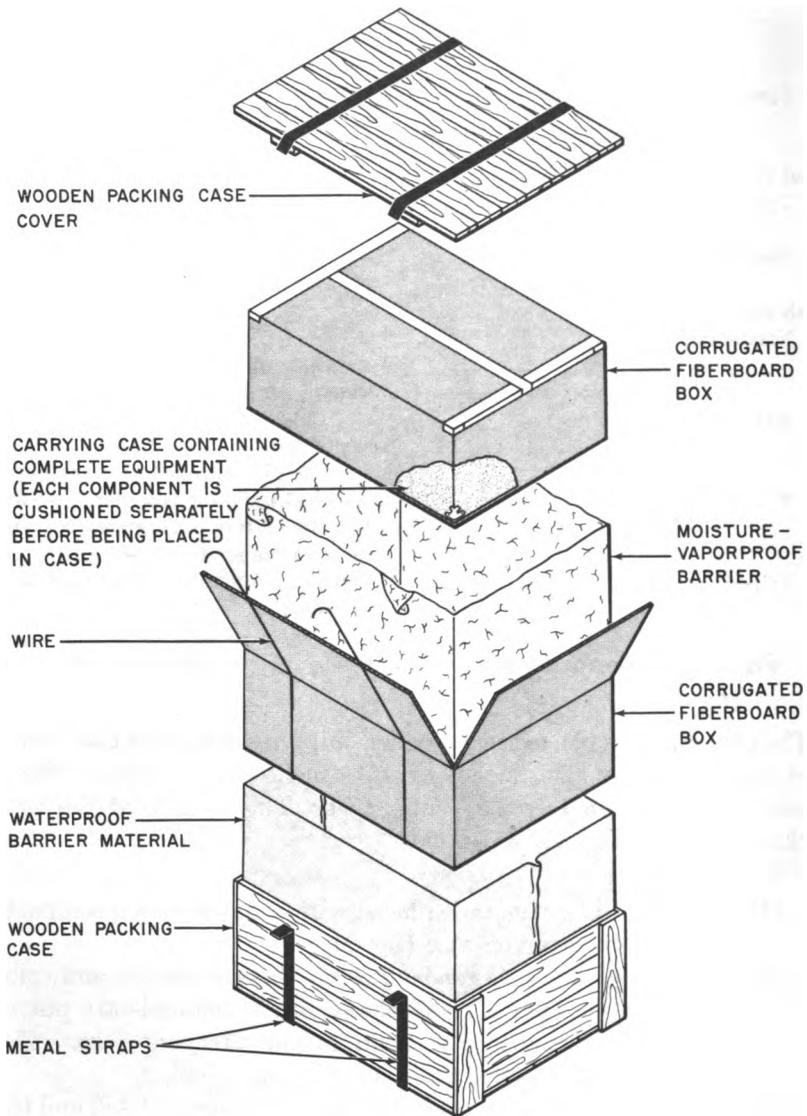
**16. Packaging and Packing Data**

(fig. 15)

The camera set is packed in a wooden shipping container that measures approximately 22<sup>5</sup>/<sub>8</sub> inches by 16<sup>1</sup>/<sub>2</sub> inches by 11 inches with a volume of approximately 2.34 cubic feet. The weight of the unit package is approximately 35 pounds.

*a. Export Shipment.*

- (1) *Camera.* The camera is placed within the designed compartment of the carrying case (fig. 24).
- (2) *Accessories and component parts.* The accessories and component parts (par. 4) and the technical manuals are put in the places designed for them in the carrying case. The tripod is disassembled (par. 18a) before packing.
- (3) *Packaging carrying case.* The carrying case is closed and the fastenings are secured. The case is cushioned on all surfaces with pads fabricated of corrugated fiberboard to absorb the shock of impact normally encountered in handling and transit. The case then is placed within a close-fitting, corrugated fiberboard box, and all closures are sealed with gummed Kraft tape. The boxed camera equipment then is placed within a moisture-vaporproof barrier. The camera equipment then is placed within a second close-fitting corrugated fiberboard box; the box is bound with wire.



**NOTES :**

1. ALL VOIDS ARE FILLED WITH CORRUGATED FIBERBOARD OR NEUTRAL CELLULOSE PADS
2. ALL COMPONENTS AND ACCESSORIES ARE CUSHIONED WITH CELLULOSE PADS.

TM2352B-15

*Figure 15. Typical export packing diagram.*

(4) *Packing camera set.* The camera set, packaged as described in (3), above, then is placed within a wooden packing case. The case is fabricated to fit the contents snugly. The wooden case is lined with waterproof barrier material. All joints are sealed with adhesive in such a manner as to provide moisture resistance equal to that of the barrier material. The case is closed and the lid is nailed on and strapped with metal straps.

*b. Domestic Shipment.* The camera set is packed for domestic shipment in the same manner described in *a* above, except that the wooden packing case and the external waterproof barrier is eliminated (*a* (4) above).

## CHAPTER 2

### INSTALLATION

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#### 17. Uncrating, Unpacking, and Checking

*Note.* The following information applies specifically to equipment packed for shipment overseas. The equipment packed for domestic shipment may be received in similar containers. Be just as careful when unpacking domestic containers as when unpacking oversea containers.

Be careful when unpacking Still Picture Camera Set KS-4A (1). Observe all precautions given in this paragraph.

*a. Unpacking (fig. 15).*

- (1) Cut the metal straps with a suitable cutting device or twist them with pliers until the straps break.
- (2) Unpack the equipment where it will not be exposed to dust, dirt, or excessive moisture.
- (3) Remove the top and sides of the shipping container with a box opener, if available. If not, a standard nail puller can be used. Avoid thrusting crowbars or other tools into the interior of any shipping container. Damage to contents may result.
- (4) Do not damage the packing material any more than absolutely necessary. Store the inside packaging materials in their shipping containers for reuse, with the exception of the bags of desiccant which may be destroyed or returned to the depot for reactivation.
- (5) Lift out the packaged equipment.
- (6) Slit the waterproof overwrap at the seams and remove it from the package.
- (7) Slit the seam of the outer carton and lift out the moisture-vaporproof package.
- (8) Slit the seam of the moisture-vaporproof package and lift out the inner carton.
- (9) Slit the seal of the inner carton, open the flaps, and lift the carrying case out of the carton.

*b. Opening Carrying Case.* Release the catches of the carrying case and lift the lid. Remove the cells which were used to cushion the components and accessories. Remove the components and accessories and place them in a convenient place for checking.

*c. Checking.* Thoroughly check the equipment against shipping documents and also against the table of components (par. 4) to see

if any equipment is missing. Inspect the equipment for possible damage during shipment. After checking, replace all components and accessories in the carrying case.

*Note.* Used or reconditioned equipments are packed in the same manner as new equipment. Service used or reconditioned equipment in the same manner described above for new equipment.

## **18. Assembling Equipment for Operation**

*a. Assembling Tripod.* When the tripod is removed from the carrying case, it will be found that the central column has been reversed. This is done for compactness and ease of packing in the carrying case. To assemble the tripod for use, proceed as follows (fig. 14) :

- (1) Remove the rubber cap from the base of the central column.
- (2) Loosen the central column locking screw and withdraw the central column completely from the locking collar.
- (3) Reverse the column and reinsert it into the locking collar from the top.
- (4) Adjust the column to the desired height, tighten the locking screw, and replace the rubber cap on the lower end of the column.
- (5) Spread the three legs and adjust them to the desired height.
- (6) To prepare the tripod for repacking in the carrying case, reverse the above instructions. If these instructions are followed, the tripod head then will nest neatly between the feet of the telescoped legs of the tripod.

*b. Setting Up Tripod.* Set up the tripod firmly on a stationary surface. Place the camera on the tripod head, and secure it firmly in position by tightening the thumbscrew and lock nut located on the underside of the panhead of the tripod.

## **19. Connections and Interconnections**

The connections and interconnections required to be made on the camera set depend on operation of the equipment and the type of exposure to be made. Refer to paragraphs 23 and 39 for instructions concerning connecting and interconnecting the equipment.

## CHAPTER 3

### OPERATION

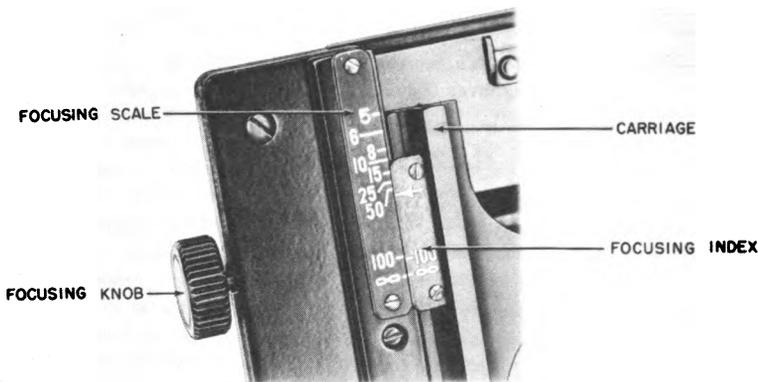
#### Section I. CONTROLS

#### 20. Camera Controls

The camera controls are listed and briefly described in the chart below. These controls include those on the between-the-lens shutter.

Location of control	Control	Function
Camera body bed . . . . .	Bed latch button (fig. 4).	Opens camera when pressed.
	Bed braces (fig. 4) . . . . .	Lock bed in horizontal or dropped position.
	Focusing knobs (fig. 4) . . . . .	Move carriage and camera front in and out for focusing.
	Semivernier focusing scales (fig. 16).	Used with focusing knobs to adjust focus in accordance with lens-to-subject distance in feet.
Carriage front . . . . .	Lock lever (fig. 4) . . . . .	Prevents carriage from slipping.
	Range limit stops (fig. 4).	Locate camera front at correct position on carriage.
	Front lock lever (fig. 4) . . . . .	Locks camera front on carriage in any desired position.
	Rising front locknut (fig. 6).	Permits raising and lowering of camera front.
	Tilt locknut (fig. 4) . . . . .	Locks front in tilted position.
Lens shutter . . . . .	Lateral shift spring catch (fig. 5).	Permits sliding of camera front to right or left.
	Stop lever (fig. 7) . . . . .	Adjusts lens aperture.
	Speed-cam (fig. 7) . . . . .	Adjusts exposure speed.
	Cocking lever (fig. 7) . . . . .	Cocks shutter.
	Shutter release lever (fig. 7)	Releases shutter manually.
	Solenoid (fig. 7) . . . . .	Connects to flash-lamp flasher through cable to provide alternate electrical shutter release.
	Press-focus lever (fig. 7) . . . . .	Opens shutter when cocked without releasing shutter mechanism; for ground-glass focusing.

Location of control	Control	Function
<b>Lens shutter—Con.</b>	<b>Synchronization-adjusting lever (fig. 7.).</b>	<p><b>Synchronizes opening of shutter with various types of flash lamps, as follows:</b></p> <p>In OFF position, keeps switch in shutter open to permit operation of solenoid and flash lamp, by firing switch of flash-lamp flasher. In position X, with connector contacts (fig. 7) connected to electronic flash equipment (not supplied), closes switch in shutter without any delay.</p> <p>In position F, with connector contacts (fig. 7) connected to flash-lamp flasher, delays opening of shutter momentarily to allow a type F (fast peak) flash lamp to reach full brightness. In position M, with connector contacts (fig. 7) connected to flash-lamp flasher, delays opening of shutter long enough to permit a type M (medium peak) flash lamp to reach full brightness.</p>
<b>Focal plane shutter.</b>	<p><b>Winding key (fig. 9) ---</b></p> <p><b>Speed control lever (fig. 9).</b></p> <p><b>Release lever (fig. 9) ---</b></p> <p><b>Connector contacts (fig. 9).</b></p>	<p><b>Winds shutter curtain on shutter roller; also operates speed setting indicator.</b></p> <p><b>Controls curtain speed; also operates exposure speed indicator.</b></p> <p><b>Releases shutter for exposure.</b></p> <p><b>Connect to flash-lamp flasher through cable for operation with flash lamp.</b></p>
<b>Ground-glass focusing screen.</b>	<b>Hood release clip (fig. 9).</b>	<b>Releases hood for ground-glass focusing.</b>
<b>Optical view finder.</b>	<b>Parallax eyepiece (fig. 9).</b>	<b>Corrects view finder sight line.</b>



TM2552B-16

Figure 16. Semivernier focusing scale.

## 21. Flash-Lamp Flasher Controls and Connections (fig.17)

The chart below lists the controls of the flash-lamp flasher and gives a brief description of their function. The connections and their functions are listed also.

Control	Function
Clamp button-----	Locks battery case to camera bracket.
Lamp firing switch-----	Fires flash lamp and operates solenoid to open camera shutter.
Circuit selector switch-----	Prepares circuits in flash-lamp flasher as follows: In position N, with shutter synchronization-adjusting lever set at OFF, connects batteries to solenoid, flash lamp, and extension lamp holder. In position 1, with shutter synchronization-adjusting lever set at F or M, connects batteries to solenoid only. In position 2, permits use with dual lamp flasher, which is not supplied. See paragraph 77.
EXTENSION outlet-----	Connects flash-lamp flasher to extension lamp holder through extension cable to place the extension flash lamp in parallel with the flash-lamp flasher lamp.
SHUTTER outlet-----	Connects flash-lamp flasher through the shutter connector contacts of either the between-the-lens shutter or the focal plane shutter to permit firing of the flash lamps by the switch in either shutter.

Control	Function
REMOTE outlet.....	Can be used to connect the flash-lamp flasher through a cable to a remote switch (not supplied) in parallel with the lamp firing switch, thus permitting remote operation of the flash-lamp flasher.
SOLENOID outlet.....	Connects the flash-lamp flasher to the solenoid through the solenoid tripper cable. This outlet is energized when the lamp firing switch is operated, when in position N or 1.
BATTERY outlet.....	Can be used to connect the flash-lamp flasher through a cable to supplementary batteries (not supplied) (par. 77).

## 22. Tripod Controls

(fig. 14)

The chart below lists the controls of the tripod and indicates their function. Note that the tripod is packed with the central column inverted.

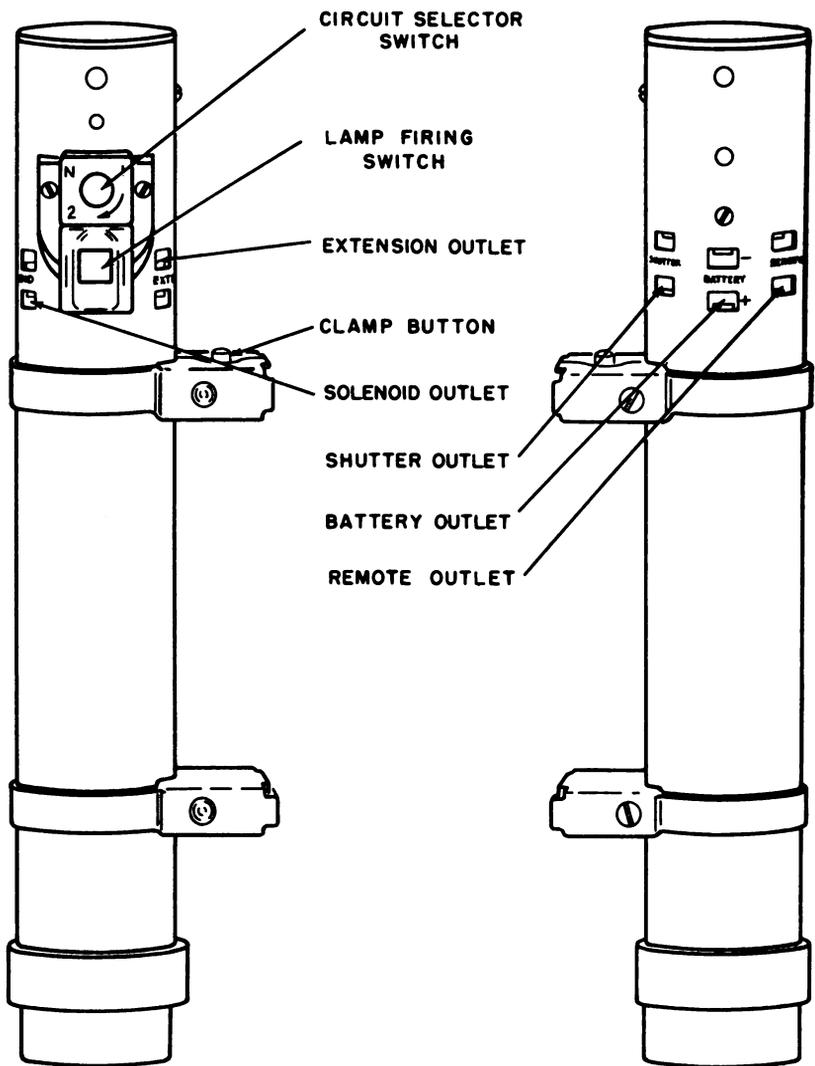
Control	Function
Camera thumbscrew and locknut.....	Secures camera to tripod head.
Pan, tilt, and locking handle.....	Tilts and pans camera and locks camera in desired position when tightened.
Central column locknut.....	Locks central column at desired height.
Telescopic leg locknuts.....	Locks telescoping leg sections in desired position.

## Section II. OPERATION UNDER USUAL CONDITIONS

### 23. Mounting Flash Equipment

*a. Flash-lamp Flasher.* To mount the flash-lamp flasher on the camera (fig. 18), first insert the lower bracket in the lower ear of the range finder bracket. Swing the upper bracket against the upper ear and press it until it latches. To remove the flash-lamp flasher from the camera, depress the latch button on the top bracket and swing the top of the battery case out and free.

*b. Lens Shutter Connecting Cable.* For synchronized flash operation, press the female plug end of the shutter connecting cable onto the connector contacts of the between-the-lens shutter (fig. 18) or of the focal plane shutter. Insert the other end of the cable (equipped with the standard household-type male plug) into the flash-lamp flasher outlet marked SHUTTER (fig. 17).

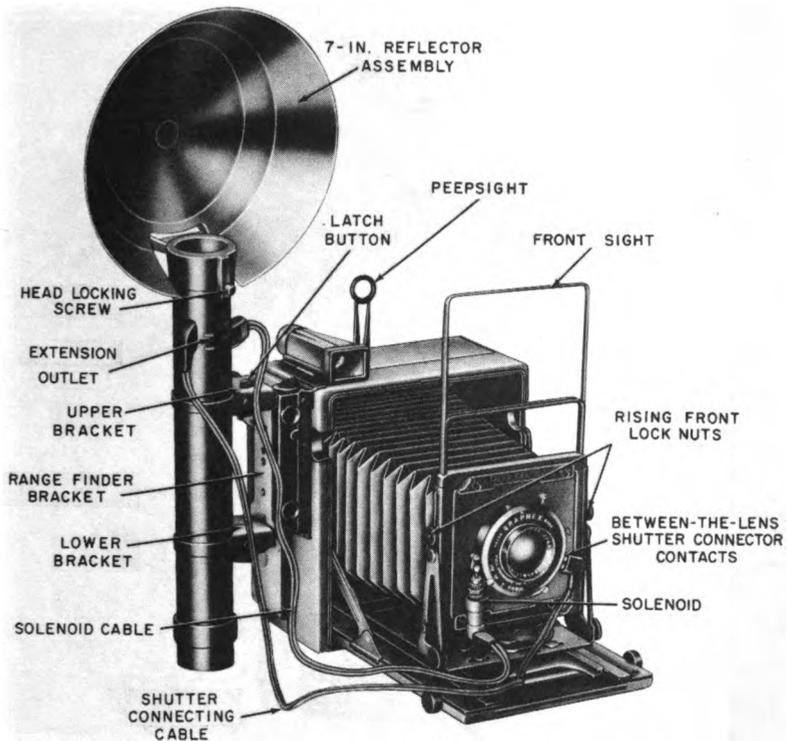


TM2352B-17

*Figure 17. Flash-lamp flasher controls and connections.*

*c. Solenoid Cable.* Connect the miniature male plug on the solenoid cable to the solenoid and the standard male plug to the battery case outlet marked SOLENOID (fig. 18).

*d. Extension Lamp Holder.* If the area to be photographed is extensive enough to require supplementary lighting, connect one end of the extension cable (fig. 10) to the outlet marked EXTENSION, and the other end to one of the two outlets on the extension lamp holder marked EXTENSION. Attach the spring clips of the extension lamp holder to a convenient stationary object.



TN 2352B-18

**Figure 18.** Camera with flash-lamp flasher and 7-inch reflector, installed and interconnected.

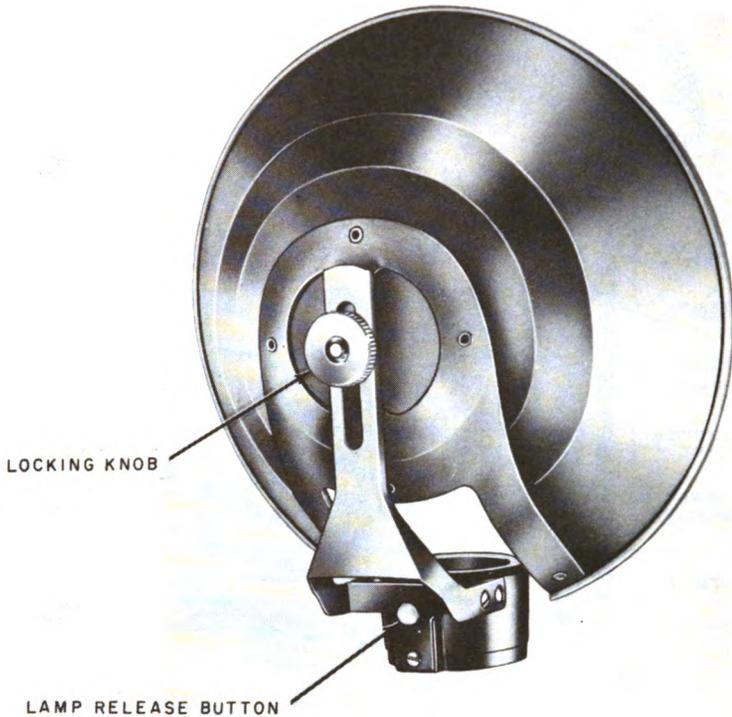
## 24. Reflector Assemblies

Install either the 7-inch or the 5-inch reflector assembly onto the flash-lamp flasher or into the extension lamp holder. Use the 7-inch reflector assembly if it is desired to use a standard base flash lamp. If a bayonet base type flash lamp is to be used, first install the bayonet lamp adapter on the socket of the 7-inch reflector assembly, or use the 5-inch reflector assembly.

*Note.* The 5-inch reflector assembly will accept only the bayonet base type lamp.

### a. Reflector Assembly, 7-Inch (fig. 19).

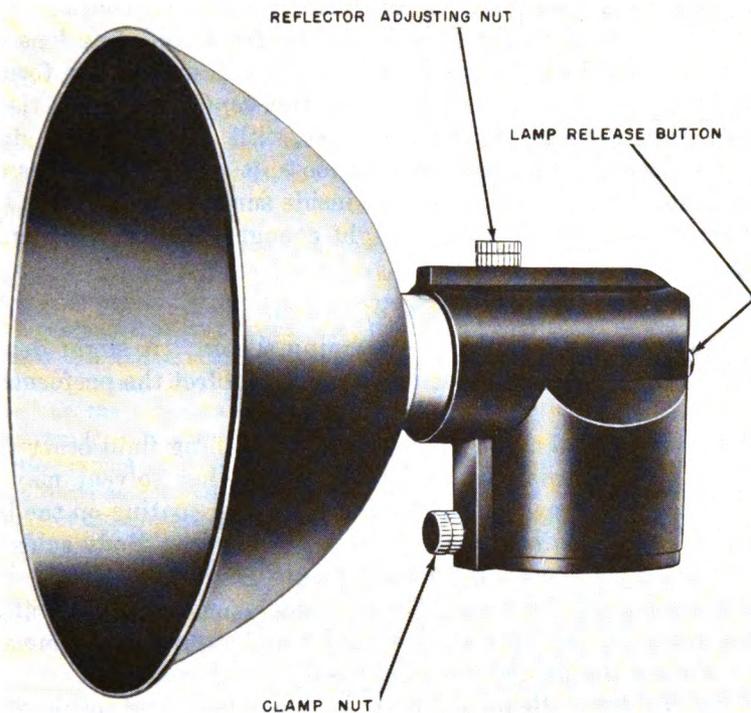
- (1) Loosen the head locking screw, slip the reflector assembly over the top of the flash-lamp flasher or the extension lamp holder, and tighten the head locking screw. Unless this screw is tightened, the electrical circuit will not be completed to fire the flash lamp.



TM 23528-19

*Figure 19. Reflector assembly, 7-inch.*

- (2) After inserting a standard base lamp (or bayonet lamp adapter and bayonet lamp) in the socket, center the reflector by loosening the locking knob at the rear of the reflector assembly, moving the reflector up or down as required, and tightening the locking knob.
- b. Reflector Assembly, 5-Inch (fig. 20).*
- (1) Loosen the head locking screw, slip the reflector assembly over the top of the flash-lamp flasher or the extension lamp holder, and tighten the head locking screw. Unless this screw is tightened, the electrical circuit will not be completed to fire the flash lamp.
  - (2) After inserting a bayonet type flash lamp in the socket, focus the reflector by loosening the reflector clamp nut, moving the reflector forward or backward to approximate the lens coverage, and tightening the reflector clamp nut. The normal position of the reflector is marked **NORMAL** on the head assembly.



TM 2352B- 20

Figure 20. Reflector assembly, 5-inch.

## 25. Checking Completeness of Equipment

Be sure that the camera equipment is complete with all necessary accessories (par. 4), including flash lamps and films (not part of this camera set). Check to see that there are enough loaded film holders or film packs to accomplish the assignment. It is advisable to use a photoelectric light meter (par. 59) to insure good results. Refer to paragraphs 29 and 30 for instructions concerning loading the film-pack adapter and the cut film holder.

## 26. Preloading and Cleaning Instructions

Before this equipment is used on any photographic mission, be sure that all components are scrupulously clean.

*a. Camera.* Remove dust from the outside of the camera with a lint-free cloth; use a soft-bristle brush, if necessary, to get into corners. Remove any firmly attached soil by rubbing with a moistened cloth. Use a soft-bristle brush to remove dust from the front of the camera,

the bed, the outside of the bellows and inside the body and bellows. Clean the ground glass (both sides) with a moistened cloth.

*b. Lens.* Dust the outer surfaces of the front and rear lens elements with a camel's-hair brush. If dusting will not remove foreign matter, breathe on the lens surface and rub *gently* with lens tissue. Remove very stubborn deposits of dirt with lens cleaning fluid. Unless the lens elements have become loose, it will not be necessary to disassemble the lens and clean the inside surfaces because the lens and shutter assembly normally is tight enough to prevent the entry of dust.

*c. Cautions Regarding Cleaning of Lenses.*

- (1) Do not use lens tissue containing silicon. A slight deposit is left on the lens coating which may affect the performance of the lens.
- (2) Do not use any organic solvent or cleaning fluid other than approved lens cleaning fluid. Any other solvent may remove or damage the reflection-absorbing coating on the lens.
- (3) *Never touch lens surfaces with the fingers.* Body acids can destroy lens coating and may pit the glass.

*d. Other Optical Surfaces.* Other optical surfaces such as filters, and the lenses of the optical view finder and range finder, must be clean. Follow the procedures prescribed in *b* above.

*e. Film Holders.* Remove dust from the outside and inside of all film holders and film-pack adapters, especially the *inside*. Even a single speck of dust left on the inside may get on the surface of the film and cause a transparent spot on the negative.

*f. Electrical Contacts.* Inspect all contact prongs on the front and focal plane shutters and on connecting cables for signs of corrosion, and scrape them clean, if necessary.

*g. Reflectors.* Polish reflectors with a soft, clean, cotton handkerchief. If finger marks or other soil are present, breathe on the surface and wipe it clean with a handkerchief. In stubborn cases, moisten the handkerchief and rub the surface gently; then dry the surface with a dry handkerchief. The stainless steel surfaces normally will not require any other treatment.

*h. Metal Surfaces.* The metal surfaces of the battery case, extension lamp holder, and tripod may be wiped clean with a lint-free cloth, or cleaned with a damp cloth if necessary, then dried.

## **27. Checking Range Finder and Focusing Scale**

Before taking the equipment out on a photographic mission, always check the range finder and semivernier focusing scales against the ground-glass focusing screen. Make this check at three lens-to-subject distances—infinity, 15 feet, and 6 feet. The 15- and 6-foot distances must be measured carefully. For an infinity target, choose

a tall building, chimney, flagpole, or tree which is at least one-half mile distant. Starting with infinity, at each of the checking distances, focus first by using the range finder; then check the focus on the ground-glass screen. If the range finder and ground glass do not agree at any setting, adjust the range finder as instructed in paragraph 92m. Check the reading on the semivernier focusing scale. If the focusing scale is found to be inaccurate, relocate it on the camera bed.

*Note.* To avoid unnecessary adjustment of the range finder, it is important to focus first with the range finder, then check the sharpness of the image on the ground glass. If the image is checked first on the ground glass, then on the range finder, it may appear that the range finder is out of focus when it is actually correctly synchronized with the lens. It is frequently possible that any such discrepancy may be due to the depth of focus of the lens. The range finder, on the other hand, has no depth of focus; focus is either in or out. However, if it is determined that the range finder requires adjustment, this practice cannot be followed. The range finder must be adjusted to critically sharp focus as determined by *first* carefully focusing on the ground glass with the aid of a magnifying glass, as instructed in paragraph 92m.

## 28. Preliminary Starting Procedures

After cleaning the equipment, complete the appropriate steps outlined in the chart below.

Step	Action	Par. ref.
1	Check cleanliness of equipment.....	26
2	Load film:	
	Film-pack adapter.....	29
	Cut film holders.....	30
3	Fit filter mount.....	34
4	Check operation of between-the-lens shutter.....	39b
5	Check operation of solenoid tripper.....	39c
6	Check operation of focal plane shutter.....	40
7	Check accuracy of range finder and semivernier focusing scale..	27
8	Check operation of flash-lamp flasher.....	39c, 40c
9	Check completeness of equipment.....	25

## 29. Loading Film-Pack Adapter

(fig. 13)

The film-pack adapter may be loaded or unloaded in full daylight. Do not, however, expose the film pack to direct sunlight during loading.

a. Simultaneously press the two cover release studs to open the cover.

b. Unwrap the film pack. Save the wrapping paper and box to re-wrap the completely exposed film pack.

**Caution:** Hold the film pack carefully by the sides. Do not depress the black paper safety cover or twist the metal frame; it may fog the film.

c. Insert the film pack with the paper safety cover facing the dark slide and pull tabs protruding through the end slot.

d. Close the cover; be sure that it latches with all the tabs centered in the aperture, not caught below the underside of the cover.

e. The safety cover or outside tab (No. 0) must be drawn out to its stop (about 5 in.) and torn from the pack before the first exposure can be made.

f. After each exposure, pull out and tear off the numbered tab, starting with No. 1 and continuing through No. 12. After the last tab has been pulled, the exposed film pack is protected by a black tab and may be removed from the adapter without fogging. Wrap the film pack in the paper and metal foil in which it was wrapped originally.

### 30. Loading the Cut Film Holder

(fig. 12)

Load and unload the cut film holder only in a darkroom. Panchromatic film must be handled in total darkness. Other films may be handled in a darkroom equipped with a recommended safelight. Practice loading the holder in daylight with a sheet of spoiled film.

a. Withdraw the dark slide clear of the film aperture.

b. Swing the bottom flap out to open the bottom of the holder.

c. Hold the sheet film, emulsion up, by the edges. The code notches of one narrow edge will be in the upper right-hand corner and should be felt by the right index finger when the unnotched short edge is nearer the operator. Slip the film under the metal lips along each long side and top of the septum.

d. Swing the bottom flap closed over the lower edge of the film, replace the slide, and turn the slide hook to prevent accidental removal of the slide.

*Note.* Unexposed film is indicated by having the light side of the dark slide handle facing outward. In the dark, the light side is identified by raised dots on the metal handle. Exposed film is indicated by the dark side of the handle facing outward.

### 31. Holding Camera

Figure 1 shows conventional methods of holding this type of camera. Variations of these methods may be used to suit the individual operator. The sole idea in holding the camera is to keep it in a rigid position when the exposure is made. Try the positions illustrated. These can

be varied until a comfortable position is found to operate the camera in a rigid position.

### 32. Mounting Camera on Tripod

Long exposures necessitate the use of the tripod. Set the tripod firmly on a stationary surface. Avoid platforms that shake or vibrate. When working on soft ground, place the legs of the tripod on boards or stones large enough not to sink or slip. Place the unopened camera on the tripod head and secure it in position by tightening the camera thumbscrew of the tripod head into one of the two camera tripod sockets provided, either on the bottom or the side. To make the side sockets available, undo the camera carrying strap and remove it from the top harness loop. Take up the camera thumbscrew slack by tightening the camera thumbscrew locknut.

### 33. Opening Camera

*a. Normal Use (fig. 4).*

- (1) Slip the palm of the left hand through the carrying strap handle, press the bed release button with the thumb, and catch the bed with the fingers to ease the drop.
- (2) With the right hand, bring the bed down until the spring-actuated bed braces lock the bed in its horizontal position.
- (3) Release the front lock lever and pull the front standard out to the range limit stops; hold the front standard against the range limit stops and swing the front lock lever to either side to lock the front standard.

*b. Drop Bed.* The drop bed (fig. 6) is used for wide-angle lenses that require bed clearance when the lens is on the rear section of the yoke; or it is used with a normal focal length lens to tilt the lens forward or lower the optical axis.

- (1) Open the bed to the horizontal position.
- (2) For normal or long focal length lenses, swing the range limit stops (fig. 4) outward, extend the bellows and lock the front standard at the appropriate focus.
- (3) Hold the bed in the palms of both hands and, with the thumbs simultaneously press both bed braces down. Let the bed swing down and the bed braces will snap into the lower lock position.
- (4) Focus by ground glass only (par. 36c).

### 34. Lens Hood Assembly

The combination lens hood and filter holder (fig. 11) slips on the front lens. The adapter ring is slotted for adjustment of the friction tension due to the slight diameter variations of lens cells. Increase the tension evenly by rolling the adapter ring on a bench while bearing slight pressure on the slotted edge. Decrease the friction by rolling

a round wooden handle inside the adapter ring while bearing slight pressure outward against the slotted edge.

a. As a lens hood, screw the lens hood directly into the adapter ring.

b. As a combination filter holder and lens hood, place the filter in the adapter ring and assemble the lens hood.

c. As a filter holder, place the filter in the adapter ring and screw the retainer ring into the adapter ring.

### 35. Filters

A colored filter alters the gray-tone rendition of the subject color on the film and absorbs part of the effective light. The charts given in a and b below are useful for choosing the proper filter and arriving at the filter factor or required increase in exposure time. Refer to TM 11-401 for information on the use of filters.

a. The following chart serves as a general guide for panchromatic film effects in respect to *contrast obtained on the print*.

Filter	Blue	Green	Yellow	Red
X1 (light green)-----	Darker...	Much lighter..	Slightly lighter.	Dark.
K-2 (medium yellow)..	Slightly darker.	Slightly lighter..	Slightly lighter.	Very slightly lighter.
G (orange)-----	Darkest...	Lighter-----	Light.....	Lightest.
A (medium red)-----	Darkest...	Darker-----	Lighter...	Very light.
No. 1 (haze)-----	(*)-----	(*)-----	(*)-----	(*).

\*No color change—reduces atmospheric haze.

b. The following chart lists the filter factors that apply to the *general* film classes for use with daylight or tungsten illumination.

Filter	Film						Color film
	Panchromatic		Orthochromatic		Noncolor Sensitive		
	Daylight	Tungsten	Daylight	Tungsten	Daylight	Tungsten	
X1-----	4	3					
K2-----	2	1.5	2.5	2	12	9	
G-----	3	2	5	3			
A-----	8	4					
No. 1-----	0		0				0

### 36. Focusing

Select a camera position to give the best view of the subject and check the framing either with the optical or the open frame view

finder. For focusing, use the ground-glass screen, the range finder, the focusing scales, or focus by hyperfocal distance.

*Note.* Refer to TM 11-401 for an explanation of hyperfocal distance.

*a. Optical View Finder.* The optical view finder has a parallax correcting lens barrel for determining the field of view. Adjust parallax by turning the parallax eyepiece (fig. 9) to the approximate subject distance that is marked on the rear surface of the eyepiece. Notches assist in locating and centering subjects at distances of 6 feet, 8 feet, 15 feet, and infinity. Settings for intermediate distances may be estimated with sufficient accuracy.

*b. Open Frame View Finder.* The open frame view finder is best suited for making pictures of rapidly moving objects that are difficult to follow in the reduced size of the optical view finder.

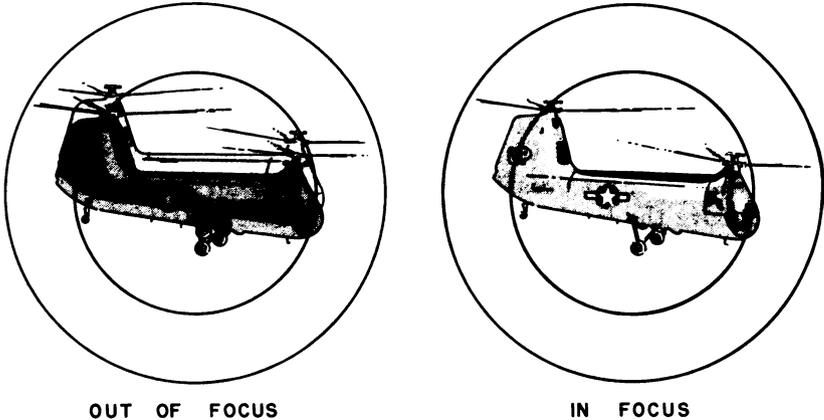
- (1) Swing the rear peep sight to the vertical position.
- (2) Lift the open frame finder to the full height by grasping the knurled finger pads with the thumb and forefinger.
- (3) Parallax corrections, visible when the open frame finder is extended, are located on the right side of the finder just above the level of the lens board frame. Notches assist in locating subjects at distances of 6 feet, 15 feet, and infinity. Settings for distances other than 6 feet, 15 feet, or infinity may be estimated with sufficient accuracy.

*c. Ground-Glass Focusing.* The camera is focused most accurately and dependably by using the ground-glass screen, because the exact framing as well as the exact image size and depth of field may be studied. Furthermore, it is the only method that can be used with an extended bellows or corrective lens movement of the front standard.

- (1) Open the lens to maximum aperture by moving the stop lever (fig. 7) to  $f/4.5$ .
- (2) Depress the cocking lever.
- (3) Depress the press-focus lever.
- (4) Be sure that the focal plane shutter speed setting indicator (fig. 9) is set to 0 (open). Refer to paragraph 40.
- (5) Press the hood release clip (fig. 9) to open the focusing hood. If extremely accurate focusing is desired, use a magnifying glass to check the focus of the image on the ground glass. If the focusing hood is in the way, remove it by pressing one of the hood retainers outward and lifting the hood on that side. Use the focusing cloth to exclude light and obtain a clearer view.
- (6) Turn one of the focusing knobs (fig. 5) until the subject appears in sharp focus. For close work, swing the range limit stops outward, disengage the front lock lever, and pull the front standard outward until the image approximates sharp focus. Lock the front lock lever and turn one of the focusing knobs until the image appears in sharp focus.

*d. Range Finder Focusing.*

- (1) Look through the range finder extension eyepiece (fig. 9). Note that two images are visible (fig. 21). One image covers the entire field; the other image is in a small, bright, circular area.
- (2) Turn one of the focusing knobs (fig. 5) until the image in the bright, small area is superimposed on the other image. Be sure that your eye is centered so that the small circular area is centered in the larger field. Try to focus on a portion of the subject containing well defined lines or clear color contrast to make sure that the two visible images coincide exactly.



TM2352B-21

*Figure 21. Range finder focusing as seen through the eyepiece.*

*e. Using Focusing Scales.*

- (1) Disengage the front lock lever and pull the front standard outward, firmly against the range limit stops. Lock the front lever while holding the front standard firmly against the range limit stops.
- (2) For infinity and 100-foot distances, match the infinity or 100-foot markings on the focusing and index scales (fig. 16). At distances between 5 and 50 feet, match the focusing index arrow with the desired setting. Use focusing scales only when the camera bed is in a normal position. With a dropped bed, use ground-glass focusing.

*f. Focusing by Hyperfocal Distance.*

- (1) If a picture must be made in a hurry, set the focusing scales to infinity and adjust the lens aperture for the approximate distance to the subject in accordance with the following chart. These distances are commonly called hyperfocal distances. Remember to adjust the shutter speed accordingly to compensate for existing light and subject conditions.

Distance (ft.)	Aperture	Distance (ft.)	Aperture
152.....	<i>f</i> /4. 5	45.....	<i>f</i> /16
128.....	<i>f</i> /5. 6	40.....	<i>f</i> /22
90.....	<i>f</i> /8	22.....	<i>f</i> /32
65.....	<i>f</i> /11		

- (2) Variations in lens aperture require corresponding adjustments in the exposure time. Therefore, as the distance to the subject becomes shorter, the lens aperture becomes smaller and, consequently, the exposure time required is longer. Thus, for shorter distances, it is better to set the focusing scales to the approximate distance to the subject. Table I gives the minimum and maximum distances to the subjects that are in acceptably sharp focus when the focusing scales are set to the various settings (commonly called depth of field) and indicates the lens aperture required for the particular lens supplied with the camera (127 mm).

### 37. Raising, Shifting, and Tilting Front Assembly

To avoid undesirable linear perspective, commonly called distortion, it may be necessary to raise, shift, or tilt the front assembly of the camera (fig. 23). For a further discussion concerning perspective, refer to TM 11-401, Elements of Signal Photography.

*a. Preliminary.* Mount the camera on the tripod and set the body assembly of the camera approximately parallel to the subject to be photographed. Focus by using the ground-glass screen (par. 36*c*).

#### *b. Raising Front Assembly.*

- (1) Loosen both rising front locknuts (fig. 5).
- (2) Lift the front assembly to the height required to center the image of the subject on the ground-glass screen.
- (3) Tighten the rising front locknuts.

#### *c. Shifting Front Assembly.*

- (1) With the front lock lever (fig. 5) disengaged (pointing forward), depress the lateral shift spring catch.
- (2) Shift the front assembly to either side, as required, to correct the perspective.
- (3) Release the lateral shift spring catch and tighten the front lock lever.

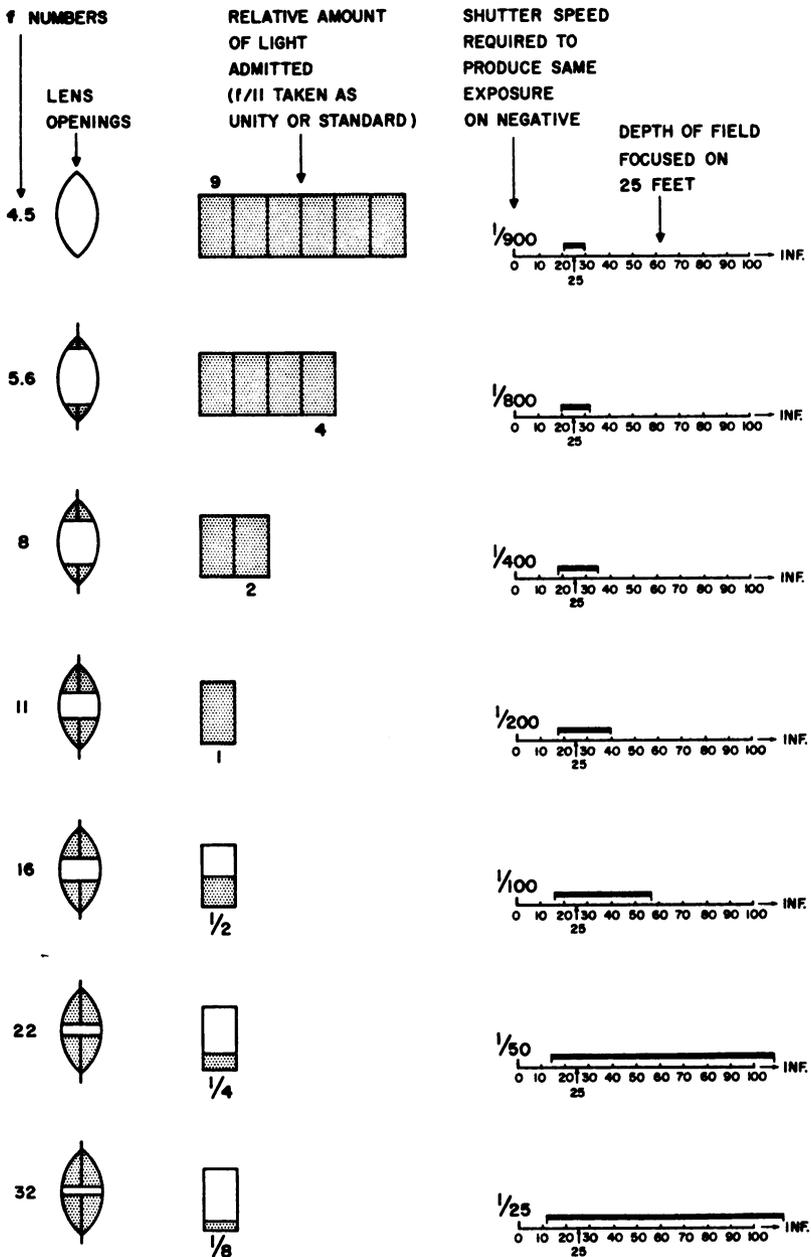
#### *d. Tilting Front Assembly.*

- (1) Loosen both tilt locknuts (fig. 5).
- (2) Push or pull the front assembly to obtain the desired perspective.

Table I. Depth of Field (127-mm Graflex Oplar Lens)  
(fig. 22)

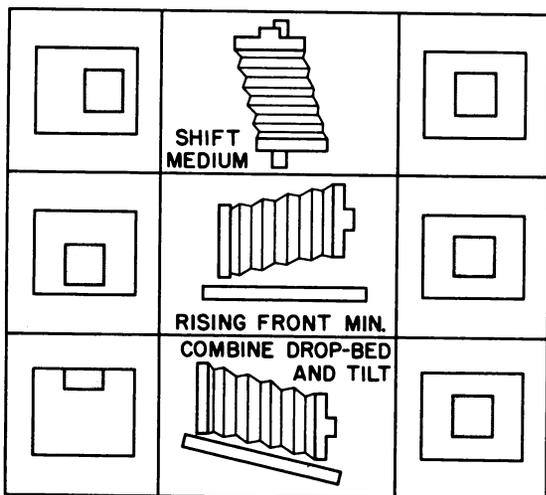
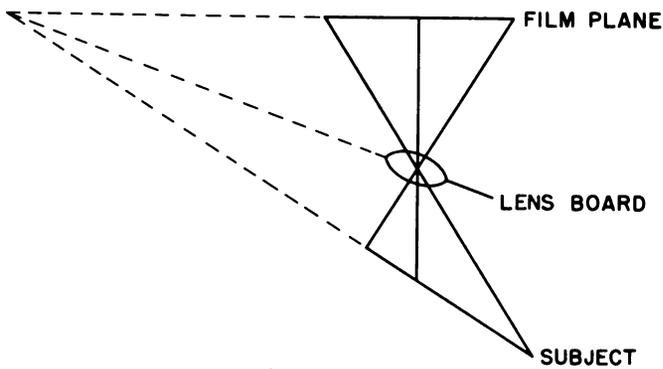
Focusing scale setting (ft.)	Lens aperture					
	f/4.5	f/5.6	f/8.0	f/11.0	f/16.0	f/22.0
Inf.-----	154' to Inf.	124' to Inf.	86.8' to Inf.	62.0' to Inf.	43.4' to Inf.	31.0' to Inf.
100'-----	60.8' to 282'	55.5' to 508'	46.6' to Inf.	38.4' to Inf.	30.4' to Inf.	23.7' to Inf.
50'-----	37.8' to 73.7'	35.7' to 83.3'	31.8' to 117'	27.8' to 250'	23.3' to Inf.	19.2' to Inf.
25'-----	21.6' to 29.7'	20.9' to 31.2'	19.5' to 34.9'	17.9' to 41.4'	16.0' to 57.7'	13.9' to 121'
15'-----	13.7' to 16.6'	13.4' to 17.0'	12.8' to 18.0'	12.1' to 19.6'	11.2' to 22.6'	10.4' to 28.3'
10'-----	9.4' to 10.7'	9.3' to 10.8'	9.0' to 11.2'	8.7' to 11.8'	8.2' to 12.8'	7.6' to 14.5'
8'-----	7.6' to 8.4'	7.5' to 8.5'	7.4' to 8.8'	7.1' to 9.1'	6.8' to 9.7'	6.4' to 10.6'
6'-----	5.8' to 6.2'	5.7' to 6.3'	5.6' to 6.4'	5.5' to 6.6'	5.3' to 6.9'	5.1' to 7.3'
3'-----	4.9' to 5.2'	4.8' to 5.2'	4.7' to 5.3'	4.7' to 5.4'	4.5' to 5.6'	4.4' to 5.9'

Note. Distances shown in feet and nearest tenth of a foot.



TM2352B-86

Figure 22. Relative depth of field for various lens openings at 25 feet.



TM 2352B-87

Figure 23. Effects of camera front movements.

- (3) Tighten the tilt locknuts.

**Caution:** Be sure to restore the front assembly to the normal position (parallel to, and in line with, the back assembly) before closing the camera. Serious damage can be caused by attempting to close the camera when the front assembly is raised, shifted, or tilted.

### 38. Loading Camera

To load the camera with a cut film holder or the film-pack adapter, hold the focusing panel (fig. 9) by the finger pads and pull the panel

backward, away from the back assembly. Slide in the film holder or adapter between the focusing panel and the back assembly.

*Note.* Be sure the holder or adapter is pushed in as far as it will go. This is necessary to position properly the film in the film plane and avoid the possibility of introducing a light leak.

*a. Cut Film Holder.* When loading the camera with a cut film holder, note that the light metal side of the dark-slide handle faces outward. When the dark slide is replaced after an exposure, be sure that the dark slide is inverted and that the black side of the dark slide faces outward.

*b. Film-pack Adapter.* When loading the camera with a film-pack adapter, be sure that the shutter is closed and that all shutter adjustments are completed before pulling the first paper tab. Pull each paper tab firmly, slowly, and straight out after each exposure. If a paper tab starts to tear, stop pulling and check your loading procedure. Be sure that the paper tabs go through the center of the end slot and are not pinched at either side.

### **39. Exposure Using Between-the-Lens Shutter**

#### *a. General.*

- (1) Be sure that the focal plane shutter is open. If the focal plane speed setting indicator (fig. 9) does not indicate 0, turn the focal plane shutter winding key to set the indicator to 0.
- (2) Choose the proper speed and lens opening by using an exposure meter (par. 59). If an exposure meter is not available, refer to tables II through V, bearing in mind that the information in these tables is of a general nature and is dependent upon the type of film used.
- (3) Set the shutter speed by rotating the speed cam (fig. 7) until the desired speed designation is immediately adjacent to the stationary pointer. The numbers on the ring indicate fractional parts of a second; for example, 25 is equivalent to  $1/25$  second, or 40 milliseconds.
- (4) Set the lens opening by moving the stop lever (fig. 7) in either direction until it points to the desired  $f$  stop. It should be noted that although the stop lever stops at every marking, the lever can be set between the marked stops for more accurate setting.
- (5) To cock the shutter, push the cocking lever fully clockwise and release it. Remove the dark slide from the adapter or holder. The camera is now ready for any exposure using the between-the-lens shutter.

#### *b. Exposure Without Flash Lamps.*

- (1) Follow instructions in *a* above.
- (2) Set the synchronization adjusting lever (fig. 7) to OFF.

- (3) If the flash-lamp flasher is connected to the camera, set the circuit selector switch of the flash-lamp flasher to position N.
- (4) Operate the shutter release lever (fig. 7) either directly by pressing it down with the thumb or by operating the cable release, previously attached to the cable release socket. For an exposure other than bulb (B) or time (T), operation of the shutter release lever opens and closes the shutter. Bulb (B) and time (T) exposures must be timed. For a bulb (B) exposure, operate the shutter release lever to open the shutter and release it to close the shutter. For a time (T) exposure, operate the shutter release lever to open the shutter, release the lever, and operate it a second time to close the shutter.

c. *Exposure With Flash Lamps.*

- (1) Follow the instructions in *a* above.
- (2) Check to see that the flash-lamp flasher is attached properly to the camera, that the solenoid tripper cable is connected to the solenoid, that the shutter connecting cable is connected to the between-the-lens shutter connector contacts (fig. 18), and that there is a flash lamp in the reflector.
- (3) Set the circuit selector switch of the flash-lamp flasher (fig. 17) to position 1.
- (4) Set the synchronization adjusting lever (fig. 7) to the position corresponding to the type of flash lamp to be used, as follows:

Position	Lamp type
M.....	M (medium peak).
F.....	F (fast peak).
X.....	Electronic speed lamps (not supplied).

- (5) Check the lens opening with table III.
- (6) Press the lamp firing switch of the flash-lamp flasher.

#### 40. Exposure Using Focal Plane Shutter

a. *General.*

- (1) Open the between-the-lens shutter by setting the cocking lever, then operating the press-focus lever.
- (2) Choose the proper shutter speed and lens opening by using an exposure meter (par. 59). If an exposure meter is not available, refer to tables II through V, bearing in mind that the information in these tables is of a general nature.
- (3) To avoid accidental exposure of the film, do not remove the dark slide from the film holder or film pack adapter until the shutter speed is set.

Table II. Daylight Exposure Guide

(For film with a speed of ASA 100 Daylight)

Subject	Shutter speed	Bright	Hazy	Cloudy	Dull
Class 1. Brilliant subject.----- Beach, snow, landscape without dark object in foreground.	1/100	f/22	f/16	f/11	f/8
Class 2. Bright subject.----- Object in foreground of beach or snow.	1/100	f/16	f/11	f/8	f/5.6
Class 3. Average subject.----- Nearby objects or people not in shade.	1/100	f/11	f/8	f/5.6	f/4.7
Class 4. Shaded subjects.----- Objects or people in open shade, not under trees or covering.	1/100	f/8	f/5.6	f/4.7	(*)
Class 5. Sheltered subject.----- Object under trees or cover- ing.	1/100	f/5.6	f/4.7	(*)	(*)

\*Use supplementary flash for class 4 and class 5 when possible (par. 77).

(4) Set the shutter speed by turning the focal plane shutter winding key (fig. 9) counterclockwise until the desired setting is shown on the speed setting indicator. To set shutter speeds of 1,000, 250, and 50, pull back the focal plane shutter speed control lever. For speeds of 500, 125, and 30, push forward the focal plane shutter speed control lever. The camera is now ready for any exposure using the focal plane shutter.

*b. Exposure Without Flash Lamps.*

- (1) Follow the instructions in *a* above.
- (2) If the flash-lamp flasher is connected to the camera, set the circuit selector switch (fig. 17) of the flash-lamp flasher to the N position.
- (3) Operate the shutter by depressing the focal plane shutter release lever (fig. 9) for any exposure other than a time (T) exposure.
- (4) For a time exposure, with the focal plane shutter speed setting indicator set at T, operate the release lever once to open the focal plane shutter and again to close it.

*c. Exposure With Flash Lamps.*

- (1) Follow the instructions in *a* above, except that only speed settings of 1,000, 500, and 250 can be used with the flash lamps.

- (2) Check to see that the flash-lamp flasher is properly attached to the camera, the solenoid tripper cable is *disconnected* from the solenoid, that the shutter connecting cable is connected to the focal plane shutter connector contacts (fig. 9), and that there is a standard FP flash bulb (with 20 milliseconds delay) in the reflector.
- (3) Set the circuit selector switch of the flash-lamp flasher (fig. 17) to position 1.
- (4) Refer to table III for information on flash exposure factor and set the lens opening accordingly.
- (5) Press the focal plane shutter release lever.

Table III. Flash Exposure Factors

(For film with speed of ASA 100 Daylight or 80 Tungsten)

Flash lamps	Shutter speeds (seconds)				
	1/100	1/400	1/250	1/500	1/1000
	Guide numbers				
No. 5, 25.....	250	140	-----	-----	-----
No. 11, 0.....	280	170	-----	-----	-----
No. 22, 2.....	420	240	-----	-----	-----
No. 31, 2A.....	-----	-----	130	85	65

*Note.* To obtain the lens opening, divide the guide number (factor) by the distance (in ft) to object. For example, to photograph a subject 20 feet away at 1/500 second with a GE No. 22 lamp, set the lens opening to  $f/12$  ( $240 \div 20$ ).

Table IV. Shutter Speeds for Subjects in Motion

At 20 to 50 mph.	Distance from subject (feet)	Motion to or from camera	Motion 45° angle to camera	Motion at right angle to camera
Automobile traffic, field sports, and boats.	25	1/500	1/1000	1/1000
	50	1/250	1/500	1/1000
	100	1/125	1/250	1/500

*Notes*

1. At 5 to 20 miles per hour (pedestrians, construction work, and street activities) use one-half the table speed.
2. Over 50 miles per hour (airplanes, birds in flight, trains, and motor races) use double the table speed.

Table V. Extended Bellows Exposure Factor

(For close-ups)

Size ratio (image to object) <sup>1</sup>	Bellows extension factor (ft) <sup>2</sup>	Exposure factor <sup>3</sup>
1:8-----	1. 125	1. 27
1:4-----	1. 25	1. 56
1:2-----	1. 5	2. 25
1:1.5-----	1. 75	3. 06
1:1-----	2	4. 00

<sup>1</sup> This is the ratio of size of object image on the ground glass to the actual size of object.

<sup>2</sup> This factor times focal length (125 mm) equals the distance from the lens to the ground glass.

<sup>3</sup> Multiply the exposure time normally required by this factor to obtain the proper exposure time.

## 41. After-Use Procedures

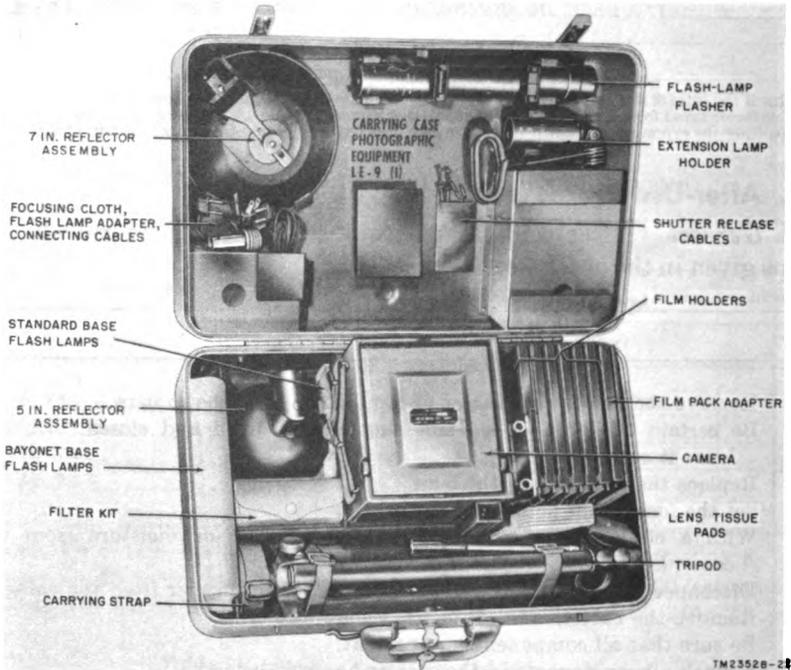
*a. General.* After completing every assignment, perform all the steps given in the check list below.

Step	Action
1	Remove the film-pack adapter or film holder from the camera.
2	Be certain the between-the-lens shutter is tripped and closed. Do not leave it cocked.
3	Replace the dust cap on the lens.
4	Set the focal plane shutter on open (0).
5	With a clean cotton handkerchief, remove dust or moisture from the camera.
6	Disconnect all cables and remove the flash-lamp flasher from the camera.
7	Remove the batteries from the flash-lamp flasher.
8	Be sure that all components are present.
9	Repack all components in the carrying case ( <i>b</i> below)

*b. Repacking Carrying Case* (fig. 24). Repack the components in the carrying case as follows:

- (1) *Front compartment.* Clear the securing straps and place the tripod in this compartment with the panhead to the right, so that it rests on the bottom of the case. Secure the straps. The space at the left end of this compartment is for the rolled-up carrying strap. If the case is to be hand carried, repack the carrying strap. If the case is to be carried on the back (fig. 26) leave the strap out.
- (2) *Left side compartment.* Place the bayonet base flash lamps in the compartment on the extreme left side.
- (3) *Left rear compartment.* Set the 5-inch reflector in this space, face down.

- (4) *Center platform.* Place the camera on this platform, back of camera down, top of camera facing the front, with optical view finder to the right. The space under the center platform can be used to store standard base flash lamps.
- (5) *Film holder slots.* Place the film holders in the slots at the right of the camera with the bottom edges against the rear of the case.

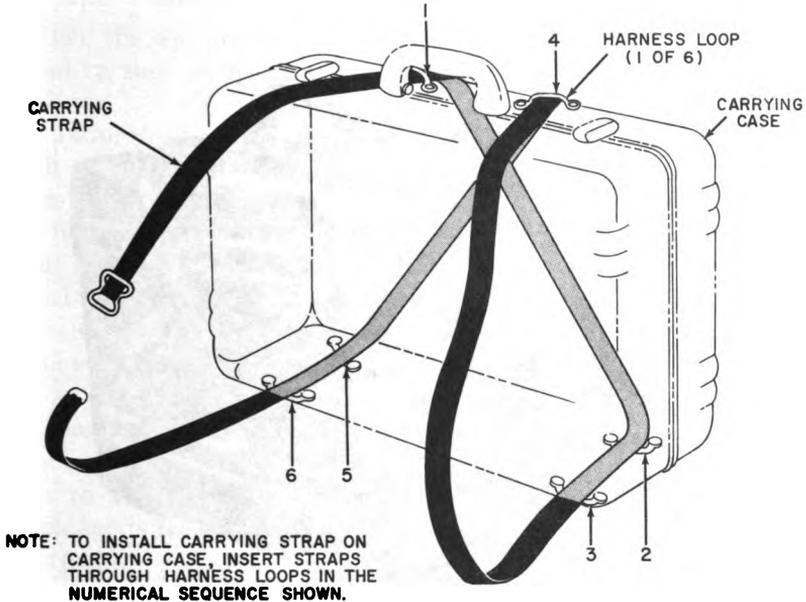


**Figure 24.** Components in carrying case.

- (6) *Film-pack adapter slot.* Place the film-pack adapter in the slot adjacent to, and to the right of, the film holders with the bottom edge against the rear of the case.
- (7) *Lens tissue slot.* Insert the lens tissue pads between the film holders and the tripod compartment.
- (8) *Lid.* Set the 7-inch reflector assembly, face down, in the upper left space and fasten it in place with the three clips on the cover. Be sure that the neck of the reflector points toward the left rear corner. Press the flash-lamp flasher into the spring clips near the edge of the cover with the camera mounting brackets facing outward. Press the extension lamp holder into the clip at the right, with the spring clip pointing to the left. Insert the two shutter release cables into the felt packet near the center of the lid. Place the flash-lamp adapter, connecting cables, and focusing cloth in the compartment below the 7-inch reflector.

## 42. Carrying Camera Set

The carrying case, containing all the components of the camera set, can be carried with one hand, like a valise, or on a man's back (fig. 26). If the packed carrying case is to be carried on the back, lace the carrying strap through the six loops provided on the case. Insert the plain end of the carrying strap through harness loop 1 (fig. 25) on the top of the carrying case, then through loops 2 and 3 at the bottom, then through loop 4 at the top and, finally, through loops 5 and 6 at the bottom. Fasten the plain end to the strap buckle and insert the arms through the loops as shown in the foreground of figure 25.



TN2352B-23

Figure 25. Installation of carrying strap on carrying case.

## Section III. OPERATION UNDER UNUSUAL CONDITIONS

### 43. Operation in Arctic Areas

Equipment operated at low temperature should be kept in low temperature storage when not in use. Cover the equipment with a water-repellent material and store it in an outdoor shelter. When equipment stored in this manner is to be used in a much warmer temperature, use the following procedure before attempting to operate the equipment.



TM 2352B-24

*Figure 26. Carrying packed carrying case on the back.*

*a.* Transfer the equipment from the cold to a warm location, and allow it to remain in its case and covered with the waterproof material for approximately 6 hours.

**Caution:** Do not uncover the equipment before it has been kept at the warmer temperature for the required time. Water may condense on the equipment and cause permanent damage.

*b.* Before operating the equipment, use a lint-free cloth to remove any water that has condensed on the outer surface. Clean the lens with lens-cleaning tissue. When moisture has condensed on the inner surface of the lens, do not attempt to operate the camera because the moisture will distort the image on the negative. To evaporate

the condensed moisture, allow the lens to remain at room temperature until it is clear. To accelerate this process, the lens may be kept at a temperature not exceeding 120° F. until the moisture evaporates from the surface of the lens.

**Caution:** At operating temperatures below 0° F., the rubber-impregnated material of the focal plane shutter curtain will stiffen. Test negatives should be made to determine satisfactory exposure times. At operating temperatures below -30° F., remove all lubricants and operate dry.

#### **44. Operation in Tropical and Desert Areas**

When the equipment is used under conditions of extreme heat and humidity, such as desert and tropical regions, take the following precautions:

*a.* Before using the equipment in desert regions, use a soft-bristled brush to remove any sand or other foreign matter accumulated on the surfaces of the camera and the tripod head. Carefully dust the film holders and slides before loading the film. Use a camel's-hair brush to clean the lens and ground glass. Unless the lens has been dusted first with a camel's-hair brush, do not clean it with lens tissue. Lens tissue will scratch the lens if it has not been dusted. Keep the equipment in the carrying case when not in use.

*b.* In climates of high humidity, such as the tropics, inspect the equipment daily for traces of fungus, mold, mites, and metallic corrosion. Remove all fouling immediately. Lubricate after cleaning. Refer to TB SIG 149 for further information on this subject. The equipment is treated for moistureproofing and fungiproofing during manufacture.

#### **45. Operation in Maritime, High Altitude, Low Temperature, and Rain Areas**

To prevent corrosion from salt-laden air or salt water spray, and to prevent rusting from condensation or moisture, wipe all exposed metal parts with a soft cloth impregnated with Oil, Lubricating, Preservative, Special (PL Special). To avoid condensation, do not bring the equipment into warm air after exposure to low temperature. Keep equipment in use in low temperature storage (usually on a protected outdoor shelf). After the camera had been used under rainy, dusty, or dirty conditions, relubrication may be required. Check the condition of the camera after each assignment; relubricate and adjust it if necessary.

## CHAPTER 4

### ORGANIZATIONAL MAINTENANCE

#### Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

##### 46. Tools Used With Camera Set

The tools that are required for organizational maintenance of the camera set are listed below and are contained in Tool Equipments TK-24/GF and TK-26/GF.

Tool	Sig C stock No.
Bulb syringe.....	6Z972
Camel's-hair brush, fine, long handle.....	6Z1451
Camel's-hair brush, 2-inch, flat.....	6Z1372
Oiler, container (TL-623/U).....	6Z7335
Phillips screwdriver, No. 1 bit (TL-469/U).....	6R15487
Pliers, needle-nosed, 6-inch (TL-126).....	6R4626
Pliers, snub-nosed, 6-inch.....	6R4721-6
Screwdriver, 6-inch, 3/16-inch (TL-360/U).....	6R16091
Screwdriver, 5 1/2-inch, 1/8-inch (TL-455/U).....	6R15293

##### 47. Materials Used With Equipment

A list of the materials that are used with the camera set for organizational maintenance follows:

Material	Sig C stock No.
Cloth, lint-free.....	6Z1989
Lens tissue.....	8A2559
Liquid lens cleaner.....	8A819
Solvent, Dry Cleaning (SD).....	6G1914

*Note.* Do not use gasoline as a cleaning fluid for any purpose.

#### Section II. PREVENTIVE MAINTENANCE SERVICES

##### 48. Definition of Preventive Maintenance

Preventive maintenance is systematic checks and adjustments made at regular intervals to keep the equipment operating at top efficiency.

It is not the same as troubleshooting or repair. Preventive maintenance *prevents* breakdowns and, therefore, the need for repair. Troubleshooting and repair *locates* and *corrects existing defects*. The importance of preventive maintenance cannot be overemphasized. Failure or inefficient operation of one piece of the equipment may cause the failure of the entire photographic system. It is important, therefore, that operators and repairmen maintain their equipment properly.

#### **49. Preventive Maintenance Techniques**

Preventive maintenance information for the camera set is given in *a* through *k* below.

*a. Lens.* Keep the lens clean at all times. Never touch the glass of the lens; fingermarks can etch the highly polished lens surface and ruin the lens. Remove dust and lint with a soft camel's-hair brush. If additional cleaning is necessary, use lens tissue. Breathing on the lens before wiping it with a lens tissue is accepted practice, but do not use water or household cleaning fluids.

*b. Solenoid and Tripper Cable.* Replace worn or damaged cable. Clean the contacts. If the solenoid functions improperly, check the batteries.

*c. Film Holders.* Dust the film holders thoroughly inside and outside before loading them with an air syringe. Use a reasonably stiff, pointed brush with bristles that will not shed. Replace any slides that have holes or cracks.

*d. Camera.* Wipe the body of camera with a lint-free cloth. Tighten all loose screws. Gears, racks, and controls should be properly meshed and work freely. Tighten where necessary (par. 100).

*e. Filters.* Filters require the same care as lenses. Check the mount (fig. 11) to see that it does not exert undue pressure on the filter (bent or warped condition).

*f. Focusing Screen.* Dust the ground glass inside and outside with a camel's-hair brush. If the glass is soiled, clean both sides with a moist cloth.

*g. Tripod.* Replace damaged metal parts (par. 101).

*h. Flash-Lamp Flasher.* If the batteries are weak or exhausted, replace them. If the contacts are corroded, burnish them with No. 000 abrasive cloth.

*i. Reflector Assemblies.* Use a dry, lint-free cloth, or a cloth dampened with solvent, SD to clean the reflectors.

*j. View Finders.* Dust the view finders with a soft camel's-hair brush; then clean them with lens tissue.

*k. Range Finder.* Dust the range finder with a soft camel's-hair brush; then clean it with lens tissue.

# 50. Use of Preventive Maintenance Forms

(figs. 27 and 28)

a. This information is presented as a guide to the individual who is making an inspection of the equipment in accordance with instructions on DA Forms 11-254 and 11-255. The decision as to which items on DA Forms 11-254 and 11-255 are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communications officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the indi-

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT STILL CAMERA SET									
EQUIPMENT NOMENCLATURE					EQUIPMENT SERIAL NO.				
INSTRUCTIONS: See other side.									
LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; ⊕ Defect corrected. NOTE: Strike out items not applicable.									
DAILY									
NO.	ITEM	CONDITION							
		S	M	T	W	T	F	S	
1	INSPECT FOR COMPLETENESS OF EQUIPMENT: LENS, CARRYING CASE, ACCESSORIES, TECHNICAL MANUALS, ALL RUNNING SPARE PARTS. PAR. 17 g								
2	CLEAN CARRYING CASE OF DIRT AND OIL. (Outdoor use).								
3	INSPECT CARRYING CASE AND STRAPS FOR CRACKS, WEAR, BROKEN SNAP FASTENER, FUNGUS. (Outdoor use). PAR. 17								
4	INSPECT EXTERIOR OF CAMERA FOR BUST, DIRT, LINT, MOISTURE, CORROSION, RUST, OIL, GREASE, CRACKS, CHIPS. PAR. 26 g								
5	CLEAN LENS AND LENS MOUNTING OF DUST, DIRT, FINGERMARKS, AND MOISTURE, USING A CAMEL'S HAIR BRUSH AND LENS TISSUE. (Do not use alcohol, polishing material or solvents, or rub lens with fingers). PAR. 26 c								
6	INSPECT LENS MOUNTING BARREL FOR CORROSION, ROUGHNESS, WORK SPOTS, BINDING THREADS. PAR. 40								
7	INSPECT ACCESSORY CLIP FOR DEFORMED RAILS AND STOP LUG.								
8	INSPECT CAMERA INTERIOR FOR FILM CHIPS, DUST, CORROSION, MILDEW, FUNGUS, MOISTURE, DUST, OIL. PAR. 26								
9	INSPECT ALL CONTROLS AND KNOBS FOR FREE MOVEMENT. PARS. 33 AND 37								
10	INSPECT FILTERS AND PEEP-HOLES FOR LINT, DUST, DIRT, MOISTURE. PAR. 26 d								
WEEKLY									
NO.	ITEM	NO.	ITEM						
11	TIGHTEN TO A HAND-TIGHT FIT - ALL LOOSE ASSEMBLY AND MOUNTING SCREWS. PAR. 18	15	INSPECT FLASHGUN BATTERIES FOR CORROSION, BULGING. PAR. 26 f						
12	INSPECT FLASH GUN CONTACTS FOR CORROSION, RUST, PITTING, DIRT. PAR. 20 f	16	INSPECT FILM SPOOLS AND MAGAZINES FOR DEFORMATION, BENT FLANGES.						
13	INSPECT LENS FOR PROPER SEATING IN LENS MOUNT. PAR. 26	17	CLEAN TRIPOD OF DIRT, GRIME, RUST, MOISTURE.						
14	INSPECT VIEWFINDER FOR FIRM MOUNTING IN PROPER POSITION. PAR. 40	18	SET SHUTTER TO PROPER POSITION WHEN NOT IN USE. PAR. 41						
19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.									

DA FORM 11-254  
1 MAY 52

REPLACES DA AGO FORM 429, 1 DEC 50, WHICH IS OBSOLETE.

TM 2352B-25

Figure 27. DA Form 11-254.

**SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT  
STILL CAMERA SET**

**INSTRUCTIONS:** See other side  
EQUIPMENT NOMENCLATURE \_\_\_\_\_ EQUIPMENT SERIAL NO. \_\_\_\_\_

**LEGEND FOR MARKING CONDITIONS:** ✓ Satisfactory; X Adjustment, repair or replacement required; ⊕ Defect corrected.  
**NOTE:** Strike out items not applicable.

NO.	ITEM	NO.	ITEM
1	INSPECT FOR COMPLETENESS OF EQUIPMENT: LENS, CARRYING CASE, ACCESSORIES, TECHNICAL MANUALS, ALL RUNNING SPARE PARTS. <b>PAR. 17 c</b>	16	INSPECT FILM SPOOLS AND MAGAZINES FOR DEFORMATION, BENT FLANGES.
2	CLEAN CARRYING CASE OF DIRT AND OIL (Outdoor use).	17	CLEAN TRIPOD OF DIRT, GRIME, RUST, MOISTURE.
3	INSPECT CARRYING CASE AND STRAPS FOR CRACKS, WEAR, BROKEN SNAP FASTENER, FUNGUS (Outdoor use). <b>PAR. 17</b>	18	SET SHUTTER TO PROPER POSITION WHEN NOT IN USE. <b>PAR. 41</b>
4	INSPECT EXTERIOR OF CAMERA FOR DUST, DIRT, LINT, MOISTURE, CORROSION, RUST, OIL, GREASE, CRACKS, CHIPS. <b>PAR. 26 d</b>	19	INSPECT FOR PROPER TENSION: SHUTTER, EYEPiece, CURTAIN SPRINGS, CURTAIN WINDING GEAR. <b>PAR. 58</b>
5	CLEAN LENS AND LENS MOUNTING OF DUST, DIRT, FINGERMARKS, AND MOISTURE, USING A CAMEL'S HAIR BRUSH AND LENS TISSUE. (Do not use alcohol, polishing material or solvents, or rub lens with fingers). <b>PAR. 26 c</b>	20	INSPECT FOR LIGHT LEAKS - SHUTTER, BELLOWS, LIGHT-LOCK DOOR AND COVER. <b>PAR. 58</b>
6	INSPECT LENS MOUNTING BARREL FOR CORROSION, ROUGHNESS, WORN SPOTS, BINDING THREADS. <b>PAR. 49</b>	21	INSPECT FOR PROPER SEATING - COVER LOCKING STUD.
7	INSPECT ACCESSORY CLIP FOR DEFORMED RAILS AND STOP LUG.	22	INSPECT CURTAIN FOR STRETCHING DUE TO WEATHER. <b>PAR. 97 g (3)</b>
8	INSPECT CAMERA INTERIOR FOR FILM CHIPS, DUST, CORROSION, MILDEW, FUNGUS, MOISTURE, DUST, OIL. <b>PAR. 58</b>	23	INSPECT GEARS FOR BROKEN TEETH, POOR WESHING.
9	INSPECT ALL CONTROLS AND KNOBS FOR FREE MOVEMENT. <b>PARS. 33 AND 37</b>	24	TIGHTEN ALL LOOSE ASSEMBLY AND MOUNTING SCREWS TO A HAND-TIGHT FIT. <b>PARS. 96 e, 98 i, 99 e AND 100 c</b>
10	INSPECT FILTERS AND PEEPSIGHTS FOR LINT, DUST, DIRT, MOISTURE. <b>PAR. 26 d</b>	25	INSPECT FLASH SYNCHRONIZER FOR PROPER OPERATION. <b>PAR. 23 g</b>
11	TIGHTEN TO A HAND-TIGHT FIT - ALL LOOSE ASSEMBLY AND MOUNTING SCREWS. <b>PAR. 18</b>	26	INSPECT SLOW SPEED DIAL FOR ACCURACY.
12	INSPECT FLASH GUM CONTACTS FOR CORROSION, RUST, PITTING, DIRT. <b>PAR. 26 f</b>	27	INSPECT TRIPOD FOR BINDING OR STRIPPED MOUNTING THREADS, SPLIT OR BROKEN WOOD, LOOSE OR MISSING SCREWS, FREE MOVEMENT OF TILT-TOP HEAD. <b>PARS. 18 g AND 101 d (2)</b>
13	INSPECT LENS FOR PROPER SEATING IN LENS MOUNT. <b>PAR. 26</b>	28	DISASSEMBLE LENS MOUNTING AND CLEAN INTERIOR OF LENS AND LENS MOUNTING BARREL. <b>PAR. 49</b>
14	INSPECT VIEWFINDER FOR FIRM MOUNTING IN PROPER POSITION. <b>PAR. 49</b>	29	DISASSEMBLE CAMERA TO TIGHTEN INACCESSIBLE SCREWS TO A HAND-TIGHT FIT. <b>PARS. 98, 99, 99 AND 100</b>
15	INSPECT FLASHGUN BATTERIES FOR CORROSION, BULGING. <b>PAR. 26 f</b>	30	LUBRICATE CAMERA IN ACCORDANCE WITH THE SPECIFIED DEPARTMENT OF THE ARMY LUBRICATION ORDER. <b>PARS. 51 AND 96</b>
		31	INSPECT CAMERA FOR PROPER MOISTURE AND FUNGUS PROOFING. <b>PAR. 23</b>

32 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

**DA FORM 11-255**  
1 MAY 53

REPLACES DA 460 FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 2352B-26

Figure 28. DA Form 11-255.

vidual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

*b.* This manual contains preventive maintenance information that will aid in completing the forms. Circled items in figures 27 and 28 are partially or totally applicable to the camera set.

### Section III. LUBRICATION

#### 51. General

Carefully follow the periodic lubrication instructions given in the lubrication illustration (fig. 29). When lubricating, observe the following precautions:

*a.* Clean the parts with a soft, clean brush or a cloth slightly dampened with solvent, SD. Thoroughly dry all parts. Do not allow the cleaning fluid to get on the lenses or focal plane curtain. Periodically check the focal plane curtain action. Slowed-up or noisy curtain action indicates the need for removing old lubricants, cleaning parts, and applying fresh lubricants.

*b.* Be careful not to get lubricants or solvent on the rubberized fabric of the focal plane curtain. If these materials do contact the curtain, carefully wipe the curtain with a dry cloth. Be careful to prevent lubricants from getting on electrical contacts. If this happens, wipe them clean, with a cloth moistened with solvent SD.

**Caution:** Remove excess lubricant from all parts of the equipment immediately. Overlubrication can cause damage to the equipment.

#### 52. Lubrication Under Unusual Conditions

In tropical climates, proper lubrication is important in the equipment operation. Lubricate the equipment frequently so that a film of oil is present at all times in joints and bearings to seal out moisture, especially from perspiration which has a highly corrosive effect and an inclination to encourage fungus growth.

### Section IV. WEATHERPROOFING

#### 53. Weatherproofing

*a. General.* Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

*b. Tropical Maintenance.* A special moistureproofing and fungi-proofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is fully described in TB SIG 13, and TB SIG 72.

Lubricant - Interval

Interval - Lubricant

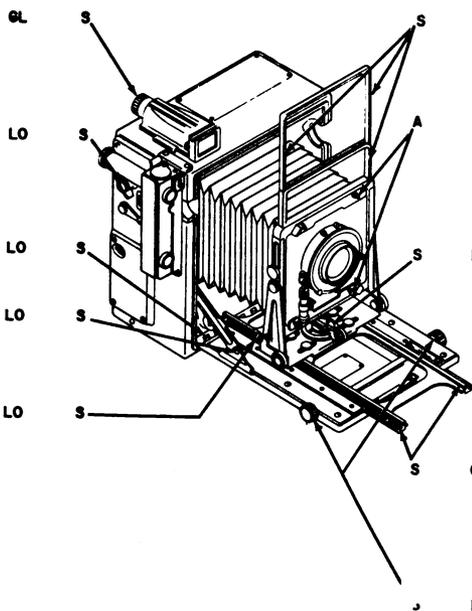
**Optical Viewfinder**  
Apply light film of lubricant to surface of housing that lens barrel rotates on.

**Focal Plane Shutter Curtain Winding Key Shaft Bearing**  
1 drop.

**Camera Bed Hinge**  
1 drop on each section.

**Bed Brace**  
1 drop on hinge, plunger, guide plate slots.

**Carriage Links**  
1 drop on each end of right and left link.



**PL** Front Sight (frame finder)  
Wipe with cloth lightly coated with lubricant.

**PL** Lensboard Slide Locks (upper and lower)  
Rub along inside surface with cloth lightly covered with lubricant.

**LO** Front Lock Lever  
1 drop under face of lever.

**GL** Carriage and Guide Rails  
With carriage fully extended apply lubricant sparingly on riding surfaces.

**LO** Focusing Shaft  
1 drop each end of pinion and each bearing surface

**Focal Plane Shutter Curtain Roller Shaft Bearings**  
2 drops on each bearing.

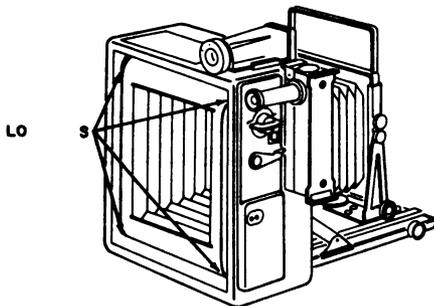


TABLE OF LUBRICANTS	
Lubricants	Stock No.
Oil, Lubricating, Light (LO)	QMC-14-0-1338-60
Grease, Aircraft and Instruments (GL)	QMC-14-G-610-900
Oil, Lubricating, Preservative, Special (PL)	QMC-14-0-2633-992
S - Semiannually A - Annually	

TM2352B-27

Figure 29. Lubrication of camera.

*c. Arctic Maintenance.* Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are fully explained in TB SIG 66 and TB SIG 219.

*d. Desert Maintenance.* Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are fully explained in TB SIG 75.

*e. Lubrication.* The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69. Observe all precautions in TB SIG 69 and pay strict attention to all lubrication orders when operating under conditions of extreme cold or heat. Refer to paragraphs 51 and 52 for detailed instructions and precautions.

#### **54. Rustproofing and Painting**

Complete refinishing is a function of organizations engaged in reconditioning equipment. Do not attempt fungiproofing at lower maintenance levels unless absolutely necessary. To remove old finish, use a paint and varnish remover on painted parts after stripping them. Wash off paint remover residue with turpentine, followed by solvent SD, before applying any new finish. Apply new finishes with a soft bristle brush or a spray gun after priming and masking off the strike plates and shafts.

**Caution:** Do not use steel wool. Minute particles frequently enter the shutter case and cause shorting and grounding of flash circuits. Never use lye solution or any harsh cleaning agent for cleaning aluminum or wood parts.

### **Section V. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL**

#### **55. General**

Familiarity with the equipment through operation will help the unit repairman diagnose and make various minor repairs. Any departure from usual performance must be checked, its cause discovered, and repairs made. Major repairs of the equipment that cannot be performed by the unit repairman must be referred to higher repair authority.

#### **56. Visual Inspection**

Check the equipment for light leakage into the camera through cracks or around loose parts. Any open screw hole that admits light will fog the film and render photographs worthless. The shutter assembly must close completely. To inspect for light leakage of the shutter, hold the camera lens to the light with the back removed.

Operate and check each shutter separately. From the open back of the camera, look through the lens while operating the shutter at different speeds. Similarly check the bellows for light leaks. The focusing panel should be removed so that a light bulb can be used to detect fine pin holes in the bellows. Check the focal plane shutter curtain for light leakage by removing the lens board; hold the camera up to the light and view through the lens board opening while slowly winding the shutter curtain. Check all operating controls and adjustments to see that they operate smoothly. Check the cause of any unusual stiffness or binding. To correct it, apply a lubricant, if necessary, or suitably adjust it.

## **57. Troubleshooting With Equipment Performance Check List**

The equipment performance check list (par. 58) will help locate trouble in the equipment. To use this list effectively, always follow the items in their numerical sequence.

*a. Action or Condition.* For some items, the information given in the action or condition column consists of various control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the normal indications column.

*b. Normal Indications.* This column lists the visible signs to be checked. These signs are normal indications. The unit repairman should apply the recommended corrective measures for any deviation from these conditions or return the equipment to the depot for repair.

*c. Corrective Measures.* The remedies listed are those which must be accomplished by an experienced repairman. If the equipment is completely inoperative and the recommended corrective measures will not yield results, return the equipment to the depot for overhaul or repair.

## **58. Equipment Performance Check List**

The equipment performance check list for the operative components of the camera set is given below. If in doubt concerning the normal indication when performing the actions listed in this check list refer to chapter 3 for operating information for the particular component.

Item No.	Item	Action or condition	Normal indications	Corrective measures
1	Bed latch button (fig. 4)	Push to open camera.	Camera opens.	Lubricate or straighten bent parts.
2	Front lock lever (fig. 5)	Pull out and turn to lock standard.	Camera front comes out and locks to carriage.	Lubricate lock or carriage, or straighten bent or misaligned parts.
3	Focusing knobs (fig. 5)	Turn.	Camera front racks in and out for focusing.	Lubricate or straighten bent or misaligned carriage guides.
4	Rising front locknuts (fig. 5).	Loosen.	Front assembly raises or lowers.	Straighten any bent parts causing binding.
5	Tilt locknuts (fig. 5)	Loosen.	Front assembly tilts.	Straighten or adjust any bent parts.
6	Lateral shift spring catch (fig. 5).	Depress for lateral shift.	Front moves left or right.	Straighten or adjust any bent parts.
7	Bed braces (fig. 4)	Depress to drop bed.	Bed drops.	Replace damaged braces.
8	Front sight (fig. 9)	Raise.	Rises to operating position.	Clean and lubricate, or replace if badly bent.
9	Rear peep sight (fig. 9)	Raise.	Swings up to operating position.	Straighten or replace if badly bent.
10	Cut film holders or film pack adapters (fig. 12 and 13).	Load film.	Film loads easily; dark slides fit into place.	Replace warped dark slides or defective holders and adapters
11	Tripod (fig. 14)	Set up for use.	Tripod stands firmly.	Tighten locking screws; replace defective parts.
12	Lens hood and/or filter mount (fig. 11).	Fit onto lens.	Slips on easily.	Bend slotted mounting collar in or out to obtain snug fit.
13	Between-the-lens shutter (fig. 7).	Operate stop lever. Adjust speed cam.	Moves across scale to desired <i>f</i> opening. Turns smoothly to desired speed. Normally difficult to move from 200 to 400.	Disassemble shutter. Disassemble shutter.

P R E P A R A T O R Y

	Operate cocking lever. . . . . Depress press-focus lever after cocking. Press shutter release lever. Connect shutter release cable to cable release socket. Set synchronizer to proper setting. Turn winding key. . . . . Move speed control indicating lever forward or backward. Press shutter release lever. Press. . . . . Look through extension eyepiece while turning focusing knobs. Insert holder or adapter into camera.	Cooking lever operates smoothly and shutter is cocked. Opens shutter; lift lever to close shutter. Shutter operates smoothly. . . . . Shutter operates smoothly. . . . . Moves across scale to desired time-delay setting. Curtain winds up and desired speed appears on indicator dial. Changes speed indicated on dial. . . . . Shutter operates smoothly. . . . . Hood opens. . . . . Images superimpose properly. . . . . Holder or adapter slides into place in camera back.	Disassemble shutter. Disassemble shutter. Meanwhile use TIME setting to keep shutter open. Disassemble shutter. Replace shutter release cable. Disassemble shutter. Lubricate roller bearings or disassemble shutter. Disassemble shutter. Lubricate roller bearings or disassemble shutter. Straighten bent parts or replace. Check range finder. Disassemble back; replace defective parts.
14	Focal plane shutter (fig. 9). . . . .		
15	Hood release clip (fig. 9). . . . .		
16	Range finder (fig. 9). . . . .		
17	Film holder or film pack adapter (figs. 12 and 13). . . . .		

N O I L V E F A O

Item No.	Item	Action or condition	Normal indications	Corrective measures
OPERATION	18 Flash lamp flasher (figs. 5 and 18).	Install on camera. Depress lamp firing switch. Operate focal plane shutter release lever.	Snaps easily into place. Solenoid operates, lamp flashes, and shutter operates. Lamp flashes and shutter operates.	Check for bent or misaligned parts; replace defective parts. Check batteries; check all contacts. Disassemble shutter and check contacts in shutter. Disassemble solenoid. Check batteries; check all contacts. Disassemble shutter and check curtain contacts; replace curtain. Check batteries; check all contacts. Disassemble shutter and check curtain contacts; replace curtain.
	19 Between-the-lens shutter (fig. 7).	Depress shutter release lever.	Shutter uncocked, released, closed.	Disassemble shutter.
	20 Focal plane shutter (fig. 9).	Operate focal plane shutter release lever.	Speed indicator dial registers 0 (open).	Disassemble shutter.
STOP	21 Camera (figs. 3 and 5)	Clean. Push front assembly back and close camera. Be sure carriage assembly and front standard are recessed fully.	Camera perfectly clean. Camera closes.	Clean camera and lenses. Check for abnormal adjustments (rising, tilting, shifting front). Correct.

## CHAPTER 5

### AUXILIARY EQUIPMENT

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#### 59. Exposure Meter

To determine the correct exposure to be used when taking a picture, an exposure meter is generally used. Either Exposure Meter PH-260 or PH-260-A may be used. For information on the use of these meters, refer to TM 11-2356, Exposure Meters PH-260 and PH-260-A. This manual covers the details, description, and operating procedure of the different meters.

#### 60. Wide-Angle Lens

a. Lens LE-6(1) (Sig C stock No. 8A2308-17) can be used with the camera set. This is a 90-mm wide-angle lens that is equipped with a between-the-lens shutter. The lens has the following characteristics:

**Lens :**

General .....	90-mm ( $3\frac{1}{2}$ "') $f/6.8$ anastigmat, anti-reflection coated.
Angle of coverage .....	$84^\circ$ on 4- by 5-inch film.
Diaphragm openings .....	Click stop adjustment $f/6.8$ , $f/11$ , $f/16$ , $f/22$ , and $f/32$ .

**Between-the-lens shutter :**

Type .....	Synchronized, adjustable to three lamp types. Hand or solenoid operated.
Speed settings .....	Time (T), bulb (B), 1, $1/2$ , $1/5$ , $1/10$ , $1/25$ , $1/50$ , $1/100$ , $1/200$ , and $1/400$ .

b. Lens LE-6(1) is similar to the lens and between-the-lens shutter assembly that is supplied with the camera. The main differences are in the diaphragm openings ( $f/4.5$  for the 125-mm lens supplied with the camera) and in the synchronization adjustment. The 90-mm lens shutter has two M settings; the white one is used with fast speeds, 100, 200, and 400 (black on the speed adjusting ring); the red one is used with the slower speeds, T, B, 1, 2, 5, 10, 25, and 50 (red on the speed adjusting ring). When set to the red M, the synchronizing mechanism adds a 12-millisecond delay to the exposure time and when set to the white M, the delay is approximately 15 milliseconds. This choice permits full use of the light that is produced by foil-filled flash lamps for different length exposures.

c. For best results, use a diaphragm opening of  $f/11$  or smaller when using the 90-mm lens. The larger aperture ( $f/6.8$ ) facilitates focusing on the ground glass.

*d.* To install Lens LE-6(1) on the camera, remove the lens board from the camera (par. 98a) and install LE-6(1). Operation of the camera with the 90-mm lens is the same as that described in paragraph 39. However, be sure to drop the bed assembly to exclude it from view.

*Note.* The rangefinder on the KE-12(1) is not coupled to Lens LE-6(1).

# CHAPTER 6

## THEORY

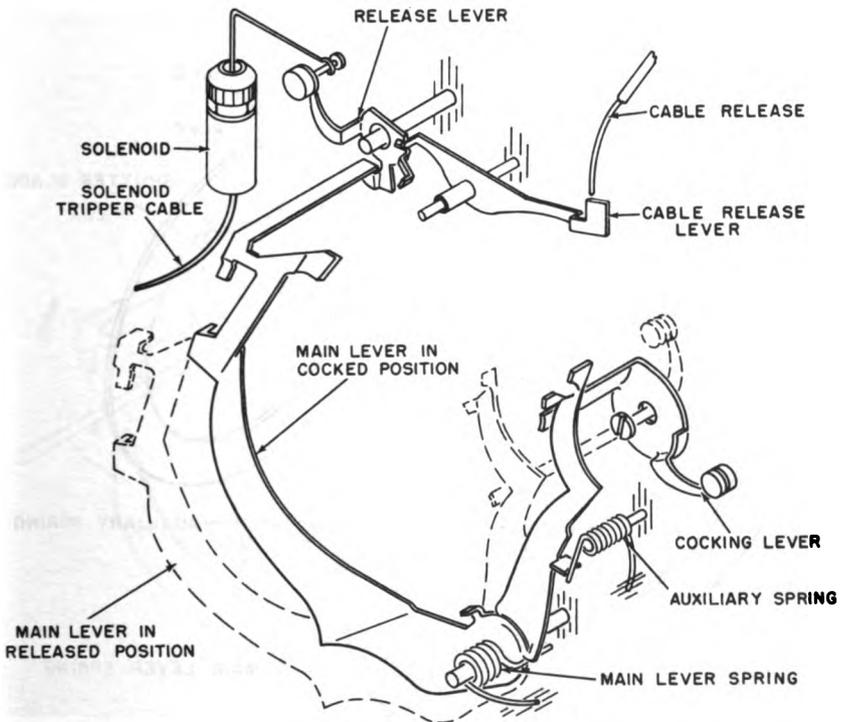
### Section I. THEORY OF BETWEEN-THE-LENS SHUTTER

#### 61. General

The theory of operation of the between-the-lens shutter is presented in five parts (pars. 62-66). These are the function of manual controls, shutter opening and closing mechanism, manual time exposure, instantaneous exposure, and synchronizing mechanism. In the schematic diagrams on shutter theory, the shape of some component parts has been somewhat distorted to aid the functional description.

#### 62. Function of Between-the-Lens Shutter Manual Controls

*a. Cocking Lever.* Manually depressing the cocking lever moves the main lever clockwise to a cocked position (fig. 30) against the



TM23528-28

Figure 30. Cocking shutter, showing main lever action, schematic diagram.

tension of the main lever spring and the auxiliary spring. The main lever is locked in this position by the release lever and the shutter is ready for an exposure.

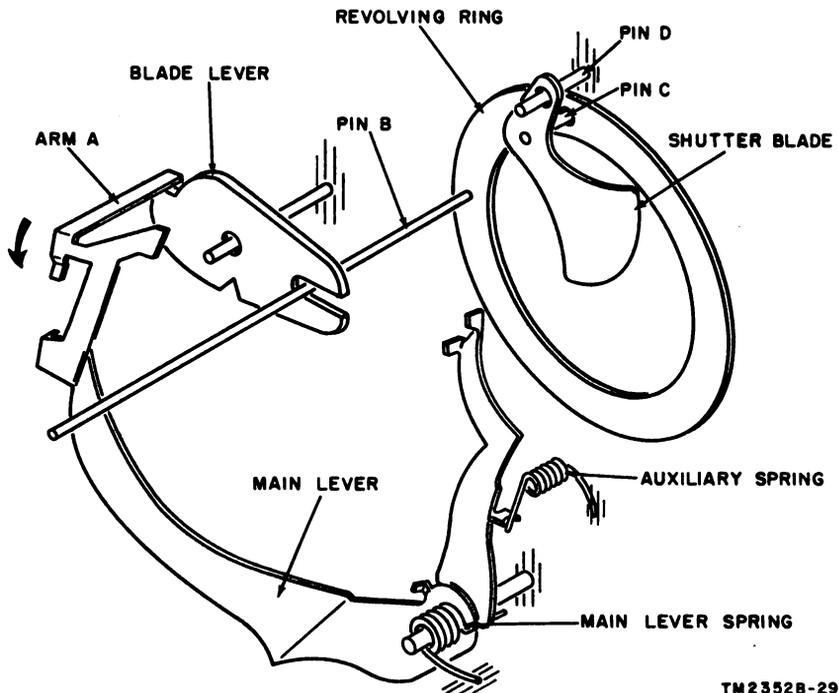
*b. Speed Cam.* Manually setting the speed cam positions the various mechanisms in the shutter. This positioning controls the mechanisms that govern the length of time that the shutter will stay open when the exposure is made. These mechanisms are described in paragraphs 64 and 65.

*c. Release Lever.* Operating the release lever (fig. 30) unlocks the cocked main lever and permits it to rotate counterclockwise to a released position because of the tension of the main lever spring and the auxiliary spring. The release lever can be operated manually or electrically by the solenoid, or mechanically through the cable release. The solenoid is electrically actuated by the flash-lamp flasher (par. 75).

*d. Focus Lever.* Refer to paragraph 63*d* for the function of the focus lever.

### 63. Shutter Opening and Closing Mechanism

*a. Shutter Opens.* Operating the release lever permits the main lever to rotate counterclockwise (par. 62*e*). As the main lever starts to rotate, arm A (fig. 31) of the main lever rotates the blade lever

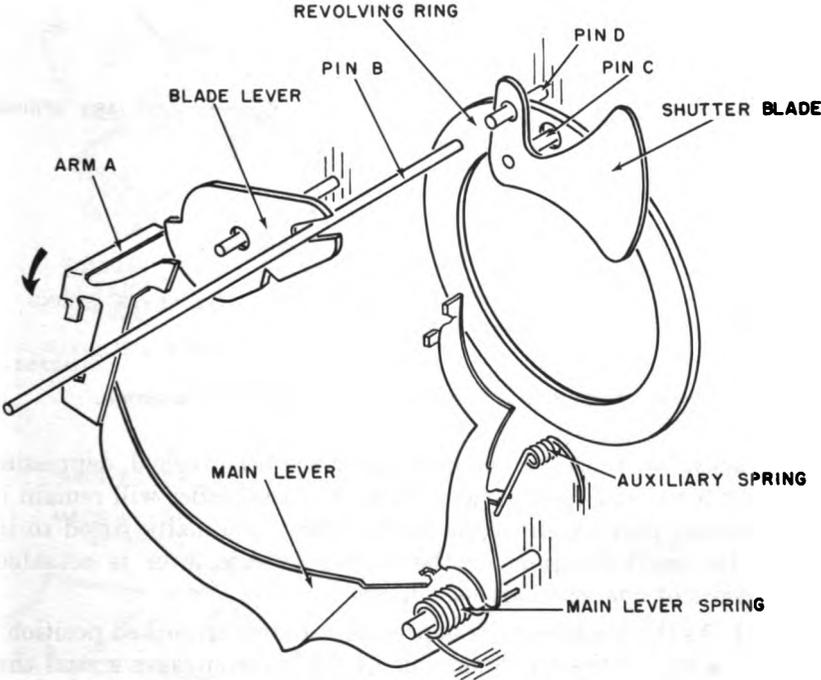


TM 23528-29

Figure 31. Shutter opening mechanism, schematic diagram.

counterclockwise. Because pin B is mounted on the revolving ring and is engaged in the slot of the blade lever, counterclockwise rotation of the blade lever results in clockwise rotation of the revolving ring. Pin C of the shutter blade fits into a hole of the revolving ring, and pin D, which is fixed, fits into a hole of the shutter blade. Thus, when the revolving ring rotates clockwise, it carries pin C around and the shutter blade rotates counterclockwise around pin D. Counterclockwise rotation of the shutter blade clears the shutter opening. Only one of five identical shutter blades is shown in figure 31; the other four blades are mounted identically to the one shown, slightly overlapping, and all five shutter blades open simultaneously. The shutter opening operation occurs almost instantaneously when the release lever is operated, because a counterclockwise movement of the main lever of less than 5° is sufficient to open the shutter blades completely.

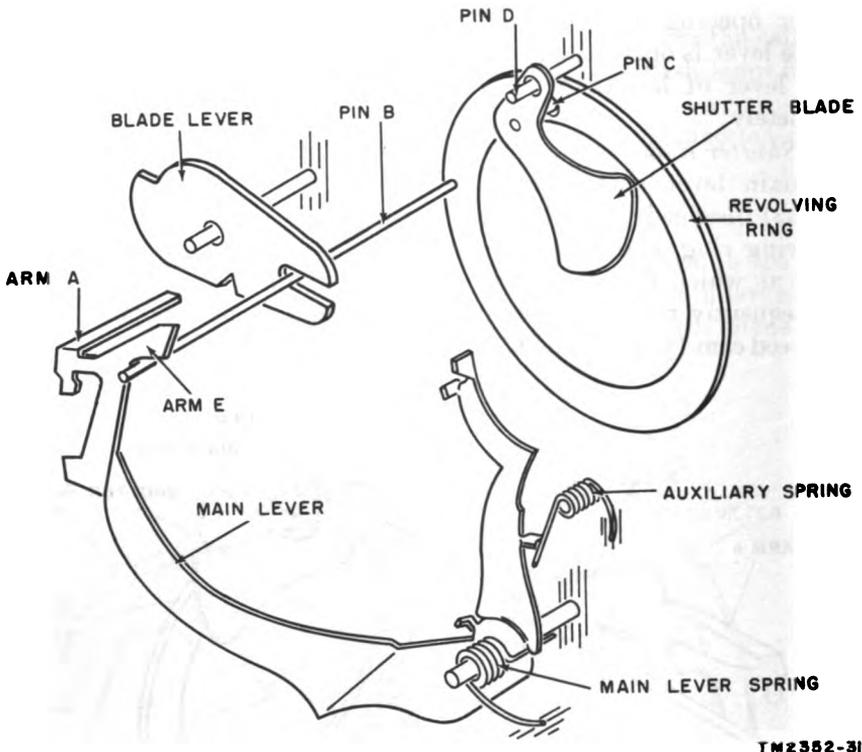
*b. Shutter Remains Open for Exposure.* After the shutter is open, the main lever continues its counterclockwise rotation. Arm A (fig. 32) disengages the blade lever, stops the clockwise rotation of the revolving ring, and causes the shutter blades to remain open. The speed at which the main lever continues to rotate counterclockwise (consequently the exposure time) is determined by the position of the speed cam (pars. 64 and 65).



TM2352B-30

Figure 32. Position of parts during exposure, schematic diagram.

*c. Shutter Closes.* Continued counterclockwise rotation of the main lever (fig. 33) causes arm E of the main lever to engage pin B and pull the revolving ring counterclockwise. This rotation of the revolving ring carries pin C counterclockwise and because pin D is fixed, the shutter blades rotate clockwise and close the opening. (For clarity, only one of five identical shutter blades is shown in figure 33.) The shutter closing operation occurs very rapidly. When the shutter blades close, the main lever has reached its extreme counterclockwise (released) position and remains so positioned until the cocking lever (fig. 30) is again actuated.

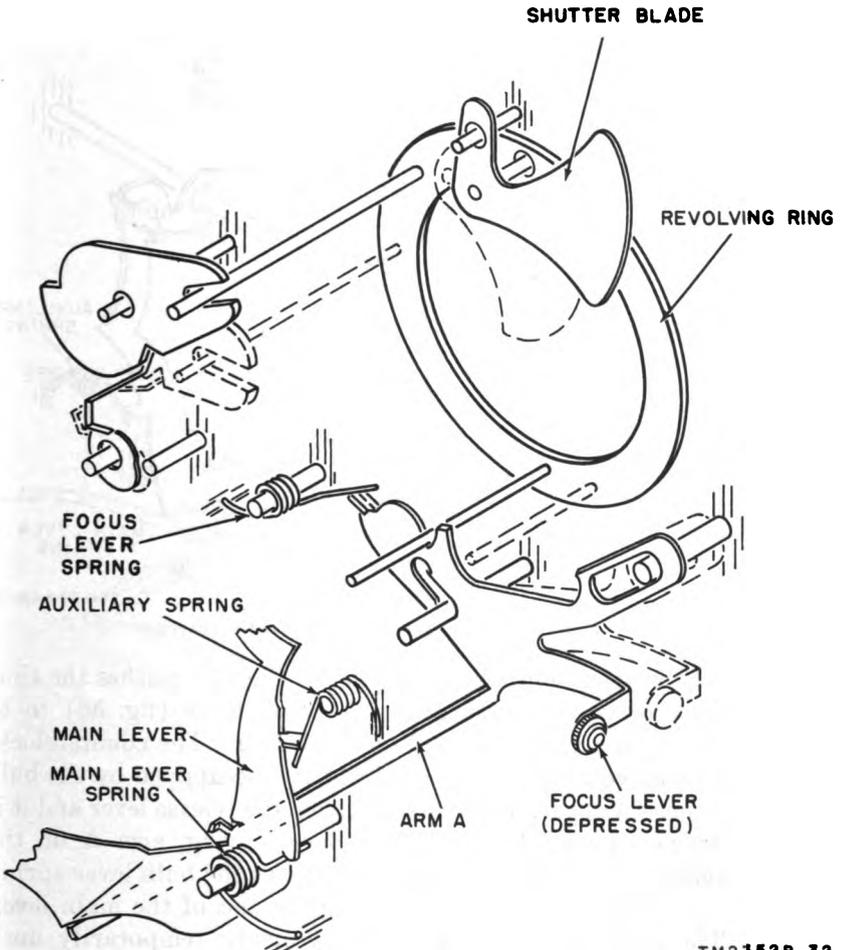


*Figure 33. Shutter closing mechanism, schematic diagram.*

*d. Focus Lever.* After the main lever has been cocked, depressing the focus lever will open the shutter blades; the blades will remain in fully opened position until the focus lever is manually lifted to its raised (normal) position, or the shutter release lever is actuated. Both cycles of operation are as follows:

- (1) As the focus lever is depressed (shutter in cocked position), a slot in the left-hand side of the lever engages a stud that is attached to the revolving ring.

- (2) The focus lever pushes the revolving ring stud downward in a clockwise direction, and opens the shutter blades. If the action is observed while the shutter is open for inspection, it will be seen that the blade lever moves also. This blade lever action, however, is caused by its engagement with the blade lever stud on the revolving ring and is independent of any main lever action during this cycle of operation.
- (3) When the focus lever is raised manually to its normal (closed) position, the action described in (2) above is reversed.
- (4) If the shutter release lever is depressed while the focus lever is in the depressed (open) position, the shutter blades will close normally (c above). The tension that is exerted by the main lever spring and the auxiliary spring (fig. 34) will overcome the tension of the focus lever spring that is exerted on the focus lever as arm E (fig. 33) pulls the revolving stud



TM 2352B-32

*Figure 34. Action of focus lever, schematic diagram.*

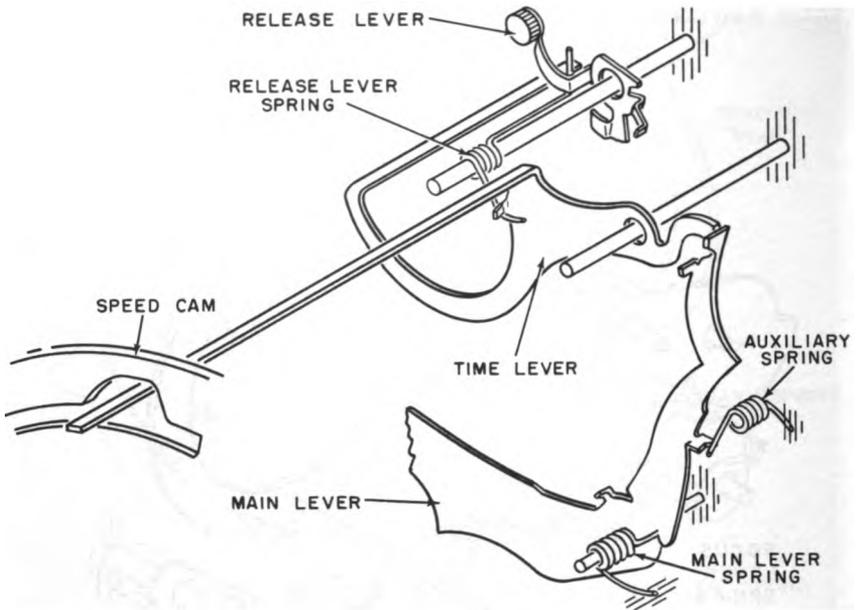
to close the shutter blades. As the shutter closes, the focus lever returns to its normal (closed) position and disengages from its revolving ring stud.

## 64. Manual Time Exposure

This paragraph describes the theory of operation of the between-the-lens shutter during a time exposure, with the speed cam set to T (time) or B (bulb).

### a. Time Exposure.

- (1) After the cocking lever has been actuated to cock the main lever, and the speed cam has been set to the T position, pressing the release lever frees the main lever and permits it to rotate counterclockwise to open the shutter (par. 63a).



TM 23 528-33

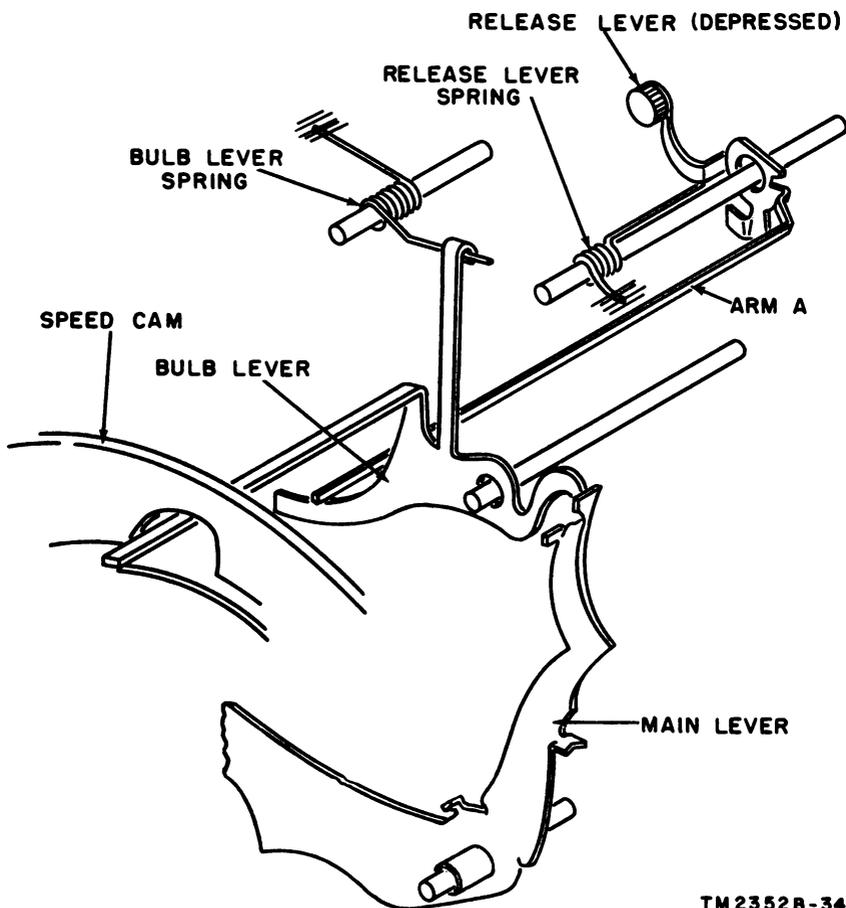
Figure 35. Function of time lever, schematic diagram.

- (2) At the same time, the release lever (fig. 35) pushes the time lever downward and allows the bulb lever (fig. 36) to be drawn upward by the bulb lever spring. The counterclockwise movement of the main lever is first stopped by the bulb lever. As pressure is removed from the release lever and it is drawn upward by the release lever spring, arm A on the release lever moves upward and allows the bulb lever spring to disengage the bulb lever from the end of the main lever. The main lever motion is then resumed temporarily until the motion is stopped by the time lever. The shutter blades

will now remain open until the release lever is again depressed.

- (3) When the release lever is depressed for the second time, the time lever is moved counterclockwise sufficiently by the release lever to release the main lever and allow it to continue to move counterclockwise to close the shutter blades (par. 63c).

*b. Bulb Exposure.* When the speed cam is set to the B position and the main lever is cocked, operation of the release lever frees the main lever and permits it to rotate counterclockwise to open the shutter (par. 63a). Setting the speed cam to the B position prevents the release lever from operating the time lever. As the release lever (fig. 36) is depressed, the bulb lever rotates clockwise by the pull that is exerted by its spring, and the counterclockwise rotation of the main lever is stopped by the bulb lever. As the release lever is released and returned to normal by tension of its spring, the bulb lever is pulled back



TM 2352B-34

Figure 36. Function of bulb lever, schematic diagram.

counterclockwise by arm A of the release lever. Therefore, it permits the main lever to continue to rotate counterclockwise to close the shutter (par 63c).

### 65. Instantaneous Exposures

This paragraph describes the theory of operation of the mechanisms that control the length of time the shutter remains in an open position during instantaneous exposures. The opening and closing of the shutter takes place as described in paragraph 63a and c. The time control mechanism controls the speed of the counterclockwise rotation of the main lever after the shutter has opened. Generally, the main lever is retarded during an instantaneous exposure when the speed cam is on any setting except 400. When the speed cam is set at 400, the main lever is accelerated.

a. *Speed Cam at 25 or 50.* When the speed cam is set at 25 or 50, which setting corresponds to 1/25 or 1/50 seconds, respectively, counterclockwise rotation of the main lever (fig. 37) is retarded by the

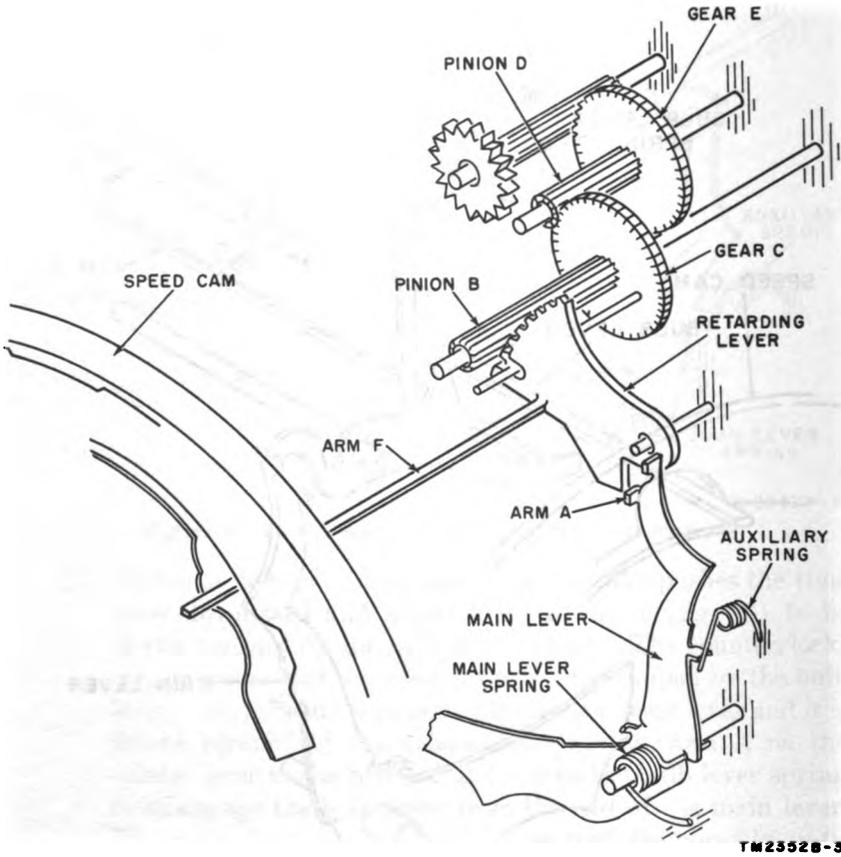
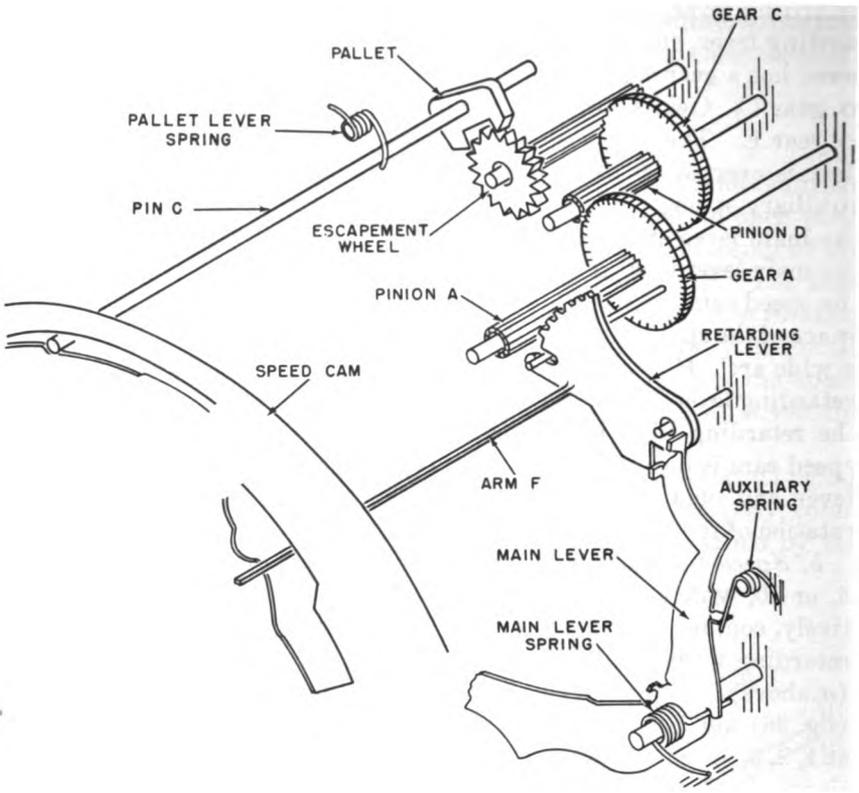


Figure 37. Time control mechanism set at 25 or 50, schematic diagram.

retarding lever. Arm A of the main lever engages a slot in the retarding lever, and causes the lever to rotate clockwise. The retarding lever has a gear segment that meshes with pinion B which is fastened to gear C. Gear C, in turn, meshes with pinion D which is fastened to gear E. The inertia that this gear train presents opposes the force that is exerted on the main lever by the main lever spring and the auxiliary spring. Thus, it retards the counterclockwise movement of the main lever and lengthens the interval of time that is required for the main lever to start the shutter closing operation (par. 63*c*). When the speed cam is set at 25, arm F of the retarding lever fits into a wide space of the speed cam, and the retarding lever is free to rotate through a wide arc. However, when the speed cam is set at 50, arm F of the retarding lever fits into a narrow space of the speed cam and, therefore, the retarding lever is limited to rotate through a narrow arc. The speed cam is designed to produce the proper retardation of the main lever and obtain the selected exposure time by limiting the arc of rotation of the retarding lever.

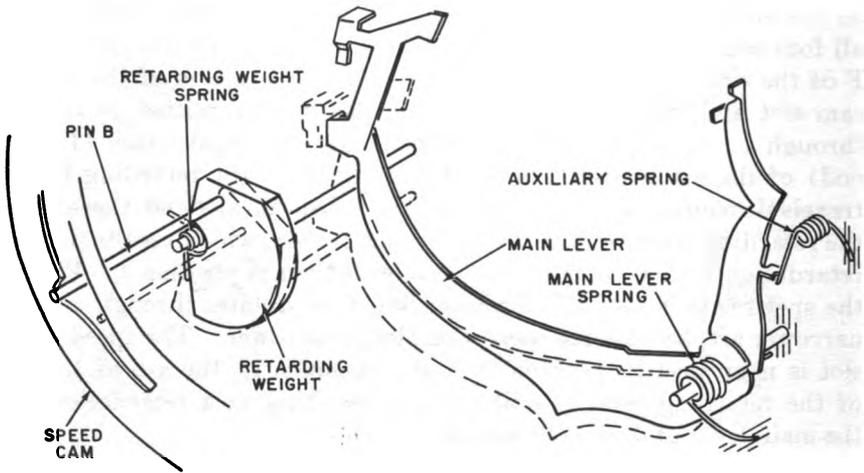
*b. Speed Cam at 1, 2, 5, or 10.* When the speed cam is set at 1, 2, 5, or 10, which corresponds to 1, 1/2, 1/5, and 1/10 second, respectively, counterclockwise rotation of the main lever is retarded by the retarding lever and by the inertia that is presented by the gear train (*a*, above). However, additional retardation is provided by the pallet (fig. 38) and the escapement (star) wheel when the speed cam is set at 1, 2, 5, or 10. When the speed cam is set to any of these four positions, pin C moves the pallet toward the escapement wheel which is being driven by the retarding lever through gears A and C. Rotation of the escapement wheel and, therefore, rotation of the retarding lever, is retarded by the back-and-forth rocking action of the pallet on the teeth of the escapement wheel. This retardation takes place in all four settings of the speed cam (1, 2, 5, and 10). In setting 1, arm F of the retarding lever travels within the wide section of the speed cam slot and, therefore, the retarding lever is permitted to rotate through a wide arc, which results in the greatest retardation (1 second) of the main lever. In setting 2, arm F of the retarding lever travels through a narrower section of the speed cam slot and, therefore, the retarding lever rotates through a smaller arc, which results in less retardation (1/2 second) of the main lever than in position 1. When the speed cam is set to 5, the retarding lever rotates through a still narrower arc, because the speed cam slot is narrower. The speed cam slot is narrowest in position 10 and, consequently, the arc of travel of the retarding lever is still smaller, resulting in a retardation of the main lever of only 1/10 second.

*c. Speed Cam at 100 or 200.* When the speed cam is set at 100 or 200, which corresponds to 1/100 and 1/200 second, respectively, counterclockwise rotation of the main lever (fig. 39) is retarded by the



TM2352B-36

Figure 38. Time control mechanism set at 1, 2, 5, or 10, schematic diagram.



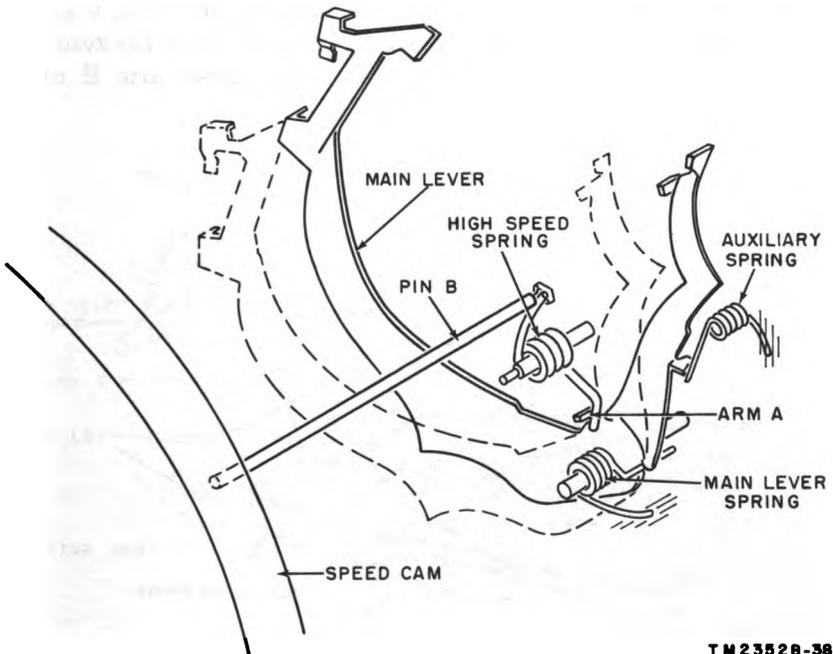
TM2352B-37

Figure 39. Time control mechanism at 100 or 200, schematic diagram.

retarding weight. When the main lever is cocked, the retarding weight is held in a counterclockwise position by the retarding weight spring. When the shutter release lever is depressed, counterclockwise rotation of the main lever is retarded by the inertia that is presented by the retarding weight, plus the tension of the retarding weight spring.

- (1) When the speed cam is set at 100, pin B of the retarding weight swings freely in a wide slot of the speed cam; therefore, rotation of the main lever is opposed by the full inertia offered by the retarding weight.
- (2) When the speed cam is set at 200, pin B of the retarding weight does not permit the retarding weight to swing fully counterclockwise. This limits its travel approximately half-way. When the main lever engages the retarding weight, the inertia that is presented by approximately only half of the retarding weight has to be overcome; therefore, the rotation of the main lever is less retarded.

*d. Speed Cam at 400.* When the speed cam is set at 400, which corresponds to 1/400 second, counterclockwise rotation of the main lever is accelerated by the high-speed spring (fig. 40). One end of this spring engages arm A of the main lever and the other end is engaged by pin B of the speed cam. Manually rotating the speed cam to a 400 setting winds the high-speed spring. When the release lever is



**Figure 40.** Time control mechanism at 400, schematic diagram.

T M 2352B-36

operated, the speed of the counterclockwise rotation of the main lever, normally caused only by the tension of the main lever spring and the auxiliary spring, is substantially increased by the tension of the high-speed spring and the shutter stays in a fully open position for only 1/400 second.

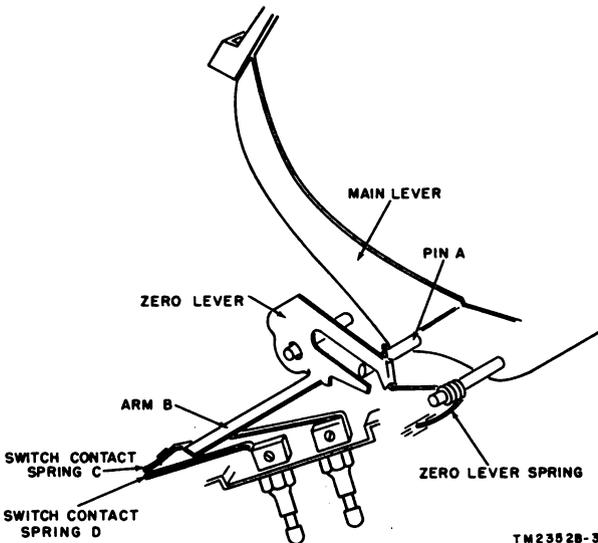
## 66. Synchronizing Mechanism

The synchronizing mechanism of the between-the-lens shutter allows the shutter to open in synchronization with the full brightness of the specific class of flash lamp that is used. The synchronizing mechanism also closes a switch to fire the lamp. The function of the synchronizing mechanism in each of the four settings OFF, X, F, and M, is described in *a* through *d* below.

*a. In OFF Position.* When the synchronizing mechanism is set to the OFF position, the synchronizer is removed from the cycle of operation. Cocking the shutter has no effect on the synchronizing mechanism. When the shutter release lever is depressed, the shutter switch remains inoperative and the synchronizing mechanism has no effect on the operation of the shutter.

*b. In X Position.* When the synchronizing mechanism is set to the X position, cocking the shutter produces the following action:

- (1) The beveled end of pin A (fig. 41) on the main lever slides between the fingers of the zero lever and remains in this position until the shutter release lever is depressed.
- (2) When the release lever is depressed (par. 63*a*), the main lever rotates counterclockwise and pin A pulls the zero lever in a counterclockwise direction; this causes arm B of the



TM2352B-39

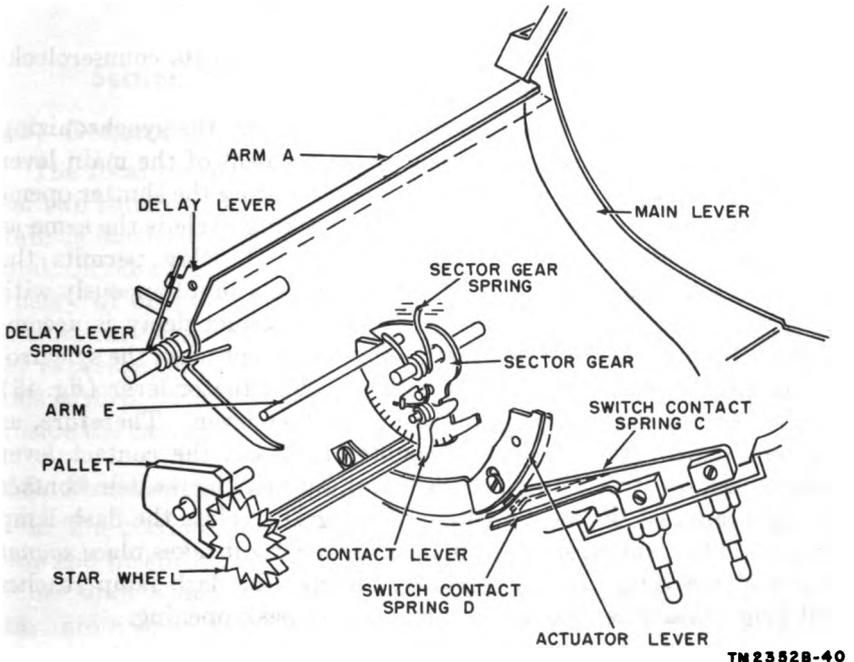
Figure 41. Synchronizing mechanism set to X position, schematic diagram.

zero lever to push switch contact spring C against switch contact D. This action closes the electrical circuit that flashes the lamp (par. 77).

- (3) When the synchronizing mechanism is set to the X position, the shutter switch closes at the instant that the shutter blades reach a fully open position. Position X is used with electronic speed lamp equipment (the lamp reaches full brightness instantaneously); the shutter opening is, therefore, synchronized with the light peak of the lamp.

*c. In F position.*

- (1) When the synchronizing mechanism is set to the F position, cocking the shutter produces this action :
  - (a) The triangular pin on the lower end of the main lever engages the synchronizer sector gear (fig. 42), and pulls it clockwise.
  - (b) As the sector gear rotates on its stud, the teeth on the gear engage the pinion on the star wheel and cause the wheel to rotate.
  - (c) When the main lever is in the fully cocked position, the star wheel stops rotating and the synchronizer sector gear is engaged by the lock lever (12, fig. 67).
- (2) When the shutter release lever is depressed, the synchronizing mechanism closes the shutter switch and retards the

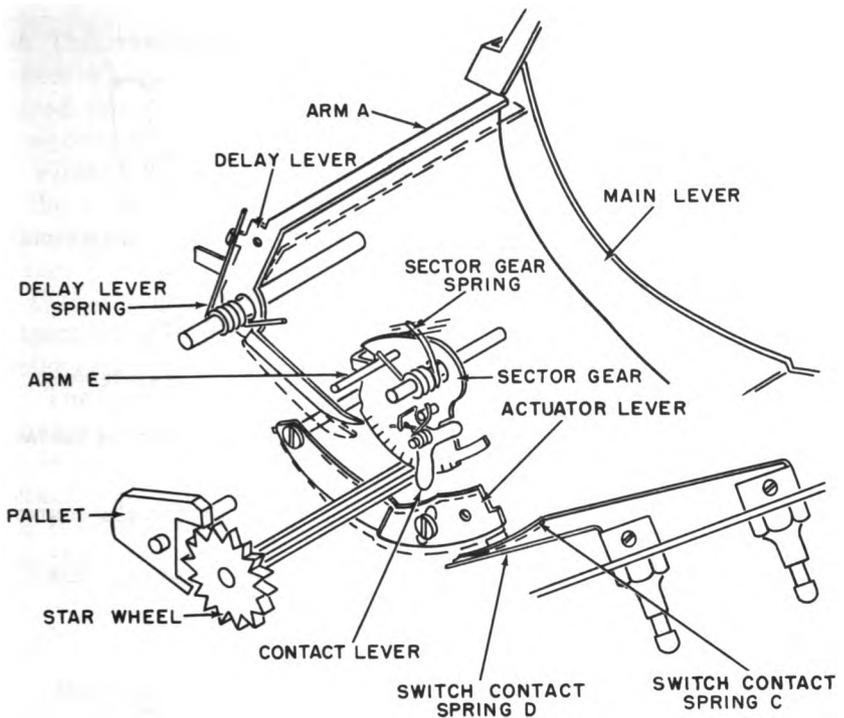


**Figure 42.** Synchronizing mechanism set to F position, schematic diagram.

counterclockwise movement of the main lever approximately  $1/200$  second (5 milliseconds). This delay permits the class F lamp (flash material consisting of a chemical, usually zirconium, pasted on the lead-in wires of the lamp) to reach full brightness simultaneously with the opening of the shutter. The  $1/200$ -second delay is accomplished as follows:

- (a) After the main lever has been cocked and the release lever is depressed, the main lever starts to rotate counterclockwise to open the shutter (par. 63a). However, before the shutter opens, the main lever is stopped temporarily by arm A (fig. 42) of the delay lever.
- (b) The tension of the sector gear spring rotates the sector gear counterclockwise.
- (c) Because the sector gear meshes with a pinion on the star wheel, counterclockwise rotation of the sector gear is retarded by the back-and-forth rocking motion of the pallet against the teeth of the star wheel.
- (d) As the sector gear rotates counterclockwise, the contact lever, which is mounted on the sector gear, sweeps against the actuator and causes it to push switch contact spring C against switch contact spring D. This closes the circuit that fires the flash lamp.
- (e) Arm E of the sector gear then pushes the delay lever clockwise. This action disengages arm A on the delay lever from the main lever.
- (f) The main lever is now free to continue its counterclockwise rotation to open the shutter.

*d. In M Position.* When set to the M position, the synchronizing mechanism retards the counterclockwise movement of the main lever approximately  $1/50$  second (20 milliseconds) before the shutter opens. The action of the main lever through the cocking cycle is the same as described in *c*(1) above. This 20-millisecond delay permits the class M (foil-filled) lamp to reach full brightness simultaneously with the peak opening of the shutter. The  $1/50$ -second delay is accomplished similarly to the F position (*c* above), except when the synchronizing mechanism is set to the M position, the actuator lever (fig. 43) is set closer to the idle position of the contact lever. Therefore, as the sector gear starts to rotate counterclockwise, the contact lever sweeps against the actuator lever and pushes the switch contact spring C against the switch contact spring D to close the flash-lamp circuit. Thus, the closing of the flash-lamp circuit takes place *sooner* in the M position. In this manner, the class M flash lamp reaches full brightness when the shutter reaches its peak opening.



TM 2352B-41

Figure 43. Synchronizing mechanism set to M position, schematic diagram.

## Section II. THEORY OF FOCAL PLANE SHUTTER

### 67. General

The focal plane shutter consists of a black curtain that is mounted on two rollers and located directly in front of the film. As the curtain is moved by spring action, openings in the curtain allow light and, therefore, the image to reach the film. For this description, the theory of operation of the focal plane shutter is presented in three parts which describe the setting, releasing mechanisms, and the length of exposure control. Note that the direction of rotation of the various parts described in paragraphs 68 through 70 is the direction from inside the camera looking toward the operator's side.

### 68. Mechanism for Setting

a. The bottom roller (fig. 44) is a hollow shaft to which is attached one end of spring A. The other end of spring A is attached to the inner shaft which is stationary because the flattened end of this shaft fits into a fixed rectangular receptacle. When the curtain is pulled up, the bottom roller is rotated counterclockwise (insert, fig. 44) against the tension of spring A.

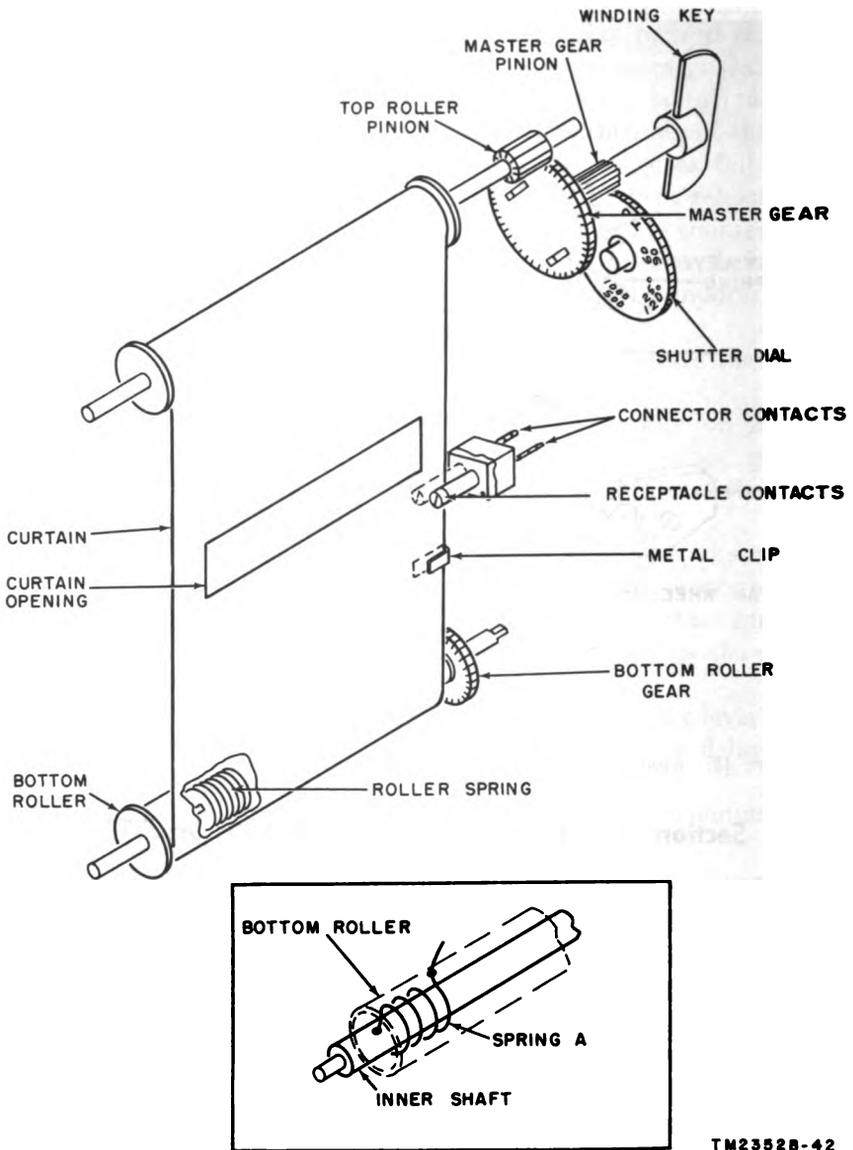


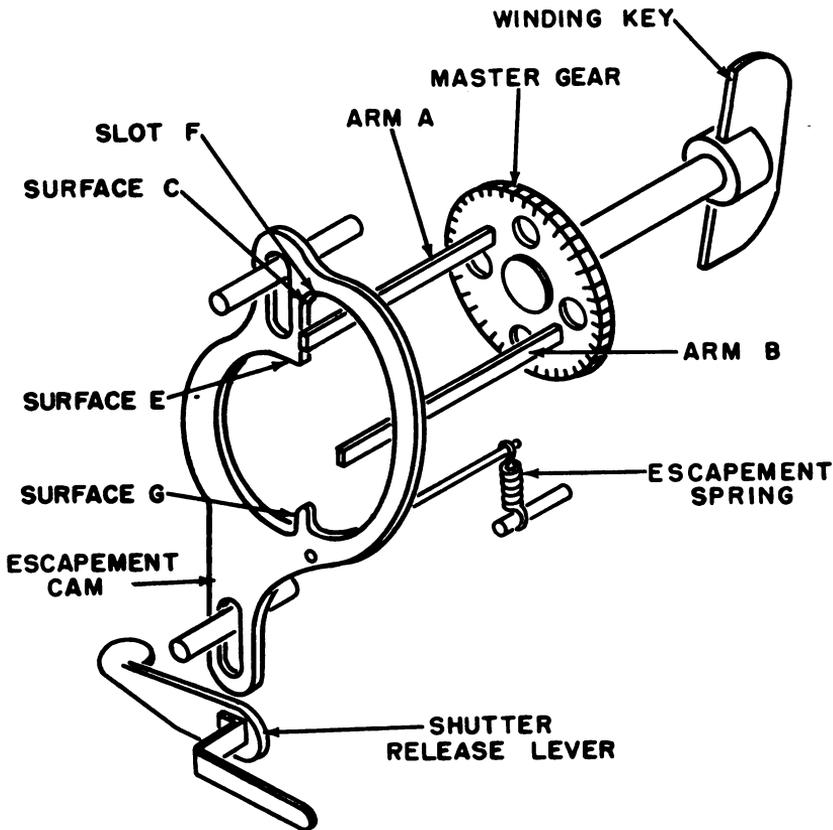
Figure 44. Focal plane shutter winding mechanism, schematic diagram.

b. Because the top of the curtain is attached to the top roller, the clockwise rotation of the winding key, which is transmitted through the master gear and the top roller pinion, rolls up the curtain against the tension of spring A.

c. Simultaneously, rotation of the winding key is transmitted to the shutter dial, which is a gear that meshes with the master gear pinion.

d. The master gear has two arms (A and B, fig. 45) on its inner surface which are placed 180° apart. The winding key cannot be rotated counterclockwise (fig. 45), because either arm A or B will hit against surface C of the escapement cam. Clockwise rotation of the winding key is possible because the escapement cam is held down by the tension of the escapement spring and, as the master gear rotates, arm A or arm B will pull up the cam by pushing against surface F. Once past this surface, arm A or arm B goes into slot F; then, the escapement cam is pulled down by the tension of the escapement spring, and prevents counterclockwise movement of the master gear.

e. The master gear meshes with the top roller pinion which is mounted on the top roller (*d* above). The tension of spring A (fig. 44) in the bottom roller is transmitted to the master gear by the curtain, top roller, and top roller pinion. Thus, when arm A or arm B of the master gear (fig. 45) locks against surface C of the cam, the curtain is kept in the selected position, as indicated by the



TM2352B-43

Figure 45. Focal plane shutter setting mechanism, schematic diagram.

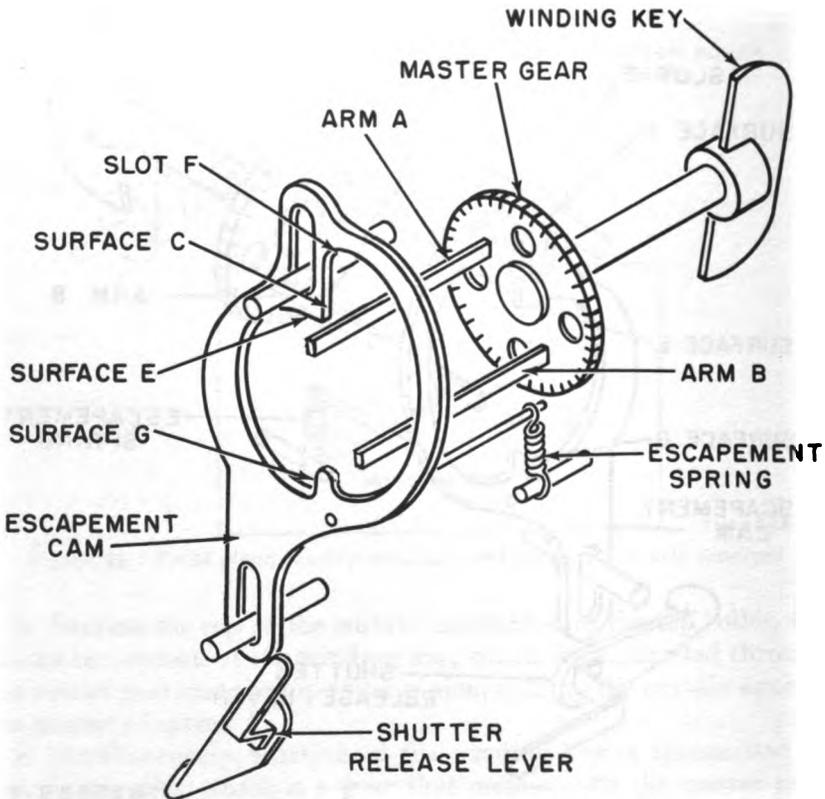
speed indicator. When the shutter is set, the curtain opening that corresponds to the selected speed is just above the film and the shutter is ready for an exposure.

### 69. Mechanism for Releasing

a. Manual operation of the shutter release lever (fig. 46) pushes the escapement cam up against the tension of the escapement spring. Arm A of the master gear is free to rotate counterclockwise and is pulled by the action of the bottom roller spring (spring A, fig. 44).

b. Counterclockwise rotation of the master gear (fig. 46) is limited to about one-half revolution because arm A is stopped by surface G of the escapement cam. The gear ratio is such that while the master gear makes one-half revolution, the curtain travels about 7 inches, and permits the opening in the curtain to move over the film, from the top roller to the bottom roller.

c. Releasing the shutter release lever allows the escapement cam to be moved down by tension of the escapement spring. Although arm A is now free of surface G on the cam, further counterclockwise



TM 2352B-44

Figure 46. Focal plane shutter releasing mechanism, schematic diagram.

rotation of the master gear is prevented by arm B hitting surface C of the escapement cam.

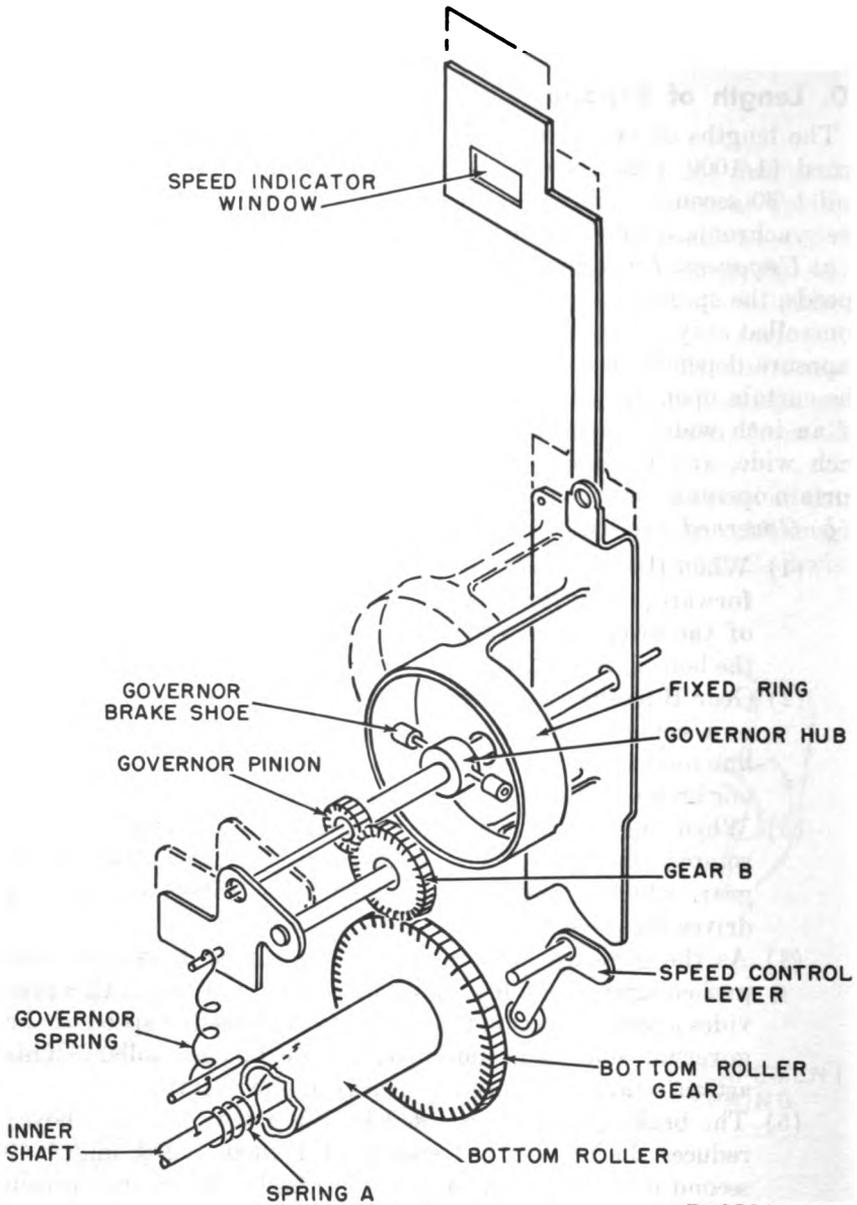
## 70. Length of Exposure

The lengths of exposure of the focal plane shutter can be ungoverned (1/1000, 1/250, and 1/50 second) or governed (1/500, 1/125, and 1/30 second). Three of the speeds (1/1000, 1/500 and 1/250) are synchronized with the flash-lamp flasher.

*a. Ungoverned Speeds.* When set to any of the three ungoverned speeds, the speed at which the curtain winds on the bottom roller is controlled only by the tension of spring A (fig. 44). The length of exposure depends on the tension of the spring and on the width of the curtain opening. The small curtain opening is about one-eighth of an inch wide; the medium opening is about three-eighths of an inch wide, and the large opening is about 1½ inches wide. The curtain opening for time is about 6 inches wide.

*b. Governed Speeds.*

- (1) When the speed control lever (fig. 47) is manually pushed forward, the governor assembly is pulled down by the tension of the governor spring; this causes gear B to mesh with the bottom roller gear.
- (2) Gear B meshes with the governor pinion, which is mounted on a common sleeve with the governor hub. The governor hub mounts two shafts at right angles to the hub. A governor brakeshoe fits loosely on each shaft (fig. 47).
- (3) When the shutter is released (par. 69), the bottom roller is rotated counterclockwise by spring A. The bottom roller gear, which is mounted on the bottom roller, rotates and drives the governor hub.
- (4) As the governor hub rotates, the governor brakeshoes are pushed against the fixed ring by centrifugal force; this provides a braking action that tends to decrease the speed of the governor hub and, therefore, of the bottom roller. This action retards the speed of travel of the curtain.
- (5) The braking action provided by the governor ((4) above) reduces the ungoverned speeds of 1/1000, 1/250, and 1/50 second to 1/500, 1/125, and 1/30 second. When the curtain is traveling at a high speed, the braking action of the governor reduces the speed in half, but when the curtain is traveling slowly (1/50 second), the governor reduces the speed only to 1/30 second; at the lower speed, centrifugal force pushes the governor brakeshoes against the fixed ring with less pressure and provides less braking action.
- (6) The governor assembly is linked to the speed indicator window. When the speed control lever (fig. 47) is pushed for-



TM 2352B-45

**Figure 47. Focal plane shutter governor, schematic diagram.**

ward to lengthen the exposure time ((1) above), the speed indicator window is lowered to indicate the new exposure setting.

*c. Synchronized Speeds.* The focal plane shutter, when set to certain speeds and connected to the flash-lamp flasher, closes the circuit to flash the lamps in synchronism with the opening of the shutter.

- (1) Metal clips (fig. 44) located on one edge of the curtain, a certain distance away from the opening, establish electrical contact between the receptacle contacts when the shutter release lever is depressed and the curtain moves downward.
- (2) Because the receptacle contacts are integral with the connector contacts (connected to the flash-lamp flasher through a cable), the lamp is fired when electrical contact is established between the receptacle contacts.
- (3) The metal clips are located near the small ( $\frac{1}{8}$ -inch) and the medium ( $\frac{3}{8}$ -inch) opening only. Synchronization is possible only in the high speeds (1/1000 and 1/500 which use the  $\frac{1}{8}$ -inch opening) and the medium speeds (1/250 and 1/125 which use the  $\frac{3}{8}$ -inch opening). However, the 1/125 speed is too slow for synchronization and, therefore, only three synchronizing speeds (1/1000, 1/500, 1/250) are marked in red numbers on the shutter dial. All other speeds, except time ((4) below), are marked in black letters on the dial.
- (4) A metal clip, similar to the clips described in (3) above is located on the edge of the curtain, along the center line of the time (6 in. wide) opening. When the focal plane shutter dial is set to T and the release lever is operated, the curtain rolls to expose the entire film through the time opening. When it reaches a fully open position, electrical contact is established between the receptacle contacts by the metal clip to flash the lamp. When the release lever is operated for a second time, the curtain rolls to the fully rolled position to cover the film and close the shutter.

### Section III. THEORY OF RANGE FINDER

#### 71. General

The range finder is of the coincident-image type and is coupled to the carriage assembly. Back-and-forth movement of the camera carriage results in equivalent movement of the range-finder focus.

#### 72. Focusing

*a. General.* The range finder consists of a glass eyepiece which is located directly behind a stationary silver-flecked (transparent) mirror (fig. 48). A prism, which is located below the mirror, bends the light rays and throws an indirect image on the mirror, which reflects it toward the eyepiece. The direct image, viewed through the mirror, covers a wide field but is not very bright because part of the light is reflected by the silver flecking. The indirect image, viewed through the prism and reflected by the mirror, is brighter but smaller in area.

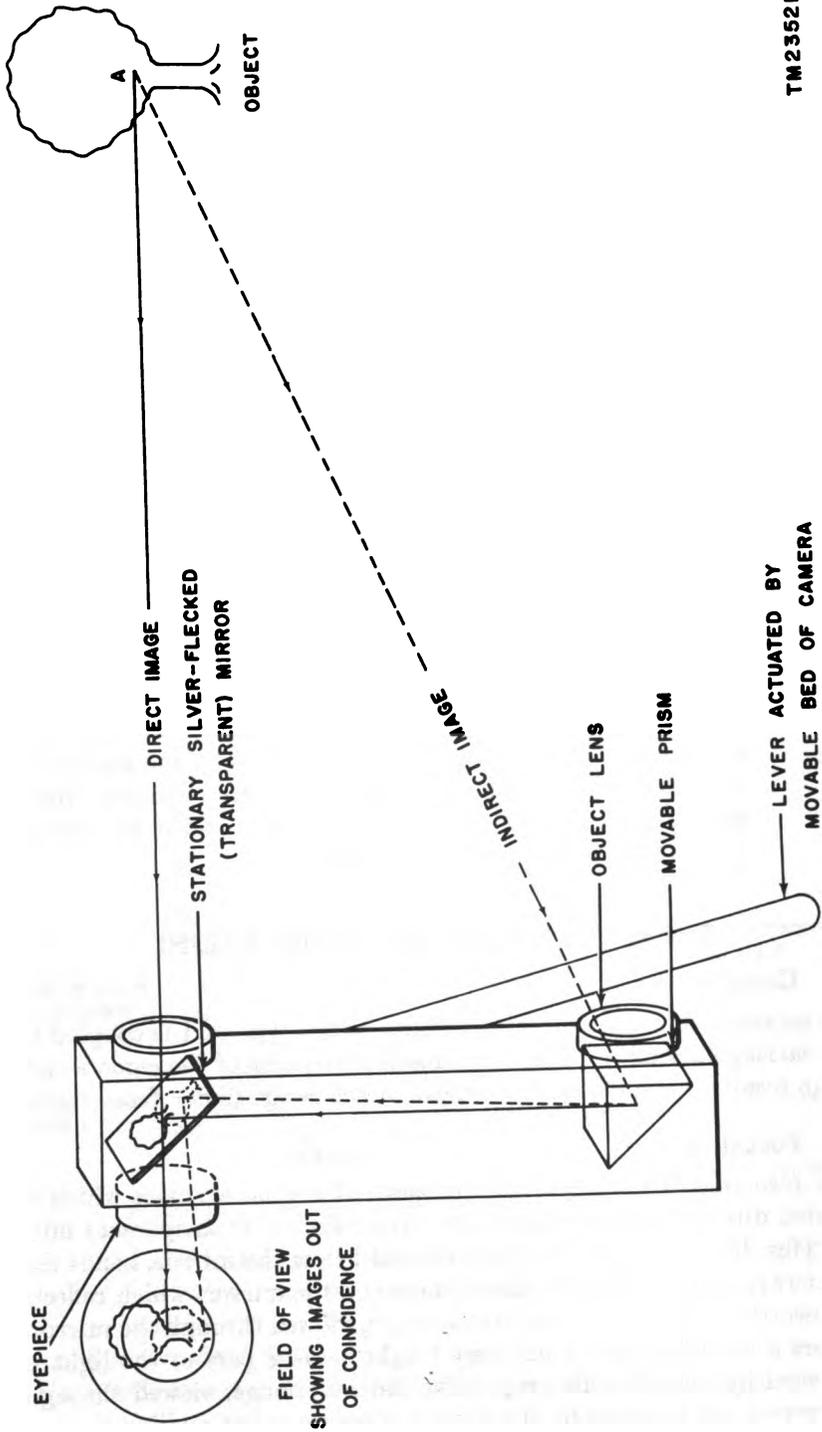
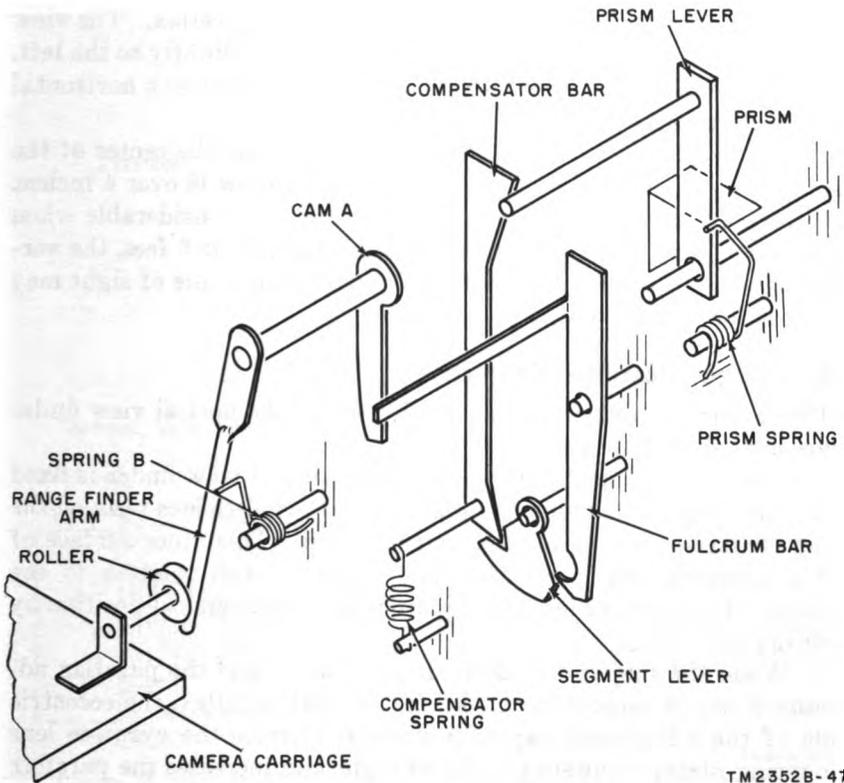


Figure 48. Principles of range finder, schematic diagram.

*b. Mechanism.* The range-finder arm (fig. 49) is held by the tension of spring B against a roller that is mounted on the camera carriage.

- (1) When the camera carriage is moved inward to focus on a distant object, the range-finder arm is pushed by the roller and rotates counterclockwise. Cam A is mounted on a common shaft with the range-finder arm; therefore, rotating the range-finder arm causes cam A to push the arm of the fulcrum bar, thus rotating the fulcrum bar clockwise.
- (2) Clockwise rotation of the fulcrum bar causes the segment lever to rotate clockwise.
- (3) Clockwise movement of the segment lever raises the compensator bar against the tension of the compensator spring.
- (4) The upward movement of the compensator bar permits the prism lever to be rotated counterclockwise by the tension of the prism spring.
- (5) Because the prism is attached to the prism lever, counterclockwise rotation of the prism lever tilts the prism downward, thereby increasing the focus range of the range finder.



*Figure 49. Range-finder mechanism, schematic diagram.*

TM 2352B-47

- (6) Moving the camera carriage outward to focus on a closer object allows the range-finder arm to be rotated clockwise by the tension of spring B, and results in upward tilting of the prism, thus decreasing the focus range of the range finder.

*c. Coincidence.* If the range finder is properly adjusted for the particular lens used in the camera, the direct and indirect images (*a* above) should be in exact coincidence and the lens accurately focused at all ranges from 6 feet to infinity.

## Section IV. THEORY OF OPTICAL VIEW FINDER

### 73. General

The field of view that is presented by the optical view finder should coincide with the field of view of the lens. Because the view finder is a certain distance from the lens, it is possible to move the view finder line of sight and compensate for the parallax angle.

*a. Horizontal Parallax.* The horizontal distance from the center of the camera lens to the center of the view finder window is only about 2 inches and, therefore, the horizontal parallax angle is negligible and no correction is provided for horizontal parallax. The view finder is mounted on the camera so that it is tilted slightly to the left. The view finder line of sight meets the lens line of sight on a horizontal plane approximately 15 feet from the lens.

*b. Vertical Parallax.* The vertical distance from the center of the camera lens to the center of the view finder window is over 4 inches. The vertical parallax angle (fig. 50), therefore, is considerable when the subject is a short distance away. For example, at 6 feet, the vertical parallax is approximately  $3^\circ$ . The view finder line of sight may be tilted for vertical parallax.

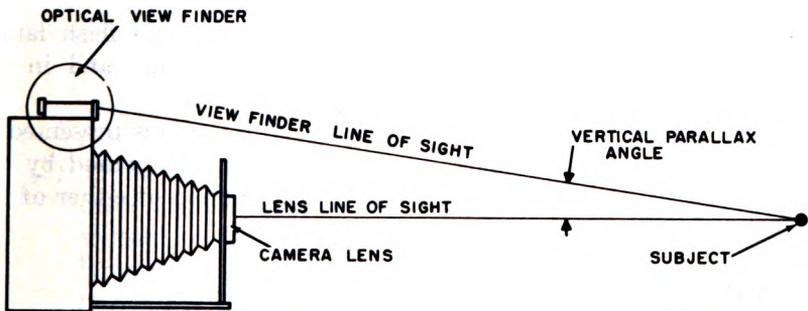
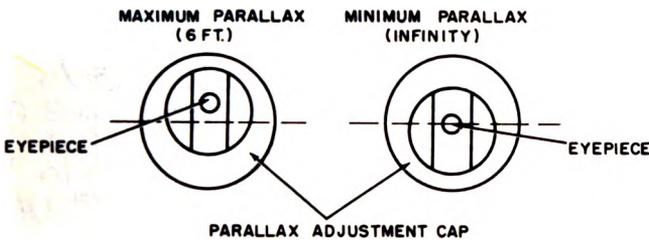
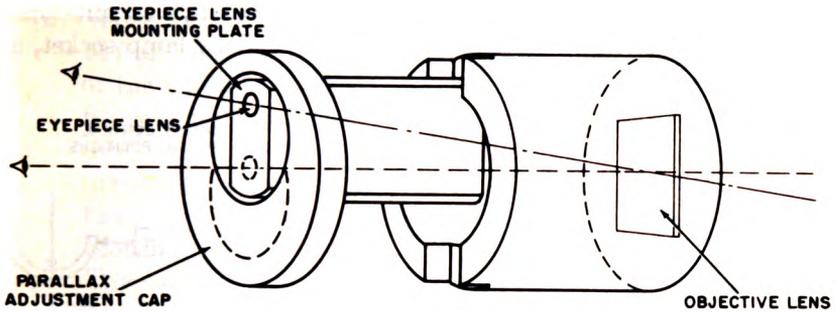
### 74. Vertical Parallax Correction

Correction for vertical parallax (fig. 50) of the optical view finder is accomplished as follows.

*a.* The rectangular objective lens of the optical view finder is fixed in the housing. The mounting plate for the eyepiece lens rests on the inner surface of the parallax adjustment cap. This inner surface of the adjustment cap is circular, but eccentric with relation to the outside. The eyepiece mounting plate is kept in a vertical position by slots in the housing.

*b.* When the subject is a short distance away and the parallax adjustment cap is rotated to correct for vertical parallax, the eccentric hole of the adjustment cap is positioned to raise the eyepiece lens mounting plate; it lowers the line of sight and increases the parallax correction.

c. When sighting a distant subject, the parallax adjustment cap is rotated so that the eccentric hole is positioned to lower the eyepiece lens mounting plate and to decrease the parallax correction.



TM2352B-48

Figure 50. Optical view finder parallax mechanism, schematic diagram.

## Section V. THEORY OF FLASH-LAMP FLASHER

### 75. General

a. The flash-lamp flasher (fig. 51) is a flash gun that is equipped with a double-pole, single-throw, lamp-firing switch, a circuit-control switch, dry batteries that produce 4.5 volts, a flash-lamp socket, and five female outlets.

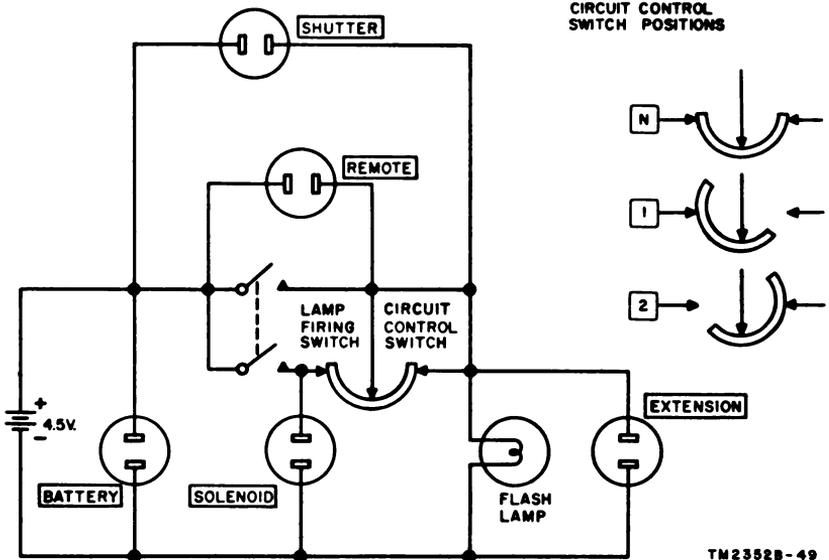


Figure 51. Flash-lamp flasher, schematic diagram.

b. For this description, the flash-lamp flasher is attached and connected to the camera and is ready for operation (the SHUTTER outlet is connected to either the between-the-lens shutter or to the focal plane shutter, whichever is being used; the SOLENOID outlet is connected to the solenoid; the extension outlet is connected to the flash-lamp extension; fresh batteries are in place, and flash lamps (type M or F) are inserted in the flash-lamp flasher and in the flash-lamp extension).

c. This description of the flash-lamp flasher circuits is presented in two parts, covering the effect on the circuits that is caused by the operation of the lamp-firing switch and by operation of either of the shutter switches.

### 76. Lamp-Firing Switch and Solenoid

The effect that is caused by closing the lamp-firing switch depends on the position of the circuit-control switch.

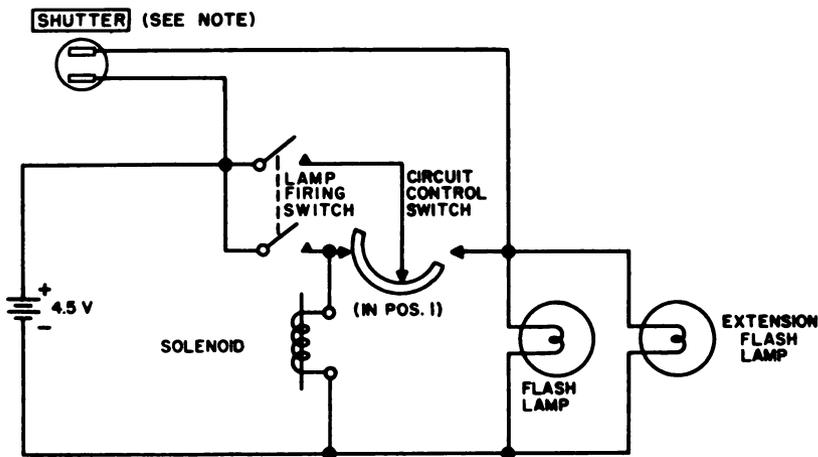
*a. Control Circuit in N Position.*

- (1) The N position of the circuit-control switch is used for solenoid operation of the between-the-lens shutter (synchronizer adjustment lever (fig. 7) in the OFF position).
- (2) When the circuit-control switch is in the N position (fig. 51) and the lamp-firing switch is operated, the positive side of the battery is connected through one contact of the lamp-firing switch to the flash lamp. The negative side of the battery is connected to the solenoid and to the flash lamp. When the lamp-firing switch is pressed, actuating the solenoid, the lamps flash and the shutter is opened almost simultaneously.
- (3) The solenoid is designed to retard the shutter opening until the class M flash lamp reaches its peak (aprx. 20 milliseconds.)

*Note.* Only class M lamps can be used with the solenoid.

*b. Control Circuit Switch in No. 1 Position.*

- (1) The No. 1 position on the circuit-control switch is intended for the following types of operation:
  - (a) Synchronized between-the-lens shutter operation.
  - (b) Synchronized focal plane shutter operation.
  - (c) Solenoid operation of the between-the-lens shutter (synchronizer adjustment lever set to M, X, or F).
  - (d) Solenoid operation of the between-the-lens shutter without flash lamp (synchronizer adjustment lever (fig. 7) set to OFF position).
- (2) When the circuit-control switch is in the No. 1 position (fig. 52) and the lamp-firing switch is pressed, the positive side of the battery is connected through one lamp-firing switch contact to the solenoid; the solenoid is then actuated as it is connected to the negative side of the battery. The solenoid opens the between-the-lens shutter through linkage between the solenoid and the shutter release arm (fig. 7) and, if the synchronizer adjustment lever is set to M, X, or F, connects the positive side of the battery to the flash lamp. The other side of the flash lamp is connected to the negative side of the battery; therefore, the lamp flashes.
- (3) If the between-the-lens shutter is tripped, and the synchronizer adjustment lever (fig. 7) is set to M, X, or F, the shutter switch connects the positive side of the battery to the flash lamp and bypasses the circuit-control switch. As the negative side of the battery is connected to the flash lamp, the lamp flashes.
- (4) If the focal plane shutter is used, depressing the focal plane shutter release lever (fig. 9) closes the shutter switch (if the



NOTE:  
THE **SHUTTER** RECEPTACLE ON THE FLASH-LAMP FLASHER CAN BE CONNECTED THROUGH AN INTERCONNECTING CORD TO THE

BETWEEN-THE-LENS SHUTTER SYNCHRONIZER OR TO THE FOCAL PLANE SHUTTER SYNCHRONIZER.

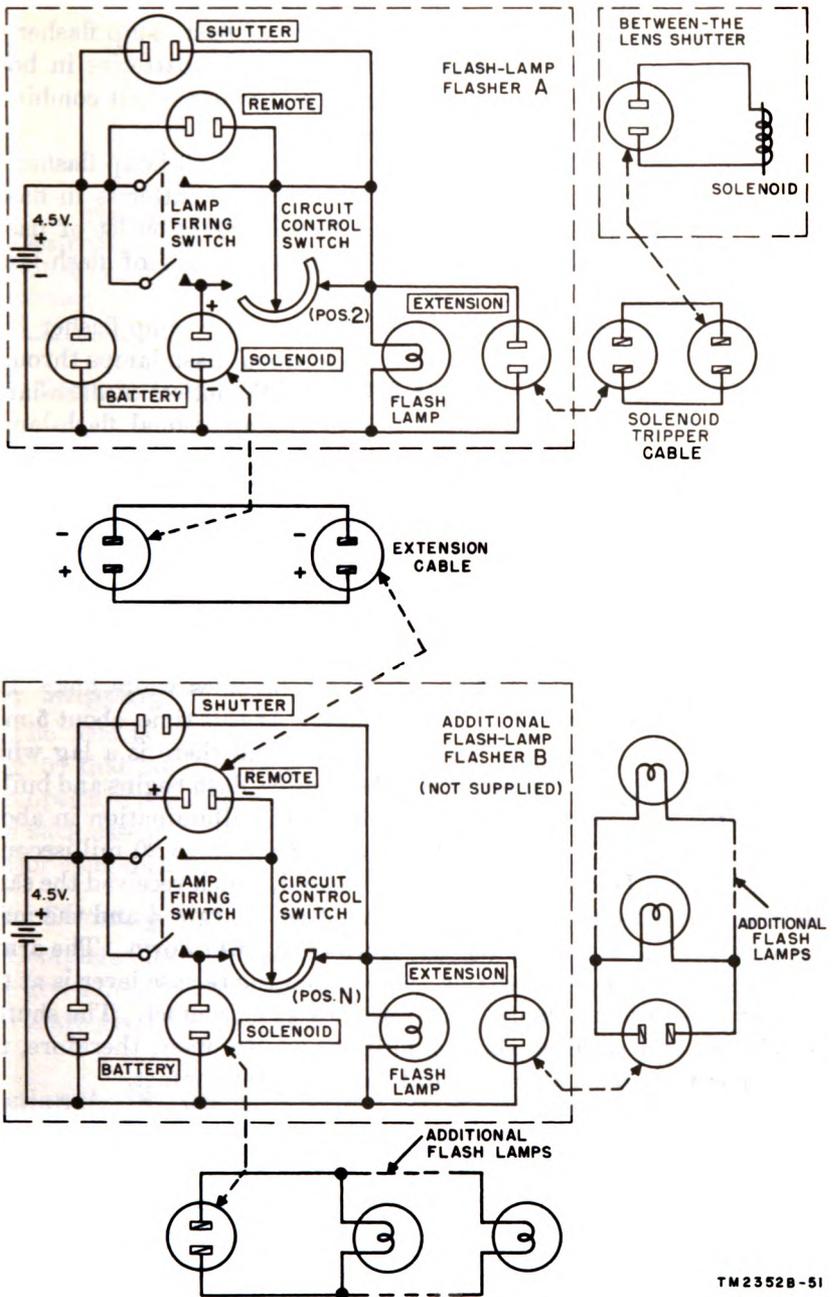
TM23528-50

Figure 52. Partial schematic diagram of flash-lamp flasher, showing solenoid connected to flash-lamp flasher.

speed indicator is set to 1/1000, 1/500, 1/250, or T). When the shutter switch closes, it connects the positive side of the battery to the flash lamp. The other side of the flash lamp is connected to the negative side of the battery; therefore, the lamp flashes.

c. *Circuit Control in the No. 2 Position.* The circuit-control switch is set to position 2 only when an additional flash-lamp flasher (not supplied) is used for additional flash lamps (between-the-lens shutter only). Figure 53 is a schematic diagram of the connections that are made when two flash-lamp flashers are used. For this description, the flash-lamp flasher that is attached to the camera, is referred to as flash-lamp flasher A and the additional as flash-lamp flasher B.

- (1) The positive side of the SOLENOID outlet of flash-lamp flasher A is connected to the REMOTE outlet of flash-lamp flasher B through an extension cord. The EXTENSION outlet of lamp flasher A is connected to the solenoid. Additional flash lamps are connected to the SOLENOID and EXTENSION outlets of lamp flasher B. The circuit-control switch of lamp flasher A is set to position 2 and the circuit control switch of lamp flasher B is set to position N.
- (2) Operation of the lamp-firing switch of lamp flasher A completes the circuit to actuate the solenoid and flash the lamp in flash-lamp flasher A (positive side of the battery is connected through one contact of lamp-firing switch and circuit-



TM 2352B - 51

Figure 53. Flash-lamp flashers interconnected, schematic diagram.

control switch to the solenoid and to the flash lamp; the other side of these two elements is connected to the negative side of the battery).

- (3) Operation of the lamp-firing switch of flash-lamp flasher A also completes a circuit that connects the batteries in both lamp flashers (A and B) in series and applies their combined voltage to all the flash lamps.
  - (a) The negative side of the batteries in flash-lamp flasher A is connected to the positive side of the batteries in flash-lamp flasher B through the SOLENOID outlet of flash-lamp flasher A and the REMOTE outlet of flash-lamp flasher B.
  - (b) The negative side of the battery in flash-lamp flasher B is connected to one side of the additional flash lamps through the SOLENOID and EXTENSION outlets of flash-lamp flasher B. The other side of the additional flash-lamps is connected through the SOLENOID and EXTENSION outlets, the circuit-control switch of flash-lamp flasher B, the REMOTE outlet of flash-lamp flasher B, the SOLENOID outlet of lamp flasher A, and one contact of the lamp-firing switch, to the positive side of the battery in flash-lamp flasher A.

*d. Solenoid Synchronization.* When a flash lamp is fired, the current passes through the filament which becomes white hot. The filament breaks and stops the current flow. At this time, about 5 milliseconds after contact, the primer explodes and there is a lag while the wire filler ignites. When wire filler ignites, flash begins and builds in brightness. The flash reaches its half peak illumination in about 8 to 13 milliseconds and its full peak in about 18 to 20 milliseconds after contact. In the meantime, the solenoid, which received the same electrical impulse as the flash lamp, has been energized and the magnetic field of the coil pulls the armature (8, fig. 64) down. The armature is linked to the shutter release lever and the release lever is at the shutter release point about 15 milliseconds after contact. The shutter is released and requires about 2 milliseconds to open; therefore, the shutter is fully open about 17 milliseconds after contact.

## 77. Shutter Switches

When the circuit-control switch is in the No. 1 position (fig. 52), and the shutter switch of the shutter being used is actuated, the positive side of the battery is connected to one side of the flash lamp through the shutter switch that is used. Because the negative side of the battery is connected to the flash lamps, the lamps flash when the shutter switch is operated. The solenoid, if connected, remains inoperative because the lamp-firing switch stays open (is not pressed). The positive side of the battery, therefore, is not connected to the solenoid.

## CHAPTER 7

### FIELD MAINTENANCE

*Note.* This chapter contains information on field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available, and by the skill of the repairman.

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#### Section I. INSPECTING, STRIPPING, AND CLEANING

##### 78. Inspecting

The camera equipment is subject to very little wearing friction. Any malfunction, therefore, is likely to be caused by fouling, dirt, sand, or corrosion. If careful inspection of the equipment fails to reveal any foreign matter causing the malfunction, inspect the camera equipment for bent or misaligned parts. Damage to the equipment is usually caused by improper lubrication or rough handling.

##### 79. Stripping

The lens is easily removed by pushing back the two slide locks (fig. 5) that hold the lens board in place. Instructions for removing the optical view finder are given in paragraph 95 and for removing the back assembly are given in paragraph 96. The removal of other major components is explained in paragraphs 86 through 101.

##### 80. Cleaning

Complete cleaning instructions covering the lenses and the camera are given in paragraph 26. Instructions for cleaning the disassembled parts are given in paragraphs 86 through 101.

#### Section II. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

##### 81. Tools and Test Equipment Required

The tools that are required for all field maintenance of this equipment, except the between-the-lens shutter, are listed in paragraph 46. Paragraph 82 lists the special tools in Tool Equipment TK-26/GF that are to be used for servicing the between-the-lens shutter. The test equipment that is required for Still Picture Camera Set KS-4A(1) is Photographic Synchronizer Tester AN/TFM-3.

## 82. Special Tools

The tools that are used to service the between-the-lens shutter and their stock numbers are listed below and illustrated in figure 54. The use of these tools has been incorporated in the disassembly and re-assembly of the shutter, where the particular use of the tool applies.

Tool	Sig C stock No.
Adjustment gage.....	6Q44623-1
Main lever lifter.....	6Q63178-2
Prong screw jig.....	6Q55681-1
Friction wrench.....	6R55048
Spanner wrench.....	6R57549-5



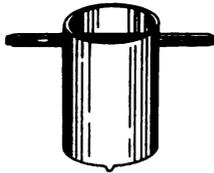
ADJUSTMENT GAGE



PRONG SCREW JIG



MAIN LEVER LIFTER



SPANNER WRENCH



FRICION WRENCH

TM23528-52

Figure 54. Special tools.

## 83. Troubleshooting Procedures

The first step in servicing any defective equipment is to sectionalize the fault. This means tracing the fault to the major component or assembly that is responsible for the defect. The second step is to localize the trouble, or track the fault still further within the component or assembly until the defective part is identified. The quickest way to follow these procedures is to use the substitution method, wherever possible. This involves substituting a component, assembly, or part known to be in good condition for an equivalent component, assembly, or part whose condition is doubtful.

## 84. Sectionalizing Trouble

If film holders are used and fogged negatives occur, determine whether one or more film holders are at fault, or whether the fault is somewhere in the camera. Try to identify the film holder from which

the fogged film came, and check it for lighttightness. If this is not possible, load all the film holders with film, expose them all to bright daylight, with the dark slides in place, then develop them. If fogged film is found, replace the defective film holder or holders. If a film pack adapter is involved, substitute another adapter. If the results of these tests are negative, then the fault must be somewhere in the camera or shutters. Follow the procedure of testing for light leaks described in paragraph 56.

*Note.* To avoid fogging the film, remove the dark slide after the focal plane shutter is wound (par. 40a(4)).

## 85. Troubleshooting Chart

The troubleshooting chart below lists the symptoms and remedies for the most common troubles that may be encountered in the camera set. This table is divided into nine parts. Each part deals with components of the set or with the major assemblies of the camera. Common symptoms are listed in the first column; the probable location and nature of the trouble in the second column; and the applicable correction in the third column.

Symptom	Probable trouble	Correction
<i>Flash-lamp flasher</i> (par. 88) Lamp does not flash ..	Broken cable .....	Check continuity of cable. Waggle cable near plug to check for broken wire. Replace cable.
	Exhausted batteries .....	Replace batteries, use BA-202/UR, or equivalent rated at 1.5 volts and at least 6 amperes.
	Worn lamp locking ring ..	Replace ring (13, fig. 55).
	Reflector contact spring assembly does not actuate lamp locking ring.	Replace spring (14, fig. 55).
	Corroded batteries caused by age or short circuit in battery case, cable, or shutter.	Disassemble switch and outlet assembly, and clean with fine sandpaper. Replace battery case liner.
<i>Reflector assembly,</i> <i>7- or 5-inch</i> (pars. 90, 91) Lamp does not flash ..	Incomplete circuit .....	Tighten contact assembly screw (2, fig. 58) and receptacle screw (7, fig. 57).
Lamp does not clamp ..	Worn lamp lock .....	Replace lamp lock (4, fig. 58) on locking ring (par. 90d).

Symptom	Probable trouble	Correction
<i>Solenoid tripper</i> (par. 93) Solenoid not energized.	Broken tripper cable.....	Check continuity of cable. Waggle cable near plug to observe broken wire. Replace cable.
Solenoid operates erratically.	Poor solenoid contact due to— Broken plastic insert of cap assembly. Bent terminals at base of coil.	Replace cap assembly (16, fig. 64).  Straighten and replace round post bushing with rubber terminal cushion (15, fig. 64).
	Dirty terminals.....	Clean terminals with fine sandpaper and wipe with swab moistened with solvent SD.
	Loose or broken terminal.	Replace solenoid.
Synchronization not consistent.	Loose parts.....	Tighten tripper ball and apply touch of lacquer to top of threads. Tighten armature cap on cap spring (par. 93e). Replace cap spring to bear on knurls of tripper cap. Set assembly pin of armature flush with side of collar. Replace armature assembly if collar does not fit snugly on armature.
	Dirty armature.....	Wipe armature with solvent (SD), and dry. Wipe inside of coil with a moist (not wet) swab of the solvent.
	Sticky armature.....	No copper spacer at bottom of armature hole. Replace spacer (10, fig. 64).
Shutter erratic..... <i>Range finder</i> (par. 92)	Dirty shutter.....	Overhaul shutter (par. 94).
Side or lateral image..	Loose mirror..... Loose prism assembly.... Lateral adjustment screw touches lateral adjustment lever. Loose adjustment screw moves by vibration.	Replace mirror assembly. Replace prism assembly. Back out lateral adjusting screw one turn.  Apply touch of lacquer to threads.

Symptom	Probable trouble	Correction
Change in horizontal image.	Loose mirror-----	Replace mirror assembly.
	Loose prism assembly----	Replace prism assembly.
	Mounting plate assembly loose from mounting block.	Tighten roundhead screw (1, fig. 61).
Change in adjustment or setting.	Loose prism adjustment screw.	Shellac screw after adjustment.
	Loose front indicator (2, fig. 63).	Tighten indicator screws.
Lag or lost motion....	Loose fulcrum bar indicator (5, fig. 63).	Tighten rear scale holding screw.
	Mechanism binds-----	Provide for free movement of parts. Clean pivots and contact surfaces of moving parts.
Circle not in center of eyepiece. <i>Between-the-lens shutter</i> (par. 94)	Weak spring tension on prism assembly.	Increase tension or prism spring.
	Mirror not set at correct angle.	Replace mirror.
Sluggish blade action..	Weak blade lever spring (2, fig. 69).	Replace blade lever spring.
	Dirty blade lever (4, fig. 69).	Remove and clean blade lever.
	Bent revolving ring assembly (3, fig. 70).	Straighten revolving ring assembly.
	Dirty revolving ring assembly.	Clean revolving ring assembly. Clean track in diaphragm plate assembly.
Locked blades.....	Blade slid under a revolving ring stud.	Replace revolving ring assembly.
	Loose blade lever screw (3, fig. 69).	Tighten blade lever screw. Replace blade lever screw, if necessary.
Stiff diaphragm movement; buckled diaphragm leaves.	Grease or dirt on diaphragm leaves.	Remove diaphragm plate and leaf assembly (5, fig. 70) from shutter and clean diaphragm leaves. Replace diaphragm leaves if bent.
	Diaphragm leaf or leaves jumped guide slots.	Replace damaged leaves, or replace with new diaphragm plate and leaf assembly.
Sluggish shutter action with synchronizer off or on.	Weak or broken main lever spring or auxiliary spring (12 or 10, fig. 68).	Replace main lever spring or auxiliary spring.

Symptom	Probable trouble	Correction
Sluggish shutter, action with synchronizer off or on— Continued	Retarding section dirty and/or damaged.  Focus lever spring (19, fig. 68) too strong. Main lever shoe rubs corner of blade lever during opening phase of blades.	Clean and lubricate retarding section. Replace damaged wheels, pallet, or retarding lever. Weaken focus lever spring at coil. File main lever shoe just enough to give sufficient clearance.
Sluggish shutter action with synchronizer on M.	Gummy synchronizer escapement and pallet (6 and 5, fig. 67) due to dirt, rust or corrosion. Damaged teeth on synchronizer escapement wheel, pallet, or sector gear.	Clean synchronizer escapement wheel and pallet. Replace either or both, if necessary. Replace damaged part.
Locked shutter action with synchronizer off or on.	Pin of retarding wheel assembly (14, fig. 69) out, loose, or bent. Damaged retarding lever assembly, retarding wheel assembly, escapement wheel assembly, or center wheel assembly. Loose pin in pallet lever assembly (18, fig. 69). Loose pin in revolving ring assembly (3, fig. 70).	Replace retarding wheel assembly. Replace damaged parts.  Replace pallet lever assembly. Replace revolving ring assembly.
Locked shutter action with synchronizer on.	Loose or bent bulb lever (5, fig. 68) which rides up and over release lever lug during first part of cocking action. Sector gear teeth damaged. Escapement wheel assembly damaged. Broken pallet stud on synchronizer support plate. Lock lever does not release sector gear because of insufficient stock at point where main lever stud pushes out lock lever.	Mill screw shoulder to tighten bulb lever. Straighten bulb lever if bent. Replace with new synchronizer subassembly (15, fig. 67). Replace escapement wheel assembly (15, fig. 69). Replace with new synchronizer subassembly (15, fig. 67). Replace with new lock lever (12, fig. 67).

Symptom	Probable trouble	Correction
<b>Locked shutter, action with synchronizer on—Con.</b>	Clutch lever spring (2, fig. 67) too strong. Clutch lever (3, fig. 67) too tight.	Weaken clutch lever spring at coil. Loosen by milling screw head or by reaming hole in clutch lever, whichever is required.
	Delay lever (10, fig. 66) sprung out to include too great an angle between its legs; thus, not releasing main lever.	Replace delay lever, if possible; otherwise carefully spring lever back just enough to clear trouble.
	Delay lever sprung up too high; thus, strikes pallet.	Bend delay lever.
	Delay lever sprung down too low; thus, strikes main lever stud.	Bend delay lever.
	Synchronizer sector gear spring (4, fig. 67) disengaged, weak or broken.	Reengage or replace spring.
<b>Synchronizer inoperative.</b>	Clutch lever spring (2, fig. 67) disengaged, weak or broken.	Reengage or replace spring.
<b>Shutter goes through on time and bulb levers.</b>	Time and bulb levers (6 and 5, fig. 68) bent.	Remove from shutter and straighten on surface plate.
	Time and bulb lever screw (4, fig. 68) too tight.	Mill head of screw to free time and bulb levers.
	Lug on time lever presses too hard against slot in speed cam assembly, causing binding action on bulb lever.	Bend lug on time lever in slightly.
	Angle of lug on main lever (13, fig. 68) not parallel to end faces of time and bulb levers.	Bend lug on main lever slightly into parallelism with end faces of time and bulb levers.
<b>Synchronizer goes through on setting shutter with synchronizer at M.</b>	Worn synchronizer stud on main lever.	Replace main lever assembly.
	Delay lever spring (8, fig. 66) disengaged, weak or broken.	Reengage or replace spring.
	Sticky lock lever (12, fig. 67).	Clean and free lock lever.
	Worn or broken corner on sector gear.	Replace with new synchronizer subassembly (15, fig. 67).

Symptom	Probable trouble	Correction
No contact at any delay setting of synchronizer.	Contacts (2 and 3, fig. 66) too far apart.	Diminish spacing between contact points.
No contact at M setting of synchronizer.	Contact lever frozen . . . . .	Free contact lever. Check contact spring (16, fig. 67); replace, if necessary.
	Actuator lever (8, fig. 67) frozen.	Free actuator lever.
No delay at M or F setting of synchronizer.	Contact lever spring (16, fig. 67) disengaged or broken.	Reengage or replace spring.
Delay at X setting or synchronizer.	Zero lever spring (9, fig. 68) off or broken.	Hook zero lever spring back into place or replace, if necessary.
	Zero lever (10, fig. 67) not engaging stud on main lever.	Bend zero lever slightly for proper engagement.
	Bent lug on zero lever . . . . .	Bend zero lever lug to close contacts when blades are open. Replace zero lever, if necessary.
Incorrect synchronization.	Weak sector gear spring (4, fig. 67).	Replace spring.
	Weak clutch lever spring (2, fig. 67).	Replace spring.
Electrical shorts . . . . .	Contacts (2 and 3, fig. 66) out of line.	Aline contacts.
	Cracked prong insulator block (7, fig. 66).	Replace insulator block.
	Defective prong insulators (5, fig. 66).	Replace prong insulators.
	Damaged indicator lever.	Replace with new synchronizer subassembly (15, fig. 67).
<i>Focal plane shutter</i> (par. 97)		
Shutter speed dial slide does not move.	Shutter plate cover (3, fig. 81) dented.	Straighten shutter plate cover or replace.
Shutter speeds slow . . . . .	Dial slide (18, fig. 81) unhooked from governor bracket.	Reassemble correctly.
	Dirty gears and bearings.	Disassemble, clean, and re-lubricate.
	Weak tension spring . . . . .	Replace tension roller.
	Low tension . . . . .	Increase tension.
No flash lamp contact.	Dirty synchronizer contacts (33, fig. 80).	Polish with crocus cloth and wipe with solvent (SD).
	Poor contact between curtain tabs and spring finger contacts.	Reform spring finger contacts (22, fig. 80).
	Defective case contacts . . . . .	Clean or replace contacts (9, fig. 81).

Symptom	Probable trouble	Correction
No flash lamp contact—Continued <i>Back assembly</i> (par. 96)	Curtain tabs fouled with spring finger contacts.	Replace all contacts and adjust.
Fogged negative..... <i>Front standard assembly</i> (par. 98)	Uneven contact between film holder and back.	Remove back and straighten.
Pictures out of focus at one edge.	Front standard not square	Check bed and body alignment with straight edge. Reposition bed guides if necessary. Check front standard with back (par. 98i).
Loose front standard..	Front standard does not clamp to carriage.	Adjust lock.
Tight open frame finder. <i>Bed assembly</i> (par. 99)	Bent frame (23, fig. 82) ...	Disassemble, straighten, and reassemble.
Loose carriage.....	Worn guides (6, fig. 83) or loose guide screws.	Tighten screws or replace guides.
Loose carriage lock lever.	Worn lever (17, fig. 83) ...	Replace lever or add extra shim washers.
Pictures out of focus at top or bottom edge.	Bed not level with body...	Loose or pulled bed brace guide; remove, plug old screw holes and reposition (par. 99f).

### Section III. REPAIRS

#### 86. Lubrication

In addition to periodic lubrication (fig. 29), certain parts, otherwise inaccessible, must be lubricated during the course of field maintenance procedures. Where necessary, specific instructions for the application of lubricants are given in the paragraphs which cover detailed reassembly instructions. The required lubricants are referred to in text by the applicable symbol (GL or PL) as listed below.

Lubricant	Symbol	Stock No.
Graphite, Lubricating.....	FG	14-G-375
Grease, Aircraft and Instruments.....	GL	14-G-610-900
Oil, Lubricating, Preservative, Special.....	PL	14-O-2833-992
Oil, Lubricating, Light.....	LO	14-O-1338-60

## 87. Flash Equipment

Paragraphs 88 through 91 give the procedures for disassembly, cleaning, inspection, repair, reassembly, adjustment, and testing of the flash equipment. Refer to the applicable exploded views referred to in each paragraph for an illustration of the parts being discussed.

## 88. Flash-Lamp Flasher

(fig. 55)

### *a. Disassembly of Battery Case.*

- (1) Pull the cap spring (2) from the cap (1) if necessary.
- (2) Remove the lower and upper bracket assemblies (3 and 5) by unscrewing the slotted nuts and the screws (6 and 7).
- (3) To disassemble the upper bracket (5), spread the bracket jaws and slide the latch (8), the spring stud (9), and the spring (10) from the bracket.
- (4) Remove the special panhead screw (11) and lift out the lamp receptacle (12) and lamp locking ring (13). The reflector contact spring (14) and the battery case gasket (15) are now free.
- (5) Remove the two screws (16) and take off the switch guard (17).
- (6) Pull out the firing switch button (18) and the contact selector switch (19); from the latter, pull off the contact (20).
- (7) To release the switch and outlet assembly, remove the two machine screws (21). The screw (21) opposite the switch guard also secures the battery negative contact (22) to the battery case. Tip the battery case up into the cupped hand to retrieve the rectangular nut (23) into which this screw (21) fits.
- (8) Grasp the lamp plunger (30) and pull out the switch and outlet assembly (24).
- (9) The battery case liner (25) is now removed through the top of the case (4).

### *b. Disassembly of Switch and Outlet Assembly.*

- (1) Unscrew the two machine screws (39). Remove the square nuts (26), but leave the screws (39) in place temporarily.
- (2) Lift the top insulator (27) from the assembly.
- (3) Remove the machine screw (29) and the square nut (28); take out the lamp plunger assembly (30).
- (4) Remove the circuit contact (31), the switch-to-remote contact (32), and the switch-to-solenoid contact (33) from the bottom insulator (38).
- (5) Remove the parts of the micro-type switch that consist of the key assembly spring (34), switch retainer (35), contact tip support (36) and the key assembly (37).

- (6) Remove the two previously loosened screws (39) from the bottom insulator (38). This also frees the negative outlet contact (40), square nut (41), positive outlet contact (42), and the contact insulator (43).

*c. Cleaning and Inspection.*

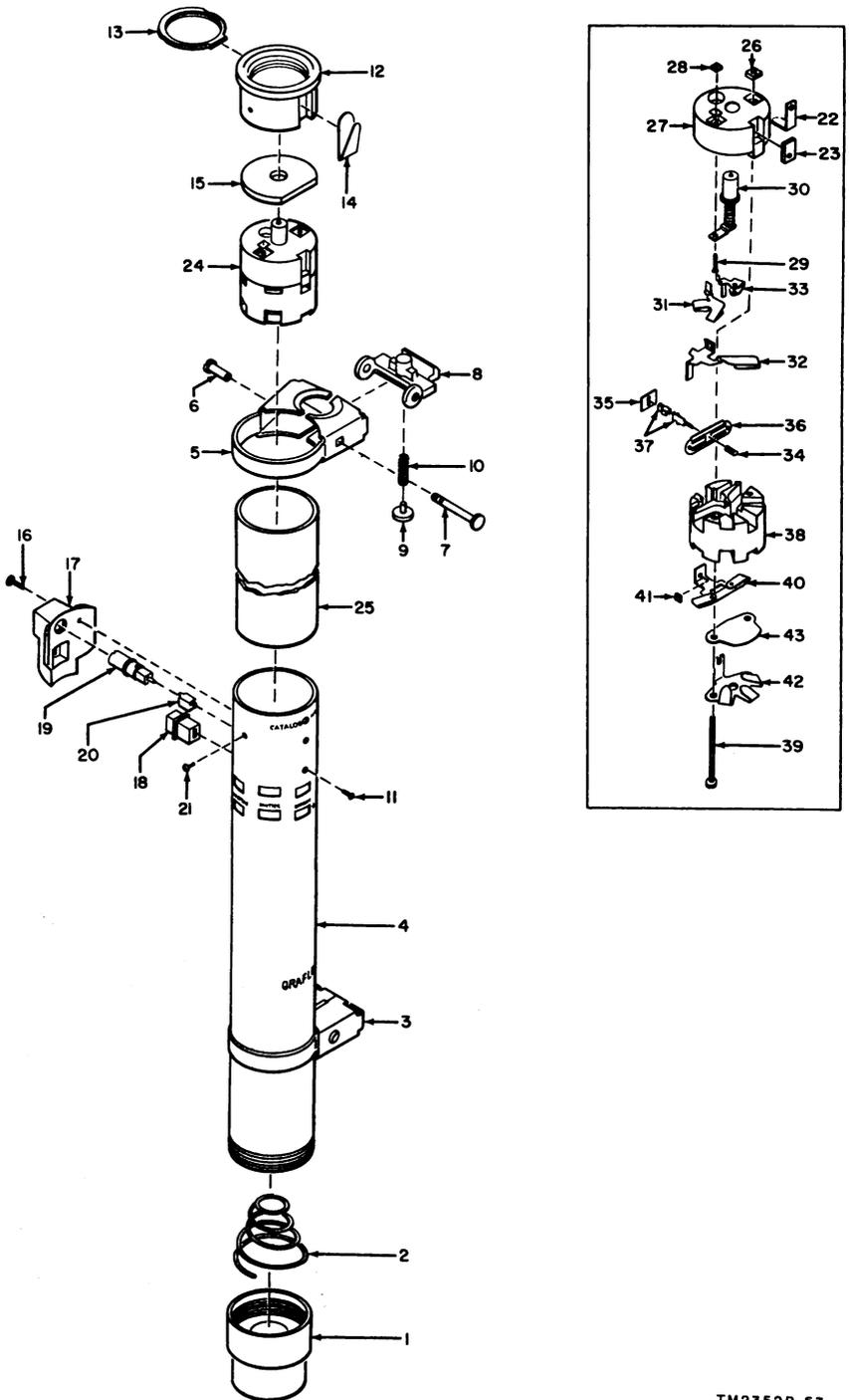
- (1) If the batteries are corroded, discard the liner (25) and clean the inside of the battery case (4) and cap spring (2).
- (2) Clean all contacts with solvent (SD) to remove dirt and grease.

**Caution:** Do not polish the contacts with any abrasives that will remove the tin coating from the copper contacts. Use fine sandpaper; do not use crocus or emery cloth.

- (3) Check the expansion action of the cap spring to assure proper operation.

*d. Reassembly of Switch and Outlet Assembly.*

- (1) Assemble the contact insulator (43) inside the three contact terminals of the positive outlet contact (42).
- (2) Mount the negative outlet contact so the rectangular hole of the negative outlet contact (40) is over the vertical fork up-right of the positive outlet contact (42). The contact insulator (43) must separate these two contacts.
- (3) Position the square nut (41) to a line with the back hole of the negative outlet contact (40).
- (4) Insert the two machine screws (39) through this assembly and the bottom insulator (38).
- (5) Assemble the spring (34) of the key assembly (37) between the inner tabs of the contact tip support (36). Position the switch retainer (35) over the back of the key assembly, and the key assembly spring (34) over the plunger tip of the key assembly.
- (6) Assemble this group of parts into the long back recess of the bottom insulator (38). The key assembly spring (34) must be compressed behind the vertical fork of the positive outlet contact (42).
- (7) Use the marked outlets of the case (4) as a guide for replacing the contacts in the correct recesses of the bottom insulator (38). Position the switch-to-solenoid contact (33), the switch-to-remote contact (32), and the circuit contact (31).
- (8) To the top insulator (27), assemble the lamp plunger assembly (30). Secure it with the square nut (28) and the machine screw (29).
- (9) Position this top insulator assembly over the machine screw (39). Be sure that all contacts fit within their recesses, and assemble the two square nuts (26) and tighten them.



TM2352B-53

Figure 55. Flash-lamp flasher, exploded view. (Insert: switch and outlet assembly, exploded view.)

*e. Reassembly of Battery Case.*

- (1) Slide the battery case liner (25) inside the top of the battery case (4).
- (2) Insert the switch and outlet assembly (24), in the top of battery case.
- (3) Insert the battery negative outlet contact nut (23) so that the negative outlet contact (22) is between the nut and the battery case, and in line with the third hole from the top at the front of the battery case (opposite switch guard). Secure the contact to the case with one of the machine screws (21). On the opposite side (rear) of the battery case, there is a hole just below the firing switch into which the other machine screw (21) fits to further secure the switch and outlet assembly to the battery case.
- (4) Insert the red lamp-firing switch button (18) into the rectangular case hole.
- (5) Assemble the circuit selector switch contact (20) with the open section down when the white dot of the contact selector switch (19) is to the upper left. Insert this assembly gently into the round hole above the lamp-firing switch button. Press and turn the assembly carefully to avoid fouling the tabs of the circuit contact (31). Press in until the assembly

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1 Cap, battery case (O 304)	22 Contact, battery negative outlet (E300)
2 Spring, cap (O 303)	23 Nut, rectangular (H300)
3 Bracket assembly, lower (A 302)	24 Switch and outlet assembly (J301)
4 Case and adapter assembly (A 300)	25 Liner, battery case (O302)
5 Bracket, upper (A304)	26 Nut, square (H309, H310)
6 Nut, bracket assembly (H342, H343)	27 Insulator, top (E303)
7 Screw, bracket assembly (H340, H341)	28 Nut, square (H311)
8 Latch, battery case bracket (H344)	29 Screw, machine (H313)
9 Stud, spring (H345)	30 Lamp, plunger assembly (E316)
10 Spring, battery case latch (O321)	31 Contact, circuit (E311)
11 Screw, panhead (H303)	32 Contact, switch to remote (E305)
12 Receptacle, lamp (J300)	33 Contact, switch to solenoid (E310)
13 Ring, lamp locking (O301)	34 Spring, key assembly (O308)
14 Spring, reflector contact (O300)	35 Retainer, switch (O307)
15 Gasket, battery case (G300)	36 Support, contact tip (E304)
16 Screw, guard mounting (H304, H305)	37 Key assembly (E309)
17 Guard, firing switch (H302)	38 Insulator, bottom (E306)
18 Button, firing switch (H306)	39 Screw, machine (H315, H316)
19 Switch, contact selector (H301)	40 Contact, negative outlet (E307)
20 Contact (E301)	41 Nut, square (H314)
21 Screw, machine (H307, H308)	42 Contact, positive outlet (E309)
	43 Insulator, contact (E308)

*Figure 55—Continued*

seats to the flange. The selector switch must turn clockwise without fouling.

- (6) Position the lamp-firing switch guard (17) and attach it to the battery case with the two mounting screws (16).
- (7) Insert the battery case gasket (15) with the flat side to the front.

*Note.* The battery case may be turned so that the lamp-firing switch button (18) is either to the front or rear. On the front, squeeze with the forefinger; on the rear, press with the thumb.

- (8) To the lamp receptacle (12), assemble the lamp locking ring (13) with its key to the spring recess. Assemble the reflector contact spring (14) in the front recess of the lamp receptacle.
- (9) Insert this assembly into the top of the battery case so that the stud of the reflector contact spring (14) centers in the front hole, second from the top. Secure it with the special panhead screw (11).

*f. Reassembly of Brackets.*

- (1) Spread the upper bracket (5) far enough to insert the battery case latch (8), the latch spring (10), and the spring stud (9).
- (2) In both the upper and lower brackets, assemble the slotted nut (6) in the round hole and the screw (7) in the square hole. A touch of any lubricant on the screw threads will ease the tightening effort later. Loosely assemble the nut and screw.
- (3) Loosely slide the upper bracket assembly (5) onto the battery case (4) from the bottom, with the latch button on top.
- (4) Loosely slide the lower bracket (3) onto the battery case with the bracket jaws facing downward. The slotted nuts of both brackets will be on the same side.
- (5) Assemble the cap spring (2) to the cap (1) by seating the large diameter end of the spring to the inside bottom of the cap.
- (6) Screw the cap (1) to the battery case.

*g. Bracket Adjustment.*

- (1) With the camera open and on a level table, engage the lower bracket to the bottom mounting ear of the camera bracket.
- (2) Turn the battery case in the bracket so that the lamp firing switch faces towards the rear of the camera; then adjust the battery case vertically so that it just clears the table top by about one-eighth of an inch. Tighten the slotted nut of the lower bracket to lock the battery case in this position.
- (3) Move the upper bracket (5) to the location of the upper camera mounting ear and engage the bracket.
- (4) Press up the latch (8) to remove the vertical play and tighten the upper bracket nut.

*h. Battery Case Batteries.* Insert three D-cell batteries, BA-202/UF or equivalent, that will produce at least 6 amperes on momentary short-circuit tests.

*i. Testing.* The tables in (2) through (4) below indicate test procedures that simulate actual photographic use. To conduct these tests, the following equipment is required: One standard base test lamp, one standard household-type male plug with contacts shorted, and Photographic Synchronizer Tester AN/TFM-3.

- (1) *General.* Insert the test lamp in the receptacle for all tests. Do not press the switch button. Turn the circuit selector switch to cover all positions; the lamp should not light. Check all outlets (except BATTERY) in this same manner. The BATTERY outlet is *hot at all times*.

(2) *N position of circuit selector.*

Test	Extension	Shutter	Remote	Solenoid	Lamp
Press switch button....	Hot.....	Dead....	Dead....	Hot.....	Hot.
Shorted plug at REMOTE.	Hot.....	Dead....	Short....	Hot.....	Hot.
Shorted plug at SHUTTER.	Hot.....	Short....	Dead....	Hot.....	Hot.

(3) *L position of circuit selector.*

Test	Extension	Shutter	Remote	Solenoid	Lamp
Press switch button....	Dead....	Dead....	Dead....	Hot.....	Dead.
Shorted plug at REMOTE.	Dead....	Dead....	Short....	Hot.....	Dead.
Shorted plug at SHUTTER.	Hot.....	Short....	Dead....	Dead....	Hot.

(4) *No. 2 position of circuit selector.*

Test	Extension	Shutter	Remote	Solenoid	Lamp
Press switch button....	Hot.....	Dead....	Dead....	Hot.....	Hot.
Shorted plug at REMOTE.	Hot.....	Dead....	Short....	Dead....	Hot.
Shorted plug at SHUTTER.	Hot.....	Short....	Dead....	Dead....	Hot.

## 89. Extension Lamp Holder

(fig. 56)

### *a. Disassembly.*

- (1) Remove the screw (1); lift out the lamp receptacle (2), the lamp locking ring (3), the spring (5), and the gasket (4).
- (2) Unscrew the three screws (6) and withdraw the outlet assembly (8) from the case (7).
- (3) Remove the two screws and nuts (9 and 10) that free the insulator (13), the lower contact (14), and the nut (15) from the bottom insulator (11).
- (4) With the insulators (12 and 13) separated, remove the upper contacts (16 and 17).
- (5) From the top insulator (12), remove the plunger assembly (20) by unscrewing the screw (18) from the nut (19).
- (6) From the side of outlet assembly (8), pry out the plug button (21), and from it remove the clip contact (22).
- (7) Remove the nut (24) and the screw (25) from the clamp (23) that frees the two flat washers (26) and the head assembly (27).

*b. Cleaning and Inspection.* Inspect all contacts and clean them with solvent (SD) to remove dirt and grease.

**Caution:** Do not polish the contacts with an abrasive that will remove the tin coating from the contacts. Use sandpaper; do not use crocus or emery cloth.

- (1) If the light unit assembly rotates on the clamp, the felt washer (28) is worn. Replace the washer or build up its thickness by cementing (MIL-C-4003) an additional felt washer on the head assembly (27).
- (2) If the head assembly does not maintain its position, tighten the nut (24) or reduce the tolerance by adding flat washers (26).

### *c. Reassembly.*

- (1) On the bottom side of the insulator (11) assemble the nut (15), the contact (14), the insulator (13), and the two screws (9).
- (2) Assemble the contacts (16 and 17) on the top side of insulator (11).
- (3) Assemble the clip contact (22), the contact plug button (21) and the plunger assembly (20) to the insulator (12). Secure the plunger assembly (20) with the screw (18) and the square nut (19).
- (4) With the contact plug button (21) positioned over the negative contact (14), mate the insulators (11 and 12) and fasten them with the two nuts (10).
- (5) Insert the outlet assembly (8) into the case (7).

- (6) Align the three screw holes of the outlet assembly with those of the case and secure the outlet assembly to the case with the three screws (6).
- (7) Assemble the gasket (4), the receptacle (2), the lamp lock ring (3), and the spring (5) to the case (7); use the screw (1).
- (8) Assemble the clamps (23) to the head assembly (27); use the two flatwashers (26), the screw (25), and the nut (24).

*d. Testing.* Connect the extension lamp holder to the battery case with its connecting cord. Position a test lamp in the top socket and attach a second test lamp to the open EXTENSION outlet of the extension lamp holder. Press the battery switch button. Both test lamps should light.

## 90. Reflector Assembly, 7-Inch

(fig. 57)

### *a. Disassembly.*

- (1) Remove the reflector locking knob (1). Remove the reflector assembly (6), and from it the reflector stud (5) and the flat washer (4).
- (2) Remove the reflector support (3) from the mounting flange (14) by taking out the four screws (2).
- (3) From the mounting flange (14), remove the lamp release button spring (10) by taking out the machine screw (7), the hexagonal nut (8), and the lockwasher (9); lift out the lamp release button (11).
- (4) Do not remove the head locking screw knob (13) unless necessary and unless both the head locking screw and knob (12 and 13) are available for replacement, as this is a pressed knurl assembly. Cut the screw shaft near the knob and remove the screw from the bushing of the first head assembly.

### *b. Cleaning and Inspection.*

- (1) Clean the chrome reflecting surface of the reflector (6) with a soft cloth and solvent (SD).
- (2) Inspect the reflector for dents and deformed edges. Press out dents; use a wooden stick padded with a few layers of soft cloth.
- (3) Inspect the lamp release button spring (10). If it has lost its tension and does not return the lamp release button (11), replace the spring.

### *c. Reassembly.*

- (1) Thread the locking screw (12) into the mounting flange (14). Support the screw on a firm surface, and press the head locking screw knob (13) on the knurled shaft of the screw; use an arbor press, if available.

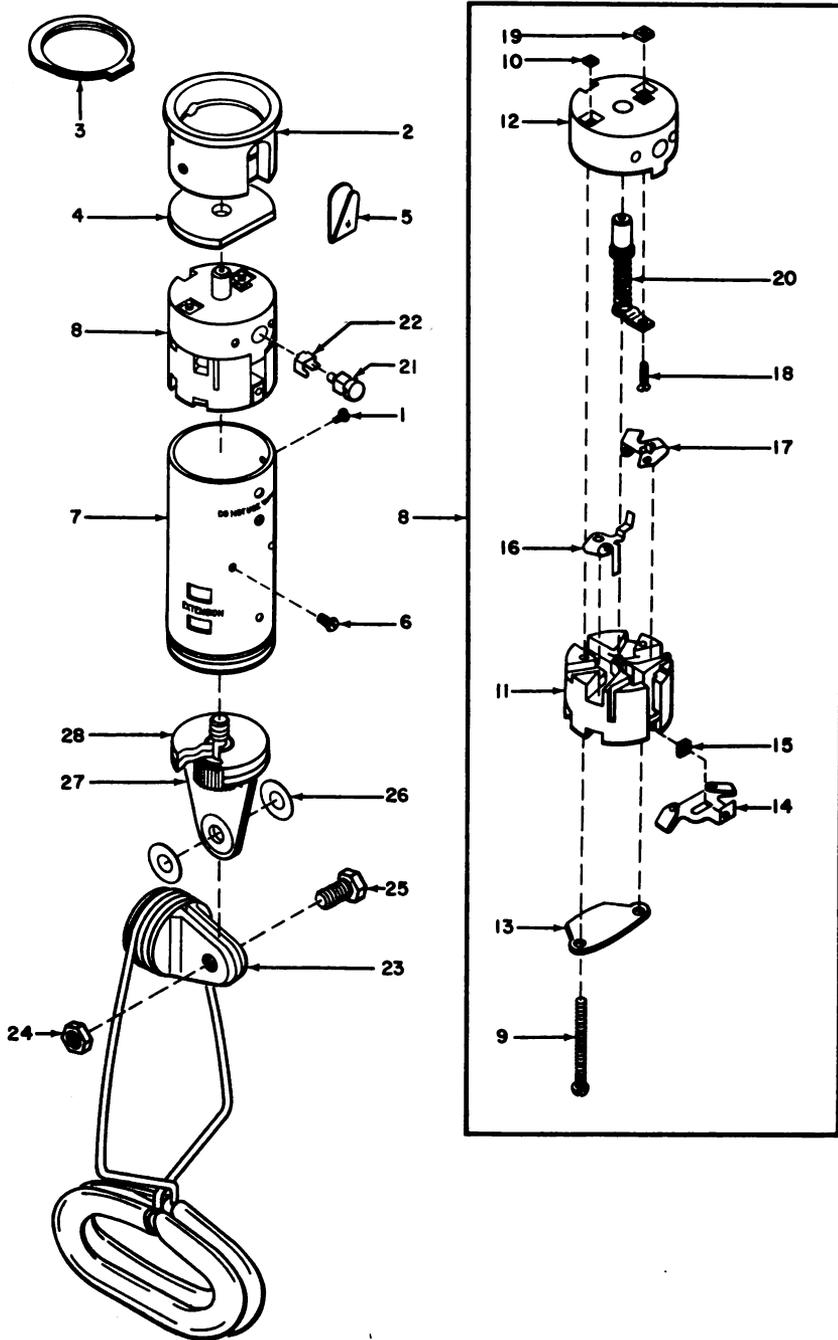


Figure 56. Extension lamp holder, exploded view.

TM2352B-54

- (2) Assemble the lamp release button (11) in the back of the mounting flange (14), and position the lamp release button spring (10) with its forked end around the button stud. The spring must face so that the tension will apply on the button. Assemble the machine screw (7) from the outside of the head, through the spring hole and into the washer (9) and lamp release spring nut (8).
- (3) Position the reflector support (3) and assemble the 1/2-inch self-tapping screw (2) in the back hole of each side; assemble the 1/4-inch self-tapping screws (2) in the front hole of each side.
- (4) The square head of the stud (5), assembled to the reflector assembly (6), must slide in the support channel. Assemble flat washer (4) over the stud. Insert the stud of the reflector assembly through the slot of the reflector support (3). Assemble the reflector locking knob (1) and lightly stake the first thread of the reflector stud so that the knob will not spin off.

*d. Testing.* Attach the reflector to the top of the battery case, or extension lamp holder. Tighten the head locking screw knob (13). The lamp locking ring should slide forward when the lamp release button (11) is pressed.

## 91. Reflector Assembly, 5-Inch

(fig. 58)

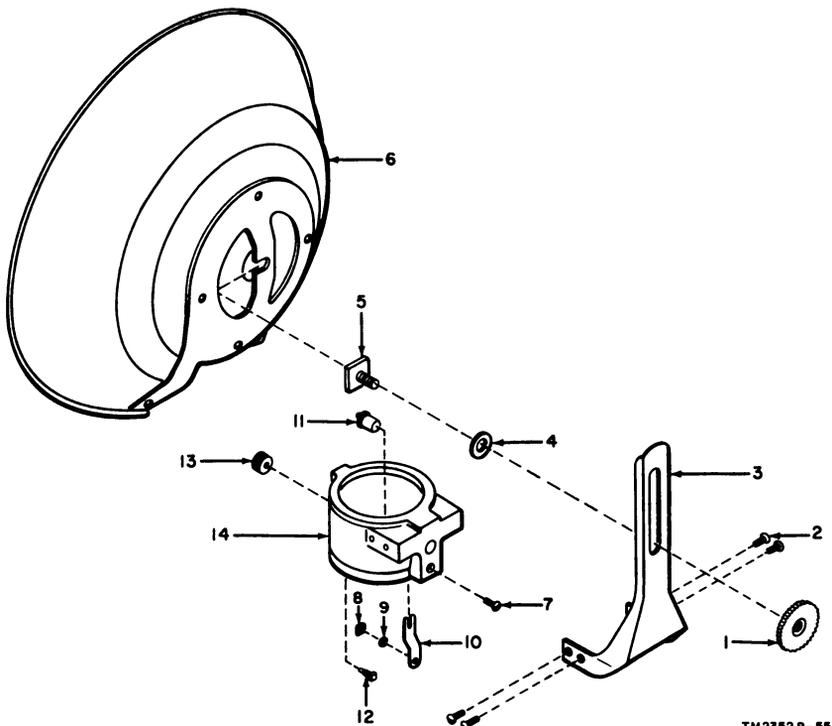
### *a. Disassembly.*

- (1) To remove the lamp receptacle assembly (1) from the head assembly (14), remove the contact assembly screw (2) and the two self-tapping receptacle screws (3).
- (2) Pull the lamp receptacle from the center of the reflector (13) and disassemble it as follows:

---

1 Screw, machine (H303)	15 Nut, square (H314)
2 Receptacle, lamp (J300)	16 Contact, circuit (E310)
3 Ring, lamp locking (O 301)	17 Contact, circuit (E311)
4 Gasket (G300)	18 Screw, machine (H313)
5 Spring, reflector contact (O 300)	19 Nut, square (H311)
6 Screw, machine (H319)	20 Lamp plunger (E316)
7 Case assembly (E318)	21 Button, plug (H317)
8 Outlet assembly (J302)	22 Contact (E301)
9 Screw, machine (H315, H316)	23 Clamp (O 334)
10 Nut, square (H309, H310)	24 Nut, hexagonal (H361)
11 Insulator, bottom (E306)	25 Screw, special (H362)
12 Insulator (E303)	26 Washer, flat (H363)
13 Insulator, contact (E308)	27 Head assembly (O 335)
14 Contact, negative outlet (E307)	28 Washer, felt (O 336)

*Figure 58—Continued*



TM2352 B-55

- |                                       |  |
|---------------------------------------|--|
| 1 Knob, reflector locking (H332)      | 8 Nut, hex. (H368)                     |
| 2 Screw, self-tapping (H364)          | 9 Washer, lock (H369)                  |
| 3 Support, reflector mounting (A 303) | 10 Spring, lamp release button (O 320) |
| 4 Washer, flat (H365)                 | 11 Button, lamp release (H337)         |
| 5 Stud, reflector (H366)              | 12 Screw, head locking (H323)          |
| 6 Reflector assembly (O 317)          | 13 Knob, head locking screw (H327)     |
| 7 Screw, machine (H367)               | 14 Flange, mounting (O 318)            |

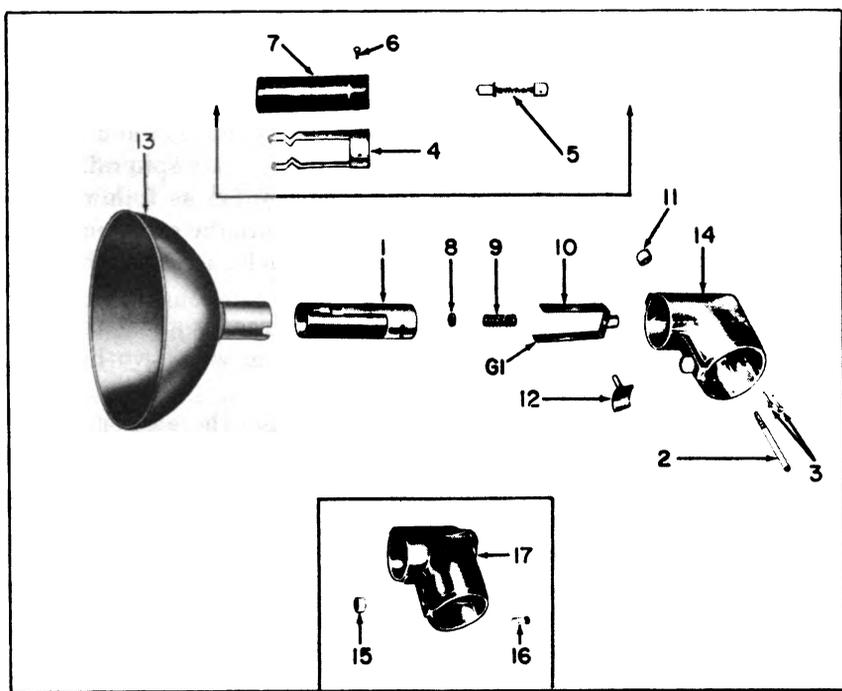
Figure 57. Reflector assembly, 7-inch, exploded view.

- (a) The lamp lock (4) is expanded slightly at the yoke and slipped from the recess of the lamp receptacle (7).
  - (b) Remove the lamp stop screw (6) and take out the lamp plunger assembly (5).
  - (3) The parts which will be free when the lamp receptacle is removed are—ejector spring insulator (8), ejector button spring (9) and the lamp release assembly (10).
- Note.* The end thread of the reflector clamp assembly (12) is staked, but not permanently.
- (4) Unscrew the reflector clamp nut (11) over this snug thread.
  - (5) The reflector clamp assembly (12) will drop inside the tube of the reflector assembly (13). Remove the reflector assembly from the head assembly (14).
  - (6) Do not remove the head locking screw knob (15) from the head (17) unless necessary, and only if both the head locking

screw and knob (16 and 15) are available for replacement. Cut the screw shaft near the knob and remove the screw from the bushing of the head (17).

*b. Cleaning and Inspection.*

- (1) Clean the chrome reflecting surface of the reflector (13) with a soft cloth and solvent (SD).
- (2) Inspect the reflector for dents and deformed edges. Press out dents; use a wooden stick padded with a few layers of soft cloth.
- (3) Inspect the lamp plunger assembly (5). Its spring must be strong enough to throw out flash lamps. Replace if defective.
- (4) Inspect the ejector button spring (9). It must be strong enough to return the lamp release assembly (10) so that the jaws of the lamp lock (4) will close.



TM2352B-56

- |                                    |                                     |
|------------------------------------|-------------------------------------|
| 1 Receptacle assembly (J305)       | 10 Release assembly, lamp (H324)    |
| 2 Screw, contact assembly (H331)   | 11 Nut, reflector clamp (H325)      |
| 3 Screw, self-tapping (H329, H330) | 12 Clamp assembly, reflector (H326) |
| 4 Lock, lamp (O 313)               | 13 Reflector assembly (O 311)       |
| 5 Lamp plunger (E318)              | 14 Head assembly (E314)             |
| 6 Screw, machine (H322)            | 15 Knob, locking screw (H327)       |
| 7 Receptacle, lamp (J304)          | 16 Screw, locking (H328)            |
| 8 Insulator, ejector spring (E313) | 17 Head (E328)                      |
| 9 Spring, ejector button (O 314)   |                                     |

*Figure 58. Reflector assembly, 5-inch, exploded view.*

- (5) Check the continuity between the head locking screw (16) and the insert molded inside the head assembly. Check at the point where the yoke of the lamp lock (4) makes contact within the second head assembly (14).

*c. Reassembly.*

- (1) Thread the head locking screw (16) into the head (17). Support the screw on a firm surface and press the head locking screw knob (15) on the knurled shaft of the screw. Use an arbor press if possible.
- (2) Check the insert that is molded inside the head assembly (14). The brass surface at the back of the small diameter tube may be polished with fine sandpaper and wiped clean with solvent (SD) to assure absolute contact with the yoke of the lamp lock (4).
- (3) To assemble the reflector (13), insert the reflector tube, slot up, in the small diameter hole of the head assembly (14). Insert the reflector clamp assembly (12) inside the reflector tube and insert the stud through the tube slot and hole at the top of the head. Assemble the clamp nut (11) and lightly stake the first thread so that the nut will not spin off.
- (4) Assemble the lamp receptacle assembly (1) as follows:
  - (a) Insert the lamp plunger assembly (5) in the receptacle (7).
  - (b) In the single top hole of the receptacle, assemble the stop screw (6).
  - (c) Slide the lamp lock (4) into the grooves along the side so that the two yoke holes will align with two holes at the back of the receptacle.
  - (d) To the lamp receptacle (1), assemble the ejector spring insulator (8) behind the plunger assembly (5) as insulation for the ejector button spring (9).
  - (e) Insert the ejector button spring (9) in the center hole of the receptacle.
  - (f) Slide the lamp release assembly (10) into position inside the side legs of the lamp lock (4).
  - (g) Check the lamp assembly ((a) through (f) above) as follows: Press the lamp release assembly and release. It must spread the lamp lock jaws and allow them to close without sticking. Check the operation; use a bayonet base flash lamp. Lightly grease the sliding surfaces of the lamp release assembly (10).
- (5) Insert the lamp receptacle assembly inside the reflector tube. Align two counterbored holes at the back of the head mounting hole with the two yoke holes and receptacle holes. Assemble the two self-tapping screws (3), and in the center hole assemble the contact assembly screw (2).

*d. Testing.* Use Photographic Synchronizer Tester AN/TFM-3 and check the electrical circuit as follows:

- (1) Be sure the lamp release assembly has been adjusted so that it operates as explained in subparagraph *c*(4)(*g*), above.
- (2) The electrical circuit must be complete from the contact assembly screw (2) to the lamp plunger (5).
- (3) The electrical circuit must be complete from the head locking screw (16) (do not check knob (15)) to the lamp lock (4).
- (4) The circuit from the contact assembly screw (2) to the head locking screw (16) must be open.
- (5) The circuit from the lamp plunger (5) to the lamp lock (4) must be open.

**Caution:** If the head assembly (14) is replaced, be positive that molding flash will not form an insulation between the molded insert and the lamp lock (4). Scrape inside the top tube so that the lamp lock yoke will contact the molded insert when the self-tapping receptacle screws are assembled.

## 92. Range Finder (Kalert E-6)

(figs. 59 through 63)

*a. General.* The range finder consists of three component assemblies—the housing assembly (10, fig. 60), the mounting plate (fig. 61), and the mounting block (fig. 62).

*b. Removal.* The mounting plate and the mounting block are removed during disassembly. To remove the housing assembly, refer to figure 59 and proceed as follows:

- (1) Remove the machine screw (8), the hexagonal nut (9) and the wood screw (10) that secure the lower end of the housing assembly to the camera body.
- (2) Remove the two wood screws (13) that secure the range finder bracket (14) to the top of the camera body.
- (3) Remove the range finder housing assembly (fig. 60).

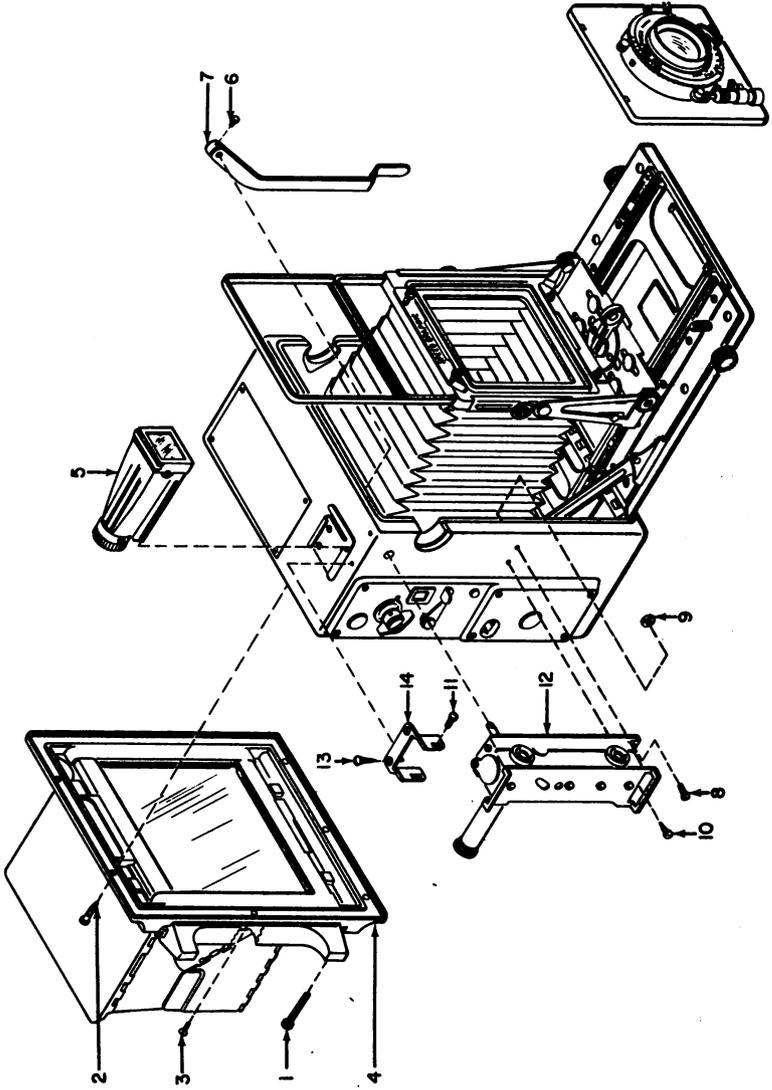
**Caution:** Lift off the housing assembly very carefully to avoid striking the mirror or prism.

- (4) Remove the range finder bracket (14, fig. 59) by taking out the two machine screws (11).

*c. Disassembly of Housing* (fig. 60).

- (1) Remove the extension eyepiece (11).
- (2) To remove the battery case bracket (3), take out the two screws (1), fiber washer (2) and bracket insulator (4).
- (3) Remove the two screws (5 and 6) and cover (7).

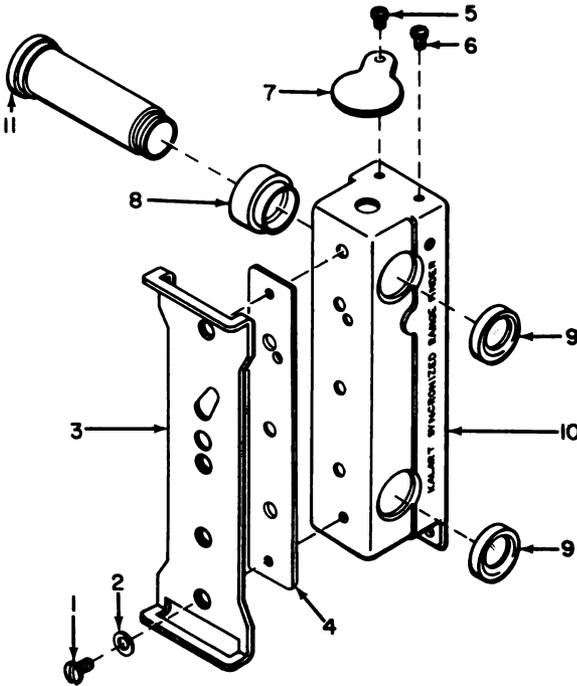
**Note.** The two front eyepiece assemblies (9) are staked into the housing (10). Replace them with new assemblies if they are removed. The rear eyepiece assembly (8) is soldered in place.



- |   |  |   |                              |    |                               |
|---|--|---|------------------------------|----|-------------------------------|
| 1 | Screw, wood (H358)                     | 5 | View finder, optical (A 312) | 10 | Screw, wood (H390)            |
| 2 | Screw, self-tapping (H351, H352)       | 6 | Screw, set (H179)            | 11 | Screw, machine (H385)         |
| 3 | Screw, self-tapping (H354, H355, H356) | 7 | Arm, range finder (O 80)     | 12 | Range finder (A 318)          |
| 4 | Back, complete (A 311)                 | 8 | Screw, machine (H384)        | 13 | Screw, wood (H117, H118)      |
|   |  | 9 | Nut, machine (H389)          | 14 | Bracket, range finder (O 359) |

*Figure 59. Camera, exploded view.*

•



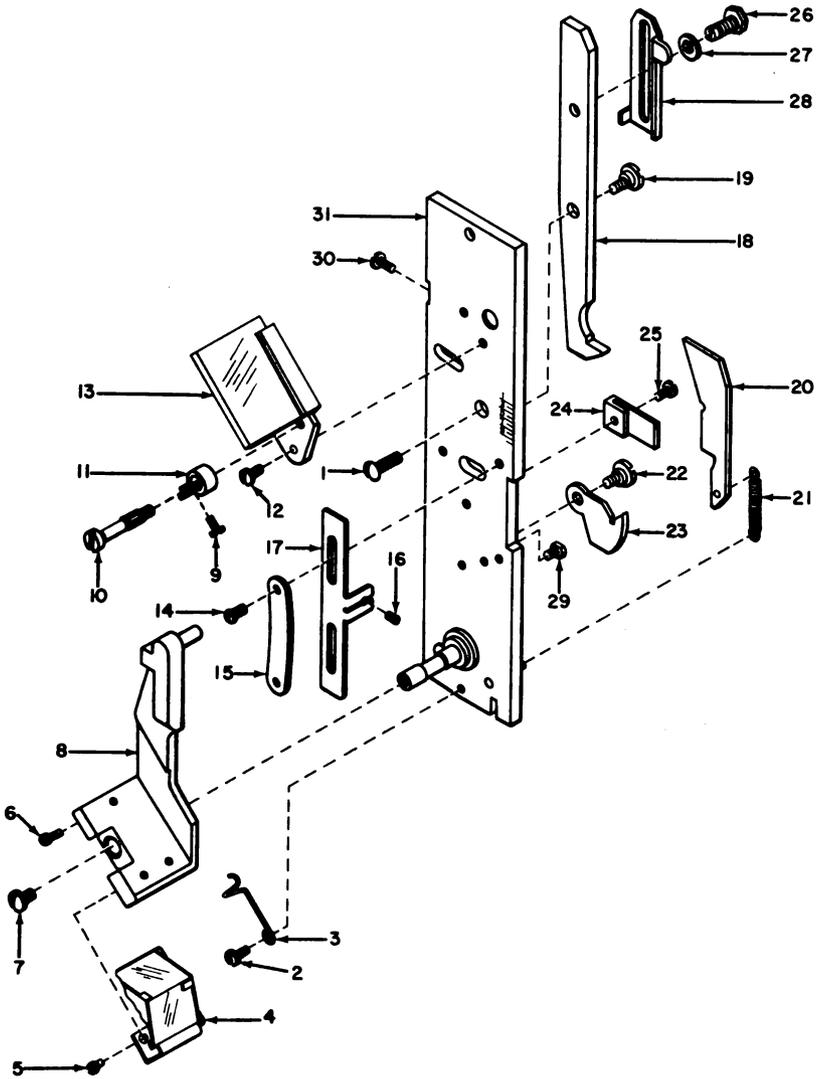
TM2352B-58

- |                                 |                                    |
|---------------------------------|------------------------------------|
| 1 Screw, machine (H412)         | 7 Cover (O 386)                    |
| 2 Washer, fiber (H415)          | 8 Eyepiece assembly, rear (A 331)  |
| 3 Bracket, battery case (O 385) | 9 Eyepiece assembly, front (A 332) |
| 4 Insulator, bracket (E322)     | 10 Housing, subassembly (A 333)    |
| 5 Screw, binding-head (H413)    | 11 Eyepiece, extension (O 387)     |
| 6 Screw, binding-head (H414)    |                                    |

Figure 60. Range finder housing, exploded view.

*d. Disassembly of Mounting Plate (fig. 61).*

- (1) Remove the roundhead screw (1) to separate the mounting plate assembly from the mounting block (fig. 62).
- (2) Take out the two fillister-head screws (12) and remove the mirror assembly (13).
- (3) Remove the special head screw (10) from the mirror assembly (13).
- (4) Remove the adjustment lever (11) from the special head screw (10). First take out the clamp screw (9).
- (5) Remove the fillister-head screw (2) and the prism assembly spring (3).
- (6) Remove the binding-head screw (7) from the prism holder stud. Lift the prism assembly (4) from the stud and disassemble.
- (7) Remove the infinity adjustment screw (6), the two fillister-head screws (5), and remove the prism assembly (4) from the lever (8).



TM2352B-59

Figure 61. Range finder mounting plate, exploded view.

- (8) To remove the indicator assembly (17) from the mounting plate (31), remove the two fillister-head screws (14) and the pressure plate (15). Remove the adjusting screw (16) from the indicator assembly.
- (9) Hold the fulcrum bar (18), lift off the compensator assembly (20), and unhook the compensator spring (21).
- (10) Remove the shoulder screw (22), the segment lever (23), and the filed head screw (29).
- (11) Remove the fillister-head screw (25) and the compensator guide (24).
- (12) To remove the fulcrum bar assembly (18), take out the shoulder screw (19).
- (13) To disassemble the fulcrum bar assembly (18), remove the special hexagonal head screw (26), flat washer (27), and fulcrum adjusting bar (28).
- (14) Remove the binding-head screw (30) from the mounting plate (31).

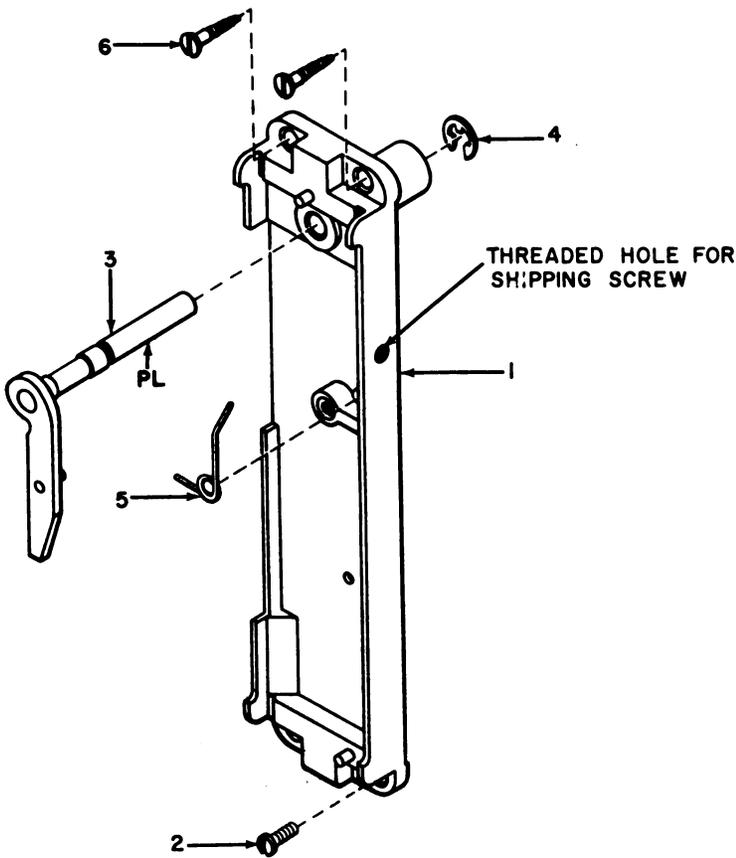
*e. Disassembly of Mounting Block.*

- (1) Use a  $\frac{3}{16}$ -inch socket wrench and remove the setscrew (6, fig. 59) from the range finder arm assembly (7); detach the range finder arm assembly from the range finder camshaft (3, fig. 62).
- (2) To remove the mounting block (1, fig. 62) from the camera body, take out the two machine screws (2) at the base and the two wood screws (6) at the top.
- (3) Remove the camshaft (3) by prying off the retaining lock spring (4). The cam spring (5) will now be free.

---

1 Screw, machine (H416)	18 Bar, fulcrum (O 395)
2 Screw, machine (H417)	19 Screw, shoulder (H426)
3 Spring, prism assembly (O 390)	20 Compensator assembly (O 396)
4 Prism assembly (A 336)	21 Spring, compensator (O 397)
5 Screw, machine (H418)	22 Screw, shoulder (H427)
6 Screw, machine (H419)	23 Lever, segment (O 398)
7 Screw, binding-head (H420)	24 Guide, compensator (O 399)
8 Lever, prism (O 391)	25 Screw, machine (H428)
9 Screw, machine (H421)	26 Screw, special hexagonal head (H400)
10 Screw, special (H422)	27 Washer, flat (H429)
11 Lever, adjustment (O 392)	28 Bar, fulcrum adjusting (O 401)
12 Screw, machine (H423)	29 Screw, filed head (H420)
13 Mirror assembly (A 337)	30 Screw, binding-head (H431)
14 Screw, machine (H424)	31 Plate, mounting, subassembly (A 338)
15 Plate, pressure (O 393)	
16 Screw, adjusting (H425)	
17 Indicator (O 394)	

*Figure 61—Continued*



TM2352B-60

- |                                 |                                   |
|---------------------------------|-----------------------------------|
| 1. Block, mounting (A 334)      | 4 Spring, retaining block (O 388) |
| 2 Screw, wood (H182)            | 5 Spring, cam (O 389)             |
| 3 Camshaft, subassembly (A 335) | 6 Screw, machine (H180)           |

Figure 62. Range finder mounting block, exploded view.

*f. Cleaning and Inspection.*

- (1) Wash the metal parts in solvent (SD) to remove dirt and dust; dry them with clean dust-free cloths.
- (2) Inspect all parts to be sure that they are not deformed or otherwise damaged.
- (3) Clean the optical parts with lens tissue. Clean carefully and rub gently to avoid disturbing the position of the mirror.
- (4) Inspect the optical parts for scratches or fractures.
- (5) Check with the troubleshooting chart (par. 85).

*g. Adjustment.* Check the following table of limits, for the approximate points of adjustment. Perform the adjustments at normal temperature (approximately 70° F.). See figure 63.

Range finder preliminary indicator setting

Lens focal length	Fulcrum bar indicator	Front indicator
5'' (127 mm).....	13	3
5¼'' (135 mm).....	15	3 5
6'' (150 mm).....	17	5
6⅝'' (162 mm).....	17	6
6½'' (165 mm).....	19	6

*h. Reassembly Procedure.*

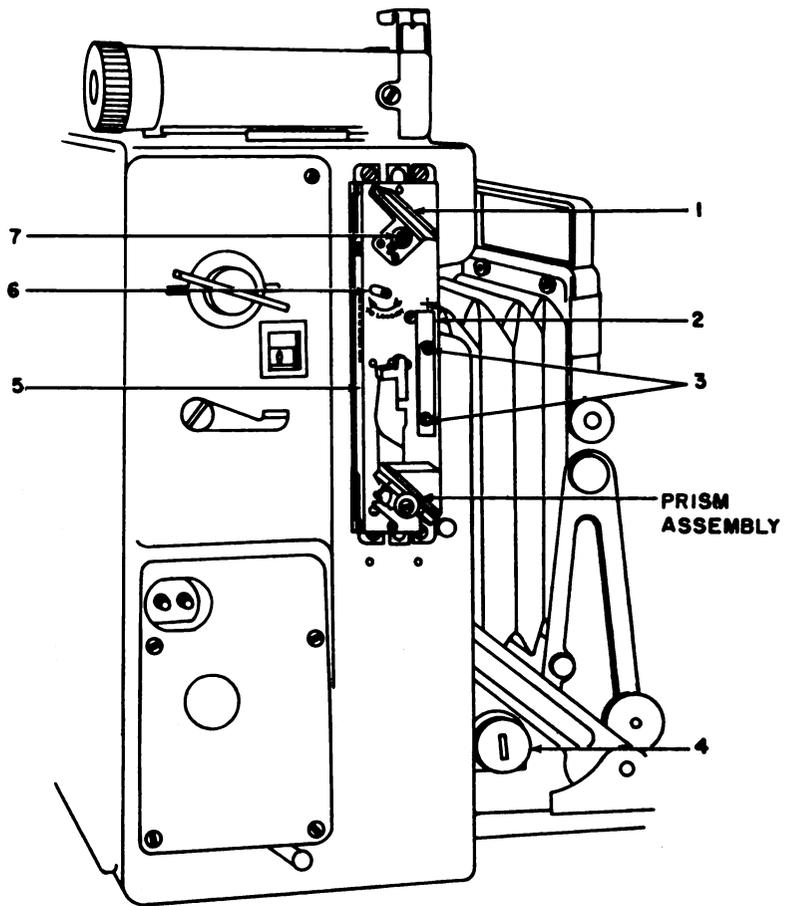
- (1) All parts of the range finder mechanism must move freely without lag or binding and without excess play. All screws should be tightened firmly in position to avoid loosening caused by jarring or vibration.
- (2) Because the range finder operates on the suspension principle, no parts of the mounting block should come in actual contact with the mounting plate except where they are held together by the roundhead screw (1, fig. 61).

*i. Reassembly of Mounting Block (fig. 62).* Apply a very thin film of grease (GL) to the camshaft assembly (3). Insert the assembly in the mounting block (1). Press the retaining lock spring (4) into position and insert the cam spring (5) so that the long end of the cam spring engages the pin of the camshaft assembly and the short end is anchored against the boss of the mounting block.

*j. Reassembly of Mounting Plate (fig. 61).*

- (1) Replace the filed head screw (29) with the filed side parallel to the long axis of the main plate (31).
- (2) Assemble the segment-lever (23), screw (22), the compensator guide (24), and screw (25) to the mounting plate (31).
- (3) Assemble the fulcrum adjusting bar (28) to the fulcrum bar (18); use the washer (27) and the special screw (26).
- (4) Install the fulcrum bar (18) to the mounting plate; use the shoulder screw (19).
- (5) Hook the compensator spring (21) to the pin at the lower end of the plate of the compensator assembly (20).
- (6) Position the fulcrum bar (18) with its nose in the V of the segment lever (23). Hold the compensator assembly in this position and replace the pressure plate (15) and the indicator (17); secure them with the two screws (14). In this position, the indicator should hold the compensator in its relative position. Assemble the adjusting screw (16) to the indicator.
- (7) Set the mirror assembly (13) in position on the mounting plate so that its face is at a 45° angle with the edge of the

- plate. Install and tighten the two fillister-head screws (12). Insert the special head screw (10) and the adjustment lever (11). Turn the head screw until the mirror assembly is at right angles to the mounting plate; then secure the adjustment by inserting and tightening the clamp screw (9) in the adjustment lever (11).
- (8) Attach the prism (4) and the prism holder assembly to the prism lever (8) with the screws (5). The prism and its holder should be flush with the prism bracket at this point. Insert the infinity adjustment screw (6) and mount the entire assembly on the prism stud. Replace the binding-head screw (7). Replace the tension spring (3) and tension spring screw (2) with the spring positioned in back of the driven stud of the main plate and bearing a clockwise pressure on the prism assembly.
  - (9) Make the lateral adjustments as follows: Sight through the assembly at a clearly defined vertical object, and draw the fulcrum bar (18) back until the lower image is approximately in the same horizontal plane with the stationary image. Now turn the adjusting screw (10) to bring the images into lateral coincidence.
  - (10) Make the horizontal adjustments as follows: Bring the fulcrum bar (18) as far back as pressure will permit, and turn the adjustment screw (6) to cause the horizontal image to coincide.
  - (11) Hold the fulcrum bar (18) as far back as possible, loosen the two screws (14) that hold the indicator, and move the indicator (17) through its range from 1 to 9. When adjustments are made calibrating the range finder for short distances, the indicator must be parallel to the compensator assembly (20) to prevent a shift of the image at infinity. If there is an appreciable horizontal change in the image when the indicator (17) is moved, replace the indicator with a new assembly; then turn the small adjusting screw (16) in the slot of the assembly until there is no further movement when the assembly is moved throughout the range.
  - (12) Tighten the two screws (14) that hold the indicator. This adjustment may cause the images to go out of horizontal coincidence, but they can be brought back by the adjusting screw (6).
  - (13) File off the head of the adjusting screw (16) of the new indicator so that it is flush.
  - (14) Turn the filed head screw (29) so that the head is at right angles to the long axis of the range finder.



NOTE: VIEW FINDER MASK SHOWN PARTIALLY PULLED OUT

TM2352B-61

- |   |                                      |   |                                 |
|---|--------------------------------------|---|---------------------------------|
| 1 | Mirror assembly                      | 5 | Indicator, fulcrum bar          |
| 2 | Front indicator                      | 6 | Screw, special, fulcrum bar     |
| 3 | Screw, machine                       | 7 | Lever, lateral image adjustment |
| 4 | Eccentric stud, range finder bracket |   |                                 |

*Figure 63. Range finder adjustment details.*

- (15) With the fulcrum bar (18) held as far back as possible, insert the binding-head screw (30) into the rear edge of the main plate. This screw limits the height of the image above infinity by acting as a stop for the fulcrum bar.
- (16) Move the adjustment lever (11) on the special head screw (10) so that it is parallel to the main plate, and tighten the clamp screw (9).
- (17) Attach the mounting plate assembly to the mounting block assembly with the roundhead screw (1). Be sure that the

dowel pins of the mounting block enter the dowel holes of the mounting plate.

- (18) Turn the camshaft assembly (3, fig. 62), to actuate the prism assembly (8, fig. 61). If the prism does not actuate at this time, check the assembly to be sure that the mounting block does not come in contact with the mounting plate assembly except where they are joined together by the roundhead screw (1, fig. 61).

*k. Reassembly of Housing* (fig. 60). Reassembly of the range finder housing is the reverse of disassembly.

*l. Reinstallation on Camera* (figs. 59, 62, and 63).

- (1) Position the mounting plate and mounting block on the side of the camera. Insert the two wood screws (2, fig. 62) at the base and the two wood screws (6) at the top.
- (2) Use a 3/16-inch socket wrench to assemble the range finder set screw (6, fig. 59) to the range finder arm assembly (7).
- (3) Set the range finder bracket eccentric stud (4, fig. 63) to its extreme rear position. Slip the range finder arm (7, fig. 59) on the range finder camshaft (3, fig. 62).
- (4) Set the range finder arm in contact with the eccentric (4, fig. 63) and hold the arm and the eccentric together with a rubber band encircling the arm and snapped over the front edge of the bed.

*Note.* Do not let the range finder arm disengage from the bracket during the next two operations.

- (5) Rack the bed yoke as far into the camera body as possible.
- (6) Use a stiff wire inserted through the screw hole on the front of the mounting plate to push the cam of the camshaft sub-assembly (3, fig. 62) to the back as far as possible. Immediately tighten the range finder arm setscrew (6, fig. 59).
- (7) Preadjust the short front scale (front indicator assembly (2, fig. 63)) and the long rear scale (fulcrum bar indicator (5)) to suit the lens focal length ( $g$  above).
- (8) Adjust the range finder as instructed in *m* below.
- (9) After the range finder has been adjusted to suit the focal length lens in use, place the housing in position.
- (10) Assemble the bracket (14, fig. 59) to the range finder (12); use the two machine screws (11). Secure the range finder to the camera body with the two wood screws (13) at the top and the two machine screws (8) at the bottom of the range finder.

*Note.* Replacement range finders are shipped with three shipping screws which must be removed prior to installation. Two of these screws attach the mounting block to the housing assembly. The third screw locks the camshaft and the prism assembly to prevent damage

during shipment; the range finder will not operate unless this screw is removed; the threaded hole for this shipping screw is shown in figure 62. The shipping screws are not used for any other purpose.

*m. Final Adjustment* (fig. 63).

- (1) Focus on either 15 or 25 feet and adjust the fulcrum bar indicator (5, fig. 63) on the rear scale as follows: Loosen the adjusting screw (6) in the direction shown by the mounting plate arrow. If the movable image is high, move the indicator down slightly; if the movable image is low, move the indicator up slightly. Tighten the adjusting screw (6) and check the range finder at infinity.
- (2) If the infinity adjustment has shifted, bring it back by turning the eccentric stud (4) and again check the range finder at either 25 or 15 feet. If the images still are not in coincidence, repeat the above directions until coincidence is attained. This method of trial and error is necessary in order to adjust the range finder accurately to the exact focal length of the lens.
- (3) At 6 feet, repeat the operation described in (1) and (2) above. When using the range finder at such close range, be sure that the upper eyepiece of the range finder is on exactly the same level as the target. First, focus carefully on the ground glass with a magnifying glass and then check on the range finder. If the images do not coincide at either of these distances, the front indicator (2) has moved. Proceed as follows: Loosen the two indicator pressure plate machine screws (3) that hold the indicator in position. If the movable image is high, raise the indicator slightly; if it is low, lower the indicator slightly. After the adjustment has been made, tighten the two machine screws (3).

*Note.* Each time the indicator is moved, the range finder should be checked at infinity.

- (4) Recheck the range finder against the image as focused on the ground glass at the close distance of 6 feet and at the far distance of either 15 or 25 feet as well as infinity. Make the necessary adjustment as explained in (1) through (3) above.
- (5) Adjust the range finder for lateral coincidence with the lateral image adjustment lever (7). Make this adjustment while viewing the images through the range finder with the housing temporarily installed. After the images are in coincidence, be sure that the lateral adjustment lever is free from contact with the adjusting screw by approximately one-fourth of a turn in the opposite direction.

- (6) Climatic and atmospheric conditions may cause the windows and mirrors of the range finder to become clouded. Remove this film from the surface of the glass with lens tissue.

**Caution:** Be careful when cleaning the mirror assembly (1) because it is a partially coated mirror. The operation of the ranger finder would be destroyed if a part of the mirrored surface is rubbed off.

- (7) Replace the housing assembly as instructed in *k* above.

### 93. Solenoid

(fig. 64)

*Note.* Check with the troubleshooting chart (par. 85) before disassembly.

#### *a. Removal.*

- (1) Remove the lens board (19) from the front standard of the camera by releasing the two lock plates in the direction away from the lens and shutter assembly.
- (2) Remove the solenoid (4) and clamp (1) from the lens board (19) by taking out the two screws (2) and unhooking the connecting link (5) from the stud of the shutter release lever.

#### *b. Disassembly.*

- (1) Loosen or remove the clamp screw (3) and slip the clamp (1) off over the top of the solenoid assembly (4).
- (2) Unscrew the ball (6) and remove the link (5).
- (3) Unscrew the tripper cap (7) and remove the armature assembly (8), the armature spring (9), and the copper foil spacer (10).
- (4) Use a  $\frac{3}{8}$ -inch open-ended hexagon wrench to remove the armature cap (11). Lift off the cap spring (12) and the tripper spacer (13).
- (5) Remove the cap nut (17) and lift off the cap assembly (16) and rubber cushion (15) to expose the coil assembly (14).

**Caution:** Do not disassemble further.

#### *c. Cleaning and Inspection.*

- (1) Gently swab the coil assembly with a piece of cotton wrapped around a match stick. After all dust and foreign matter have been removed, use another swab moistened with solvent (SD) to further clean the terminals.

**Caution:** Do not allow excess solvent to drip into the coil. The swab is to be *moistened only*.

- (2) Examine the connecting cable contacts. They must be cleaned bright and stand at right angles to the base of the terminal block.
- (3) Wipe the armature assembly (8) with a clean cloth *moistened* with solvent (SD). Thoroughly dry the cleaned parts before reassembly.



- (4) The armature spring (9) must be  $\frac{9}{16}$ -inch long with free coil measurement.
- (5) The coil assembly, when connected to the three-cell battery case, must have a resistance of 5 ohms.

*d. Reassembly.*

- (1) Assemble the rubber cushion (15) and the cap assembly (16), and secure the parts with the cap nut (17) to the bottom of the coil assembly (14).
- (2) To the coil assembly (14), assemble the tripper spacer (13) and the cap spring (12), and secure the parts with the armature cap (11). Tighten the armature cap with a  $\frac{3}{8}$ -inch open-ended hexagon wrench.
- (3) Assemble the cap (7) and link (5) to the armature (8) and secure the parts with the tripper ball (6). A drop of shellac on top of the tripper ball will seal the top thread and help prevent accidental loosening.
- (4) Place the armature spring (9) over the armature assembly (8) and seat the spring inside the brass collar at the top of the armature.
- (5) Insert the copper foil spacer (10) into the tripper assembly. Follow it with the entire armature assembly and secure it with the tripper cap (7).

*Note.* The tripper cap (7) should be screwed down approximately halfway on the armature cap (11).

- (6) Depress the armature assembly several times with the fingers; it should return each time when released. If not, the armature spring has not been positioned correctly, and it must be disassembled and repositioned.
- (7) Attach the solenoid tripper to the flash-lamp flasher battery, case with its connecting cable. Depress the firing switch on the battery case, and thus energize the solenoid. The solenoid should trip each time the switch is pressed. If it does not,

---

1 Clamp (A306)	12 Spring, cap (D405)
2 Screw, machine (H370)	13 Spacer, tripper (D412)
3 Screw, clamp (H371)	14 Coil assembly (D414)
4 Solenoid tripper (A307)	15 Cushion (O338)
5 Link, connecting (D401)	16 Cap, assembly (D429)
6 Ball, tripper (D408)	17 Nut, cap (D406)
7 Cap, tripper (D411)	18 Lens and shutter (w/jamb nut) (A308)
8 Armature assembly (D424)	19 Lens board (A309)
9 Spring, armature (D407)	20 Nut, jamb (part of A308)
10 Spacer, copper foil (E317)	
11 Cap, armature (D410)	

*Figure 64—Continued*

turn the tripper cap (7) clockwise for 2 complete turns until the solenoid operates.

*Note.* If the solenoid refuses to trip, check the troubleshooting chart (par. 85).

- (8) Insert the solenoid tripper (4) through the bottom of the clamp (1) and tighten the clamp screw (3).
- (9) Attach the link (5) to the stud of the shutter release lever and secure the clamp (1) and the entire solenoid tripper assembly (4) to the lens board (19) with the two screws (2).

*e. Adjustments.*

- (1) The solenoid is adjusted at the factory so that it will open the shutter 18 to 20 milliseconds after the circuit is closed by the lamp firing switch button on the battery case. After re-assembly, use Photographic Synchronizer Tester AN/TFM-3 to reset the solenoid-to-shutter synchronization.
- (2) To shorten the time interval between the closing of the electrical circuit and the operation of the shutter (as indicated on the AN/TFM-3), turn the knurled solenoid cap (7, fig. 64) at the top clockwise (as viewed from above) until the desired time delay is obtained. A retaining spring (12), pressing against the knurled cap at the back, will prevent accidental change by vibration, shaking, or normal use. To lengthen the time interval between circuit closing and shutter operation, turn the knurled solenoid cap counterclockwise until the desired timing effect is obtained.
- (3) Adjustment of the position of the solenoid in its clamp is required when it is transferred from one lens board to another, when the shutter is exchanged, or when the factory setting has been disturbed. To make this adjustment, proceed as follows:
  - (a) Slightly loosen the clamp screw (3) of the clamp (1), so that the solenoid tripper may be moved vertically (up or down) in its mount.
  - (b) Connect the hooked link (5) to the stud of the shutter release lever.
  - (c) Set the shutter at its top speed (1/400 second) and cock it.
  - (d) Connect the solenoid to the SOLENOID outlet of the battery case with the solenoid connecting cable.
  - (e) Close the lamp firing switch button and hold it closed so that the armature within the solenoid tripper remains down only long enough to complete the next step.
  - (f) Slowly move the solenoid tripper away from the shutter (down) until the shutter just releases.
  - (g) Hold the solenoid tripper in this exact position and tighten the clamp screw (3).

- (h) The solenoid armature should be at the bottom of its stroke when the shutter release arm is at the point of tripping. To test this, cock the shutter and move the shutter release lever down very slowly by hand. At the exact point where the shutter releases, energize the solenoid by pressing the switch button on the battery case. This should not cause any further movement of the shutter release lever, and if the adjustment has been correct (the switch button being kept down during this process), the finger can be removed from the shutter release lever without the lever moving back.
  - (i) Slowly unscrew the knurled cap (7) and check the shutter every few knurls at 1/400 second by energizing the solenoid. Continue this process as long as the solenoid will continue to operate the shutter.
- (4) Now test the TIME and BULB positions. When cocking the shutter in the TIME and BULB positions, allow at least 1 second after cocking the shutter before pressing the switch button. The shutter may operate satisfactorily at both positions without making any further adjustments. If it does not, note the following faults and remedies:
- (a) The shutter may fail to open because the solenoid is not adjusted properly. To correct this, screw the knurled cap (7) down slowly until the shutter does operate. Test the shutter after each fractional turn.
  - (b) If the shutter does not hold its OPEN position as it should on TIME and BULB exposures, adjust the shutter as instructed in paragraph 94.
  - (c) If the solenoid opens the shutter on the TIME or BULB setting, but fails to close it again, try closing the shutter manually by operating the release lever. If it is still inoperative, the shutter requires adjustment (par. 94), provided that the knurled tripper cap (7) was not screwed down further than necessary as described in (2) above.
  - (d) If the release lever does not latch after the opening movement, but the solenoid armature travel is not sufficient to accomplish the closing movement, reset the solenoid tripper upward in the solenoid mount. This setting is described in (3) (i) above, but in this case, instead of having the shutter set at its highest instantaneous setting, make the adjustment with the release lever latched and ready to close the shutter on the TIME setting.
  - (e) After the shutter has been reset, the solenoid should operate it for both the TIME and BULB settings with some adjustment of the knurled tripper cap (7). If it is not possible

to get satisfactory shutter operation by carefully following the above procedure, shorten the release stroke as described in paragraph 94p.

- (5) Test the synchronization by using Photographic Synchronizer Tester AN/TFM-3.

## **94. Between-the-Lens Shutter**

(figs. 64-77)

For greater clarity, disassembly and reassembly of the shutter are broken down into six stages. Check with the troubleshooting chart (par. 85) before disassembly.

*a. Removal of Shutter from Lens Board* (figs. 64 and 65).

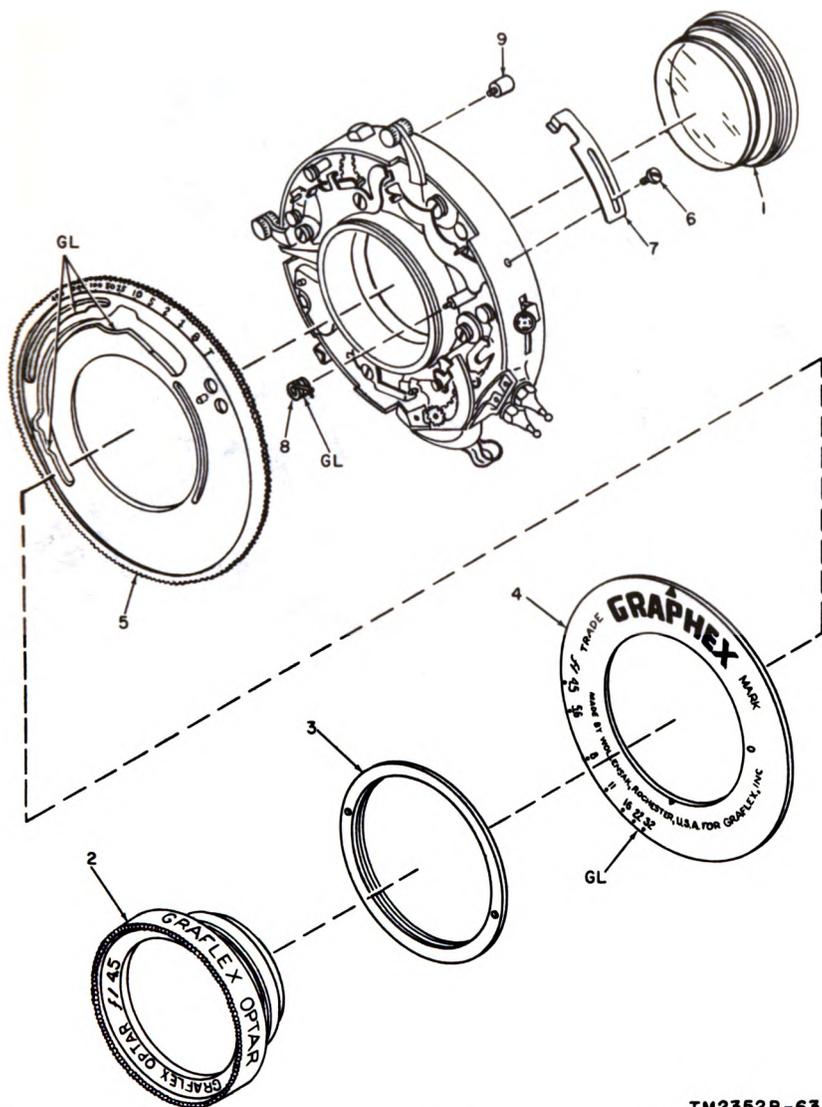
- (1) Be sure that the shutter has been tripped.
- (2) Use the special pin-type spanner wrench (par. 82 and fig. 54); remove the jamb nut (20, fig. 64) that secures the lens and shutter assembly (18) to the lens board (19).

*b. Disassembly, Stage One* (fig. 65).

- (1) Use the applicable friction wrench (par. 82 and fig. 54) and remove the rear and front lens elements (1 and 2), unscrewing them counterclockwise.
- (2) Remove the name plate lock ring (3). If the ring is tight, use lacquer thinner sparingly on the thread. Lift the name plate (4) and the speed cam assembly (5) from the shutter.
- (3) From the side of the back case, at the cocking lever, remove the dust shield (7) by taking out the dust shield screw (6).
- (4) With tweezers, pick out the high speed spring (8).
- (5) From the back of the back case, unscrew the locating pin (9).

*c. Disassembly, Stage Two* (fig. 66).

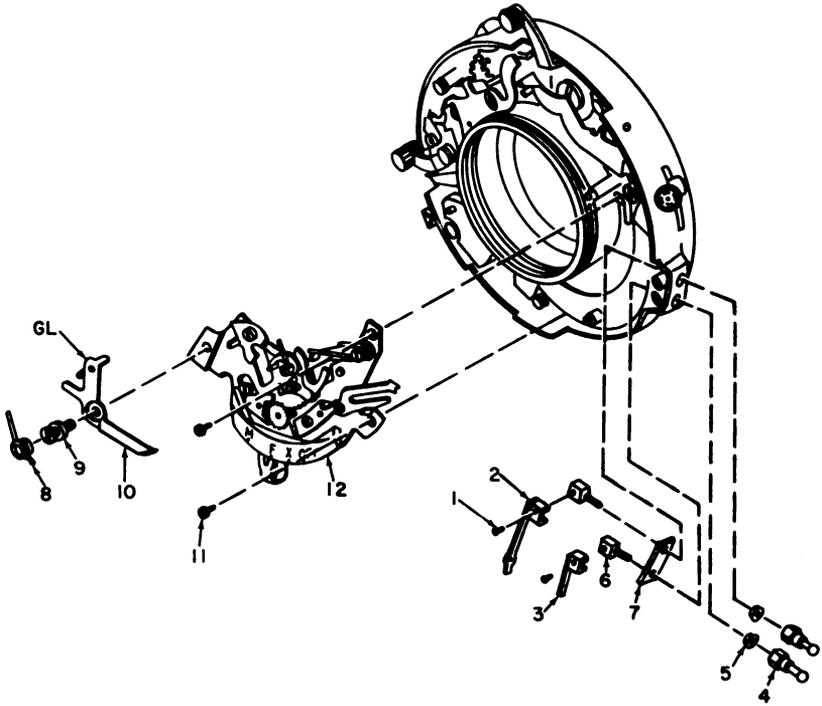
- (1) Remove the two contact screws (1) and lift out contact assembly A (2) and contact assembly B (3).
- (2) Unscrew the two prongs (4). Remove the two prong screws (6, fig. 66) by laying their ends against the work bench or other convenient flat surface and forcing them out through the holes in the back case. This will break any lacquer seal which may have held them to the prong insulators (5). The prong screws now may be lifted out carefully from the shutter. Remove the prong insulators (5) only if they are loose or damaged. Remove the prong insulator block (7).
- (3) Unhook the end of the delay and lock lever spring (8) from the delay lever (10). Remove the delay lever screw (9) with the spring (8) and lift out the delay lever.
- (4) Set the synchronizer indicator lever to M and then remove the three synchronizer support plate screws (11). Lift out the synchronizer assembly (12) very carefully.



TM2352B-63

- |                                 |                              |
|---------------------------------|------------------------------|
| 1 Lens, rear                    | 6 Screw, dust shield (H495)  |
| 2 Lens, front                   | 7 Shield, dust (A 513)       |
| 3 Lock ring, name plate (O 434) | 8 Spring, high speed (O 435) |
| 4 Plate, name (N519)            | 9 Pin, locating (O 477)      |
| 5 Cam assembly, speed (O 433).  |                              |

Figure 65. Between-the-lens shutter, exploded view, speed cam removed.



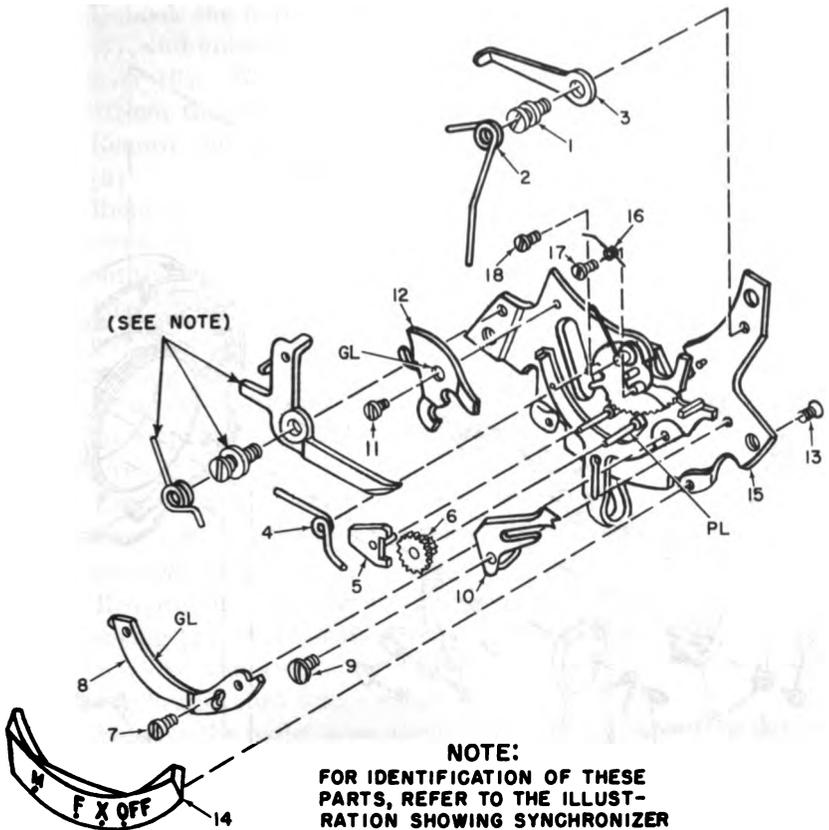
TN2352B-64

- |                               |  |
|-------------------------------|--|
| 1 Screw, contact (H483, H484) | 7 Insulator block, prong (E525)        |
| 2 Contact assembly A (E521)   | 8 Spring, delay and lock lever (O 441) |
| 3 Contact assembly B (E522)   | 9 Screw, delay lever (H482)            |
| 4 Prong (E523)                | 10 Lever, delay (O 442)                |
| 5 Insulator, prong (E526)     | 11 Screw, sync. support plate (H485)   |
| 6 Screw, prong (E524)         | 12 Synchronizer assembly (A 511)       |

Figure 66. Between-the-lens shutter, exploded view, synchronizer unit removed.

*d. Disassembly, Stage Three (fig. 67).*

- (1) Remove the clutch lever (3) by unscrewing the clutch lever screw (1) with the clutch lever spring (2) attached.
- (2) Unhook the zero lever spring (9, fig. 68) from the zero lever assembly (10, fig. 67). Unhook the sector gear spring (4) from the sector gear stud.
- (3) Remove the sector gear spring (4), the synchronizer pallet (5), and the synchronizer escapement wheel (6).
- (4) Unscrew the two actuator lever screws (7) and lift out the actuator lever (8). Remove the zero level screw (9), the zero lever assembly (10), the lock lever screw (11), and the lock lever (12).
- (5) The millisecond scale (14) may be removed if necessary by taking out the two millisecond scale screws (13).



TM2352B-65

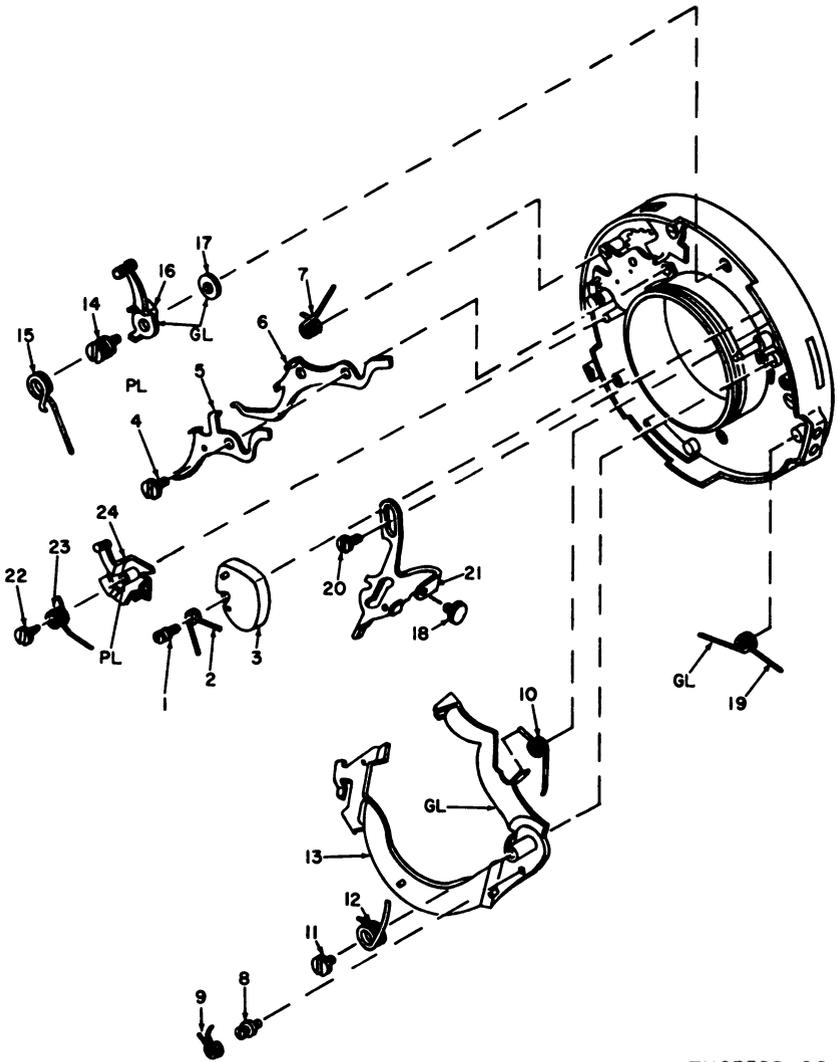
- |  |                                     |
|--|-------------------------------------|
| 1 Screw, clutch lever (H486)             | 10 Lever, assembly, zero (O 449)    |
| 2 Spring, clutch lever (O 443)           | 11 Screw, lock lever (H489)         |
| 3 Lever, clutch (O 444)                  | 12 Lever, lock (O 450)              |
| 4 Spring, sector gear (O 445)            | 13 Screw, millisecond (H490)        |
| 5 Pallet, synchronizer (O 446)           | 14 Scale, millisecond (N520)        |
| 6 Wheel, synchronizer escapement (O 447) | 15 Synchronizer subassembly (A 512) |
| 7 Screw, actuator lever (H487)           | 16 Spring, contact lever (O 451)    |
| 8 Lever, actuator (O 448)                | 17 Screw, contact lever (H491)      |
| 9 Screw, zero lever (H488)               | 18 Screw, sector gear (H492)        |

Figure 67. Between-the-lens shutter, exploded view, synchronizer unit disassembled.

(6) No further disassembly of the synchronizer subassembly (15) should be performed except for replacement of the contact lever spring (16), the contact lever screw (17), and the sector gear screw (18).

e. Disassembly, Stage Four (fig. 68).

(1) Remove the retarding weight screw (1) and the retarding weight spring (2). Lift out the retarding weight assembly (3).



TM2352B-66

- |                                     |                                    |
|-------------------------------------|------------------------------------|
| 1 Screw, retarding weight (H480)    | 13 Main lever assembly (O 455)     |
| 2 Spring, retarding weight (O 436)  | 14 Screw, cocking lever (H497)     |
| 3 Retarding weight assembly (O 437) | 15 Spring, cocking lever (O 456)   |
| 4 Screw, bulb and time lever (H481) | 16 Cocking lever assembly (O 457)  |
| 5 Lever, bulb (O 438)               | 17 Washer, cocking lever (H496)    |
| 6 Lever, time (O 439)               | 18 Button, focus lever (O 458)     |
| 7 Spring, bulb and time (O 440)     | 19 Spring, focus lever (O 459)     |
| 8 Screw, zero lever spring (H493)   | 20 Screw, focus lever (H498)       |
| 9 Spring, zero lever (O 452)        | 21 Lever, focus (O 460)            |
| 10 Spring, auxiliary (O 453)        | 22 Screw, release lever (H501)     |
| 11 Screw, main lever (H494)         | 23 Spring, release lever (O 463)   |
| 12 Spring, main lever (O 454)       | 24 Lever assembly, release (O 464) |

Figure 68. Between-the-lens shutter, exploded view, mechanism levers removed.

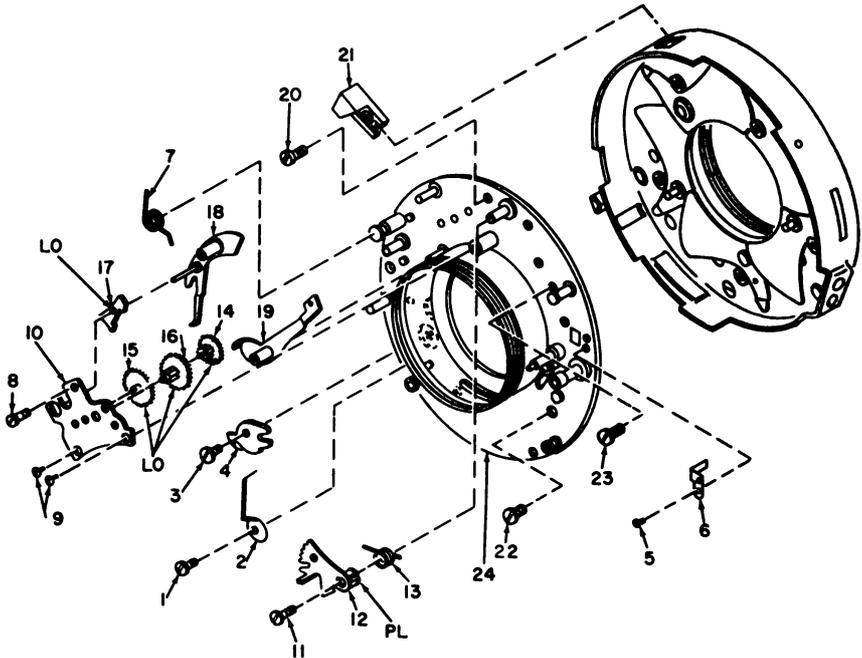
- (2) Unhook the bulb and time spring (7) from the bulb lever (5), and unhook the release lever spring (23) from the time lever (6). Remove the bulb and time lever screw (4) and lift out the bulb lever (5) and the time lever (6).
- (3) Remove the stop lever screw (8) with the zero lever spring (9).
- (4) Remove the auxiliary spring (10). Unscrew the main lever screw (11) and remove the main lever spring (12). Lift out the main lever assembly (13).
- (5) Unscrew the cocking lever screw (14) and remove the cocking lever spring (15), the cocking lever assembly (16), and the cocking lever washer (17).
- (6) Unscrew the focus lever button (18). Remove the focus lever spring (19), the focus lever screw (20), and the focus lever (21).
- (7) Unscrew the release lever screw (22) and lift out the release lever spring (23) and the release lever assembly (24).

*f. Disassembly, Stage Five (fig. 69).*

- (1) Remove the blade lever spring screw (1), the blade lever spring (2), the blade lever screw (3) and the blade lever (4).
- (2) Remove the two click stop spring screws (5) and the diaphragm click stop spring (6).
- (3) Remove the pallet lever spring (7) and the retarding device cover screw (8) with bulb and time spring (7, fig. 68) attached. Unscrew the two retarding device cover screws (9, fig. 69) and lift off the retarding device cover screws (10). Unscrew the retarding lever screw (11) and lift out the retarding lever assembly (12) with the retarding lever spring (13) attached. Lift out the retarding wheel assembly (14), the escapement wheel assembly (15), the center wheel assembly (16), and the pallet lever assembly (18) with the pallet (17) attached.
- (4) Lift out the cable release lever assembly (19).
- (5) Remove the cable release socket screw (20) and slide out the cable release socket (21).
- (6) Unscrew the three long support plate screws (22) and the four short support plate screws (23). Open the shutter blades. Lift out the support plate assembly (24).

*g. Disassembly, Stage Six (fig. 70).*

- (1) Remove the blade separator washer (1) and the five shutter blade assemblies (2). Lift out the revolving ring assembly (3).
- (2) Unscrew the three diaphragm plate screws (4), turn the shutter upside down, and drop out the diaphragm plate and leaf assembly (5).



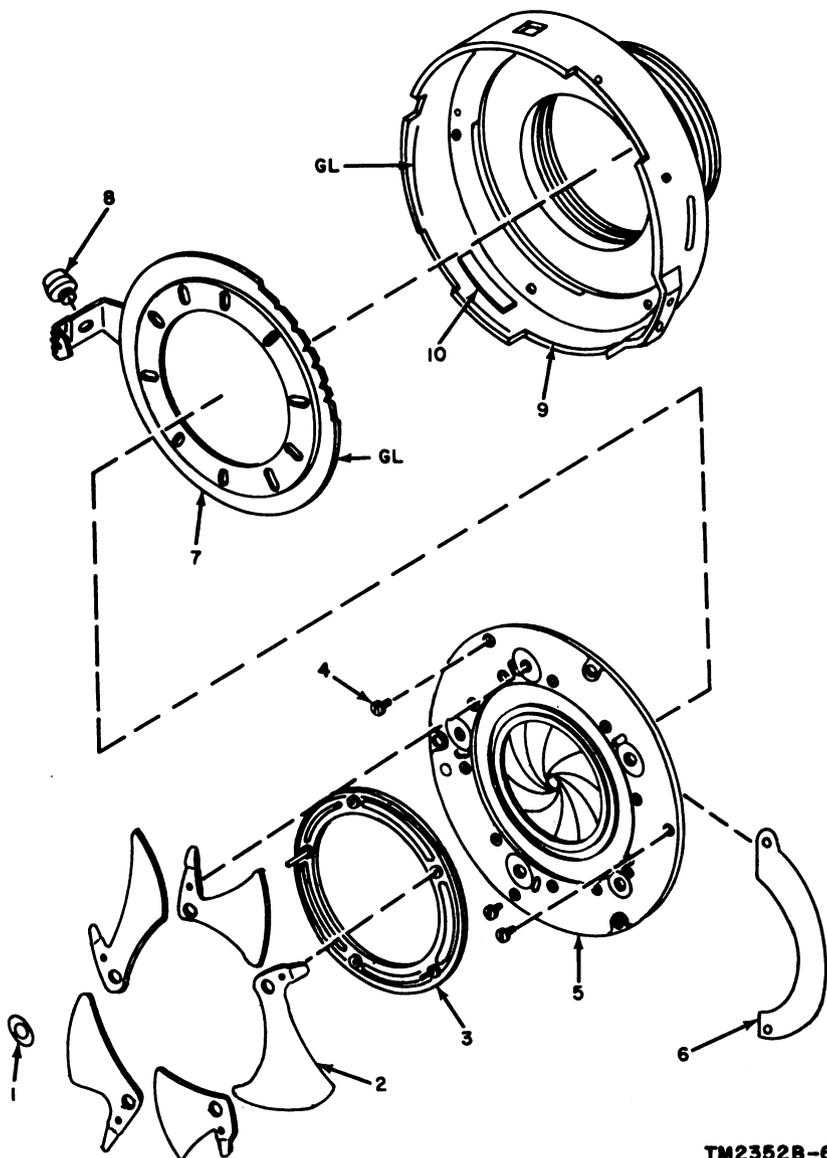
TM2352B-67

- |  |  |
|--|--|
| 1 Screw, blade lever spring (H499)     | 14 Retarding wheel assembly (O 468)      |
| 2 Spring, blade lever (O 461)          | 15 Escapement wheel assembly (O 469)     |
| 3 Screw, blade lever (H500)            | 16 Center wheel assembly (O 470)         |
| 4 Lever, blade (O 462)                 | 17 Pallet (O 471)                        |
| 5 Screw, click stop spring (H510)      | 18 Pallet lever assembly (A 515)         |
| 6 Spring, diaphragm click stop (O 479) | 19 Cable release lever assembly (O 472)  |
| 7 Spring, pallet lever (O 465)         | 20 Screw, cable release socket (H505)    |
| 8 Screw, retarding device cover (H502) | 21 Socket, cable release (A 516)         |
| 9 Screw, retarding device cover (H503) | 22 Screw, support plate (3 long) (H506)  |
| 10 Cover, retarding device (A 514)     | 23 Screw, support plate (4 short) (H507) |
| 11 Screw, retarding lever (H504)       | 24 Support plate assembly (A 517)        |
| 12 Retarding lever assembly (O 466)    |  |
| 13 Spring, retarding lever (O 467)     |  |

Figure 69. Between-the-lens shutter, exploded view, retard sector removed.

- (3) Remove the 10 diaphragm leaves (6) only if they need replacing.
- (4) Lift the diaphragm indicator ring (7) out from the back case (9) and unscrew the button (8) from the diaphragm ring.
- (5) If defective, remove the cushion (10) that is cemented to the inside of the back case (9).

*h. Cleaning and Inspection.* After complete disassembly of the shutter, submerge parts (except those listed below) in clean solvent (SD). Wipe each part carefully with a clean cloth. *Do not use a*



TM2352B-68

- |   |                                  |
|---|----------------------------------|
| 1 Washer, blade separator (H508)            | 8 Leaf, diaphragm (O 475)        |
| 2 Blade assembly (O 473)                    | 7 Ring, diaphragm (O 476)        |
| 3 Revolving ring assembly (O 474)           | 8 Button, diaphragm ring (O 478) |
| 4 Screw, diaphragm plate (H509)             | 9 Case, back (A 519)             |
| 5 Diaphragm plate and leaf assembly (A 518) | 10 Cushion                       |

Figure 70. Between-the-lens shutter, exploded view, shutter blades removed.

cleaner on the items listed below. It will be sufficient to clean with a lintless cloth.

Lens

Lens cap.

Speed cam assembly.

Millisecond scale.

Contact assemblies.

Insulators.

Zero lever assembly.

*i. Reassembly, Stage One (fig. 70).*

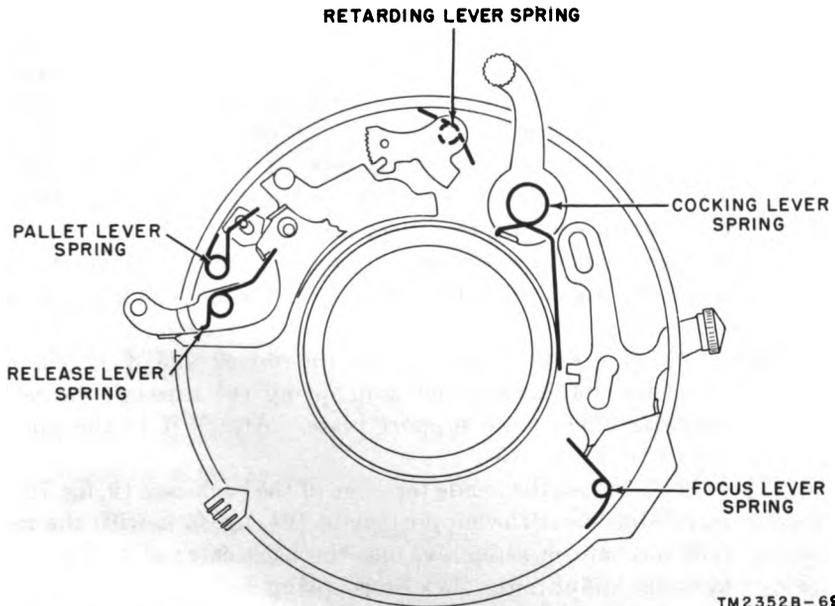
*Note.* Lubricants are to be applied as noted in the following reassembly instructions. In addition, one drop of oil is to be applied to all bearings with a thin wire.

- (1) If the cushion (10) is removed from the inside of the back case assembly (9), assemble a replacement cushion in the position shown, and attach it with cement (MIL-C-4003).
- (2) Screw the button (8) to the indicator of the diaphragm ring (7).
- (3) Apply a thin film of grease (GL) to the outer edge and click stop notches of the diaphragm ring (7). Insert the diaphragm ring through the slot in the back case assembly (9). Work the diaphragm ring back and forth in its track to distribute grease evenly. Move the diaphragm to its extreme clockwise position.

**Caution:** Be sure that there is no grease on the face of the diaphragm indicator ring near the slots.

- (4) If the diaphragm plate and leaf assembly (5) has been previously disassembled, reassemble by staking the 10 diaphragm leaves (6) one by one in a counterclockwise direction. The starting point is not critical. Each successive leaf will lie on top of the preceding one. When the leaves are all staked on, work them to full-open position by inserting a pencil (or any other convenient tool) into the center of the diaphragm opening. Move carefully in a circular motion against the inner edge of the leaves until they open to full aperture. The pencil will then be riding against the inner edge of the diaphragm plate.
- (5) Position the guide hole of each leaf for mating with the slots in the diaphragm ring by inserting an awl into the pivot hole of each leaf. This procedure automatically moves the leaf into proper position. Insert the diaphragm plate and leaf assembly into the back case with the leaves toward the back case oriented so that the two adjacent holes with embossing will be just to the left (counterclockwise) of the release lever slot in the back case. Aline the holes in the diaphragm plate and leaf assembly with those in the back case and lower the plate into place; move the diaphragm ring slowly in a counterclockwise direction until it clicks

- into engagement with the diaphragm leaves. Check the diaphragm for proper and smooth action. Install the three diaphragm plate screws (4) through the countersunk holes.
- (6) Open the diaphragm to its widest aperture. Set the revolving ring assembly (3) into its track and align the large pin with the slot in the diaphragm plate located closest to the pointer of the open diaphragm ring (7, fig. 70). Using tweezers, lay the five blade assemblies (2, fig. 70) successively into position, starting with the first blade assembly on the large pin of the revolving ring assembly and working counterclockwise. Be sure that the stud in each blade assembly rides in the proper slot of the diaphragm plate. Place the blade separator washer (1) on the last blade. Keep the blades in the open position.



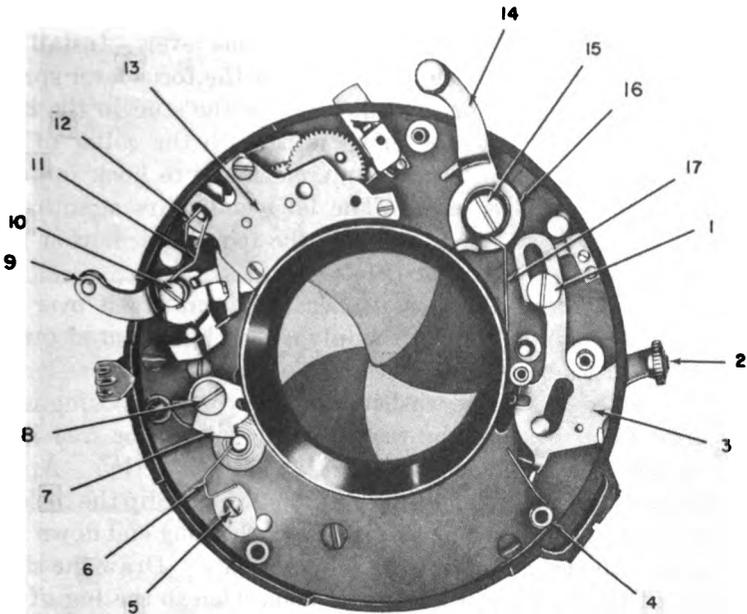
TM2352B-69

Figure 71, *Between-the-lens shutter, showing assembled positions of springs on support plate.*

*j. Reassembly, Stage Two (figs. 60 through 72).*

- (1) Assemble the cable release lever (19, fig. 69) on its stud on the support plate (24). Swing the lever and check for free movement.
- (2) Slip the pallet lever assembly (18) on to its stud. Oil the pallet (17) and install it on the pallet lever assembly.
- (3) Oil the center wheel assembly (16) by touching each end of the pinion to a felt pad moistened with oil (LO). Insert the short end of the pinion on the center wheel assembly into the center hole in the support plate assembly. Oil the

- escapement wheel assembly (15) in the same manner and insert the wheel into its hole with the gear end down. Oil the retarding wheel assembly (14) in the same manner and insert the wheel into its hole with the pin up. Place the retarding device cover (10) carefully over the wheels and hold the cover in place by partially screwing the retarding device cover screw (8) into the hole near the outer edge and the two retarding device cover screws (9) into the other two holes. First tighten device cover screws (9) and then tighten the other screw. Hold the pallet out of engagement and spin the retarding wheel to check the wheels for free movement.
- (4) Place the retarding lever spring (13) on the retarding lever assembly (12) with the long end of the spring down between the bearing and the lug. The short end of the spring will then be up (farthest away from the plane of the lever) and between the bearing and the lug on the other side (fig. 71). Rotate the retarding wheel assembly so that its pin is near the cable release socket hole. Grease the retarding lever assembly and slip it on the post. Push the retarding lever assembly down to engage the pin of the retarding wheel assembly (14, fig. 69). Put in the retarding lever screw (11). Check the gear train for smooth action.
  - (5) Slip the pallet lever spring (7) over the stud with the hook end down and behind the pallet lever pin as shown in figure 71.
  - (6) Apply grease (GL) sparingly to the convex side of the V and insert the diaphragm click stop spring (6) through the rectangular hole in the support plate. Attach it to the plate with two screws (5).
  - (7) Lightly grease the inside top edge of the back case (9, fig. 70). Carefully insert the support plate (24, fig. 69), with the retard mechanism assembly, into the back case; align the rectangular diaphragm click stop spring holes of the support plate. As the plate is inserted, draw the retarding lever spring (13) counterclockwise to rest against the inside of the back case (fig. 71), and draw the pallet lever spring (7, fig. 69) clockwise to rest in the scored recess inside the back case (fig. 71, and 12, fig. 72). Screw the three long support plate screws (22, fig. 69) into the outer holes and the four short support plate screws (23) into the inner holes of the support plate assembly (24). Seat all screws below the surface.
  - (8) Insert the cable release socket (21) into the back case (9, fig. 70) and put in the cable release socket screw (20, fig. 69).
  - (9) Assemble the blade lever (4) so that its slot engages the long pin of the revolving ring assembly (3, fig. 70). Put in the



TM23528-70

- |                              |                                |
|------------------------------|--------------------------------|
| 1. Screw, focus lever        | 10. Screw, release lever       |
| 2. Button, focus lever       | 11. Spring, release lever      |
| 3. Lever, focus              | 12. Spring, pallet lever       |
| 4. Spring, focus lever       | 13. Cover, retarding mechanism |
| 5. Screw, blade lever spring | 14. Cocking lever assembly     |
| 6. Spring, blade lever       | 15. Screw, cocking lever       |
| 7. Lever, blade              | 16. Washer, cocking lever      |
| 8. Screw, blade lever        | 17. Spring, cocking lever      |
| 9. Release lever assembly    |                                |

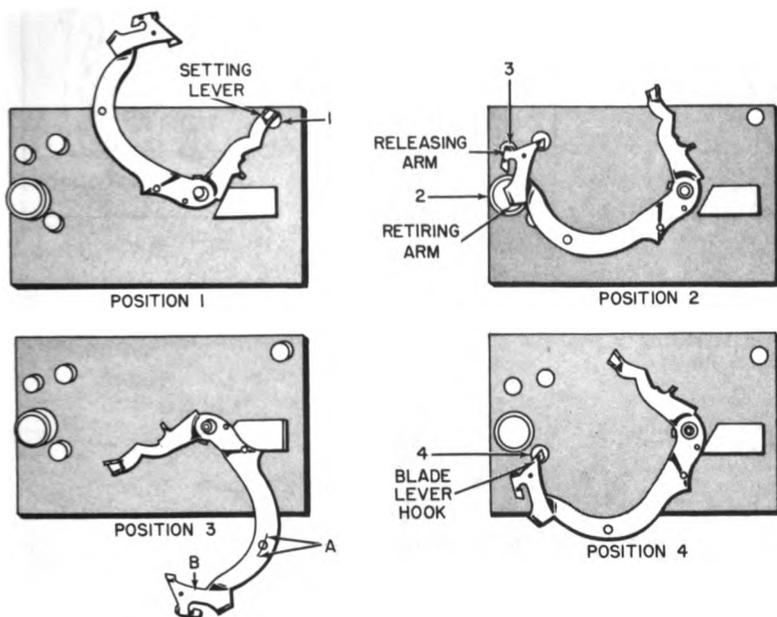
*Figure 72. Between-the-lens shutter reassembly, stages one and two.*

blade lever screw (3, fig. 69) and check for free movement of the shutter blades. Lay the blade lever spring (2) in position on the support plate (24) with the long end against the notch in the blade lever. Screw in the blade lever spring screw (1). Tighten the screw but do not bend the spring. Push the blade lever with a screwdriver and check to see that the blades snap open because of the impulse of the spring.

*k. Reassembly, Stage Three (figs. 68 through 76).*

- (1) Lightly grease the bearing of the release lever assembly (24, fig. 68) and then slip it on the stud. Insert the release lever spring (23) with the short end down and between the bearing and the handle of the release lever assembly. Put in the release lever screw (22). Now draw the long end of the spring clockwise and temporarily lay on the retarding device cover (10, fig. 69). Later, this spring will be hooked to the time lever (6, fig. 68). Refer to figures 71 and 72.

- (2) Insert the focus lever (21, fig. 68) through the slot in the back case (9, fig. 70). Engage the pin of the revolving ring assembly (3) in the slot of the focus lever. Install the focus lever screw (20, fig. 68). Grease the focus lever spring (19) and slip it, short end down, over the stud in the back case. Be sure that the spring is beneath the collar of the stud; draw the short end counterclockwise to hook into the notch on the focus lever. The long end bears against the case (figs. 71 and 72). Assemble the focus lever button (18, fig. 68) to the focus lever (21).
- (3) Grease the cocking lever washer (17) and lay it over the hole in the support plate. Apply a very light film of grease (GL) on the bottom surface of the cocking lever assembly (16), place it over the washer, and screw in the cocking lever screw (14). Center the washer so that it will be free when the screw is tightened. Check for smooth action. Apply grease (GL) to the lug of the cocking lever. Slip the cocking lever spring (15) over the screw with the long end down and against the lens collar of the support plate. Draw the short end of the spring clockwise and hook it on to the lug of the cocking lever assembly (figs. 71 and 72).
- (4) Before installation into the shutter, give the main lever assembly a preliminary check and adjustment on the main lever adjusting gage (par. 82 and fig. 54).
  - (a) Bend the cocking lever end of the main lever assembly to just lightly touch the pin of the gage (1, fig. 73). Bend the lever while it is on the gage, holding the lever firmly at the pivot point.
  - (b) Move the main lever assembly clockwise (position 2, fig. 73) so that the resting arm lies on its post (2), and the releasing arm lies on its post (3) with a slight pressure. If the arms do not touch these posts properly, make the bending adjustment described in (c) below.
  - (c) To properly bend the main lever assembly, rotate it on the gage (position 3, fig. 73). Hold the main lever assembly firmly on the gage at the pivot with the left hand. Place the index finger of the right hand along the underside of the main lever assembly to support the portion indicated at A, and press downward with the thumb on the portion indicated at B. Give a slight twisting bend.
  - (d) Test the amount of bending by moving the main lever assembly to position 4, figure 73. See that the blade lever hook of the main lever assembly just touches the post (4) to aid in determining the right pressure of the release and resting arms on the posts (2 and 3). Repeat the procedure in (b) above.

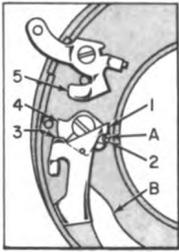


TM2352B-71

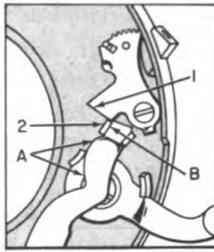
- |                       |                          |
|-----------------------|--------------------------|
| 1 Post, setting lever | 4 Post, blade lever hook |
| 2 Post, retiring arm  | A Point of adjustment    |
| 3 Post, releasing arm | B Point of adjustment    |

**Figure 75.** Between-the-lens shutter, main lever adjusting gage.

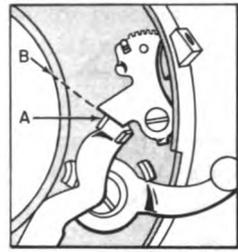
- (5) Install the main lever assembly (13, fig. 68) into the shutter. See that the blade lever hook (1, fig. 74 **A**) of the main lever assembly has slight clearance and does not touch at point A, the blade lever stud (2) of the revolving ring assembly. File this hook slightly if necessary. See that the releasing arm (3) of the main lever assembly just clears the blade lever (4) and hooks solidly on the releasing hook (5) of the release lever assembly when cocking the shutter. If this end of the main lever assembly is too high to hook solidly on the releasing hook (5), bend the main lever assembly slightly downward at point B. Make the bending adjustment with the main lever assembly installed in the shutter.
- (6) Slip the main lever spring (12, fig. 68) over the pivot with the short end down to hook into the cutout in the outer edge of the main lever assembly. Hold the spring down firmly with the fingers, draw the spring counterclockwise, and slip the long end into the slot in the back case. Screw in the main lever screw (11, fig. 68). Refer to figures 75 and 76. Apply a light film of grease (GL) on the edge of the main lever assembly that rides against the cocking lever assembly (16, fig. 68). Grease the coil of the auxiliary spring (10) and



A



B



C

TM 2352B-72

**A Release adjustment**

- 1 Hook, blade lever
- 2 Stud, blade lever
- 3 Arm, releasing
- 4 Lever, blade

- 5 Hook, releasing
- A Point of adjustment
- B Point of adjustment

**B Fitting retarding lever assembly, stage one**

- 1 Face, retarding lever assembly
- 2 Lug, short

- A Point of adjustment
- B Point of adjustment

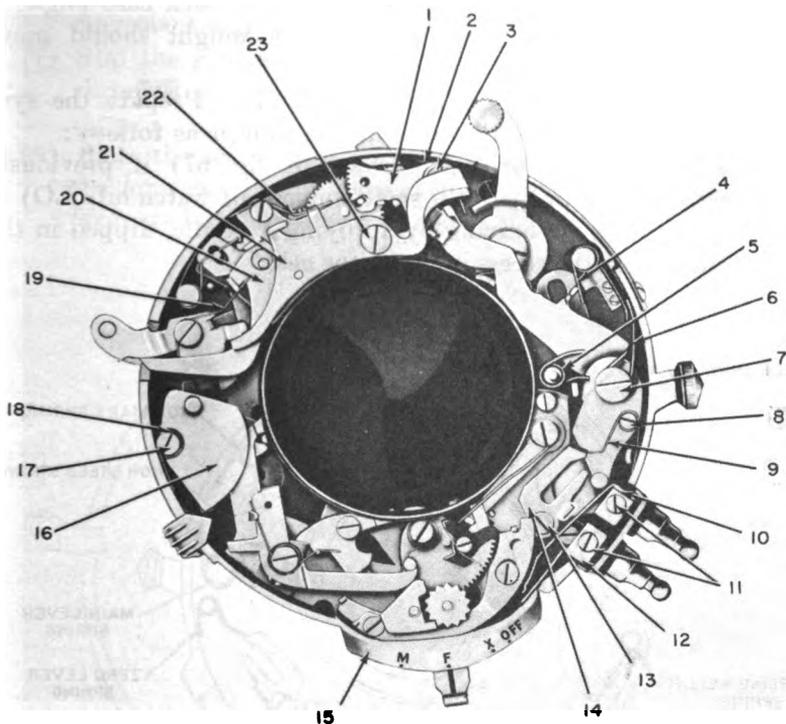
**C Fitting retarding lever assembly, stage two**

- A Point of adjustment
- B Point of adjustment

*Figure 74. Between-the-lens shutter.*

slip it over the stud with the long end down and against the back case. With tweezers, draw the short end of the spring counterclockwise to hook into the little slot of the lug on the main lever assembly (figs. 75 and 76). Test the shutter action.

- (7) With the shutter released, hold the retarding lever assembly up against the cable release socket. Draw the main lever assembly slowly with the cocking lever until its short stud (2, fig. 74 B) is at the end of the retarding lever assembly face (1). At this point, the stud and face should just clear each other without touching at point B.
- (8) While holding the retarding lever assembly, let the main lever assembly return to rest position A figure 74 C. The clearance in this position should be between 0.005 inch and 0.010 inch. If necessary, file the face slightly and be sure to maintain the original angle (B) of this face. Try the shutter for full retarding action, which should give approximately 1-second speed.
- (9) Slip the zero lever spring (9, fig. 68) over the zero lever spring screw (8, fig. 68) with the hook end of the spring up. Assemble the screw into the tapped hole on the main lever which is near the main lever bearing (figs. 75 and 76).
- (10) Lay the time lever (6, fig. 68) and bulb lever (5) over the hole in the retarding mechanism cover; screw them in place with the time and bulb lever screw (4). The move-



TM 2352B-73

- |                            |                              |
|----------------------------|------------------------------|
| 1 Retarding lever assembly | 13 Screw, zero lever         |
| 2 Spring, retarding lever  | 14 Lever, zero               |
| 3 Screw, retarding lever   | 15 Synchronizing assembly    |
| 4 Spring, auxiliary        | 16 Retarding weight assembly |
| 5 Spring, high speed       | 17 Screw, retarding weight   |
| 6 Spring, main lever       | 18 Spring, retarding weight  |
| 7 Screw, main lever        | 19 Spring, release lever     |
| 8 Screw, stop lever        | 20 Lever, time               |
| 9 Spring, zero lever       | 21 Lever, bulb               |
| 10 Contact assembly, A     | 22 Spring, bulb lever        |
| 11 Screw, contact lever    | 23 Screw, bulb and time      |
| 12 Contact assembly, B     |                              |

Figure 75. Between-the-lens shutter reassembly, stages three, four, and five.

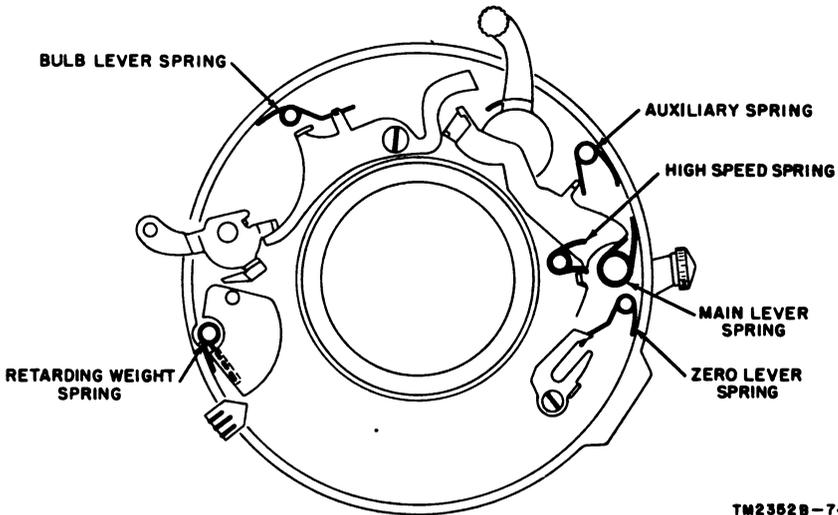
ment should be free. Hook the release lever spring (23) on the time lever (figs. 75 and 76). Slide the bulb lever spring (7, fig. 68) over the retarding mechanism cover screw with the short end down, and hook the long end on the bulb lever (figs. 75 and 76).

- (11) Slide the retarding weight assembly (3, fig. 68) on the post. Cock the shutter. Slip the retarding weight spring (2) over the retarding weight screw (1) with the long end at the top of the screw. Turn the screw in part way. Slide the bend end of the spring between the retarding weight assembly

and the back case. Draw the straight end of the spring counterclockwise and lay it against the back case (figs. 75 and 76). Tighten the screw. The weight should move freely.

*l. Reassembly, Stage Four* (figs. 67 and 77). Prepare the synchronizer assembly for installation into the shutter as follows:

- (1) Put in the sector gear screw (18, fig. 67) if previously removed. Apply a very small amount of watch oil (LO) to the sector gear bearing by applying a needle, dipped in the oil, around the recess in the sector gear.



*Figure 76. Between-the-lens shutter, springs positioned.*

- (2) Put in the contact lever screw (17), if previously removed, and slip the contact lever spring (16) over the screw with the short end of the spring down. Hook this end of the spring onto the small lug of the contact lever and draw the other end of the spring clockwise to rest against the stud (fig. 77).
- (3) Grease the friction surfaces of the synchronizer indicator lever, and then place the millisecond scale (14, fig. 67) on the synchronizer subassembly (15) and screw in the 2-millisecond scale screws (13).
- (4) Grease the friction surfaces of the lock lever (12), place it on the synchronizer support plate, and put in the lock lever screw (11). Check the lever for free movement without up and down play.
- (5) Lay the zero lever assembly (10) in place on the synchronizer support plate and screw in the zero lever screw (9). Be sure the zero lever can be moved freely.

- (6) Grease the actuator lever (8), lay it in place, and put in the two actuator lever screws (7). Check the lever for free movement without up and down play.
- (7) Slip the synchronizer escapement wheel (6) and the synchronizer pallet (5) over their respective studs after oiling them.
- (8) Place the sector gear spring (4) over the screw (18) with the long end down, so that the bent end stops against the large stud of the sector gear (fig. 77).

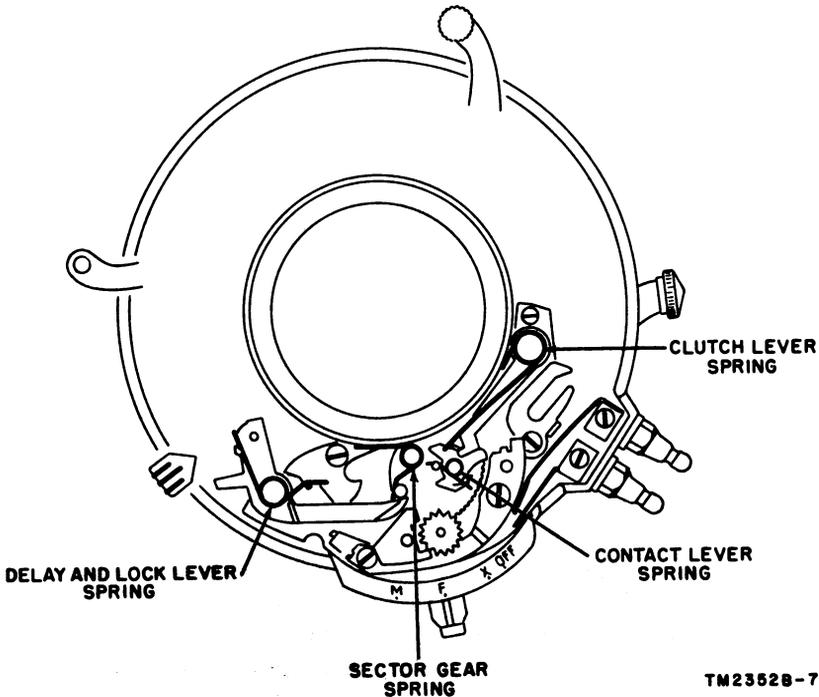


Figure 77. Between-the-lens shutter, synchronizer section, springs positioned

- (9) Place the clutch lever (3, fig. 67) over the hole in the synchronizer support plate and put in the clutch lever screw (1). Slip the clutch lever spring (2) over the screw with the short end down.

*m. Reassembly, Stage Five* (figs. 66, 67, 68, 76, and 77).

- (1) Set the synchronizer indicator lever to the M position.
- (2) While drawing the main lever assembly into position, put the synchronizer assembly (12) into the shutter so that its synchronizer stud passes through the slot in the synchronizer support plate.
- (3) Put in the three synchronizer support plate screws (11).

- (4) Hook the sector gear spring (4, fig. 67) in back of the large sector gear stud with the long end down and bearing against the lens collar of the synchronizer support plate (fig. 77).
- (5) Hook the long end of the clutch lever spring (2, fig. 67) onto the inside notch of the clutch lever (3). Refer to figure 77.
- (6) Draw the bent end of the zero lever spring (9, fig. 68) to hook onto the zero lever (fig. 76).
- (7) Grease the bearing surfaces, then put the delay lever (10, fig. 66) in place and screw in the delay lever screw (9). The lever screw should be free without up and down play.
- (8) Slip the delay and lock lever spring (8) over the delay lever screw (9) with the short end down, hooking on the lug of the lock lever. Draw the other end of the spring to rest against the lug of the delay lever (fig. 77).
- (9) Insert the two prong insulators (5, fig. 66) into the shutter case if they had been previously removed. Lay the prong insulator block (7) inside the back case. Insert the two prong screws (6) through the insulator block and back case and hold them with the finger while lightly screwing on the two prongs (4). Place the prong screw jig (par. 82 and fig. 54) over the holes in the prong screws and tightly secure the two contact screws (1, fig. 66). This automatically aligns the faces of the prong screws. Tighten the prongs and remove the jig.
- (10) Install the B contact assembly (3, fig. 66) by placing it over the left prong screw. Tighten it in place with the contact screw (1). The B contact assembly should lie tightly against the back case and just below the top surface of the millisecond scale. Lay the A contact assembly (2) over the right prong screw, and fasten it in place with contact screw (1). Be sure that the contact points align. Spacing between contact points should be the maximum permitted by proper shutter action and is somewhat dependent upon the strength of the A contact assembly. If the sector gear does not go through quickly and without hesitation when operating the shutter at M, the A contact assembly should be weakened by pressing it against the B contact assembly with the actuator lever.

*n. Reassembly, Stage Six (fig. 65).*

- (1) Screw the locating pin (9) into the rear of the back case.
- (2) Slip the curved end of the dust shield (7) under the cam near the cocking lever and lay it against the back case. Align the slot of the dust shield with the hole in the back case and fasten the dust shield in place with the dust shield screw (6).

- (3) Grease and slide the high speed spring (8) over the stud with the short end down to fit in the notch in the main lever assembly (figs. 76 and 77).
- (4) Move the diaphragm indicator ring to about midposition. Grease the rises and slide the speed cam assembly (5, fig. 65) on and rotate it to TIME position. Cock the shutter and see that the pallet pin is in the outer slot. Rotate the cam clockwise until the lugs of the time and bulb lever slip into the second slot. Turn the cam further until the weight lug slips into the slot. Grease the back of the nameplate (4) and put on the nameplate and the nameplate lock ring (3). Tighten down the lock ring so that the speed cam moves smoothly.

**Caution:** Do not overtighten the lock ring. Overtightening may freeze the lever action.

- (5) Install the front lens (2) and the rear lens (1).

*o. Reinstallation on Lens Board (figs. 64 and 65).*

- (1) When installing the lens and shutter assembly (18, fig. 64) on the lens board (19), be certain that the locating pin (10, fig. 65) in the rear of the lens and shutter assembly engages a hole in the lens board.
- (2) Secure the lens and shutter assembly to the lens board with the jamb nut (20, fig. 64). Tighten the nut with the spanner wrench (fig. 54).

*p. Shortening Shutter Release Stroke.*

**Caution:** Do not shorten the shutter release stroke until the instructions contained in paragraph 93e have been rechecked. After each slight adjustment, recheck the solenoid operation.

- (1) Disassemble the shutter (*a* through *g* above). Shorten the travel of the time lever (20, fig. 75) by slightly bending the release lever assembly tip clockwise at point A of figure 74A.
- (2) Reassemble the shutter (*i* through *o* above) and check the solenoid operation.

*q. Testing.* The shutter should be tested so that it will function as described in paragraph 6. As a further test, photographic shots should be made at various shutter speeds and diaphragm settings to prove that the various balanced shutter speeds and diaphragm settings will produce uniform negatives. The shutter should be tested further and more accurately with Photographic Synchronizer Tester AN/TFM-3.

## 95. Optical View Finder

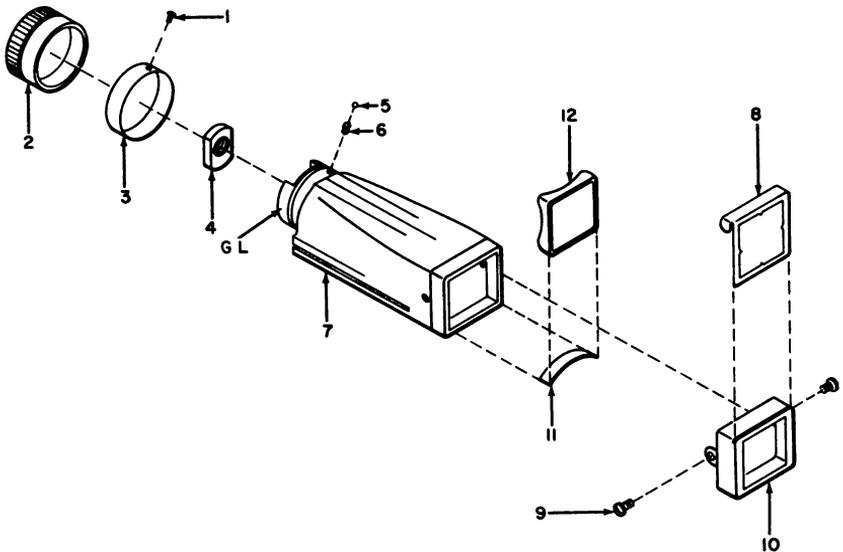
(figs. 59 and 78)

Remove the optical view finder (5, fig. 59) from the camera view finder shoe by depressing the tab on the left side and sliding the view finder forward and free of the mounting shoe.

### a. Disassembly.

- (1) Remove the two retaining screws (1, fig. 78) from the sleeve (3) and the parallax adjustment cap (2).
- (2) Carefully remove the parallax adjustment cap from the housing (7) so as not to lose the steel index ball (5), the index spring (6), and the eyepiece lens (4).
- (3) To remove the objective lens (12), slide the mask (8) out of the cap (10).
- (4) Unscrew the two machine screws (9) and pull the objective lens cap (10) from the housing (7). Ease the objective lens (12) out with the point of a knife as the objective lens spring (11) may cause the lens to bind.

b. Replacement of Objective Lens. For replacement of the objective lens, remove as described in a(3) and (4) above and reassemble as described in d(1) and (2) below.



TM2352B-76

- |   |                                 |    |                               |
|---|---------------------------------|----|-------------------------------|
| 1 | Screw, retaining (H372)         | 7  | Housing (A 310)               |
| 2 | Cap, parallax adjustment (A 12) | 8  | Mask (O 57)                   |
| 3 | Sleeve (O 339)                  | 9  | Screw, machine (H91, H92)     |
| 4 | Lens, eyepiece (I 1)            | 10 | Cap, objective lens (O 58)    |
| 5 | Ball, index, steel (O 340)      | 11 | Spring, objective lens (O 59) |
| 6 | Spring, index (H373)            | 12 | Lens, objective (I 2)         |

Figure 78. Optical view finder, exploded view.

*c. Cleaning.*

- (1) Wipe the eyepiece lens (4) with lens tissue. Wipe the objective lens with lens tissue to remove dirt and fingerprints.
- (2) Dust the inside surfaces to remove loose grit that may have sifted inside.

*d. Reassembly.*

- (1) Position the objective lens (12) with the plane surface out. Slide the objective lens spring (11) into position at the bottom of the objective lens between the lens and housing.
- (2) Reassemble the objective lens cap (10) with the slot to the top. Reassemble the mask (8).

*Note.* The mask for the 127-mm or 135-mm focal length lens should be stamped *No. 4* on the back.

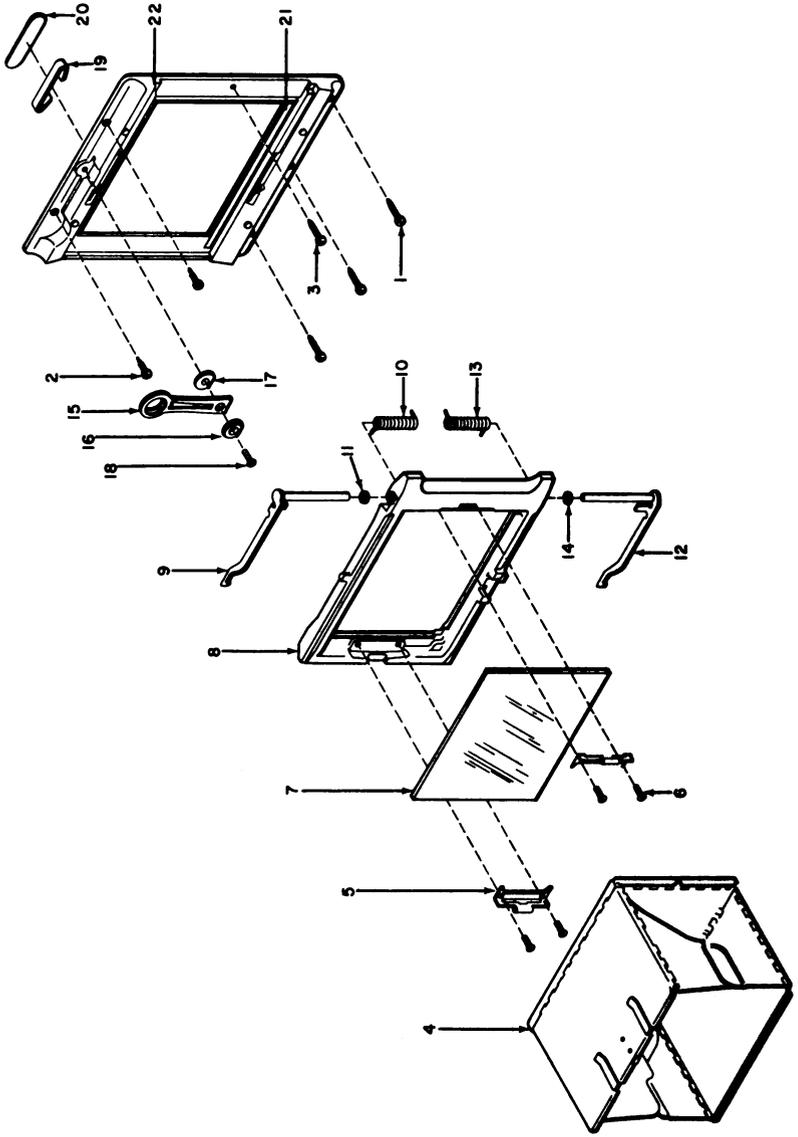
- (3) Replace the eyepiece lens (4) with the guide pin out and at the bottom of the guide channel.
- (4) Insert the index spring (6) and steel index ball (5) into the top of the housing (7). Apply a light film of grease (GL) to the housing (7) and slip the parallax adjustment cap (2) in place with the infinity mark at the top. The eyepiece lens pin should ride in the spiral groove at the inside bottom of the parallax adjustment cap. It may be necessary to adjust the eyepiece lens up or down to catch the pin in the spiral groove. Rotate the parallax adjustment cap several times to assure smooth operation.
- (5) Assemble the parallax adjustment cap retaining screws (1). Apply a small drop of shellac to the threads of the screws to act as a sealer.
- (6) Install the optical view finder on the camera by inserting the view finder (5, fig. 59) from the front of the mounting shoe, and slide it rearward until the locking tab locks.

## **96. Back Assembly**

(fig. 79)

*a. Disassembly.*

- (1) Remove the focusing panel frame assembly (8) by simultaneously pressing the knurled finger pads of the upper and lower arm assemblies (9 and 12) and sliding the frame to the right, free of the arm assembly hooks (9).
- (2) From the back (22), remove the 3 long self-tapping screws (1) at the bottom, 2 short self-tapping screws (2) at the top, and 1 wood screw (3) at the right side (fig. 59).
- (3) Remove the hood assembly (4) by pressing outward on the tab of the hood assembly retainer (5).



- |   |   |    |                             |    |                                  |
|---|---|----|-----------------------------|----|----------------------------------|
| 1 | Screw, self-tapping (H354, H355, H356)  | 7  | Screen, focusing (M53)      | 15 | Peep sight assembly (I 7)        |
| 2 | Screw, self-tapping (H351, H352)        | 8  | Frame (A304)                | 16 | Cap (H346)                       |
| 3 | Screw, wood (H353)                      | 9  | Arm assembly, upper (O 325) | 17 | Washer, special flat (H349)      |
| 4 | Hood assembly (O 322)                   | 10 | Spring, upper (O 332)       | 18 | Screw, machine (H345)            |
| 5 | Retainer, hood assembly (O 324)         | 11 | Washer, flat (H344)         | 19 | Spring (O 327)                   |
| 6 | Screw, machine (H340, H341, H342, H343) | 12 | Arm assembly, lower (O 334) | 20 | Plate (O 328)                    |
|   |   | 13 | Spring, lower (O 333)       | 21 | Strip, light seal (O 329, O 330) |
|   |   | 14 | Washer, flat (H360)         | 22 | Back (A 319)                     |

*Figure 79. Back assembly, exploded view.*

- (4) Remove the ground-glass focusing screen (7), and the 2 hood assembly retainers (5) (1 from each side), each of which is secured by 2 machine screws (6).
- (5) To remove the peep sight assembly (15), take out the machine screw (18), the cap (16), and the special flat washer (17).

*Note.* A peep sight erecting spring (19) is located in the cavity on the inside of the back and is concealed by a peep sight spring plate (20).

- (6) To remove the peep sight erecting spring (19), use a sharp pointed instrument to pry out the peep sight plate (20); do not disassemble unless the peep sight will not stand erect.

**Caution:** When performing the operation in (7) below, hold the panel so that the springs will not fly into the face.

- (7) Pry the arm assemblies (9 and 12) from their respective bearing holes, ease the terminal of each spring (10 and 13) from its associated arm tab, and remove the washers (11 and 14) from the arm shafts.
- (8) Take out the light seal strips (21).

*b. Cleaning and Inspection.*

- (1) Wash the ground-glass focusing screen (7) with soap and water, rinse thoroughly, and dry.
- (2) Examine the upper and lower arm assemblies (9 and 12) for deformity or damage. If necessary, replace.

*c. Reassembly of Peep Sight.*

- (1) If the peep sight erecting spring (19) has been removed from the inside frame cavity, position the new spring in the cavity with the open end of the spring at the bottom. Place the cover plate (20) in the cavity and stake at several points along the edge.
- (2) To assemble the peep sight assembly (15), position the special flat washer (17) over the mounting hole on the outer surface of the back (22), lay the peep sight assembly (15) in the slot provided, position the peep sight cap (16) and assemble the machine screw (18). The washers should all lie with their flat side toward the base of the sight. The sight should swing in the slot. Apply a touch of shellac beneath the screw-head and tighten.

*d. Reassembly of Focusing Screen.*

- (1) The ground-glass focusing screen (7) is assembled to the focusing frame (8) with the polished side of the focusing screen to the outside (nearest the operator).
- (2) Position the hood assembly retainer (5) at each side and assemble the two machine screws (6) in each retainer.

*e. Reassembly of Focusing Frame, Arm, and Spring.*

- (1) To simplify the following step, fabricate a special spring tool by drilling a .086-inch (No. 44) diameter hole in the

end of a  $\frac{1}{4}$ -inch diameter rod that is about 6 inches long. If facilities do not permit fabrication of this tool, use heavy pliers.

**Warning:** Hold the frame in such a position that the spring will not hit the face of the repairman if it should fly out.

- (2) To reassemble the arms and spring, first place one washer (11 or 14) over the arm shaft. The upper spring (10) actuates the upper arm assembly (9), and the lower spring (13) actuates the lower arm assembly (12).
- (3) Drop the straight end of one spring into its correct relative position in the cavity of the focusing frame (8). Use long-nosed pliers and wind the terminal one-half of a turn clockwise and hold. Push the arm shaft through the outer casting hole and the spring into the center casting hole. Replace the spring terminal so that it bears on the arm tab.
- (4) Fold the focusing hood assembly (4) by squeezing the sides together, swinging up on the bottom and, lastly, swing the top down to latch.
- (5) Assemble the light seal strips (21) to the back (22) and lay the back on the camera. Be sure that the fabric covering the camera case is tucked under all overlapping edges of the back. Assemble three long self-tapping screws (1) on the bottom, two shorter self-tapping screws (2) on the top, and one wood screw (3) on the right center edge.
- (6) Lay the frame assembly on the back and slide it to the left to hook the upper and lower arm assemblies (9 and 12) under the back frame hooks.

## 97. Focal Plane Shutter

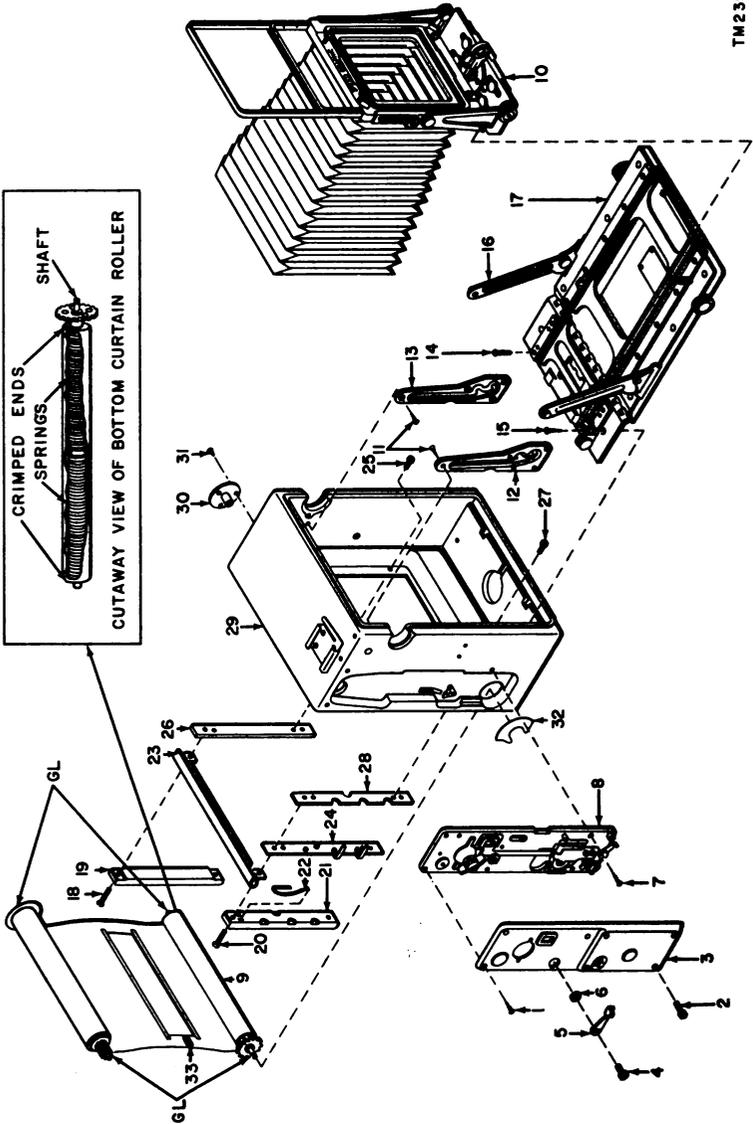
(figs. 80, 81, and 84)

### a. *Disassembly (General).*

- (1) Inspect the shutter to determine faulty operation before disassembly. Check with the troubleshooting chart (par. 85).
- (2) Remove the camera back as described in paragraph 96.

### b. *Disassembly of Cover Plate and Mechanism Plate.*

- (1) To remove the shutter plate cover assembly (3, fig. 80) remove the release lever screw (4), shutter release lever (5), and flat washer (6); also remove 4 machine screws (2) and 2 wood screws (1).
- (2) Take out the two receptacle contact studs (9, fig. 81) and remove the receptacle insulator (7) and washer (8) from the cover assembly (3).
- (3) Remove the dust seal (10) and shutter plate window (11) from the cover assembly (3).



- |   |                                     |    |                                |    |                                   |
|---|-------------------------------------|----|--------------------------------|----|-----------------------------------|
| 1 | Screw, wood (H38, H39)              | 10 | Front standard (A 315)         | 22 | Contact, spring finger (E1, E2)   |
| 2 | Screw, machine (H40, H41, H42, H43) | 11 | Screw, wood (H10)              | 23 | Guide, curtain (O 364)            |
| 3 | Cover assembly, shutter plate       | 12 | Plate, bed brace, right (O 5)  | 24 | Jumper assembly (E9)              |
| 4 | Screw, release lever (H401)         | 13 | Plate, bed brace, left (O 362) | 25 | Screw, machine (H398)             |
| 5 | Lever, shutter release (O 372)      | 14 | Screw, bed hinge (H16)         | 26 | Spacer block (O 365)              |
| 6 | Washer, flat (H403)                 | 15 | Screw, wood (H391)             | 27 | Screw, machine (H394)             |
| 7 | Screw, wood (H46, H47)              | 16 | Brace assembly (O 6)           | 28 | Strip, mounting insulator (O 366) |
| 8 | Plate assembly, shutter (A 321)     | 17 | Bed (A 316)                    | 29 | Body, camera (A 317)              |
|   | (A 320)                             | 18 | Screw, machine (H175, H176)    | 30 | Bearing, curtain roller (O 14)    |
| 9 | Curtain and roller assembly (O 361) | 19 | Block, left (BC3)              | 31 | Screw, wood (H29, H30, H31)       |
|   |                                     | 20 | Screw, machine (H175, H176)    | 32 | Seal, roller (O 360)              |
|   |                                     | 21 | Block, right (BC2)             | 33 | Synchronizer                      |

*Figure 80. Camera body, exploded view.*

- (4) Remove the four wood screws (7, fig. 80) to free the shutter plate assembly (8).
- (5) Remove the dial slide (18, fig. 81) from the governor stud.
- (6) Unscrew the shaft retainer screw (15) and slowly unwind the tension shaft retainer (16).
- (7) Swing the speed control lever assembly (17) back to raise the governor. Lift the shutter mechanism plate assembly (14) from the camera (fig. 80).

*c. Disassembly of Escapement, Master Gear, and Winding Gear (fig. 81).*

- (1) The escapement assembly (21) is secured by two screws (22).
- (2) Unhook and remove the escapement spring (36).
- (3) Remove the taper pin (13), winding key assembly (12), and master gear assembly (20). Lift the shutter dial (19) from its boss.
- (4) Take out the machine screw (24) and remove the escapement lever (23), the flat washer (25), and the shaft (26).

*Note.* Do not remove the governor assembly (37) unless necessary.

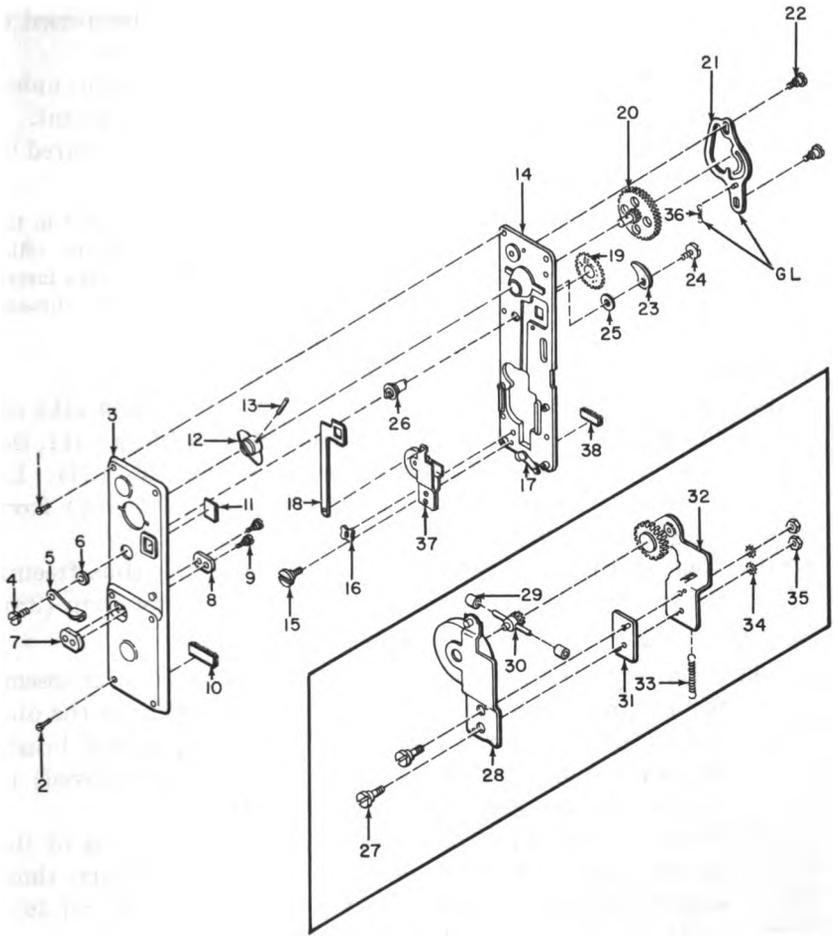
*d. Disassembly of Governor (fig. 81).*

- (1) Disconnect the governor spring (33).
- (2) Remove the two machine screw nuts (35), two lockwashers (34), and two screw studs (27).
- (3) Lift the top bracket assembly (28) from the shutter mechanism plate assembly (14).
- (4) Remove the governor pinion assembly (30).
- (5) The governor shoes (29) are removed from the pinion assembly. The bracket assembly (32) and spacer (31) now can be removed.
- (6) If the speed control lever assembly (17) is bent or damaged, drill out the brass stud, using a No. 50 drill.
- (7) Remove the dust seal (38) from the shutter mechanism plate assembly (14).

*Note.* Items 1 through 6, figures 80 and 81, are disassembled during removal of the cover plate *a*(1) above, and reassembled as described in *l*(18) below. These items are repeated on figure 81 to show their relationship to internal parts.

*e. Disassembly of Curtain and Roller Assembly (fig. 80).*

- (1) To remove the curtain and roller assembly (9), it will be necessary first to tear out the tension roller seal (32), cemented around the lower tension roller gear. Save the torn shield for a pattern if a replacement shield is not in stock.
- (2) Shift the curtain and roller assembly to the right of the camera case bearings, and lift it from the camera body (29).



TM 2352B-79

- |  |                                     |
|--|-------------------------------------|
| 1 Screw, wood (H38, H39)                     | 18 Slide, dial (N2)                 |
| 2 Screw, machine (H40, H41, H42, H43)        | 19 Dial, shutter (O 17)             |
| 3 Cover assembly (A 322)                     | 20 Gear assembly, master (O 16)     |
| 4 Screw, release lever (H401)                | 21 Escapement assembly (O 15)       |
| 5 Lever, shutter release (O 372)             | 22 Screw, escapement (H23, H49)     |
| 6 Washer, flat (H403)                        | 23 Lever, escapement (O 374)        |
| 7 Insulator, receptacle (E3)                 | 24 Screw, machine (H402)            |
| 8 Washer, receptacle (E4)                    | 25 Washer, flat (H404)              |
| 9 Stud, receptacle contact (E14, E15)        | 26 Shaft (O 375)                    |
| 10 Seal, dust (O 373)                        | 27 Stud, screw (H167, H168)         |
| 11 Window, shutter plate dial (MC3)          | 28 Bracket assembly, top (O 77)     |
| 12 Key assembly, winding (H37)               | 29 Shoe, governor (H173, H174)      |
| 13 Pin, taper (H36)                          | 30 Pinion assembly, governor (O 78) |
| 14 Plate assembly, shutter mechanism (A 323) | 31 Spacer, bracket (O 376)          |
| 15 Screw, shaft retainer (H48)               | 32 Bracket assembly, bottom (O 79)  |
| 16 Retainer, tension shaft (O 20)            | 33 Spring, governor (O 19)          |
| 17 Lever assembly, speed control (O 21)      | 34 Washer, lock (H169, H170)        |
|  | 35 Nut, machine (H171, H172)        |
|  | 36 Spring, escapement (O 22)        |
|  | 37 Governor assembly (O 18)         |
|  | 38 Seal, dust (O 377)               |

Figure 81. Focal plane shutter, cover and mechanism plates, exploded view. (Insert: governor assembly (37), exploded view.)

- (3) Do not lose the spacer washers that may have been used to prevent too much end play of the rollers.
- (4) Do not disassemble the rollers from the curtain unless necessary. In case of a defective roller, replace as a unit.
- (5) Remove the two curtain roller bearings (30), each secured by three wood screws (31).

*Note.* For emergency replacement of the parts incorporated in the tension roller assembly, pry up the crimped-over ends of the roller and remove the end plugs with the shaft and the springs (see insert, fig. 80). Note, however, that these parts are now available through normal sources.

*f. Disassembly of Contact Assemblies (fig. 80).*

- (1) Remove the four machine screws (18 and 20) and take off the left contact block (19), the right contact block (21), the two curtain guides (23), and the jumper assembly (24). Be careful to retrieve the two spring finger contacts (22) from the grooves in back of the contact block (21).
- (2) Remove the four machine screws (25 and 27), thus freeing the spacer block (26) and the mounting insulator strip (28).

*g. Cleaning and Inspection (fig. 81).*

- (1) *Shutter plate cover.* Examine the shutter plate cover assembly (3), for dents that will obstruct the working of the dial slide (18) or the governor assembly. Using a stiff brush, brush the fabric dust seals (10 and 38) (if not removed) to remove dust and grit that may have collected.
- (2) *Shutter mechanism plate assembly.* Clean all parts of the shutter plate (14) with solvent (SD). Dry all parts thoroughly before reassembly. Check the springs (33 and 36); replace if stretched or deformed. Inspect the gears for worn teeth and loose stop pins.
- (3) *Curtain and roller assembly (fig. 80).* Examine the curtain for pinholes, tears, or weak points near the struts. If the curtain and rollers have been disassembled, remove all old cement before reassembly. Rough the brass rollers with very coarse sandpaper. Carefully clean the curtain synchronizer contacts (33) with very fine sandpaper. Check the curtain for any distortion or stretching. This condition will cause the curtain to run off the edge of the roller. When reassembled, hang the curtain so that the top roller is absolutely level; then check the edges to see that they hang absolutely perpendicular to within one-fourth of an inch at the base. Replace the curtain if it has been distorted or stretched.

**Caution:** Do not allow solvent (SD) to contact the rubber shutter curtain.

- (4) *Contact assemblies.* Check the height of the receptacle contact (11, fig. 84) and case contact (9). Both of these must be arched above the wood surface so that they will make positive contact with the receptacle contact studs (9, fig. 81). Check the curvature of the spring finger contact (22, fig. 80); these contacts should be arched evenly not more than five thirty-seconds of an inch above the block.

*h. Reassembly of Contact Assemblies* (figs. 80 and 84).

- (1) Assemble the spacer block (26, fig. 80) and the mounting insulator strip (28), and secure these items with the four machine screws (25 and 27).
- (2) Reposition the jumper assembly (24, fig. 80) and form the right angle tabs at a slight arch so that they will make positive contact with the case contacts (9 and 12, fig. 84).
- (3) Slip the spring finger contacts (22, fig. 80) into the grooves from the back of right contact block (21). Assemble the left contact block (19), the right contact block (21), the two curtain guides (23), and the jumper assembly (24). Secure these parts with the four machine screws (18 and 20).

*i. Reassembly of Curtain and Roller Assembly* (fig. 80).

- (1) Assemble the gear roller to the curtain end which has the largest aperture. Assemble the tension drive roller to the end of the curtain having the narrowed slits. The synchronizer contacts (33) are on the right curtain edge facing the spring finger contacts (22).
- (2) Check the ends of the curtain for squareness; then apply cement (MIL-C-4003) to the rollers and the curtain ends. Attach the ends of the curtain to the rollers; it is essential that the ends of the curtain be placed parallel to the longitudinal axis of the rollers to insure proper alinement in the roll-up.

*Note.* Do not install the curtain in the camera until the cement is firmly set.

*j. Reassembly of Governor* (fig. 81).

- (1) If the governor assembly (37) has been dismantled, lubricate the assembly by wiping the outside ends of the governor shoes (29) and the governor pinion assembly (30) with graphite powder (FG) (par. 86). The governor shoes must slide freely on the cross shaft of the pinion assembly.
- (2) Position the bottom bracket assembly (32) and the bracket spacer (31) on the lower cutout of the shutter mechanism plate assembly (14).
- (3) Place the governor pinion assembly (30) with the governor shoes (29) in position between the top and the bottom bracket assemblies (28 and 32).

- (4) Secure the bracket assemblies with the two screw studs (27), the lockwashers (34), and the machine nuts (35).
- (5) Hook the governor spring (33) to the bottom bracket assembly (32) and to the lower stud on the shutter mechanism plate assembly (14).

*k. Reassembly of Plate Assemblies* (fig. 81).

- (1) Apply cement (MIL-C-4003) to the fabric dust seal (38) and cement it in place.
- (2) Position the shutter dial (19) on its boss at the back of the shutter mechanism plate assembly (14).
- (3) Assemble the shaft (26), the flat washer (25), and the escapement lever (23), and secure the parts with the machine screw (24).
- (4) Lubricate the master gear assembly (20) lightly with grease (GL) and insert the gear assembly in the hole on the shutter mechanism plate assembly. Be sure that the stem gears mesh with the shutter dial.
- (5) Note the taper of the pinhole of the winding key assembly (12) and position it on the master gear shaft to coincide with the taper of that hole. Assemble the taper pin (13) and set the pin with a drive punch and light hammer.
- (6) Attach the escapement spring (36) to the necked stud of the escapement assembly (21) attached to the stud at the back of the shutter mechanism plate assembly (14). Position the escapement assembly (21) over its bosses and assemble the escapement screws (22).
- (7) With the escapement in the release position (up), be sure that the master gear stop pins cannot snap back beneath the escapement brake spring; if the latch is not positive, bend the tip of the escapement brake spring down so that it snaps one thirty-second of an inch below the top of the stop pin.
- (8) Lubricate the escapement spring (36) and the escapement assembly (21) slots with grease (GL).

*l. Timing* (figs. 80 and 81).

- (1) Install the two curtain roller bearings (30, fig. 80) into the camera body (29), and secure each bearing with the three wood screws (31).
- (2) Position the curtain and roller assembly (9) after lubricating the bearings of the rollers with grease (GL).
- (3) Cement (MIL-C-4003) the tension roller seal (32) behind the tension roller gear that extends through the side of the case.
- (4) Wind the curtain so that the open O aperture is showing.
- (5) Rotate the winding key assembly (12, fig. 81) until both O's appear squarely in the shutter speed dial window when the

upper master gear pin is stopped against the top step of the escapement assembly (21).

- (6) With the top strut of the curtain set three-fourths of an inch (plus three-sixteenths or minus one-eighth of an inch) from the top inside edge of the case, position the shutter mechanism plate assembly (14) over the pinion ends of the curtain rollers. The gear of the top roller meshes with the master gear assembly (20).
- (7) Swing the speed control lever assembly (17) back to raise the governor assembly (37). Drop the bearing shaft of the tension roller in the lower bearing hole of the plate.
- (8) Note the horizontal side play of each roller. If this side play is more than one sixty-fourth of an inch, place .007-inch washers at the camera case bearing end of the shafts.
- (9) Mount the shutter plate assembly (8, fig. 80) on the camera body (29) with the four wood screws (7).
- (10) With a screwdriver, bring tension on the lower roller by winding the slotted shaft counterclockwise. Hold the roller and pull the curtain out by hand several times to remove the cloth slack; then release the spring tension slowly.
- (11) Position the tension shaft retainer (16, fig. 81) over the shaft and start the shaft retainer screw (15). Draw a pencil line on the retainer and, using this as an index, wind the slotted shaft 6 revolutions counterclockwise. Tighten the shaft retainer screw so that the screw shoulder fits into the tension shaft retainer cutout edge.

**Caution:** If it is necessary to wind the initial tension more than  $6\frac{1}{2}$  revolutions, check for possible area of binding. Check the roller bearing, the master gear, and the governor.

- (12) Wind and release the full length of the curtain several times. Check the distance of the top strut of the open aperture from the top inside edge of the camera body. If this distance is not three-fourths of an inch (plus three-sixteenths inch or minus one-eighth of an inch), it will be necessary to change the gear positions of the upper roller and the master gear assembly. To correct this gear position, move the wood screws (7, fig. 80), lift the upper edge of the shutter plate assembly (8), and raise or lower the mesh of the gears by one or two teeth as necessary.
- (13) Check the strut position after relocation and reassembly of the wood screws (7).
- (14) Install the fabric dust seal (10, fig. 81) and shutter plate dial window (11) on the cover assembly (3). Secure both with cement (MIL-C-4003).

- (15) Assemble the two receptacle contact studs (9), the receptacle insulator (7), and the receptacle washer (8) to the cover assembly (3).
- (16) Replace the shutter plate cover assembly (3, fig. 80) and assemble the two wood screws (1) at the top and the four machine screws (2) at the bottom. Install the shutter release lever (5) and the flat washer (6) and secure the parts with the release lever screw (4).
- (17) Lay the camera face down and draw a pencil line across the center of the top roller; lift the curtain and, below the line which shows, apply a thin film of cement (MIL-C-4003) about one-half of an inch wide.
- (18) Wind the curtain until the smallest slit is at the top. To cement the curtain at the bottom, repeat the procedure used to cement the curtain at the top.
- (19) Arch the spring finger contacts (22) at least five thirty-seconds of an inch above the block. The arch must be curved evenly and as long as permissible.

*m. Focal Plane Shutter Check.*

- (1) Set the shutter at the open O aperture; with the camera either horizontal or vertical, the shutter opening should move slowly and smoothly across the camera and the curtain should latch in this position when the shutter release is depressed. The winding key should lock and not rotate.
- (2) If the curtain movement is not smooth and even, and if the curtain does not latch when the movement is completed, the tension of the lower roller must be increased as described in l(10) and (11) above. The tension should be added and checked by one-half turns above the six turns prescribed.
- (3) Check the accuracy of the shutter with Photographic Synchronizer Tester AN/TFM-3.
- (4) Check the synchronizer contact (33, fig. 80) of the curtain by inserting a test lamp in the battery case. Contact should be tested at settings of 1000, 500, 250, and 0. Refer to paragraphs 64 and 65 for operational procedure.

## **98. Front Standard Assembly**

(figs. 80 and 82)

*a. Disassembly of Bellows.*

*Note.* If it is not necessary to remove the bellows assembly, slide the front standard (10, fig. 80) from the bed (17) and proceed as instructed in *b* below.

- (1) Remove the camera back (par. 96).
- (2) Open the camera bed and snap the camera into the normal horizontal position. Remove the four machine screws (25, fig. 80). Withdraw several inches of the curtain from the

bottom roller, lift and remove the inside frame. It is not necessary to disassemble this frame.

- (3) The rear metal bellows frame is crimped at each corner to the metal box frame. Straighten this crimped edge to remove the rear bellows frame from the camera body (29).
- (4) To remove the bellows assembly (38, fig. 82) from the frame and support section, remove the lens board (11) and the lens board lower lock (4) that is secured by the two slide lock screws (1), the flat washers (3 and 5), the spring washer (2), and the slide locknuts (37). Remove the lens board upper lock (9) secured by the slide lock screws (6), the slide locknuts (37), the two flat washers (8 and 10), and the spring washer (7). Swing the lower edge of the inner front frame (36) back, and drop the upper edge free from the slide locknut head.

*b. Disassembly of Front Sight (fig. 82).*

- (1) Remove the clamp knob (12) and the flat washer (13) from each side of the outer front assembly frame (15). This will free the front frame clamps (14).
- (2) Spread the standard support assembly (35) enough to slide the outer front assembly frame (15) evenly upward and free of the channel to expose the inner parts of the finder frame (23).

*Note.* Disassemble the finder plungers (17) carefully so that the plunger spring (18) does not throw and lose the finder plungers.

- (3) From the plunger sleeve (19), remove the two plunger sleeve brackets (20).
- (4) Lift the finder (16) and the finder frame (23) from the assembly.

*c. Disassembly of Lateral Shift Spring and Lock Lever Assemblies (fig. 82).*

- (1) Remove the two support locking knobs (24), the flat washers (25), the support locking screws (26), and the two flat washers (27 and 28).
- (2) Remove the two eccentrics (22) and their nuts (21).
- (3) The lever assembly (31) and the shift locking spring (30) are secured by the special hexagonal nut (29).
- (4) Unscrew the hexagonal nut (29) from the bottom of the front standard support assembly (35). The shift locking spring now may be removed.
- (5) Unscrew the slotted stud of the lever assembly (31); be careful not to lose the steel balls (34), one flat washer (33), and one lever assembly spring washer (32).

*d. Cleaning and Inspection (fig. 82).*

- (1) The bellows assembly should be wiped free of dirt on the outside with a damp cloth. Scrub the inside surface with a stiff brush (old toothbrush) and blow out all loose dirt and grit.
- (2) Inspect the finder frame (23); if the parallax detent holes are worn by the finder plunger (17) so that the plunger does not quickly snap into the selected parallax height, the finder frame (23) should be replaced.
- (3) If the finder plungers do not snap audibly into position and hold the finder frame, the plunger spring (18) should be replaced.
- (4) Clean the sliding area of the finder (16), the finder frame (23), and the front frame clamp (14) in solvent (SD) and dry before reassembly.

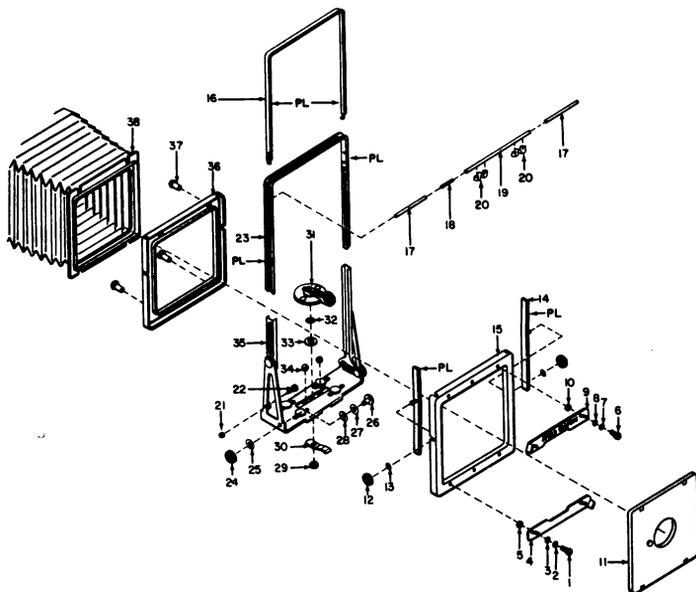
*e. Reassembly of Lateral Shift and Lock Lever Assemblies (fig. 82).*

- (1) Assemble the spring washer (32) and the flat washer (33) to the lever assembly (31).
- (2) Fit the two steel balls (34) into their positions between the lever assembly (31) and the standard support assembly (35).
- (3) Thread the lever assembly stud through the front standard support assembly.
- (4) Lay the shift locking spring (30) into position and secure it with the hexagonal nut (29).
- (5) Assemble the two eccentrics (22) and their nuts (21).
- (6) Assemble the two support locking screws (26), the flat washers (27 and 28), and the support locking knobs (24) and flat washers (25).

*f. Adjusting Lock Lever.* Check the front standard to determine how tightly it will lock by placing it on the bed carriage and setting the lever assembly (31). It should clamp tightly enough to prevent slippage when the bellows assembly and lens are assembled. To tighten the lever assembly, loosen the hexagonal nut (29) on the bottom side and turn the screw in a counterclockwise direction; to loosen the lock, turn the screw in a clockwise direction, then tighten the locknut.

*g. Reassembly of Outer Front Frame Assembly (fig. 82).*

- (1) Lubricate the flat surface of each front frame clamp (14), the sliding areas of the finder (16), and the finder frame (23) with grease (GL).
- (2) Mount one front frame clamp (14) to each side of the outer front assembly frame (15). Assemble the finder (16) to the finder frame (23).
- (3) Assemble the plunger spring (18) to the plunger sleeve (19) and insert a finder plunger (17) at each end. Compress the



TM232B-80

- |                                     |   |
|-------------------------------------|---|
| 1 Screw, slide lock (H114, H119)    | 20 Bracket, plunger sleeve (O 61, O 63)   |
| 2 Washer, spring (H120, H115)       | 21 Nut, eccentric (H130)                  |
| 3 Washer, flat (H116, H121)         | 22 Eccentric (H127)                       |
| 4 Lock, lower, lens board (H118)    | 23 Frame, finder (I 5)                    |
| 5 Washer, flat (H122, H117)         | 24 Knob, support locking (H131)           |
| 6 Screw, slide lock (H106, H110)    | 25 Washer, flat (H128)                    |
| 7 Washer, spring (H105, H111)       | 26 Screw, support locking (H126)          |
| 8 Washer, flat (H104, H112)         | 27 Washer, flat (A 395)                   |
| 9 Lock, upper, lensboard (H102)     | 28 Washer, flat (H396)                    |
| 10 Washer, flat (H103, H113)        | 29 Nut, hexagonal (H125)                  |
| 11 Lens board (A 309)               | 30 Spring, shift locking (O 66)           |
| 12 Knob, clamp (H107, H132)         | 31 Lever assembly (O 64)                  |
| 13 Washer, flat (H108, H109)        | 32 Washer, spring (H123)                  |
| 14 Front frame clamp (A16, 17)      | 33 Washer, flat (H124)                    |
| 15 Frame, outer front assembly (A 1 | 34 Ball, steel (O 65)                     |
| 16 Finder (I 4)                     | 35 Standard support assembly (F2)         |
| 17 Plunger, finder (H100, H101)     | 36 Frame, inner front (A 15)              |
| 18 Spring, plunger (O 62)           | 37 Nut, slide lock (H98, H99, H133, H134) |
| 19 Sleeve, plunger (O 60)           | 38 Bellows assembly (H397)                |

Figure 82. Front standard assembly, exploded view.

- finder plungers and drop the finder into position between the uprights of the front standard support assembly (35).
- (4) Install a plunger sleeve bracket (20) at each end of the plunger sleeve (19) and center the middle section of the plunger bracket over the hole intended for the slide lock screw (6). Mount the inner front frame (36) to this assembly, and position the upper slide locknuts (37) to the top rear holes.
  - (5) Position the flat washers (10) on the outer front assembly frame (15), lay the lens board upper lock (9) in position,

and assemble the slide lock screw (6) that has been fitted with the spring washer (7) and a flat washer (8).

- (6) Attach the frame assembly to the bellows assembly (38) by sliding the top edge of the front bellows frame under the slide locknuts (37). Swing the lower edge of the front bellows frame against the inner front frame (36) and install the lower slide locknuts (37) through the lower bellows frame slots. Assemble the lens board lower lock (4) and its attaching parts, the slide lock screw (1), the spring washer (2), and the two flat washers (3 and 5).
- (7) To mount the outer front assembly frame (15) to the front standard support assembly (35), spread the upright channels and drop the outer front frame into position with the threaded studs of the two front frame clamps (14) extending through the vertical slot on each side of the vertical section. To each stud, assemble two flat washers (13) and a frame clamp knob (12). Peen the first thread lightly to prevent loss of the knob.

*h. Replacement of Bellows.*

- (1) Attach the front bellows assembly frame as instructed in *g* (6) above.
- (2) Position the rear bellows frame inside of the camera body frame and, with pliers, crimp the rear bellows frame to the camera frame at each of the four corners.
- (3) Replace the inside frame made up of the right and left blocks (21 and 19, fig. 80), the two curtain guides (23), the jumper assembly and spacer block (24 and 26), the insulator strip (28), and install the four machine screws (25).
- (4) Replace the camera back as instructed in paragraph 96e.

*i. Adjustment of Front Standard.*

- (1) Squareness adjustment is set by the front standard eccentric (22, fig. 82) and special eccentric nut (21) located on each side.

*Note.* Use the height gage and the surface gage with dial indicator (part of Tool Equipment TK-24/GF) for this next adjustment.

- (2) Remove the camera back (4, fig. 59). Set the camera on its back on parallel blocks, pull the front standard forward on the bed carriage against both range limit stops and lock the standard. Check the height at each corner and adjust the eccentrics (22, fig. 82) or relocate the range limit stops (par. 99g).

## **99. Bed Assembly**

*a. Removal* (fig. 80).

- (1) Slide the front standard (10, fig. 80) forward and free of the camera bed (17).

- (2) Release the brace assemblies (16) from the opened position so that they slide freely as the bed is dropped.
- (3) Remove the two wood screws (11) and detach the left and right bed brace plates (12 and 13) from the camera body (29).
- (4) Remove the two wood screws (15) and bed hinge screws (14), thus freeing the bed assembly (17) from the camera body (29).

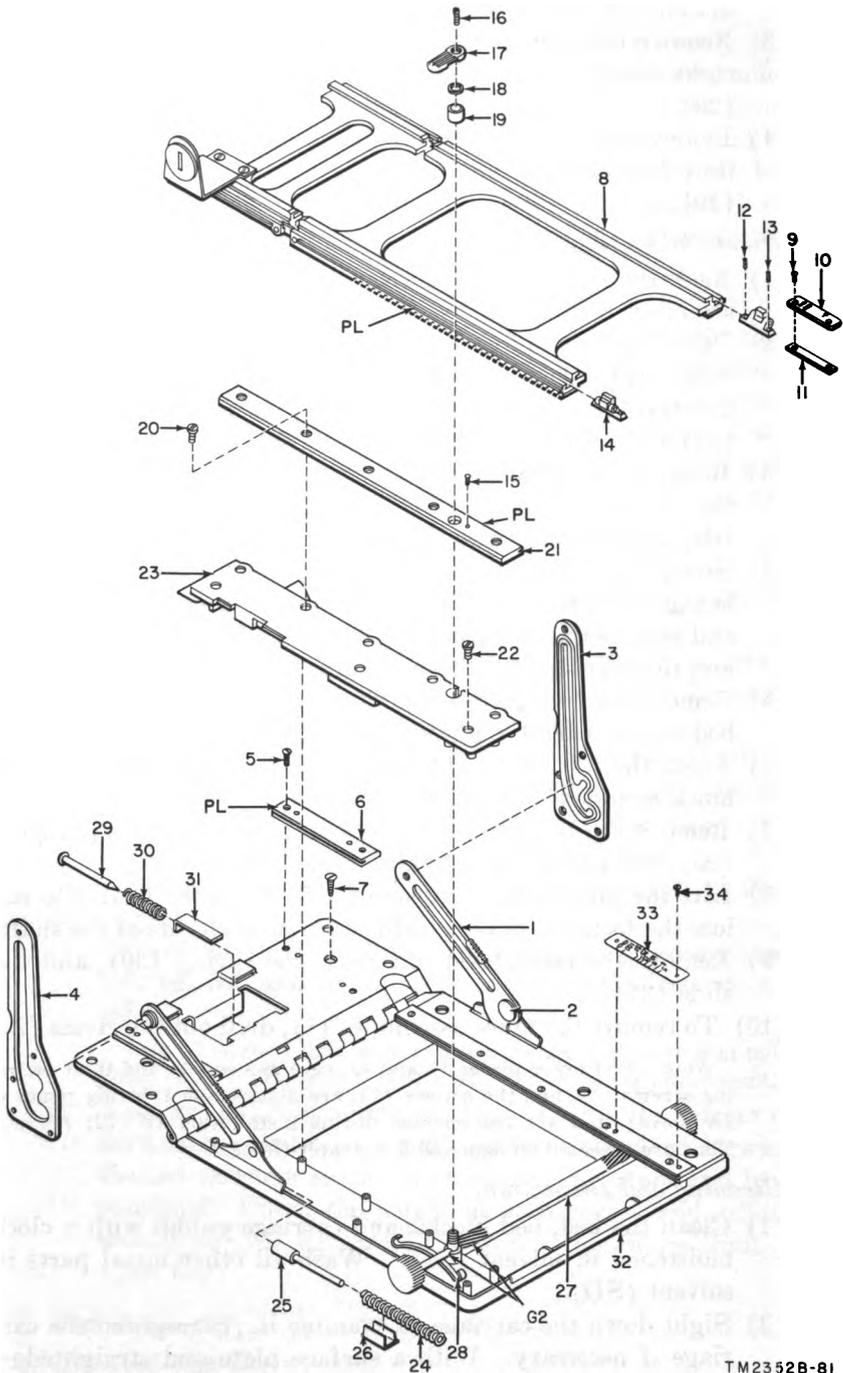
**b. Disassembly (fig. 83).**

- (1) Rack the carriage (8) forward until it is free of the bed assembly (32).
- (2) Partially back out the two machine screws (9) and slide the index scale plate (10) and the clamp plate (11) from the dovetail track of the carriage (8). Remove the two screws (34) and lift off the focusing scale (33).
- (3) Remove the range limit stops (14) by partially backing out the two screws (12 and 13) on each stop, and slide the stops from the dovetail track off the carriage (8).
- (4) Swing the carriage lock lever (17) clockwise to remove the hexagonal screw (15); then unscrew the tension screw (16), and remove the carriage lock lever (17), the flat washer (18), and the carriage lock bushing (19).
- (5) Remove the five guides screws (20) from the left and right bed section carriage guides (21) and remove the guides.
- (6) From the left and right bed blocks (23), remove the three block screws (22) and remove the bed blocks.
- (7) Remove the bed brace springs (24), the bed brace plungers (25), and the spring retaining clips (26).
- (8) Lift the pinion shaft assembly (27) from the bed. Do not lose the focusing pinion spring (28) on each side of the shaft.
- (9) Remove the escutcheon pin (29), the spring (30), and the slide (31).
- (10) To remove the brace assemblies (1), drill out the rivets (2).

*Note.* Bed brace plates (3 and 4), case guides (6) and their securing screws (5), and the screws (7), are disassembled during removal (*a* above), and are reassembled during installation (*e* (12) below). They are repeated on figure 83 for greater clarity.

**c. Cleaning and Inspection.**

- (1) Clean the bed, bed blocks, and carriage guides with a cloth moistened in solvent (SD). Wash all other metal parts in solvent (SD).
- (2) Sight down the carriage to examine it. Straighten the carriage if necessary. With a surface plate and straightedge, proceed as follows:



TM2352B-81

Figure 83. Bed assembly, exploded view.

- (a) Lay the carriage on the surface plate and check for flatness. Bend the carriage slightly if necessary to remove warp.
- (b) Check the carriage guide surfaces with a straightedge and bend slightly, if necessary, to remove warp.
- (c) Recheck the carriage and guides on the surface plate in all positions until the carriage is square and level on both sides.
- (3) If the carriage guides of the bed and hinge sections cannot be aligned, the hinge section guides should be shimmed; check with a straightedge lengthwise on the carriage.
- (4) Check the bed hinge for smooth operation. Replace the hinge if the hinge binds.
- (5) Use cement (MIL-C-4003) on loose fabric, assuring that the edge of the fabric is bound beneath the bed blocks.

*d. Lubrication.* In the process of reassembly, use grease (GL) to lubricate the parts shown on figure 83 and as prescribed below.

- (1) Wipe the sliding grooves of the right bed section guides (21) and the case guides (6) with a film of lubricant.
- (2) The small diameter shaft at both ends of the pinion shaft assembly (27) and the helical gear teeth should be lubricated.
- (3) Lubricate the guide edges and bottom teeth of the carriage (8) with a film of lubricant.

*e. Reassembly (fig. 83).*

- (1) Assemble the escutcheon pin (29), the spring (30), and the slide (31).

---

1	Brace assembly (O 6)	19	Bushing, carriage lock (O 12)
2	Rivet, bed brace (H23)	20	Screw, machine, guide (H1, H3, H5, H7, H8)
3	Plate, left, bed brace (O 369)	21	Guide, right bed section (A 5)
4	Plate, right, bed brace (O 5)	22	Screw, machine, block (H4, H6, H9)
5	Screw, case guide (H16, H17, H18, H19)	23	Block, right, bed (A 4)
6	Guide, case, right (A 24)	24	Spring, bed brace (O 9)
7	Screw, wood (H15, H20)	25	Plunger, bed brace (O 8)
8	Carriage (O 3)	26	Clip, spring retaining (O 371)
9	Screw, machine (H398)	27	Shaft assembly, pinion (O 10)
10	Plate, index scale (N2)	28	Spring, focusing pinion (O 11)
11	Plate, clamp (O 370)	29	Pin, escutcheon (H21)
12	Screw, pointed (H399)	30	Spring (O 7)
13	Screw, flat-point (H400)	31	Slide (H22)
14	Stop, range limit (O 1)	32	Bed assembly (A 1)
15	Screw, hexagonal (H2)	33	Focusing scale
16	Screw, special tension (H28)	34	Screw, machine (H398)
17	Lever, carriage lock (O 13)		
18	Washer, flat (H26)		

*Figure 83—Continued*

- (2) Attach the assemblies brace (1) with the rivets (2).
- (3) Position the pinion shaft assembly (27) with the locking post to the right front bed.
- (4) Place the focusing pinion springs (28) beneath each end of the pinion shaft.
- (5) Insert the bed brace plungers (25), the bed brace springs (24), and the spring retaining clips (26). Position these assemblies forward of each brace assembly (1) (left and right) with the plungers against the projection at the base of each brace assembly.
- (6) Assemble the two bed blocks (23) to the bed assembly (32). Be sure that the focusing pinion springs (28) and the bed brace spring assemblies fit into the spaces provided for them at the bottom outside edge of the bed blocks (23). Secure the blocks to the bed using the three screws (22).
- (7) Assemble the carriage lock bushing (19), the flat washer (18), the carriage lock lever (17), and the tension screw (16) on the focusing post. For correct locking, the double lead thread of the lever must lock so that it is pointed forward at about  $60^\circ$  right of the carriage guide. This adjustment must be done by trial and error. Insert and tighten the hexagonal screw (15).
- (8) Position the right bed section guides (21).
- (9) Assemble carriage (8) to the right bed section guide (21); assemble the left bed section guide to the carriage and attach both carriage guides to the bed (32) with the 10 guide screws (20).
- (10) Install the range limit stops (14) in the carriage grooves with the cone point screws (12 and 13). Do not tighten the screws at this point, as further adjustment is required (*g* below).
- (11) Slide the clamp plate (11), with the index scale plate (10) attached, into the left side carriage groove, and temporarily tighten the two machine screws (9). Install the focusing scale on the left carriage guide and secure the scale with the two screws.
- (12) The installation of the bed assembly to the camera body is the reverse of removal (*a* above).

*f. Checking Bed Alinement.* Test the bed assembly (32) with a straightedge to be sure that it is level with the bottom of the camera body. Lay the straightedge across the bed boss on the camera bottom. The bed brace plates (3 and 4) may have to be moved up or down slightly to attain this level. If adjustment is necessary, first loosen the brace guide plate screws and try to obtain alinement without completely removing the plate. Secondly, lay the straightedge across the

right bed section guide (21) and the right case guide. Next, check the top surface of the carriage (8). If the top surfaces of the carriage guide are not level, the front standard will not slide smoothly on the carriage. If necessary, shim the case guide (6) as follows:

- (1) Loosen the case guide screws (5), and slip the blade of a knife beneath the guide to raise it enough to insert the necessary number of shims.
- (2) The shims are available in three thicknesses: 0.016 inch, 0.040 inch, and 0.060 inch; adjust as necessary by trial and error until the top surface of the carriage is level.

*g. Locating Range Limit Stops (fig. 83).*

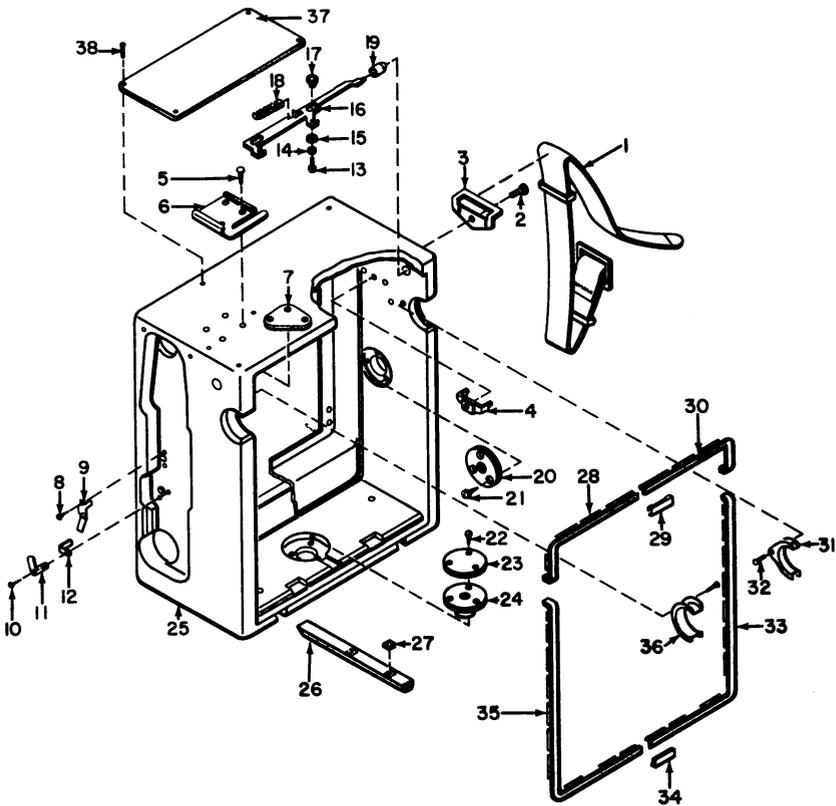
- (1) Slide the range limit stops (14) to the front of the camera.
- (2) Install the lens and shutter assembly on the camera.
- (3) Mount the camera on the tripod.
- (4) Rack the carriage assembly back into the camera body as far as it will go and lock it with the carriage lock lever (17).
- (5) Open the focusing hood to permit the ground glass to be used for focusing.
- (6) Grasp the front standard lock lever with the thumb and forefinger, turn it to the front to unlock it, and pull on the lock lever to draw the front standard out far enough to focus the camera on an infinity target. Turn the lock lever to the right or left to lock the front standard in position.
- (7) Check the squareness of the front standard with the carriage guide and adjust (par. 98: (1)), if necessary.
- (8) Move the range limit stops up to the front standard and tighten the front setscrews (13) securely. Position the focusing index (10) so that the infinity mark ( $\infty$ ) on the index is aligned opposite the infinity mark on the focusing scale (33). See figure 16.
- (9) Recheck the infinity focus on the ground glass with a magnifying glass. If necessary, loosen the setscrews (13) and relocate the range limit stops.
- (10) Move the front standard back into the camera and assemble the rear range limit setscrews (12).

## **100. Body Assembly**

(fig. 84)

*a. Disassembly.*

- (1) Disassemble the case contacts (9, 11, and 12) by removing two screws (8 and 10) from camera body (25).
- (2) Remove the strap handle (1).
- (3) Unscrew the screws (2) that will free the upper and lower strap handle plates (3) and the anchor nuts (4).



TM2352B-82

- |                                     |                                   |
|-------------------------------------|-----------------------------------|
| 1 Strap handle, camera (O 341)      | 20 Socket, tripod, side (O 347)   |
| 2 Screw, machine (H374)             | 21 Screw, wood (H381)             |
| 3 Plate, strap handle (O 342)       | 22 Screw, wood (H382)             |
| 4 Nut, anchor (H375)                | 23 Cover, socket (O 348)          |
| 5 Screw, machine (H94, H95, H96)    | 24 Socket, tripod, bottom (O 349) |
| 6 Shoe, view finder mounting (A 13) | 25 Body, camera (A 318)           |
| 7 Plate, shoe (A 14)                | 26 Foot, camera (O 350)           |
| 8 Screw, wood (H376)                | 27 Nut (H383)                     |
| 9 Contact, receptacle (E11)         | 28 Molding, upper right (O 351)   |
| 10 Screw, wood (H377)               | 29 Plate (O 352)                  |
| 11 Contact, receptacle (E11)        | 30 Molding, upper left (O 353)    |
| 12 Contact, case (E13)              | 31 Escutcheon, left (O 354)       |
| 13 Screw, machine (H378)            | 32 Pin (O 355)                    |
| 14 Washer, lock (H379)              | 33 Molding, lower left (O 356)    |
| 15 Washer, flat (H380)              | 34 Plate (O 357)                  |
| 16 Latch, bed (O 343)               | 35 Molding, lower right (O 358)   |
| 17 Collar, bed latch insert (O 344) | 36 Escutcheon, right (O 367)      |
| 18 Spring, bed latch (O 345)        | 37 Plate, depth of field (N1)     |
| 19 Button, bed release (O 346)      | 38 Pin (H388)                     |

Figure 84. Body assembly, exploded view.

- (4) To remove the view finder mounting shoe (6), take out the three screws (5) from the shoe plate (7).
- (5) Remove the two screws (13), the washers (14 and 15), the insert collar (17), and the spring (18) to release the bed latch (16) and the bed release button.
- (6) Take out the three screws (21) to remove the tripod socket (20).
- (7) To remove the bottom tripod socket (24), take out the three screws (22) and remove the socket cover (23).
- (8) Remove the camera foot (26) with the nut (27) on each side by sliding it forward out of the dovetail groove.
- (9) Items 28 through 36 of figure 84 should not be disassembled unless the camera body is to be recovered, in which case they can be removed easily during stripping operations. Use figure 84 as a guide for their replacement.
- (10) Remove the depth of field plate (37) by taking out the four pins (38).

*b. Cleaning and Inspection.* Clean and inspect all parts for damage. Replace all damaged parts.

*c. Reassembly.* Reassemble the camera body by reversing the disassembly procedure.

## 101. Tripod Assembly

(fig. 85)

### *a. Disassembly.*

*Note.* The knurled clamp screws (2 and 7) and the panhead camera thumbscrew (12) are not removable.

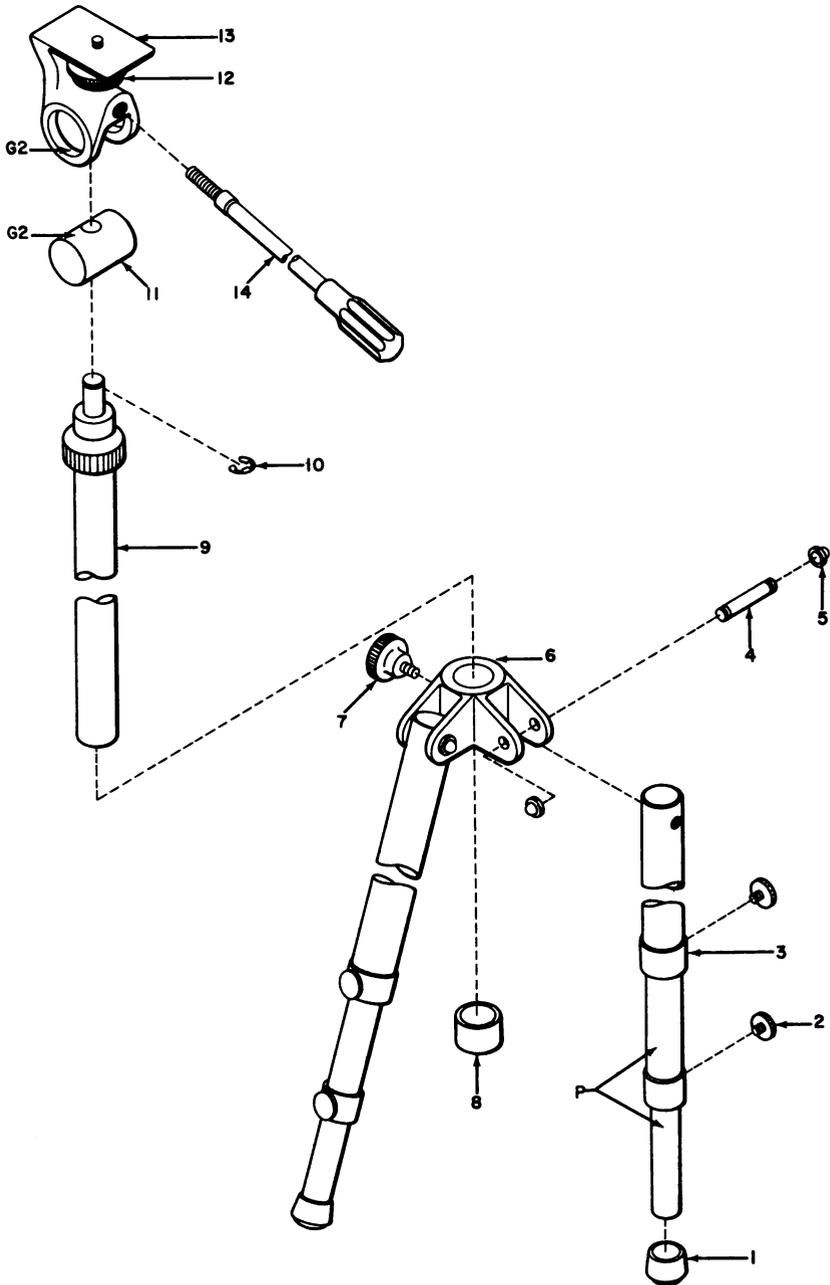
- (1) Remove the rubber cap (8) from the center support column (9) and loosen the knurled thumbscrew (7). Remove the center support column from the tripod support casting (6).
- (2) Unscrew the pan handle (14) and tilt the panhead (12) to expose the snap ring (10). Remove the snap ring.
- (3) Lift the panhead (12) off the center support column, and slip the panhead pivot bearing (11) out of the panhead.
- (4) Remove the clamp nut (5) and slip out the leg pivot stud (4), freeing the tripod leg (3).

### *b. Cleaning and Inspection.*

- (1) Extend the tripod legs and clean them with solvent (SD). Clean all parts of the panhead.
- (2) Visually inspect all parts for wear or damage and replace if necessary.

### *c. Reassembly.*

- (1) Assemble the tripod leg (3) to the tripod support casting (6); use the leg pivot stud (4) and the clamp nut (5).



TM2352B-83

Figure 85. Tripod, exploded view.

- (2) Grease the inside of the counterbore of the panhead pivot bearing (11) and the inside bearing surface of the panhead (12), and slip the panhead pivot bearing into the panhead.
- (3) Place the counterbored end of the panhead pivot bearing on the center support column stud.
- (4) Secure the panhead pivot bearing (11) to the center support column (9) with the snap ring (10).
- (5) Screw the pan handle (14) into the panhead.
- (6) Insert the center column into the tripod support casting (6). Cap the bottom of the center support column with the rubber cap (8).

## Section IV. FINAL TESTING

*Note.* Use Photographic Synchronizer Tester AN/TFM-3 to test the flash-lamp flasher batteries. The batteries must indicate full power of the AN/TFM-3 meter. Do not perform any synchronization tests with weak batteries.

### 102. General

This section is to be used as a guide in determining the quality of a repaired component. The operational tests outlined in *a* through *c* below may be performed by maintenance personnel with the necessary skills. These tests should be made after each overhaul or repair of the equipment or during a periodic inspection of the equipment.

*a. Focus.* Focus on an object by either range finder, ground glass, or focusing scale. Check the other two focusing methods against the method used. The range finder, ground glass, and focusing scale must agree at all distances. If any disagreement is found, recheck the position of the ground glass (par. 99*g*) and adjust the range finder (par. 92*m*) or the focusing scale (par. 99*g*) as required; use the ground glass as a reference.

*b. Shutter.* Make a series of balanced exposures at different shutter speeds as indicated by an exposure meter; for example, 1/50 second at *f*/16; 1/100 second at *f*/11; 1/200 second at *f*/8. Negatives exposed at these settings and processed identically should have the same density

---

1 Cap, rubber, leg (O 382)	8 Cap, rubber—center support column (O 383)
2 Screw, clamp (thumbscrew, leg) (H406)	9 Column, center support (A 326)
3 Leg, complete (A 324)	10 Ring, snap (H410)
4 Stud, leg pivot (H407)	11 Bearing, panhead pivot (A 327)
5 Nut, clamp (H408)	12 Panhead (A 328)
6 Casting, tripod support (A 325)	13 Pad, camera (O 384)
7 Screw, clamp (locking screw, central column) (H409)	14 Handle, pan (A 329)

*Figure 85—Continued*

if the shutter is operating properly. If any density difference is obtained among the negatives, test the shutter for speed accuracy with Photographic Synchronizer Tester AN/TFM-3 (par. 103).

*c. Synchronization.* Make a series of correctly balanced exposures with the flash-lamp flasher and the camera. These exposures should be made in a room that has average ceiling and wall color. Be sure that the negatives are exposed correctly and are processed in accordance with the specifications governing the film and developer being used. With due consideration given to the subject matter, all negatives should show no differences in density and should be readily printable on normal contrast photographic paper.

### **103. Testing Synchronization and Shutter Speeds Accurately**

#### *a. Synchronization.*

- (1) *Focal plane shutter.* With a contact delay of 20 milliseconds, the allowable accuracy deviation for the focal plane shutter at 1/1,000 or 1/500 second is minus 30 percent (minimum level of 14 milliseconds) and plus 55 percent (maximum level of 31 milliseconds). At 1/250 second, the allowable deviation is minus 30 percent (minimum level of 14 milliseconds) and plus 0 percent (no allowable tolerance). If the shutter speeds exceed the limits specified, adjust the delay by moving the curtain contact tab so that the tab is 2.250 inches below the inside edge of the top slit strut.
- (2) *Solenoid.* The solenoid must be adjusted so that it will open the shutter 18 to 20 milliseconds after the lamp firing circuit is closed by the lamp firing switch button on the flash-lamp flasher. When using the AN/TFM-3 to check the solenoid synchronization, the allowable percentage deviation is plus or minus 10 percent.
- (3) *Between-the-lens shutter internal synchronizer.* At the OFF position, the synchronizer mechanism in the shutter must be out of the circuit so that no connection to the flash-lamp flasher is made when the shutter is tripped. At the X position, zero delay is required; contact must be made at the instant the shutter reaches a fully open position. At the F position, the delay objective is 5 milliseconds, plus or minus 10 percent (1 millisecond). At the M position, the delay objective is 20 milliseconds, plus 0 percent, minus 10 percent (18 milliseconds).

*b. Shutter Speeds.* Shutter speeds from 1 second to 1/400 second must be accurate to within plus or minus 20 percent. Shutter speeds from 1/500 to 1/1,000 second must be accurate to within plus or minus 33 percent.

## CHAPTER 8

# SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

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### 104. Disassembly for Packaging

If the camera is mounted on the tripod and the flash equipment is being used, remove the flash equipment from the camera and remove the camera from the tripod before repackaging. Be sure to remove the filter and lens shade components from the lens assembly before closing the camera bed.

### 105. Repacking for Shipment or Limited Storage

*a. Camera.* Place the camera within the designated compartment of the carrying case (fig. 24).

*b. Accessories and Component Parts.* Place these parts in the space provided for them in the carrying case (fig. 24). Disassemble the tripod as instructed in paragraph 18*a*. Be sure to invert the tripod center column so that the tripod head will nest neatly between the feet of the telescoped legs of the tripod.

*c. Packaging Carrying Case.* Close the carrying case and secure the fastenings. Cushion the case on all surfaces with pads fabricated of corrugated fiberboard designed to absorb the shock of impact normally encountered in handling and transit. Place the case, cushioned as described above, within a close-fitting, corrugated fiberboard box and seal all closures with gummed Kraft tape. Place the boxed camera equipment within a waterproof bag, then place the equipment within a second, close-fitting, wire-bound box.

*d. Packing Camera Set.* Place the camera set, packaged as described in *a* through *c* above, within a nailed, wooden box. Be sure that the contents fit snugly in the box. Close the wooden box, nail on the lid, and strap the box with steel tape.

### 106. Methods of Destruction

The demolition procedures in this paragraph will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon order of the commander.

*a. Smash.* Smash all lenses, glass internal parts; use sledges, axes, pickaxes, hammers, crowbars, or other heavy tools.

*b. Cut.* Cut film, fabric, leatherette; use axes, handaxes, or machetes.

*c. Burn.* Burn film, fabric, leatherette, manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

*d. Explosives.* If explosives are necessary, use firearms, grenades, or TNT.

*e. Disposal.* Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

*f. Destroy.* Destroy everything.

## INDEX

	<i>Paragraph</i>	<i>Page</i>
Adjustments .....	88g, 92g, m, 93e, 98f, i, 99f, g	110,
	125, 130, 134, 172, 174, 178,	179
After-use procedures .....	41	49
Assembling equipment .....	18	25
Auxiliary equipment .....	59, 60	65
Back assembly. (See Camera.)		
Batteries. (See Flash-lamp flasher.)		
Battery case. (See Flash-lamp flasher.)		
Bed and carriage assembly. (See Camera.)		
Bellows. (See Camera.)		
Body assembly. (See Camera.)		
Cable:		
Extension .....	19, 23d	30
Shutter connecting .....	19a, 23b	29
Shutter release .....	3h, 8, 19d	4, 17
Solenoid .....	19b, 23c	30
Camera:		
Back assembly .....	6j, 96	14,
		157
Bed and carriage assembly .....	6d, 33b, 99	9,
		37, 174
Bellows assembly .....	6f, 40, 98	12,
		46, 170
Body assembly .....	6b, 100	7, 179
Checking and adjusting .....	17c, 25, 98f, i, 99f, g	24,
	33, 172, 174, 178, 179	179
Carrying camera set .....	42	51
Carrying case:		
Description .....	3i, 14	4, 19
Opening .....	17b	24
Repacking .....	41b	49
Cleaning .....	26	33
Controls .....	20	25
Description .....	3a, 6a	3, 7
Disassembly .....	96, 98a, c, 99a, b, 100a	157,
	170, 171, 174, 175, 179	179
Front standard assembly .....	6e, 37, 98	11,
		41, 170
Holding .....	31	36
Loading .....	38	44
Lubrication .....	86	105
Mounting on tripod .....	32	37
Opening .....	33	37
Operating .....	23-42	29-51

Cleaning—Continued

Front standard assembly—Continued

	<i>Paragraph</i>	<i>Page</i>
Reassembly.....	96c, e, 98e, h, 99e, 100c	160, 172, 174, 177, 181
Theory.....	97, 98, 102	161, 170, 183
Components.....	4	5
Components, common names.....	5	7
Connections.....	19	25
Contacts, electrical.....	26f, 88, 89, 94, 97f	34, 106, 112, 136, 166
Controls:		
Camera.....	20	26
Flash-lamp flasher.....	21	28
Tripod.....	22	29
Corrective photography.....	37	41
Corrosion prevention.....	44, 45, 52-54	53, 58-60
Daylight exposure guide (table II).....	40	46
Demolition, methods.....	106	185
Depth of field. ( <i>See Focusing.</i> )		
Disassembly.....	104	185
Electrical contacts. ( <i>See Contacts, electrical.</i> )		
Equipment completeness check.....	25	33
Equipment performance check list.....	58	61
Exposure:		
Extended bellows exposure factor (table V).....	40	46
Guide (table II).....	40	46
Meter.....	59	65
Shutter speeds for subjects in motion (table IV).....	40	46
Extended bellows. ( <i>See Focusing.</i> )		
Extension cable. ( <i>See Cable.</i> )		
Extension lamp holder.....	3f, 7b, 89	4, 16, 112
Film holder.....	10, 26e, 30, 38a	17, 34, 36, 45
Film pack adapter.....	3g, 11, 29, 38b	4, 18, 35, 45
Filter:		
Effects.....	35a	38
Factors.....	35b	38
Kit.....	9, 34, 35	17, 37, 38
Flash:		
Equipment.....	7, 87	15, 106
Exposure factors (table III).....	40	46
Flash-lamp flasher:		
Adjustment.....	88g	110
Controls.....	21	28
Description.....	3b, 7a	4, 15
Disassembly.....	88a, b	106
Mounting.....	22a	29

	<i>Paragraph</i>	<i>Page</i>
<b>Flash-lamp flasher—Continued</b>		
Operation.....	39, 40	45, 46
Reassembly.....	88 <i>d, f</i>	107, 110
Testing.....	88 <i>i</i>	111
Theory.....	75-77	92-96
<b>Focal plane shutter. (See Shutter.)</b>		
<b>Focusing:</b>		
Cloth.....	3 <i>i</i> , 13	4, 19
Depth of field (table I).....	36 <i>f</i>	40
Drop bed.....	33 <i>b</i>	37
Extended bellows (table V).....	40	46
Ground glass.....	13, 27, 33, 36 <i>c</i> , 96	19, 34, 37, 39, 157
Hyperfocal distance.....	36 <i>f</i>	40
Lens tilt.....	37 <i>d</i>	41
Range finder.....	36 <i>d</i>	40
Scales.....	27, 36 <i>e</i>	34, 40
Vertical shift.....	37 <i>b</i>	41
Forms and records.....	2, 50	3, 56
Front standard. (See Camera.)		
Fungiproofing. (See Rustproofing.)		
Ground glass. (See Focusing.)		
Hyperfocal distance. (See Focusing.)		
Inspection. (See Cleaning.).....	56, 78	60, 97
Lamp holder, extension. (See Extension lamp holder.)		
<b>Lens:</b>		
Cleaning.....	26 <i>b, d</i> , 44 <i>a</i> , 49, 80	34, 53, 55, 97
Hood.....	34	37
Wide angle.....	60	65
Lubrication.....	51, 52, 53 <i>e</i> , 86	58, 60, 105
<b>Maintenance:</b>		
Desert.....	53 <i>d</i>	60
Forms.....	50	56
Materials.....	47	54
Preventive.....	48, 49	54, 55
Tools.....	46, 81, 82	54, 97, 98
Tropical.....	53 <i>b</i>	58
Winter.....	53 <i>c</i>	60
Open frame view finder. (See View finder.)		
<b>Operation:</b>		
Arctic areas.....	43	51
Maritime, high altitude, low temperature rain areas.....	45	53
Tropical and desert areas.....	44	53
Under usual conditions.....	23-42	29-51
Optical view finder. (See View finder.)		
Packaging and packing data.....	16	21
Painting. (See Rustproofing.)		
Parallax.....	6 <i>i</i> , 36 <i>a</i>	13, 39
Preliminary starting procedures.....	28	35

	<i>Paragraph</i>	<i>Page</i>
Preloading and cleaning procedures .....	26	33
Preventive maintenance check list .....	49	55
<b>Range finder:</b>		
Adjustment .....	92 <i>g</i>	125
Checking .....	27	34
Description .....	6 <i>h</i>	13
Disassembly .....	92 <i>c, e</i>	119, 124
Final adjustment .....	92 <i>m</i>	130
General .....	92 <i>a</i>	119
Operation .....	27, 36 <i>d</i>	34, 40
Reassembly .....	92 <i>h, k</i>	125, 129
Reinstallation .....	92 <i>l</i>	129
Removal .....	92 <i>b</i>	119
Theory .....	71, 72	87
<b>Reflector, 5-inch:</b>		
Cleaning .....	26 <i>g, 91b</i>	34, 117
Description .....	3 <i>d, 7c</i>	4, 16
Disassembly .....	91 <i>a</i>	115
Operation .....	24 <i>b</i>	32
Reassembly .....	91 <i>c</i>	118
Testing .....	91 <i>d</i>	119
<b>Reflector, 7-inch:</b>		
Cleaning .....	26 <i>g, 90b</i>	34, 113
Description .....	3 <i>d, 7c</i>	4, 16
Disassembly .....	90 <i>a</i>	113
Operation .....	24 <i>a</i>	31
Reassembly .....	90 <i>c</i>	113
Testing .....	90 <i>d</i>	115
Repacking for shipment or limited storage .....	105	185
Rustproofing and painting .....	54	60
Scope .....	1	3
<b>Shutter:</b>		
<b>Between-the-lens:</b>		
Cleaning and inspection .....	49, 94 <i>h</i>	55, 142
Description .....	6 <i>c</i>	8
Disassembly .....	94 <i>b, g</i>	136, 141
Lubrication .....	94 <i>i</i>	144
Operation .....	39	45
Reassembly .....	94 <i>i, n</i>	144, 154
Reinstallation on lens board .....	94 <i>o</i>	155
Removal .....	94 <i>a</i>	136
Shortening shutter release stroke .....	94 <i>p</i>	155
Synchronizing delay setting .....	39 <i>c</i> (4)	46
Testing .....	94 <i>g, 103a, b</i>	155, 184
Theory .....	61-65	67-74

Shutter—Continued

	<i>Paragraph</i>	<i>Page</i>
Focal plane:		
Check.....	97 <i>m</i>	170
Cleaning and inspection.....	97 <i>g</i>	166
Description.....	6 <i>g</i>	12
Disassembly.....	97 <i>a, f</i>	161, 166
Lubrication.....	51, 52, 86	58, 105
Operation.....	40	46
Reassembly.....	97	161
Shutter speeds for subjects in motion (table IV).....	40	46
Testing.....	103 <i>a, b</i>	184
Theory.....	66-70	78-85
Timing.....	97 <i>l</i>	168
Solenoid tripper:		
Adjustments.....	93 <i>e</i>	134
Description.....	6 <i>c</i>	8
Disassembly.....	93 <i>b</i>	131
Operation.....	23 <i>c, 39c</i>	30, 46
Reassembly.....	93 <i>d</i>	133
Removal.....	93 <i>a</i>	131
Theory.....	63, 77	68, 96
Special tools. (See Maintenance.)		
Stripping.....	79	97
Technical characteristics.....		
Testing.....	89 <i>d, 90d, 91d, 94q, 102, 103</i>	113, 115, 119, 155, 183, 184
Tilt. (See Focusing.)		
Tools. (See Maintenance.)		
Tripod:		
Assembling.....	18 <i>a</i>	25
Cleaning.....	101 <i>b</i>	181
Controls.....	22	29
Description.....	3 <i>c, 12</i>	4, 19
Disassembly.....	101 <i>a</i>	181
Reassembly.....	101 <i>c</i>	181
Setting up.....	18 <i>b</i>	25
Troubleshooting.....	57	61
Uncrating, unpacking.....	17	24
View finder:		
Ground glass.....	36 <i>c</i>	39
Open frame.....	6 <i>k, 36b</i>	15, 39
Optical.....	6 <i>i, 36a</i>	13, 39
Theory.....	73, 74	90
Visual inspection. (See Troubleshooting.)		
Weatherproofing.....	53	58
Wide-angle lens. (See Lens.)		

[AG 413.53 (5 Nov 54)]

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