SERVICE INSTRUCTIONS

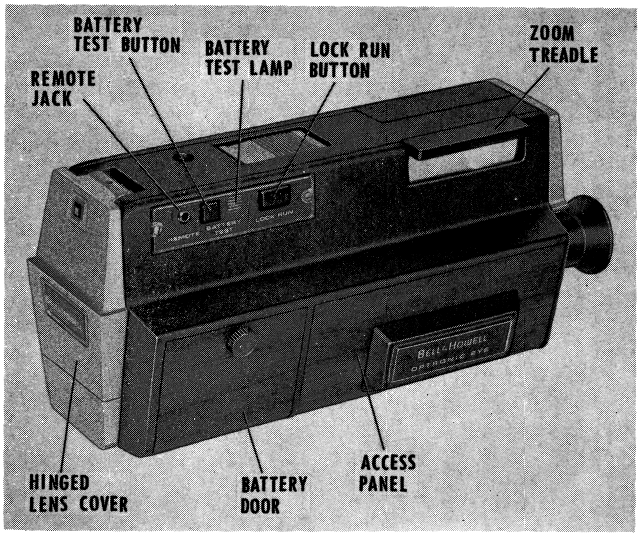
AUTOLOAD ®
SUPER 8 CAMERA

DESIGN 440

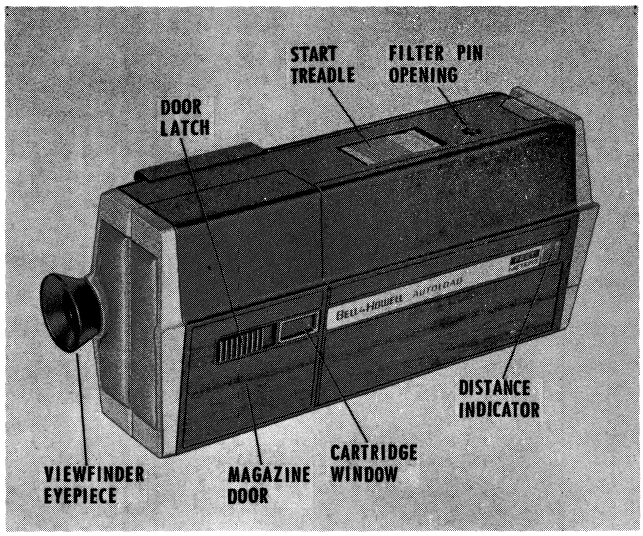
BELL & HOWELL

PHOTO SALES COMPANY
GENERAL SERVICE DEPT.
7100 McCORMICK ROAD
CHICAGO, ILLINOIS 60645

PART NO. 70497 PRINTED IN U.S.A. AUGUST 1967



Front 3/4 View of Design 440 Camera



Rear 3/4 View of Design 440 Camera

FEATURE DESCRIPTION LIST
(BELL & HOWELL DESIGN 440 SUPER-8 AUTOLOAD)

GENERAL DESCRIPTION: . . . . . Cartridge-loading camera with manual zoom lens. Uses Super-8 film only. Film cartridge automatically sets correct A.S.A. and filter settings.

COLOR: . . . . . Dark brown with walnut trim.

LENS: . . . . . Varizoom 9 to 45 mm f/1.8 with adjustable focus ring.

LENS ZOOMING RANGE: . . . . . 3 feet to infinity.

EXPOSURE CONTROL: . . . . . Under-exposure indicator; lens focus indicator in viewfinder, iris range f/1.8 to f/64; automatic A.S.A. setting with A.S.A. 10 to 400 range.

FILTER: . . . . . Type A behind-the-lens filter, removed from position by cartridge or by filter pin.

VIEWFINDER: . . . . . Reflex viewfinder with focusing lens; viewing through the zoom lens.

FILM DRIVE: . . . . . Battery-powered camera motor; four 1-1/2 volt size AA Penlite batteries (Eveready Type E91 or Mallory Type MN-1500).

ELECTRIC EYE: . . . . . Through-the-lens photocell sensing.

FILM SPEED: . . . . . 18 fps (normal) and 36 fps (slow motion).

FILM RUN: . . . . . 50 foot on one loading (cartridge reversal unnecessary).

SPECIAL FEATURES: . . . . . Remote power socket.
Battery test indicator.
Single frame by cable release.
Takes pistol grip and sun gun.

FACTORY SERVICE ADDRESSES

PRODUCT ONLY

CHICAGO

Bell & Howell Photo Sales Co.
General Service Department
2409 West Howard Street
Evanston, Illinois 60202
Area Code: 312-673-3300

NEW YORK

Bell & Howell Photo Sales Co.
General Service Department
200 Smith Street
E. Farmingdale, L.I., New York 11735
Area Code: 516-293-8910

GLENDALE

Bell & Howell Photo Sales Co.
General Service Department
623 Rodier Drive
Glendale, California 91201
Area Code: 213-245-6631

PARTS ORDERS AND SERVICE INFORMATION

Bell & Howell Photo Sales Co.
General Service Department
7100 McCormick Road
Chicago, Illinois 60645
Area Code: 312-673-3300

TABLE OF CONTENTS

Introduction

This Service Manual has been prepared to aid the serviceman in the overhaul and adjustment of the Bell & Howell Design 440 Super 8 Autoload Camera. Special camera features are listed in the Feature Description List on the preceding page. Four 1-1/2 volt size AA alkaline "Penlite" batteries provide the power to drive a motor which, through a gear-and-cam shuttle arrangement, advances the film. Proper batteries recommended for use are the Eveready Type E91 or the Mallory Type MN-1500. A hinged lens cover, when closed, activates a switch plunger to disconnect the batteries from the electrical circuit and thus prevent unnecessary drain on the batteries. The condition of the batteries can be checked by pressing the "Battery Test" button. If the test lamp beside the button fails to glow, the batteries should be replaced.

Through the-lens viewing is accomplished by means of the optical system pictured in Figure A. Viewfinder focusing is accomplished by rotating the rubber viewfinder eyeshield. The camera lens is zoomed to the "wide angle" and "telephoto" positions by manipulating the zoom treadle near the rear of the camera. The rear element of the zoom lens assembly moves on a precision track and is connected to the zoom treadle by a rocker link. For best results and smoothest operation, the friction surfaces of the zoom treadle and casting must be free of all dirt and lubricant.

An illustrated Parts Catalog is included at the rear of this Instruction Book to identify replacement parts of the camera. All parts in the exploded view illustrations are indexed in a suggested order of disassembly and, therefore, will serve as an aid to the serviceman during camera repair. When making specific repairs and replacements, the serviceman must use his own judgement in eliminating unnecessary steps of procedure. Illustrations referred to by letter (Figure A, Figure B, etc.) will be found in the service instructions portion of this manual; those identified by number are in the Parts Catalog section.

THEORY OF ELECTRIC EYE OPERATION.

The reflex electric eye sensing system used in the Design 440 Super 8-mm camera consists of two independent sections: (1) Behind the iris light sensing and, (2) Type A filter, A.S.A. film speed disc and Speed mask. The upper portion of Figure A illustrates, pictorially, the physical layout of the optical components; the lower portion of Figure A depicts the entire system schematically.

(1) Behind the Iris Light Sensing. The light enters the zoom lens, passes through the opening formed by the meter iris blades, and then through the prime lens. At this point, the light is directed alternately to the film and to the photoconductive cell by means of a mirror attached to the reciprocating shutter. When the shutter is in the "down" position, the light passes through aperture opening to the film; when the shutter is in the "up" position, the shutter mirror is in front of the aperture and the light is directed to the photocell, which automatically establishes the correct light level at the film plane.

The electric eye meter bridge circuit is shown schematically in the enclosed box at the lower left-hand corner of Figure A. When used in conjunction with the photoconductive cell, this system is precisely calibrated (or trimmed) for a particular exposure, or light level, as sensed by the cell. Instructions for checking and trimming the system will be found in the Test Procedure section.

The electrical resistance of the photoconductive cell is instantaneously affected by the light level to which the cell is exposed. For example, a decrease in light level through the zoom lens will cause an immediate increase in the resistance of the cell to a value greater than the calibrated resistance value of the trim calibrating resistor (RT). Therefore, the current, following the path of the solid arrows in the Figure A bridge circuit diagram, will increase in proportion to the decrease in light level. The increase in current through the electric eye meter coil causes the iris blades to open, thus increasing the light to the photocell until the balanced ("trimmed") condition of the system once more has been attained. Conversely, an increase of the light level through the zoom lens will cause a corresponding decrease in photocell resistance. Thus, the current following the path of the dashed arrows in the diagram will increase and cause the iris blades to close until the system once more is balanced, or trimmed.

(2) Type A Filter and A.S.A. Film Speed Disc and Speed Mask. As illustrated in Figure A, the Type A filter adjusts the electric eye sensing system for artificial or for daylight operation. The A.S.A. film speed disc adjusts the electric eye system for operation at the proper film speed. Both of these operating conditions are automatically compensated for by notches in the film cartridge. When the cartridge is inserted into the camera, one notch determines whether or not the Type A filter is to be removed from the light path. A second notch designates the precise A.S.A. value of the film and, through linkage within the camera mechanism, rotates the A.S.A. film speed disc until a wedge of proper density is po-

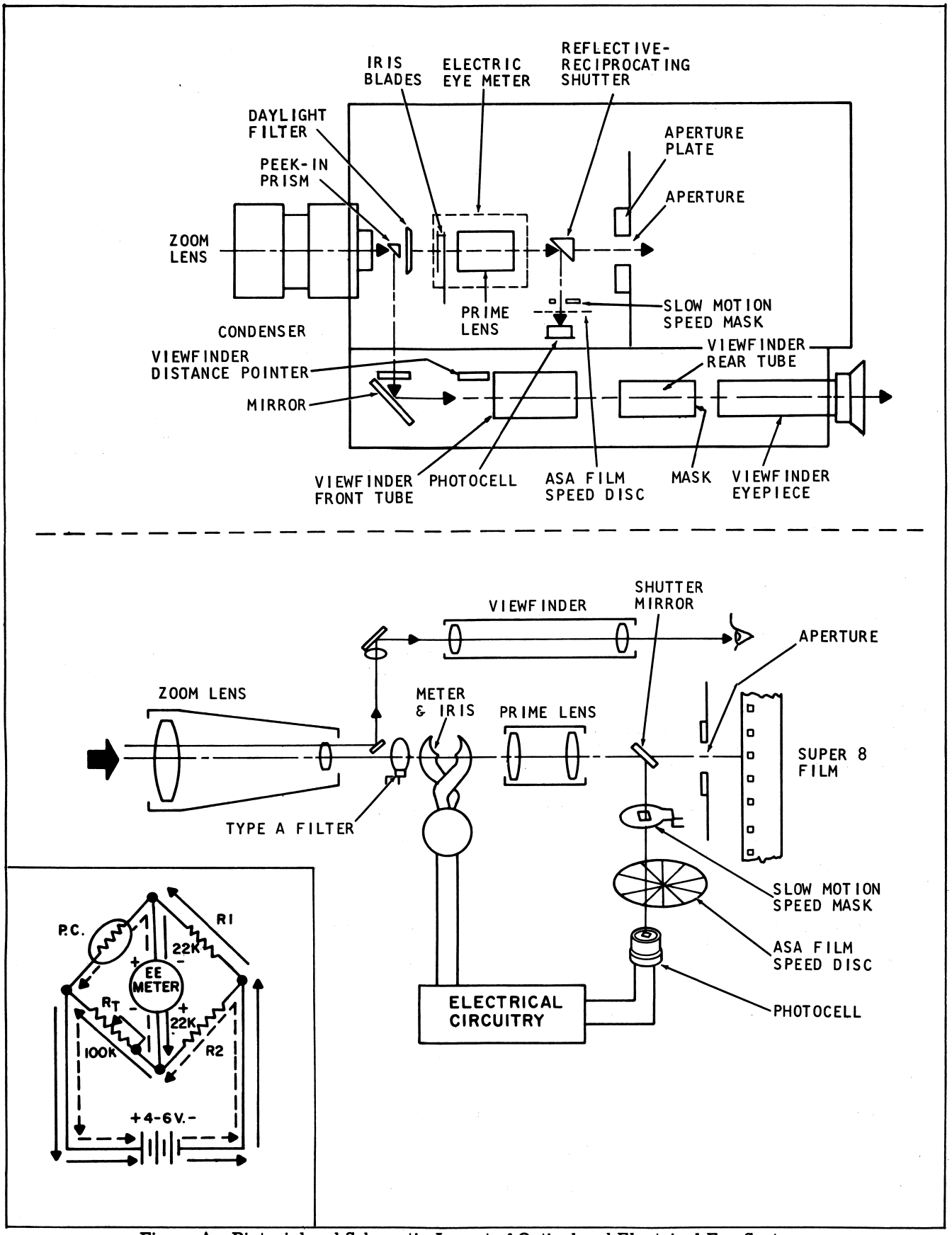


Figure A. Pictorial and Schematic Layout of Optical and Electrical Eye Systems

sitioned in front of the photoconductive cell. When the start button is depressed all the way down, the speed mask is positioned in front of the cell and cuts the light approximately in half, causing the iris blades to open and pass twice the amount of light to the film. This speed mask position will also compensate for half of the light available to the film at the slow motion speed.

SPECIAL MAINTENANCE PRECAUTIONS.

During repairs, the removal and installation of camera parts can be accomplished with tools normally available in all photo repair shops (retaining ring pliers, assorted screwdrivers and socket head wrenches, Bristol setscrew wrenches, etc.). All of the setscrews used in this camera have fluted sockets. Special tools, gages and test equipment, as well as the Bristol setscrew wrenches required, are listed at the end of this section. Most of the special tools and gages are illustrated in Figures B and C, and their use is covered in the repair instructions.

NOTE

BEFORE ATTEMPTING CAMERA REPAIRS

(1) Check camera operation by performing tests outlined in the Test section.

(2) Refer to Troubleshooting Chart for probable causes and recommended remedies involving customer complaint.

When repairing equipment, be sure that the work table surface is clean. As parts are removed, group them in an orderly fashion to avoid confusion during reassembly. Remove dirt and old lubricant from parts (except electrical components and lenses) with a good cleaning solvent. Hardened film emulsion can be removed from the aperture plate by using alcohol and a sharpened orange stick. Do not use a knife, or other metal tool, to scrape away film emulsion.

During reassembly procedure, be sure to perform lubrication procedures noted in the instructions. Do not over-lubricate any part. Lubricant must be applied sparingly and special precautions must be taken to avoid getting oil and grease on optical elements (filters, lenses, etc.). Be sure to use only Bell & Howell grease (part no. 70468) and Bell & Howell oil (part no. 04979).

Always handle the meter and iris assembly with extreme care and keep the camera away from electrical equipment characterized by strong magnetic fields during repair operations.

After the camera has been repaired and adjusted, perform the inspections and test procedures outlined in the Final Test section to insure satisfactory operation.

BRISTOL SETSCREW WRENCHES REQUIRED FOR MAINTENANCE

Setscrew Size	No. of Flutes	B&H Part Number	
		Handle	Wrench
No. 1-72NC	4	STK9339	STK9340
No. 2-56NC	6	STK8709-B	STK8710-B

NOTE: Wrench G165-F3 is required to tighten setscrew in tool handle.

TOOLS AVAILABLE FROM BELL & HOWELL COMPANY

TOOL NAME	TOOL NO.	USE
Shuttle Centering Gage	SD-440-6-N1	Check centering of shuttle tooth in slot of aperture plate.
Shuttle Penetration Gage	SD-431-92-N1	Check penetration of shuttle tooth beyond surface of aperture plate.
Switch Blade Bending Tool Bending Tool Handle	012459-2-FX4 STK11165	Bend switch blades of master switch for proper contact gap.
Trimming Cartridge	SD-431-4-F7	Trim calibration.
Special Cable	SD-431-4-F9	Trim calibration.
A.S.A. 40 Plug	SD-431-4-F10	Trim calibration.
A.S.A. 160 Plug	SD-431-4-F11	Trim calibration.
Cartridge Clip	SD-431-4-F8	Furnished with Trimming Cartridge; used to hold test cartridges in place in camera.

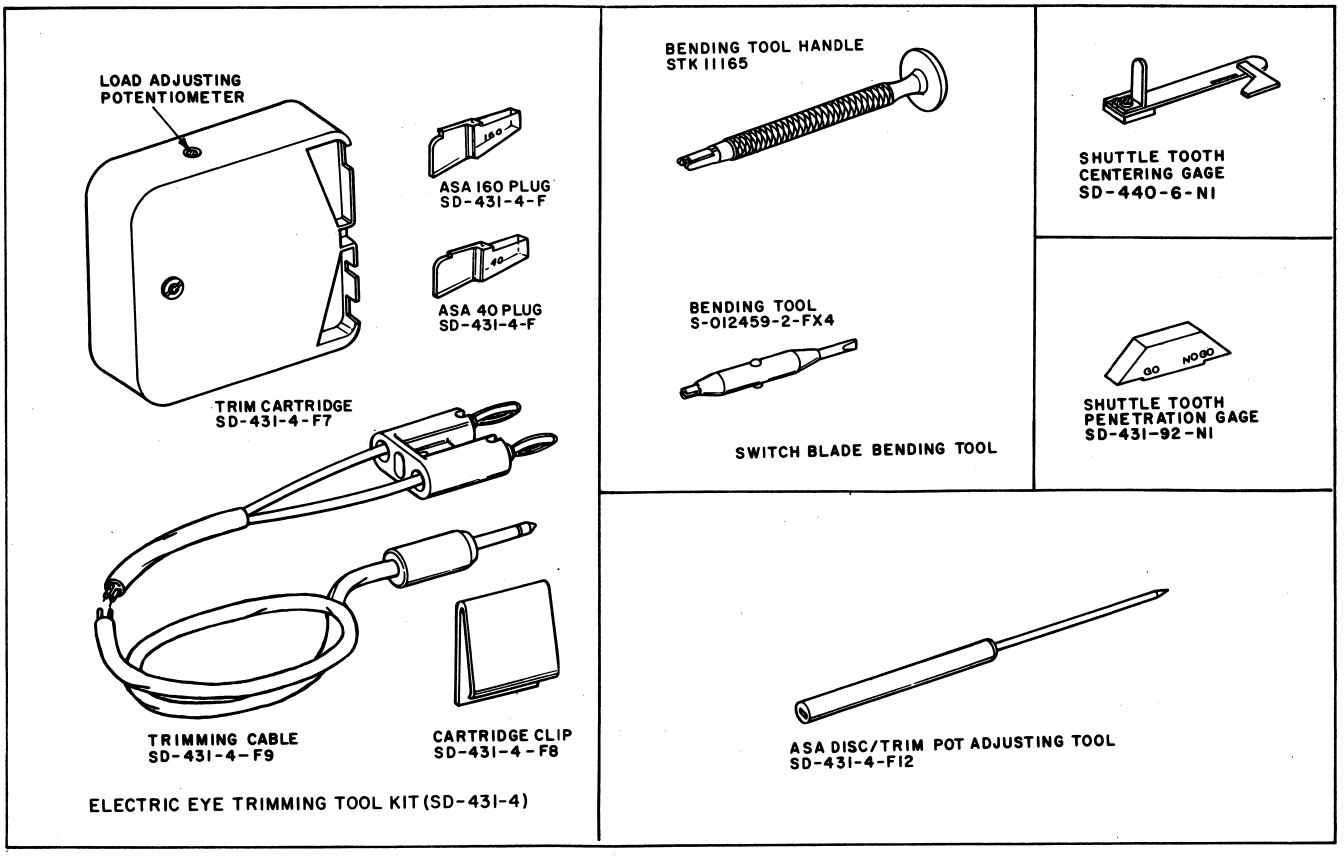


Figure B. Special Tools Available from Bell & Howell

TOOLS WHICH CAN BE MADE BY SERVICE STATIONS

TOOL NAME	FIGURE	USE
A.S.A. Checking Gage	C	Check A.S.A. setting of camera and adjusting filter.
Battery Block	C	Simulated battery fixture for power supply attachment.
Pointing Mirror Block	C and K	Align viewfinder optics with zoom lens.
Take-Up Torque Test Fixture	N	Check camera take-up torque.
*Prime Lens Focusing Tool	C	Focus camera prime lens.
Film Run Checking Cartridge	C	Check film advance with camera running.
Mechanism Holding Block	C	Support for mechanism assembly.
Lens Focus Cartridge	C	Focus camera prime lens.

*NOTE: Except for dimensions, the prime lens focusing tool is the same as that used in focusing Design 300 series cameras.

TEST EQUIPMENT REQUIRED FOR SERVICE	
NAME	DESCRIPTION
AUTOCOLLIMATOR	Bell & Howell SER220-6 or high-grade commercial quality with a 12-mm focal length and focused at infinity.
LIGHT SOURCE	Diffused, uniformly bright surface with iris-adjustable light source of 24 foot-Lamberts and 600 foot Lamberts at a color temperature of 2850°K (±200°K).
AC-VTVM (VACUUM TUBE VOLTMETER)	High-grade commercial quality with 0.01-volt scale, 0.5 mv maximum noise level at 0.01-volt scale, ±5% accuracy; 1 megohm minimum input impedance at 1 kc. (Heathkit Model AV-2, Eico Model 255, or equal).
LIGHT METER	High-grade quality light meter capable of f/1.8 to f/16 at A.S.A. 40.
DC MILLIAMMETER	High-grade quality portable type voltohm-milliammeter; 500 ma range with 5% accuracy.
DC POWER SUPPLY	Bell & Howell SD-431-127-F1 or see Figure P for recommended styles.

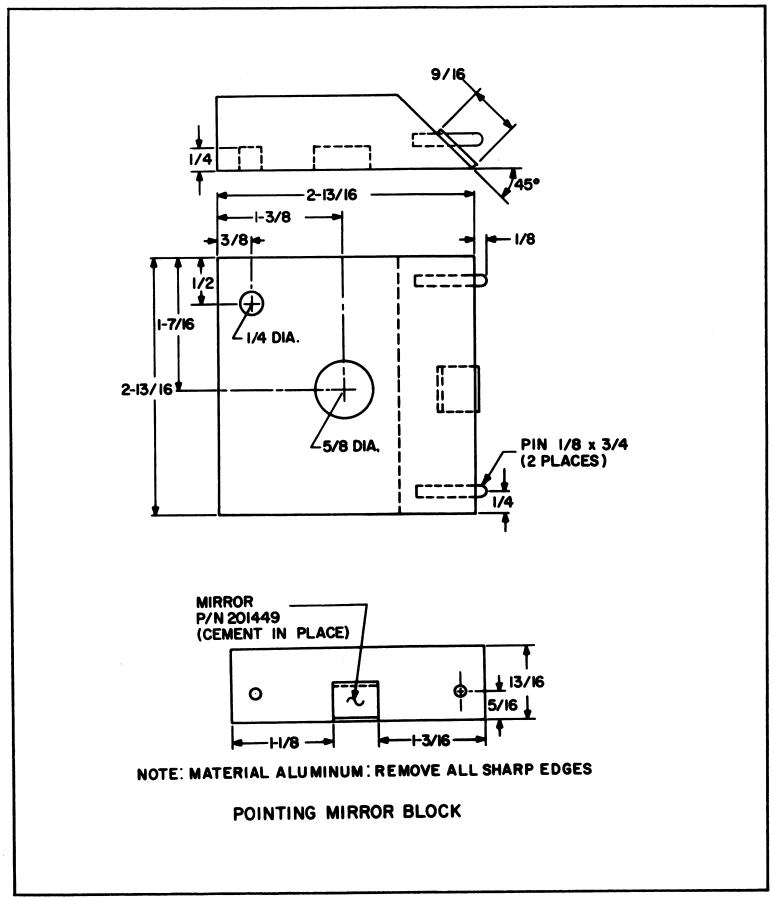


Figure C. Special Tools and Fixtures Which Can Be Fabricated by Service Stations (Also See Figures N and P)

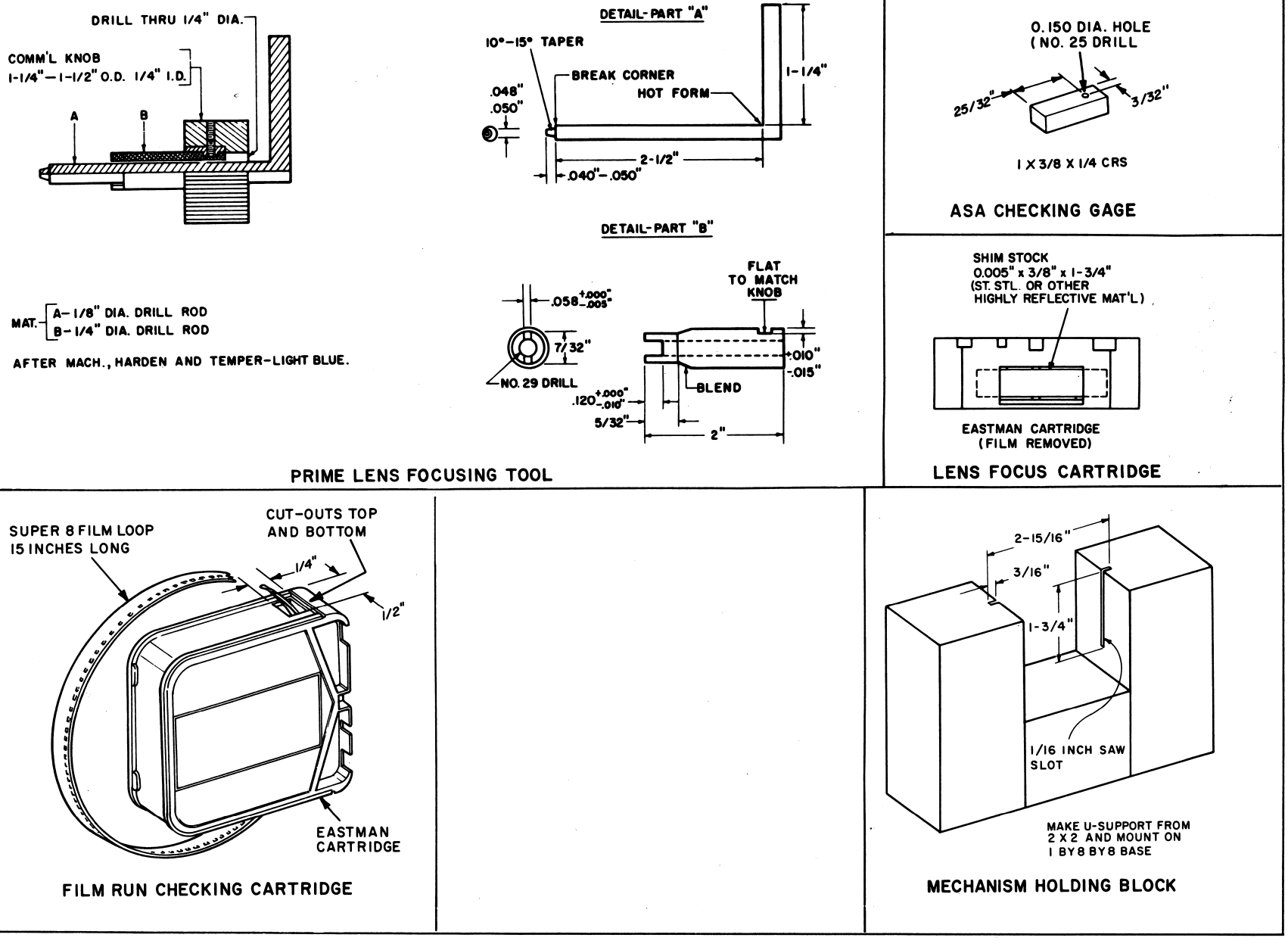


Figure C. Special Tools and Fixtures Which Can Be Fabricated by Service Stations (Also See Figures N and P) (Cont)

Disassembly Procedure

1. GENERAL DISASSEMBLY INSTRUCTIONS.

a. Before proceeding to disassemble the camera, remove the battery door (1, Figure 1) by loosening the captive thumb screw; then remove the four batteries (2).

b. Keep the camera away from any electrical equipment which is characterized by strong magnetic fields.

c. During repair operations, handle the meter and photocell assembly (32, Figure 2) with extreme care. Careless handling can easily bend or distort the scissors-like iris blades or break off the indicator arm which projects from the right-hand blade.

d. When necessary to loosen or remove setscrews, check the setscrew size in the parts lists and use the proper Bristol wrench listed at the end of the Introduction section.

e. Avoid leaving fingerprints on lens surfaces. Handle all optical parts by their metal holders or by their edges. Clean glass surfaces with lens cleaning fluid and lens tissue when removed and wrap these items in tissue paper until ready to reassemble.

f. To prevent the loss of attaching parts, reassemble these parts loosely to the removed part or to the casting from which it was removed.

g. When removing staked parts, the staking points must be filed away before the part can be pressed from the plate or casting. When necessary to remove riveted parts, check the diameter of the rivet in the parts list; then drill out the rivet with a drill that is the same diameter, or slightly smaller, than the rivet. Blow away filings or drill chips with a low-pressure jet of compressed air.

2. REMOVAL OF PARTS IN FIGURE 1. Remove parts as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Insets, nameplates, and windows are secured in place with adhesive. These items need not be removed unless damaged and in need of replacement or unless they cover attaching screws for other parts as in the case of nameplates (7), (11) and (15). Pry up as carefully as possible with a knife blade to avoid kinking or bending the plate.

b. Remove two screws (5) and the side panel assembly (6). Pry off the small nameplate (7) to expose the screw (8). Remove the screw (8) and the hinged lens cover (9). If the window (9A) is damaged, press it from the cover; if in good condition, clean it with lens cleaning fluid and lens tissue and wrap the hinged cover in tissue paper.

c. Carefully pry off the front nameplate (11) to expose the two screws (12). Remove these screws and the single screw (13) inside the battery compartment and lift the front plate (14) from the camera.

d. Carefully pry off nameplate (15) to expose the screw (16). Remove this screw, the two screws (17) and the single screw (18) in the battery compartment and lift off the mechanism cover panel assembly (19). The decorative insets (19A) and (19B) and the lens focus window (19C) need not be removed from the panel unless damaged and in need of replacement.

3. REMOVAL OF PARTS IN FIGURE 2. Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Remove the two screws (1) and lift out the decorative nameplate assembly (2).

b. Remove the two screws (4) and disassemble the nameplate (5), lock-run button (6), spring (7) and battery test button (8) from the recess in the side housing.

c. Remove the five screws (10), (11) and (12) which secure the side housing assembly (14) to the main frame assembly (38). Remove the single screw (13) which attaches the circuit board assembly to the side housing. Separate the side housing and main frame to the limit of connecting leadwires. These two major assemblies can be completely separated by removing the screw (34) which fastens the battery test assembly leadwire to the mechanism assembly (36) and by unsoldering the master switch leadwire from the circuit board assembly. Refer to paragraph 4 for side housing disassembly instructions.

d. Withdraw the lock-run plunger (15) and spring (16) from the hole in the main frame.

e. Remove the screws (17), shoulder bushings (18) and focus indicator bar (19). Remove the screws (20), (21) and (22), the flat washer (23), friction washers (24), zoom rocker link (25) and tension spring (26) from the main frame. Carefully pry off the nameplate (27) and remove the screw (28) and zoom treadle (29).

f. Remove the screws (30) and (31) and carefully disassemble the meter and photocell assembly (32) from the main frame. Unsolder leadwires, as necessary, from the meter terminals. Do not disassemble meter and photocell parts (32A through 32G) unless in need of replacement.

g. Remove the screws (33) and (34) and lift the mechanism assembly (36) from the main frame. The upper screw (34) also secures the solder lug (35) of the circuit board assembly. Refer to paragraphs 5 and 6 for main frame disassembly instructions and to paragraph 7 for mechanism disassembly instructions.

4. REMOVAL OF PARTS IN FIGURE 3. Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Remove the screws (1) and tension bracket assembly (2) and withdraw the viewfinder eyepiece assembly (3) from the side housing. Remove the two screws (4) and lift the viewfinder tube assemblies (5) and (6) from the side housing.

b. Remove the screw (7) and the focus indicator bracket (8). Disassemble the spring (8A) from the pointer and bracket.

c. Remove the screw (9) and the battery test assembly (10). The leadwires from the socket assembly (12) must be unsoldered from the battery test assembly to complete the removal.

d. Remove the socket nut (11) and remote socket (12), unsoldering leadwires as necessary.

e. Remove the screw (14) and lift the switch housing (15) from the side housing. Remove the retaining ring (16) and disassemble the spring (17), switch plunger (18) and switch contact (19) from the switch housing, unsoldering leadwires as necessary.

f. Remove the lens retainer (21) and lens element (22). The mirror cover (23) and mirror (24) are cemented in place and should not be removed unless the mirror is damaged and in need of replacement. The mirror surface can be cleaned without removing it from the side housing.

g. The battery link (29) and battery contacts (31) are secured to the side housing with riveted eyelets (28) which must be drilled out to permit replacement.

5. REMOVAL OF PARTS IN FIGURE 4. Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Press out the treadle pivot (1) and remove the start treadle assembly (2).

b. Loosen the three setscrews (3) and carefully withdraw the complete zoom lens unit (4) from the main frame. Do not attempt to disassemble the zoom lens unit.

c. Hold the detent bearing (6) while pressing out the lens cover hinge pin (5); then release the bearing slowly and catch the steel ball (7) and tension spring (8) as they drop from position.

d. Remove two retaining rings (9) and disassemble the filter adjusting lever assembly (10) from the A.S.A. mechanism, disengaging the lower link of the filter (19) from the hole in the adjusting lever. Slide the filter pusher assembly (11) out from behind the gear rack of the A.S.A. mechanism. Loosen the screw (12) and disconnect the spring (13) from the lever (16) and screw (12). Remove screw (14), eccentric (15) and lever (16), disengaging the upper link of the filter (19) from the lever. Loosen the setscrew (17) and withdraw the filter pivot (18) and filter assembly (19) from the main frame. Remove the retaining ring (20) and filter button (21).

e. Remove the focusing bushing (23) and washer (24) and withdraw the prime lens assembly (25) from the main frame.

f. Disassemble the screw (26), shoulder bushing (27) and contact plate (28) from the start slide lever assembly (33). Check to make certain that the red leadwire from the motor assembly is securely soldered to the contact plate.

g. Remove the retaining ring (30), screw (31) and shoulder bushing (32) and disassemble the start slide lever assembly (33) from the main frame. Remove the retaining ring (34) and disassemble the pinion (35) and gear rack (36) from the main frame.

h. Carefully pry the A.S.A. clutch gear (37) from the A.S.A. mechanism gear shaft. Remove two screws (38) and disassemble the A.S.A. plate and linkage assembly (39) and shutter spacer (41) from the main frame. Note the manner in which the two springs (40) are engaged with the A.S.A. levers. Do not remove shuttle covers (43) and (44) unless the shuttle is to be inspected.

6. REMOVAL OF PARTS IN FIGURE 5. Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Setscrew (1) is used to lock the shuttle pin after adjusting the height of the shuttle tooth and then is sealed. Do not loosen this setscrew unless the shuttle requires readjustment (paragraph 11).

b. Except for the face gear and pinion (3), which is secured to the shuttle cam shaft by means of the setscrew (2), do not attempt to disassemble the shutter and shuttle parts or aperture plate from the main frame. Shuttle height is adjustable (paragraph 11) to to compensate for shuttle tooth wear. If these parts are damaged, the complete frame and door assembly (16) must be replaced.

d. The window (9) is cemented in place and should not be removed unless in need of replacement. Clean the window with lens cleaning fluid and lens tissue.

e. To replace the door latch knob (10), wear plate (11) or door latch (12), the staking points must be filed away at the inner (pin) end of the knob.

f. If the cartridge tension spring (14) is in need of replacement only four of the eight rivets (13) need be removed. If the hinge (15) needs replacing, all eight

rivets must be removed. Drill out the rivets carefully. The camera main frame and door are matched parts. If either is damaged, replace complete frame and door assembly (16).

7. REMOVAL OF PARTS IN FIGURE 6. Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Disassemble the pointer spring (1) and pointer (2) from the mechanism plate.

b. Remove the retaining ring (3) and wild speed toggle assembly (4), disengaging the coil spring (5) from the wild speed mask (28).

c. Remove the screw (6) and spring tension washer (7) and disassemble the counter lever bushing (8) and counter gear (9) from the mechanism plate.

d. Remove the screw (10) and backlash adjuster eccentric (11). Remove the retaining ring (12) and disassemble the centering spring (13) from its stud.

e. Remove the retaining ring (14) and disassemble the washer (15), torque spring (16), take-up gear (17), one-tooth gear (18) and take-up driver (19) from the mechanism plate.

f. Support the motor and clutch assembly (21) while removing the two screws (20); then carefully withdraw the assembly from its mounting bracket.

g. If the spring (24) or counter lever (25) are in need of replacement, the counter lever pin (23) must be pressed out.

h. The wild speed mask (28) and the gears (30) and (31) are secured to the mechanism plate with staked studs and should not be removed unless in need of replacement.

Reassembly and Adjustment

8. GENERAL REASSEMBLY INSTRUCTIONS.

a. When the reassembly procedures include the staking or riveting of parts, perform such operations before proceeding with other reassembly procedures. Always support castings or metal plates solidly to prevent distortion during the staking operation.

b. Before reassembly, clean all metal parts and subassemblies (except the meter and photocell assembly and lens assemblies) with trichlorethylene or other non-corrosive grease solvent. Dry all parts with a low-pressure jet of compressed air or with clean, lint-free cloths. Clean all mirrors and lens surfaces with lens cleaning fluid and lens tissue.

c. During reassembly procedures, be sure to follow the lubrication instructions noted therein. Lubricate sparingly and avoid getting oil and grease on optical parts. Use only Bell & Howell grease (part no. 70468) and Bell & Howell oil (part no. 04979).

d. When parts must be cemented in place, use the adhesives noted in the reassembly instructions. Make certain that surfaces are clean before applying the adhesive. When tacky, press the cemented part in place; then wipe away excess adhesive with a clean cloth. The following list indicates the commercial equivalent for Bell & Howell specification adhesives.

B&H SPEC.	COMMERCIAL ADHESIVE
327	3M Company adhesive EC-847
355	3M Company adhesive EC-524
935	3M Company adhesive EC-870
1758	General Cement Company No. 32 cement

9. REASSEMBLY OF PARTS IN FIGURE 6. Reassemble Figure 6 parts as outlined in the following paragraphs, noting any special precautions.

a. Assemble the wild speed mask (28) and stud (27) to the mechanism plate and stake the end of the stud.

b. If gears (30) and (31) were replaced, assemble the new gears to the mechanism plate with the gear studs (29) and stake the studs securely. Apply a single drop of oil to each gear stud and check to make certain that both gears rotate smoothly without binding.

c. Assemble the counter lever (25) beneath the counter lever bracket and install the spring (24) and counter lever pin (23) as shown in Figure D. The inner end of the pin must be pressed in flush with the face of the counter lever hub. Install spring (24) with bent end facing out, away from the mechanism plate, and hooked beneath the lever bracket.

d. Assemble the motor assembly (21) to its mounting bracket with the two screws (20). Hook the three long leadwires of the circuit board (22) and the red motor leadwire behind the long and short formed ears of the mechanism plate. The circuit board should hang 3 inches below the mechanism plate when the three long leadwires are secured. Dress the blue motor leadwire behind the two formed ears and solder the tinned end of this leadwire to the formed solder lug of the wild speed bracket near the upper front corner of the mechanism plate. The blue leadwire should effectively hold the other four leadwires in place.

e. Assemble the take-up driver (19), one-tooth gear (18), take-up gear (17), take-up torque spring (16), and flat washer (15) to the mechanism plate and secure all parts with the retaining ring (14). The open segment of the retaining ring must be positioned at the flat on the end of the take-up driver shaft.

f. Assemble the centering spring (13) to the two studs on the mechanism plate and secure it with the retaining ring (12). Fasten the backlash adjuster eccentric (11) to the mechanism plate with the screw (10).

g. Assemble the counter gear (9) and bushing (8) to the mechanism plate and install the screw (6) and spring tension washer (7). The concave (dished) surface of the washer (7) must be against the mechanism plate. Assemble the spring (1) to the footage counter pointer (2) and assemble the pointer to the bushing (8), hooking the free end of the spring around the spring stud in the rear upper corner of the mechanism plate.

h. Assemble the wild speed spring (5) to the wild speed toggle assembly (4) and assemble the toggle assembly to its mounting stud while engaging the free end of the spring with the hole in the speed mask (28). Install the retaining ring (3).

i. Manually rotate the cluster gear (31) to make certain that all gears rotate smoothly. Operate the counter lever to make certain that it returns smoothly under spring tension. Set the assembled mechanism aside for later installation (paragraph 13).

10. REASSEMBLY OF PARTS IN FIGURE 5. Reassemble Figure 5 parts as outlined in the following paragraphs, noting any special precautions.

a. Assemble the hinge (15) and cartridge tension spring (14) to the camera door and secure with four rivets (13). Secure the hinge to the main frame with the remaining four rivets (13).

b. Assemble the door latch knob (10), wear plate (11) and door latch (22) to the camera and stake the pin end of the knob to the latch. The knob and latch must move smoothly but with some tension. Assemble the window (9) into its opening in the camera door and hold in place with a small square of cardboard (to protect window surface) and a piece of tape. Apply a heavy bead of adhesive (B&H Spec. 1758) around the edge of the window inside the door casting. When the adhesive has hardened, remove the tape and clean the surface of the window with lens cleaning fluid and lens tissue.

c. Before proceeding with the reassembly of the main frame, inspect the shuttle tooth for any burrs or nicks with a magnifying glass. Check the shuttle tooth height (paragraph 11) and adjust the height if necessary. Make a swab of cotoon on the end of a toothpick and dip the swab in lens cleaner. Squeeze out excess liquid so that the swab is only damp and clean the surface of the shutter mirror. Wipe dry with an unmoistened swab. Assemble the face gear and pinion (3) on the end of the camshaft. Insert a 0.003-inch shim between the gear and the bushing in the main frame and press all parts together while tightening the face gear setscrew (2). Seal the setscrew with shellac. Dip a small brush in oil and lightly lubricate the cam surfaces of the shuttle cam, the elongated slot in the upper end of the shuttle and the washer which makes contact with the shuttle. Rotate the face gear to make certain that the shutter and shuttle move smoothly and freely.

c. Secure the light seal (8) to the main frame and the shuttle cover (4) to the aperture mask with adhesive (B&H Spec. 327). Be very careful not to leave adhesive on the shutter mirror or the sliding surface of the shutter.

11. ADJUSTING SHUTTLE TOOTH HEIGHT.

a. Rotate the shutter and shuttle cam manually until the shuttle tooth is at its maximum height above the surface of the aperture plate.

b. Check the height of the shuttle tooth with the shuttle penetration gage (Figure B). The penetration gage should be positioned on the aperture plate and held there with one finger just above the aperture opening. The aperture plate is slightly rounded from

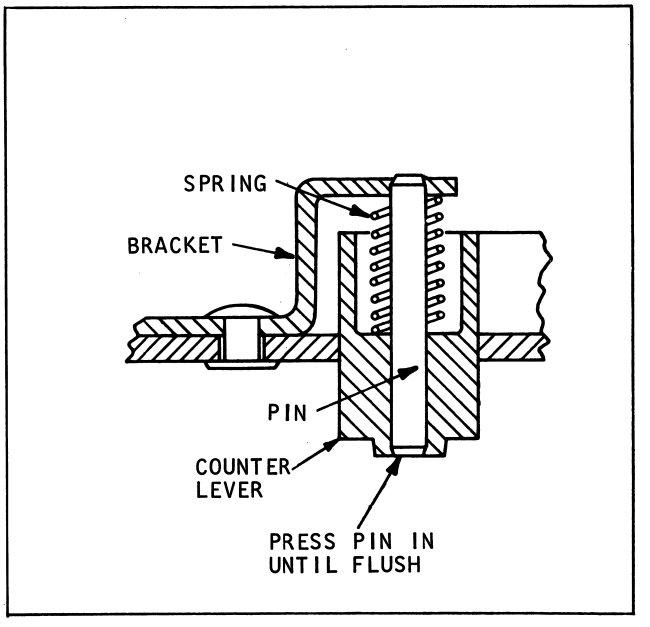


Figure D. Installing Counter Lever, Pin and Spring

top to bottom and this will prevent the gage from rocking and thus giving a false reading. The shuttle tooth should clear the "GO" step of the gage, but must not clear the "NO GO" step.

c. To adjust the height of the shuttle tooth, first loosen the setscrew that locks the shuttle pin (see Figure E). With a screwdriver, carefully rotate the shuttle pin and the press-fit eccentric a bit at a time, checking frequently with the shuttle penetration gage until the proper shuttle tooth height has been obtained; then tighten the locking setscrew securely.

12. REASSEMBLY OF PARTS IN FIGURE 4. Reassemble Figure 4 parts as outlined in the following paragraphs, noting any special precautions.

a. Insert the gear rack (36), the longer unthreaded end up, into the hole at the bottom of the main frame. Assemble the pinion (35) to its stud, engaging pinion teeth with gear rack, and secure with the retaining ring (34). Lightly oil the pinion and gear rack teeth with a small brush.

b. Dip the screw (26) in shellac and assemble the insulator (29), contact plate (28) and shoulder bushing (27) to the tapped hole at the top of the start slide lever (33) with the screw. Lightly oil the lower elongated hole of the start slide lever with a small brush. Position the gear rack as shown in Figure F; then install the start slide lever in the following manner: Engage the upper end of the start slide lever with the upper mounting stud. Press the lever to the uppermost limit of its mounting slot and lower the bottom end of the lever until its teeth engage those of the pinion (35). Secure the upper end of the lever with the retaining ring (30) and the lower end with the shoulder bushing (32) and screw (31). Seal the screw with shellac.

c. Lightly oil the spacer (41) and place it in the long vertical groove of the shutter. Carefully assemble the A.S.A. plate and linkage assembly (39) to the main frame and install the two screws (38). The upper screw must pass through the spacer (41). Seal both screws with shellac. Assemble the clutch gear (37) to the A.S.A. shaft, with the boss side of the gear toward the main frame. Install the two springs (40) at the top and bottom of the A.S.A. linkage.

d. Insert the prime lens (25) into its opening in the main frame and temporarily install the washer (24) and focusing bushing (23). The bushing will be tightened during the focusing procedure. Secure the baffle (22) to the main frame with adhesive (B&H Spec. 327).

e. Assemble the filter button (21) into the main frame and secure it with the retaining ring (20). Assemble the pivot (18) to the filter and link assembly (19) and secure these parts into the main frame with setscrew (17). Engage the upper link of the filter with the small hole in the lever (16). Assemble the eccentric (15) into the lever and secure these parts to the main frame with the screw (14). Engage one end of the spring (13) with the lever and secure the other end of the main frame with the screw (12). Insert the pusher assembly (11) between the A.S.A. subplate and the A.S.A. lever with jaw-like teeth, and engage the hole in the pusher with the linkage stud. Engage the lower filter link with the small hole in the filter adjusting lever (10). Assemble the adjusting lever to the two studs of the A.S.A. linkage and secure it with the two retaining rings (9). After the camera has been reassembled, the filter linkage must be adjusted as outlined in paragraph 17.

f. Assemble spring (8) and oiled steel ball (7) into the hole in the main frame and hold with a piece of shim stock while assembling the detent bearing (6) between the two arms of the main frame. Withdraw the

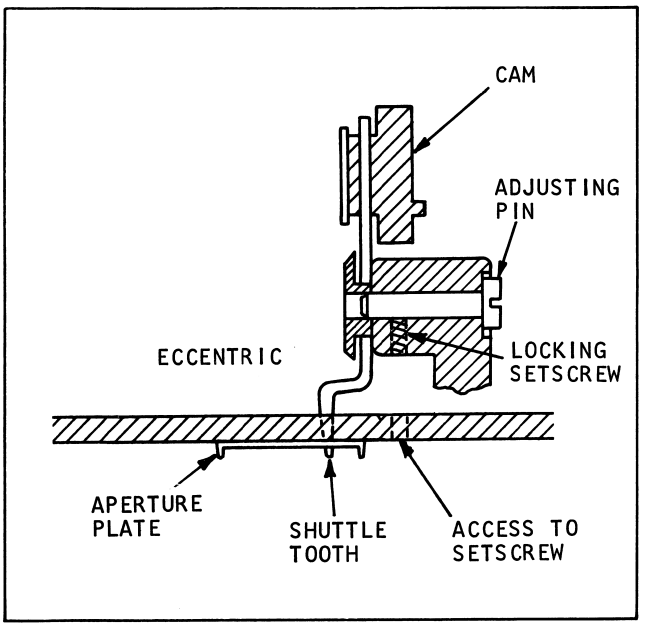


Figure E. Adjusting Shuttle Tooth Height

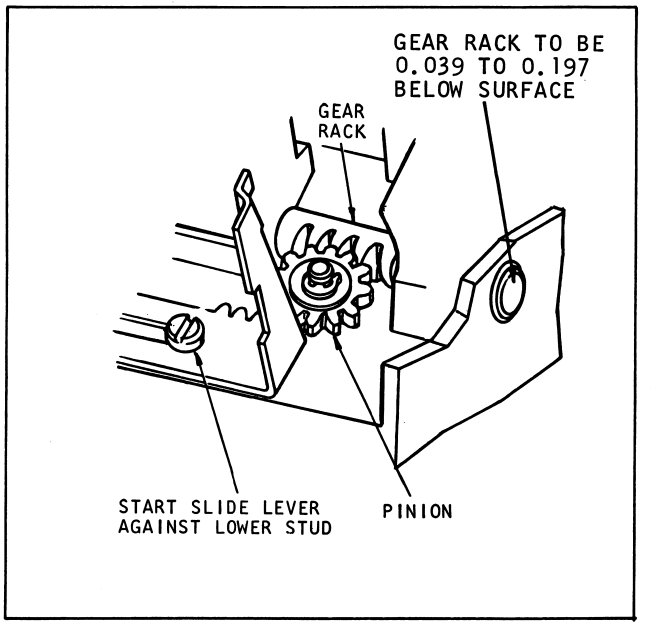


Figure F. Installing the Start Slide Lever

shim stock carefully, making certain that the steel ball engages the detent hole in the bearing. Then press the hinge pin (5) into place.

g. Secure the treadle cover (42) to the main frame with adhesive (B&H Spec. 327). Adhesive should be applied to the three unnotched edges of the cover. If the cover pulls away from the main frame, seal any resulting spaces with adhesive to provide a light seal.

h. Secure the shuttle covers (43) and (44) to the main frame with adhesive (B&H Spec. 327). Be careful that excess adhesive is not forced out onto the shutter mirror or on the sliding surface of the shuttle. Seal the space between the main frame with a mixture of optical black paint and adhesive.

i. Assemble the zoom lens unit (4) into the main frame and secure it with the three setscrews (3). Install the start treadle (2), engaging it with the start lever, and install the treadle pivot (1).

13. REASSEMBLY OF PARTS IN FIGURE 3. Reassemble Figure 3 parts as outlined in the following paragraphs, noting any special precautions.

a. Assemble the screw retainer (27) into the battery compartment of the side housing with adhesive (B&H Spec. 327). Secure the decorative plate (13) into the remote socket recess of the side housing with adhesive (B&H Spec. 327).

b. Remove the protective backing from the insulator (30) and assemble the insulator to one of the battery contacts (31). Assemble both contacts to the side housing with two of the eyelets (28), riveting the eyelets securely. The contact with the assembled insulator must be installed at the position closest to the battery door opening. Secure the battery link (29) to the side housing with two eyelets (28), riveting the eyelets securely. Temporarily secure the solder lug (26) to the side housing with the screw (25).

c. Secure the mirror (24) into its recess in the side housing with adhesive (B&H Spec. 327). Apply adhesive to edges of mirror and remove excess from mirror surface. Assemble the mirror cover (23) into the side housing with adhesive (B&H Spec. 327).

d. Assemble the lens element (22) into its recess in the side housing. Apply adhesive (B&H Spec. 327) to the lens retainer (21) and install the retainer to hold the lens element in place. Be careful not to get adhesive on the lens surface.

e. Make certain that the black leadwires are securely soldered to the ear of the switch contact (19) and into the hole in the large diameter end of the plunger (18). Secure the switch contact (19) to the switch housing (15) with adhesive (B&H Spec. 327). Then insert the plunger (18) through the housing and install the spring (17) and retaining ring (16). Fasten the assembled switch to the side housing with the screw (14). Refer to Figure 7 for proper leadwire connections.

f. Assemble the remote socket assembly (12) to the side housing with the socket nut (11). Refer to Figure 7 for proper leadwire connections. All socket solder connections must be toward the rear (eyepiece end) of the side housing.

g. Secure the battery test assembly (10) to the side housing with screw (9). Connect remote socket leadwires to the battery test assembly as shown in Figure 7, being very careful not to heat the diode of the tester with the soldering iron.

h. Assemble the spring (8A) to the focus indicator bracket assembly (8), one end engaging the spring ear of the bracket and the other end hooking into the small hole in the indicator pointer. Fasten the bracket assembly (8) to the side housing with the screw (7). Make certain that the small locating pin engages the locating hole in the bracket before tightening the screw.

i. Assemble the two tube assemblies (5) and (6) into the side housing and install and tighten the screws (4). Be careful not to reverse the positions of the tubes. Lightly grease the spiral groove of eyepiece assembly (3) and the eyepiece opening in the side housing. Insert the eyepiece assembly into its opening and install the tension bracket assembly (2) so that its stud engages the spiral groove in the eyepiece barrel. Secure the bracket assembly with the two screws (1).

14. REASSEMBLY OF PARTS IN FIGURE 2. Reassemble Figure 2 parts as outlined in the following paragraphs, noting any special precautions.

a. Apply adhesive (B&H Spec. 935) to the areas at the rear of the main frame and camera door where the padded panels (37) will be installed. When adhesive is tacky, press these panels firmly in place.

b. Carefully assemble the mechanism assembly (36) into the main frame assembly (38). Note, in Figure G, the manner in which the legs of the centering spring straddle the narrow neck of the start lever while the shortest leg of the wild speed toggle engages the fork-like end of the start lever. When installing the mechanism attaching screws (33) and (34), note that the upper front screw (34) also attaches solder lug (35) while the lower front screw (34) also secures the terminal lug at the end of the battery test assembly leadwire. Refer to Figure 7 for wiring connections. Solder the red leadwire of motor assembly to the contact plate which is fastened near the top of the start slide lever. Press the start treadle to make certain that the wild speed toggle and mask operate properly and to check for minimum play in the start lever. If the start lever has too much end play, loosen the screw in the backlash adjuster eccentric (Figure G) and rotate the eccentric to reduce end play. Do not overadjust the eccentric. Rotate only to the point where end play is reduced to a minimum; then tighten the locking screw securely.

c. Secure the contact spring (32G) to the meter frame with the two screws (32F). Insert the shaft of the A.S.A. disc assembly (32E) through the meter

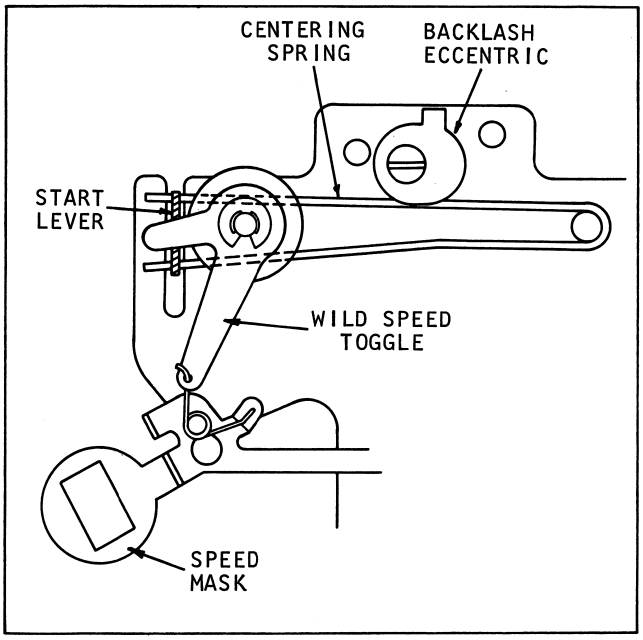


Figure G. Engaging the Mechanism With the Start Slide Lever

frame and install the torsion spring (32D) and retaining ring (32C) as shown in the inset on Figure 2. The open side of the retaining ring must straddle the leg of the spring. The A.S.A. disc must be adjusted as outlined in paragraph 16 before continuing with the reassembly.

d. Carefully assemble the meter and photocell assembly (32) to the main frame, making certain that the contact spring blade of the meter assembly is engaged in the notch at the left side of the start slide lever contact plate. Push down slightly on the front end of the start treadle while assembling the meter and photocell assembly to the main frame. This will assist in engaging the spring blade with the notch in the contact plate. Install but do not tighten the two screws (30) and (31). Make certain that the notch in the edge of the A.S.A. disc is at the position shown in Figure H, with the long leg of the spring behind the protruding ear of the meter frame.

e. Then make leadwire connections to the meter assembly as illustrated in Figure 7. Check to make certain that the meter contact spring blade is centered in the gap at the left edge of the motor contact plate. Minor centering adjustments can be made by loosening the two screws which secure the blade to the meter mount; then shifting the blade until centered and retightening the screws. Press the start treadle and check to see that the contact plate and spring blade are making contact.

f. Make certain that the mating friction surfaces of the zoom treadle (29) and the camera main frame are completely free of foreign matter, lubricant, burrs and scratches. Remove burrs and scratches by polishing lightly with fine emery cloth. Assemble the zoom treadle (29) to the main frame with the screw (28) and secure decorative plate (27) to treadle with adhesive (B&H Spec. 327). Assemble spring (26), a friction washer (24) and zoom rocker link (25) on tapped mounting post protruding from mechanism plate and secure the link to the post with a second friction washer (24), a flat washer (23) and a screw (22) installed finger-tight. Secure the two ends of the link with screws (20) and (21); then tighten screw (22) securely. Operate the zoom treadle to make certain that the link moves the zoom lens carriage smoothly in both directions.

g. Assemble the shoulder bushings (18) into the elongated holes of the focus indicator bar (19) and secure the indicator bar to the main frame with the two screws (17).

h. Check to make certain that circuit board leadwires have been properly soldered (Figure 7). Secure the circuit board to the side housing with the screw (13). Insert the spring (16) and the plunger (15) into the lock-run opening in the main frame and hold in place with a piece of shim stock while assembling the side housing to the main frame. Withdraw the shim and secure the side housing to the main frame with three screws (10) inserted from the side housing side and two screws (11) and (12) inserted from the main frame side.

i. Perform the adjustments outlined in paragraphs 17 through 22. After all adjustments have been made, assemble the battery test button (8), Lock-Run button (6) and spring (7) into their openings in the side housing. Be sure that the slant of the battery test button matches the slant of the housing opening. Install the nameplate (5) and screws (4). Then fasten the decorative nameplate (2) in place with the two screws (1).

15. REASSEMBLY OF PARTS IN FIGURE 1. Reassemble Figure 1 parts as outlined in the following paragraphs, noting any special precautions.

NOTE: The mechanism cover panel (19) should not be permanently installed until all adjustments have been made and tests have indicated that the camera is operating properly.

a. Assemble the window (19C) into the mechanism cover panel (19D), making certain that the slant of the window matches the slant of the opening. Protect the window with a small square of cardboard and hold the window in place with a strip of tape. On the inside of the panel casting, apply a bead of adhesive around all four edges of the window. After the adhesive has set, remove the tape and cardboard and clean the window with lens cleaner and tissue. Remove the protective backing from the decorative insets (19A) and (19B) and apply them to the recesses in the panel. After all adjustments have been made and test performed, assemble the panel to the main frame with four screws (16), (17) and (18). Screw (18) is inserted through the side housing from within the battery compartment. Tighten all screws securely; then assemble the nameplate (15) to the panel with adhesive (B&H Spec. 327).

b. Secure the front plate (14) to the main frame and side housing with the two upper screws (12) and

the single screw (13) inserted from within the battery compartment. Secure the front nameplate (11) to the front plate with adhesive (B&H Spec. 327).

c. Cement the window (9A) into the hinged lens cover (9) with adhesive (B&H Spec. 1758). Fasten the lens cover (9) to the detent bearing with the screw (8) and secure the small nameplate in place over the screw head with adhesive (B&H Spec. 327).

d. Assemble the side panel (6) to the side housing and install and tighten the two screws (5). Install the batteries (2) and the battery door assembly (1).

16. ADJUSTING THE A.S.A. DISC. The camera side housing assembly and mechanism cover panel must be disassembled from the main frame to expose the meter and photocell assembly and the A.S.A. mechanism respectively. The adjustment of the disc requires the use of the trim pot tool (Figure B) and the A.S.A. adjustment gage block (Figure C). Refer to Figure H during the adjustment procedure.

a. Remove the photocell from the meter frame so that the A.S.A. disc can be seen through the photocell opening.

b. The meter and photocell assembly is secured to the main frame with two screws. Completely remove the lower attaching screw and make certain that the upper attaching screw is loose enough so that the meter frame can be pivoted. Swing the lower end of the meter assembly toward the front end of the main frame until the pinion gear on the inner face of the A.S.A. disc is disengaged from the clutch gear on the A.S.A. shaft.

c. When adjusting the A.S.A. disc, the disc must be rotated in a clockwise direction. Rotation is accomplished by engaging the screwdriver end of the trim pot tool with the slot in the end of the A.S.A. disc shaft.

d. With the gears disengaged, carefully rotate the A.S.A. disc one full revolution clockwise; then slowly continue rotation until the dividing line between the clear wedge and fully opaque wedge of the A.S.A. disc moves down out of the rectangular mask within the photocell opening.

e. Carefully re-engage the A.S.A. disc gear with the clutch gear by swinging the meter assembly back until its lower mounting hole is aligned with the tapped hole in the main frame. Be sure that the spring contact blade at the top of the meter enters the notched gap in the edge of the start slide lever contact plate. Install the lower attaching screw and tighten both screws.

f. Carefully rotate the A.S.A. disc counterclockwise until the dividing line between the clear and opaque wedges is bisecting the mask within the photocell opening.

g. Insert an A.S.A. 40 film cartridge into the camera film compartment and hold camera door closed. The edge of the notch in the photocell disc must be aligned with the molded edge of the photocell mount as shown in Figure H.

17. ADJUSTING THE FILTER ASSEMBLY (Figure J). To insure positive adjustment of the automatic filter assembly, the camera must be running. Insert the batteries into the battery compartment and install the battery door.

a. Set the zoom lens at "telephoto" position and screw the filter removal screw down into the filter plunger opening at the top of the main frame.

b. Hold the camera so that light is shining into the aperture area and look directly into the center of the zoom lens while pressing the start treadle. The circle of light in the lens should be clear, or white, indicating that the filter disc is fully withdrawn from

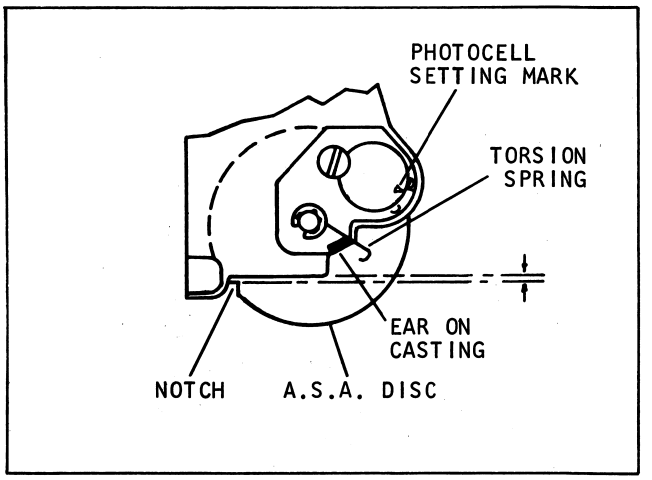


Figure H. Adjusting the A.S.A. Disc

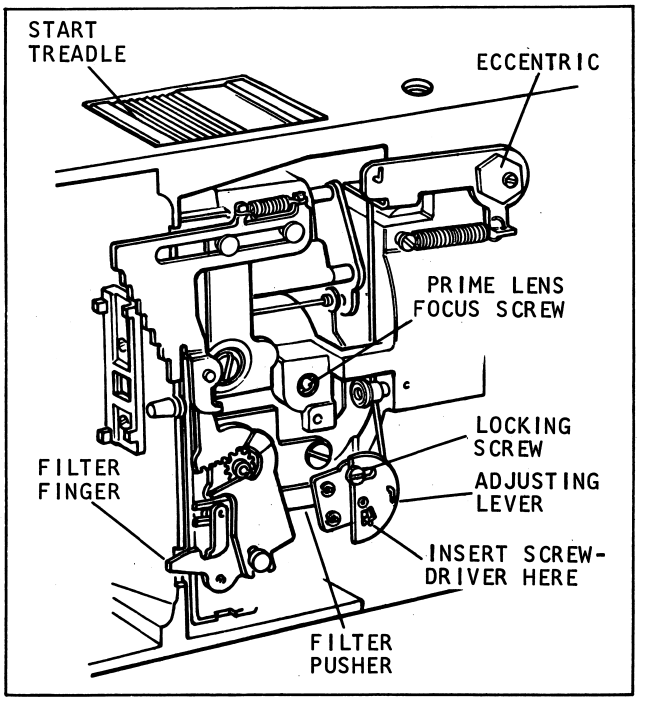


Figure J. Adjusting the Filter Assembly

in front of the lens. Remove the filter screw and note that the circle of light is now pale amber. Reinstall the filter screw.

c. If an arc of amber was noted across the bottom of light circle with the filter screw installed, loosen the eccentric lock screw (Figure J) and, with the camera in Lock-Run mode, adjust the eccentric until the circle of light is clear. Then tighten the lock screw securely and release the start treadle.

d. Remove the filter screw from the filter plunger opening and slightly loosen the locking screw at the top of the filter adjusting lever (Figure J). With the flat of the A.S.A. adjusting gage, depress the filter finger at the bottom of the A.S.A. mechanism until it is flush with the aperture plate mounting surface. With the camera running, look into the zoom lens and check to see if the circle of light is completely clear. If an arc of amber appears across the bottom of the light circle, insert a narrow screwdriver blade into the slots of the adjusting lever and its plate and rotate screwdriver slightly in a clockwise direction until the arc of amber disappears. Then tighten the locking screw securely.

18. VIEWFINDER POINTING ADJUSTMENT. If the prime lens or viewfinder components were removed or disturbed during repair operations, it will be necessary to check camera pointing and to realign the optical system. The check and adjustment requires the use of the tools shown in the inset, Figure K, and the pointing cartridge (Figure C), plus the focusing target initially furnished with Bell & Howell Instructions Book No. 70411 (Design 416 Camera). The horizontal and vertical bisecting lines of the target should be marked off in perpendicular lines 1/4-inch apart, and it is recommended that every fifth line be slightly longer and in a color, preferably red.

a. Remove the battery door and batteries. Also remove the side housing cover to expose the mechanism and circuit board. Short out the trim pot at the circuit board (Figure L) by rotating the wiper arm fully counterclockwise. This will open meter iris blades.

b. With a knife blade, carefully pry out the round, black access hole cover in the bottom of the battery compartment. Mount the camera on a tripod or similar support in such a manner that the access hole is not blocked.

c. Position the camera exactly seven feet from the wall-mounted target (Figure K). Set the lens distance ring at 7 feet and zoom the lens to the "telephoto" position. Install the filter removal screw into the filter plunger opening at the top of the camera frame.

d. Insert the pointing cartridge into the camera and insert cartridge clip SD-431-4-F8 (Figure B) to

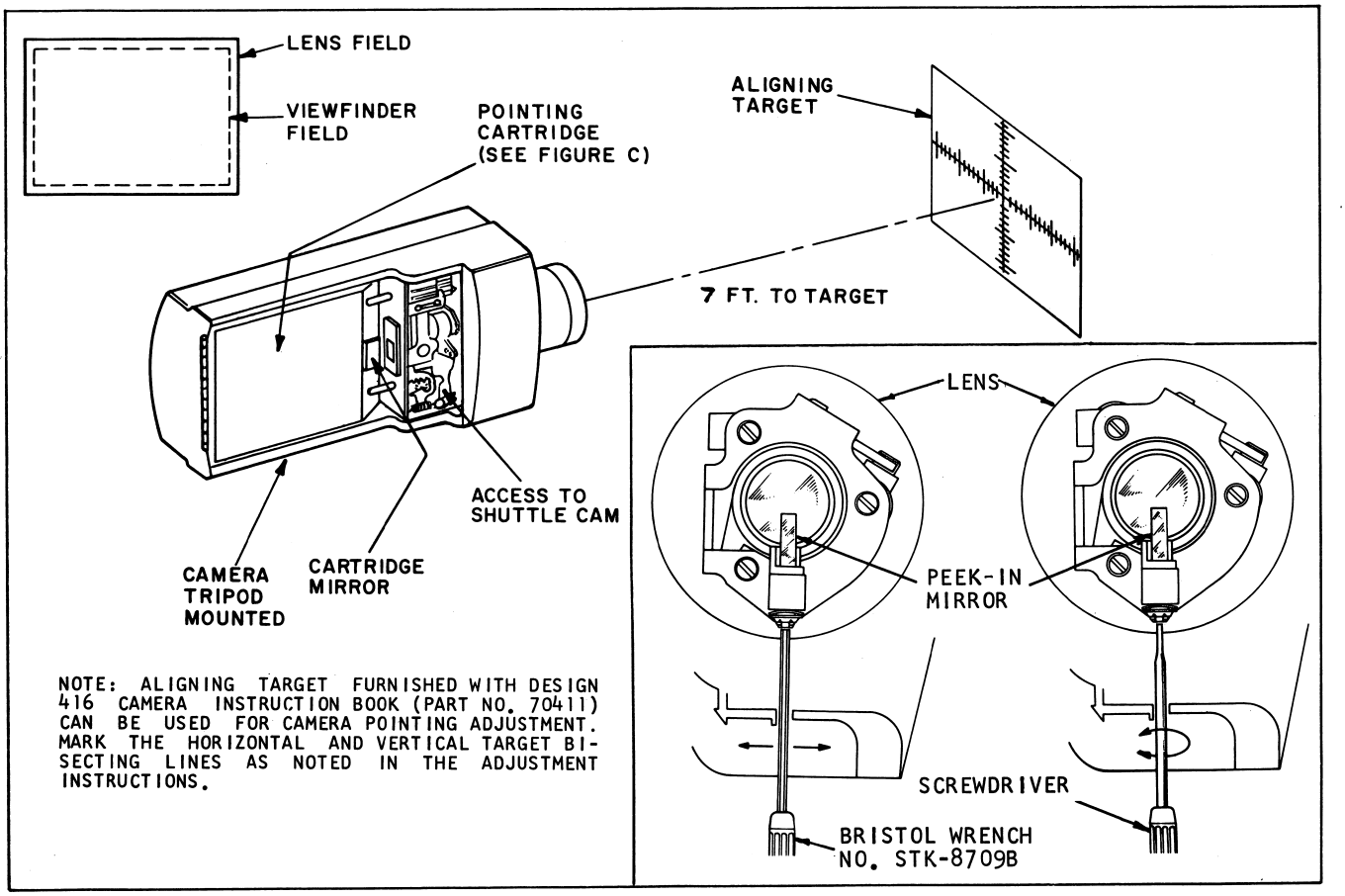


Figure K. Adjusting Camera Pointing

hold it in place. Then hold the start treadle down and rotate the shuttle cam manually until the shuttle mirror is no longer in front of the aperture opening.

e. While looking into the pointing cartridge mirror, adjust the position of the camera until the lens is centered on the target. The lens is centered on the target when the field of view encompasses an equal number of horizontal and vertical spacings on either side of the target center cross-hairs.

f. Without disturbing the position of the camera, look through the viewfinder eyepiece. The viewfinder field-of-view should be squared within the area which was covered by the lens field-of-view.

g. As shown in Figure K, viewfinder pointing is accomplished by rotating and/or tilting the angle of the peek-in mirror mounted at the rear of the camera lens, and will be necessary only if the mirror was disturbed in disassembly. Remove the access hole cover located in the battery compartment. Loosen sealer on mirror pivot post with cotton on a toothpick, dipped in solvent. Use a narrow blade screwdriver to rotate the mirror or the Bristol bit tool No. STK-8709B to tilt the mirror until the viewfinder field is properly centered within the lens field of view. Reseal the mirror pivot post with Loc-tite and reinstall the access hole cover. Refer to paragraph 35 for trim adjustment.

19. LENS FOCUSING ADJUSTMENT. The prime lens must be refocused whenever the prime lens and/or the zoom lens unit have been removed or disturbed during repair procedures. Lens focusing requires the use of the focusing tool and focusing cartridge shown in Figure C plus an autocollimator with a focal length of 12 inches. The autocollimator must be focused at infinity.

a. Remove the side housing cover to expose the camera circuit board. Short out the trim pot at the circuit board (Figure L) by rotating the wiper arm fully counterclockwise. This will open the meter iris blades.

b. Install the filter removal screw into the filter plunger opening at the top of the camera main frame, thus removing the filter from in front of the prime lens. Set the zoom lens distance ring at infinity and zoom the lens to the "wide angle" position. Place the camera in the collimator fixture and set the collimator at infinity.

c. Prime lens focusing bushing is shown in Figure J. Insert the eccentric tip of the focusing tool (Figure C) through the hollow center of the bushing so that the eccentric pin engages the spiral groove around the lens barrel while the spanner ears of the tool engage the slots in the focusing bushing.

d. Turn the knurled knob of the tool counterclockwise until the focusing bushing is loose. Look through the collimator to observe the color fringe. Slowly turn the handle of the focusing tool until the lens is properly focused for color compromise (equal banding of red and green). Hold the handle of the tool firmly to prevent accidental shifting of lens position and turn the knurled knob of the tool clockwise until the focusing bushing is tight.

e. Remove the focusing tool and cartridge. Then return the trim pot wiper arm to the position shown in Figure L and reinstall the side housing cover with its two screws. The precise position of the trim pot arm must be determined by the trim adjustment (paragraph 35).

20. FOCUSING POINTER ADJUSTMENT. The focusing pointer is visible at the bottom edge of the viewfinder mask. This pointer will move from right (CLOSE) to left (FAR) as the zoom lens distance ring is rotated from 3 feet to infinity.

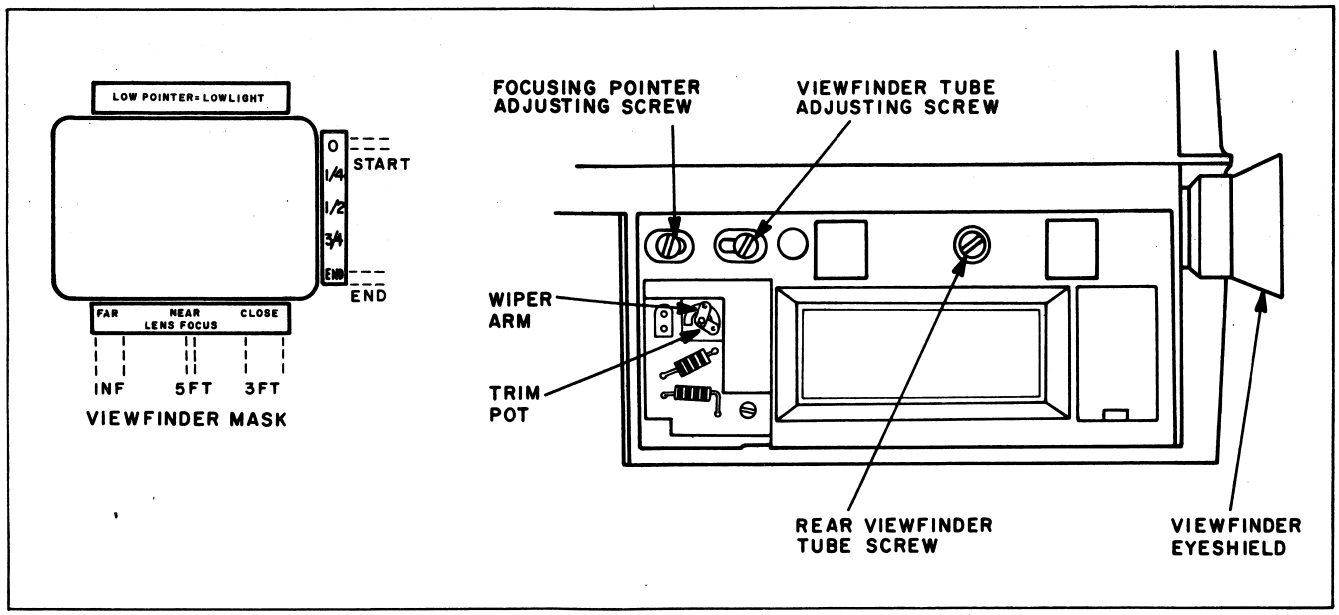


Figure L. Adjusting the Focusing Pointer and Viewfinder Tube

a. Look into the viewfinder and adjust the viewfinder eyepiece to focus on the mask.

b. Temporarily install the mechanism cover panel and set the zoom lens distance ring at 5 feet. Look into the viewfinder and note the position of the indicating needle. The needle should be positioned directly in front of the letter "F" in LENS FOCUS.

c. To adjust the focusing pointer, remove the side housing cover and just barely loosen the pointer attaching screw (Figure L). While looking through the viewfinder, carefully shift the screw back or forward in its elongated slot until the indicator needle covers the letter "F." Carefully tighten the screw without changing the position of the pointer.

d. Check in the viewfinder to see that the focusing pointer is in the correct position when at 3 feet and at infinity. Then reinstall the side housing cover with its two screws.

21. FOOTAGE COUNTER POINTER ADJUSTMENT. The footage counter pointer is visible at the right edge of the viewfinder mask. Look into the viewfinder and adjust the viewfinder eyepiece until the pointer and footage markings are in focus. The pointer should be at the "zero" position. Remove decorative nameplate to expose footage lever and adjusting screw (Figure M). Manually position footage lever so that its follower point is in the last groove of the footage gear. Depress hub of the lever while looking through the viewfinder. The footage pointer should now be located at or slightly below the word "END." To adjust the pointer, proceed as follows:

a. Remove the small rectangular cover from the decorative nameplate (Figure M) to expose the pointer adjusting screw.

b. Loosen the adjusting screw just enough so that the screw can be shifted up or down in its elongated slot. While looking through the viewfinder, shift the screw until the pointer is centered at the "zero" position. Then carefully tighten the adjusting screw without altering the position of the pointer.

c. Rotate the counter lever hub clockwise to its stop and check to see that the pointer is positioned just below the word "END." Reinstall the adjusting hole cover with adhesive (B&H Spec. 327).

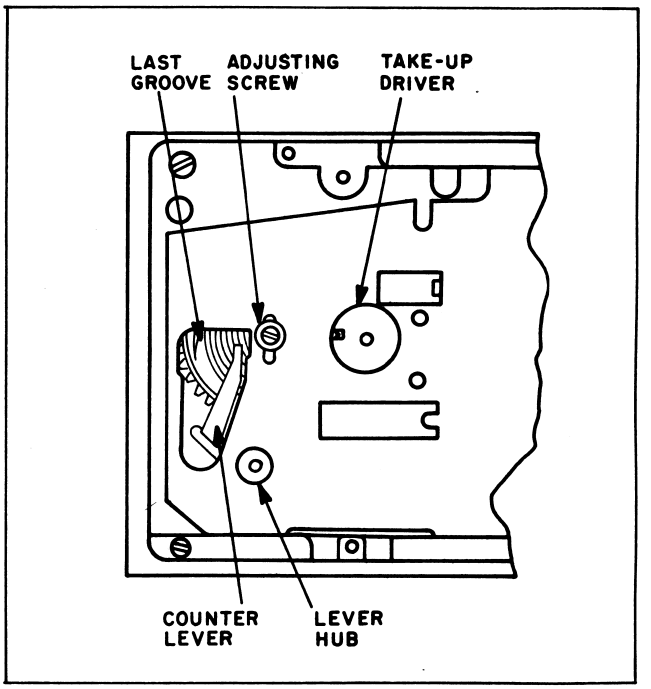


Figure M. Adjusting the Footage Counter Pointer

22. VIEWFINDER FOCUSING ADJUSTMENT.

a. Remove the side housing cover to expose the viewfinder tube attaching screws (Figure L) and mount the camera on a tripod. Position the camera exactly 7 feet from the wall-mounted focusing target.

b. Set the zoom lens distance ring at exactly 7 feet and zoom the lens to the "telephoto" position. Look through the viewfinder and check viewfinder focus.

c. To adjust viewfinder focus, loosen the viewfinder tube adjusting screw (Figure L) just enough so that the screw can be shifted in its elongated slot. While looking through the viewfinder, shift the screw and tube until the target is sharply focused. Then tighten the screw without disturbing the position of the screw.

d. Reinstall the side housing cover with its two screws.

Trouble Shooting

TROUBLE	PROBABLE CAUSE	REMEDY
Camera will not run	1. Weak or dead batteries.	1. Replace batteries.
	2. Battery contacts corroded.	2. Clean contacts or replace contacts (item 3-31).
	3. Bad solder connection on motor lead.	3. Resolder connection.
	4. Pinched wire causing short or ground.	4. Check wiring and correct condition.
	5. Drive motor "open" or has "dead spots."	5. Replace drive motor (item 6-21).
	6. Contact spring out-of-adjustment.	6. Center spring blade (item 2-32G) in the gap of the contact plate (paragraph 14, step e).
Camera energized when in "off" position	1. Contact spring out-of-adjustment.	1. Center spring blade (item 2-32G) in the gap of the contact plate (paragraph 14, step e).
Camera runs but does not pull film, or tears perforations	1. Weak batteries.	1. Replace batteries.
	2. Batteries installed backwards.	2. Install batteries per etched markings in battery compartment.
	3. Improper shuttle tooth height or centering (paragraph 25).	3. Adjust shuttle (paragraph 11).
	4. Film cartridge not seating properly.	4. Check door for distortion.
	5. Shuttle arm disengaged from shoulder of cam.	5. Re-engage shuttle on cam and set end play of face gear (item 5-3) to 0.003 inch maximum.
Viewfinder does not focus	1. Viewfinder out-of-focus.	1. Focus viewfinder (paragraph 19).
	2. Viewfinder tube or tubes loose.	2. Tighten tube attaching screws.
Zoom lens binding	1. Mechanical trouble in lens carriage.	1. Replace zoom lens assembly.
	2. Dirt or lubricant on zoom treadle friction surface.	2. Clean friction surfaces; buff with fine emery cloth.
	3. Zoom rocker link (item 2-25) bent or distorted.	3. Replace zoom rocker link.

TROUBLE	PROBABLE CAUSE	REMEDY
Developed films consistently over-exposed	1. A.S.A. disc out-of-adjustment.	1. Check disc alignment and adjust, if necessary (paragraph 16).
	2. Filter in "open" position (upper link disengaged or filter sticking).	2. Reconnect upper link or adjust filter (paragraph 17).
	3. Trim pot of meter assembly shorted out; iris blades in "open" position.	3. Replace meter assembly (item 2-32).
	4. Faulty meter assembly (item 2-32) (see "Meter Stays Open or Closed").	4. Replace meter assembly.
	5. Electric eye system out-of-trim.	5. Retrim electric eye system (paragraph 35).
Developed films consistently under-exposed	1. A.S.A. disc out-of-alignment.	1. Check disc alignment and adjust, if necessary (paragraph 16).
	2. Iris blades stuck in near-closed position.	2. Free up iris blades, or replace meter assembly (item 2-32).
	3. Dirt or oil on optics.	3. Clean optics.
	4. If under-exposed on indoor films only, filter out-of-adjustment.	4. Adjust filter (paragraph 17).
	5. Faulty meter assembly (item 2-32) (see "Meter Stays Open or Closed").	5. Replace meter assembly.
	6. Electric eye system out-of-trim.	6. Retrim electric eye system (paragraph 35).
Meter Stays Open or Closed	1. Open or grounded meter wiring.	1. Check wiring; correct condition or replace meter (item 2-32).
Electric Eye Meter "Dead"	1. Loose ground lead on meter.	1. Resolder ground lead.
	2. Meter out of pivot holes.	2. Replace meter (item 2-32).
	3. Meter magnet loose.	3. Replace meter (item 2-32).
Footage indicator sticking or inoperative	1. Faulty footage indicator parts.	1. Replace footage indicator parts.
A.S.A. Speed Mechanism	1. Faulty A.S.A. speed mechanism.	1. Replace complete A.S.A. mechanism assembly (item 4-39).
	2. A.S.A. clutch gear (item 4-37) binding on A.S.A. disc.	2. Readjust clutch gear for 0.003-inch maximum end play.
Camera speed too slow or too fast	1. Check camera speed (paragraph 34).	1. If speed is improper, replace motor and clutch assembly (item 6-21).

TROUBLE	PROBABLE CAUSE	REMEDY
Start switch shorts out	1. Excessive play in start slide lever.	1. Adjust start slide lever end play (paragraph 14, step b).
Scratches on film	1. Burr on aperture plate (item 5-6).	1. Polish to remove burr or replace main frame assembly.
Battery test indicator not working	1. Wire disconnected from battery test circuit.	1. Resolder disconnected wire.
	2. Indicator lamp burned out.	2. Replace battery test assembly (item 3-10).
Camera excessively noisy during operation	1. Burr or nick on shuttle cam.	1. Remove burr or replace main frame assembly (item 5-16).
	2. Too much end play in shuttle cam.	2. Readjust face gear (item 5-3) for 0.003-inch maximum end play.

Test Procedure

23. GENERAL INSPECTION PROCEDURES.

a. Visually inspect the camera for obvious physical damage and for loose or missing parts.

b. Look through the viewfinder and manipulate the zoom treadle from "wide angle" to "telephoto" position and back again. The lens must zoom smoothly, without binding or hesitation.

c. Check the latching action of the film cartridge door. The door must latch securely with a minimum of play.

d. Check the zoom lens surface for scratches, fingerprints or smears. Clean lens surface with lens cleaning fluid and lens tissue.

e. With batteries installed, run the camera and listen for unusual noises not normally associated with camera operation.

f. Perform the tests outlined in the following paragraphs to check camera performance.

24. CHECKING THE BATTERY TEST INDICATOR. Operation of the battery test indicator can be checked with the power supply (Figure P), the voltmeter and the trimming cable (Figure B).

a. Connect the power supply to the REMOTE jack of the camera with the trimming cable (SD-431-4-F9) and connect the 0 to 10 VDC voltmeter across the output terminals of the power supply.

b. While depressing the BATTERY TEST button, adjust the power supply (RS, Figure P) for 3.8 volts. The battery test indicator lamp should glow dimly and the power supply meter should read 80 to 120 ma.

c. Adjust the power supply for 3.3 volts and depress the BATTERY TEST button. The battery test indicator lamp should not glow at this voltage setting.

d. Adjust the power supply for 5 volts and depress the BATTERY TEST button. The battery test indicator lamp should glow brightly at this voltage setting.

e. If the battery test indicator fails to pass any of the preceding tests, the camera must be partially disassembled and the indicator replaced.

25. CHECKING THE SHUTTLE. Shuttle tooth height and centering are checked with the Go-No Go height gage and the centering inspection gage shown in Figure B.

a. Shuttle Tooth Centering. Open the cartridge door and position the centering inspection gage in the channel of the aperture plate with the slot in the gage over the shuttle tooth, and the heavy end of gage down. Hold the camera so that the aperture plate is level; then tilt the back end of the camera approximately 45 degrees to the left so that the heavy lower end of the gage tends to swing in toward the decorative nameplate. Press the start button to run the mechanism.

If the gage vibrates, the shuttle tooth is not centered in the slot and the frame and shuttle assembly must be replaced.

b. Shuttle Tooth Protrusion. With the batteries removed, press down on the start treadle until the ear at the bottom of the start lever is disengaged from the shuttle cam. Rotate the cam until the shuttle tooth is at its maximum protrusion through the slot in the aperture plate. Check the height of the shuttle tooth with the shuttle penetration gage (Figure B). The shuttle tooth must clear the "GO" end of the gage, but must not clear the "NO GO" end. If shuttle height is incorrect, disassemble the camera and adjust the shuttle as outlined in paragraph 11.

26. CHECKING CAMERA TAKE-UP TORQUE. Camera take-up torque can be checked in the fixture illustrated in Figure N.

a. Place the fixture near the edge of the bench or desk so that both weights are resting in a drawer or on a shelf below the string slot.

b. With batteries installed, position the camera so that the nylon driver of the fixture engages the camera take-up driver as shown. Do not tilt or force the camera against the nylon driver. The ears of the nylon driver should make contact only with the finger of the take-up driver.

c. Press the start treadle to run the camera. Torque must be great enough to draw the lightest weight upward but not the heaviest, or to raise the heaviest weight partially and then hesitate.

d. Take-up torque can be corrected by disassembling the camera to expose the mechanism (side cover separated from main frame) and replacing the cross-shaped torque spring (item 16, Figure 6).

27. CHECKING IRIS BLADE FRICTION AND MINIMUM OPENING.

a. With the batteries installed, remove the mechanism cover and set the zoom lens at "wide angle" position.

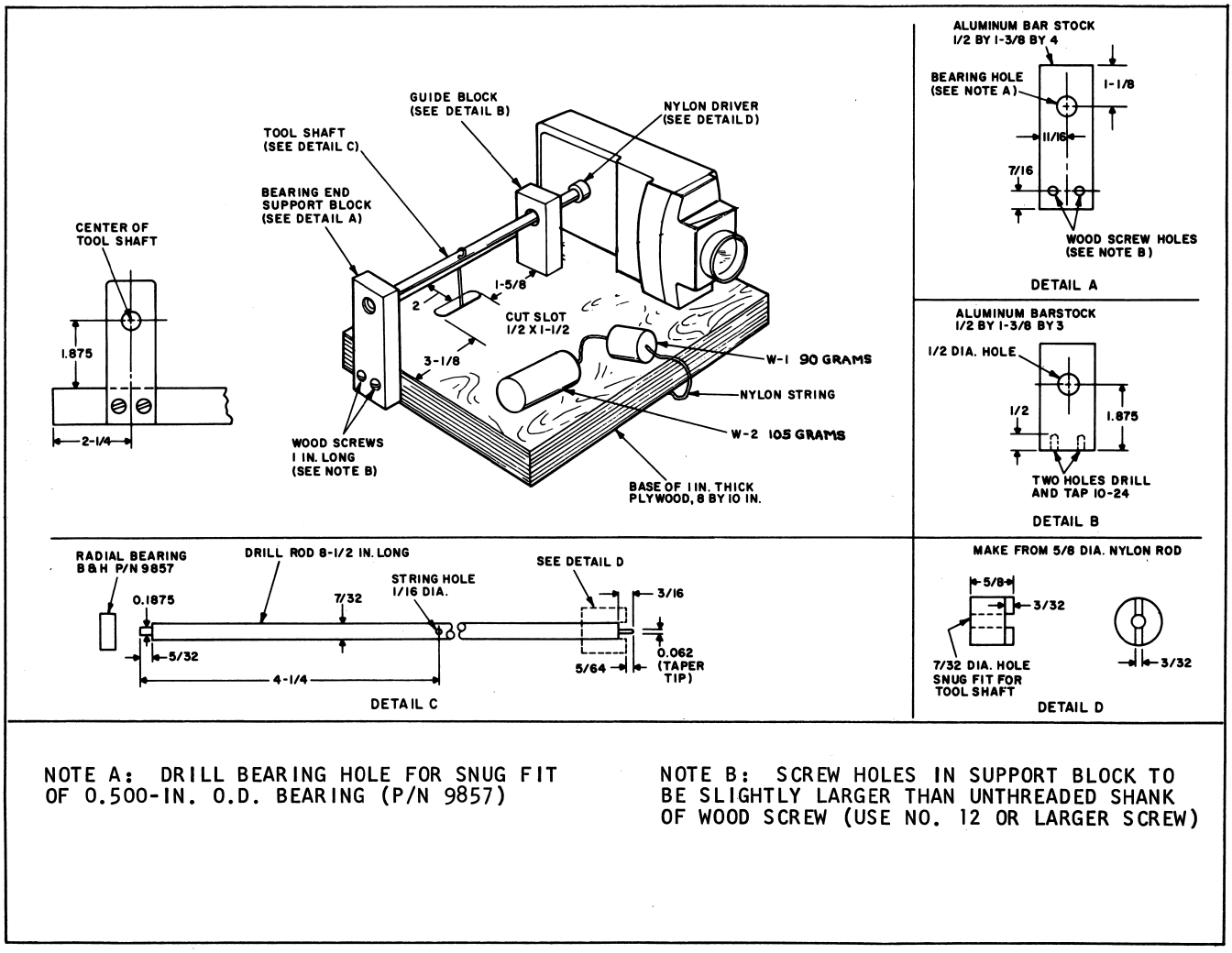


Figure N. Checking Camera Take-Up Torque

b. Hold the camera with the zoom lens toward you and bright light shining directly into the exposed mechanism area.

c. Look straight into the zoom lens and, with camera in "lock-run" position, pass your hand back and forth between the light source and the camera. The iris blades must open and close smoothly, without hesitation or friction.

d. Repeat the test, first with the rear end of the camera pointing downward at 45 degrees, and then with the rear end pointing upward at 45 degrees. Camera angle must not affect the smooth movement of the iris blades.

e. With light directed into the exposed mechanism area, look into the zoom lens and check to make certain that the iris blades close to a minimum but do not close all the way.

f. If the iris blades do not function as described above, the complete iris and meter assembly (item 32, Figure 2) must be replaced.

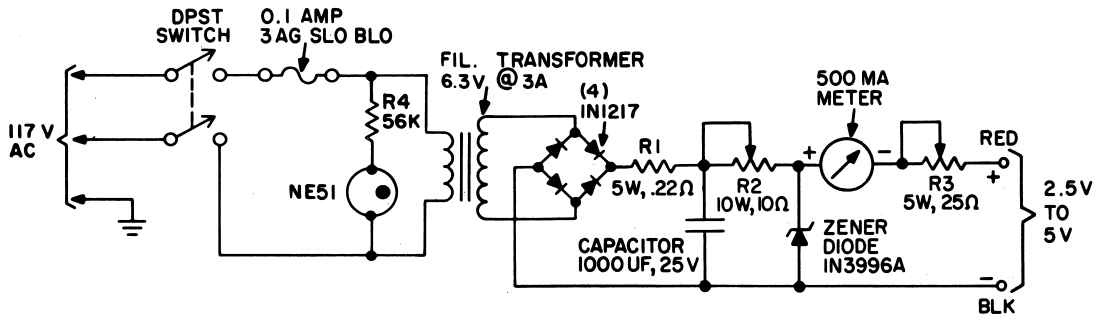
28. CHECKING MOTOR CLUTCH FRICTION.

a. Connect the power supply (Figure P) to the camera by plugging the trimming cable (Figure B) into the "REMOTE" jack of the camera.

b. Apply 5 volts to the camera and press the start treadle down slowly until the motor is energized but the camera is not actually running (start lever ear still not clear of the shuttle cam). This is the "stalled" condition of the motor, and the power source meter should indicate a current reading greater than 500 milliamps.

c. Press the start treadle down until the camera is running at normal (18 fps) speed. The current reading on the power source meter must not exceed 150 milliamps.

d. If the camera does not meet friction requirements, check for binding in the gear train or replace the motor and clutch assembly (item 21, Figure 6).



PARTS REQUIRED

SWITCH, DPST: Cutler-Hammer No. 7590K6
RESISTOR, 5W (±5%), 0.22 OHM: International Resistor Co., Type AS-5
RESISTOR, 10W, 10 OHM: Ohmite "Dividohm"
POTENTIOMETER, 5W, 25 OHM: Centralab Type WN
CAPACITOR, 1000 UF; 25V: Cornell-Dubilier No. 1000-25
PANEL METER, 500 MA: Simpson Electric Co. Model 1227, 0-500MA-DC

CALIBRATION PROCEDURE. Connect the 500 MA-DC meter in series with the Zener Diode and adjust the 10-ohm resistor (R2) for 400 ma. The battery test indicator test voltage (5V, 4.2V and 3.5V) can be preset in the following manner. Mark the settings on the front panel behind the 25-ohm potentiometer.

NOTE: The power supply illustrated is a "universal" power supply, designed for use with most Bell & Howell Electric Eye Cameras. The battery test voltages should be present and marked even though the camera being tested is not equipped with the battery test feature.

(1) Set the 25-ohm potentiometer (R3) to minimum resistance and mark the panel "5V" opposite the knob indicator.

(2) Connect a 25-ohm (±2%) load resistor across the output terminals and connect a voltmeter across the load resistor. Adjust the potentiometer (R3) for a reading of 4.2 volts and mark the panel; then adjust the potentiometer for a reading of 3.5 volts. When operating the camera for adjustments and tests, set the potentiometer at the 5-volt position.

Figure P. Power Supply for Tests and Adjustments

29. CHECKING FILTER OPERATION.

a. Remove the mechanism cover to expose the filter linkage and A.S.A. mechanism. Set the zoom lens at "telephoto" position.

b. Remove the filter removal screw from its stored position in the battery compartment and screw it down into the filter plunger opening at the top of the main frame.

c. With the camera in "lock-run" position and light shining directly into the exposed mechanism area of the camera, look directly into the center of the zoom lens. The circle of light in the lens should be clear white. Remove the removal screw and note that the circle of light is now pale amber.

d. With the flat of the A.S.A. adjusting gage (Figure C), depress the filter finger at the bottom of the A.S.A. mechanism until the tip of the finger is flush with the aperture plate mounting surface. Again look into the zoom lens and check to make certain that the circle of light is clear.

e. If the amber filter does not completely withdraw from the circle of light with the removal screw installed or the filter finger depressed, adjust the filter as instructed in paragraph 17.

30. CHECKING THE FOOTAGE POINTER.

a. Open the cartridge door and remove the decorative nameplate to expose the footage lever and adjusting screw (Figure M).

b. Look through the viewfinder and adjust the eyepiece until the footage markings at the right side of the mask are sharply focused. The footage pointer should be bisecting the "zero" at the top of the mask.

c. Manually move the footage lever (Figure M) so that its follower point is in the last groove of the footage gear. Depress the hub and look through the viewfinder. The footage pointer now should be located at or slightly below the word "END."

d. If the pointer is not functioning properly, refer to paragraph 21 for adjustment.

31. CHECKING LENS FOCUS. Lens focus can be checked with the focusing cartridge (Figure C) and an autocollimator with a focal length of 12 inches or greater.

a. Remove the side housing cover to expose the circuit board (Figure L) and rotate the wiper arm fully clockwise to open the meter iris blades.

b. Set the lens distance ring at infinity and zoom the lens to "wide angle" position. Install the filter removal screw into the opening in the top of the main frame to remove the filter from in front of the prime lens. Insert the focusing cartridge into the camera.

c. Place the camera in the collimator fixture and set the collimator at infinity. Check camera focus by observing the color fringe. If there is equal banding of red and green, the camera is in focus.

d. If the camera lens is not in focus, refer to paragraph 19 for proper lens focusing. Then retrim the electric eye system as outlined in paragraph 35.

32. CHECKING CAMERA POINTING AND VIEWFINDER FOCUS. Camera pointing can be checked with the pointing mirror block (Figure C) and the focusing target initially furnished with Bell & Howell Instruction Book No. 70411.

a. Remove the side housing cover to expose the circuit board (Figure L) and rotate the wiper arm fully clockwise to open the meter iris blades.

b. Mount the camera on a tripod. Insert the mirror block into the camera and use the cartridge clip (Figure B) to hold it in place.

c. Set the lens distance ring at 7 feet and zoom the lens to "telephoto" position. Position the camera exactly 7 feet from the wall-mounted target and, while looking into the pointing block mirror, adjust the camera position until the lens is centered on the target cross-hairs.

d. Without disturbing the position of the camera, look through the viewfinder. The viewfinder field-of-view should be squared within the area which was covered by the lens field-of-view. If not, adjust viewfinder pointing as instructed in paragraph 18.

e. Check viewfinder focus by rotating the viewfinder eyepiece. If the target lines will not come into sharp focus, adjust the front viewfinder tube as instructed in paragraph 22.

NOTE: Be sure to retrim the electric eye system (paragraph 35) after adjustments are made.

33. CHECKING THE FOCUSING POINTER.

a. Set the lens distance ring at 3 feet and look through the viewfinder. Adjust the viewfinder eyepiece to focus on the mask markings. The focusing pointer should be positioned at the far right of the mask (near the end of the word "CLOSE").

b. Rotate the lens distance ring to the opposite stop (infinity) and note that the pointer moves to the left until it is positioned beneath the word "FAR."

c. Set the lens distance ring at 5 feet and look through the viewfinder. The pointer now should be positioned in front of the "F" of the word "FOCUS."

d. To adjust the focusing pointer, refer to paragraph 20.

34. CHECKING CAMERA SPEED. Camera speed can be checked by inserting the pointing mirror block (Figure C) into the camera and using a shutter strobe to

check shutter rotation at standard speed. When the shutter appears motionless, the strobe dial must read between 960 rpm minimum (16 fps) and 1200 rpm maximum (20 fps). Ideal camera speed is 1080 rpm (18 fps). If a shutter strobe is not available, use an accurate stop watch and count the number of revolutions of the take-up driver (Figure M) in 10-3/4 seconds. The take-up driver must make 16 to 20 revolutions within the time specified. If speed does not fall within the specified limits, check motor clutch friction (paragraph 28) and for possible binding in motor drive gearing.

35. TRIM CALIBRATION AND ADJUSTMENT. The electric eye system has been factory-calibrated by means of a light transmission test. Since the camera has no external means by which service stations can verify electric eye calibration, the check and adjustment must be made by using a light sensor at the camera film plane. The light source must consist of a diffused, uniformally bright surface capable of being adjusted within the range of 24 to 600 foot-Lamberts. The color temperature should be 2850°K (±200°K). The trim cartridge (SD-431-4-F7, Figure B) is marked, in D-C micro-amp reading, for 24 foot-Lamberts, and the light source must be adjusted accordingly.

To run the camera during the test, connect the power supply (Figure P) to the camera with the trimming cable (Figure B), plugging the cable into the camera "REMOTE" jack.

Calibrating the Trim Cartridge.

a. The trim cartridge has been factory-calibrated, but correlating results must be established for each trim fixture set-up. To accomplish this place the trim cartridge flat against the light fixture glass, and adjust the light level to 24 foot-Lamberts, as read in D-C micro-amps.

b. Remove the side housing cover to expose the circuit board (Figure L) and short out the trim pot by rotating the wiper arm clockwise. This will open the meter iris blades. It should be noted that clockwise rotation of the trim pot wiper arm will increase the output level reading on the vacum-tube voltmeter.

c. Insert the trim cartridge into the camera and hold in place with the special cartridge clip (Figure B). Set the zoom lens at Normal and at universal focus position (the dot above the 25 foot mark).

d. Run the camera and note the millivolt reading on the vacuum-tube voltmeter. This reading is the correlated reference for the trim cartridge. Periodic checks should be made to maintain this reference by adjusting the load adjusting pot on the top of the trim cartridge (Figure B). Move the trim pot wiper arm back to its original position.

Checking and Adjusting the Electric Eye System

a. The following readings are the established limits for trimming the electric eye system. For convenience in checking, this millivolt limit can be marked on the face of the voltmeter dial with strips of tape.

A.S.A. 40	2.2 MV to 5.2 MV
A.S.A. 160	0.55 MV to 1.5 MV

b. Place the A.S.A. 40 plug into the trim cartridge and insert cartridge into the camera to be tested. Place the camera in the light fixture and, with camera running at normal speed, note the reading on the vacuum tube voltmeter. This reading must be within the A.S.A. 40 limits noted in step a. Repeat this check with the A.S.A. 160 plug inserted in the trimming cartridge. The reading on the voltmeter must be within the limits noted in step a.

c. If the readings obtained at A.S.A. 40 and/or A.S.A. 160 are not within the limits noted in step a, the electric eye system must be trimmed. If the reading at A.S.A. 40 (step b) was below the lower limit specified in step a, rotate the trim pot wiper arm slightly counterclockwise; if the reading was above the upper limit specified, rotate wiper arm clockwise.

d. Recheck trim with the A.S.A. 160 plug in the trimming cartridge. It is imperative that the millivolt readings at both A.S.A. 40 and A.S.A. 160 are within the limits specified in step a.

Replacement Parts

The following pages list all replacement parts for the Design 440 Super 8 Autoload Camera by part name and part number. All of the illustrations are indexed in the suggested order of parts removal, and will serve to aid the repairman during repair operation.

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
		CAMERA DOORS, PANELS AND NAMEPLATES		
1-1	041704	DOOR ASSEMBLY, Battery	1	
-1A	30024	. RING, Retaining, 0.101 ID (Type C)	1	
-1B	433080	. SCREW, Battery door	1	
-2	35272	BATTERY, Alkaline, Size AA, "Penlite," 1-1/2 volt	4	
-3	433050	SCREW, Special	1	
-4	433057	INSET, Decorative, camera door (remove backing sheet)	1	
-5	433037	SCREW, Special	2	
-6	041713	PANEL ASSEMBLY, Side	1	
-7	433091	NAMEPLATE, Lens cover (cement in place)	1	
-8	29558	SCREW, Binding head, 4-40 by 1/4-inch	1	
-9	041847	COVER ASSEMBLY, Lens, hinged	1	
-9A	433092	. WINDOW, Lens cover (cement in place)	1	
-10	433048	COVER, Pointing	1	
-11	432938	NAMEPLATE, Front (cement in place)	1	
-12	30163	SCREW, Binding head, 5-40 by 3/8-inch	2	
-13	35267	SCREW, Binding head, 2-56 by 0.228-inch	1	
-14	432908	PLATE, Front	1	
-15	433061	NAMEPLATE, Mechanism cover panel (cement in place)	1	
-16	29420	SCREW, Pan head, 2-56 by 5/16 inch	1	
-17	433090	SCREW, Special	2	
-18	30163	SCREW, Binding head, 5-40 by 3/8 inch	1	
-19	041845	PANEL ASSEMBLY, Mechanism cover	1	
-19A	433045	. INSET, Cover panel, small (remove backing sheet)	1	
-19B	433044	. INSET, Cover panel, large (remove backing sheet)	1	
-19C	432918	. WINDOW, Lens focus (cement in place)	1	
-19D	432925	. PANEL, Mechanism cover	1	
-20	041810	MAIN FRAME AND SIDE HOUSING ASSEMBLY (See Figure 2 for parts breakdown)	1	

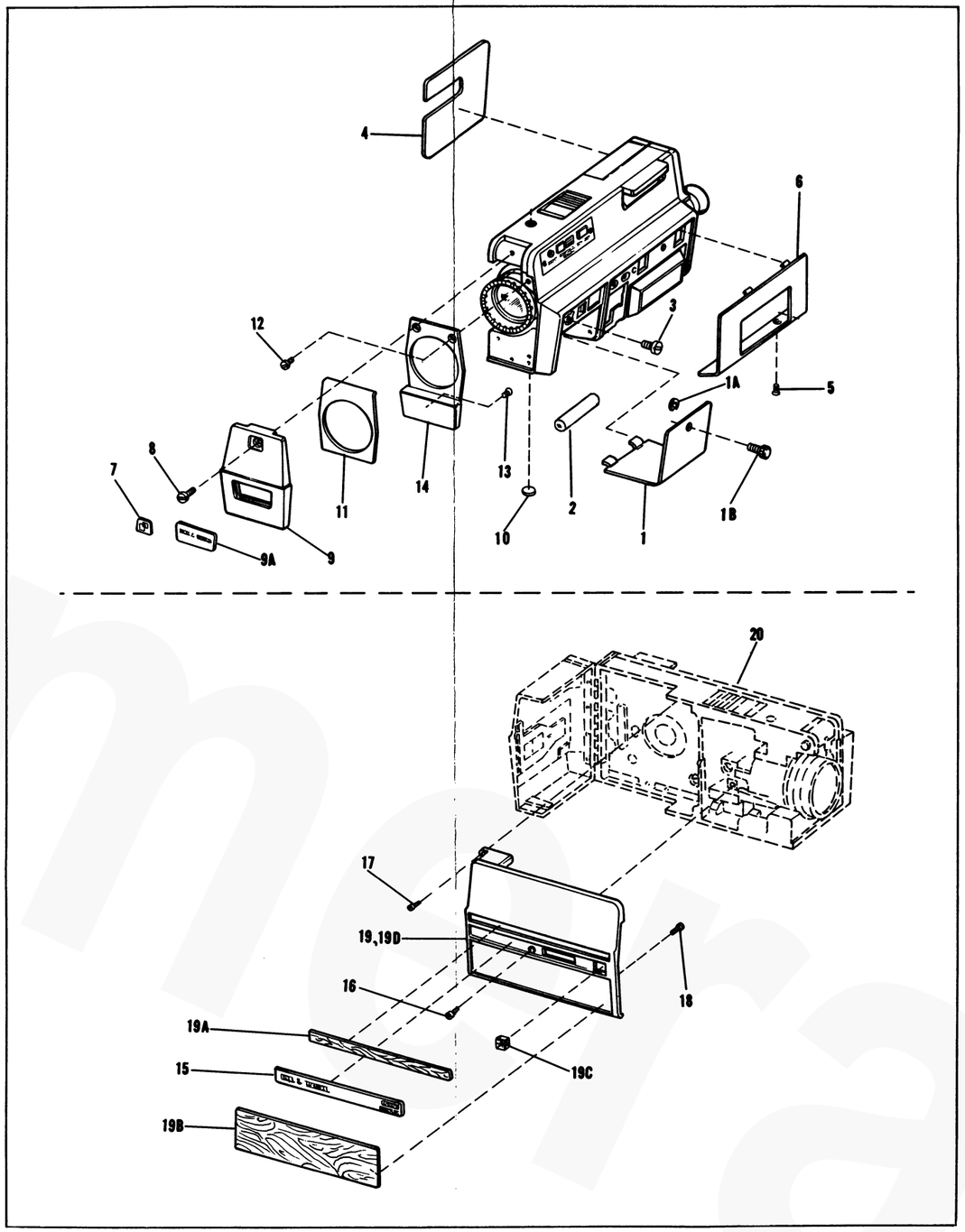


Figure 1. Camera Doors, Panels and Nameplates

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
		SIDE HOUSING, METER AND MECHANISM		
2-1	29831	SCREW, Pan head, 2-56 by 1/8 inch	2	
-2	041811	NAMEPLATE ASSEMBLY, Decorative	1	
-3	433076	COVER, Nameplate (cement in place)	1	
-4	433053	SCREW, Special	2	
-5	433922	NAMEPLATE, Battery test	1	
-6	432916	BUTTON, Lock-Run	1	
-7	432995	SPRING, Lock-Run button	1	
-8	432919	BUTTON, Battery test	1	
-9	433042	NAMEPLATE, Side housing (cement in place)	1	
-10	30163	SCREW, Binding head, 5-40 by 3/8 inch	3	
-11	34893	SCREW, Binding head, 2-56 by 0.218-inch	1	
-12	600928	SCREW, Pan head, 2-56 by 0.438 inch	1	
-13	29831	SCREW, Pan head, 2-56 by 1/8 inch	1	
-14	041812	SIDE HOUSING ASSEMBLY, Complete (see Figure 3 for parts breakdown)	1	
-15	432980	PLUNGER, Lock-Run	1	
-16	432996	SPRING, Lock-Run plunger	1	
-17	29831	SCREW, Pan head, 2-56 by 1/8 inch	2	
-18	432973	BUSHING, Shoulder	2	
-19	432937	BAR, Focus indicator	1	
-20	432979	SCREW, Zoom link, special	1	
-21	432978	SCREW, Zoom link, special	1	
-22	38632	SCREW, Special 2-56 NC	1	
-23	38739	WASHER, Flat	1	
-24	432976	WASHER, Friction	2	
-25	432928	LINK, Zoom rocker	1	
-26	432994	SPRING, Tension	1	
-27	433081	NAMEPLATE, Zoom treadle (cement in place)	1	
-28	432977	SCREW, Zoom treadle	1	
-29	432915	TREADLE, Zoom	1	
-30	38603	SCREW, Pilot, 3-48	1	
-31	35490	SCREW, Pan head, 2-56 by 0.187 inch	1	
-32	041711	METER AND PHOTOCELL ASSEMBLY	1	
-32A	301565	. SCREW, Binding head, 2-56 by 1/8 inch	1	
-32B	433003	. PHOTOCONDUCTIVE CELL	1	
-32C	99828	. RING, Retaining, external Type E, 0.062 inch ID	1	
-32D	433084	. SPRING, Torsion	1	
-32E	041735	. DISC AND SHAFT ASSEMBLY, A.S.A.	1	
-32F	29831	. SCREW, Fillister head, 2-56 by 0.128 inch	2	
-32G	432961	. SPRING, Contact	1	
-33	35490	SCREW, Pan head, 2-56 by 0.187 inch	1	
-34	38603	SCREW, Pilot, 3-48	2	
-35	433082	LUG, Solder	1	
-36	041734	MECHANISM ASSEMBLY (See Figure 6 for parts breakdown)	1	
-37	433055	PANEL, Decorative, rear (cement in place)	2	
-38	041736	MAIN FRAME ASSEMBLY, Complete (see Figure 4 for parts breakdown)	1	

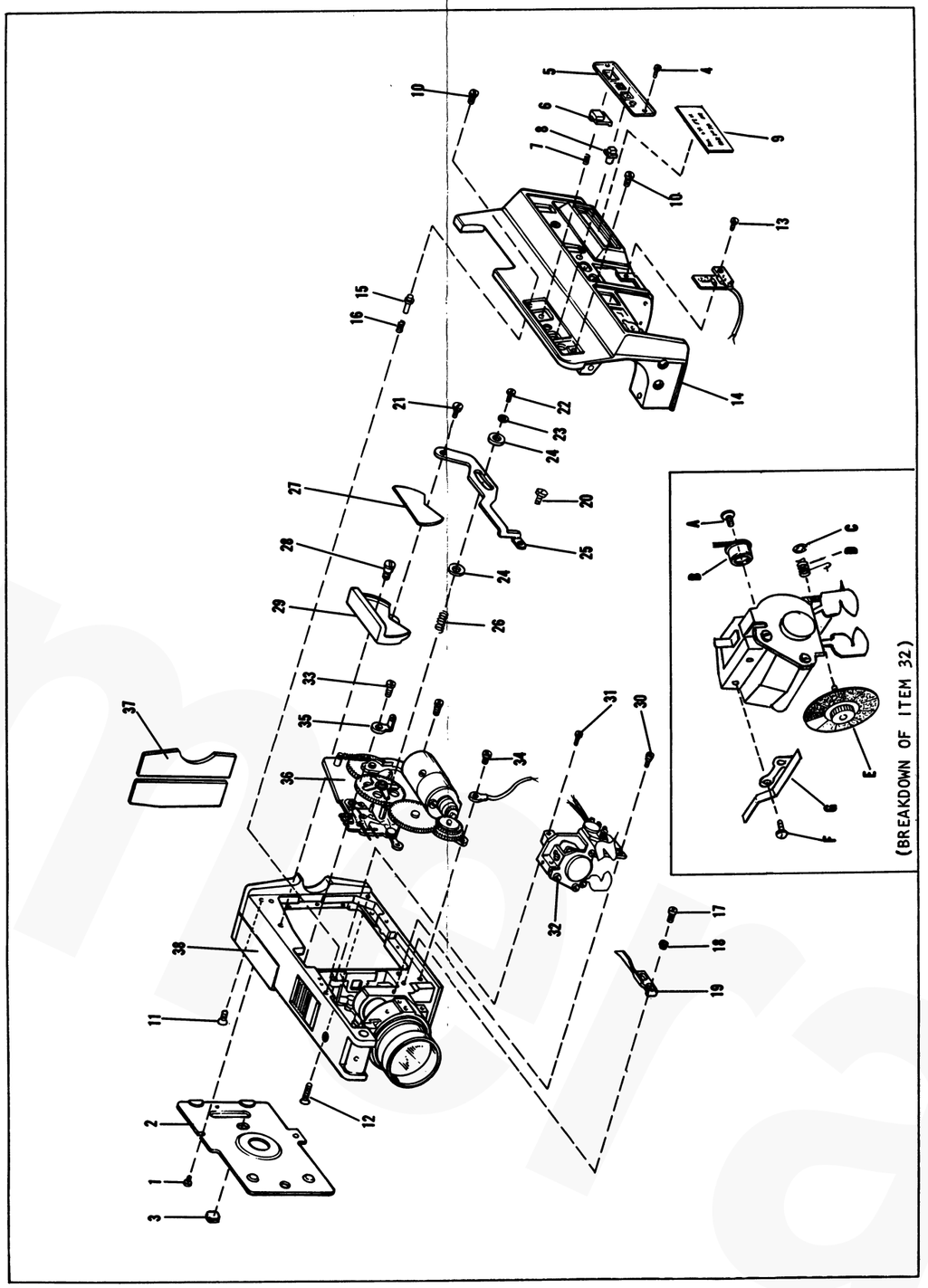


Figure 2. Side Housing, Meter and Mechanism

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
		SIDE HOUSING ASSEMBLY		
3-1	29831	SCREW, Pan head, 2-56 by 1/8 inch	2	
-2	041818	BRACKET ASSEMBLY, Eyepiece tension	1	
-3	041724	EYEPIECE ASSEMBLY, Viewfinder	1	
-3A	433036	. EYESHIELD, Rubber	1	
-4	30163	SCREW, Binding head, 5-40 by 3/8 inch	2	
-5	041723	VIEWFINDER TUBE ASSEMBLY, Rear	1	
-6	041722	VIEWFINDER TUBE ASSEMBLY, Front	1	
-7	30163	SCREW, Binding head, 5-40 by 3/8 inch	1	
-8	041819	BRACKET ASSEMBLY, Focus indicator	1	
-8A	432993	. SPRING, Indicator bracket	1	
-9	28412	SCREW, Binding head, 2-56 by 0.156-inch	1	
-10	041700	BATTERY TEST ASSEMBLY	1	
-11	No Number	NUT, Socket retaining	1	
-12	041732	SOCKET AND LEADWIRE ASSEMBLY (Includes item 11)	1	
-13	433046	PLATE, Decorative (cement in place)	1	
-14	30163	SCREW, Binding head, 5-40 by 3/8 inch	1	
-15	433138	HOUSING, Switch	1	
-16	99828	RING, Retaining, Type E, 0.062 inch ID	1	
-17	433137	SPRING, Tension	1	
-18	433136	PLUNGER, Switch	1	
-19	433135	CONTACT, Switch	1	
-20	041846	SIDE HOUSING SUBASSEMBLY	1	
-21	432955	. RETAINER, Lens	1	
-22	431448	. LENS ELEMENT, First, viewfinder	1	
-23	433047	. COVER, Mirror protecting (cement in place)	1	
-24	202751	. MIRROR, Viewfinder (cement in place)	1	
-25	29831	. SCREW, Pan head, 2-56 by 1/8 inch	1	
-26	38726	. LUG, Solder	1	
-27	433063	. RETAINER, Screw (cement in place)	1	
-28	433052	. EYELET	6	
-29	432942	. LINK, Battery	1	
-30	433133	. INSULATOR, Battery contact	1	
-31	433093	. CONTACT, Battery	2	
-32	432924	. HOUSING, Side (order complete subassembly, item 20)	NP	

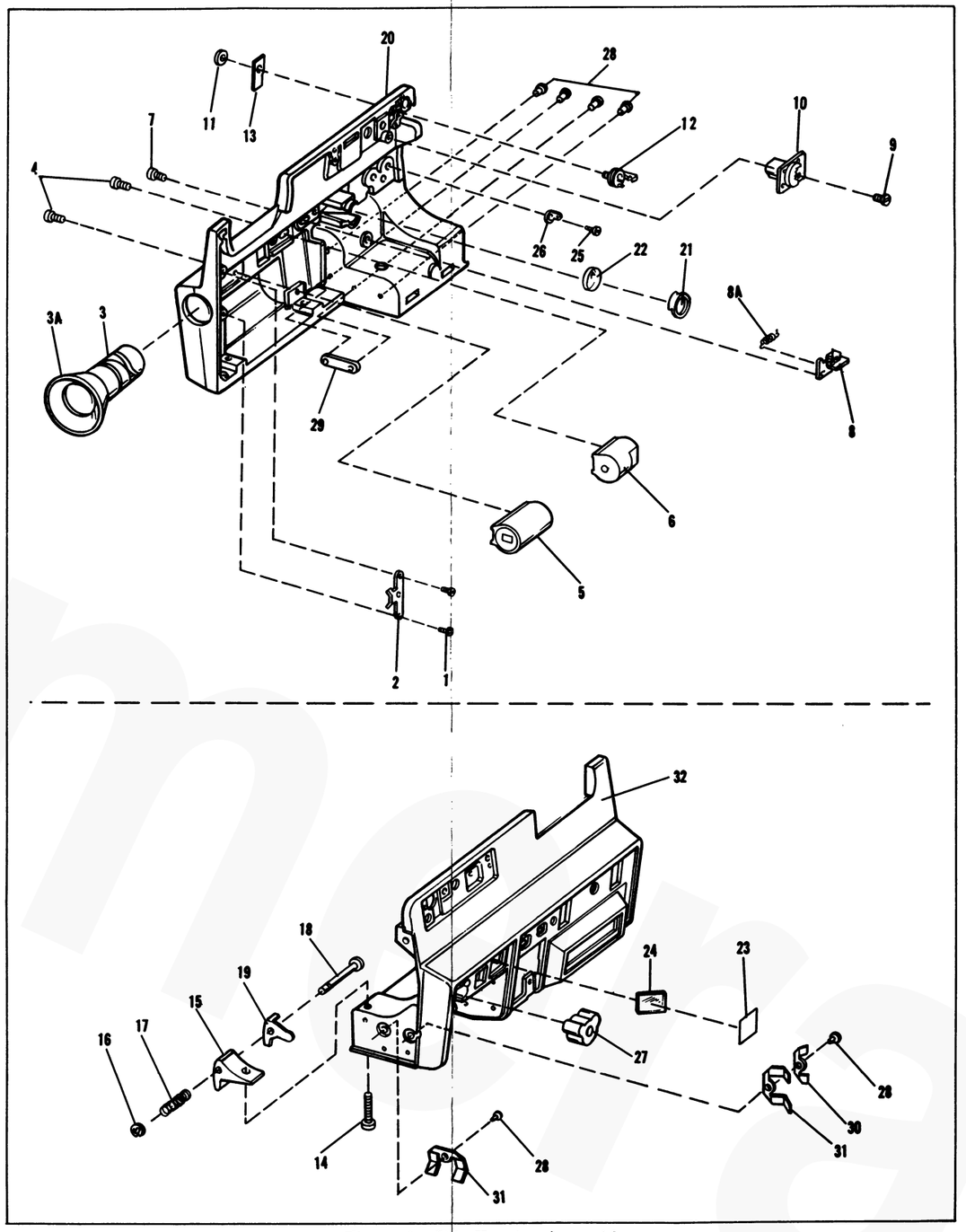


Figure 3. Side Housing Assembly

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
		MAIN FRAME ASSEMBLY		
4-1	432981	PIVOT, Treadle	1	
-2	041701	TREADLE ASSEMBLY, Start	1	
-3	38627	SETSCREW, Fluted cone pt, 2-56 by 1/8-inch	3	
-4	041714	ZOOM LENS UNIT, Complete, 11-35 mm f/1.9	1	
-5	432983	PIN, Hinge, lens cover	1	
-6	432986	BEARING, Detent	1	
-7	900321	BALL, Steel	1	
-8	432997	SPRING, Tension	1	
-9	28348	RING, Retaining, Type E, 0.094 inch ID	2	
-10	041813	LEVER ASSEMBLY, Filter adjusting	1	
-10A	28412	. SCREW, Binding head, 2-56 by 0.156-inch	1	
-11	041814	PUSHER ASSEMBLY, Filter	1	
-12	38603	SCREW, Pilot, 3-48	1	
-13	433097	SPRING, Filter	1	
-14	32332	SCREW, Fillister head, 2-56 by 0.228 inch	1	
-15	432987	ECCENTRIC	1	
-16	432959	LEVER	1	
-17	33740	SETSCREW, Fluted socket cone pt, 2-56 by 3/32 inch	1	
-18	432991	PIVOT, Filter	1	
-19	041728	FILTER AND LINK ASSEMBLY	1	
-20	17676	RING, Retaining, external, Type E, 0.156 inch ID	1	
-21	432988	BUTTON, Filter	1	
-22	433095	BAFFLE, Light (cement in place)	1	
-23	36154	BUSHING, Focusing	1	
-24	34574	WASHER, Focusing bushing	1	
-25	041597	PRIME LENS ASSEMBLY	1	
-26	36831	SCREW, Pan head, 2-56 by 1/8 inch	1	
-27	40163	BUSHING, Shoulder, fiber	1	
-28	432934	CONTACT PLATE	1	
-29	432950	INSULATOR, Contact plate (cement in place)	1	
-30	27067	RING, Retaining, external, Type E, 0.094 inch ID	1	
-31	38788	SCREW, Binding head, 0-80 by 0.156 inch	1	
-32	39887	BUSHING, Shoulder	1	
-33	041702	LEVER ASSEMBLY, Start slide	1	
-34	27067	RING, Retaining, external, Type E, 0.094 inch ID	1	
-35	38544	PINION, Start lever	1	
-36	38546	GEAR RACK, Start lever	1	
-37	38722	GEAR, Clutch, A.S.A.	1	
-38	38603	SCREW, Pilot, 3-48	2	
-39	041815	A.S.A. PLATE AND LINKAGE ASSEMBLY	1	
-40	38715	SPRING, A.S.A. linkage	2	
-41	38644	SPACER, Shutter	1	
-42	432969	COVER, Start treadle (cement in place)	1	
-43	433058	COVER, Shuttle (cement in place)	1	
-44	433079	COVER, Shuttle (cement in place)	1	
-45	041817	FRAME AND DOOR ASSEMBLY, Main (see Figure 5 for parts breakdown)	1	

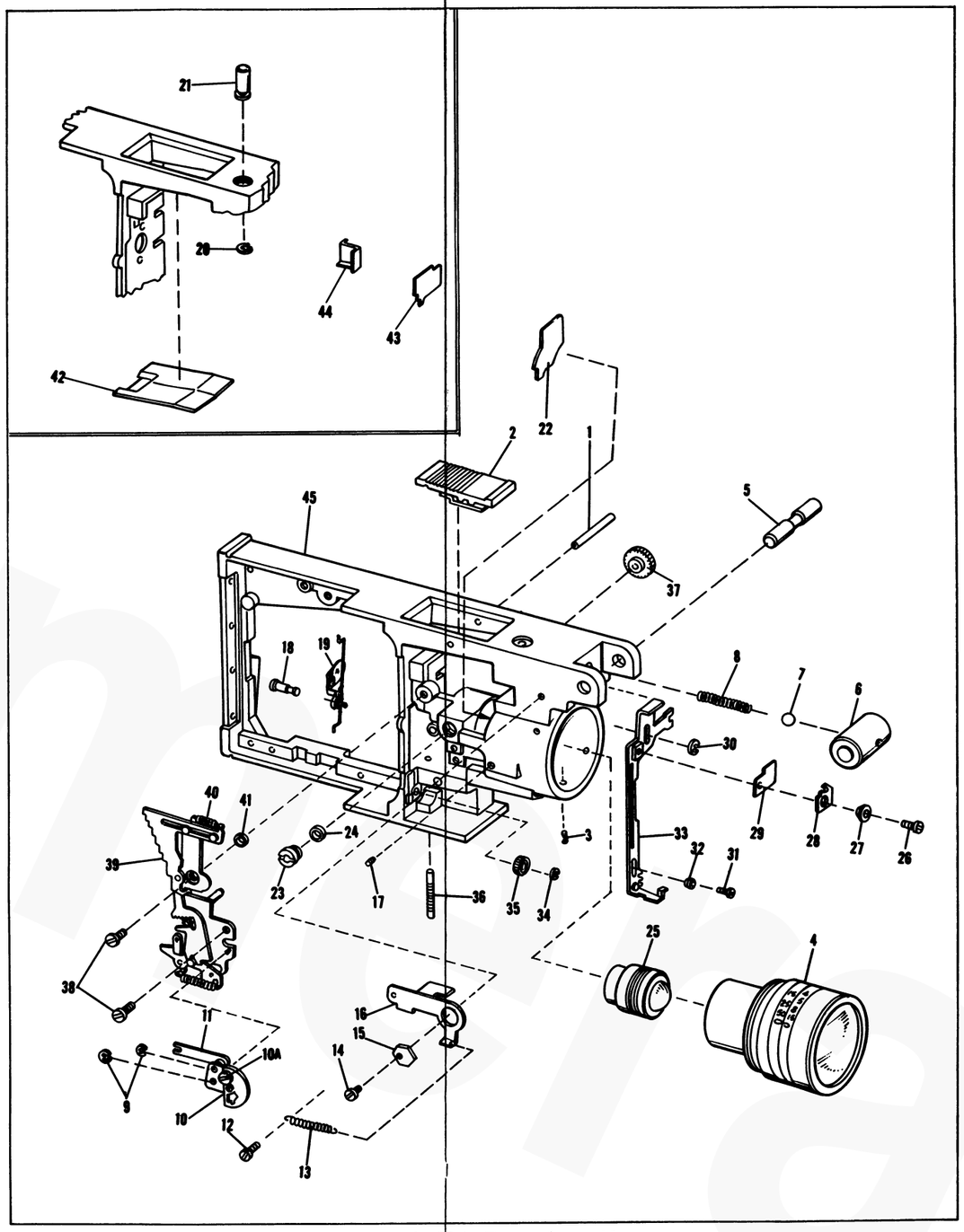


Figure 4. Main Frame Assembly

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
		FRAME AND DOOR ASSEMBLY		
5-1	32286	SETSCREW, Slotted cone pt, 1-72 by 0.099-inch	1	
-2	200999	SETSCREW, Fluted socket cup pt, 2-56 by 3/16 inch	1	
-3	432987	FACE GEAR AND PINION	1	
-4	433393	COVER, Shuttle	1	
-5				
-6				
-7	433075	MASK, Aperture (remove backing sheet)	1	
-8	433120	LIGHT SEAL (Cement in place)	1	
-9	38758	WINDOW, Camera door (cement in place)	1	
-10	432907	KNOB, Door latch	1	
-11	433056	WEAR PLATE, Knob	1	
-12	433094	LATCH, Door	1	
-13	38630	RIVET, Tubular, 0.061 inch diameter	8	
-14	432960	SPRING, Cartridge tension	1	
-15	35274	HINGE, Camera door	1	
-16	041848	FRAME AND DOOR ASSEMBLY	1	
		MECHANISM ASSEMBLY, COMPLETE		
6-1	433071	SPRING, Tension, pointer	1	
-2	433099	POINTER, Footage counter	1	
-3	99828	RING, Retaining, Type E, 0.062 inch ID	1	
-4	041820	TOGGLE ASSEMBLY, Wild speed	1	
-5	38683	SPRING, Wild speed	1	
-6	38632	SCREW, Special, 2-56NC	1	
-7	38646	WASHER, Spring tension	1	
-8	433068	BUSHING, Counter gear	1	
-9	433101	GEAR, Counter	1	
-10	38687	SCREW, Pan head, 2-56 by 1/8 inch	1	
-11	40233	ECCENTRIC, Backlash adjuster	1	
-12	27067	RING, Retaining, external, Type E, 0.094 inch ID	1	
-13	38536	SPRING, Centering	1	
-14	99828	RING, Retaining, Type E, 0.062 inch ID	1	
-15	38524	WASHER, Flat	1	
-16	433096	SPRING, Take-up torque	1	
-17	38520	GEAR, Take-up	1	
-18	39870	GEAR, One-tooth	1	
-19	38523	DRIVER, Take-up	1	
-20	36831	SCREW, Shoulder, 2-56 by 1/8 inch	2	
-21	041821	MOTOR AND CLUTCH ASSEMBLY	1	
-22	041729	CIRCUIT BOARD ASSEMBLY	1	
-23	433087	PIN, Counter lever	1	
-24	39871	SPRING, Counter lever	1	
-25	433100	LEVER, Counter	1	
-26	041828	PLATE ASSEMBLY, Mechanism	1	
-27	38686	. STUD, Wild speed mask	1	
-28	433039	. MASK, Wild speed	1	
-29	38532	. STUD, Gear	2	
-30	38506	. GEAR, Spur	1	
-31	38505	. GEAR, Cluster	1	
-32	No Number	. PLATE, Mechanism (replace with item 26)	NP	

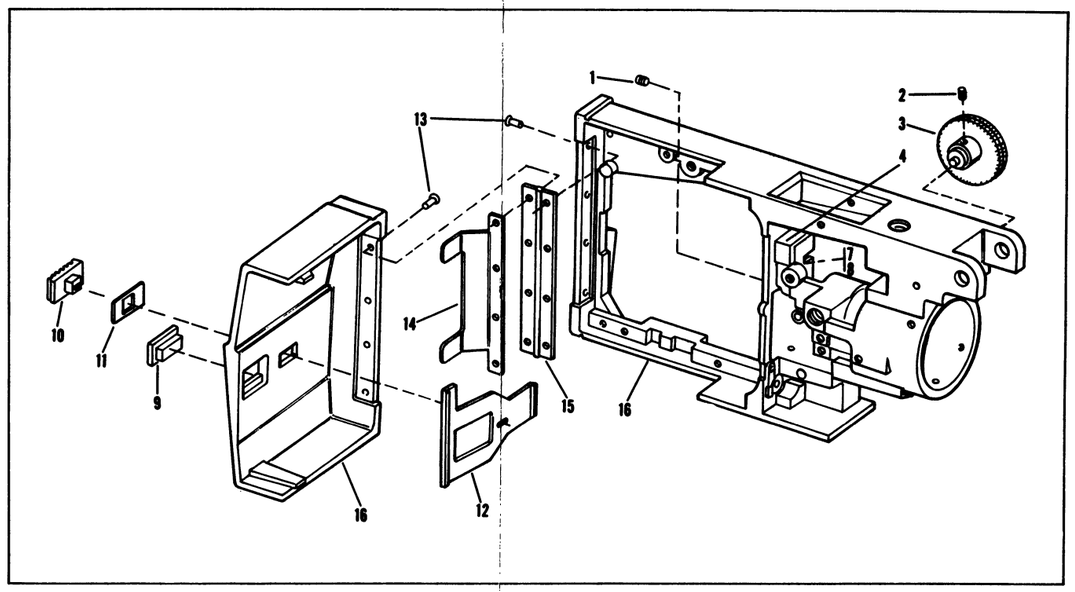


Figure 5. Frame and Door Assembly

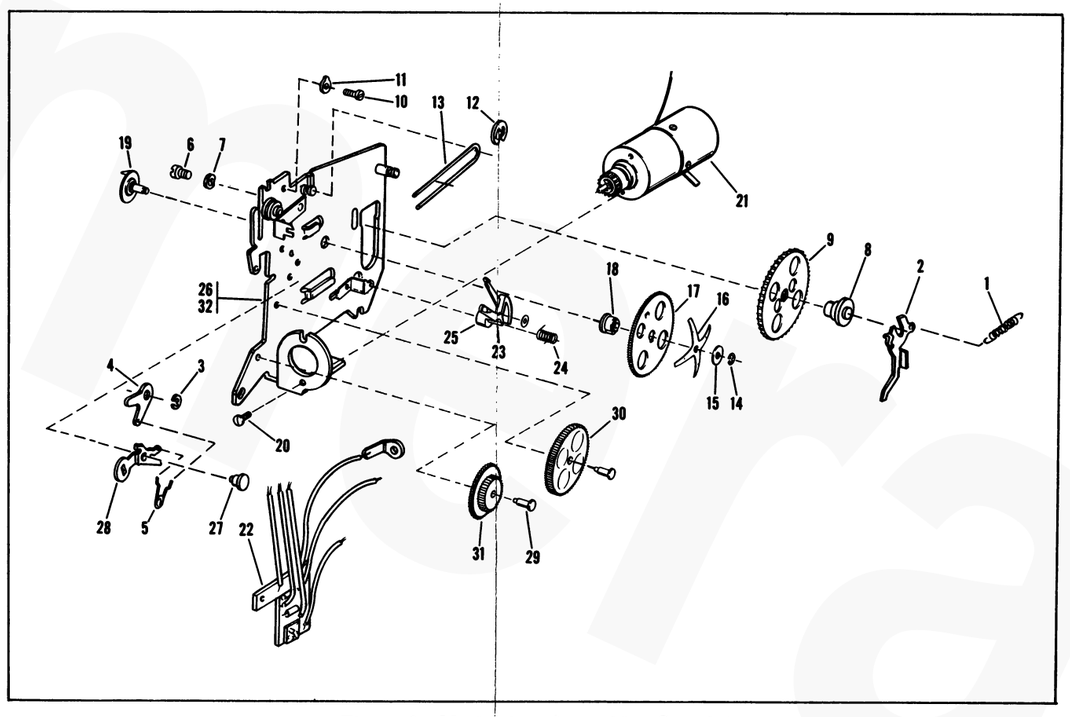


Figure 6. Mechanism Assembly, Complete

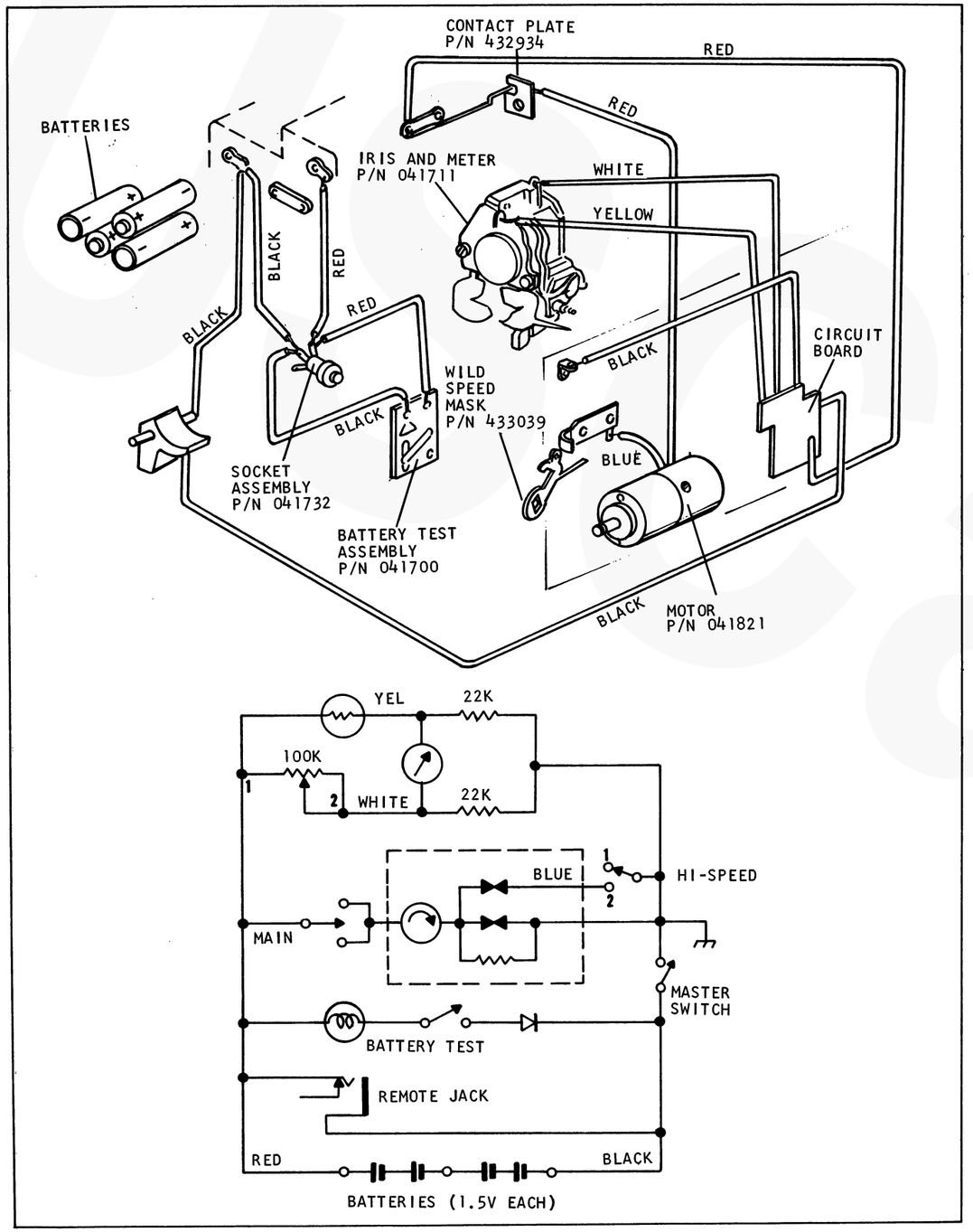


Figure 7. Design 440 Camera Wiring Diagrams

NUMERICAL INDEX OF PARTS

PART NO.	FIG. & INDEX NO.	PART NO.	FIG. & INDEX NO.	PART NO.	FIG. & INDEX NO.
041597	4-25	38505	6-34	432983	4-5
041700	3-10	38506	6-33	432986	4-6
041701	4-2	38520	6-17	432987	4-15, 5-3
041702	4-33	38523	6-19	432988	4-21
041704	1-1	38524	6-15	432991	4-18
041711	2-32	38532	6-32	432993	3-8A
041713	1-6	38536	6-13	432994	2-26
041714	4-4	38546	4-36	432995	2-7
041722	3-6	38603	2-30, 2-34,	432996	2-16
041723	3-5		4-12, 4-38	432997	4-8
041724	3-3	38627	4-3	433003	2-32B
041725	6-29	38630	5-13	433036	3-3A
041728	4-19	38632	2-22, 6-6	433037	1-5
041729	6-22	38644	4-41	433039	6-31
041732	3-12	38646	6-7	433042	2-9
041734	2-36	38683	6-5	433044	1-19B
041736	2-38	38686	6-30	433045	1-19A
041738	6-35	38687	6-10	433046	3-13
041735	2-32E	38715	4-40	433047	3-23
041810	1-20	38722	4-37	433048	1-10
041811	2-2	38726	3-26	433050	1-3
041812	2-14	38739	2-23	433052	3-28
041813	4-10	38758	5-9	433053	2-4
041814	4-11	38788	4-31	433055	2-37
041815	4-39	39870	6-18	433056	5-11
041817	4-45	39871	6-24	433057	1-4
041818	3-2	39887	4-32	433058	4-43
041819	3-8	40163	4-27	433061	1-15
041820	6-4	40233	6-11	433063	3-27
041821	6-21	99828	3-16, 3-32C,	433068	6-8
041828	6-26		6-3, 6-14	433071	6-1
041845	1-19	200999	5-2	433075	5-7
041846	3-20	202751	3-24	433076	2-3
041847	1-9	301565	2-32A	433079	4-44
041848	5-16	431448	3-22	433080	1-1B
17676	4-20	432907	5-10	433081	2-27
27067	4-30, 4-34,	432908	1-14	433082	2-35
	6-12	432915	2-29	433084	2-32D
28348	4-9	432916	2-6	433087	6-23
28412	3-9, 4-10A	432918	1-19C	433090	1-17
29420	1-16	432919	2-8	433091	1-7
29558	1-8	432924	3-32	433092	1-9A
29831	2-1, 2-13,	432925	1-19D	433093	3-31
	2-17, 2-32F,	432928	2-25	433094	5-12
	3-1, 3-25	432934	4-28	433095	4-22
30024	1-1A	432937	2-19	433096	6-16
30163	1-12, 1-18,	432938	1-11	433097	4-13
	2-10, 3-4,	432942	3-29	433099	6-2
	3-7, 3-14	432950	4-29	433100	6-25
32286	5-1	432955	3-21	433101	6-9
32332	4-14	432959	4-16	433120	5-8
33740	4-17	432960	5-14	433133	3-30
34574	4-24	432961	2-32G	433135	3-19
34893	2-11	432969	4-42	433136	3-18
35267	1-13	432973	2-18	433137	3-17
35272	1-2	432976	2-24	433138	3-15
35274	5-15	432977	2-28	433922	2-5
35284	6-27	432978	2-21	433393	5-4
35490	2-31, 2-33	432979	2-20	600928	2-12
36154	4-23	432980	2-15	700849	6-28
36831	4-26, 6-20	432981	4-1	900321	4-7