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DESCRIPTION AND INSTRUCTIONS ON OPERATION AND TECHNICAL SERVICING OF AUTOMATIC AERIAL CAMERA AFA-33M

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DESCRIPTION AND INSTRUCTIONS

ON OPERATION AND TECHNICAL SERVICING OF

AUTOMATIC AERIAL CAMERA AFA-33M

50X1

This description is intended to familiarize the reader with the design of the AFA-33M aerial camera, with rules of operation, and with the most frequently encountered malfunctions and methods of eliminating them.

CONTENTS

SECTION ONE

Technical Description of the AFA-33M

SECTION TWO

Instructions on Operation and Technical Servicing of Aerial Camera AFA-33M

SECTION ONE

TECHNICAL DESCRIPTION OF THE AFA-33M AERIAL CAMERA

I. General Characteristics of the Camera

The AFA-33M aerial camera is fully automatic with remote control from a command instrument and is designed for taking aerial photographs of strips, areas, and individual objects for purposes of photo reconnaissance and photographic observation of the results of bombing.

In addition, the AFA-33M is designed for taking topographic aerial photographs.

Aerial photography of one, two or three strips during a single pass of the aircraft is possible by placing the AFA-33M on automatic oscillating camera mounts of the type (AKAFU-3, AKAFU-156) AKAFU-33.

Aerial photographs may be taken with this camera at different altitudes depending on the desired scale.

Minimum permissible altitudes with respect to the flight speed and allowing an image shift of 0.1 mm at different exposures may be determined from a special table (see appendix No 1, p 43).

II. Basic Technical Data

Variation of the AFA-33M / Data	AFA-33/20M	AFA-33/50M	AFA-33/75M	AFA-33/100M
Type of lens	"Orion-1a"	"Indust-52"	"Telemar-2"	"Telemar-7"
Focal length, cm	20	50	75	100
Relative aperture	1:6.3	1:5	1:6.3	1:7
Field of view angle	74°	34°	23°	17°
Type of shutter	iris-type	← louver-type →		
Exposure range, sec	1/50 1/100 1/200	1/75 1/150 1/300	1/75 1/150 1/300	1/75 1/125 [?] 11/200
Shutter efficiency	65-75%	not less than 40%	not less than 40%	not less than 40%
Light filters	ZhS-18 OS-14 KS-14	ZhS-18 OS-14 KS-14	ZhS-18 OS-14 KS-14	ZhS-18 OS-14 KS-14

50X1

For all variations:

Photograph size	30 cm x 30 cm
No. of photographs	190 - 195
Size of film strip	32 cm x 6000 cm
Duration of cycle:	
at temperature of $+15^{0}$ C / $+25^{0}$ C	not more than 2 sec
at temperature of -60^{0} C	not more than 2.5 sec
Power consumption at temperature of +15°C to +25°C with electric heaters turned on	up to 13.5 a
Power consumption at temperature of -60° with heaters on	up to 16 a
Time intervals of command instrument	from 2 to 60 sec
Camera operating voltage	26 v ±10%

Camera operates under normal conditions as well as with:

a) vibrations at frequency from 10 to 200 cps
b) ambient air temperature from +50°C to -60°C
c) relative humidity up to 98% at temperatures from +15°C to +25°C
d) altitudes above sea level up to 12,000 m.

III. Description of the AFA-33M

The AFA-33M consists of the following basic elements:

1. Camera housing.
2. Objective lens section with lens and shutter.
3. Film holder.
4. Command instrument.
5. Drive and blower unit.
6. Electrical wiring.
7. Cardan shaft.
8. Flexible hose.

1. Camera Housing (Figures 4, 5, 6, 7, 8, 9, 10, and 11)

The camera housing forms the intermediate connection between the cone and the film holder. Camera housing 1 is a rectangular cast housing, the top part of which is an attached frame 2 with four alignment lugs. On two sides of the frame are lock plates 3 by means of which the film holder is attached to the camera housing. On the two opposite sides of the frame are four guide pins 4 which hold the film holder when the latter is placed on the camera housing. The camera drive mechanism

13, receptacle 12 for connection of the electrical wiring, and a jack with a lamp holder for illuminating the clock and level are mounted on the right wall of the camera housing. On the left wall are a nipple for connection of the flexible hose which supplies air to the camera housing for the purpose of keeping the film flat, a jack for the clock, and jacks with lamp holders which illuminate the clock and level. 50X1

On the front and rear walls are trunnions 11 which are used to attach the camera to the camera mount. On the rear wall of the camera housing is, in addition to the trunnion, a hinged level 306 which is used to place the focal plane of the camera in a horizontal position; the level has 60 minute graduations.

The objective lens section 14 is attached tightly to the lower base of the camer housing.

A wide-angle lens is mounted on the AFA-33/20M aerial camera. This camera is not used with the AKAFU automatic oscillating mount. The camera part is indentical for all four cones.

The following recording elements are located at the corners of the camera unit: clock 5 with a heater which is controlled by a thermostat, level 6, and counter 7. The shaft of the counter extends through the housing of the camera unit and is terminated by a handle 74, which is used to set the counter at the zero position.

The level may be read with an accuracy of 60 minutes; the value of each division is 60 minutes.

When the table is pressed, the recording units are illuminated by electric lamps and the level, clock and numbers of the counter may be photographed through the recording lenses.

The power transmitting mechanism of the camera, which consists of shaft 26, bevel gears 24, 27, and 28, and contack disks 42, 43, and 288, receives motion from a drive agregate by means of a Cardan shaft 15 (Figures 8, 9, and 10) which is connected to the sleeve of shaft 16 of the drive mechanism.

The drive mechanism consists of a worm gear 17 and 18, shaft 19, bevel gears 20, 21, and 25, sleeve 22, and driving pin 23.

Motion is transmitted through worm gear 17 and 18 to horizontal shaft 19 and then through the first bevel gear 20 and 21 to the film cassette (holder) by means of sleeve 22 and driving pin 23. Motion is transmitted through the second bevel gear 24 and 25 to shaft 26, located parallel to the side of the camera unit, and thence to the shutter through the third bevel gear 27 and 28.

Three contact disks 42, 43, and 288, connected to the other end of shaft 26, perform the following functions: contact disk 42 switches off the camera motor after each complete revolution of horizontal shaft 26. 50X1

At the moment the motor is switched on, contact disk 42 begins to turn with shaft 26 and, in turning, closes contacts 44 which remain closed until the disk opens them. Contact disk 43, which closes contacts 45, switches on the electric lamps of the recording instruments for the period of the exposure. Contact disk 288, which closes contacts 289, sends a current pulse to the oscillating camera mount. The electric motor of the mount is turned on and sets the mount and camera in motion. The frame of the camera mount ceases its oscillations at the moment the electrical circuit of the AKAFU switching devices is broken. The power transmitting and drive mechanism of the camera unit, with the exception of shaft 16, makes one revolution for each complete cycle of operation of the camera.

The fourth bevel gear 35 and 36 transmits motion through intermediate shaft 34 by means of spur gears 37, 38, 39, and 40 to shaft 41 of counter 7. The counter is a hollow cylinder (see Figure 11) containing drums 55, 56, 57, and 61 mounted on a shaft (Figure 11).

Drum 56 indicates units, drum 57 -- tens, and drum 61 -- hundreds. The surfaces of three of the drums have graduated numbers from 0 to 9 while the surface of drum 55 is smooth. In conjunction the three drums can register a three-digit number.

Trip gears 62, 63, and 287 are mounted on a shaft beneath the drums. Rotation of spur gear 40 turns drum 55, which sits freely on shaft 41, and this transmits motion to the second drum 56 by means of auxiliary trip gear 62. Drum 55 has two teeth. Drum 56 has 20 teeth on one side and two teeth on the other. The teeth on the two other drums are located in analogous positions. Each of the trip gears has 8 teeth -- four long and four short arranged alternately.

The counter operates as follows: when drum 55 turns one revolution it engages a short tooth of trip gear 62 and turns the trip gear through 45°. Then the second tooth of drum 55 engages the next (long) tooth of trip gear 62 and turns the trip gear through another 45°, simultaneously turning drum 56 by its two teeth, that is, 1/10 of a complete revolution, and registers the digit 1. After this the two teeth of the trip gear are engaged with the teeth of drum 55. Consequently, the trip gear becomes stationary as does drum 56, since its teeth are engaged with those of the trip gear. When drum 55 turns one more revolution drum 56 turns through 1/10 of a revolution and registers another unit.

When drum 56 turns through a complete revolution, the two teeth on its one end engage trip gear 63 and turn it 90°. This movement is transmitted to drum 57 which is turned by its two teeth, that is, 1/10 of a revolution, and registers the first ten, etc. 50X1

Motion is transmitted in a similar manner by trip gear 287 to drum 61, which registers hundreds.

The trip gears rotate freely on shaft 72 which is attached by means of two springs 73 to housing 7 of the counter.

In order to set all drums to zero it is necessary to pull out knob 74 and turn it until zeros appear on all drums.

Shaft 41 is prevented from turning by the projection of spring 75 which enters a slot in a sleeve attached to the shaft.

When the cogs of all the drums are resting in the slot in shaft 41, the drums are set at zero.

2. Objective Lens Part AFA-33/20M
(Figures 1a, 4, 5, 8, and 19)

The objective part 14 of the camera is a cast metal section which is attached tightly to the base of the camera unit by bolts.

Within the objective part are: a lens, an iris-type shutter with heater, and the mechanism for transmitting motion from the power transmitting section of the camera to the shutter.

Motion is transmitted to the shutter through a telescoping shaft 53 and gears 76, 77, and 78.

On the front wall of the objective part are a knob 82 and indicating disk 81 which are used to change the exposure times, and rheostat 364 (Figures 4 and 6) which is used to change the brightness of the lamps for the recording instruments of the camera in accordance with the sensitivity of the film.

Motion is transmitted from the knob through telescoping shaft 91 to valve 115 (Figure 14) which, as it moves, creates more or less air resistance in the cylinder of the pneumatic regulator and thus changes the exposure of the shutter.

The turning motion of knob 82 (Figure 19) is transmitted through a pair of idler gears 273 to a crown wheel and disk. Because of the planetary transmission, the disk turns through a small angle when the knob is turned through a wide angle.

The disk is held at the desired exposure settings by means of catch 274, consisting of a rod and spring, which, as the knob is turned, falls into depressions in the crown wheel which correspond to each setting. 50X1

To avoid breaking the handle, the latter may be turned in one or the other direction for only a certain number of revolutions before coming to a stop position. These rotations are limited by means of a special device which functions as follows: washer 275 is linked to bevel gear 84 by means of pins. When knob 82 is turned one revolution the lug on washer 275 engages the lug of the second washer which sits freely on the shaft.

When the knob makes the second revolution the lug on the second washer engages the lug of the third washer, which also sits freely on the shaft, etc. As a result, the knob may be turned until the lug on the last freely rotating washer contacts the lug of the washer which is firmly attached to the sleeve of the shaft.

The bottom of the objective part is closed by a cover which protects the lens against dirt and dust during its transportation and when it is attached to the camera in the aircraft before flight.

3. Objective Lens Part AFA-33/50M, 75M, 100M (Figures 6, 7, 9, and 10)

Objective lens part 14, type AFA-33/50M, 75M, 100M, represents a cone-shaped cast metal unit which is bolted tightly to the lower part of the camera unit.

The following elements are mounted in the objective part: lens, louver-type shutter with electric heater, protective covers 50, and a mechanism for transmitting motion from the power transmitting apparatus of the camera to the shutter.

Protective covers 50 (Figures 9 and 10) cover the lens and protect the film against exposure through the segments of the shutter which do not fit tightly against each other when the shutter is in the closed position. The protective cover assembly consists of the following main parts: covers 50; gears 65 and 66 with shafts 67 and 68; springs 69 and 70; rack 64; disk 52 with roller 51; and pin 60.

Motion is transmitted from the power transmitting mechanism of the camera through telescoping shaft 53 to disk 52. When disk 52 turns, roller 51, which sits on a semiaxis screwed to the disk, presses pin 60 and moves the rack to the left.

The teeth on the rack are engaged with those of spur gears 65 and 66, which are permanently fixed to axles 67 and 68. 50X1

When the rack moves, gears 65 and 66 turn and open the protective covers.

The covers are closed and the rack moved backward by the action of springs 69 and 70 on axles 67 and 68.

The mechanism for transmitting motion to the shutter consists of telescoping shaft 53 and gears 54, 71, and 58.

On the housing of the objective lens part are attached a disk with a knob for changing exposure times and a rheostat for changing the illumination of the recording instruments of the camera.

Motion is transmitted from knob 82 to the shaft of the exposure mechanism through bevel gears 84 and 85, telescoping shaft 86, and helical gears 87 and 88.

The bottom of the objective lens part is closed by a cover which protects the lens against dirt.

4. Lenses of the AFA-33M (Figure 12)

Each variant of the AFA-33M aerial camera is equipped with the appropriate lens mounted in the objective lens section of the camera. The outer surfaces of the lenses are coated with two layers of a chemical clearing agent, while the outer surfaces of the first and last lenses are coated with a single layer of clearing agent.

The "ORION-1A" lens is mounted in the AFA-33/20M camera. The focal distance of the lens is 200 mm. The relative aperture is 1:6.3.

Resolution of the lens:

not less than 35 lines per mm at the center;
not less than 4 lines per mm at the edges.

The lens is equipped with three light filters ZhS-18, OS-14, and KS-14 which may be placed on the bayonet mount on the lens unit. An "INDUSTAR-52" lens comes with the AFA-33/50M camera. The focal distance of the lens is 500 mm. The relative aperture is 1:5.

Resolution of the lens:

not less than 25 lines per mm at the center;
not less than 12 lines per mm around the field.

The AFA-33/75M camera is equipped with a "TELEMAR-2" lens. The focal distance of the lens is 750 mm. Its relative aperture is 1:6.3. 50X1

Resolution of the lens:

not less than 28 lines per mm at the center;
not less than 11 lines per mm around the field.

The AFA-33/100M camera is equipped with a "TELEMAR-7" lens. The focal distance of the lens is 1,000 mm. Its relative aperture is 1:7.

Resolution of the lens:

not less than 28 lines per mm at the center;
not less than 17 lines per mm around the field.

The following three light filters may be used with the "INDUSTAR-52", "TELEMAR-2", the "TELEMAR-7" lenses: ZhS-18, OS-14, and KS-14. The lenses are attached to the bayonet mount of the lens unit.

When using the light filters it is necessary to consider their filter factor, that is, the value which shows to what extent the exposure time must be changed in comparison with photographing without a filter. (Filter factors are given in appendix No 2, page 45).

5. Shutters of the AFA-33M

Iris-type Shutter AFA-33/20M (Figures 13, 14, and 15)

The iris-type shutter with heater is placed in the objective lens unit of the AFA-33M between the lenses and has shutter speeds of 1/50, 1/100, and 1/200 sec. The efficiency of the shutter is 65-75%.

The iris shutter mechanism consists of five basic parts:

1. operating mechanism;
2. drive;
3. external-internal contact ring gear with disks;
4. pneumatic regulator;
5. electric heater.

Operating mechanism of the shutter.

The operating mechanism of the iris shutter (Figure 14) imparts rotating motion to ring gear 102 with disks 103 and consists of the following basic parts:

1. shaft 260;
2. starting drum 94 with two gear sectors 95 and 96;
3. drum cover 97;

4. operating spring 98;
5. stop 99;
6. driving gear 100 with notches;
7. movable tooth 101.

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Starting drum 94 with the two gear sectors 95 and 96 are mounted on ball bearings on shaft 260.

Gear sector 96 engages the teeth of drive sector 104, while sector 95 engages the teeth of rack 105 of the pneumatic regulator.

In the upper part of the starting drum is operating spring 98, one end of which is connected to the drum and the other to the drum cover 97. The cover is prevented from turning by stop 99.

On the lower part of the drum is driving gear 100 which engages the teeth of ring gear 102.

Driving gear 100 has a cylindrical ring with notches. A movable tooth 101 provides contact between the drum and this cylindrical ring. The tooth enters a slot of the ring at the moment the shutter is triggered and transmits motion from the drum through driving gear 100 to the ring gear and disks.

The drive (Figures 8, 14, and 15).

The drive serves to cock and trigger the shutter and receives motion from the power transmitting mechanism of the camera through a Cardan shaft and spur gears 76, 77, and 78.

The drive consists of the following basic parts:

1. shaft 106;
2. cam 107;
3. gear sector 104;
4. oscillating fork 108;
5. shaft 109.

Double ring gear with four disks.
(Figures 13, 14, and 15)

The double ring gear consists of the following basic parts:

1. shutter housing;
2. race;
3. double ring gear 102;
4. four disks 103 with spur trip gears 112.

Race 111 with a groove in which the double ring gear rests is attached to the shutter housing 110. Between the race and the ring gear 102 are ball bearings. 50X1

Ring gear 102 has external and internal contact.

The ring gear, which receives motion from external contact with driving gear 100, transmits rotary motion to spur trip gears 112 with disks 103, thus opening and closing the shutter.

Pneumatic regulator (Figures 13, 14).

The pneumatic regulator is designed to change the exposure of the camera within limits of 1/50 to 1/200 sec, as well as to protect the mechanism from shock loads at the end of the triggering cycle.

The regulator consists of the following basic parts:

1. housing 113;
2. piston 114 with rod 105;
3. valve 115;
4. adjustment needle 116.

When the shutter is cocked the piston and rod are placed in their initial position by gear sector 95 of starting drum 94. At the moment the shutter is triggered sector 95 transmits motion to the rod and piston which move at a certain speed depending on the amount of air pressure in the cylinder created by the piston. The amount of pressure (air "cushion") is controlled by the valve. When the valve is closed the air pressure is at a maximum and the piston moves slowly. When the valve is open the piston moves at maximum speed. The speed of movement of the piston controls the speed of rotation of ring gear 102 with disks 103, that is, controls the exposure time.

Adjustment needle 116 serves to adjust the mode of operation of the regulator.

Electric heater 307 is used to heat the shutter mechanism particularly when operating the camera at temperatures down to -60°C. The heater is a ceramic block wound with a helical wire and is attached to the cover of the shutter; the heater is turned on by means of a thermostat located in the camera part when the temperature is from + 3°C to + 13°C and is turned off when the temperature is from +20°C to + 30°C.

Operation of the Iris Shutter Mechanism
(Figures 14 and 15)

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When cam 107 turns, its gear sector 104 engages the sector of the starting drum 94. As the drum turns it winds the operating spring of the shutter.

At first the drum and the driving gear 100 turn together, since tooth 101 is engaged in the notch of the cylindrical ring of the driving gear. During this time the shutter disks turn in a direction oppsite to their normal travel, that is,the direction for opening the shutter.

Once the starting drum has moved through an angle of 12°, fork 108, which is turned by the action of cam 107, enters the groove of the driving gear and pushes movable tooth 101 from the groove, taking its place; the driving gear stops turning, and the slots in the disks take their initial position, corresponding to an angle of 270° through which the disks must pass before exposure.

After the driving gear and disks have stopped, the starting drum continues to rotate, winding the operating spring. When the drum has turned through an angle of 72° (from its starting position), the sector of cam 104 disengages from the gear sector 96 of the drum and the latter stops turning. At this moment the movable tooth is forced by a spring into the next groove of the cylindrical ring of the driving gear, thus connecting the driving gear with the drum.

Cam 107 continues to rotate and begins to push fork 108 from the groove in the driving gear. Once the fork has withdrawn from the groove, the winding spring causes the drum to rotate in the "unwinding" direction.

As the drum turns so also does gear 100, transmitting motion to double ring gear 102 which causes the spur trip gears and disks to rotate.

As the disks rotate their slots approach the effective aperture of the lens, open this aperture for a certain period of time, and then close. The exposure is them made.

Louver Shutter for the AFA-33/50M, 75M, and 100M

The louver shutter with electric heater is installed in the AFA-33/50M, 75M, and 100M cameras, between the lenses in the housing of the objective lens unit, and has exposure times of 1/75, 1/150, and 1/300 sec, with the exception of the AFA-33/100M shutter which has exposure times of 1/75, 1/125, and 1/200 sec. The efficiency of the louver-type shutter is not less than 40%.

The louver shutter mechanism consists of four basic parts: 50X1

1. frame with bars;
2. winding mechanism;
3. operating mechanism;
4. electric heater.

Shutter frame with bars (Figures 16, 17).

Frame 117 is a cast metal form in which are attached 9 bars for the AFA-33/50M and 75M shutters and 11 bars for the AFA-33/100M shutter.

On one end of the bars (118) is a semiaxis, and on the other -- a semiaxis with spur gear teeth.

On the operating mechanism side of the frame is a rack 119 which engages the teeth on the semiaxes of the bars. The rack has a lug 120 by which it is connected to a fork of the rocker lever of the shutter operating mechanism.

Winding mechanism (Figures 17, 18).

The shutter winding mechanism consists of: eccentric 121, jumping cam 122, ratchet wheel 123, and winding gear 58, which are connected to each other and rotate on a common axis 59.

The winding mechanism serves to wind and trigger the shutter operating mechanism.

Operating mechanism (Figures 17, 18).

The shutter operating mechanism consists of the following parts:

1. Screw 124, having single-cut right and left hand threads on each end, on which are screwed spring-holding sleeves 125.

2. Two slide blocks 126 with rollers 127.

3. Two springs 128.

4. Two springs 130.

5. Two small cups 129.

6. Rocker lever 131.

7. Two pneumatic buffers 132.

The operating mechanism operates the bars of the shutter and permits changing exposure times with the aid of springs 128 and 130. 50X1

Springs 130 provide an exposure of 1/75 sec, while springs 128 provide the remaining exposure times.

The operating mechanism is designed so that the right and left springs 128 and 130 function alternately during operation of the mechanism.

Electric heater 307 (Figure 16) is designed to heat the shutter mechanism, particularly during operation of the camera at temperatures down to -60°C. The heater is a ceramic block wound with wire and attached to the cover of the shutter housing.

Interaction of Parts and Operation of the Mechanism (Figures 17 and 18)

Motion is transmitted from the power transmitting mechanism of the camera through the Cardan shaft and gears 54 and 71 (Figures 9, 10) to winding gear 58. Eccentric 121, jumping cam 122, and ratchet wheel 123 turn with the winding gear. As the winding gear turns, eccentric 121 moves either the right or left slide block 126 along screw 124, compressing the operating springs of the shutter.

When the eccentric moves the right slide block and compresses the right spring, the left spring is kept in a cocked position since the left slide block is held by the edge of rocking lever 131 and roller 127, and the rocking lever is in turn held by the projection of upper lever 133.

With further movement of eccentric 121, when the smaller radius of the eccentric is adjacent to the roller of the left slide block, cam 122 releases upper lever 133 to the side. The projection on lever 133 frees rocking lever 131, and the latter turns on axis 134 due to the force of spring 128. The fork on lever 131, since it is engaged with rack 119, moves the rack along guide pins, and the latter turns the bars 180°, that is, trips the shutter.

The shutter triggers when gear 58 and eccentric 121 turn a half revolution in a counter-clockwise direction. Further rotation of gear 58 and eccentric 121 cause the shutter to be triggered by the right spring.

Ratchet wheel 123 and pawl 135 prevent gear 58 and eccentric 121 from turning in the opposite direction.

A shock absorbing action occurs at the end of the travel of rocking lever 131 when the shutter trips. This action, which reduces shock when the shutter bars close, is provided by pneumatic buffers 132 whose rods contact projection 136 of the rocking lever as the latter moves. 50X1

To prevent backward movement of the rocking lever and, consequently, of the shutter bars, the shutter has a device (Figure 17) which provides overlapping of the projection on rocking lever 131 and the projection on upper lever 133.

This device operates as follows: when the right spring triggers the shutter, rocking lever 131 strikes agains the rod of the pneumatic regulator while eccentric 121 at this time turns so that plate 137 butts against projection 138. Plate 137 is attached permanently to eccentric 121 (Figure 18).

Continuing to rotate, plate 137 pushes against projection 138 and turns the rocking lever so that the projection on upper lever 133 catches projection 139 of the rocking lever and prevents the latter from moving backward.

When the left spring triggers the shutter, projection 139 engages that of upper lever 133 as a result of the pressure exerted by lever 141, which is on the axis of eccentric 121, on peg 140, which is attached to rocking lever 131.

Exposure time may be changed by changing the tension of the springs, which is done with the aid of the two sleeves 129 and screw 124.

Screw 124 is turned by means of the exposure setting knob which operates through a telescoping shaft and spiral gears 87 and 88; the sleeves move along the threads of the screw and change the tension of the springs.

6. Film Holder

(Figures 20, 20a, 21, 22, 23, 24, and 25)

The film holder is designed for advancing, measuring off, and aligning the film and for protecting it against unwanted exposure.

The film holder can hold up to 60 meters of perforated film with a width of 32 centimeters.

Useful frame size is 30 x 30 cm with a spacing between frames of 10 to 25 m.

The film holder consists of the following basic parts:

1. housing;
2. operating mechanism.

The housing serves to protect the film against accidental or unwanted exposure and consists of the following components: 50X1

1. frame 142;
2. two spools 143;
3. cover 144.

A film counter 248 and a celluloid plate 298 for recording are mounted on the cover of the housing.

The cover is attached to the housing of the film holder by four hinged catches located in pairs on opposite sides. The catches are locked with a key to prevent accidental opening of the film holder during operation.

The film drive, signalling device, and two catches 249 are mounted on the right side. On the left side are the movable semiaxes on which the spools are placed and two catches.

A slide plate is mounted at the bottom in grooves of the frame; the function of the plate is to protect the film against accidental exposure through the window of the frame during removal of the film holder.

The film holder mechanism (see Figures 20 and 21) is mounted within the housing and consists of the following basic parts:

1. film drive;
2. film metering mechanism;
3. film smoothing mechanism;
4. disengaging mechanism;
5. friction clutch;
6. film counter;
7. film winding signal device.

The film drive (Figure 20) serves to transmit motion from the drive mechanism of the camera to the film holder and consists of a drive head 201 attached to a shaft and a pair of bevel gears 202 and 203.

The film metering mechanism transmits motion from the drive to metering shaft 215 and serves to advance a constant amount of film equal to the length of a frame plus the interval between frames.

The film metering mechanism consists of two spool cams 204, spur gears 216, 217, 218, and 219, and metering shaft 215.

The metering shaft 215 may be disconnected from the overall kinematic arrangement of the film holder by means of a special disengaging device (see Figure 20) which consists of an end coupling 240, spring 245, lever 241, and lock 242. 50X1

The shaft is disengaged to facilitate loading the spool with the film. The metering shaft may thenbe turned freely. The disengaging device operates as follows: when lever 241 is pressed, the end coupling is disengaged and the shaft is freed.

The end coupling is engaged automatically by means of hook 244 when the cover of the film holder is closed. Hook 244, which is attached to the cover, presses on lock 242 and frees the lever, after which both halves of the end coupling are connected by means of spring 245, engaging the metering shaft.

The smoothing mechanism consists of:

1. central shaft 206 with eccentric 231;
2. press plate 222;
3. roller 232 with its support;
4. two springs 233 and 234;
5. bushing 235.

The disengaging mechanism serves to disengage the film holder mechanism from the drive mechanism of the camera when the slide plate is open for the purpose of preventing damage to the drive mechanism.

The disengaging mechanism consists of:

1. roller 208;
2. lever 209;
3. stop rod 210;
4. fork 211 on shaft 212;
5. end coupling 213;
6. spring 214.

The friction clutch (see Figure 23) is designed to turn the take-up spool when the diameter of the latter changes as film is wound on the spool, and also provides the necessary tension during winding.

The main parts of the friction clutch are:

1. housing 191;
2. gear 192;
3. shaft 193;
4. nut 194;
5. flange 195;
6. spring 196;
7. gasket 197.

The friction clutch is designed as follows: housing 191 containing felt gasket 197 is placed on shaft 193. Gear 192 with an insert for spring 196 is attached to the bushing of the housing. There are pins in the end of the gear. On the bushing of gear 192 is a flange 195 which is connected to the pins. Spring 196 forces flange 195 against felt gasket 197 and thus provides the necessary friction between the housing and flange 195. 50X1

As a result of the gradual increase in diameter of the winding spool, advance of the film without the friction clutch would cause a gradual increase in the amount of film wound on the spool in one cycle, which, as a result of the presence of the film metering mechanism, would cause the film to break or would damage the mechanism.

The friction clutch permits turing of the take-up spool whose flange is connected to the driving pins of housing 191. At the same time, the film is advanced as a result of the turning forces of the take-up spool.

The combined friction clutch of the film supply spool 225 consists of two friction clutches: an internal constant-action friction clutch, and an upper periodic-action friction clutch. This combined clutch provides normal operation when the film is advanced (avoids loops in the film).

The main parts of the brake are:

1. housing 350;
2. bushing with pin 351;
3. spring 352;
4. check bushing 353;
5. gasket 354;
6. ratchet wheel 355;
7. gasket 356;
8. nut 357;
9. stop 358.

Combined friction clutch 225 is constructed as follows:

Within housing 350 is felt gasket 354. Over bushing with pin 351 is placed check bushing 353 which is forced by spring 352 against felt gasket 354, thus providing the required friction between housing 350 and check bushing 353.

Ratchet wheel 355 is placed around the outside of housing 350 and is held between two felt gaskets 356 which are squeezed together by nut 357 and subsequently arrested by stop 358; the gaskets provide

the required friction between housing 350 and ratchet wheel 355. The upper friction clutch is placed in operation by a pawl at the end of the film advance cycle. 50X1

The film counter (Figure 24) indicates the amount (in meters) of unexposed film remaining on the film supply spool.

The counter mechanism consists of the following basic parts:

1. counter housing with dial 148;
2. lever with roller 147;
3. gear sector 146;
4. shaft with spring 149;
5. shaft with gear teeth 150;
6. pointer 190.

The counter operates as follows: when the cover of the film holder is closed, the roller on lever 147 rests on the surface of the film on the film supply spool.

As the diameter of the roll of film decreases, the roller on the lever arm drops and motion is transmitted through gear sector 146 to shaft 150 to which pointer 190 is attached. The pointer indicates on the scale the amount of film remaining on the spool; the scale is located on the bottom of the housing.

The film advance signal device indicates normal operation of the camera and advance of the film. It is a combined mechanical and electrical device and is mounted on the semiaxis of the film spool. The electrical indicator is a disk 237 with lugs which open and close contact plates 238 as the semiaxis rotates, transmitting a current pulse to a light on the command instrument. The electrical circuit of the contact plates on the film holder is connected with that of the camera by means of contact block 239. The electrical device is covered by a housing 311; on the outside and attached to the semiaxis is the mechanical signal device, which is a black and white disk.

Interaction of Parts and the Film Holder Mechanism

50X1

(Figures 20, 23, and 25)

The operating cycle of the film holder begins with advancement of the film (second half of the frame). At this moment the table of the film holder is completely raised and makes it possible to open and close the slide plate without hinderance.

With the slide plate closed, the film holder mechanism is disconnected from drive head 201 and, consequently, advancement of the film and lowering of the table are impossible at this time. The mechanism is actuated only when the slide plate is open.

When the slide plate is open extension 207 lifts roller 208, which sits on lever 209, and the lever, as it turns around its own axis, disengages gear sector 210 from gear 205. Simultaneously with the lowering of gear sector 210, lever 209 frees fork 211 which turns around axis 212 and is connected to end coupling 213.

Due to the action of spring 214, the end coupling is lowered and its teeth enter the corresponding depressions in the drive head.

Drive head 201, bevel gears 202 and 203, the cams of gear 204, and the central shaft 206 of the film holder make one revolution for each complete operating cycle of the film holder.

As soon as drive head 201 begins to turn, the motion is transmitted through bevel gears 202, 203 and cam 204 to gear 205 and then through spur gears 216, 217, 218, and 219 to metering roller 215.

The metering roller begins to advance the film which moves from the supply spool 220 over guide roller 221, under table 222, and then between pressing roller 223 and metering roller 215 to take-up spool 224.

At the beginning of the film advance, only the internal part of combined friction clutch 225 of the supply spool operates. At the end of the film advance cycle the upper friction unit is engaged in the following manner: eccentric 359, which sits with the cam gear on shaft 206, turns the roller on pawl 360. Pawl 360 is attached to shaft 361.

Eccentric 359 turns with shaft 206 and presses on the roller of pawl 360, dropping the pawl into ratchet wheel 355 through the tension applied by spring 362 and thus engaging the upper part of friction clutch 225. The latter provides for normal operation of the film advance mechanism by preventing the formation of loops.

After a certain length of film (the second half of a frame) has been advanced, can 204 disengages from gear 205. The gear stops turning and film advance ceases, but central shaft 206 continues to turn with eccentric 231. The eccentric begins to press on roller 232 and transmits this motion through spring 233 to the table. The table begins to drop and, at the end of its movement, presses the film against the detachable frame of the camera unit, at the same time creating a pressure within the camera as a result of the continuous delivery of air by the blower.

The air pressure in the camera presses the film against the table and levels it, while the air remaining between the table and the film escapes through the gasket and grooves in the table into the film holder and thence to the outside.

After exposure of the film, rotation of the eccentric permits the table to return to its original position as a result of the action of return spring 234.

When the table has been raised to a certain height, cam 204 again engages gear 205 and the film again begins to advance (the first half of a frame).

Shaft 206 turns eccentric 359, the roller on pawl 360 hits the projection on eccentric 359, and the pawl is shifted to the upper position, disengaging from ratchet wheel 355.

At this moment the internal friction part of combined friction clutch 225 begins to function.

When the table has been raised to its maximum position, the film holder mechanism and the camera mechanism cease operating and the operating cycle of the film holder terminates.

With the table in this position it is possible to close the slide plate, wherein pointer 243 must be placed opposite the inscription "Svobodno" [Free]. This corresponds to the maximum raised position of the table.

When pointer 243 is placed opposite the inscription "Shiber ne zakryvat'" [Do not close slide plate], then it is forbidden to close the slide plate since the table of the film holder is down.

The pointer may be seen through the top and side windows of the disengaging mechanism.

The supply spool is held in the film holder on semiaxes. These are formed by a projection on combined friction clutch 225 with drive pin 226, and a rotating semiaxis with a safety catch. 50X1

The semiaxes of the take-up spool are formed by a projection on friction clutch 229 with drive pins 226, and rotating semiaxis 227 with safety catch 228. The catches protect the semiaxes against arbitrary shifting and prevent the spools from coming off the axes during operation of the camera.

7. Command Instrument KPU_2

(Figures 26, 27, 28, and 29)

The command instrument (KPU_2 -- Universal Command Instrument) is designed for remote control of the camera and the oscillating camera mount. It provides for:

a) automatically delaying the time interval between photographs within limits from 2 to 60 sec;

b) taking individual photographs;

c) automatic photographic observation of bombing results. Once the ESBR [electric bomb release] button has been pressed, the camera begins operating within 5 to 15 sec before explosion of the bomb and automatically switches off after 25 sec of continuous operation;

d) monitoring the operation of the camera according to the flashing of a signal lamp;

e) switching the aerial camera to continuous operation;

f) determining the number of photographs taken;

g) switching on and off the electric heaters of the KPU;

h) switching on the AKAFU-33 when operating with the aerial camera.

The command instrument has the shape of a square box within which are mounted the KPU mechanisms. All control elements and signal devices are accessible on the front panel.

50X1

In the center of the panel is setting dial 151. A scale with white numbers is inscribed around the circumference of the dial. Graduations of the scale correspond to the time interval between photographs in seconds. To set the desired time interval, white index 152 is placed opposite the appropriate number on the white scale.

In addition to the white index on cover 153 is a yellow index 154 ("T-bombs"). When the AFA-33M is used for the purpose of observing the results of bombings, it is necessary to align yellow index 154 and setting dial 151 so that one of the numbers or graduations on the dial corresponds to the calculated drop time of the bomb (this time is determined from ballistics tables). For non-automatic operation (using the "Odinochnyy snimok" [single photograph] button), white index 152 should be placed opposite the graduation with the sign "∞".

Beneath the setting dial are three buttons: in the middle is starting button 156, used to start operation of the instrument, button 157 on the right is used to switch off the instrument, and button 158 on the left is used to take single photographs.

There are two groups of switches located to the left and right of the buttons. Switch 159 is used to set the command instrument in the bombing observation mode of operation ("Kontrol' bombometaniya" [bombing observation]) or for photographing with time intervals ("Interval"). Switch 160 is switched on only if the camera is to be operated in the continuous mode, that is, with the interval between photographs equal to the duration of the operating cycle of the camera, wherein the "∞" sign on dial 151 is aligned with the white index. Switch 162 is used to switch on and off the electric heaters of the command instrument.

When switch 161 is in the up position (inscription "AKAFU"), oscillating camera mount AKAFU-33 is in the operating mode corresponding to 2 or 3-strip photography. If the switch is in the down position, the oscillating camera mount will operate in the single-strip mode and the oscillating frame will be automatically set in the middle position. (The above cases are applicable when the AFA-33M camera is used with the AKAFU-33 camera mount).

At the top of the command instrument are three signal lights. Light 163 is on when the instrument is under current, that is, after starting button 156 has been pressed, or when dial 151 is set at "∞". When button 157 is pressed light 163 should go out if dial 151 is not set at "∞".

Light 164 burns periodically during operation with the AKAFU-33 oscillating camera mount. The light should be out when using single-strip photography. 50X1

Light 165 "flashes" during advance of the film. In addition, when switch 159 is in the "Kontrol' bombometaniya" position the burning of light 165 shows that the command instrument mechanism has occupied the initial position and is ready for photographic observation of bombing. Light 165 goes out when the ESBR button is pressed. Then, within 10 sec before explosion of the bomb the light should begin to "flash", signalling normal operation of the camera during the period of operation of the camera (approximately 25 sec). The light is then extinguished and goes on when the mechanism again reaches its initial position. Until this time it is useless to press the ESBR button since the instrument will not carry out photographic observation in this case.

To the right under protective cover 346 is frame counter window 166 which covers a numbered drum. The value of each division on the drum is 5 frames, and the counter is capable of registering up to 400 frames.

The drum is set at the zero position by turning disk 167 in the direction shown by the arrow. A replaceable "BP-20" safety fuse is located under cover 168.

The electrical cable for the KPU is connected to receptacle 169. Next to this is a two-pin receptacle 170. This receptacle serves for connection of the two-wire electrical cable of the ESBR through which a current pulse is sent from the ESBR button.

The command instrument is held down in the aircraft by means of dovetail fitting 171. The dovetail receptacle and catch lever are screwed to base 172. When this receptacle is slid into the dovetail fitting, the tooth of catch 173 engages that of the lever and thus protects the command instrument against slipping off the mount. In order to remove the command instrument it is necessary to press the protruding part of the lever and lift up.

Cover 153 together with the sides, which form a single unit, may be tilted back on hinges after removing three screws 186 (which secure the setting dial 151) and loosening the two catches 187 which join cover 153 with base 172.

The KPU mechanism consists of the following basic units:

1. Drive mechanism.

2. Central mechanism.

3. Frame counter 188.

4. Electric heater 189.

5. Rectifier 198.

The drive mechanism serves to turn the ratchet wheel of the central mechanism at a constant number of revolutions per minute.

The drive mechanism consists of:

a) electric motor MU-010 (199);

b) two pairs of worm gears 200, 252, 253, 257;

c) speed governor 259.

The time mechanism of the KPU is actuated by the special MU-010 electric motor.

This is a small separately-excited device with a constant magnetic field. The direction of rotation of the shaft in this type of motor depends on polarity.

Electric motor MU-010 operates from direct current at a voltage of 26 v ± 10% and a speed of 8700 rpm at a load of 40 gcm.

Figure 28 shows a cut-away view of the motor, where 276 is the motor housing, 277 are the poles, 278 is the permanent magnet, 279 is the armature, 280 is the commutator (end), 281 are the brushes, 282 is the front plate with ball bearings, and 283 is a brush spring.

The constant speed of electric motor 199 is maintained by a special governor 259. If the speed of the motor increases beyond the permissible value due to the effect of increasing centrifugal force, contacts K3 (Figure 36) of governor 259 separate. Then the armature current will pass through resistor R1 (Figure 36) rather than directly to the armature. As a result, the voltage across the armature drops and the speed of the motor begins to decrease until contacts K3 close once again due to the effect of spring tension. The resistor is then shunted and current flows directly to the armature whose speed begins to increase once more.

In this manner the motor is maintained at a constant speed equal to 7500 rpm ± 5%.

Worm gear 200 is connected to the output end of the shaft. Motion 50X1
is transmitted from this worm gear to gear 252 and worm gear 253. The latter turns the drive gear of the central mechanism.

The main function of the central mechanism is to close starting contact K1 (Figure 36) at predetermined time intervals and to switch on the AFA-33M camera when observing bombing results.

The central mechanism is located on base 172 of KPU and consists of:

a) the central mechanism proper;

b) electromagnet 284 of the electric bomb release;

c) setting dial 151.

Gear 257 sits freely on shaft 285. Plastic cam washer 286 (the bombing control cam) is friction mounted on the body of gear 257 and is rigidly connected to ring 299. On this ring is a depression "a." A ratchet wheel is screwed to gear 257. Cam washer 286 is thus located between washer 300 and ratchet wheel 301. Washer 300 is continually subjected to the action of three springs 302 recessed in the body of gear 257 and, consequently, continually presses cam washer 286 against ratchet wheel 301. Washer 300 is connected to gear 257 by guide pin 303.

Above ratchet wheel 301 is a hinged lever 304. The lever is not rigidly connected to gear 257 but is capable of turning relative to the gear and ratchet wheel 301.

At the end of hinged lever 304 is pawl 305 which, during the operation of the mechanism, periodically engages the teeth of ratchet wheel 301. The pawl is held against the ratchet wheel by spring 312. The pawl is controlled by means of a system consisting of auxiliary lever 313 with pin 314 and catch 315, which is held against the projection on auxiliary lever 313 by spring 316. Auxiliary lever 313 turns on axis 317, while catch 315 turns on axis 318.

In addition, a textolite strip 319 is attached to hinged lever 304 by screws and post 320 is attached to the lever by upsetting. The end of spring 321, which attempts to turn lever 304 counterclockwise against fixed support 322, is attached to the post.

Above hinged bracket 304 is bracket 323 with two pairs of contacts K1 and K2. Contacts K1 are closed by textolite strip 319, and contacts K2 are closed by cam washer 286.

Bracket 323 is rigidly attached to setting disk 151. Consequently, 50X1 when the disk is turned contact K1 will move either toward or away from support 322 depending on the direction of rotation of the disk. The position of contact K2 with respect to the projection on cam washer 286 will change in exactly the same manner. The cam washer is fixed in a certain position by arm 324 whose tooth sits in the depression of ring 299 due to the tension of spring 325.

When a current pulse is applied to the ESBR electromagnet 284 (when a bomb is released), the magnet pulls armature 326 into the core and arm 324 turns around axis 327. The tooth on arm 324 withdraws from depression "a".

On armature 326 is a plastic pin 328 which, in its initial position, that is, when arm 324 is holding cam washer 286, closes contacts K4. When the armature is attracted into the core or when the tooth of arm 324 is not in depression "a", contacts K4 are open.

Contact K5, consisting of three contact leaves, is attached to base 172. In the free state the middle leaf makes contact with the upper leaf.

When dial 151 is set on the "∞" position the projection on bracket 323 presses against the middle contact leaf. This disturbs the contact between the upper and middle leaves and the latter makes contact with the lower contact leaf.

Frame counter 188 is mounted on cover 153 and serves to indicate the number of photographs which have been taken. Its mechanism operates from current pulses sent from the camera unit. One pulse is applied to the mechanism for each cycle of operation of the camera.

The counter consists of:

1) Electromagnet 329.

2) Ratchet wheel 330.

3) Counter trip gear 331 and gear 332.

4) Numbered drum 333.

5) Disk 167.

Current is applied to the winding of electromagnet 329. Armature 334 is pulled into core 335, which is hinge-connected to armature 334, and pawl 336 turns one tooth of ratchet wheel 330. Trip gear 331 turns together with the ratchet wheel. The trip gear transmits motion through gear 332 to numbered drum 333. 50X1

Each of the divisions on the cylindrical part of the drum corresponds to five frames. Readings are made opposite an index mark made on the protective glass cover. As the current pulse is removed, spring 338 pulls armature 334 out of core 335 and pawl 336 moves to the next tooth on ratchet wheel 330. The latter is prevented from turning in the opposite direction by check pawl 339. The numbered drum is set on the zero position by means of disk 167.

The command instrument contains, in addition to the above mentioned parts, electric heater 189, rectifier 198, and an electrolytic capacitor.

The electric heater is used to heat the KPU mechanisms and the electric motor in low temperature conditions (down to -60° C).

Electric heater 189 is attached to the lower wall of cover 153 in KPU. With the cover placed on base 172, the heater is adjacent to the electric motor.

The electric heater represents a ceramic core wound with nichrome wire. The core is attached to the wall of the instrument by means of a bracket.

Rectifier 198, attached to the side wall of the cover next to the counter, se ves to prevent current from going to the dynamic braking relay during photographic observation of bombing results. This may occur when the signal contact K7 in the film holder is left in the closed position and switch P1 is in the "Kontrol' bombometaniya" [bombing observation] position.

The rectifier passes current going from signal contacts K7 to the film advance signal light in KPU but does not pass return current going through P1, K4 from KPU.

Basically the rectifier consists of two metal disks 340 with layers of selenium 341 applied to them, two spring washers 342, and two leads 343. The spring washers press against the selenium layer. A boundary layer is formed between the selenium and the disk to which it is applied which has the property of passing current in only one direction.

The choke and capacitor are intended to reduce the level of radio noise.

8. The Drive and Air Pressure Units

50X1

(Figures 31 and 32)

The drive and air pressure units, mounted in common housing 29, serve to actuate all mechanisms of the aerial camera and to supply air to the camera for the purpose of levelling the film.

Mounted in the two cups screwed onto either side of the assembly are two type MA-40A electric motors which are of the open type and operate from direct current with compound exciatation and natural cooling. The MA-40A electric motors operate in two modes with rating data given in the following table:

Name	Operating mode No 1 for camera drive	Operating mode No 2 for blower
Voltage	26 volts	26 volts
Useful power	40 watts	20 watts
Speed of rotation	9500 rpm ±10%	10,000 rpm +20% -10%
Current	3.5 amps	2.6 amps
Duration of operation	15 min	3.5 hours

The operating mode of electric motor 8 is short-term, while that of electric motor 30 is long-term -- up to 3.5 hours. Electric motor 8 serves as the drive for all mechanisms of the camera, while electric motor 30 turns fan 31 (blower), which forces air through a flexible hose to the camera unit for the purpose of levelling the film.

Motion is transmitted to the camera from electric motor 8 through a reduction gear system 32 consisting of one pair of worm gears 46, 47 and two spur gears 48 and 49.

The gear ratio of the reduction gear system is 30.

In order to protect the camera against damage in the event of jamming or other malfunctions during operation, the reduction gearing contains a friction gear which operates as follows:

Gear 48 sits freely on worm gear shaft 174. End coupling 177 is attached to key 176 on this same shaft. The coupling has teeth in one end which engage the same type of teeth in gear 48. Coupling 177 is held against the gear by the force of spring 175; consequently, motion is transmitted from worm gear 47 through coupling 177 to gear 48. 50X1

In the event of seizing or other malfunction, when a torque of 22.5 to 24 kg/cm is created on the output shaft of the reduction gearing, clutch 177 disengages from gear 48 and slides, whereby motion ceases to be transmitted to gear 48 and the camera.

The friction clutch is lubricated with 1TsKP lubricant for the purpose of creating 22.5 - 24 kg·cm steady torque at the output of the reduction gearing.

Nut 178 is used to adjust the tension of spring 175. The output shaft of the reduction gearing terminates in a fitting to which Cardan shaft 15 is connected to transmit motion to the film holder mechanism (Figures 8, 9, and 10).

Electric motor 8 is actuated by a current pulse from the command instrument after each set time interval and operates for no longer than 2 sec, making a complete cycle of operation. During operation of the camera the motor receives current through a pair of contacts which are closed by contact cam 42. The blower motor is switched on simultaneously with the power switch of the command instrument and operates continuously during the photographing period.

9. The Electrical Cables

(Figures 30, 30a, 33, and 33a)

All parts of the AFA-33M camera, the command instrument, and the drive and air pressure units are connected to each other by electrical cables. In addition, a special cable connects the command instrument with the ESBR button.

The AFA-33M set includes two cables and a jumper cable for connection to the AKAFU-33 mount.

The first cable consists of two parts connected to each other by plug 180 and socket 181.

The first part of cable 179 has a common disconnect-type plug 180 by means of which it is connected to the socket of the intermediate cable installed in the aircraft or to socket 181 of the second part of cable 182.

50X1

At the end of one branch is plug 183 which is used for connecting the drive and blower unit.

At the end of the second branch is plug 184 for connection to the camera, and at the end of the third branch is plug 347 with a cap which is used for connection to AKAFU-33 through the jumper cable.

The second part of cable 182 has plug 185 which connects to the command instrument.

On the end of one branch of the cable is disconnect-type socket 181 which may be used to connect to plug 250 of the aircraft's intermediate electrical cable or to plug 180 of the first part of the cable. On the end of the second branch is two-pin plug 251 for connection to the power supply receptacle.

The intermediate electrical cable is not included in the set. It is supplied by the aircraft parts manufacturing plant.

The second electrical cable (ESBR cable) 344 (Figure 30) serves to connect the command instrument to the electrical bomb release button.

One end of the cable has a two-pole plug 345 which connects to the two-pole socket on the command instrument, and the other end is terminated by a two-pin plug 363 which connects to the bomb release button.

The jumper cable serves for connecting the AKAFU-33 camera mount with a branch of the AFA-33M cable.

It has a four-pole socket 348 which connects to plug 347.

The other end of this cable has a four-hole socket 349 (special) which connects to the drive of AKAFU-33.

50X1

10. CARDAN SHAFT (fig 8, 9, 10)

The cardan shaft transmits driving power from the reduction gear of the drive mechanism to the camera actuating mechanism through a bayonet connection.

The cardan shaft can transmit the driving power even at parallel displacement of the output shafts of the reduction gear relative to the camera actuating mechanism; it also will transmit power if the distances between such shafts is varied within the limit up to 60 mm.

11. FLEXIBLE HOSE (fig 1, 2, 3)

The flexible hose consists of a rubber tube with nipples on its ends.

The flexible hose provides passage for air from the blower to the camera, and is connected to the blower and to the camera nipple by a bayonet coupling.

12. CAMERA MOUNTING

The camera mounting is intended to support firmly the camera on the aircraft and to reduce vibrations caused by the engine propellers; these vibrations affect adversely the sharpness of photographs.

This camera mounting is manufactured in three variants: for camera AFA-33/20M, for camera AFA-33/50M, 75M and for camera AFA-33/100M.

A. Camera Mounting for AFA-33/20 M (fig 34)

This camera mounting consists of frame 261 with studs 262 and two cross-bars.

The camera mounting is fastened to the aircraft by bolts.

On the side of the frame is a small platform for mounting of the drive mechanism. The cross-bars 263 are mounted on the frame studs. In the middle part of both cross-bars are supporting recesses for the camera trunnions. Over these recesses are mounted swing clamps 264, and locks 265 to hold the clamps in place.

At the ends of the cross-bars are placed adjusting screws 266. On th 50X1
adjusting screws, from below, are mounted shock-absorbing springs 267. These springs are 1.1 and 1.6 mm thick and are placed inisde each sleeve of the camera mounting.

Sleeves 268 are placed over studs 262 and fastened by clamp rings 269.

To avoid possible breakage of the spring during landing or take-off of the aircraft, a felt shock-absorber is placed at the bottom of each sleeve.

On the adjusting screws 266 are placed knobs 270 which permit to bring the aerial camera into vertical position.

On one of the cross-bars is placed a wing screw 271 which serves to fasten the camera trunnion to the hook.

Such a fastening is essential to prevent camera rotation on its trunnions during the flight. Felt shock absorbers are placed under the mounting frame to further reduce the camera vibrations.

B. Camera Mounting for AFA-33/50M, AFA-33/75M And AFA-33/100M (fig 35)

Shock-absorbing arrangement of the camera mounting for AFA-33/50M and AFA-33/75M is similar to that for AFA-33/20M.

The difference in construction of camera mounting for AFA-33/50M and AFA-33/75M, as compared to camera mounting for AFA-33/20M, consists in that instead of studs and base there are provided special components for mounting the camera.

Such a special mounting consist of two separate plates on which are welded sleeves with external thread.

On the ends of each of these plates are two holes for the bolts with which the plates are fastened to welded brackets.

The brackets have three pairs of holes for fastening with the bolts to the plates. By fastening the plate ends with the aid of bolts passing through any one of the mentioned pair of holes, it is possible to secure three different positions between the planes of the brackets mounted on the longerons.

Either maximum, medium or minimum positions may be selected depending on the model of the aircraft.

To the near plate is welded-on a small platform with four holes. On this small platform are mounted and fastened by four bolts the drive and blower assemblies.

The sleeves with their shock-absorbing springs of the upper frame of the camera mount are inserted into the sleeves on the angle iron; the frame is then fastened to clamp rings. 50X1

The camera mounting for AFA-33/100M is analogous to that for cameras AFA-33/50M and AFA-33/75M.

The only difference is that instead of 1.1 and 1.6-mm springs placed in the sleeves of camera mounting for AFA-33/50M and AFA33/75M, the camera mounting for AFA-33/100M has two 1.6-mm springs.

NOTE: The mentioned camera mountings are not included in the aerial camera assembly, but are made by the factory on special request.

13. PACKING (fig 39, 40, 41, 42)

All parts of cameras AFA-33/20M, AFA-33/50M, AFA-33/75M or AFA-33/100M are packed in two boxes. In the first box is placed the cassette with the portable board, and in the second all other components.

14. INTERDEPENDENCE OF THE AERIAL CAMERA PARTS AND DESCRIPTION OF ELECTRICAL CIRCUIT OF CAMERA AFA-33/20M (fig 36)

For proper performance of all the camera components they must be connected in the following manner: the camera is first mounted with its conical portion of the trunnions on the camera mounting. Then the cassette is mounted on the camera and the slide plate is opened.

The drive and blower assemblies are mounted on the frame of the camera mounting. The reduction-gear shaft of the drive mechanism and the exit shaft of the camera are connected by Cardan shaft 15 (fig 8). The air-blower nipple is connected to the camera nipple by a flexible hose.

The command instrument, the drive-and-blower assemblies and the camera are connected to each other by an electric cable. One end of the cable with a two-pin plug is connected to the power line.

The current is admitted to contract pair 9 of the terminal box (of KPU), and then through fuse PR1 to common switch V_1, to upper contact plate K_5 (on diagram shown as lower) and to electric heater switch V_2.

Current is supplied to plus wire 1 either through switch V_1 or through contact K_5 when the setting dial of KPU is set on "∞". At this time the lower pair of the contacts will close (on the electric diagram, the upper). Now lamp L_1 will glow indicating that the current is flowing. Camera AFA-33/20M can operate in several modes. 50X1

A. Photographing with a Set Inteval

In this case the function of KPU is reduced to supplying to the RDT of the camera, and consquently to the camera actuating motor, current pulses of specified duration at predetermined time intervals. When photographing at intervals through the upper pair of contacts K_5 and switch P_1, the current is fed to contact K1 (on KPU is inscription "Interval"). When switch B_1 (button "Start") is turned on the current passes through the lower pair of contacts K_5 to the motor armature of the command instrument M_1, and then passing through the system of the rpm regulator R_1 and K_3 is admitted to the minus wire 4. The torque from the motor shaft is transmitted to gear 257 (fig 29).

Swing lever 304 becomes engaged with its pawl 305 to ratchet wheel 301 and moves together with it toward contact K_1.

When plate 319 closes contact K_1, a current pulse will be admitted to the camera. Then pawl 305 becomes disengaged from ratchet wheel 301 and swing lever 204 under the tension of spring 321 is retracted back to stop 322. After this pawl 305 again comes in mesh with ratchet wheel 301 and the swing lever again begins to move toward contact K_1. Now again, after contact K_1 becomes closed, lever 304 will be again retracted back to the stop, etc. Thus the swing lever 304 will make reciprocal motion between stop 322 and contact K_1. The time interval between two successive closings of contact K_1 depends on the distance between contact K_1 and stop 322. The greater the distance, the longer will be the time interval between two successive pulses sent to the camera. Since the position of contact K_1 is determined by the position of the setting dial of KPU, therefore the time interval between two successive current pulses will also depend on the setting of the dial.

At the instant of closing of contacts K_1 current will be supplied to the relay winding of the dynamic brake (circuit OR_1) through wire 2 in the camera (see fig 63).

As a result of relay tripping, the middle plate of K_{10} of this relay will disengage from the upper plate and engage the lower plate.

Current will now flow from wire 1 through series winding SO 1 and armature Ya 1 of the camera motor. Prior to this current was passing only through the parallel winding ShO 1. The armature now begins to rotate.

The torque from the motor is transmitted by Cardan shaft 15 (fig 18) to power distributing mechanism (beginning of the operating cycle); as a result of this cam 42 begins to rotate (fig 8) and closes blocking contacts K6 prior to the breaking of contacts K1 and KPU. Now the current will be admitted to relay OR 1 only through contacts K6 during the rest of the cycle. When cam 42 will turn with its depressed portion toward contacts K6, then the latter will open and current will stop flowing to the relay winding of dynamic braking. The middle plate of K 10, acted on by the spring tension, will contact the upper plate and, thus, short circuit the armature. Motor armature of the camera drive will stop until the next closing of contacts K1. 50X1

During the motor operation motion is also transmitted to the cassette through a drive pinion and driving pin 23. Spool cam 204 and gear 205 are now in mesh and begin to advance the film in the cassette of the second half of the frame (beginning of the cycle).

During the advance of the film, eccentric 231, which is connected to central shaft 206, begins to press on the table roller and gradually lower the table.

When the film has been advanced to the desired length, the spool cam becomes disengaged from gear 205 and the movement of the film stops; however, the central shaft with eccentric 231 will continue to rotate.

After a certain period eccentric 231 will fully lower the table over the attached frame of the camera. With the table lowered, air pressure in the camera rises to a specified value, thus pressing the film to the table and aligning the film with the focal plane.

During the advance of the film motion from the distributing mechanism is transmitted to counter 7 and to winding of the shutter. When the table has been fully lowered over the attached frame and the film has been tightly pressed by the air to the table, then the shutter is ready for operation.

When cam 107 (fig 14, 15) has rotated through a certain angle it presses the fork pin 108 out of the slot of driving gear 100.

Motion is transmitted from the driving gear to the disk gear. In their rotation the disks will open and close the camera lens, thus effecting the film exposure. Simultaneously with operation of the shutter, contacts K 8 (fig 36) for the lamps of recording instruments and KPU counter will also close. Readings of the recording instruments (clock, level and counter) will be photographed on the film while the electromagnet of counter OEM1 KPU will operate and rotate ratchet wheel 330 (fig 29) by one tooth.

50X1

Then, after operation of the shutter, the cassette eccentric 231 will turn and raise the table, releasing the film.

The spool cam in the cassette now again will mesh with gear 205 and will advance the film from the unwinding spool to the winding spool (first half of the frame).

Movement from the camera section is transmitted to the shutter throughout the entire period of operation of the apparatus.

During the rotation of cam 107 with its geared sector 104, the latter engages the geared sector of the drum. The drum, during its rotation, winds the spring.

After the completion of film advance (prior to the opening of safety covers and lowering the table) contacts K 6 will open. Thus the winding plate of this relay quickly disengages from the lower plate and engages the upper plate, thus shorting the Ya 1 winding.

Since armature Ya 1 continues to rotate due to its inertia and due to the presence of magnetic field caused by shunt winding Sh0 1 of the camera motor, an emf is induced in its winding. The kinetic energy of swiftly rotating armature is converted into electric energy, which in turn is converted into heat energy.

Thus, to the drag forces of the mechanism which help to stop the rotating armature is added another, more effective, braking force.

During the advance of the film current pulses are admitted through the making-and-breaking contact K 7 to the lamp L3 ("Winding"). The lamp now flickers.

Mechanical signalling is effected by rotation of a signal disk in the cassette mounted on the semi-shaft of the unwinding spool. The camera operating cycle is completed when the table and cassettee are fully raised and the pointer on the driving shaft of the cassette is opposite inscription "Free.".

In such a position the sliding plate can be closed and cassette removed.

B. Photographic Control of the Results of Bombing

In such a case the electric cable of ESBR is connected by its plug to the socket of KPU and by the other end to the bomb-release button.

Switch P 1 is turned-on in its downward position (to KPU -- in position "Control of Bombing"). Just before bomb release, the KPU is switched on by pressing button "Start" VI. Current is admitted

through contacts K 5, switch P 1 and contacts K 4 to lamp L 3 ("Ready for Control of Bombing"). This lamp will glow only if contacts K 4 are closed, and this will occur if the electromagnet of ESBR 284 (fig 29) is de-energized and pawl 324 has entered recess "a". Current will also be admitted through contacts K 5 to motor M 1. 50X1

When the motor of KPU operates, gear 257 rotates at constant rpm. Pawl 324 holds cam washer 286 from rotation.

At the instant of pressing the bomb-release button (for 0.2 to 0.3 sec), electromagnet 284 operates, pawl 324 releases cam washer 286, which begins to rotate with gear 257, contacts K 4 open and lamp L 3 goes out.

After a certain period, depending on the position of bracket 323, which is set by the yellow index on the dial, the projecting part of cam washer 286 will close contact K 2.

The current will pass through closed contact K 2 and along wire 2 to relay winding OR 1 which in turn will connect camera motor for continuous operation.

Cam washer 286, while rotating, will hold contacts K 2 closed for 25 sec while the protruding part of the washer passes over the plate of contacts K 2. During this time lamp L3 will flicker indicating advancment of the film. Then the cam, after a complete turn, will return to initial position and will be held there by pawl 324, when the latter enters recess "a".

Lamp L 3, which had momentarily stopped flashing, begins to glow again. During 25 seconds of continuous operation of the camera it will take approximately 12 to 13 pictures, of which 2 to 7 will be taken prior to bomb explosion and 10 to 6 after explosion.

Operation of mechanisms in preparation for next photographing cycle is carried out in the same sequence. During the operation of KPU in this mode, the swing lever 304 will close the contact plates of contact K 1, however the current will not flow through them since the contact K 1 in this case will be still disconnected.

After completion of photographing it is necessary to disconnect the command instrument or to set the dial into position " ∞ " so as to prevent wear of the instrument mechanisms.

When contact K 4 is closed during bombing control, the current would flow through wire 3 to contact K 7 in the cassette if selenium rectifier V_n were not present.

50X1

If the cam for electric signalling of film advance (located in the cassette) would have been in position at which contacts K 7 were closed, then current would have passed to winding OR 1 and would have actuated the drive motor, thus upsetting the coordinated performance of camera AFA-33M.

Rectifier V_n incorporated in KPU will not conduct current in this direction, but will pass the dc current from K 7 to KPU unhindered.

C. Individual Photographs and Continuous Operation

Individual photographs are taken by pressing button K_n.

Setting dial is placed in position " ∞ ". The middle plate of contact K 5 in this case (according to diagram) is connected to the top plate. Normally, the middle plate of KPU is connected to the lower plate.

Thenthe current is admitted to the first wire when switch V 1 is turned off (button on KPU "Stop" is pressed). Now the KPU motor does not operate. By pressing down the button K_n wires one and two are connected and current is then admitted to winding OR 1 of the camera; now the camera begins to operate. When the button K_n 1 is released the wires one and two remain connected only through contact K 6 which will open at the end of the camera cycle.

Switching-on for continuous mode of operation is effected by switch V 3 which is connected in parallel with button K_n.

The setting dial is placed in position " ∞ ".

15. INTERCONNECTION BETWEEN PARTS OF AERIAL CAMERA AFA-33/50M, AFA-33/75M and AFA-33/100M

Since the mechanisms of power transmission to the shutter and cassette are fundamentally identical for all types of AFA cameras (fig 9, 10), the interaction of the assembly components is also almost identical, with an exception that cameras AFA-33/75M, AFA-33/50M and AFA-33/100M, which are equipped with "Louver" shutter have over the lens inside the camera a safety cover.

At the instant when the film is being advanced in the cassette, in the lens section of the camera the shutter is being cocked and the lens cover opened.

When the table in the cassette is fully lowered over the attached frame and the film pressed by the table to the frame, then the lens covers will be fully open and the shutter ready for operation.

When the winding gear 58 of the shutter and release cam 122 have been turned through a certain angle (fig 9, 10), the release cam shifts upper lever 133 to the side and thus releases the oscillating lever 131 of the shutter (fig 17).

The latter under the action of spring 128, actuates the shutter, i.e., exposes a picture frame.

Simultaneously with the operation of the shutter the contacts will be closed in the camera section, which will switch on for a certain period of time the lamps of recording instruments (clocks, levels and counter) so that their readings can be recorded on the film. After operation of the shutter, cam 288 will close contact 289 K 9 (fig 36) and transmit a current pulse to the oscillating camera mounting. If camera AFA-33M is mounted on AKAFU-33 mount and is connected to it by an electric cable, then the motor of AKAFU-33 mount begins to operate and to oscillate the camera frame with the camera (continuous operation of the camera).

During further movement transmitted from distributing mechanism of the camera to the cassette and shutter the lens covers in the lens portion of the camera will close under the action of springs 69 and 70. Now eccentric 231 begins to rotate and the table, under the action of spring 234, rises to its initial position. The rest proceeds in a manner similar to that with camera AFA-33/20M. Electric heater of KPU is turned on by switch V 2 (fig 36) when camera AFA-33M has to operate at temperatures between -15°C to -60°C. The clock and shutter heaters are turned on automatically by thermostat TR 1 when the temperature drops between +3° to + 13°C.

16. INTERCONNECTION OF AKAFU-33 PARTS WITH AERIAL CAMERA AFA-33M (fig 36a)

To ensure proper performance of camera AFA-33M all the units of KPU_2, the camera AFA-33M, the drive and blower assemblies are connected to each other by an electric cable (from AFA-33M assembly). The camera mount AKAFU motor is connected to electric cable through an intermediate cable which is part of the AFA-33A assembly.

In the given variant the electric cable AKAFU-33 and the control panel are not used in the circuit. In this case KPU_2 performs the functions of a control panel, which is part of AFA-33M assembly.

The smallestinterval set on KPU_2 when operating with AFA-33M and AKAFU-33 should be not less than 4 sec. AKAFU-33 in conjunction with AFA-33M can execute three types of photography:

50X1

Plane photography (one-strip)
Two-strip photography
Three-strip photography

Switching of AKAFU-33 to a desired type of photography (number of strips) is carried out with the aid of switch P3 mounted on the motor housing of AKAFU-33. Position of switch P3 knob for two-strip or three-strip operation is marked by labels placed on the housing of AKAFU-33 motor.

1. One-strip Photography
(fig 36a)

To bring AKAFU-33 from any position to one-strip position it is necessary to set the P_2 switch on KPU_2 into position "Off".

When the common switch of the command instrument V_1 is turned on, the current from power line will travel along wire 9 through fuse PR_1, through switch V_1, through switch P2 (point A), through contact K_{11} (in AKAFU-33) to winding OR_2. The relay will now operate and close contact K_{14}, so that the motor will operate until the cam by its sector will break contact K_{11}. The cam sector is set in such a position that the breaking of contact K_{11} takes place before the oscillating frame reaches a horizontal position. The frame of AKAFU-33 together with mounted on it camera AFA-33M will continue to move (due to inertia of the motor armature) for a certain time after opening of contact K_{11} until it stops in an exactly horizontal position. Now the optical axis of camera will be directed vertically.

When the contact K_{11} is broken, current will stop flowing through relay OR_2 winding and the relay will switch the contact; now the motor will stop. The frame of AKAFU-33 now remains in this position.

2. Two-strip Photography
(fig 36a)

To switch AKAFU-33 to the two-strip operation it is necessary to place the knob of switch P 3 in position S (two-strip photography). After this set the AKAFU switch on KPU_2 in position "On" (P_2 of point V). Then press button "Start" on the command instrument, thus turning on the common switch V_1. Now the current through contacts K5 will be admitted to motor M_1 of KPU2. Passing through a system of rpm regulators R_1 and K_3 the current is admitted to neutral wire 4.

Now the motor, through a system of gears and levers, will close contacts K_1 and send a current pulse to the camera. This is followed by an operating cycle of camera AFA-33M. At the end of the cycle, i.e.,

after operation of the shutter, camera contacts K_9 close and send a current pulse along wire 7 and through switch P_2 set in position V to KPU2; along wire 8 to relay winding OR_2 of the AKAFU-33. Relay OR_2 is now actuated by this current and switches over contact K_{14}, thus turning on the motor of AKAFU-33 which begins to supply power at the output shaft. When the output shaft begins to rotate, the two-strip photography cam with its sector will recede from the spring of contact K_{12}. 50X1

Now contacts K_{12} will close and the current from command instrument will pass to AKAFU-33 along wire 1 through switch P 3 (type of photography), which is set in position S (two-strip photography), and further through contacts K_{12} along wire 7 to the command instrument. At this instant the current pulse from the camera contacts K_9 has not yet ended, so that there will be two parallel circuits. The first circuit consists of wire 1, circuit of camera pulse contact K_9 and wire 7. The second circuit consists of wire 1, switch P3 circuit, point S (for two-strip photography), contacts K_{12} and wire 7. The duration of simultaneous operation of both circuits is determined by required value of time overlap for transmitting a pulse from camera contacts K_9 to the beginning of closing of two-strip photography contacts K_{12}.

The time overlap, i.e., the instant of simultaneous operation of the two circuits, is needed to avoid a dead position, which is possible in the case when the current pulse from camera contacts K_9 will end before the AKAFU-33 cam has receded from the spring of contacts K_{12}.

When contacts K_{12} are closed the current will travel through the second circuit and then along wire 7 to KPU through switch P_2 set in position V, then along wire 8 to relay winding OR_2 of AKAFU-33; as a result of this current will be admitted to the relay winding of AKAFU-33 even after the pulse from the camera has ended. The driving pin on the crank, while rotating, will carry along the connecting rod, which in turn will force the oscillating frame with the aerial camera to move from one extreme position to another extreme position. At this instant the contacts K_{12} open. Now the relay winding OR_2 becomes de-energized and its contact K_{14} is switched over in such a manner that the armature of the AKAFU-33 motor is shorted and the motor stops.

When next pulse arrives at the relay winding OR_2 the oscillating frame will return to the initial extreme position.

Thus, to each pulse supplied to the AKAFU-33 relay there will correspond a shifting of the oscillating frame from one extreme position to another, with an appropriate delay during which one picture frame is exposed.

3. Three-strip Photography (fig 36a)

For switching of AKAFU-33 to three-strip photography, set switch P_3 into position D (three-strip photography), then turn on the AKAFU-33 switch on KPU_2 (P_2 point V) and finally press button "Start", which in

turn connects common switch V_1 of KPU_2. When the switch V_1 is turned the command instrument comes into action and transmits through its contact system a pulse to AFA-33M. The latter, after completion of the operating cycle, will send from contacts K_9 a current pulse through wire 7 and switch P_2 (point V) to the command instrument and to winding OR_2 of the AKAFU-33 motor. The relay now will switch on the motor. Torque of the motor is transmitted to the output shaft through a worm gear. The three-strip photography cam rotating together with the shaft will disengage its sector from the contact K_{13} spring, in consequence of which the contact will close. Therefore, current to the relay winding OR_2 will continue to be admitted even after the pulse from the camera has ended. 50X1

The driving pin of the crank while rotating will carry along the connecting rod which will shift in turn the oscillating frame with aerial camera from the middle to the extreme position. At this instant the contacts K_{13} break, the relay OR_2 becomes de-energized and the motor stops.

After operation of the shutter of camera AFA-33M the contacts K_9 will again send a current pulse to the AKAFU-33. The oscillating frame will being to shift from extreme position to the initial position until the first sector on the cam reaches the contact terminal and breaks contacts K_{13}. The motor will now stop, relay OR_2 will stop the inertial movement of the motor shaft and the oscillating frame will occupy the initial extreme position, being ready for the next exposure.

Similarly to the discribed procedure during operation of the AFA-33M shutter, the AKAFU-33 will move from the middle position to the next extreme position (the angle between sector No 2 and No 3 on the first cam is 90°) and then from extreme position to middle position (angle between sectors No 1 and No 2 is 90°). Then the operating cycle of AKAFU-33 repeats again.

APPENDIX TO SECTION50X1

Appendix No 1

Table of altitude ranges at which aerial photographs may be made for various flight speeds and exposure times

For the AFA-33/20M:

Exposure	Flight speed in km/hr												
	200	250	300	350	400	450	500	550	600	650	700	750	800
1/50 sec	2220	2780	3330	3380	4440	5000	5550	6100	6660	7220	7780	8300	8800
1/100 sec	1100	1380	1660	1840	2220	2500	2780	3050	3330	3600	3890	4110	4400
1/200 sec	550	690	830	970	1125	1250	1375	1500	1660	1800	1940	2080	2200

Exposure	Flight speed in km/hr			
	850	900	950	1000
1/50 sec	9400	10000	10400	11100
1/100 sec	4700	5000	5250	5500
1/150 sec	2370	2500	2630	2800

For the AFA-33/50M:

Exposure	Flight speed in km/hr											
	200	250	300	350	400	450	500	550	600	650	700	750
1/75 sec	3700	4620	5550	6480	7400	8330	9250	10180	11100	12030	-	-
1/150 sec	1850	2500	2750	3250	3700	4150	4625	5090	5550	6000	6500	6900
1/300 sec	925	1160	1375	1625	1850	2080	2300	2550	2775	3000	3250	3460

Exposure	Flight speed in km/hr				
	800	850	900	950	1000
1/75 sec	-	-	-	-	-
1/150 sec	7400	7850	8330	8780	9200
1/300 sec	3700	3900	4170	4400	4650

50X1

For the AFA-33/75M:

Exposure	Flight speed in km/hr											
	200	250	300	350	400	450	500	550	600	650	700	750
1/75 sec	5550	6900	9330	9720	11100	-	-	-	-	-	-	-
1/150 sec	2780	3470	4160	4860	5550	6250	6940	7640	8330	9030	9720	10400
1/300 sec	1390	1740	2360	2420	2780	3120	3470	3820	4160	4500	4880	5520

Exposure	Flight speed in km.hr				
	800	850	900	950	1000
1/75 sec	-	-	-	-	-
1/150 sec	11100	11800	-	-	-
1/300 sec	5550	5900	6250	6600	6950

For the AFA-33/100M:

Exposure	Flight speed in km/hr											
	200	250	300	350	400	450	500	550	600	650	700	750
1/75 sec	7400	9250	11100	-	-	-	-	-	-	-	-	-
1/125 sec	4540	5680	6800	7950	9090	10230	11360	12500	-	-	-	-
1/200 sec	2770	3470	4170	4860	5550	6250	6850	7640	8330	9030	9720	10500

Exposure	Flight speed in km/hr				
	800	850	900	950	1000
1/75 sec	-	-	-	-	-
1/125 sec	-	-	-	-	-
1/200 sec	11100	11800	12500	-	-

50X1

Appendix No 2

Table of Light Filter Factors

Designation and Filter Color / Type of Film	ZhS-18	OS-14	KS-14
Domestic Panchromatic Aerial Photography Film	1.7 ± 0.2	2.7 ± 0.4	7 ± 1

Appendix No 3

Parts List, Weights and Dimensions

Components of the AFA-33/20M, AFA-33/50M, AFA-33/75M, and AFA-33/100M cameras come in two boxes (see Figures 40, 41, and 42).

The complete set for the AFA-33/20M camera includes:

Part No	NAME	Quantity
1	2	3
1	Camera with cone, objective lens unit, clock, lens cover, and light filters ZhS-18, OS-14, and KS-14	1
2	Film holder with two spools	1
3	Command instrument with dovetail mounting plate	1
4	Drive and air pressure assembly	1
5	Cardan shaft	1
6	Electrical cable	1
7	Electrical cable	1
8	Flexible hose	1
9	Drive handle	1
10	Film holder handle	1
11	Key to film holder	2
12	Attachment for opening slide plate	1
13	Camera cover	1
14	Nipple	1
15	Contact with brush	1
16	BP-20 safety fuse	6
17	Universal spanner wrench	1
18	Spring for mount	4
19	Can with non-freezing 2TsKPa lubricant (70 g)	1
20	Punch	1

1	2	
21	Can with 1TsKP lubricant (20 g)	1
22	Can with GSA lubricant (20 g)	1
23	Brush for MA-40A electric motor	4
24	Spring for MA-40A electric motor	4
25	Brush for MU-010 electric motor	2
26	Cover for MU-010 electric motor	2
27	Wrench (for round nuts)	1
28	Aircraft electric bulb, 26 v, 5 w	8
29	Miniature bulb, 26 v, 0.15 a or 0.12 a	10
30	Cloth, 30 cm x 15 cm	2
31	Film holder box with carrying board	1
32	Box for complete set	1
33	Description of the AFA-33M	1
34	Data card (log)	1
35	Description for MA-40A	1
36	Certificate for MA-40A	2
37	Certificate for MU-010	1
38	Certificate for clock	1

The complete set for the AFA-33/50M, 75M and 100 M cameras includes:

Part No	NAME	Quantity
1	2	3
1	Camera with cone, objective lens unit, clock, lens cover, and light filters ZhS-18, OS-14, and KS-14	1
2	Film holder with two spools	
	for the AFA-33/50M	1
	for the AFA-33/75M	1
	for the AFA-33/100M	1
3	Command instrument with dovetail mounting plate	1
4	Drive and air pressure assembly	1
5	Cardan shaft	1
6	Electrical cable	1
7	Electrical cable	1
8	Flexible hose	1
9	Drive handle	1
10	Film holder handle	1
11	Key to film holder	2
12	Attachment for opening slide plate	1
13	Camera cover	1
14	Nipple	1
15	Contact with brush	1
16	BP-20 safety fuse	6

1	2	50X1
17	Universal spanner wrench	1
18	Spring for mount	4
19	Can with non-freezing 2TsKPa lubricant (70 g)	1
20	Punch	1
21	Can with 1TsKP lubricant (20 g)	1
22	Can with GSA lubricant (20 g)	1
23	Brush for MA-40A electric motor	4
24	Spring for MA-40A electric motor	4
25	Brush for MU-010 electric motor	2
26	Cover for MU-010 electric motor	2
27	Wrench (for round nuts)	1
28	Aircraft electric bulb, 26 v, 5 w	8
29	Miniature bulb, 26 v, 0.15 a or 0.12 a	10
30	Electrical cable	1
31	Cloth, 30 cm x 15 cm	2
32	Film holder box with carrying board	1
33	Box for complete set	
	for the AFA-33/50M	1
	for the AFA-33/75M	1
	for the AFA-33/100M	1
34	Description of the AFA-33M	1
35	Data card (log)	
	for the AFA-33/50M	1
	for the AFA-33/75M	1
	for the AFA-33/100M	1
36	Description for MA-40A	1
37	Certificate for MA-40A	2
38	Certificate for MU-010	1
39	Certificate for clock	1

The film holder with two spools and film, the camera with objective lens unit, and the command instrument, drive and air pressure assembly, Cardan shaft, flexible hose, electrical cables, light filters, and clock comprise the flight set for the AFA-33M (see Figures 1, 2 and 3).

Variant	Flight Weight, kg	Stowage Weight, kg	Packaged Weight, kg
AFA-33/20M	not more than 72	not more than 140	not more than 185
AFA-33/50M	not more than 80	not more than 150	not more than 235
AFA-33/75M	not more than 85	not more than 155	not more than 250
AFA-33/100M	not more than 95	not more than 165	not more than 285

50X1

Over-all dimensions of the camera with mount (mm):

AFA-33/20M	(620 x 773) x 570 x 510
AFA-33/50M	(765 x 950) x 745 x 815
AFA-33/75M	(765 x 950) x 745 x 845
AFA-33/100M	(765 x 950) x 745 x 1075

NOTE: Dimensions in parentheses are those of the minimum and maximum width of the camera mount which is achieved by extension of the angle plates (when using the factory-supplied camera mount).

Over-all dimensions of the command instrument (mm):

180 x 190 x 123.

Stowage dimensions (mm):

Variant	Camera Box	Film Holder Box
AFA-33/20M	767 x 477 x 852	512 x 310 x 602
AFA-33/50M	672 x 621 x 812	"
AFA-33/75M	672 x 621 x 812	"
AFA-33/100M	682 x 613 x 982	"

Package dimensions (mm):

Camera Box			
AFA-33/20M	AFA-33/50M, 75M	AFA-33/100M	Film Holder Box
915 x 590 x 1042	800 x 725 x 980	822 x 720 x 1160	652 x 412 x 780

50X1

SECTION TWO

INSTRUCTIONS ON OPERATION AND TECHNICAL SERVICING OF THE AFA-33M AERIAL CAMERA

I. Basic Regulating and Technical Data

The AFA-33M aerial camera must possess the following basic adjustment and technical characteristics:

1. The camera must operate reliably at a voltage of 26 v ± 10%.

At 23.4v the end of the cycle should occur with the film holder table in the extreme uppermost position. Continuous operation should not be observed at 28.6v. The duration of the operating cycle should not exceed 2 sec at a voltage of 26v and temperatures from +15° C to +25° C.

2. Current consumption of all units of the camera with the KPU electric heater, clock recorder heater, and shutter heater turned on for the AFA-33/20M, 50M, 75M, and 100M cameras should not exceed 13.5a at a voltage of 26v and temperatures from +15° C to +25° C. Current consumption at a temperature of -60° C with electric heaters on should not exceed 16a.

3. A 20 ampere fuse must be installed in the aircraft electrical network which supplies the camera.

4. The electric motors of the camera and the air pressure unit should operate at 9500 rpm ±10% at 26v and under rated load, while the no-load current of the motors should not exceed 2.2a.

The KPU_2 electric motor must operate at 8700^{+750}_{-500} rpm (without regulator at 26v and the rated load moment of 40 gcm.

5. True shutter exposure times must lie within the following limits:

a) Iris shutter in the AFA-33/20M

At 1/50 sec	from 1/42	to	1/72 sec
At 1/100 sec	from 1/87	to	1/133 sec
At 1/200 sec	from 1/167	to	1/250 sec

50X1

b) Louver shutter in the AFA-33/50M and AFA-33/75M

At 1.75 sec	from 1/65	to	1/94 sec
At 1/150 sec	from 1/130	to	1/188 sec
At 1/300 sec	from 1/261	to	1/375 sec

c) Louver shutter in the AFA-33/100M

At 1/75 sec	from 1/65	to	1/94 sec
At 1/125 sec	from 1/104	to	1/156 sec
At 1/200 sec	from 1/167	to	1/250 sec

6. Mechanical adjustments of the AFA-33M camera must correspond to the following table:

No	Name of Element Subject to Mechanical Adjustment	Mech. Adjust. in Revolutions of Manual Drive
1	Exposure	0
2	Closing of Protective Covers	not less than 0.25
3	Beginning of Closing of AKAFU pulse contacts	0.5 - 1.5
4	Extinguishing of Lights of Recording Instruments	not more than 1.0
5	Separation of Table From Detachable Frame of Camera (Beginning)	0.5 - 1.5
6	Beginning of Film Advance	1.25 - 2.50
7	End of Film Advance	7.25 - 8.50
8	Beginning of Opening of Protective Covers	not later than 9.0
9	Pressing of Table Against Frame (at Pressure of 130 mm H_2O for AFA-33/50M, 75M, 100M, and 110 mm H_2O for AFA-33/20M)	8.5 - 9.3
10	Beginning of Illumination by Lights of Recording Instruments	not earlier than 9.0
11	Exposure	10.0

NOTE: The mechanical adjustment of each camera must ensure the absence of any overlapping of adjacent elements of the cycle with the exception of elements 2 and 3 above.

7. The cam of the contacts which interrupt the operating cycle of the camera must be adjusted so that the cycle terminates at that moment when thetable of the film holder is in the extreme uppermost position.

50X1

8. The cam of the recording instruments contact must provide a normal image density of the clock, level, and counter on panchromatic aerial photographic film with a sensitivity Sd 0.85 = 400°, 600°, and 800°. The intensity of the lights of the recording instruments may be adjusted by means of a rheostat.

9. The cam of the AKAFU camera mount must permit adjustment of the duration of the current pulse from 1.25 to 2.5 revolutions of the camera handle.

10. The camera mechanism must be assembled in such a manner that, beginning with the moment of contact between the film holder table and the detachable frame of the camera, the rod of the table drops 1-2 mm due to the action of the eccentric.

11. No jerking or seizing motion is permitted in the operation of the mangle gear transmission.

12. The gluing on the film holder table must be level and tight.

13. The slide plate of the film holder must move freely in the guides without jerking or seizing.

14. The shutter should operate at the moment the protective covers are beyond the field of view of the lens system.

15. Pressure in the camera chamber must be at a maximum but not less than 130 mm H_2O for the AFA-33/50M, 75M, and 100M and 110 mm for the AFA-33/20M at temperatures from +15° C to +25°C and a voltage of 23.4v.

16. The end sleeve of the film holder should not become disengaged during operation of the AFA-33M camera.

17. The thermostat should switch on at temperatures from +3° C to +13° C and should switch off at temperatures from +20° C to +30° C.

18. The centrifugal governor of the electric motor for command instrument KPU_2 must provide a constant number of revolutions equal to 7500 rpm ±5% at a line voltage of 26 v ±10%.

19. Deviations of the actual time intervals between exposures from the rated time intervals at a voltage of 26 v and temperatures from +15° C to +25° C must not exceed the limits noted in the following table:

50X1

3 sec ±0.4 sec for an average of 10 cycles
5 sec ±0.5 sec for an average of 10 cycles
20 sec ± 3 sec for an average of 5 cycles
60 sec ± 5 sec for an average of 3 cycles

20. The setting dial of the command instrument must turn freely by hand but must not change its position during the operation of KPU_2.

21. The closing time of the contacts of command instrument KPU_2 which supply the current pulses to the camera must lie within limits of 0.3 to 0.7 sec.

22. The resolution of the AFA-33M must be no less than that given in the log.

23. There should be no short-circuits in any of the electrical wiring of the AFA camera unit.

24. The camera takes 190 photographs with a size of 30 x 30 cm and a spacing between photographs of 10 to 25 mm.

25. The gap between open contacts must be no less than 0.5 mm, and the surfaces of the closed contacts must be flat and parallel.

26. The following are mutually interchangeable parts of the AFA-33M:

a) Film holder.

b) Command instrument KPU_2.

c) Drive and air pressure units.

d) Electric motors of the drive and air pressure units.

e) Spools.

f) Electrical cables.

g) Drive handles of the camera unit and film holder.

h) Electric bulb holders.

i) Keys for the film holder.

j) Board for carrying the film holder.

k) Dovetail fitting of KPU_2.

50X1

l) Flexible hose.

m) Cardan shaft.

n) Electric motor MU-010 of command instrument KPU_2.

o) Light filters (only within their own camera variant).

27. Operation of the AFA-33M from the ESBR [electric bomb release] button:

The command instrument should provide for operation of the aerial camera from the ESBR button when the latter is pressed for a period of time between 0.2 and 0.3 sec.

When the 30 sec mark inscribed on the dial of the KPU_2 is placed opposite the yellow index mark ("T bomb"), the cam washer should switch the camera to continuous operation after a period of 20 sec $\pm$ 2 sec from the moment the ESBR button is pressed.

The duration of continuous operation of the camera should be 25 $\pm$ 2 sec.

50X1

II. INSTRUCTIONS ON OPERATION AND TECHNICAL SERVICING

1. Preliminary Checking.

Prior to using a newly received aerial camera the following should be checked:

1. Check whether all parts of the aerial camera are present according to the list.

2. Remove the protective grease, examine the external apperance of the equipment and check the operation of the mechanisms.

3. Check the mechanical alignment of the AFA camera.

4. Check the air pressure in the camera during exposure.

5. Test the performance of the camera with current on.

If the aerial camera was in storage for more than one year, then the ball bearings of electric motor MA-40A should be lubricated with GSA. Lubrication should be carried out according to instructions presented in the description of electric motor MA-20A.

For lubrication the reduction gear and the blower motors MA-40A should be removed from their cups (housings).

The presence of all parts of aerial camera in packing boxes is checked by comparing with the list attached to the box covers.

Examination of external appearance:

1. Be sure that there are no external damages to the protruding parts of the aerial camera.

2. Be sure there are no cracks or chipping on parts made of plastic.

3. Check for cleanness inside the cassette and camera, and for the absence of foreign objects in the camera mechanism.

4. Check cleanness of the lenses.

To check the performance of the camera mechanisms, connect all of the parts in the following manner:

50X1

a) Connect the Cardan shaft to the reduction gear of the drive assembly and to the input shaft of the camera actuating mechanism.

b) Connect the flexible hose to the nipple of the air blower of the drive and blower assembly, and to the camera nipple.

c) Connect the two parts of the electric cable.

d) Connect the cable plugs to the command instrument, to the camera, and to the drive and blower assembly.

e) Connect the cable plug (connected to ESBR) to the socket of the command instrument.

f) Press red button "Stop" on the command instrument, set all the switches in lower position, set the command instrument counter into zero position. Then connect the power supply plug to the 26-v, dc power source.

NOTE: The thick pin of the supply should be connected to the positive terminal.

The performance of the AFA mechanisms is checked in the following manner:

a) Pull the sliding locks all way out, remove the safety cover from the camera attached frame.

b) Set the command instrument dial on the interval 5 to 7 sec.

c) Press the green button "Start".

d) Check during operation if the red lamp is glowing, whether the exposure counter of the command instrument works properly; check whether air is supplied to the camera, whether the shutter and the lens safety covers operate properly (in AFA-33/50m, 75M, 100M) and whether the recording instruments become properly illuminated during the shutter operation.

e) If testing of the AFA camera is carried out with the oscillating mount AKAFU-33, then it is necessary to connect the intermediate electric cable. Now connect appropriate switches on the command instrument and check its performance and signalling (yellow lamp).

f) Set the setting dial in position "∞" and check the performance of camera AFA with the aid of button for single exposures and for the continuous operating mode.

g) With the yellow index on the dial ("T bomb") set at 30 sec, set the 50X1
switch in position "Control of Bombing" and press green button. After the green lamp at the end of electric cable leading to the electric release starts to glow supply a short 26-volt pulse. Check the camera for continuous operation 20 sec after the supply of the pulse and turn it off after 25 second of continuous operation.

It is possible that the camera mechanism might stop in such a position that the safety cover stays open and the last frame becomes exposed.

It should be remembered that turning-on of the switch "Control of Bombing" should be made only after setting the yellow index ("T bomb") opposite a graduation or number of the dial corresponding to estimated time of the bomb fall prior to impact, which, however, should not exceed 60 sec.

After completion of the indicated tests press the red button, insert the cassette load with an exposed film into the camera and remove the cassette cover. Check the camera operation with the aid of the crank and observe the advance of the film. Set the setting dial at an interval of 5-7 sec and set the switch into lower position, then press the button "Start".

During the operation observe the advance of the film, the signalling lamp of the command instrument and the rising and lowering of the table. Pay special attention to the operation of the command instrument counter. If the oscillating camera mount is in use check its performance; also check whether the switch on KPU is properly set for the oscillating mode and continuous photographing.

The proper sequence of performance of the aerial camera components during the operating cycle is checked in the following manner:

a) disconnect the Cardan shaft from the camera input shaft and the reduction gear of the drive assembly;

b) connect to the camera input shaft the manual drive;

c) remove the cassette;

d) rotate slowly clockwise the manual drive lever until the shutter operates (as determined by the click).

50X1

Count the number of turns of the manual lever from the instant of shutter operation till the closing and the beginning of opening of the safety cover. The instant of closing and opening of the safety cover is determined visually. Then load the cassette with an exposed film and place it in camera with cover removed. The mechanism is now brought into action by the drive lever.

Count from the instant of shutter operation the number of turns of the drive lever up to the instant of separation of the table from the attachable camera frame; count from the beginning of film advance and the end of advance to the instant the table firmly presses against the frame.

The measured number of turns of the drive lever should be within the limits indicated in the table on page 44.

After indicated checking do the following:

a) load the camera with 3-5 m of unexposed film;

b) set the rheostat handle with its index opposite a number on the dial corresponding to the sensitivity of the aerial film loaded;

c) interconnect all the components and take 8-10 ground exposures;

d) develop the exposed film in a manually operated developing device using fast developer for 8-10 min.

If the image density of the recording instruments does not differ considerably from the density of the rest of the film, then the cams of recording instruments are properly adjusted. Checking the contacts of the AKAFU mount is carried out with the aid of test lamp. For this it is necessary to:

a) connect one end of the electric-lamp wire to the fourth receptacle of the socket of the AKAFU cable and the second end to the first receptacle.

b) rotate the camera lever and count the number of turns at which the pulse contacts open and close, i.e., the lamp goes on and off. The number of turns should be within the limits indicated in the table on page 44.

Checking the adjustment of the switch-off contacts with the RDT of the camera motor is carried out in the following manner:

a) set an interval of 3 sec on the command instrument and connect the aerial camera for operation;

b) at the end of each cycle see that the cassette table is in the extreme upper position and the table-position indicator is over the inscription "Clear". 50X1

To check the air pressure in the camera remove the screw from trunnion 11 and screw in a nipple supplied in the spare part kit (ZIP) which is a part of the AFA-33M assembly. Connect to this nipple the rubber hose of a water manometer, place the cover over the cassette and pull out the sliding plate. Then set the interval disk of the command instrument in position "∞", turn on the general switch and rotate the manual drive up to the instant of the shutter operation.

At the instant of the shutter operation stop the rotation of the manual drive and measure the pressure as indicated on the water manometer. The difference in height of the water columns of the right and left tubes at a voltage of 23.4 v should be not less than 130 mm for cameras AFA-33/50M, 75M, and 100M, and not less than 110 mm for camera AFA-33/20M.

NOTE: In taking the pressure measurements sharp bends of the rubber hose should be avoided.

If these preliminary tests gave positive results then it is necessary to check the camera performance in actual operation by taking 5-10 pictures.

50X1

2. Pre-Flight Preparation of the AFA.

Installing the AFA in the Aircraft

The aerial camera is installed in the aircraft as follows:

a) Open the catches on the hinged clamps of the camera mount.

b) Set the trunions of the camera in the receptacles of the mount so that the drive head is on the right when looking in the direction of flight.

c) Close the hinged clamps of the camera mount.

d) Tighten the thumb screws which holds the camera trunion to the frame of the camera mount.

e) Using the hinged level of the camera and the set screws on the camera mount, set the focal plane of the camera in a horizontal position and then return the level to its position in the camera.

f) Mount the drive and air pressure assembly on the camera mount or on a bracket.

In the event that the drive and air pressure assembly is not mounted on regular mounting surface but in some other area, it will be necessary to loosen the screws which hold the reduction gear unit 309 (Figure 32) and turn the unit so that the bayonet sockets for the Cardan shaft are parallel. In this case the angle between the axes of the Cardan shaft and the bayonet sockets must be no more than 30°.

g) Place the command instrument on the dovetail mounting.

h) Remove the lens cover.

i) Wipe the lens and light filter with a flannel cloth.

j) Place the appropriate light filter on the lens.

Connect all parts of the camera as shown in the section "Preliminary Preparation."

Do not permit sharp bends in the rubber hose when connecting it to the respective openings. If necessary connect the ESBR electrical cable to the command instrument and the ESBR.

Placing the film holder on the camera

50X1

Pull out the lock bars as far as possible and remove the top protective cover from the camera unit.

Unfasten the film holder from its carrying board and place it on the camera.

The guide pin of the camera will connect with the drive head of the film holder automatically.

NOTE: If there is difficulty in mounting the drive and air pressure assembly due to design peculiarities in the aircraft or mounting area, the blower housing may be turned 90° in either direction.

This is done as follows:

a) Loosen the screws holding the blower housing and remove it.

b) Unscrew the nut from the shaft of the electric motor and remove fam 31 (Figure 31), being careful not to damage the blades.

c) Unscrew the four countersunk screws and turn the housing of the blower 90° in either direction.

Reassemble the blower in the opposite sequence.

When replacing the upper half of the housing make sure that it is pressed against the sealing ring; otherwise, a leakage of air may occur.

After performing the above adjustments, test the operation of the blower with the camera by connecting all parts with the electrical cable and connecting the apparatus to the 23.4 v power supply network.

The pressure must be not less than 130 mm H_2O in the AFA-33/50M, 75M, and 100M camera and not less than 110 mm in the AFA-33/20M.

Listen to the fan to check whether or not it is operating; the fan must not brush against the blower housing as it turns.

After performing the above work and tests, the responsible person should make the appropriate entry in the log.

After placing the film holder on the camera unit, close the lock bars. Open fully the slide plate of the film holder. 50X1

When the slide plate is fully open the four red marks (two on the slide plate and two on the slide plate guide) should form a straight line.

The following procedure is required when the camera has been installed in the aircraft:

1. Perform an external inspection of all components and parts of the photographic equipment and check the tightness of the attachments.

2. Check that parts of the camera do not come into contact with parts of the aircraft. Particular attention should be devoted to checking that parts of the camera and camera mount do not touch the cables and control linkages of the aircraft.

3. Check the operation of the control elements for the camera ports. If the ports do not have remote control, the doors (covers) must be opened before taking off.

4. Check the rating of the fuse in the camera's electrical circuit.

5. Set the desired exposure.

6. Set the index mark on the rheostat handle opposite the number corresponding to the sensitivity of the film.

7. Set the proper time interval on the command instrument in accordance with the photography mission.

8. Open the slide plate of the film holder, wind the clock and place it in the camera.

9. Set the counters on the camera and the command instrument to zero.

10. Test the operation of the camera by taking two to three photographs.

50X1

When doing this, check the following:

a) advance of the film and operation of the signal light on the command instrument;

b) operation of the shutter by direct observation at the side of the lens or by listening;

c) operation of the AKAFU camera mount.

Before take-off for a photography mission the navigator is required to inspect the photographic equipment and to check the following:

a) operation of the control elements of the camera port doors. If the ports do not have remote control the doors (covers) of the camera ports must be opened before flight;

b) the presence of the proper fuse in the camera circuit;

c) whether the slide plate of the film holder is open;

d) whether the lens cover has been removed;

e) whether the exposure, the rheostat handle, and the light filter have been correctly set;

f) that the type and quantity of photographic film correspond to the photography mission.

Test the operation of the camera by taking two or three photographs in the presence of the photo technician or the aircraft mechanic.

3. Operation of the AFA Camera in Flight

Switch on the electric heaters in the command instrument while observing the following conditions:

a) In winter with a ground temperature of -15° C and less, the heater should be switched on 15 minutes before using the camera.

b) When the ground temperature has not reached -15° C, the electric heater is switched on during flight when the air temperature has dropped to -15° C and remains on during the entire period of camera operation.

c) The electric heaters for the clock and shutter are switched on automatically at a surrounding air temperature from +3° C to +13° C and are switched off at a temperature from +20° C to +30° C. 50X1

When photographing strips it is necessary to: set the computed time interval on the command instrument and place the switches on the operating mode with the interval; place the switch for the oscillating camera mount in the required position and press the green "PUSK" [start] button when the aircraft approaches the starting reference point.

By means of the signal light periodically check that the film is advancing. Note the number of photographs taken according to the counter on the command instrument, and check the operation of the oscillating camera mount with the signal light. As the aircraft approaches the finishing reference point switch off the camera by pressing on the red "Ostanov" [stop] button. Subsequent strips are photographed in the same sequence given above.

Single photographs may be taken by pressing the button marked for this purpose. The setting dial must be placed on "∞". If it is required that one or several additional photographs be taken during a strip photography sequence, this button may be pressed at the appropriate moment. The button should be depressed for approximately 0.5 seconds.

Photographic observation of bombing results is carried out in the following manner: set the division or number on the dial corresponding to the calculated bomb drop time opposite the yellow index mark ("T-bombs"). Place the switch in the position "Kontrol' bombometaniya" [bombing observation]. Place the switch for the operating mode of the oscillating camera mount in the desired position. The continuous operation switch must be off. Press the "PUSK" [start] button 1.5 - 2 minutes before the bomb is dropped.

Once the ESBR button has been pressed, note the signal light for film advance, the reading of the counter, and the signal light for operation of the oscillating camera mount.

The next bombing approach may be made when the "Gotov k kontrolyu bombometaniya" [ready for bombing observation] goes on.

When the photographing run is finished turn off the command instrument by pressing the red button. If the setting disk is on the mark "∞", set it to some other time interval, switch off the heater, and close the camera port.

50X1

4. Post-Flight Preparation

1. Question the flight crew on the operation of the photographic equipment in the air. Fill out the report sheet. Record in your own work book any malfunctions which were noted in the equipment.

2. Test the operation of the camera (2 - 3 frames) in the presence of the navigator or pilot.

3. Close the slide plate and remove the film holder. Place the protective cover on the camera and the lens cover on the lens.

4. Remove the exposed film from the film holder and send it to be processed.

5. Conduct a detailed external inspection of the photographic equipment and clean off all dirt and dust. Check the following:

a) the condition of the components and parts of the apparatus which are accessible without disassembly of the mechanisms;

b) the attachment of the mounts to the aircraft, attachment of the camera to the camera mount, and the condition of the shock absorbers;

c) the attachment of the command instruments, toggle switches, signal lights, locks, port covers, and other components of the photographic equipment;

d) the condition of the doors (covers) and control elements of the camera ports;

e) the tightness of the electrical cables and plug connectors and the reliability of the cable connections with the command instrument, camera, and other units.

6. Correct all defects which were noted.

7. Load the film holder and place it on the camera.

8. Check the operation of the camera by taking 2 - 3 photographs.

9. Disconnect the camera from the aircraft power supply and loosen the catch springs, having set the camera at maximum exposure. Place the lens cover on the lens and close the camera port.

NOTE: Film holders must be carried between the aircraft and the film loading area carefully in either film holder boxes or on carrying boards. 50X1

5. Unloading the Film Holder

The film holder is unloaded as follows:

a) Unfasten the strap and remove the film holder from the carrying board.

b) Place the film holder on a clean table with the drive mechanism to the right.

c) Open the hinged catches using the key.

d) Remove the cover from the film holder and disconnect the film metering roller.

e) Turn the take-up spool 2 or 3 revolutions and cut the film between the metering roller and the take-up spool.

f) Depress the safety catch and pull out the semi-axis.

g) Remove the take-up spool.

h) Record the date the film was exposed and the name of the navigator on an unused frame at the end of the removed film.

i) Wrap the take-up spool with the film in black paper and insert it in a metal film can.

j) Write the size, type, and sensitivity of the film, the date the film was unloaded from the film holder, the number of the report sheet, and the name of the person unloading the film holder on the can.

6. Loading the Film Holder

The film holder should be loaded in a photo laboratory on a clean, dry bench which is free if extraneous objects which might interfere with the loading.

The film holder is unfastened from the carrying board and its reference plane (base) is placed on the bench so that the drive head is on the right.

If the spool with the film has a safety threading end (leader) the film holder may be loaded in indirect daylight. If there is no leader on the film, loading must be carried out in complete darkness. 50X1

The following steps should be taken after the film holder has been placed on the table:

a) Check that the pointer is opposite the white arc with the inscription "Svobodno" [free]. If the edge of the pointer does not lie within the white arc, set the pointer opposite the middle of the arc by turning the head of the film holder.

b) Open the hinged catches and, by lifting the cover of the film holder upward, remove it from the housing and place it on the bench on the left side.

c) Disconnect the metering roller from the drive.

d) Press the safety catches and pull out the semi-axes as far as possible.

e) Hold the take-up spool in the middle and turn it slightly until the lead pin of the right semi-axis enters the side openings in the spool; then align the left semi-axis with the opening in the spool.

f) Place the supply spool on its semi-axes in the same manner as the take-up spool.

If the threading end of the film has not been prepared, cut the film at an angle with a pair of scissors (at an angle of approximately 45°). The threading end of the film must leave the spool in the direction toward the person loading the film holder.

Grasp the threading end of the film with both hands and pull it out over the guide roller to a length of 30 - 40 cm. Then bend the film around the guide roller and pass it between the spring table and the slide plate until it emerges at the side toward the metering roller.

Pass the end of the film between the press roller and the metering roller. Attach the end of the film to the take-up spool, checking carefully that the film is aligned and that the teeth on the metering roller are engaged in the perforations of the film.

Then, holding the supply spool tightly, turn the take-up spool 1.5 - 2 revolutions. Place the cover on the film holder and lock the catches with the key. Record the following information with a pencil on the record plate (cover of the film holder): type and length of the loaded film in meters (determined by reading the film length counter), the date of loading, and the name of the person who loaded the film holder. 50X1

Place the film holder on the carrying board and tighten the straps.

7. Routine Maintenance

Routine maintenance work on the AFA-33M is subdivided into three groups:

First group -- routine maintenance performed after 1,000 cycles, or once a month.

Second group -- routine maintenance performed after 3,000 cycles, or once every three months. The work performed for this group should include the routine maintenance work of the first group.

Third group -- routing maintenance performed after 6,000 cycles, or once every six months (before summer and winter operations).

Routine maintenance work of the first and second groups are performed simultaneously with work of the third group.

After 1,000 cycles or once a month:

Inspect and clean the command instrument, film holder, camera, drive and air pressure unit, check the tightness of the screws securing the mechanisms. If there are traces of corrosion on metal parts, remove the parts and smear a thin layer of yellow petrolatum on those layers of the parts which do not contact other parts.

Apply a thin layer of special 2TsKP non-freezing lubricant on those areas of the contact surfaces of worm and spur gear drives which are subject to corrosion.

Perform the following maintanance on individual components:

50X1

Command instrument (KPU)

1. Check the turning of the setting dial for seizing or jerking.

2. Inspect and, if necessary, clean the contacts of the command instrument.

3. Inspect the frame counter.

4. Check the tightness of the electric motor mounting.

5. Check the operation of the hinged lever.

6. Check the electrical circuit of the command instrument for short circuits. Before checking, disconnect the wires which connect to ground.

7. Check the operation of the command instrument under current.

Film holder

1. Check the operation of the friction clutches on the axles of the take-up and supply spools using the special accessories and adjust them.

2. Check the operation of the cog gearing for jerking and seizing.

3. Check the condition and smoothness of travel of the slide plate in its guides.

4. Inspect and, if necessary, clean and adjust the signalling contacts of the film advance mechanism.

5. Check the condition of the sealing around the film holder table. The sealing must be flat and tight.

6. Check the operation of the catches which hold the semi-axes of both spools.

7. Check the electrical circuit of the film holder for short circuits.

8. After placing the film holder on the camera, check the reliability of engagement of the end coupling of the vertical shaft by engaging and disengaging it with the slide plate.

Check the reliability of operation of the coupling on the sprocket roller using the manual drive. 50X1

Camera, drive, and air pressure assembly

1. Check for synchronous operation of the shutter and safety covers.

2. Check the electrical circuit of the drive and air pressure assembly for short circuits.

3. Inspect and, if necessary, clean and adjust the RDT contacts which turn on the electric motor, the AKAFU mount, and the recording lights, as well as the moving contacts which signal advance of the film.

4. Check the reliability of connection of the Cardan shaft and the telescoping shafts.

5. Check the condition of the flexible hose.

6. Wash the outer surfaces of the camera lens, the lenses of the recording instruments, and, if necessary, the light filters with refined alcohol and wipe with clean flannel.

7. After performing routine maintenance on the individual components of the camera, check mechanical adjustments of the camera and its operation under current.

[Translator's note: two pages of original document missing.]

. . . should be stored in receptacles in the storage box and removed just before placing them on the lens.

If the camera is to be stored for a long period of time, loosen the springs on the shutter after setting the shutter at maximum exposure. Loosen the spring of the hinged lever in the command instrument after placing the setting dial at the 2-second time interval. If the camera has been subjected to sharp temperature changes, do not remove (wipe off) the moisture which has appeared on its parts, but allow them to dry and then wipe all parts of the camera with a clean dry cloth. The lens should be wiped off only with a flannel cloth.

If the aircraft is to be inactive for a long period of time, the camera must be removed from the aircraft.

50X1

10. Preservation of the AFA-33M for Storage

The AFA-33M camera is preserved for the purpose of protecting the metal parts against corrosion during periods of transport and storage.

Preservation is applied to unpainted surfaces (unfinished surfaces and surfaces with oxide or galvanic coatings).

Preservation guarantees the AFA-33M against corrosion for a period of two years if the following storage conditions are observed:

1. The storage area must be dry and the relative humidity not more than 70%.

2. The air temperature in the storage area must be within limits of +5° C to +25° C.

3. Storage of the instruments near heating furnaces or windows on the sunny side of the building is forbidden.

4. It is forbidden to store acids, alkalies, and other chemical substances which might cause corrosion in the same storage area as the instruments.

After two years from the time of preserving the AFA-33M, it is required that the camera equipment undergo re-preservation. Preservation and re-preservation must be carried out in a dry, dust-free room.

The following preservative substances are used:

1. Yellow petrolatum GOST 3581-47 for application to parts made of steel and brass, with or without galvanic coatings, and units of the spare parts and tools set.

2. Special lubricant 2TsKP (standard factory specifications 0-9) for internal parts and components subject to friction.

Preservative substances must be stored in tightly closed metal, glass, plastic, or porcelain vessels.

There must be no acids, alkalies, or other chemical materials in the room where the preservative agents are stored. The preservative substances must have an OTK [technical inspection section] rating in accordance with GOST standards.

50X1

Preservative is applied to the camera equipment in the following manner: parts to be preserved are wiped with a cotton or gauze pad moistened in aviation gasoline to remove dirt, dust, and grease from the surfaces. In re-preserving the AFA-33M, all parts are first wiped with a clean dry cloth and then with aviation gasoline. The surfaces should not be touched by hand after this.

After the gasoline has completely evaporated, the exterior parts and units should be coated with yellow petrolatum using a soft cloth specially intended for this purpose or a pad of soft material.

The preservative may be applied by two methods:

a) Where it is stipulated below that the parts are to be "rubbed," lubricant is applied with a clean cotton cloth moistened with the appropriate lubricant, using a rubbing method. The lubricant may be applied with a clean, stiff hair brush and then rubbed with a cotton cloth. The lubricant must be applied in a thin continuous layer.

b) Where it is stipulated below that the parts are to be "smeared," the lubricant is applied with a soft hair brush or a pad made of soft material.

The lubricant is applied in a melted state, whereby it is heated on a heater with a covered electrical heating element to a temperature of 45-55° C. The layer of lubricant must be flat, without discontinuities or air bubbles, and should have a thickness of approximately 0.2 to 0.5 mm.

Preservation of instruments before storage is carried out by units (the command instrument, the film holder, the camera and cone, etc.).

A. Preservation of the command instrument

1. All exterior unfinished parts and fastenings are smeared with yellow petrolatum.

2. Lubrication is not applied to the sockets for the plug connectors.

B. Preservation of the film holder

1. Remove the cover of the film holder.

2. The unfinished parts within the film holder should be rubbed with special 2TsKP lubricant.

3. The lever of the film length counter and the fastenings on the inside of the cover should be rubbed with special 2TsKP lubricant. 50X1

4. Close the cover.

5. All exterior unfinished surfaces of parts and fastenings should be smeared with yellow petrolatum.

NOTE: 1. The bottom of the film holder should not be covered with lubricant.

2. Only exterior parts should be subjected to re-preserving. Do not remove the cover.

C. Preservation of the camera and cone

1. Remove the cover from the camera and the hood from the cone.

2. Smear the pins in the lens unit and the screws holding the lens with yellow petrolatum.

3. Smear yellow petrolatum on exterior unfinished parts having galvanic coatings or which are simply polished, and on fastenings.

4. Do not apply preservative to internal parts of the camera.

5. Do not apply preservative to the socket for the plug connector.

D. Preservation of the drive and air pressure assembly

1. Smear yellow petrolatum on exterior unfinished parts having galvanic coatings, and fastenings.

2. Do not apply preservative to the socket for the plug connector.

E. Preservation of light filters

Smear the springs and screws with yellow petrolatum.

F. Preservation of electrical cables

Smear the external fittings with yellow petrolatum.

G. Preservation of ZIP [spare parts and tools] parts 50X1

1. All unfinished metal parts (accessories, wrenches, punches, etc.) should be smeared with yellow petrolatum.

2. ZIP parts which are stored in boxes should be wrapped in clean paper moistened with the appropriate lubricant or in parchment.

H. Preservation of boxes.

All fastenings and locks should be smeared with yellow petrolatum.

After two years from the time of preserving the aerial camera the camera must undergo re-preservation. This is carried out as follows: all exterior metal parts are first wiped with a clean cloth moistened in aviation gasoline.

Upon evaporation of the gasoline preservation is carried out in the manner described above.

Before placing the camera into operation, all exterior parts must be wiped with a dry cloth for the purpose of removing the excess layer of preservative material.

III. Characteristics of Lubricants Used for Preserving the Aerial Photographic Equipment

Physical-chemical properties of yellow petrolatum

1. Dropping point in °C ..... 37 - 50
2. Viscosity at 60° C .....
   a) kinematic ..... not less than 11.0
   b) corresponding conditional viscosity in Engler degrees ...not less than 2.0
3. Acid number in mg KOH per 1 g petrolatum .not more than 0.28
4. Ash content in %% . . . . . not more than 0.03
5. Water content . . . . . none
6. Content of mechanical impurities in %% . . not more than 0.025

7. Content of water-soluble acids and alkalies . . . . . none

50X1

Special lubricant 2TsKPa

Composition: liquid petrolatum MVP 76%

high-melting ceresin 22%

bone oil 2%

NOTE: 1. Solidification point of MVP liquid petrolatum -- not higher than 64°C.

2. Bone oil -- top grade.

Physical and chemical constants

1. External appearance -- Vaseline-like, homogeneous viscous grease.

2. Color -- pale yellow.

3. Dropping point -- 65° C.

4. Water content in % -- none

5. Content of mechanical impurities -- none.

6. Corrosion test -- satisfactory.

7. Content of water-soluble acids and alkalies -- none.

8. Acid number in mg KOH -- not greater than 0.2.

9. Freezing temperature in °C -- not higher than 60.

IV. Malfunctions in the Operation of the Aerial Camera and Their Causes

The following are malfunctions in the aerial camera which cannot be remedied without special equipment:

1. Faulty shutter.

2. Cracked lens (excessive chipping).

50X1

3. Poor image as result of defocusing.

The following malfunctions in the operation of the camera may be remedied in part:

Nature of Malfunction No.	Cause of Malfunction and Sequence for Correction	Order of Eliminating Fault
1	2	3	4
1	KPU motor or camera motors do not operate when equipment is connected to electrical circuit.	a) Faulty fuse b) Faulty electrical cable c) KPU contacts do not close d) KPU motor faulty e) RDT contacts do not close f) Electric motor faulty	replace see page 77 see page 78 see page 78 see page 79 see descrip. of MA-40A
2	With camera connected to electrical circuit, KPU motor operates but pulse is not received by camera	Polarity not observed when connecting into electrical circuit	
3	Operating cycle of camera exceeds 2 sec with 26 v in supply circuit	Faulty electric motor	see descrip. of MA-40A
4	Current consumption of AFA-33/20M, 50M, 75M, and 100M with 26 v in supply circuit exceeds 13.5 a	a) Faulty electric motor b) Electrical wiring grounded c) Jamming of camera mechanisms d) Short circuit in wiring	" see page 79 see page 79
5	On processed film from AFA-33/20M, 50M, 75M, and 100M, one photo is normal and next is overexposed or underexposed, etc.	Faulty shutter	see page 79
6	Mechanical alignment of camera is disturbed	a) Incorrect adjustment of cam which exceeds operating cycle of camera b) Break of key or cotter in kinematic link	see page 80 see page 80
7	Image of clock, level, and counter on photo too dense (cloudy) or faint	Incorrect adjustment of contact cam 43 of recording lights	see page 80

50X1

1	2	3	4
8	When operating with the AFA-33/50M, 75M, and 100M pressure in camera is less than 130 mm H_2O at supply voltage of 23.4 v and less than 110 mm in AFA-33/20M	a) Speed of blower electric motor has decreased b) Camera not hermetically sealed	see descrip. of MA-40A see page 85
9	Light illuminating recording instruments does not go on	a) Lights have burned out b) Contact springs bent	see page 84 see page 84
10	Reduction gear clutch slips when operating camera	Spring of friction clutch in reduction gear is weak	see page 85
11	Loops form in film in front of take-up spool	Friction clutch spring of take-up spool is weak	see page 81
12	Jerking or seizing during transmission of motion by cog gearing	Seizing in ball bearing of film holder transmission gears	see page 81
13	Slide plate jams in guides	Guides damaged; edge of slide plate broken or bent	see page 81
14	Film will not pass under metering roller when loading film holder	Comb guides of film holder are damaged	see page 83
15	End couplings of film holder become disengaged during operation of camera	Teeth of coupling 213 broken	see page 83
16	Semi-axis of spool cannot be released	Seizing in sleeve in center of spool as result of corrosion of semi-axis	see page 83
17	Film length counter does not operate	Lever of film counter is catching in semi-axis	see page 84
18	Catch of metering roller does not operate	Spring of catch lever is broken	see page 84

50X1

1	2	3	4
19	Film advance signal system on KPU does not operate (light does not burn or burns but does not flash)	a) Bulb is burned out b) Signal contact in film holder is faulty	replace see page 81
20	Time intervals of KPU differ from actual measured intervals (more than 11 or less than 9 sec when set at 10 sec)	a) Governor contacts in KPU_2 are out of adjustment or burned out b) Pawl on hinged lever in KPU_2 broken	see page 82 see page 82
21	Light does not burn when switch is in position "Observation of Bombing"	Contacts of electromagnet in KPU are faulty	see page 78
22	Oscillations of AKAFU camera mount not matched with operating cycle of camera	a) Incorrect adjustment of AKAFU pulse cam b) Threads of set screw are broken or screw not all way in	see page 85 see page 85

When a malfunction is detected in the operation of the aerial camera, the cause of the detected malfunction should be determined and, in accordance with the order for correction of malfunctions noted below, the necessary repairs should be carried out.

If the cause of the malfunction has not been established, do not attempt to disassemble the camera.

V. Order for Correction of Malfunctions

Before beginning any repair, disconnect the camera from the electrical circuit.

Malfunction of the electrical cable

Malfunctions of the electrical cable may be caused by: broken conductors, short circuiting between conductors, and short circuiting between the conductors and the metal shielding of the cable.

Faults may be detected by testing the cable in an electrical circuit; then correct the detected malfunction.

Contacts of the KPU do not close (Figures 26 and 27) 50X1

Normal operation of the contacts may be disturbed by burning out of the contacts.

This defect may be corrected by removing three screws 186, removing setting dial 151, opening the two catches 187, and carefully opening cover 153. Then clean the contacts using sandpaper. After this replace the cover and dial, replace the three screws, and check the operation of the KPU.

Electric motor of the KPU is faulty (Figures 26, 27, and 28)

Malfunctions in the electric motor may be caused by:

a) poor contact between the brushes and the commutator;

b) dirty commutator.

If there is poor contact between the brushes and the commutator the motor will not operate altogether or will operate at a reduced speed with sparking. If the brush is held down the motor will begin to operate normally.

The following procedure should be used when fitting the brushes against the commutator and cleaning the commutator in the KPU motor:

1. Remove the three screws 186 and setting dial 151.

2. Open the two catches 187 and carefully tilt back cover 153.

3. Unscrew the caps located at the ends of the motor and remove the brushes from under the springs (see Figure 28). If the brushes are damaged, smooth their ends with fine sandpaper and replace them in the motor.

It is recommended that this operation be performed with a device in the form of a steel washer, inserting the brush in the opening. The height of the washer must be somewhat less than that of the brush so that the brush can be held by the fingers when sanding it.

The brush may be considered properly ground if the contact between the surface of the brush and the commutator is not less than 70% of the working surface of the brush.

The following must be done in addition when cleaning the commutator;

a) unscrew the two detainers and remove the motor from base 172;

b) unscrew the two side screws in the motor and remove front plate 282;

50X1

c) without removing armature 279 from housing 276 (so as not to demagnetize the magnet), clean commutator 280 with a clean rag soaked in V-70 benzene.

After sanding the brushes and cleaning the commutator, reassemble and test the operation of the motor.

The RDT contacts do not close

The cause of a malfunction of the RDT contacts may be their burning. This may be corrected by cleaning the contacts with sandpaper and, if necessary, adjusting the gap between them. Access to the RDT is provided by unscrewing two screws and removing the cover.

Short circuit in electric wiring

If the wiring has made contact with the frame (with the exception of contact with the negative wire of the circuit), a short circuit will occur which will burn out the fuse.

To correct this fault it is necessary to disconnect the camera from the electrical network and check the wiring in the circuit with an ohmeter. Visually determine the short in the faulty section and correct it.

Electrical contact between conductors and frame

In the event of shorting of conductors to the frame, determine the location of the short (with the exception of the command instrument KPU_2) by connecting one of the 26-volt line conductors to an unpainted spot on the chassis of the instrument. A 30-volt portable voltmeter or a 26-volt lamp is connected to the second line conductor.

The other lead of the voltmeter or lamp is connected in turn to terminals of the terminal block. After locating the short and correcting it, check the wiring once again. There should now be no sharp deflections of the pointer of the voltmeter and the lamp should not burn out.

Jamming of the camera mechanism

If the camera mechanism is jammed, the pointer on an ammeter will show a sharp jump in current consumption and the camera will fail to operate. The camera should be quickly disconnected from the electrical network. If the cause of the jamming cannot be determined upon

50X1

inspection or if a correction cannot be made, the camera should be sent to an air force shop or a plant representative should be called.

Malfunctioning of the Shutter

If the shutter fails to operate properly then send the aerial camera for repair to the air force shops or call the factory representative.

Improper Adjustment of the Cam which Interrupts the Operating Cycle of Camera AFA (fig. 8, 9, 10)

Cam 42 may fall out of adjustment due to shifting of its position on the shaft.

The cam may be shifted due to improper fastening to the shaft. To correct this situation it is necessary to carry out the following operations: remove the jacket covering the contact cams and fasten contact cam 42 of the camera in such a manner that the camera cycle would end at the instant of maximum lift of the cassette table.

If the stopper thread has been damaged, unscrew the shelf nuts, remove cams 43 and 288, and then cam 42. Cut a new thread and replace the stopper. Place cams back on the shaft, and adjust their position according to the table of mechanical adjustment.

Shearing of Cotter or Key in the Kinematic Link

The sequence of mechanical alignment in the aerial camera is disturbed if a key or cotter becomes sheared in the kinematic link of AFA camera. In such a case the camera should be sent to the air force repair shops, or the factory representative should be called.

Improper Adjustment of Contact Cam 43 of the Recording Lamps (fig 8, 9, 10)

For the adjustment of contact cams the following operations should be carried out: remove the jacket of the contact cams and fasten the cam engaging the recording instruments in such a manner that the lamps would glow at the instant when the film is leveled.

50X1

Friction-Clutch Spring of the Take-up Spool Has Weakened (fig 23)

To correct this defect do the following:

a) remove the cover of the cassette;

b) remove the stopper holding nut 194;

c) tighten spring 196 with the nut and check the friction clutch tension with the aid of a special device which is included among the accessories.

This device is placed over the housing of clutch 191 and the load is set at the nearest mark (smaller arm). With this position of load the friction clutch should not move. When the load is shifted to the farthest mark the friction clutch should begin to rotate. After this the stopper on nut 194 must be fastened and the operation of the cassette loaded with film should be tested.

Seizing in the Bearings of the Cassette Transmission Gears

When this defect is observed send the aerial camera to the air force repair shop or call the factory representative.

Malfunctioning of the Guide; the Corner of the Slide Plate is Torn or Bent

To correct this defect replace the slide plate by a new one taken from the spare parts. The new guide slide plates should first be washed and lubricated with non-freezing lubricant.

Signalling Contact in the Cassette is Malfunctioning (fig. 20)

To repair the contact for signalling film advance proceed as follows:

a) remove the screw from the shaft of mechanical signal device 230;

b) remove the mechanical signal device;

c) remove four nuts with a wrench (for round nuts) which is included in the tool kit and remove the housing;

50X1

d) bend contact plates K7 in such a manner that during the rotation of the spool center, with camera AFA connected to the power line, the signal lamps of KPU_2 will flicker;

e) If the contacts are burned they must be cleaned with sandpaper and then adjusted in such a manner that the clearance between them should be not less than 0.5 mm.

Contacts of the RPM Regulator (for KPU_2) are Improperly Adjusted or Burnt. (fig. 27, 29)

If the dial is set for 10 sec while the true measured time interval is found to be either greater than 11 sec or smaller than 9 sec, then such irregularities are either due to misadjustment or burning of the contacts of the centrifugal RPM regulator 259 of the KPU_2 electric motor (fig 27).

To remove such a defect it is necessary to:

a) remove three screws 186 and take off the setting dial 151;

b) open two locks 187 and swing upward cover 153;

c) clean contacts K3 with sandpaper;

d) on the flat portion of the gear 252 engaging the worm make a mark with white paint or glue on a white paper circle. Connect the KPU_2 to the power line and count the rpm of the gear engaging the worm. With proper adjustment, the gear should rotate at 90 to 98 rpm;

e) by rotating the stopper screw located on the regulator opposite the contact bring the gear speed to the indicated limits.

Wear of the Pawl of the Swing Lever of KPU_2 (fig 29)

If the pawl tooth 305 of swing lever 304 become excessively worn, then the KPU_2 will form incorrect intervals, not corresponding to the settings of the dial.

To eliminate this defect the KPU_2 should be sent to a repair shop or the factory representative called.

50X1

Malfunctioning of the Cassette Guide Comb

If during loading the leading end of the film does not emerge from measuring roller 215, then one or several teeth of the guide comb might have been bent.

To eliminate this defect perform the following:

a) remove the key holding together the measuring roller shaft and the bushing;

b) remove the screws fastening the bushing;

c) holding the measuring roller by the left hand remove the bushing;

d) remove the measuring roller;

e) straighten the bent teeth;

f) now replace the roller and other parts in the reverse sequence and check the ease of threading the film.

Wear of the Clutch Teeth 213

To correct this defect send the cassette to the air force repair shop or call the factory representative.

Seizing of the Spool Center Bushing Due to Corrosion of the Semi-shaft

To eliminate this defect perform the following:

a) remove the screw which fastens the handle to the semi-shaft;

b) unscrew the handle;

c) remove the semi-shaft from the bushing;

d) clean with sandpaper or fine file the semi-shaft and the bushing and wash them with benzene;

e) lubricate the shaft and bushing with non-freezing lubricant;

f) assemble the reel center in the reverse sequence.

Seizing of the Lever Semi-shaft of the Film Meter.

50X1

To eliminate this defect do as follows:

a) remove the spring from the lever shaft;

b) unscrew the shaft;

c) remove the lever;

d) with a very fine file clean the lever bearing of the semi-shaft;

e) clean the lever hole with a file;

f) wash the semi-shaft and the lever hole with benzene and oil them with non-freezing lubricant found in the supply kit;

g) reassemble the lever with the semi-shaft in the reverse sequence. During the assembly see that the lever (with the roller) spike rests on the body of the driving gear (during meshing with the rack) and that the pointer is set at zero.

Spring of the Lock Lever is Torn.

When the lock lever spring is torn, the lock of the measuring roller fails to work because the pawl is not able to hold the lever.

To eliminate this defect it is necessary to coil a new spring in the shop and to mount it on the lock lever in the cassette.

Burn out of the Illumination bulbs

If a burn out of the illumination bulb occurs than proceed as follows:

a) remove the hood and the base with the bulb from the receptacle;

b) replace the old bulb with a new one from the spare parts;

c) install the new base with the bulb and replace the hood.

Contact Springs Become Bent

To eliminate this defect remove the bulb hood, pull the base with the bulb out of the receptacle and bend slightly upward the contact springs with a screwdriver. Then replace the bulb and the hood.

50X1

The Friction-Clutch Spring of the Reduction Gear Become Weak

To eliminate this defect remove the hood on the reduction gear housing and tighten the nut controlling the spring tension of the friction gear so that the torque on the output shaft would be within the limits of 22.5 - 24 kg/cm. Then test the camera during operation, and if the clutch operates normally, without slipping, replace the hood.

Camera has Lost Its Air Tightness.

To eliminate this defect place the cassette on the camera, put the camera into operation and with one hand feel the junction places between the register units with the camera, between the lens hood and the cone, for possible air leaks. Place some putty over the air leaks. After the air leaks have been eliminated, check the air pressure with the aid of a manometer during the operation of the camera; such a pressure should be not less than 130 mm W. C. at 23.4 v for cameras AFA-33/50M, 75M, 100M, and not less than 110 mm for AFA-33/20M.

Improper Adjustment of Pulse Cam of AKAFU Mount.
(fig. 9, 10)

Maladjustment of cam 288 may occur due to the shifting of the cam on the shaft.

The cam may shift if it is improperly fastened by the lock screw to the shaft (in case the thread is worn or damaged).

In this case the timely delivery of pulses to the AKAFU mount will be disturbed. To eliminate such a disturbance remove the jacket which covers contact cam 288 and fasten the cam in such a position that the current pulse would arrive at the AKAFU mount not earlier than 0.5 and not later than 1.5 turns of the camera drive crank after each exposure.

The Lock Screw is Insufficiently Tightened or its Thread Damaged.

If the screw thread is stripped, remove the nut, take off cam 43 which closes the contacts of the recording instruments, and then remove cam 288 which supplies current pulses to the AKAFU mount. Cut new threading and adjust the screw. Replace the cam on the shaft, adjust the position of the cams according to instruction in paragraphs 5 and 8 of the table for mechanical alignment "Fundamental Adjustment and Technical Data". Then replace the jacket and fasten it with screws.

50X1

INSTRUCTIONS

Handling of Coated Lenses.

The surfaces of lenses are coated to reduce loss of light due to reflection. The uncoated lens surfaces generally reflect about 5% of incident light, while the coated lens reflects less than 2%.

The AFA camera lenses are coated chemically.

The coating is softer than the lens glass, therefore the coated lenses should be handled with great care.

Dust on the coated lens can be removed with a brush.

Non-greasy spots can be removed by light rubbing with clean flannel cloth or chamois.

Greasy spots (finger prints, etc.) should be removed with a flannel cloth wetted in absolute alcohol or ether, but rubbing should be avoided.

Moisture has a detrimental effect on the coating and in time may totally ruin it.

To preserve the lens coating protect it from being soiled so that less cleaning will be needed.

INSTRUCTIONS

Maintenance of Electric Motor Type MU-010

1. Lubrication with oil OKB-122-5 ensures satisfactory performance of the electric motor ball bearings for the quaranteed life time.

2. The motor has round brushes with sealed covers.

During operation it is not permissible to unscrew the brush covers and to remove the brushes, because replacing of the removed brushes will require new adjustment and possible, additional grinding of the brushes to fit the commutator.

50X1

3. For examination of the commutator and brushes remove the motor cover (without removing the brush cover), for which purpose first make a line mark on the frame and the brush; then remove two screws which hold the cover.

4. After expiration of the camera guaranteed service period it might be necessary to carry out the following operations: disassemble the motor, remove carbon dust, replace or grease the ball bearing located on the commutator side, and replace brushes with subsequent testing of the motor.

5. Disassembly of the motor is carried out in the following order:

a) Loosen the terminal screws and disconnect the ends of the wires.

b) Loosen the capacitor screws and remove the capacitor. The capacitor is located on the side of the motor panel.

c) Mark the position of electric motor in the recess of the command instrument to ensure proper reassembly and prevention of motor overloading. Improper assembly of the motor will place an overload several time larger than the rated load on the motor.

d) Unscrew the lock screws and remove the motor from the command instrument receptacle. The flange of the coupling clutch should not be removed from the motor shaft so that the armature may remain in the motor and thus prevent partial demagnitization of the permanent magnet.

e) Place a line mark on the frame and cover of the motor to ensure proper reassembly, then unscrew the fastening screws and remove the cover.

f) Remove the compensating washers from the ball bearing receptacle in the cover.

g) Unscrew the brush covers and remove the brushes.

6. Removal of the brush (carbon) dust is carried out as follows:

a) With a dry and clean rag wound on a wooden pin or wire (the rag being folded twice) remove the brush dust from the inner wall of the motor frame. In this operation the motor should be tilted with commutator downward.

50X1

b) With a clean rag wetted in benzene and wound on a wooden pin or a wire, rub the commutator and inner walls of the motor frame. In this operation the motor should be tilted with commutator down.

c) Wash the ball bearing without removing it from the shaft in pure benzene by dipping it carefully several times into benzene and rotating by hand.

d) Dry the commutator body and the ball bearing until they are free of benzene.

e) With dry clean rag remove the brush dust from the motor cover.

7. After removal of the brush dust from the ball bearing lubricate it with two drops of OKB-122-5 oil.

8. Reassemble the motor in a reverse order and install new brushes. With new brushes the adjustment and replacement of the springs is not allowed. The ribbon connecting the brush with the nipple should be intact.

9. To replace the motor in the command instrument perform the following operations:

a) Check the resistance of motor insulation with a 500-v megohmmeter. Insulation resistance should be not less than 20 Megohms.

b) Grind the new motor brushes and run the motor at idle speed with terminal voltage at 20 v for 30 min. After this do not unscrew the brush covers.

c) Test the idle run current of the motor with new brushes at a terminal voltage of 26 v. Such an idle run current should not exceed 0.15 a. There should be no sharp oscillations of the voltmeter pointer. Presence of such oscillations would be indicative of poor contact between the brushes and the commutator.

10. The electric motor should be replaced precisely into its former place in the receptacle of the command instrument to ensure proper connection to the coupling clutch and to avoid possible overloading of the motor.

50X1

INSTRUCTIONS

Restoration of the Selenium Rectifiers.

During the exploitation of the camera deterioration of the semiconductor layer of the selenium pile rectifier of KPU_2 is sometimes observed, which results in leakage of current in reverse direction to the motor of the drive and blower assembly. Such a deteriorated rectifier can be restored by forming with dc or ac current at a voltage of 45-60 v without disturbing the instrument wiring. For this purpose one end of the wire is connected to lamp L3 contact (the lamp which signals the advance of the film), while the other end is connected to pin 3 of the plug-and-socket connector ShR32P12EShl (fig 43).

During electric forming with dc current the plus line is connected to the lamp and the minus to pin 3 of the connector.

The voltage should be raised gradually during 3-5 min interval from 0 to 45-60 v.

The electric forming is completed when a characteristic cracking noise appears in the selenium pile when 45-60 v have been applied.

To test the full restoration of the selenium pile, i.e., complete prevention of reverse leakage current, perform the following:

1. Connect the 26-v power supply to the camera with cassette, the drive and blower assembly, the KPU_2 and the connecting cables.

2. Place the KPU_2 switch in position "Bombing Control" and the dial index on any number opposite "T bombs", but not higher than 50 sec.

3. Press button "Start" (KPU_2) and rotate the film supply spool in the cassette.

At this time the drive and blower assembly motor should not be in operation.

50X1

LIST OF DESIGNATIONS FOR THE ILLUSTRATIONS

1. Camera housing (fig. 4, 6)
2. Attachable frame (fig. 4,6)
3. Lock plate (fig. 4, 6)
4. Guide pin (fig. 4, 6)
5. Recording device - - clock (fig. 4, 6)
6. " " - - level (fig. 4, 6)
7. " " - - counter (fig. 4, 6)
8. Reduction gear motor (fig. 31, 32)
9. Nipple (fig. 5)
10. Trunnion (fig. 4, 5, 6, 7)
11. Camera receptacle (fig. 4, 5, 6)
12. Drive mechanism (fig. 6, 4)
13. Objective (lens) section (fig. 4, 6)
14. Cardan shaft (fig. 8, 9, 10)
15. Entry shaft (fig. 8, 9, 10)
16. Worm-gear of the drive mechansim (fig. 8, 9, 10)
17. Gear meshing the worm (fig. 8, 9, 10)
18. Horizontal shaft (fig. 8, 9, 10)
19. Bevel gear (fig. 8, 9, 10)
20. Bevel gear (fig. 8, 9, 10)
21. Sleeve (fig. 8, 9, 10)
22. Driving pin (fig. 8, 9, 10)
23. Bevel gear (fig. 8, 9, 10)
24. " " " "
25. Shaft (fig. 8, 9, 10)
26. Bevel gear (fig. 8, 9, 10)
27. " " " "
28. Housing for the drive and blower mechanisms (fig 31)
29. Blower motor (fig. 31, 32)
30. Air turbine blower (fig. 31)
31. Reduction gear for the drive and blower unit (fig. 31)
32. Flexible hose (fig. 1, 2, 3)
33. Intermediate shaft (fig. 8, 9, 10)
34. Bevel gear (fig. 8, 9, 10)
35. " " "
36. Spur gear "
37. " " "
38. " " "
39. Spur gear of the counter (fig. 8, 9, 10, 11)
40. Shaft of the camera counter (fig. 8, 9, 10, 11)
41. Contact disk for switching-on of the motor (fig. 8, 9, 10)
42. Contact disk (fig. 8, 9, 10)
43. Switching-on contacts of the motor (fig. 8, 9, 10)
44. Switching-on contacts for the lamps of recording insttuments (fig. 8, 9, 10)
45. Reduction-gear worm of the drive mechanism (fig. 8, 9, 10)

50X1

46. Gear meshing the worm of the drive mechanism (fig. 8, 9, 10)
47. Gear of the drive mechanism reduction-gear (fig. 8, 9, 10)
48. " " " " " " "
49. Safety cover (fig. 9, 10)
50. Roll (fig. 9, 10)
51. Disk (" ")
52. Telescoping shaft (fig. 8, 9, 10)
53. Gear actuating the shutter (fig. 9, 10) in AFA-33/50M, 75M, 100M
54. Counter drum of the camera (fig. 11)
55. " " " " " "
56. " " " " " "
57. Winding gear of the shutter "Zhalyuzi" (fig. 9, 10, 17, 18)
58. Shaft of winding mechanism of the shutter "Zhalyuzi" AFA-33-50M (fig. 9, 17)
59. Pin (fig. 9, 10)
60. Drum of the camera counter (fig. 11)
61. Auxiliary driving gear of the counter (fig. 11)
62. " " " " " " "
63. Rack (fig. 9, 10)
64. Gear of the safety covers AFA-33/50M, 75M, 100M (fig. 9, 10)
65. " " " " " " " " " "
66. Shaft " " " " " " " "
67. " " " " " " " " " "
68. Spring (fig. 9, 10)
69. " "
160. Continuous-operation switch (fig. 26)
161. Switch for AKAFU operation (fig. 26)
162. Heater switch (fig. 26)
163. Lamp ("Current-off") (fig. 26)
164. Lamp ("AKAFU") (fig. 26)
165. Lamp ("Rewinding of aerial film" and "Ready for photographic control of bombing") (fig. 26)
166. Window for the picture counter (fig. 26)
167. Wheel for setting the counter to zero. (fig. 26, 29)
168. Fuse cover (fig. 26)
169. Terminal box for electric cable KPU (fig. 26)
170. Two-pole terminal box (fig. 26)
171. Dovetail (fig. 26)
172. Base of the KPU (fig. 26, 27)
173. Cog of the pawl (fig. 26)
174. Reduction gear shaft (fig. 31)
175. Spring (fig. 26)
176. Cotter pin (fig. 31)
177. End sleeve (fig. 31)
178. Nut (fig. 31)
179. First section of the electric cable (fig. 33)
180. Plug of the connector (fig. 33)
181. Connecting socket (fig. 33)
182. Second section of the electric cable (fig. 33)

50X1

183. Plug of the connector (fig. 33)
184. Plug of the connector (fig. 33)
185. " " " " "
186. Dial screws (fig. 27)
187. Snaps for fastening cover to the base of KPU (fig. 27)
188. Picture counter (fig. 27)
189. Electric heater (fig. 27)
190. Pointer of the counter (fig. 24)
191. Body of the friction clutch (fig. 23)
192. Gear (fig. 23)
193. Shaft (fig. 23)
194. Nut "
195. Flange "
196. Spring "
197. Gasket
198. Rectifier (fig. 27)
199. Electric motor MU-010 (fig. 27, 29)
200. Worm (fig. 29)
201. Drive head of the cassette mechanism (fig. 8, 9, 10, 20)
202. Bevel gear (fig. 20)
203. " " "
204. Spool cam "
205. Gear (fig. 8, 9, 10, 20)
206. Central shaft (")
207. Extension of the slide plate (fig. 20)
208. Roller (fig. 20)
209. Lever "
210. Stop rod "
211. Fork "
212. Fork shaft (fig. 20)
213. End sleeve coupling (fig 20)
214. Spring of the end coupling (fig. 20)
215. Measuring roller (fig. 20)
216. Spur gear of the measuring mechanism (fig. 20)
217. " " " " " " "
218. " " " " " " "
219. " " " " " " "
220. Supply spool (fig. 20)
221. Guide roller "
222. Press plate "
223. Press roller "
224. Take-up spool "
225. Friction clutch (fig. 20, 21)
226. Drive pin (fig. 20a, 23)
227. Rotating semi-shaft (fig. 20)
228. Safety catch "
229. Friction clutch "
230. Indicator "
231. Eccentric "

50X1

232. Roller (fig. 20)
233. Spring of the press plate (fig. 20)
234. Return spring "
235. Bushing "
236. Spring "
237. Indicator disk with a lug "
238. Contact plates "
239. Contact block (fig 20, 22)
240. End coupling of the measuring shaft (fig. 20)
241. Lever "
242. Lock "
243. Indicator (fig. 25)
244. Hook for disengaging the lock (Fig. 20)
245. Spring "
246. Stop "
248. Length counter (fig. 20, 25)
249. Swing snap of the cassette (fig. 21)
250. Connector insert (fig. 33)
251. Plug for connection to the airborne power line (fig. 33)
252. Gear engaging the worm gear (fig. 29)
253. Worm (fig. 29)
254. Pin of the reduction gear of the drive mechanism (fig. 31)
255. Case (fig. 31)
256. Socket "
257. Gear engaging the worm (fig. 29)
258. Screw holding the bushing (fig 20)
259. Regulator of speed of rotation (fig. 27)
260. Shaft of the shutter winding mechanism AFA-33/20M (fig 14)
261. Mounting frame of AFA-33/20M (fig 34)
262. Stud (fig. 34)
263. Cross-bar "
264. Swing clamp "
265. Lock "
266. Adjusting screw (fig. 34)
267. Spring "
268. Sleeve "
269. Clamp ring "
270. Knob "
271. Wing nut and screw "
272. Castellated nut (fig. 19)
273. Pair of idling gears (fig. 19)
274. Catch "
275. Washer "
276. Electric motor housing "
277. Poles "
278. Permanent magnet "
279. Armature "
280. Commutator "
281. Brushes "

50X1

282. Front cover (fig. 28)
283. Brush spring "
284. Electromagnet ESBR (fig. 29)
285. Shaft of the central mechanism (fig. 29)
286. Cam washer "
287. Auxiliary driving gear of the counter (fig. 11)
288. Contact disk for admission of pulse to AKAFU (fig 8, 9, 10)
289. Contact for admission of pulse to AKAFU "
298. Plastic cover (fig. 25)
299. Ring (fig 29)
300. Gasket "
301. Ratchet wheel "
302. Spring "
303. Guiding pin "
304. Swinging lever"
305. Pawl "
306. Hinged lever (fig. 5, 6)
307. Heater (fig 13, 16)
308. Wiring diagram of the electric cable (fig 33a)
309. Reduction gear screws (fig 32)
311. Cover (fig 25)
312. Spring (fig 29)
313. Auxiliary lever (fig 29)
314. Pin of the auxiliary lever (fig 29)
315. Catch "
316. Spring "
317. Shaft of the auxiliary lever "
318. Shaft of the catch "
319. Textolite plate "
320. Support "
321. Return spring "
322. Fixed stop (fig 29)
323. Dial Bracket "
324. Pawl "
325. Spring "
326. Armature of the electromagnet ESBR (fig 29)
327. Shaft "
328. Plastic rod "
329. Electromagnet of the counter "
330. Ratchet wheel of the counter "
331. Driving gear of the counter "
332. Gear "
333. Number drum of the counter "
334. Electromagnet armature of the counter "
335. Electromagnet core of the counter "
336. Pawl "
338. Counter spring "
339. Pawl "
340. Metal washers of the rectifier "

50X1

341. Layer of selenium (fig. 29)
342. Spring washers "
343. Leads "
344. Electric cable of ESBR (fig. 30)
345. Coupling of the electric cable (fig. 30)
346. Cover (fig 26)
347. Coupling (fig. 33)
348. Socket (fig. 30a)
349. Socket "
350. Frame (fig. 20a)
351. Bushing with pin "
352. Spring "
353. Check bushing "
354. Gasket "
355. Ratchet wheel "
356. Gasket "
357. Nut "
358. Stop "
359. Eccentric (fig. 21)
360. Pawl (fig. 20)
361. Shaft "
362. Spring "
363. Plug (fig. 30)
364. Rheostat (fig. 3, 6)

50X1

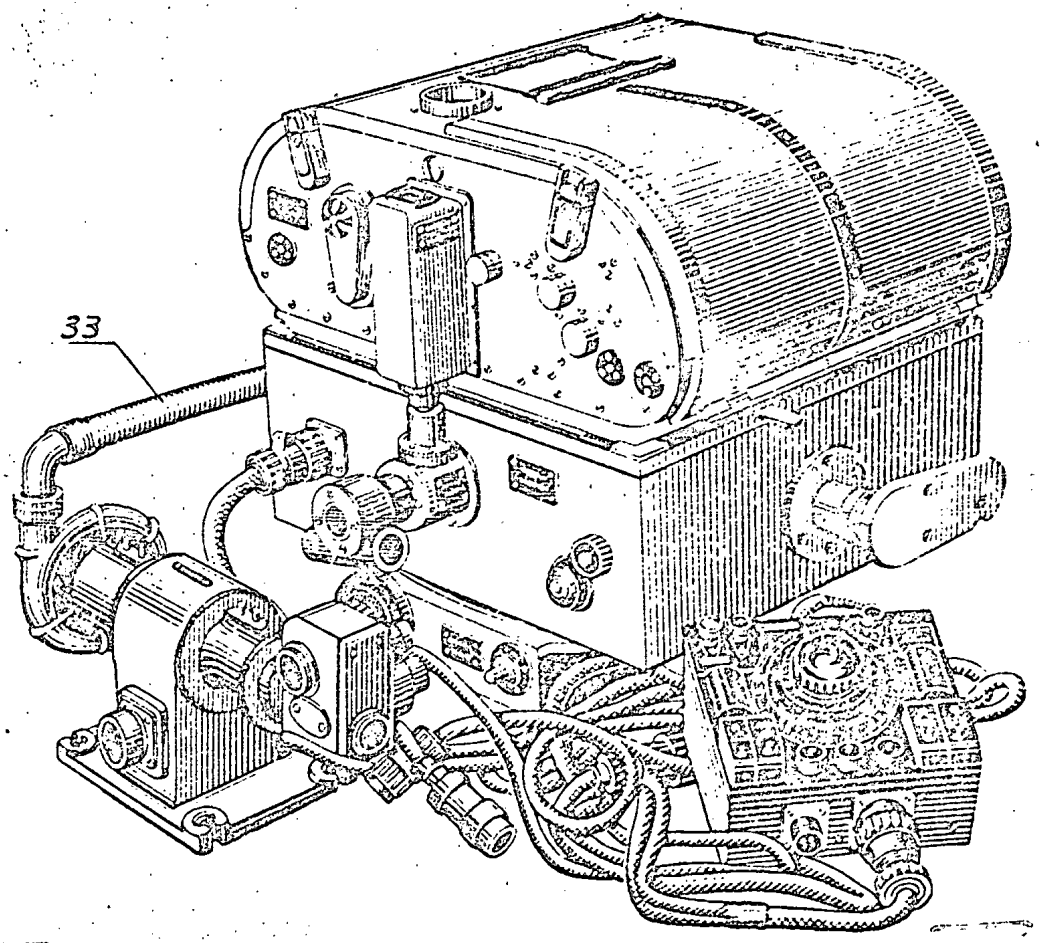


Figure 1.

General View of the Aerial Camera AFA-33/20M.

50X1

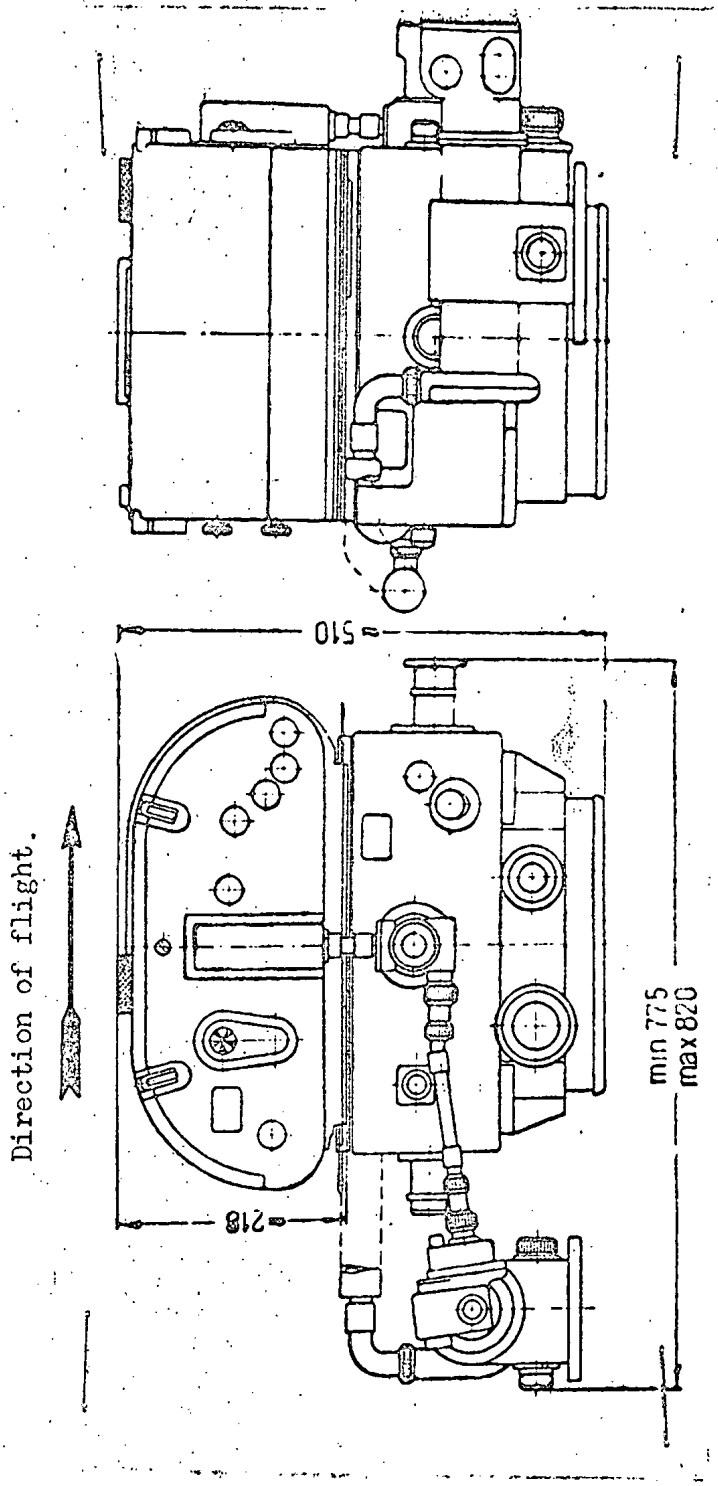


Figure 1a. Dimensions of Camera AFA-33/20M in mm.

50X1

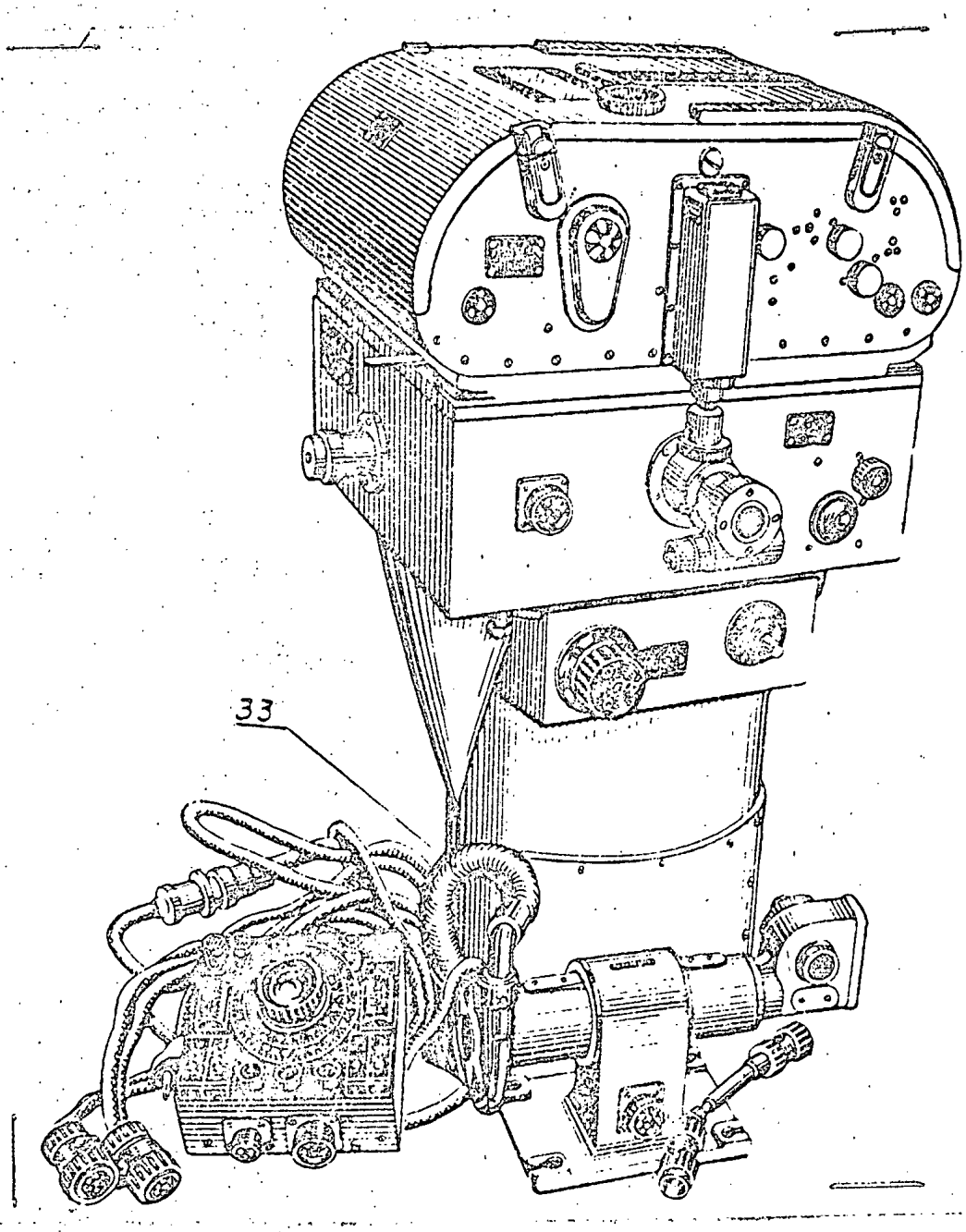


Figure 2.

General View of Aerial Camera AFA-33/75M

50X1

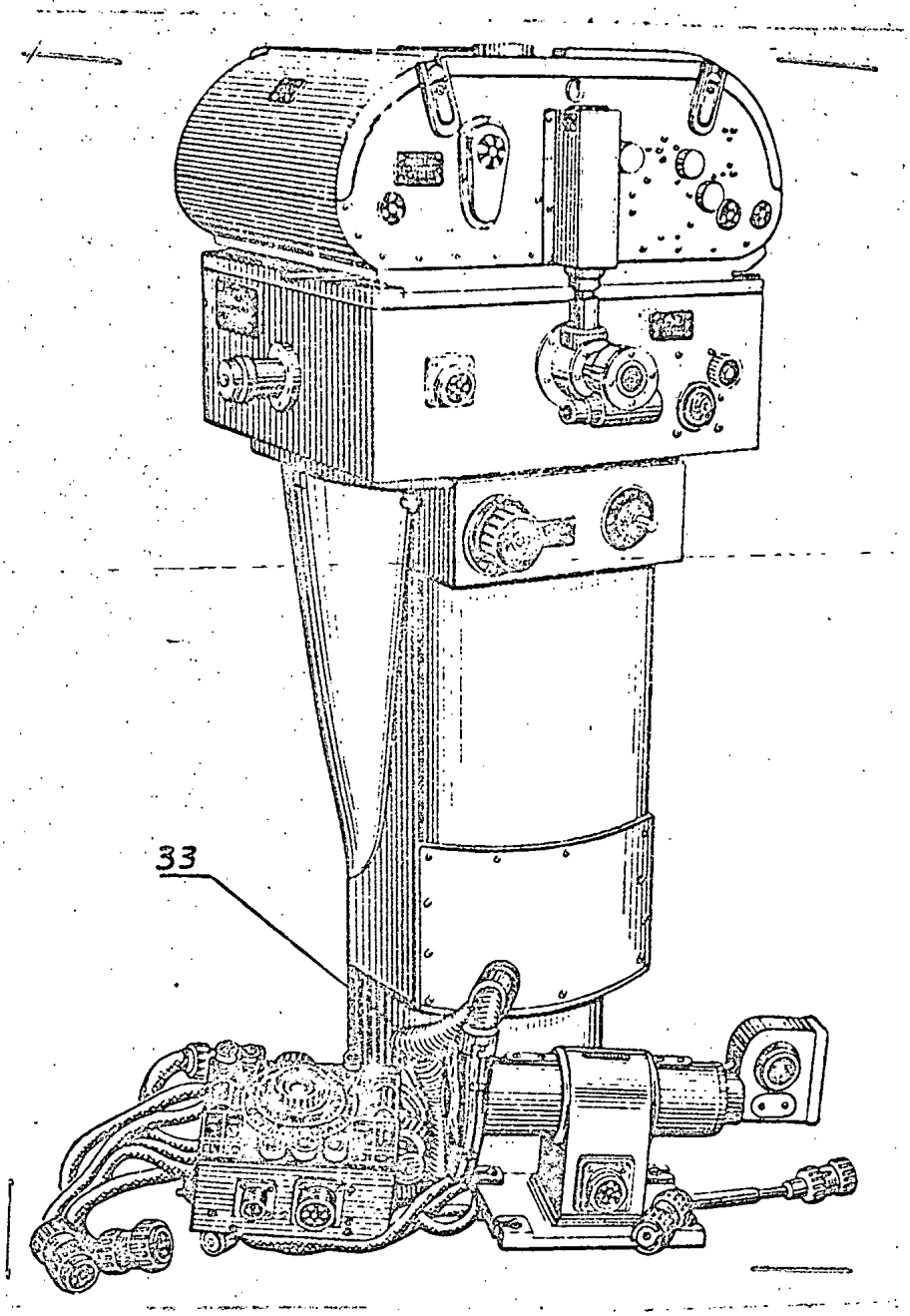
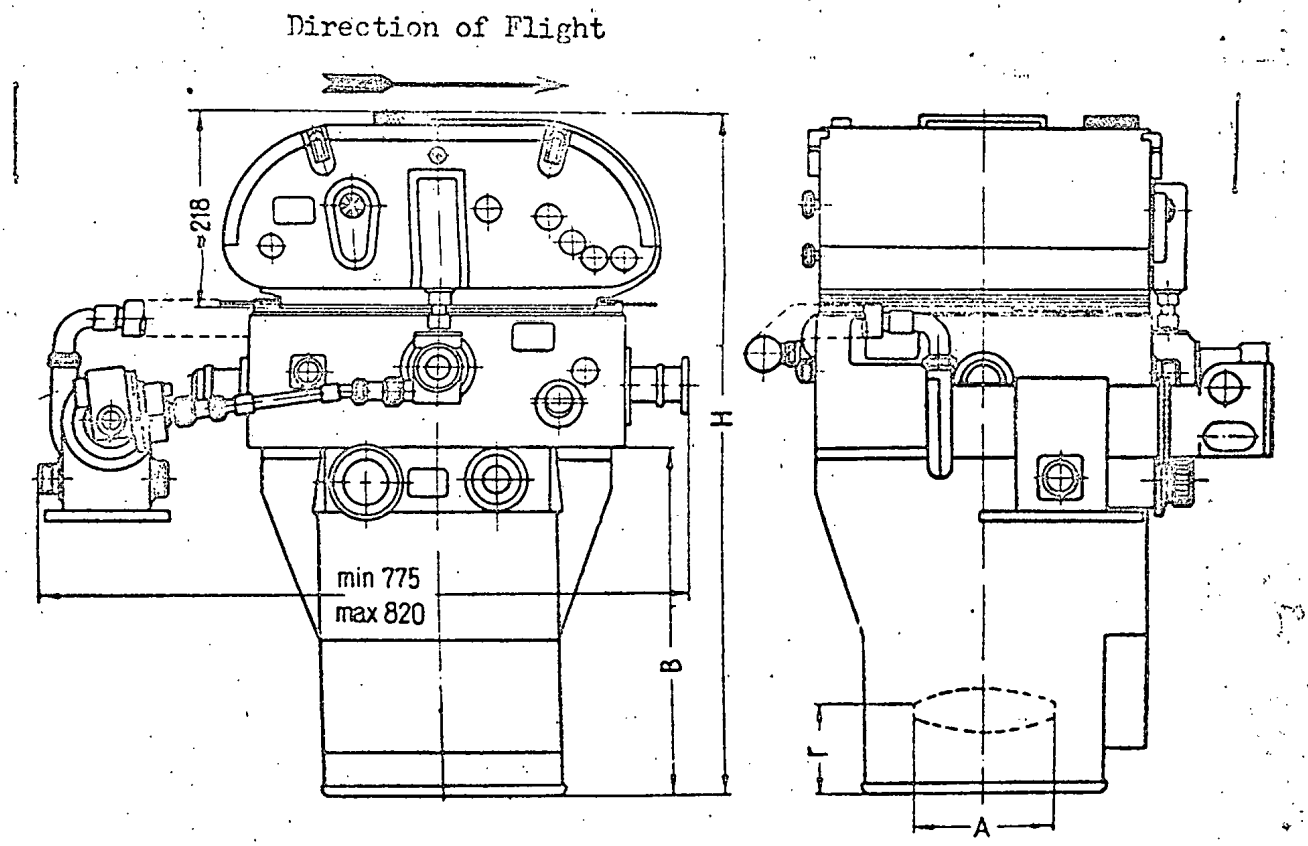


Figure 3.

General View of Aerial Camera AFA-33/100M

50X1



Type of camera	H	B	Γ	A	2β side photo	2β diagonal of photo
AFA-33/50M (f=500)	815	434	56,3÷67	100	34°	46°
AFA-33/75M (f=750)	845	465	50,5÷65	119	23°	32°
AFA-33/100M (f=1000)	1075	695	75,6÷94	142	17°	24°

Figure 3a.

Dimensions of Cameras AFA-33/50, 75 and 100.

50X1

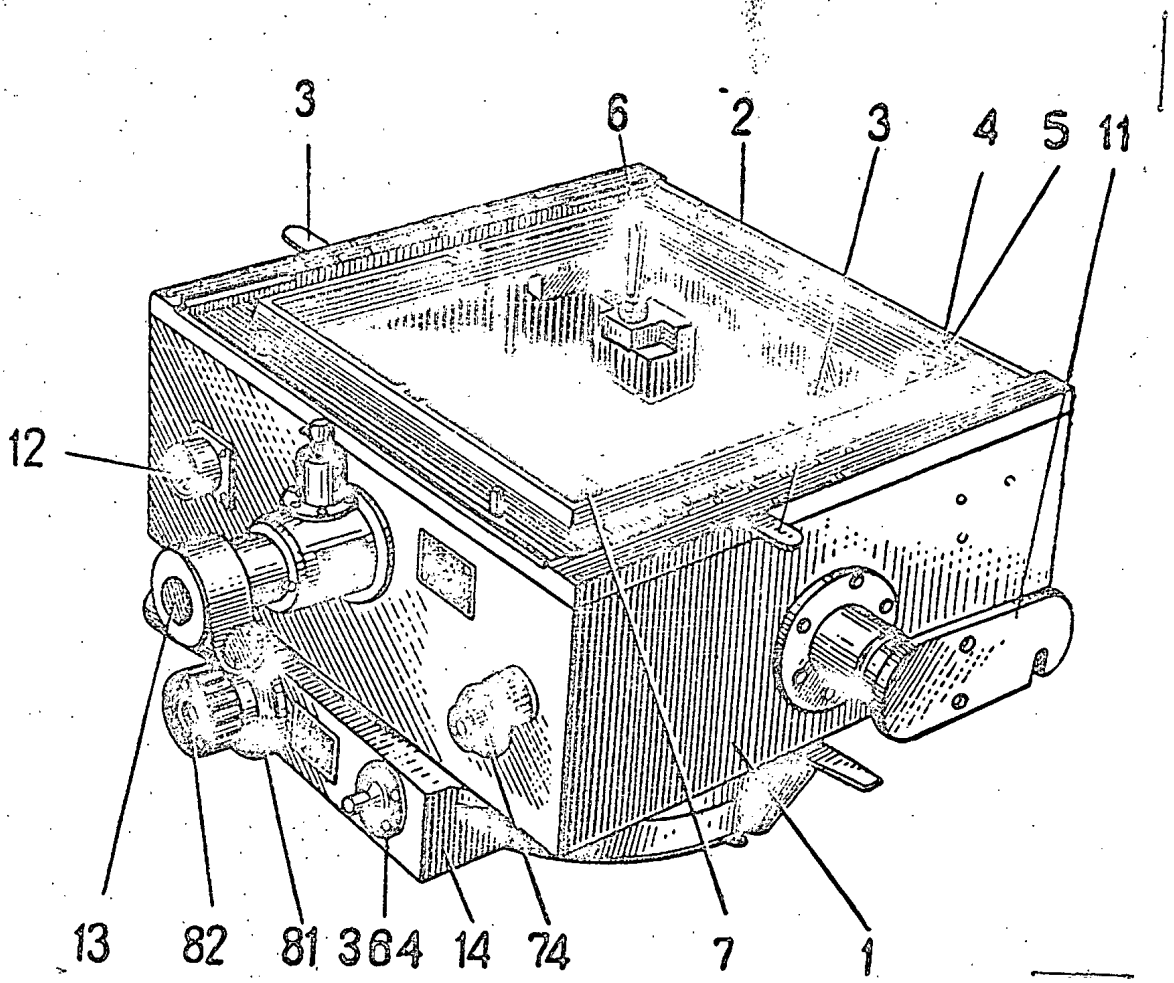


Figure 4.

Camera with Cone F = 200. Front View.

50X1

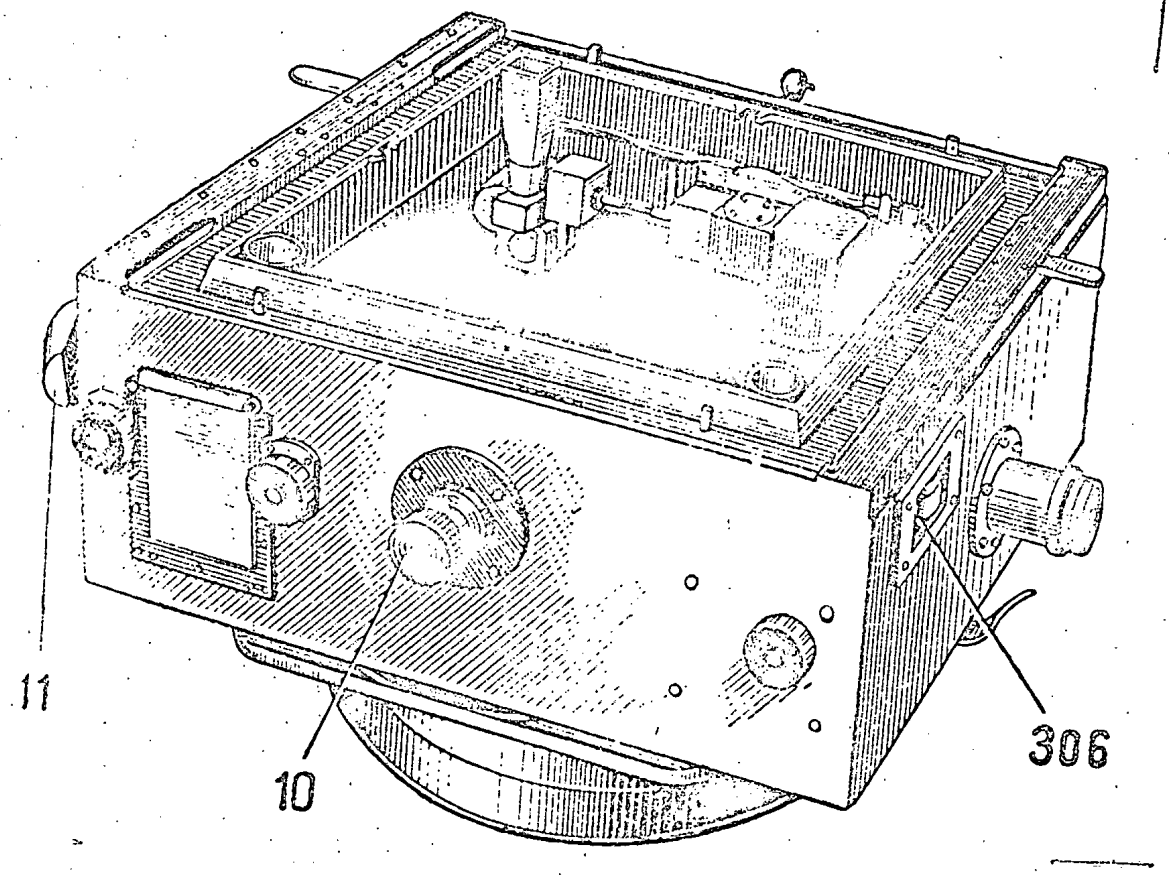


Figure 5.

Camera with Cone F = 200. Rear View.

50X1

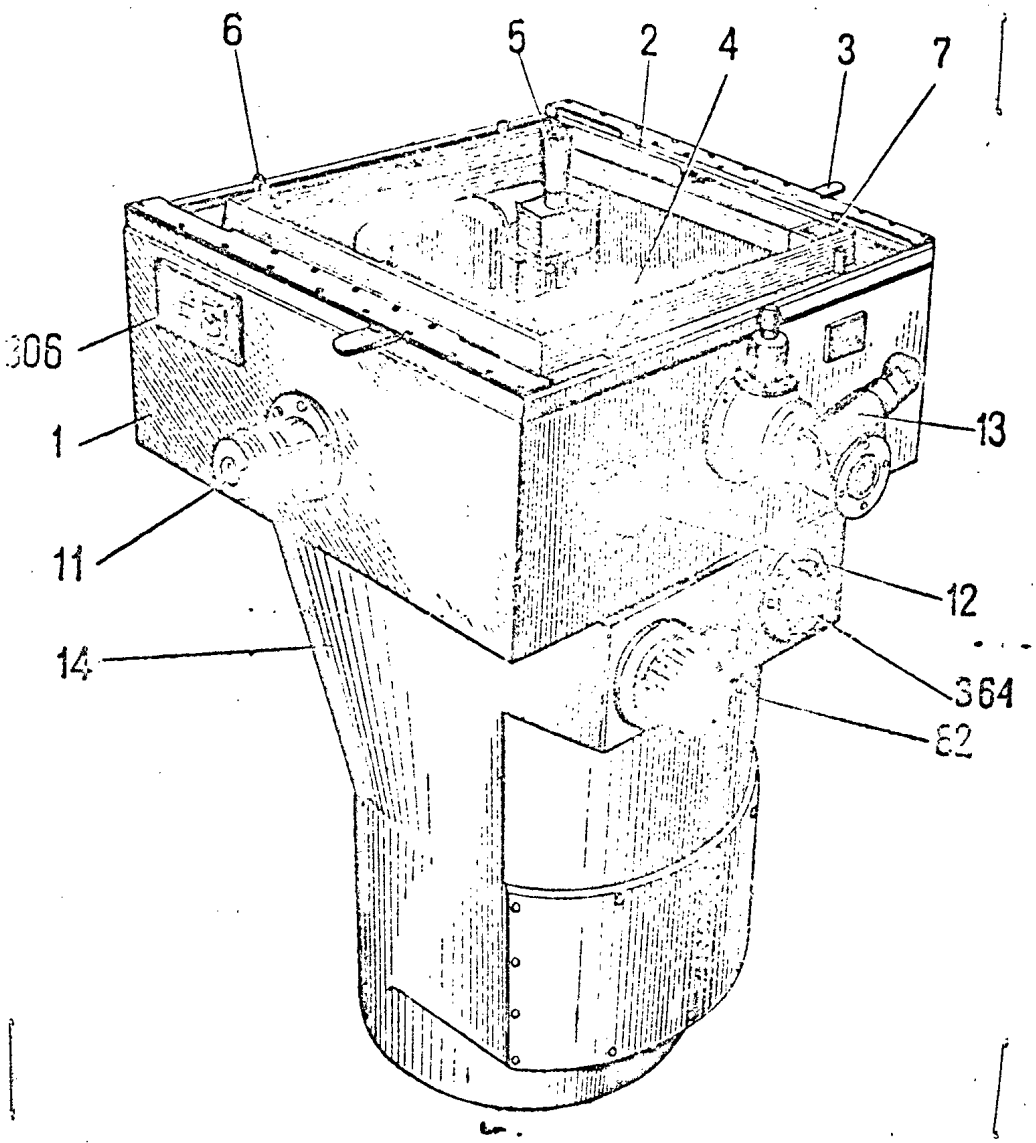


Figure 6.

Camera with Lens F = 750. Side View.

50X1

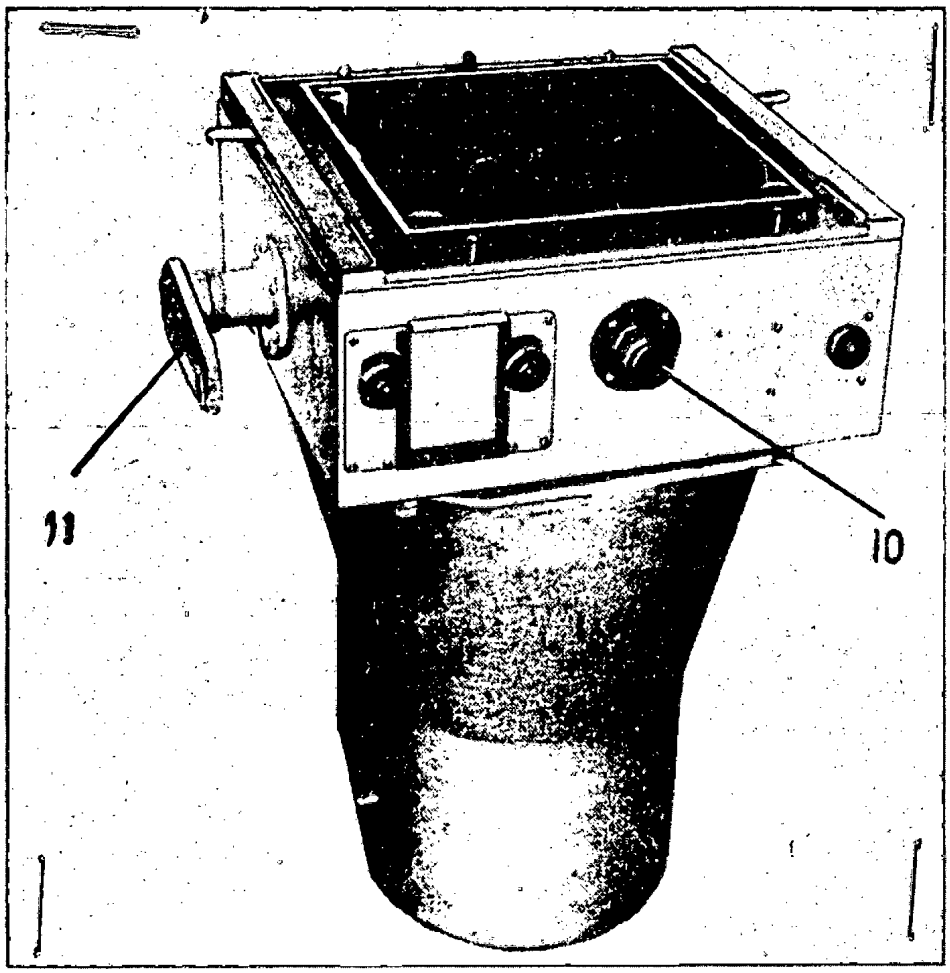


Figure 7.

Camera with Lens F = 750. Rear View.

50X1

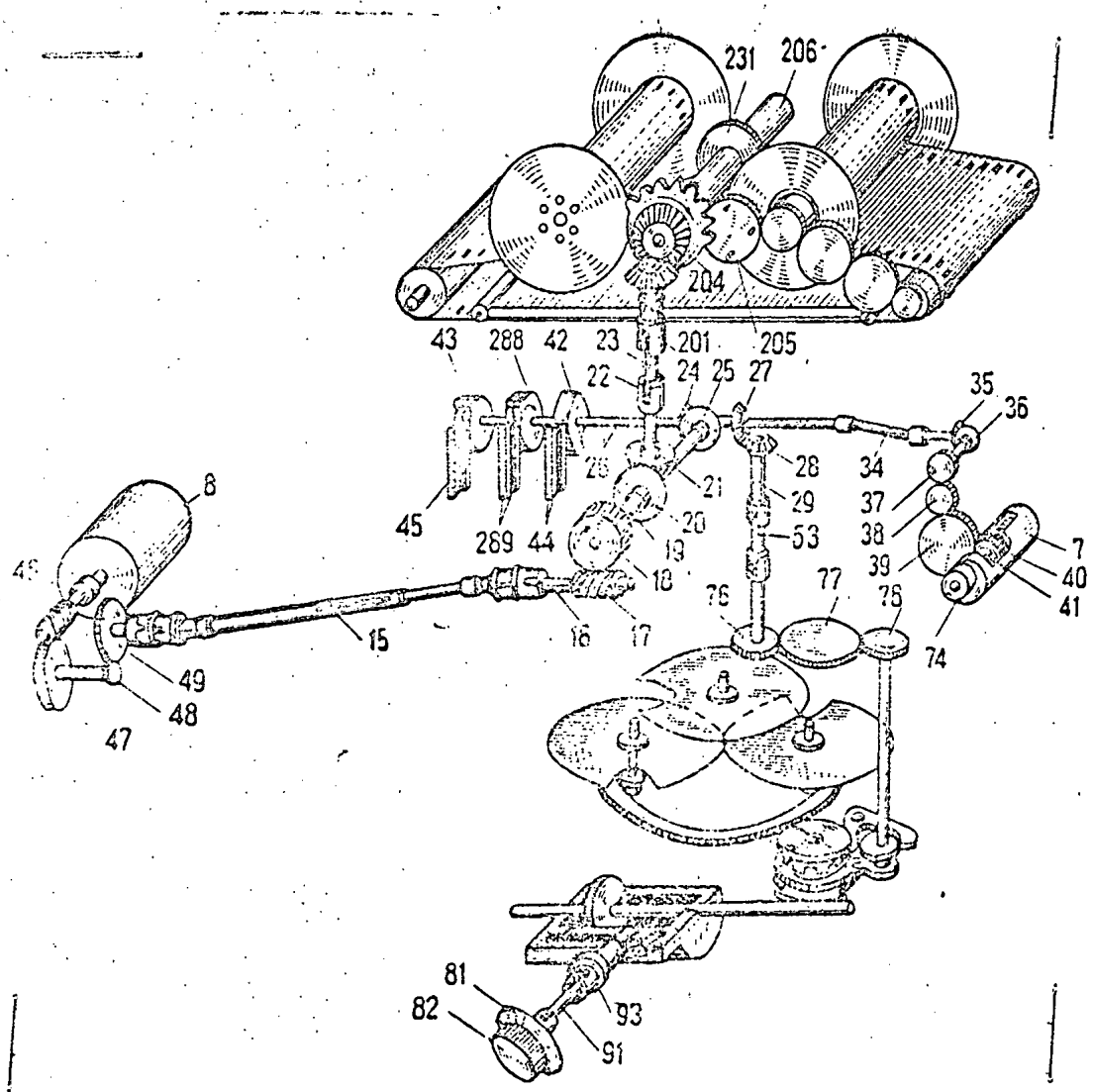


Figure 8.

Kinematic Link of Camera AFA-33/20M.

50X1

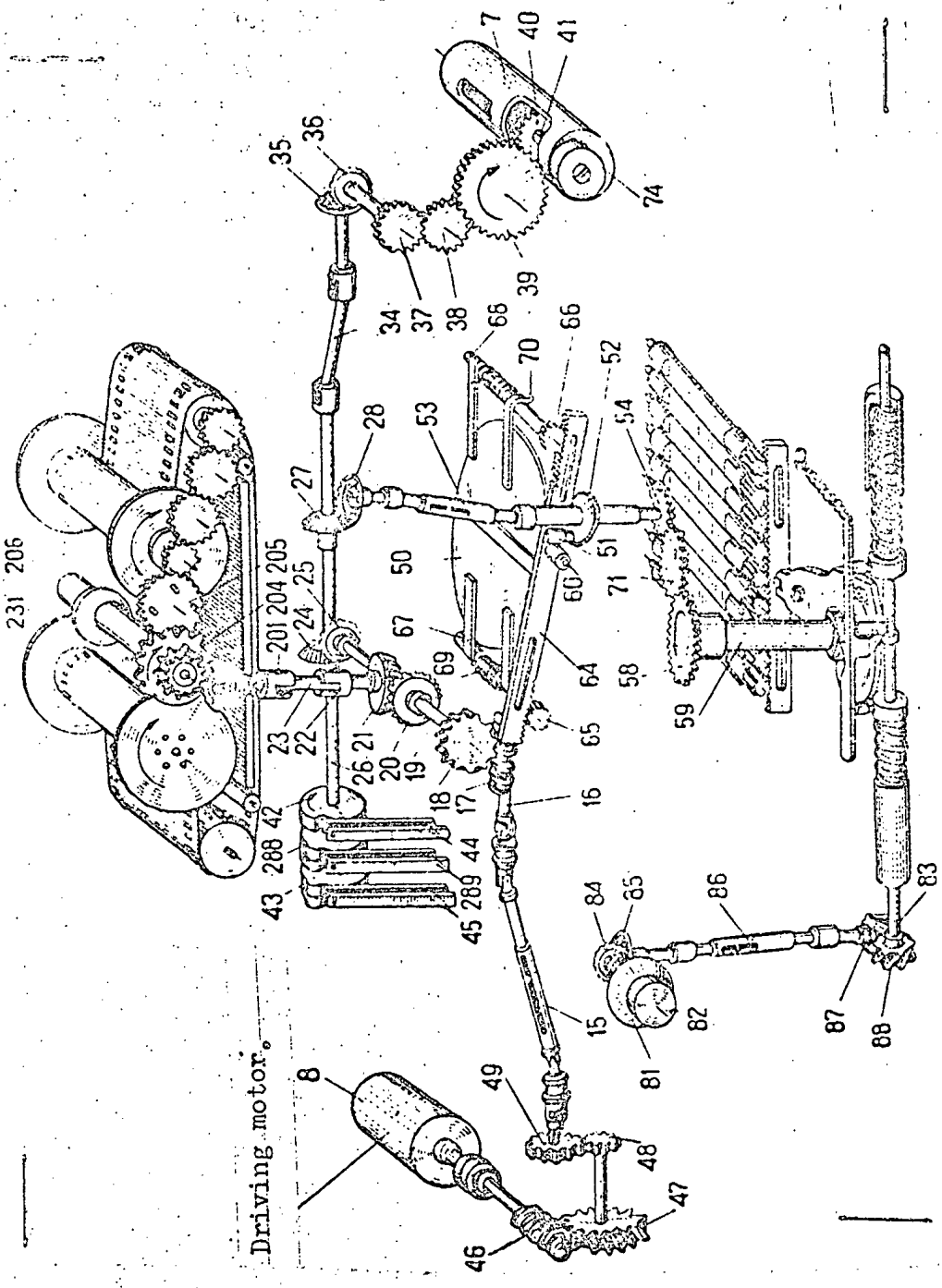


Figure 9. Kinematic Diagram of Camera AFA-33/50M.

50X1

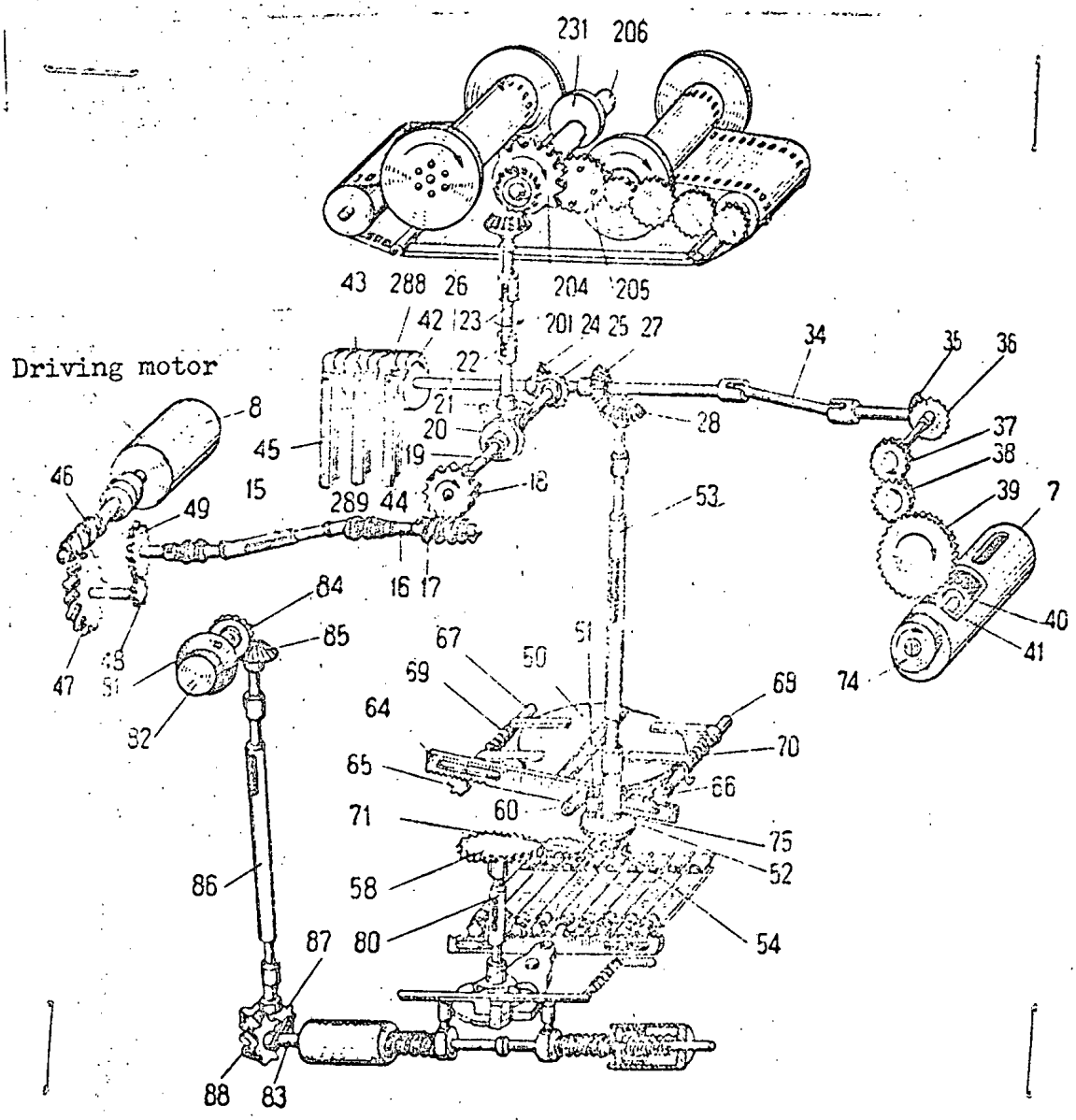
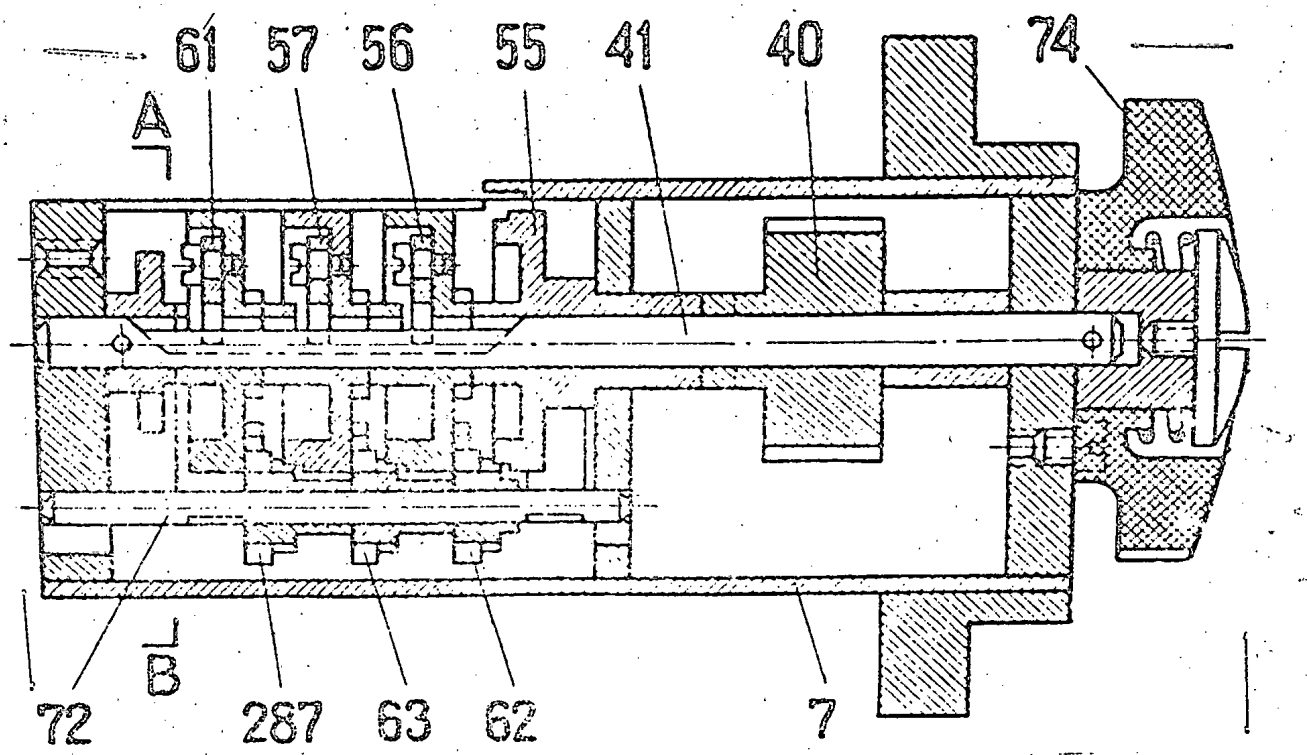


Figure 10.

Kinematic Diagram of Camera AFA-33/75-100M.

50X1



Section AB

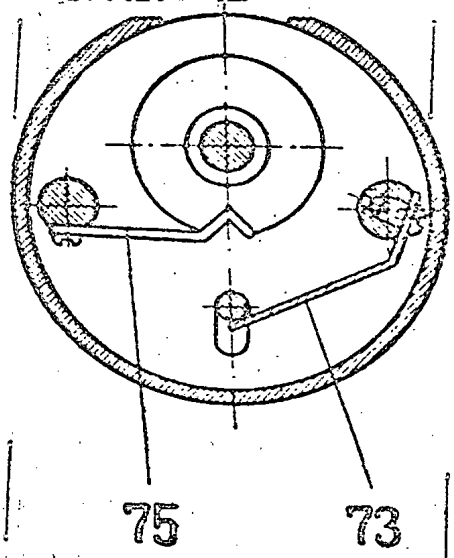


Figure 11. Camera Exposure Counter.

50X1

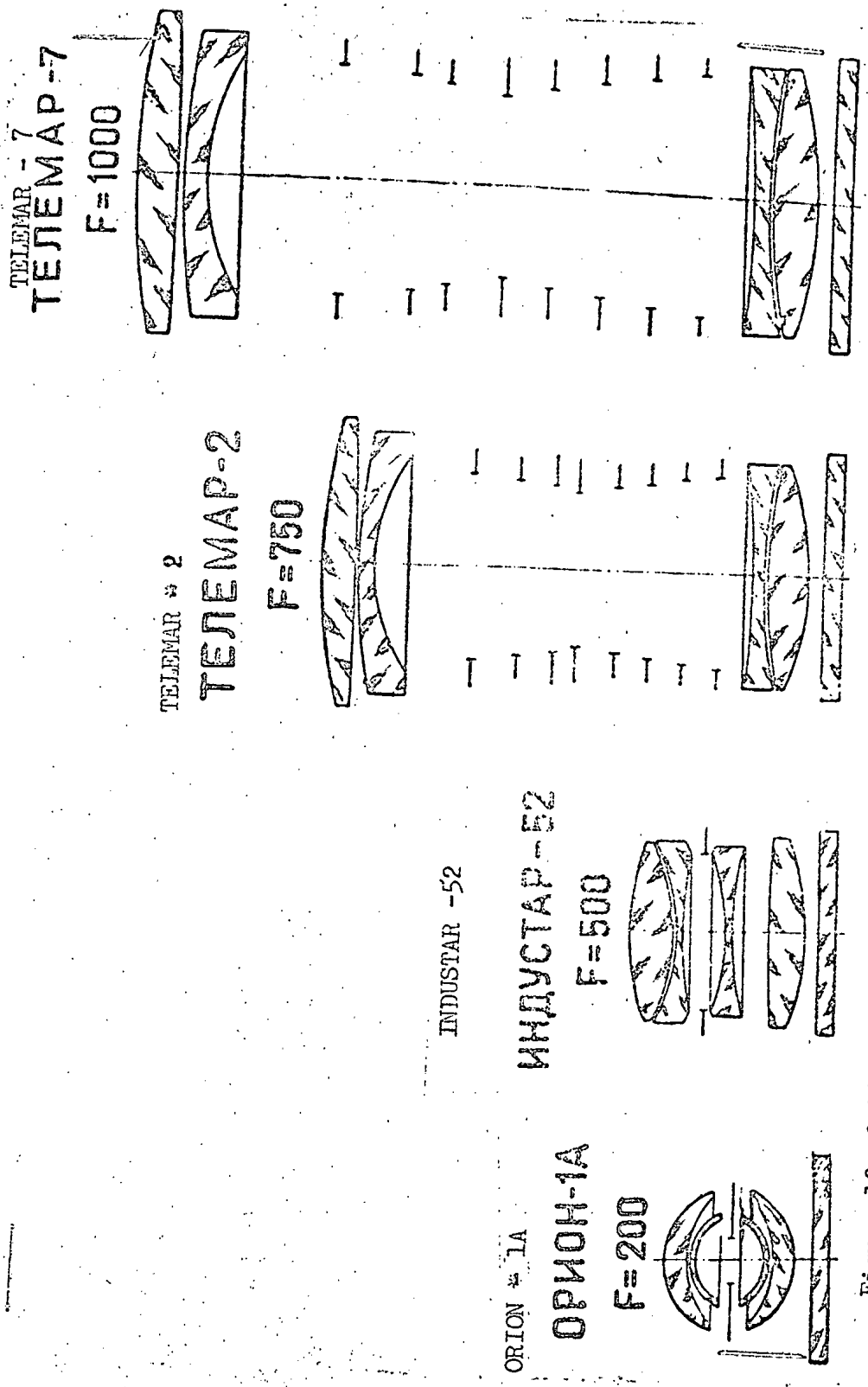


Figure 12. Optical Systems of Lenses with Light Filters.

50X1

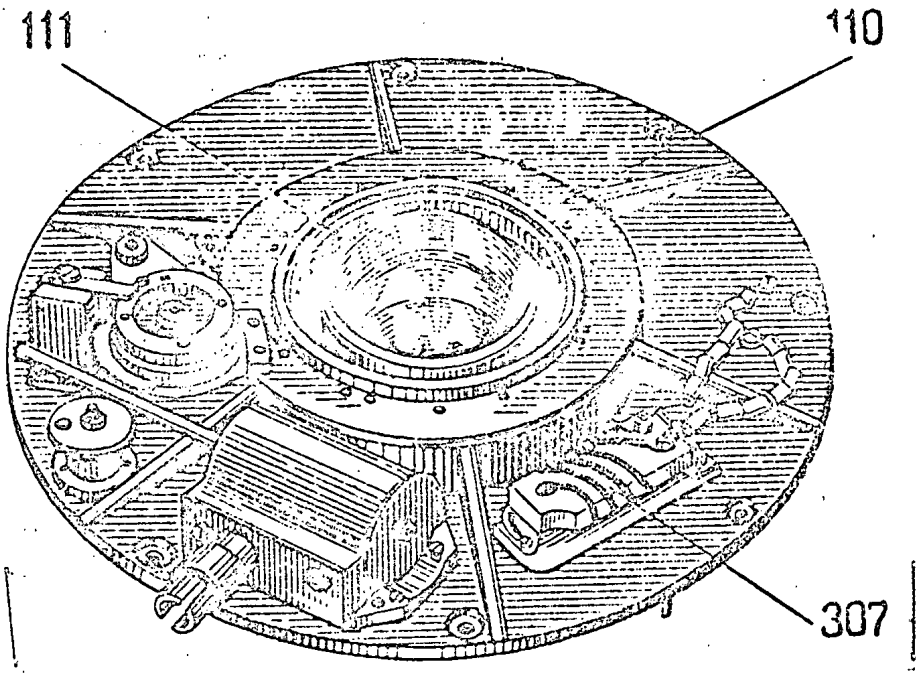


Figure 13.

Central Shutter. View of the Mechanism.

50X1

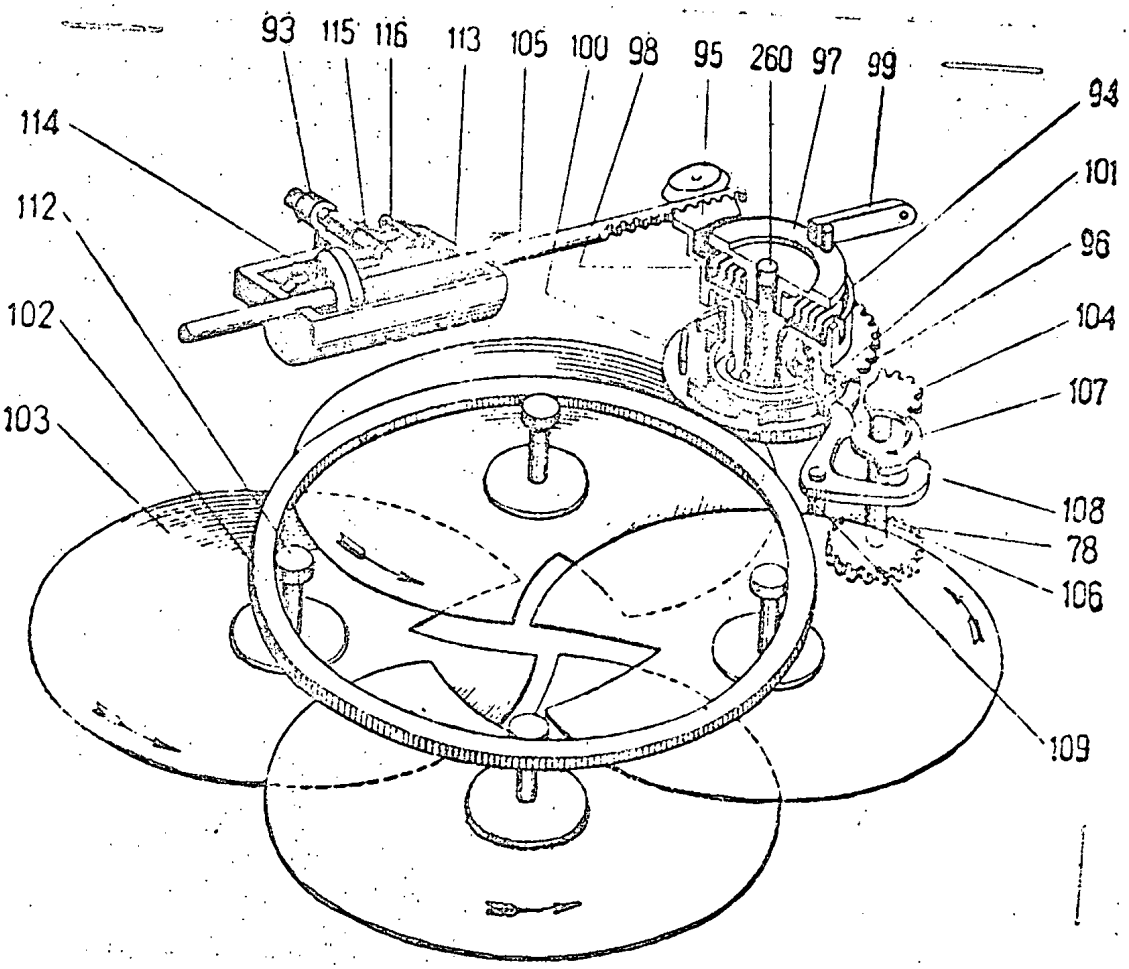


Figure 14.

Kinematic Diagram of the Central Shutter.

50X1

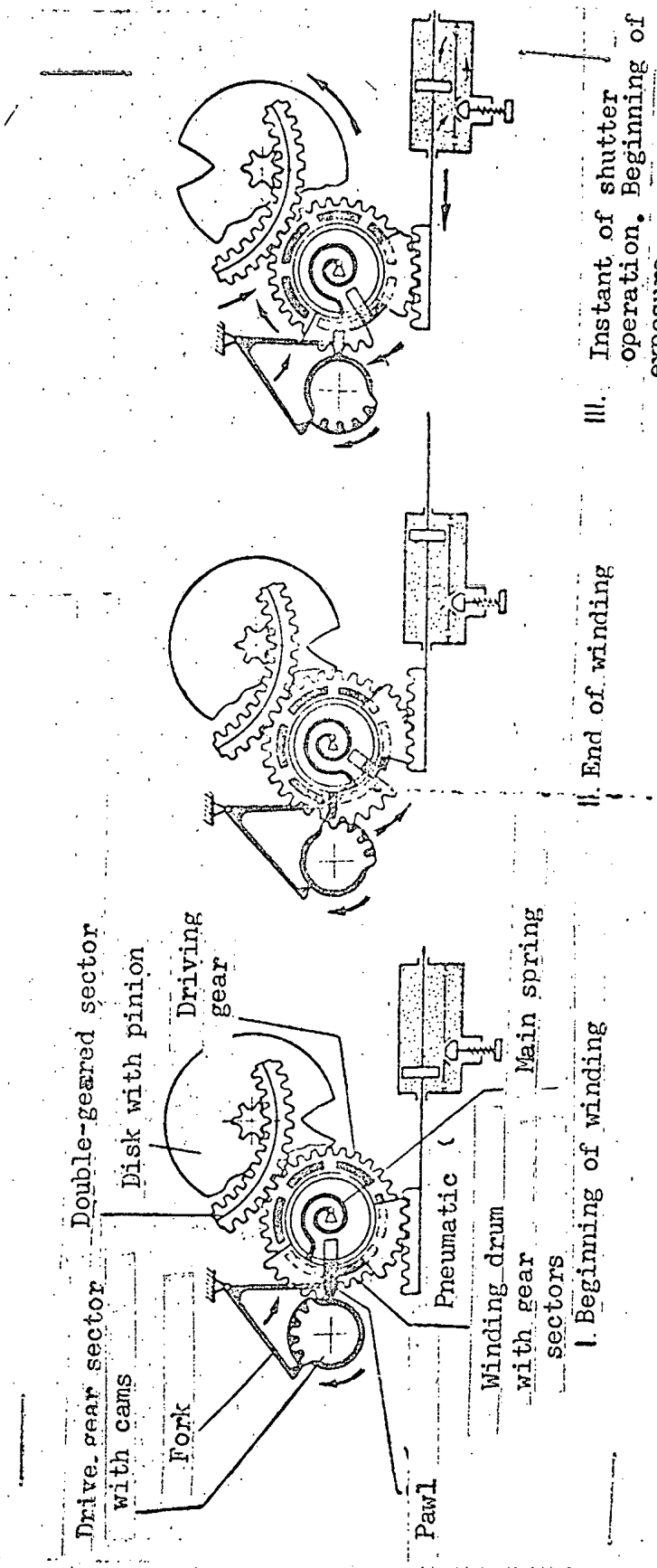


Figure 15.

Operational Diagram of the Central Shutter.

50X1

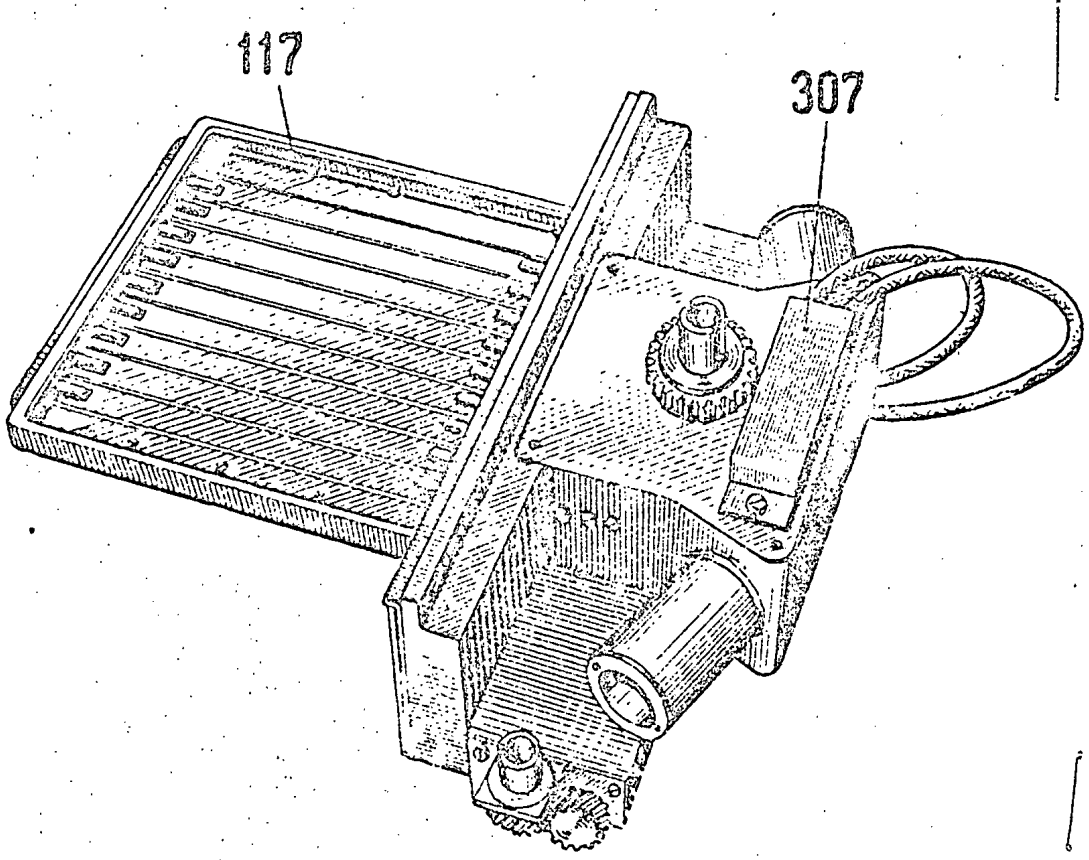


Figure 16.

Louver Type Shutter.

50X1

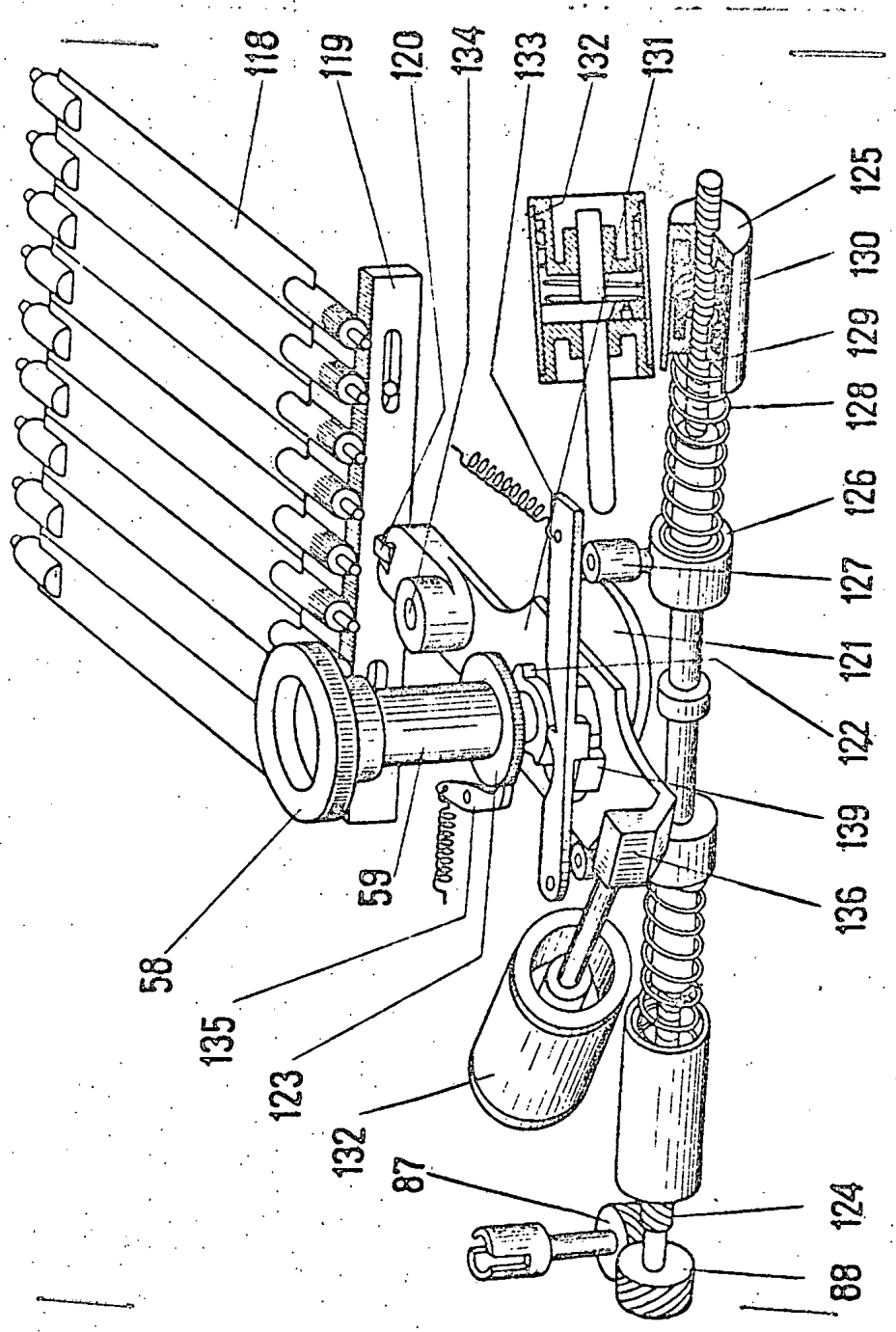


Figure 17.

Kinematic Diagram of the Louver Type Shutter.

50X1

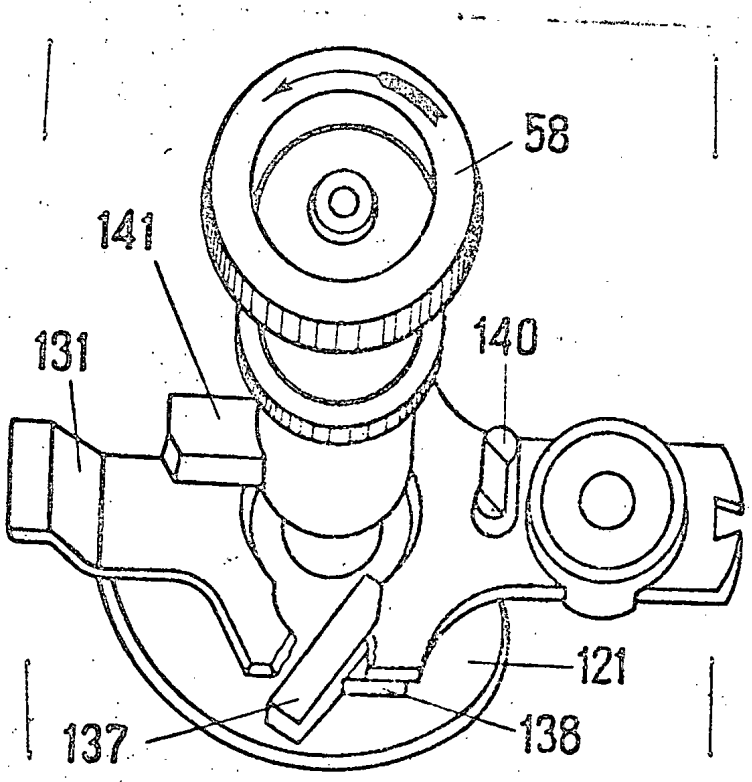


Figure 18.

The Mechanism of the Louver Type Shutter.

50X1

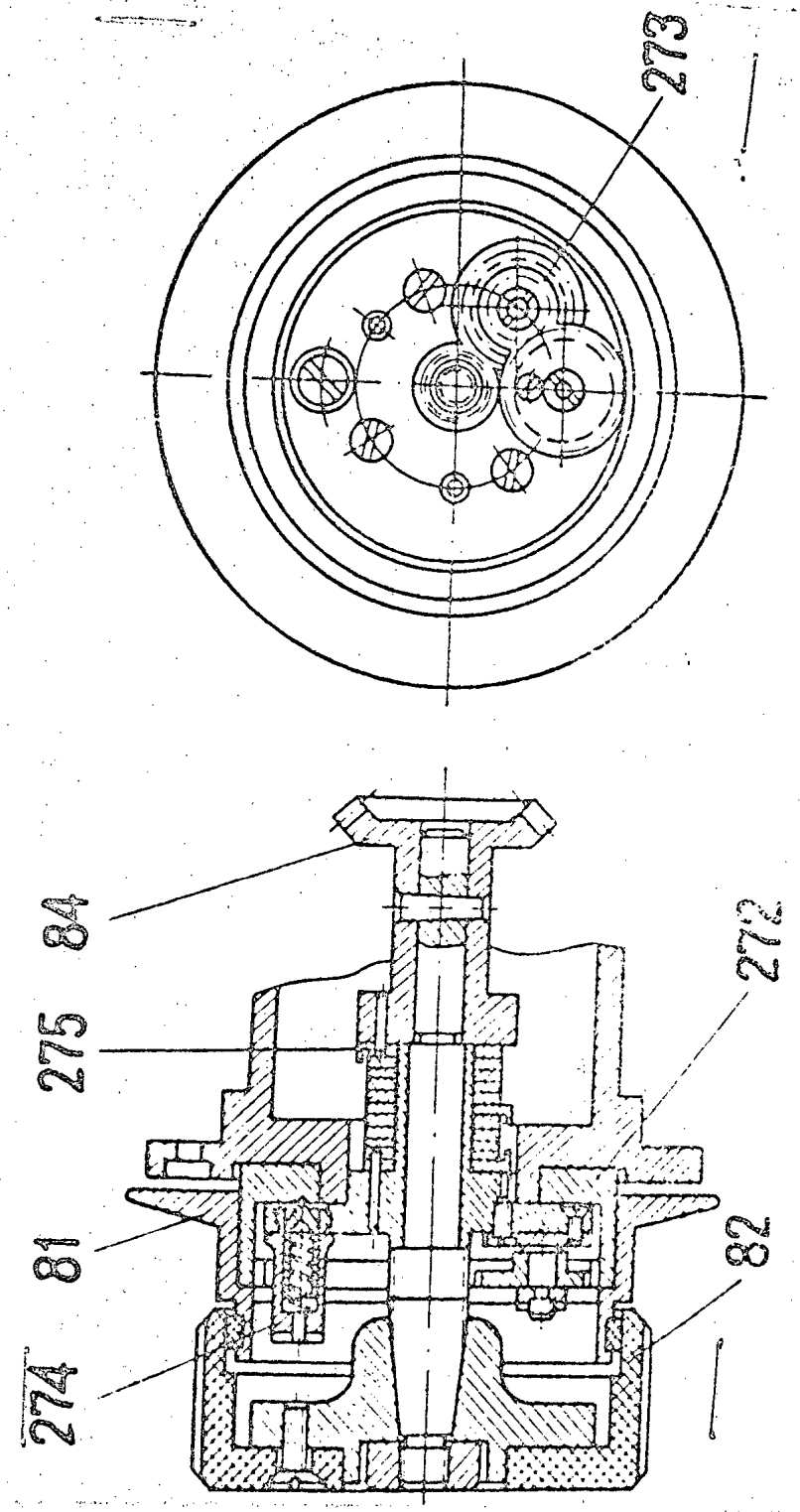


Figure 19.
Lever for the Advance of the Film.

50X1

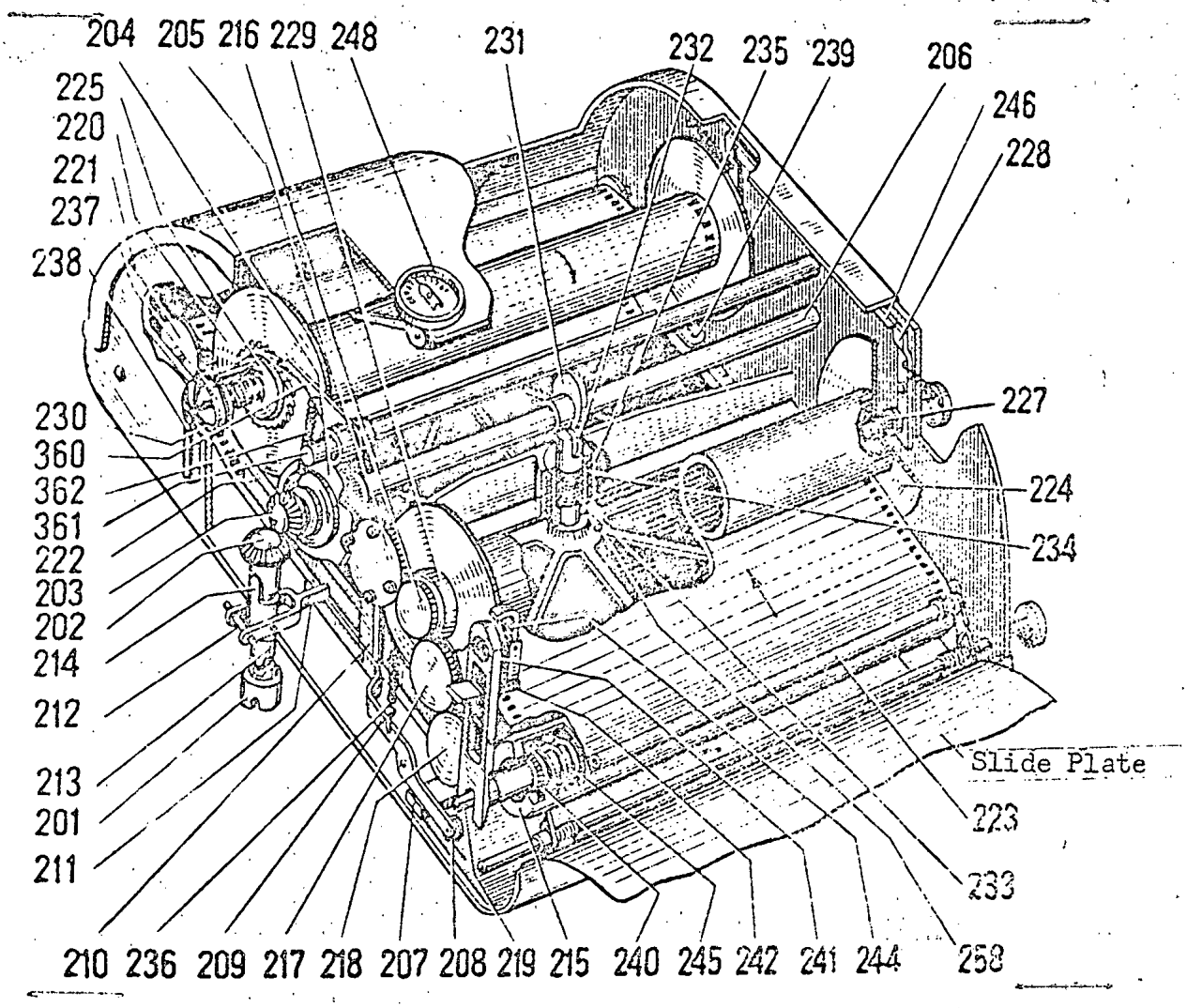


Figure 20. Kinematic Diagram of Film Holder

50X1

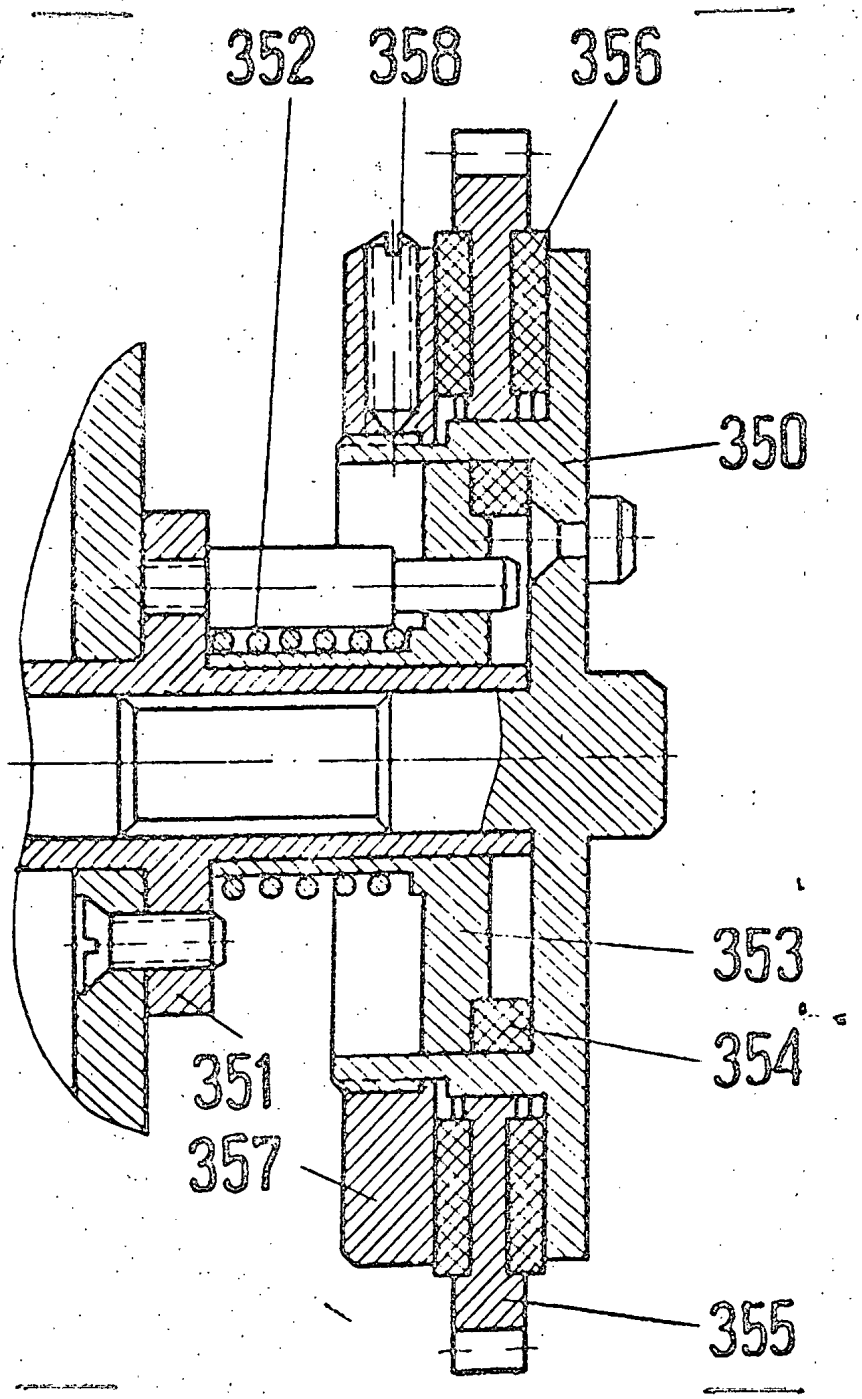


Figure 20a. Combined Friction Clutch

50X1

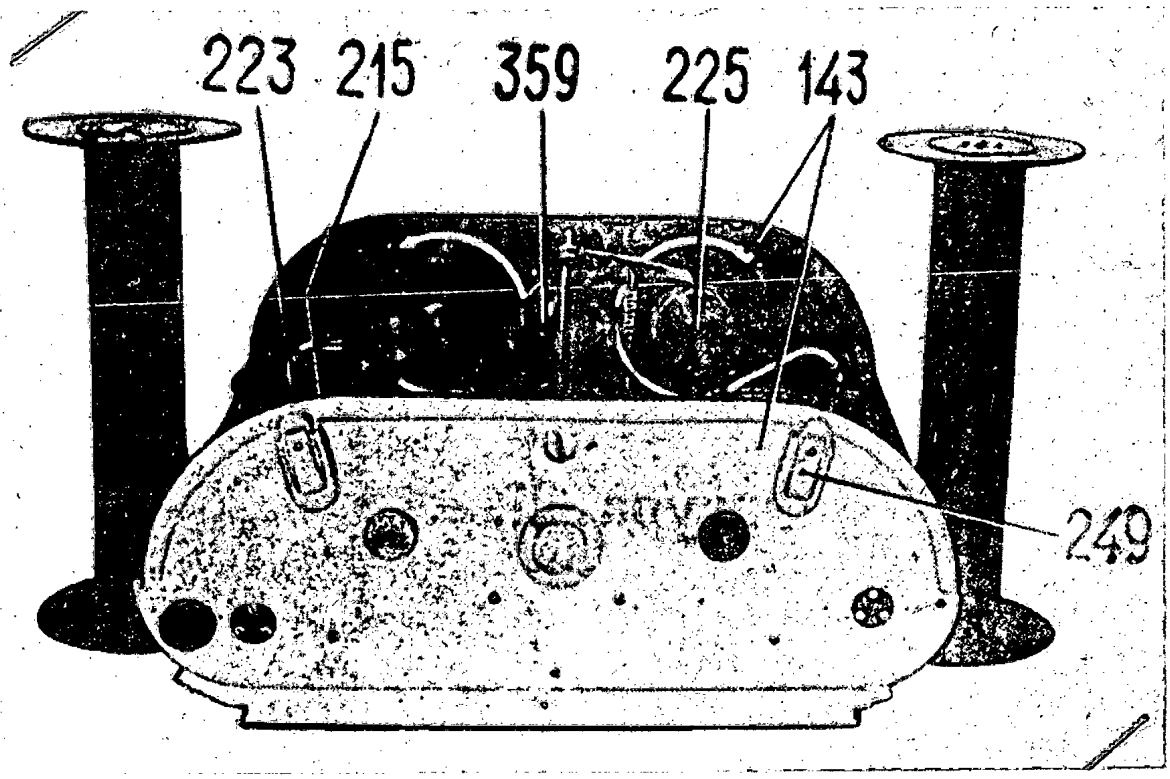


Figure 21. Film Holder. View of Mechanism

50X1

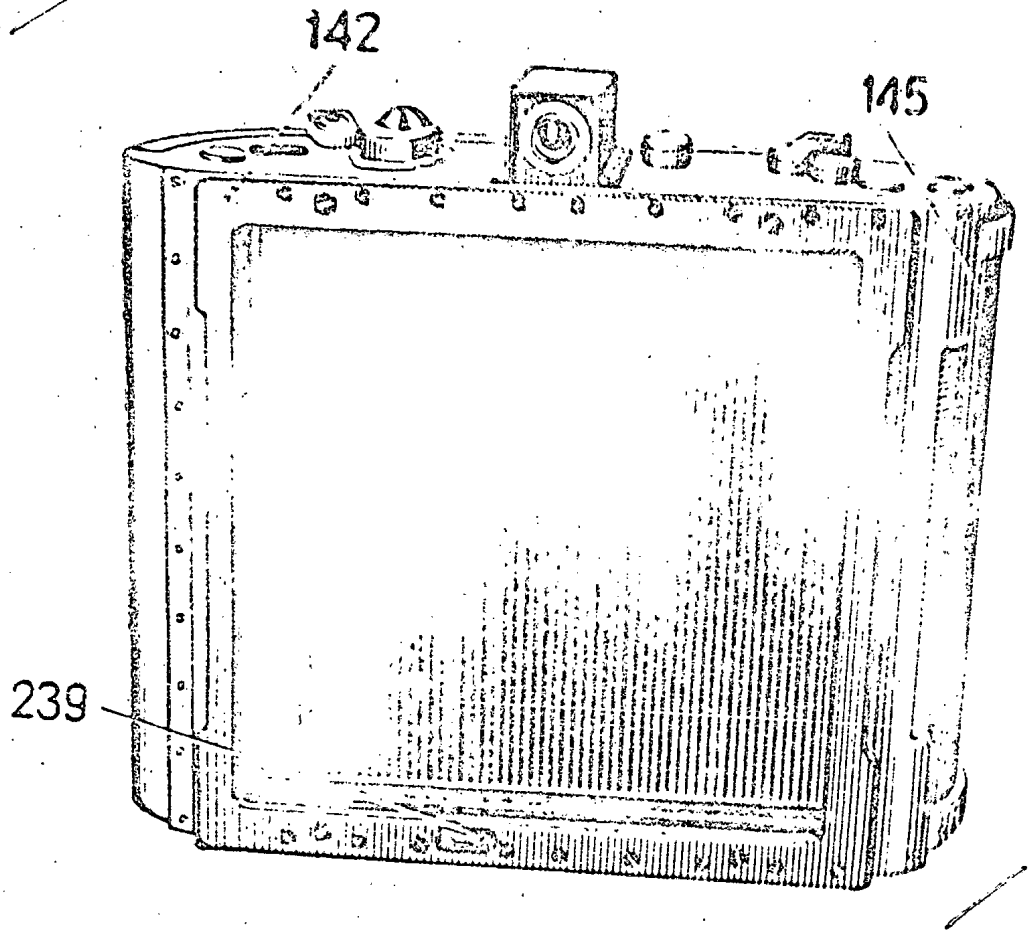


Figure 22. Film Holder. View of Table

50X1

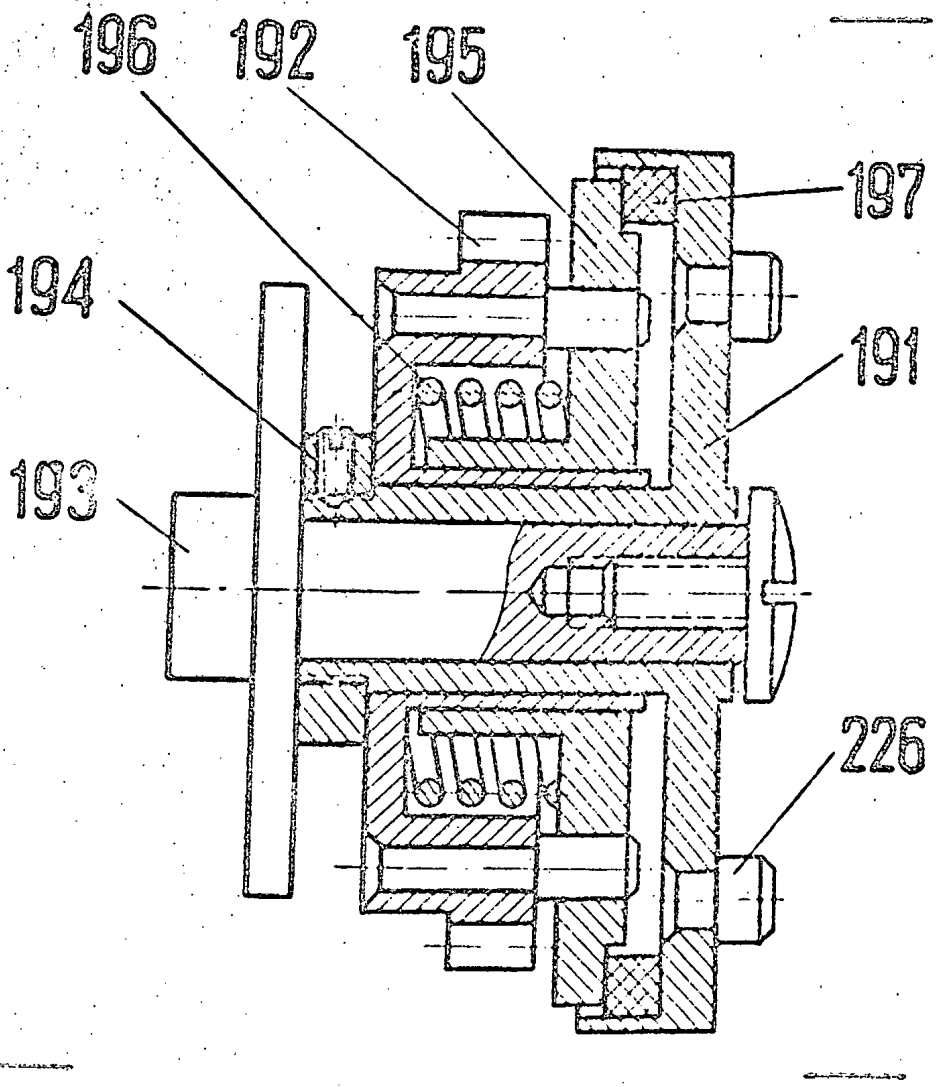


Figure 23. Friction Clutch of Take-up Spool

50X1

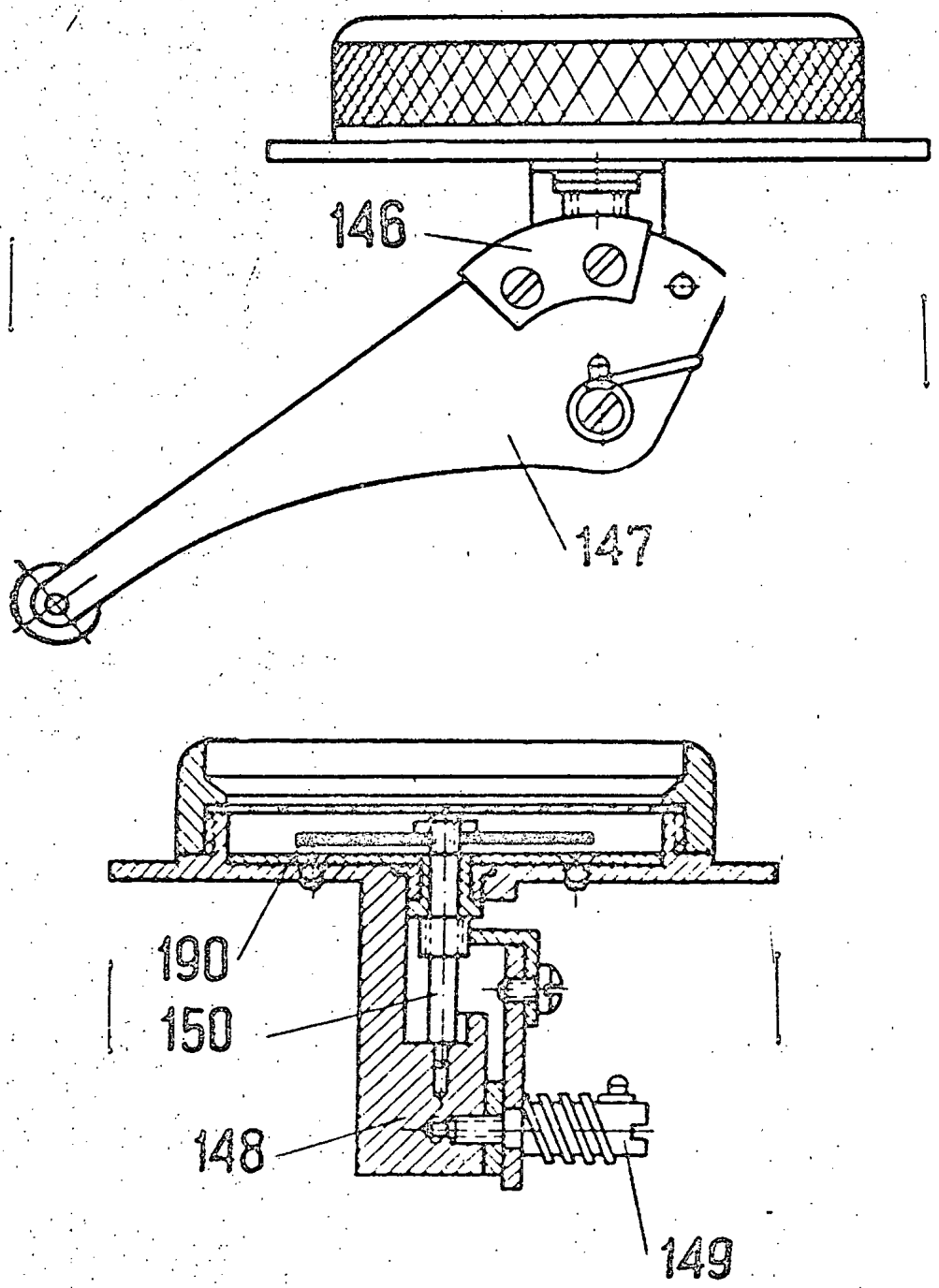


Figure 24. Film Length Counter

50X1

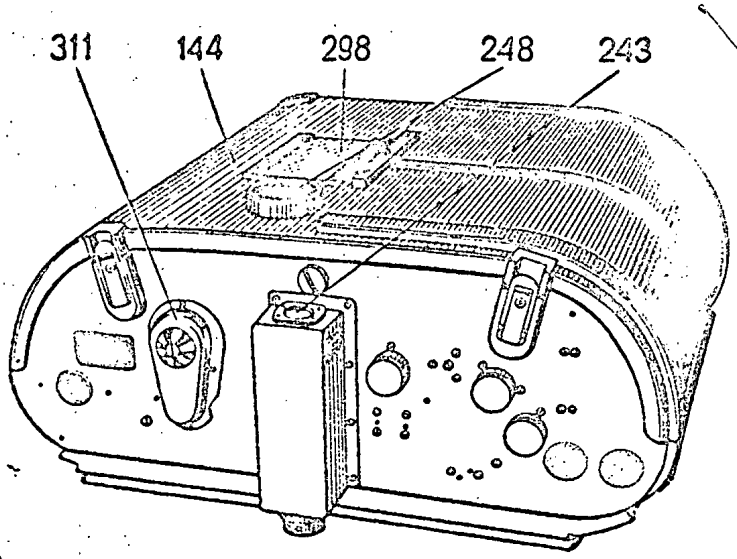


Figure 25. Film Holder. External View

50X1

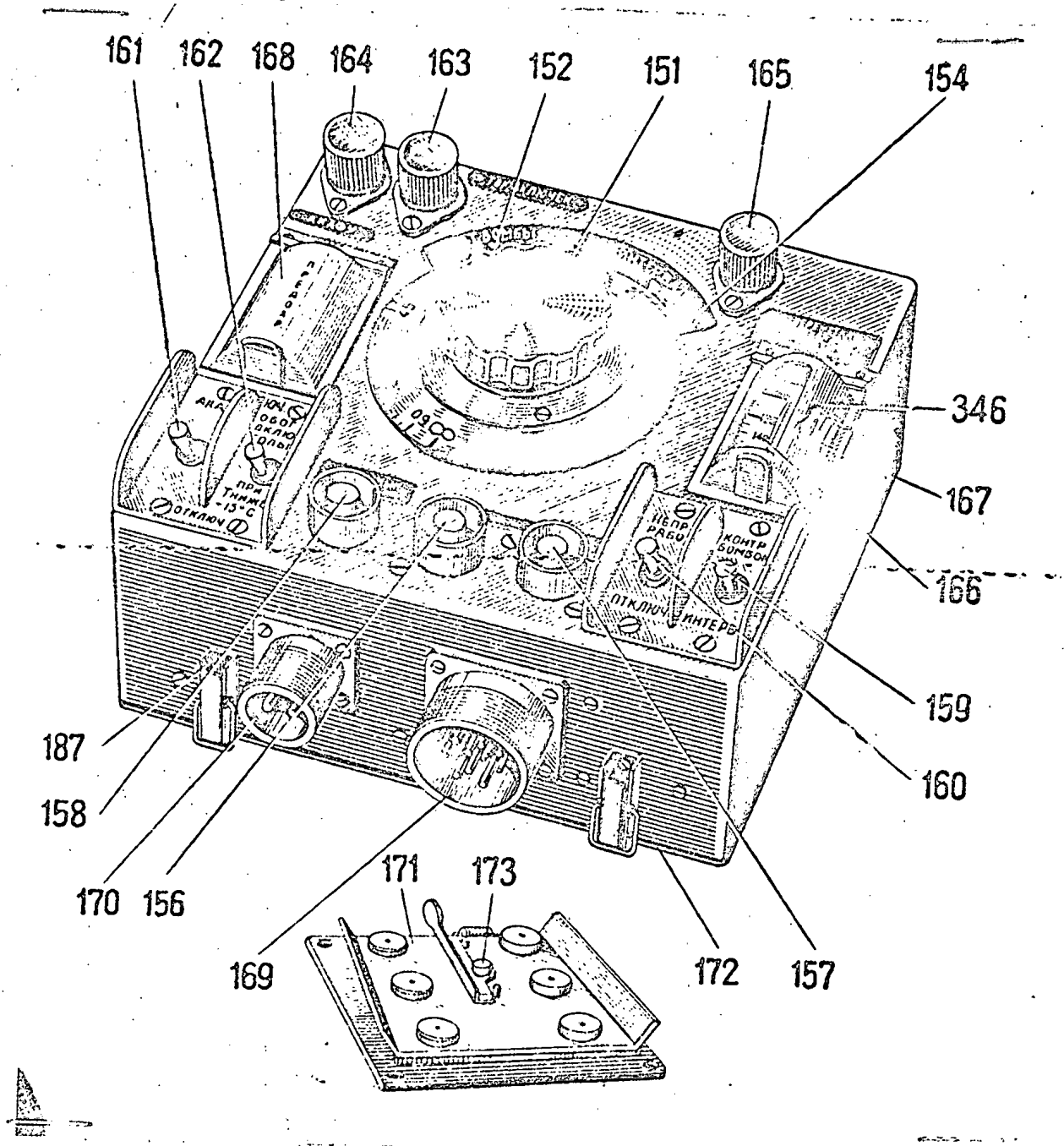


Figure 26. Command Instrument

50X1

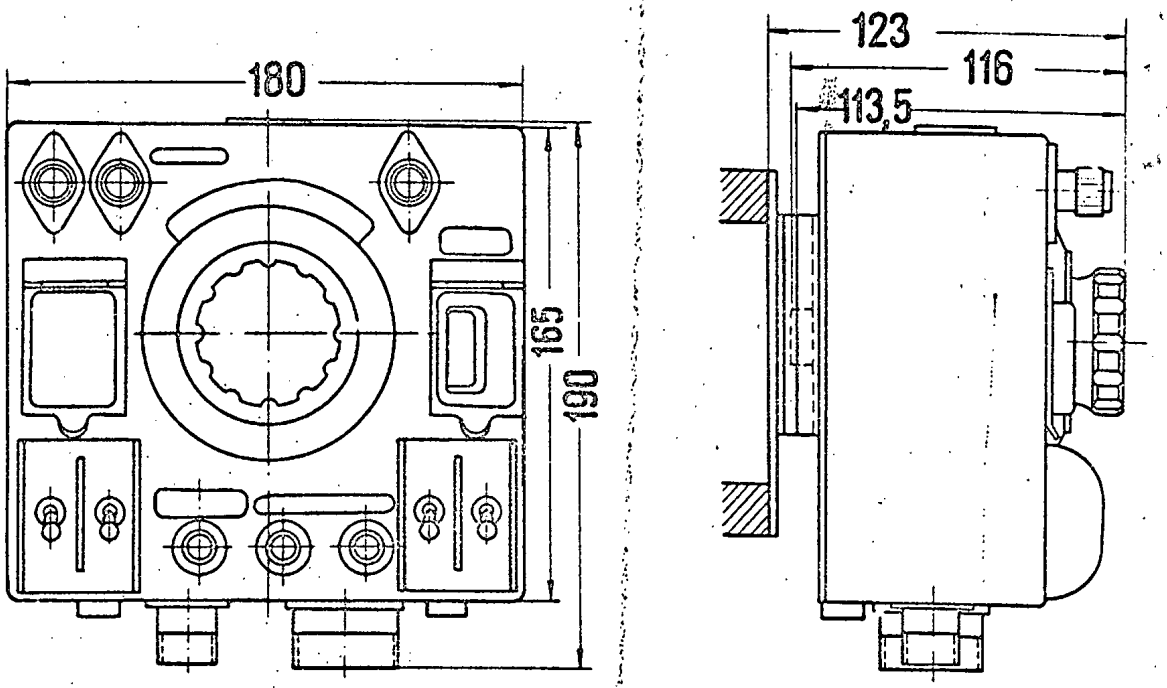


Figure 26a. Over-All Dimensions of Command Instrument

50X1

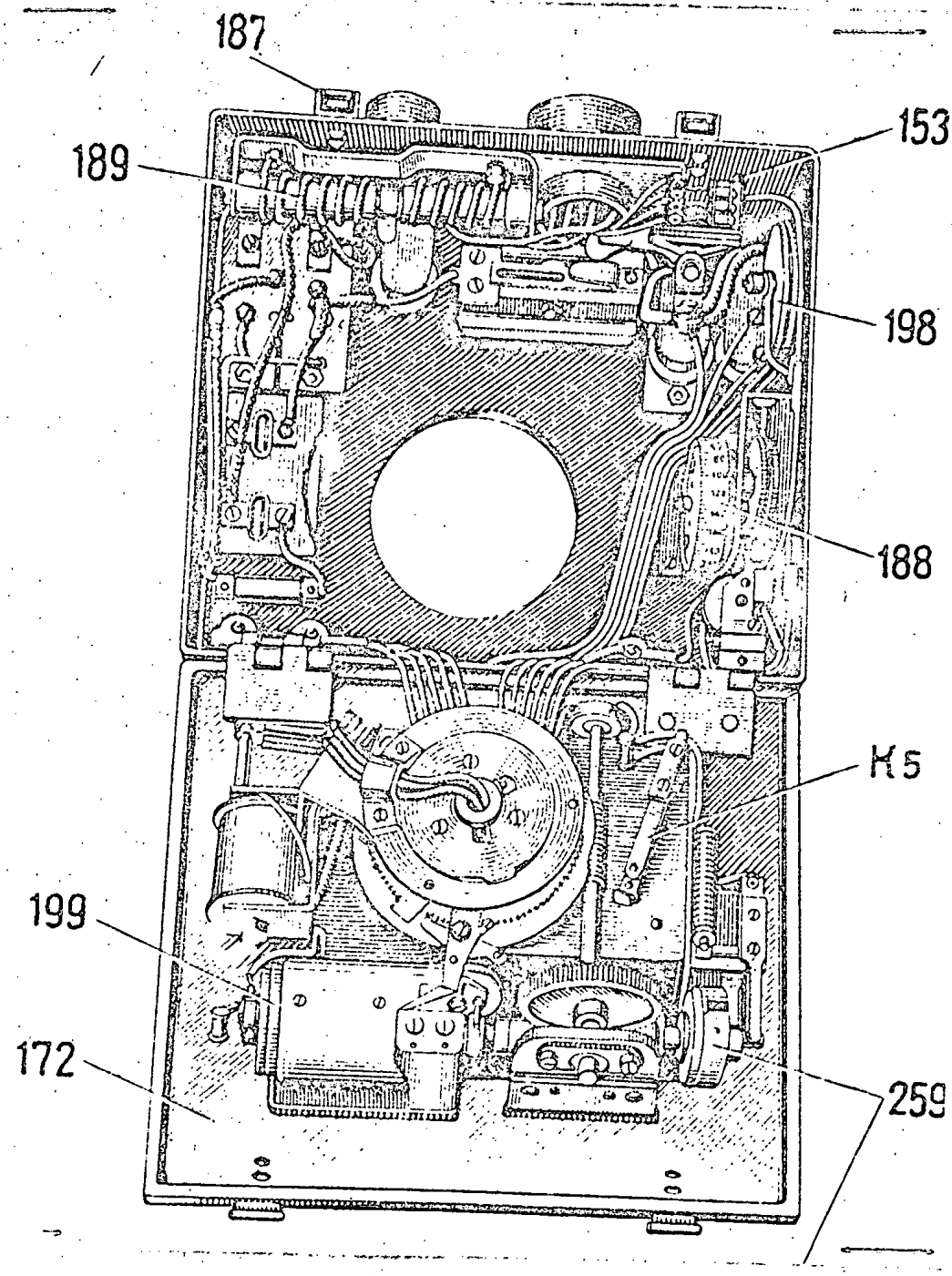


Figure 27. Command Instrument. View With Cover Open

(continued on next page)

50X1

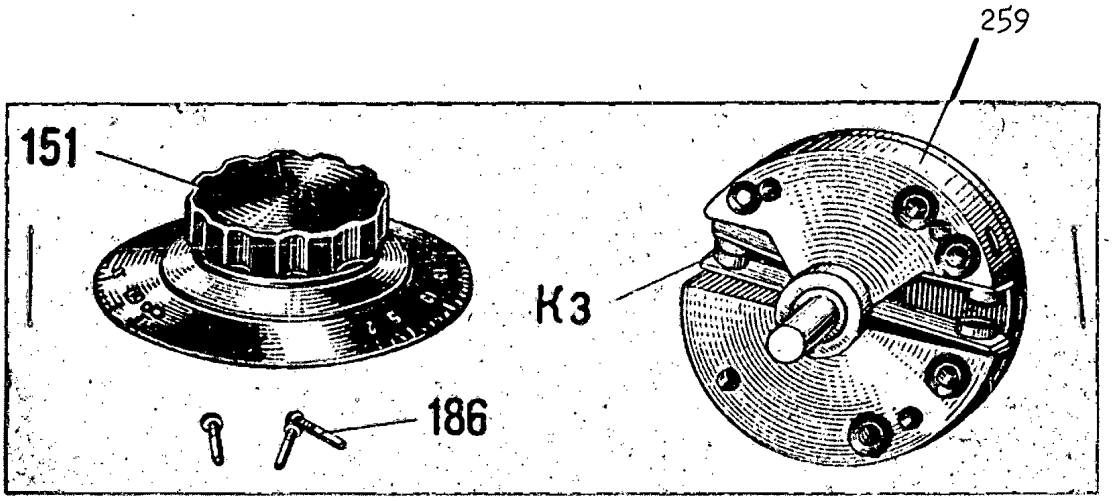


Figure 27. (continued from previous page)

50X1

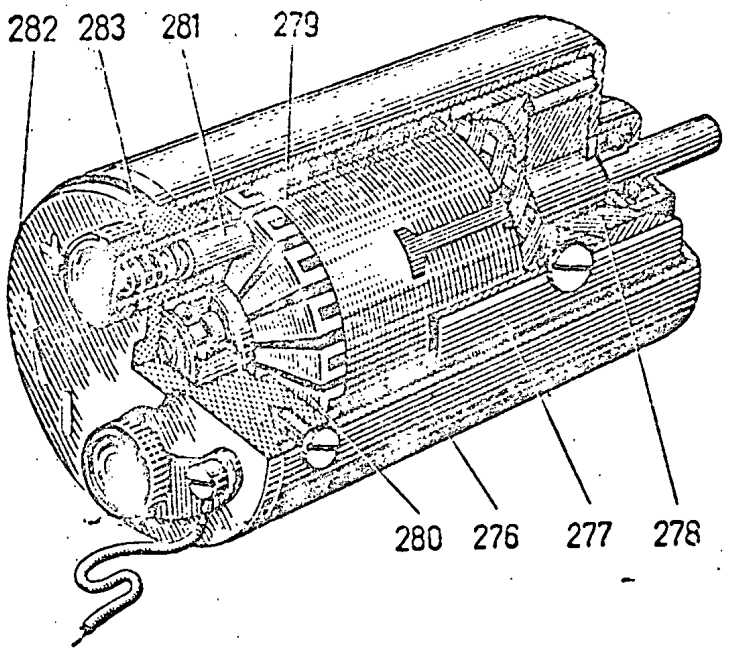


Figure 28. Electric Motor MU-010

50X1

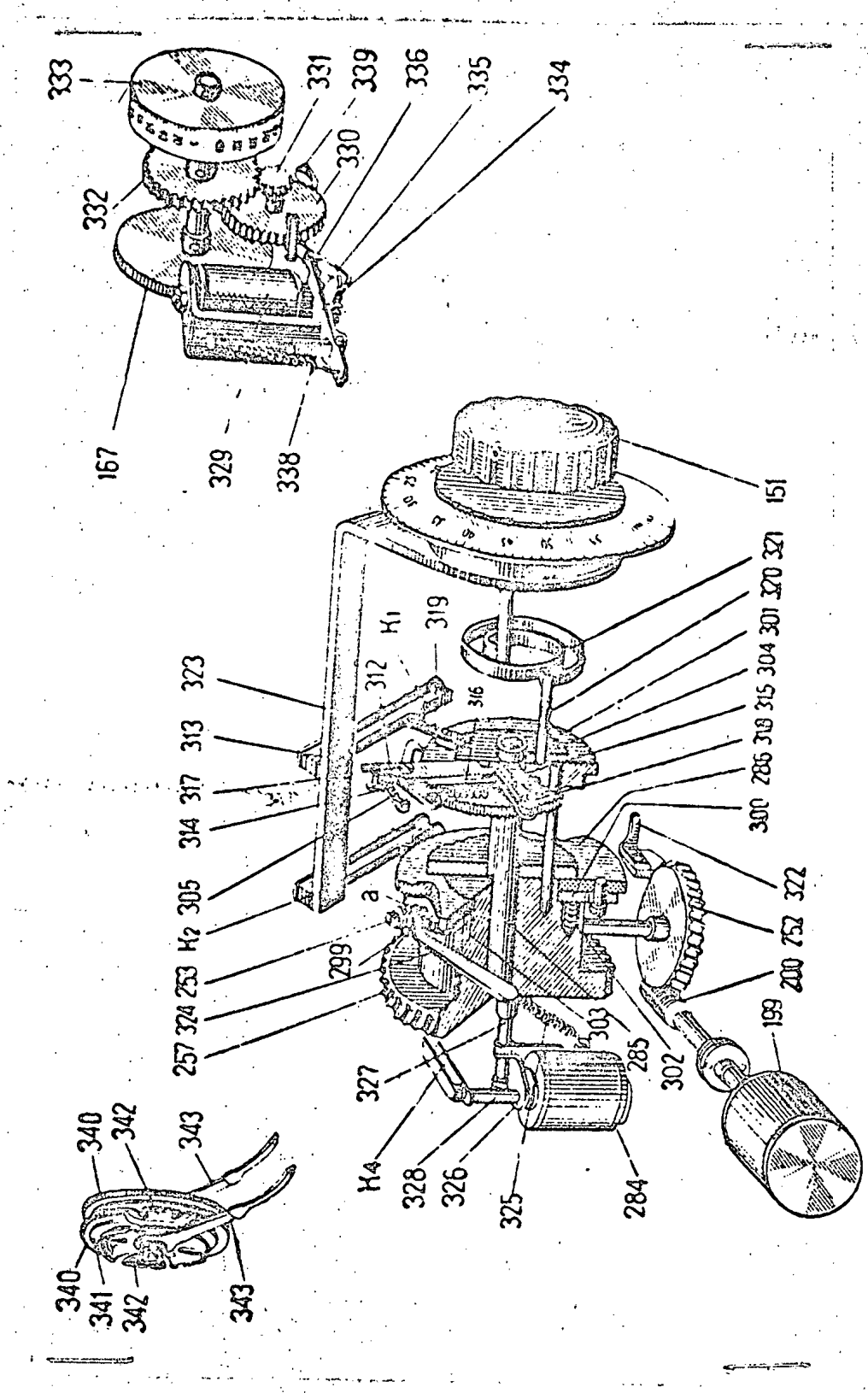


Figure 29. Kinematic Diagram of Command Instrument

50X1

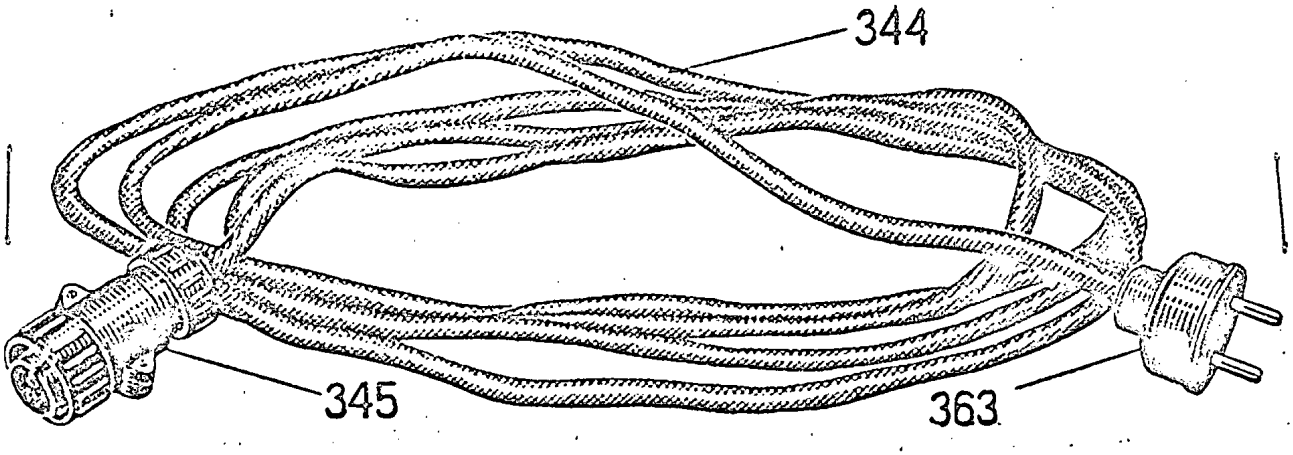


Figure 30. ESBR Electrical Cable for AFA-33M

50X1

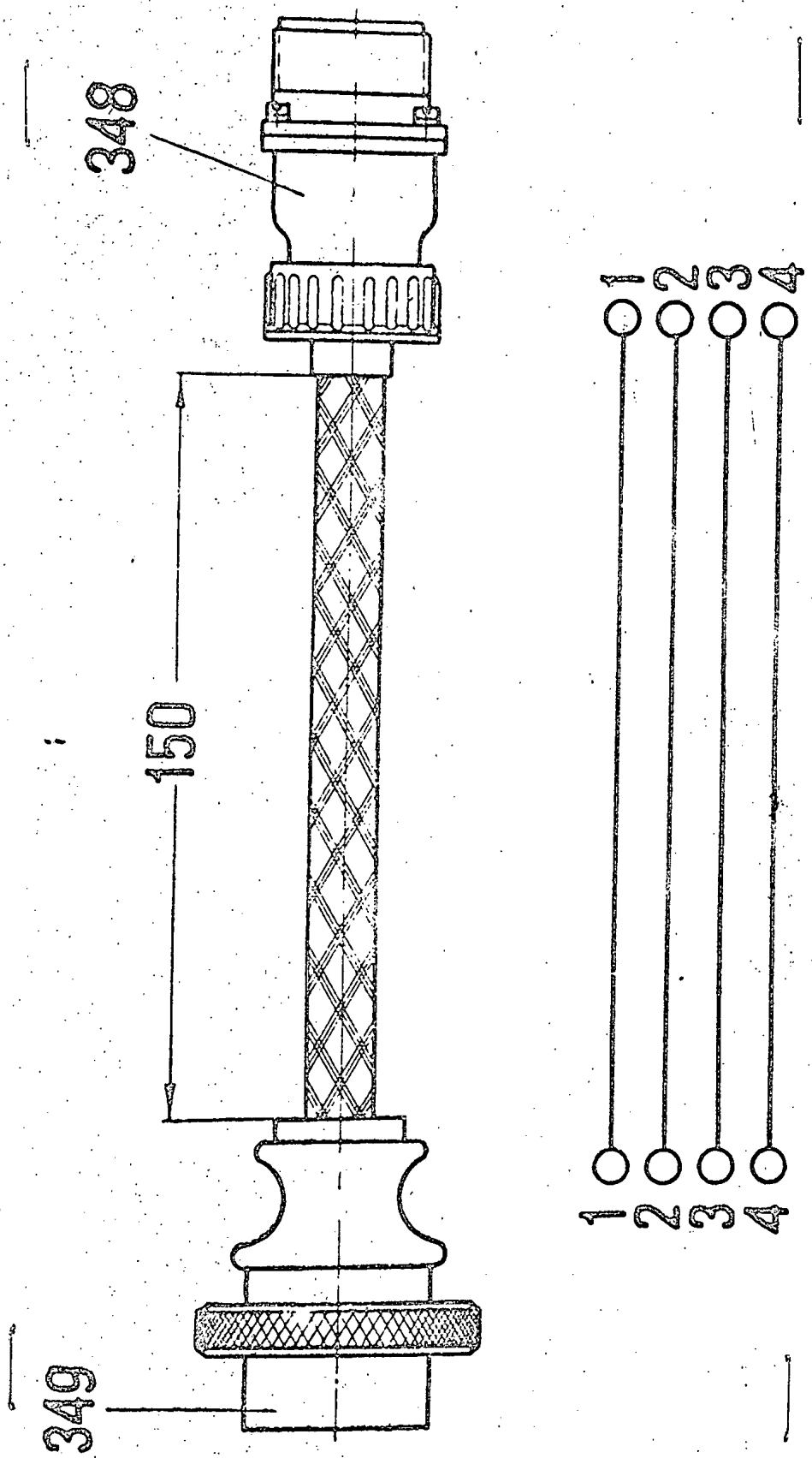


Figure 30a. Intermediate (Adapter) Cable

50X1

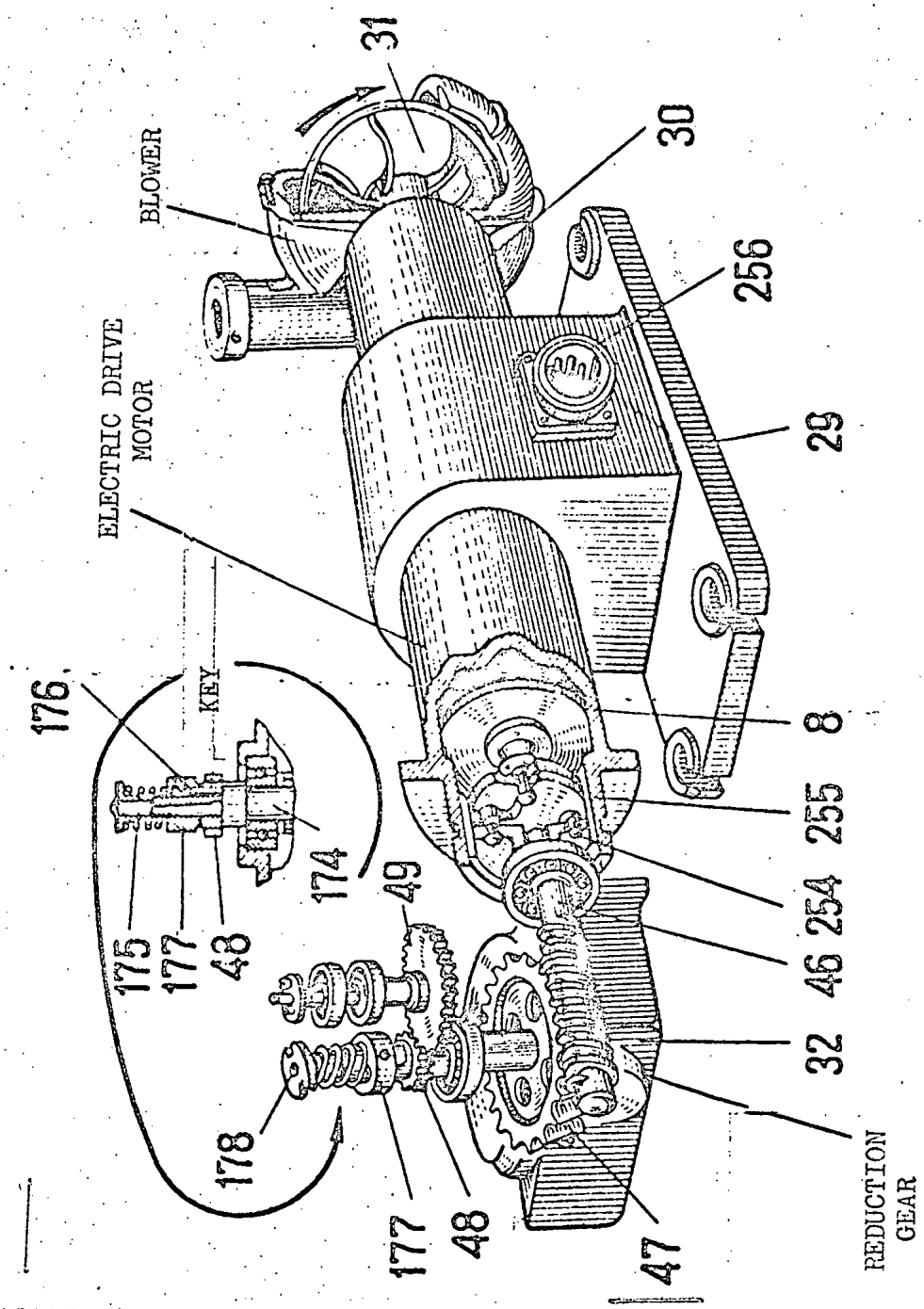


Figure 31. Kinematic Diagram of Drive-Blower Assembly

50X1

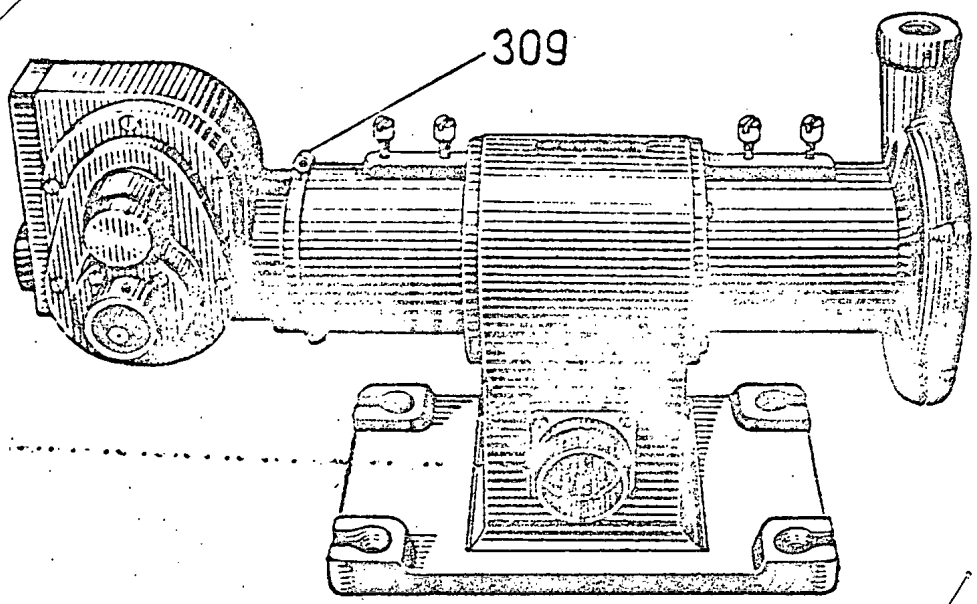
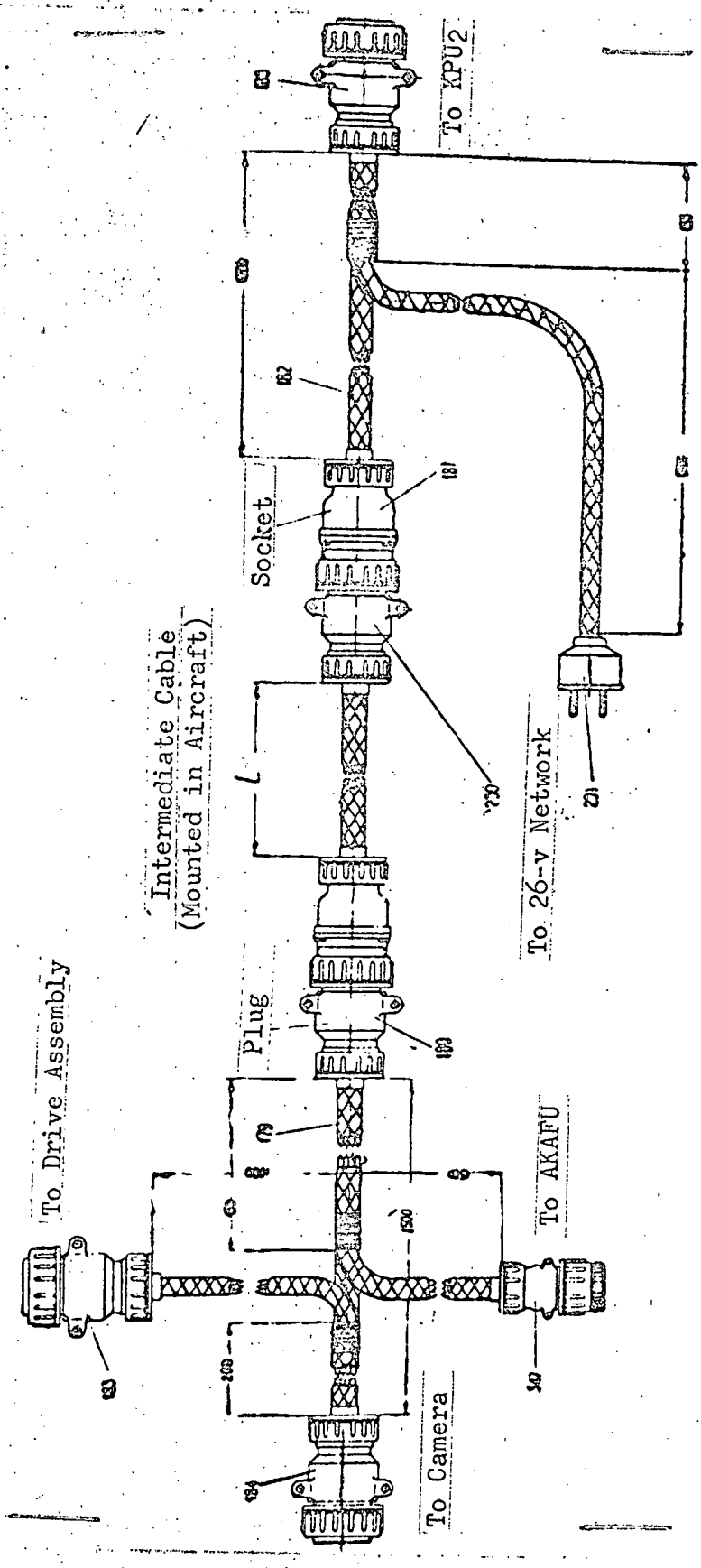


Figure 32. Drive and Blower Assembly

50X1



The length of the intermediate cable in the aircraft depends upon the distance between the camera and the command instrument

Figure 33. Electrical Cables

50X1

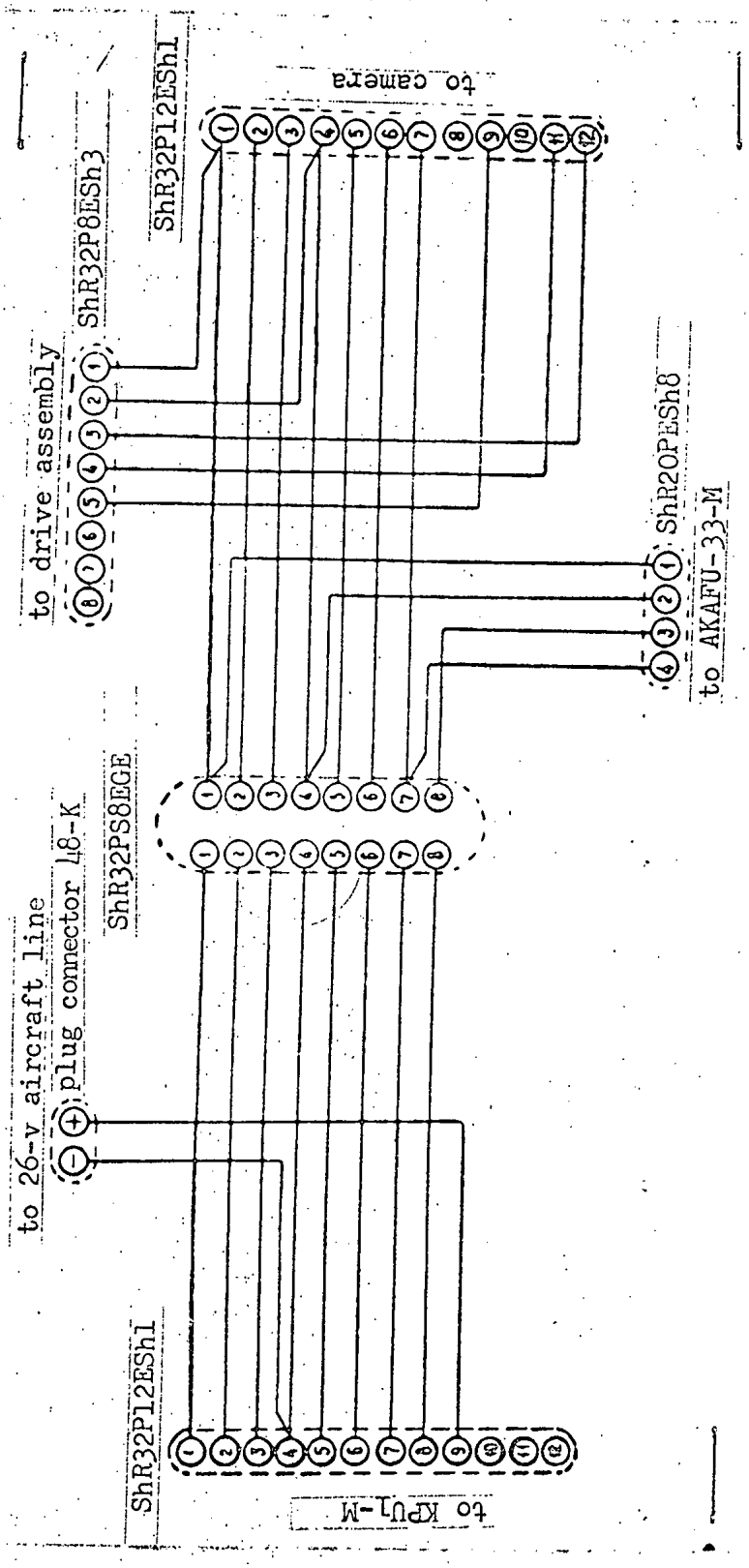


Figure 33a. Cable Wiring Diagram for the AFA-33M

50X1

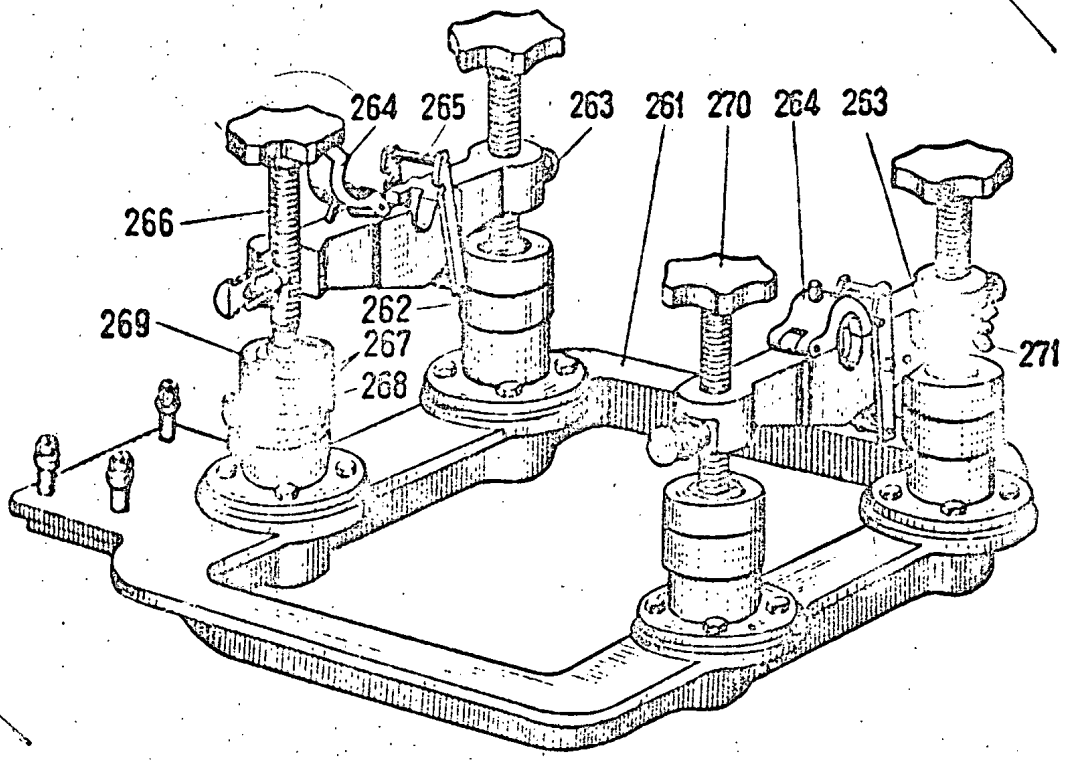


Figure 34. Mount for the AFA-33/20M Camera

50X1

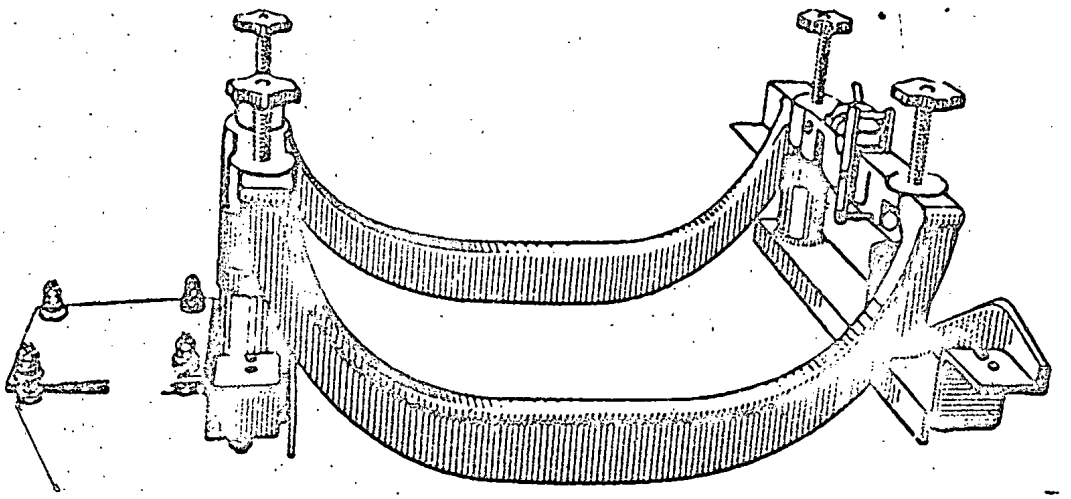


Figure 35. Mount for the AFA-33/75M and 100M Cameras

50X1

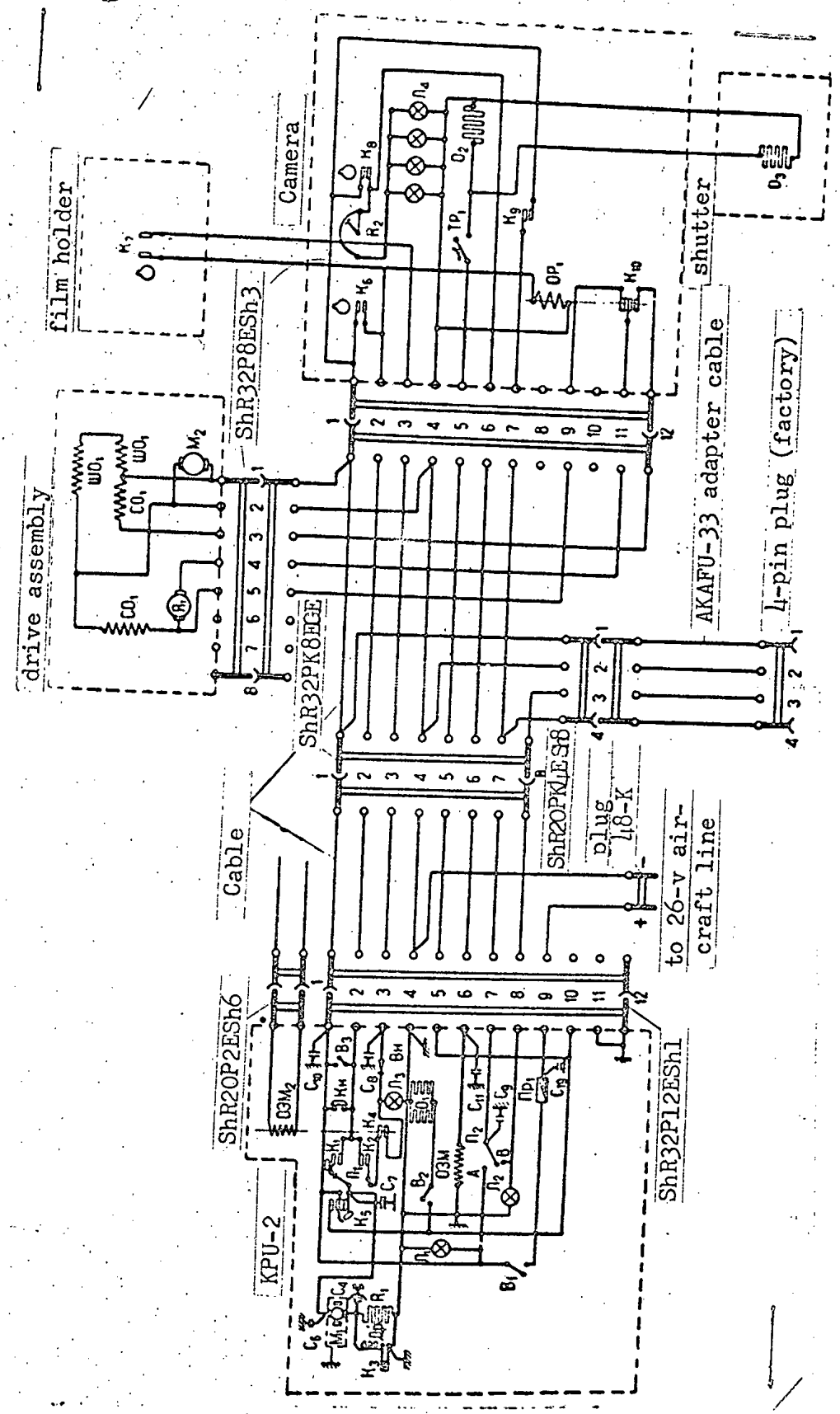


Figure 36. Schematic Electrical Diagram of the AFA-33M

50X1

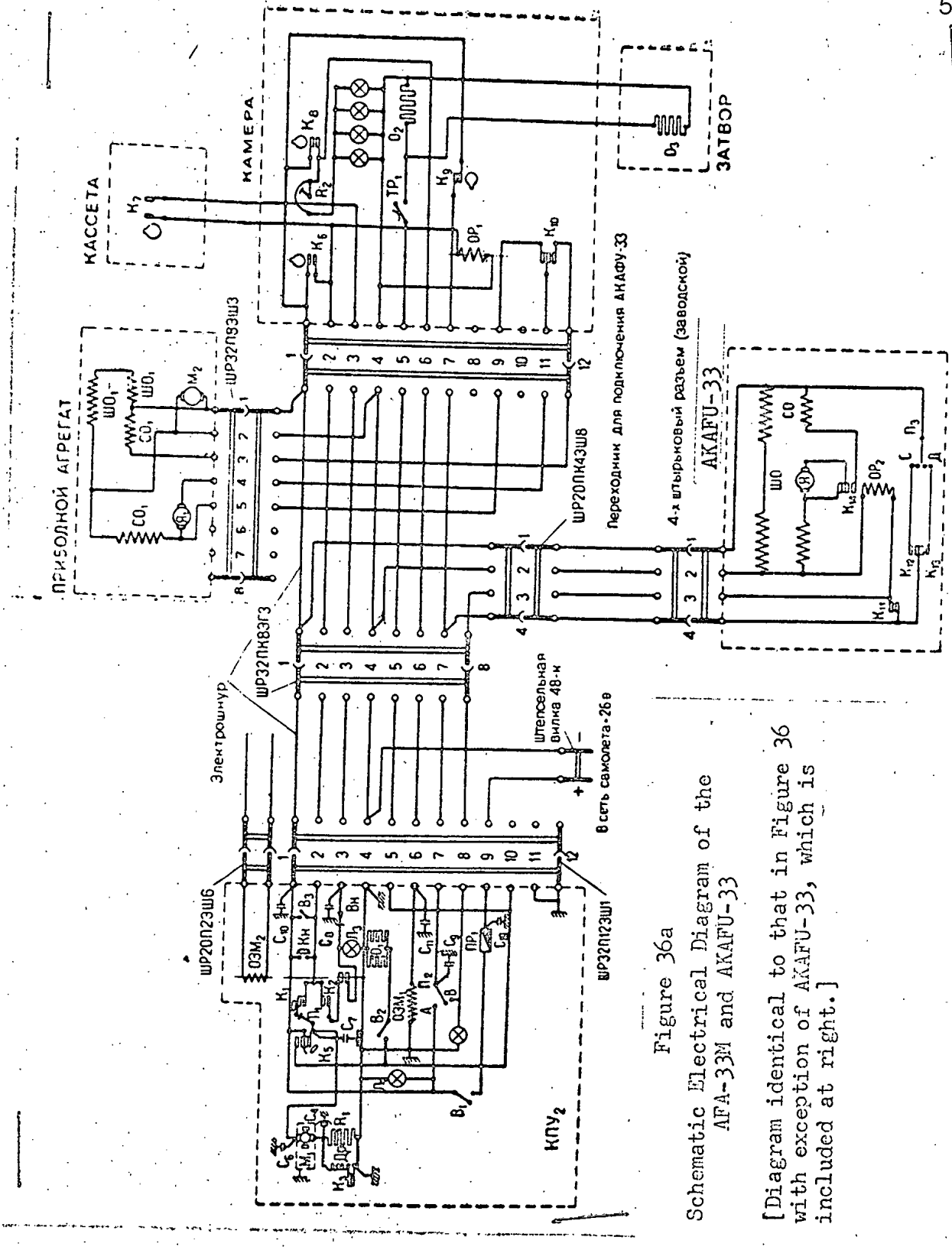


Figure 36a

Schematic Electrical Diagram of the AFA-33M and AKAFU-33

[Diagram identical to that in Figure 36 with exception of AKAFU-33, which is included at right.]

50X1

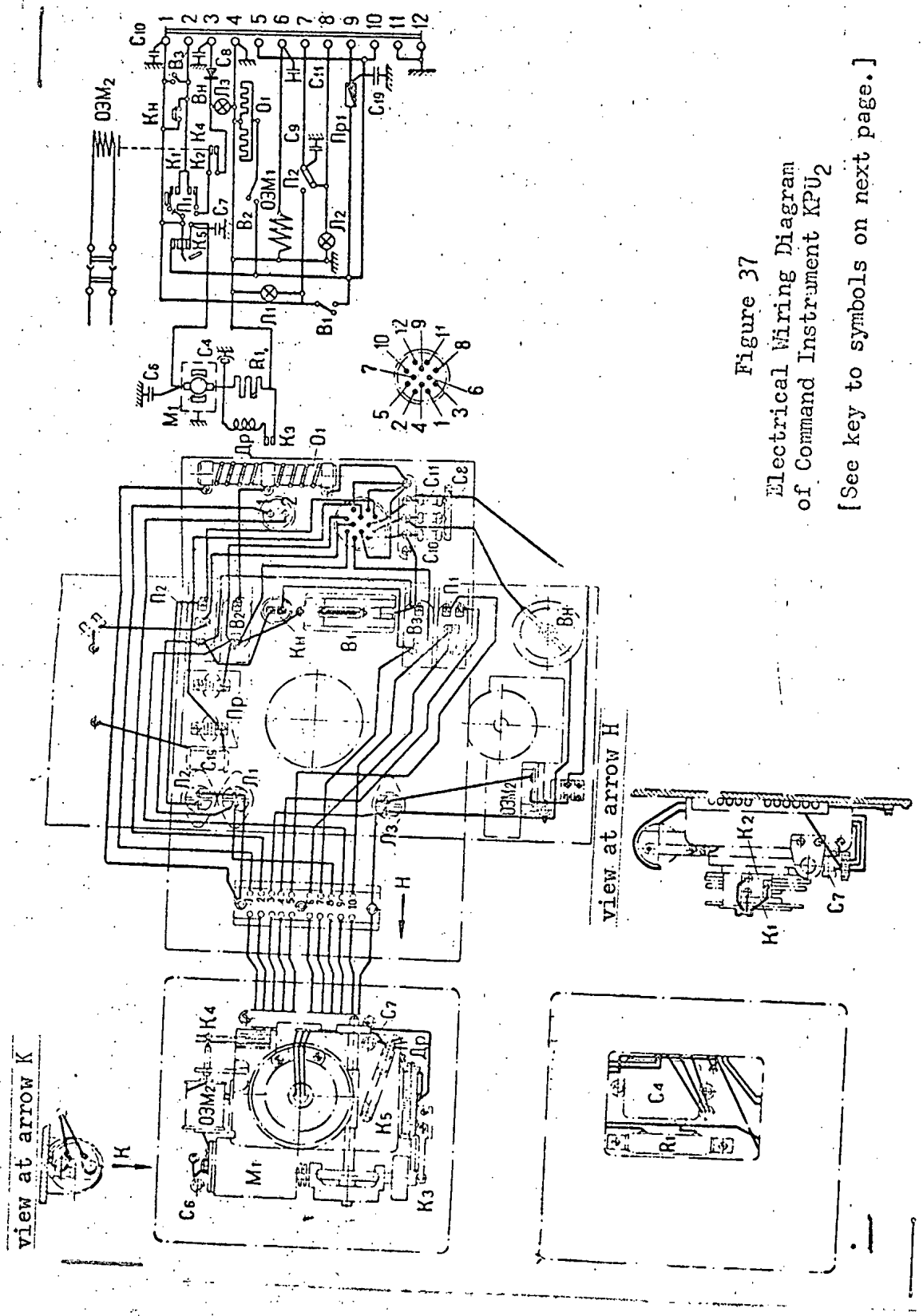


Figure 37
Electrical Wiring Diagram
of Command Instrument KPU_2

[See key to symbols on next page.]

50X1

Key to Symbols in Figure 37

OEM [ОЭМ] - winding for electromagnet of counter; OEM_2 [$ОЭМ_2$] - winding for starting electromagnet for observation of bombing results; Vn [Вн] - rectifier; Prl [Пр1] - 20-amp fuse; C4 - electrolytic capacitor KEG-1-B-50 $\frac{50}{0MK}$ -V; C6, C7, C8, C9, C10, C11 - filter capacitors KBGI-200v-$\frac{1000\ pikof}{u}$ - II; C19 - filter capacitor KBGI-200v- $\frac{01\ microf}{u}$ - II; Dr [Др] - choke coil; R1 - governor resistor in electric motor of command instrument; P1 [П1] - bombing observation operating mode switch; P2 [П2] - switch for changing camera mount from oscillating mode to steady position; V1 [В1] - common switch; V2 [В2] - heater switch for KP of shutter and light filter; V3 [В3] - switch for continuous camera operation; L1 [Л1] - light signalling current in camera and mount circuit; L2 [Л2] - light signalling operation of camera mount (oscillating); L3 [Л3] - light signalling advance of film or ready for observation of bombing; O1 - command instrument heater; K1 - contact supplying pulses to camera when operating with time intervals; K2 - contacts switching on camera when observing bombing; K3 - contact regulating speed of KP (command instrument) motor; K4 - contact signalling ready for bombing observation; K5 - contact for setting KP on ∞; Kn [Кн] - button for individual photographs; M1 - electric motor of KPU_1.

50X1

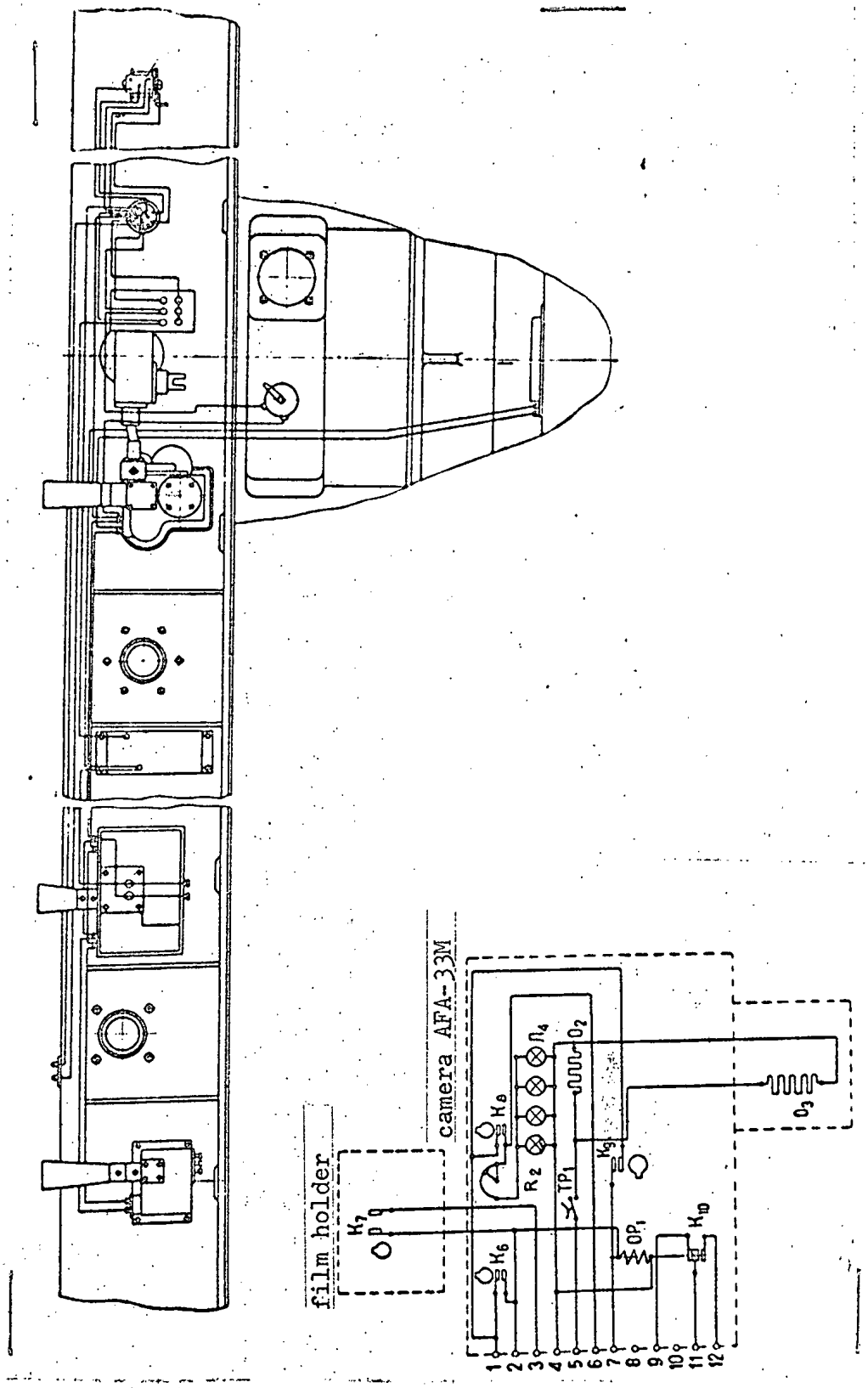


Figure 38. Electrical Wiring Diagram of Camera With Cone

50X1

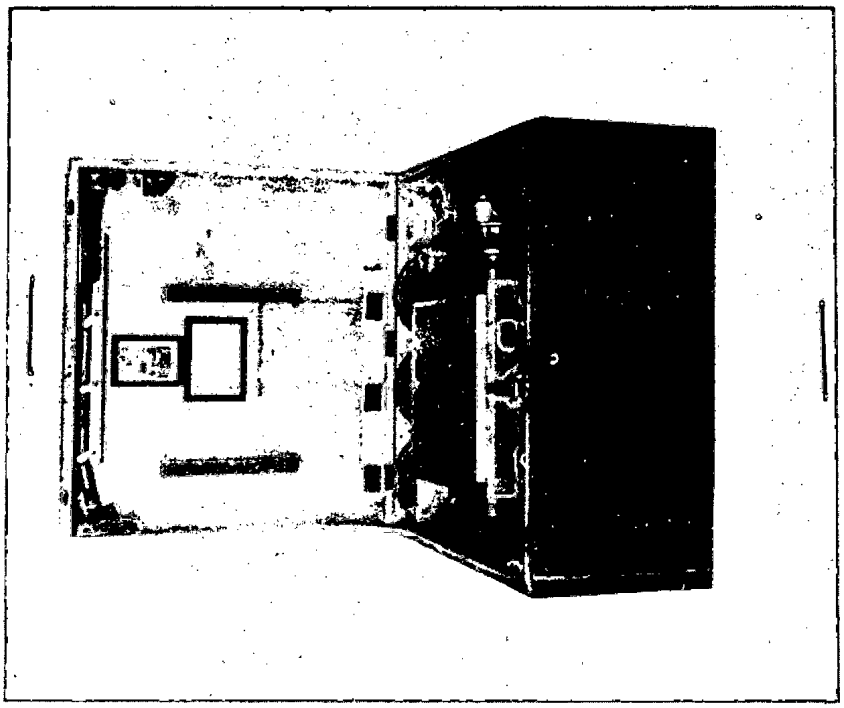


Figure 40
AFA-33/20M in Packing Crate

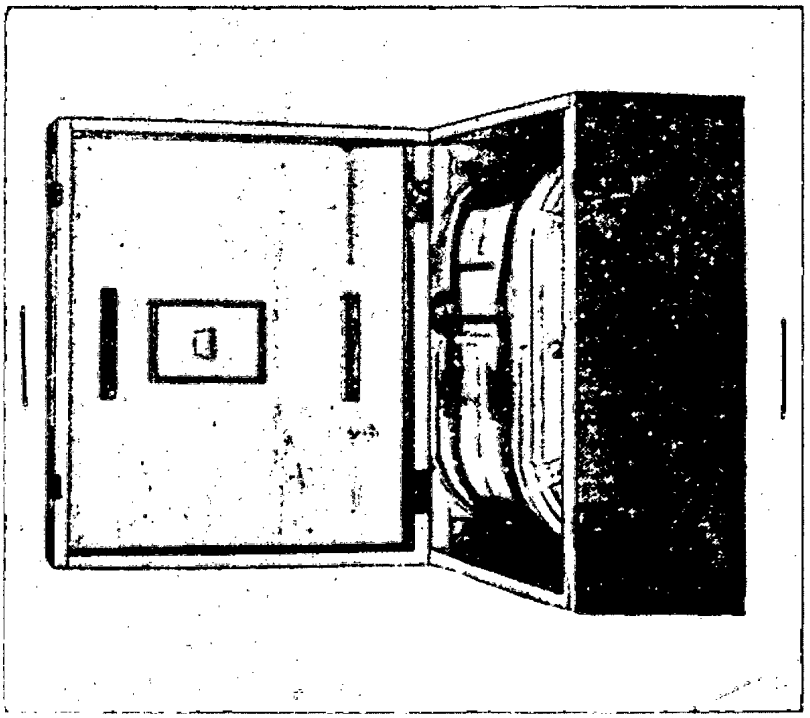


Figure 39
Film Holder in Packing Crate

50X1

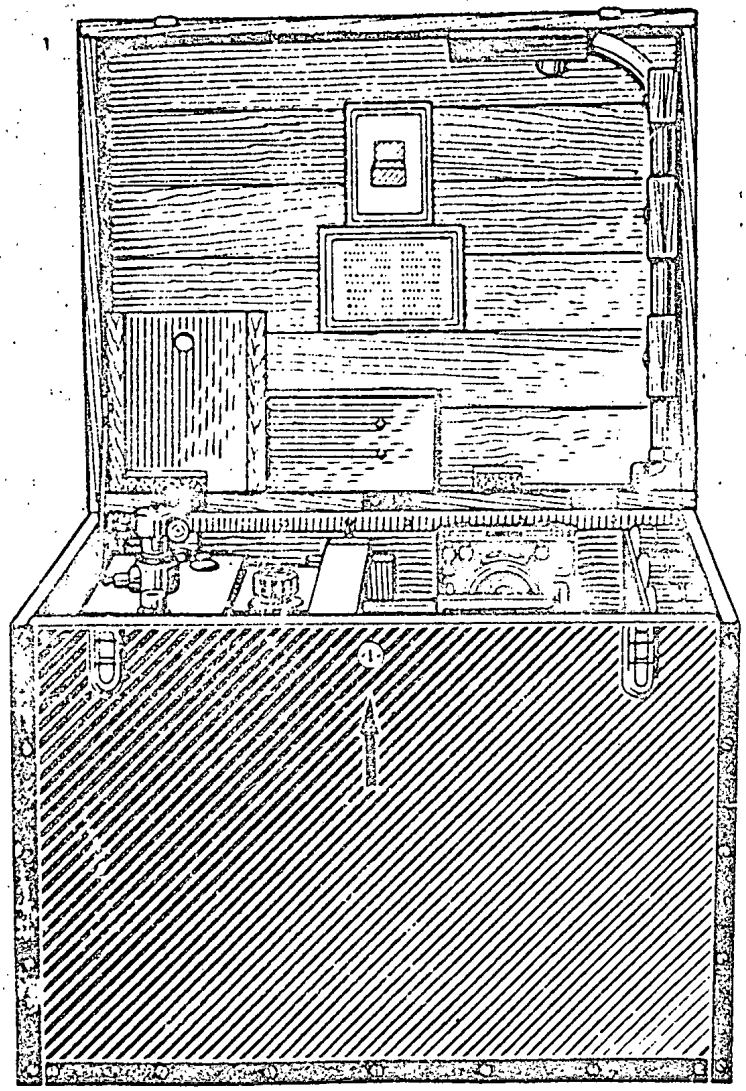


Figure 41. AFA-33M in Packing Crate

50X1

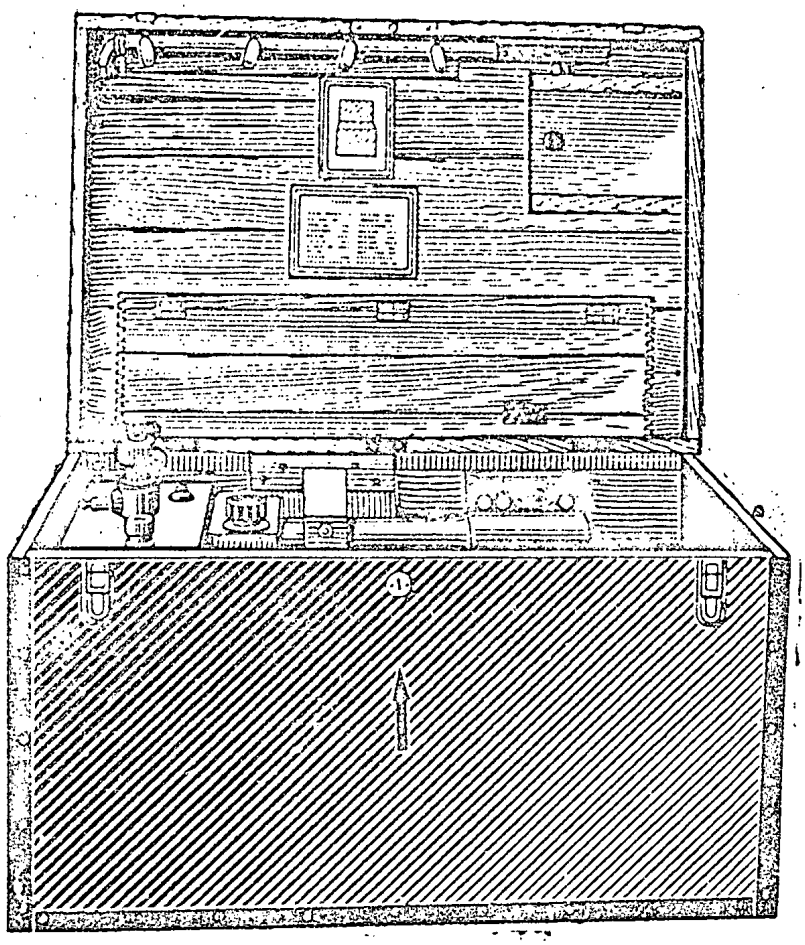


Figure 42. AFA-33/100M in Packing Crate

50X1

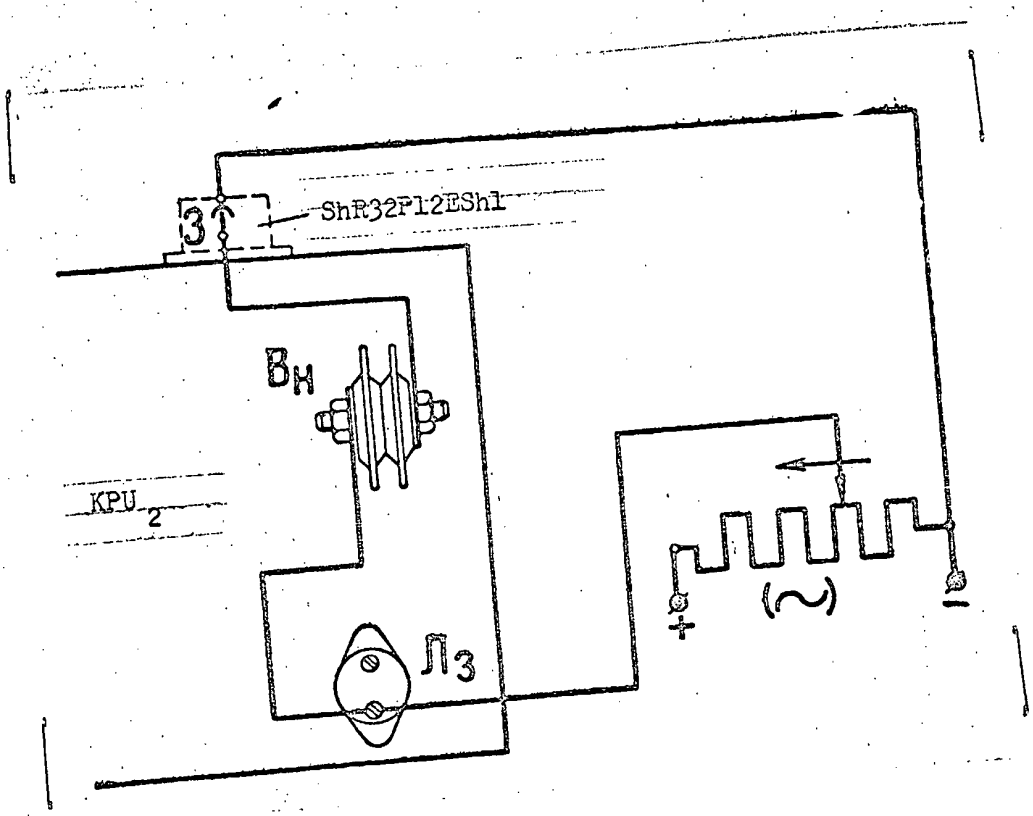


Figure 43. Circuit for Restoration of Selenium Pile

[B_H - selenium rectifier; $Л_3$ - signal light L3]