OPERATION AND SERVICE MANUAL

VIDEO RECORDING CAMERA

MODEL PA-302

GENERAL PRECISION LABORATORY, INCORPORATED
63 BEDFORD ROAD, PLEASANTVILLE, N.Y.

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PLEASANTVILLE, NEW YORK

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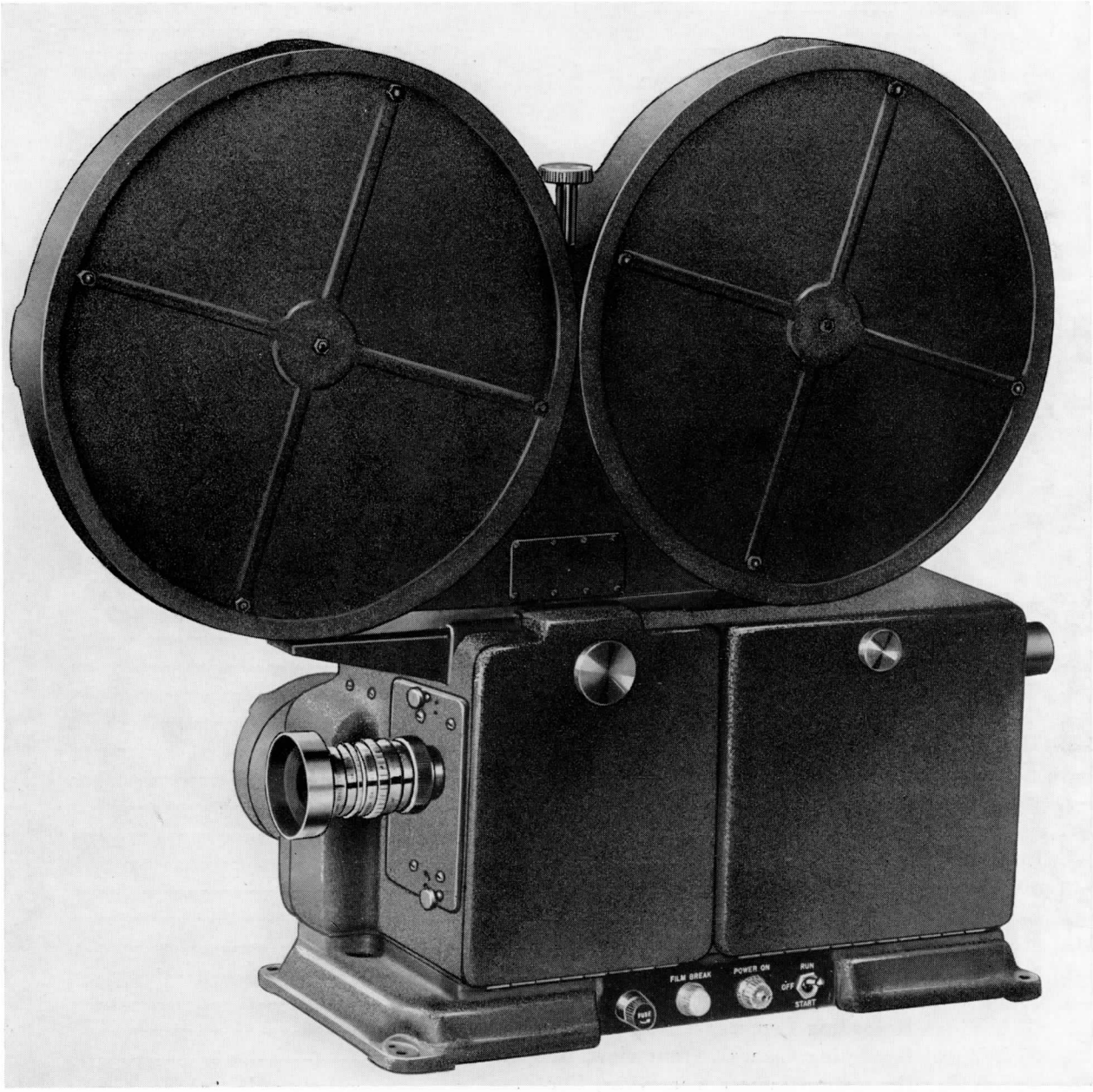


Figure 1-1. Video Recording Camera, Model PA-302

PA-302 16MM VIDEO RECORDING CAMERA

SECTION I

GENERAL

General Precision Laboratory, Inc. has prepared this manual for the use of GPL 16mm Recording Camera operating and maintenance personnel. Section II supplies all necessary installation information. The complete operation of the camera is explained in Section III. Data relevant to the required operational checks and adjustments are contained in Section IV. Minor repairs and replacement of parts that do not require the use of special tools or fixtures and that can be performed by the operator are discussed in Section V. The Maurer Sound Recording System is treated separately in Section VI.

a. Picture Steadiness.—Good recording requires the picture to be steady in both the horizontal and the vertical directions within 0.2% of its width. In a properly designed camera, horizontal unsteadiness is due entirely to dimensional errors in the film and can be minimized by the proper method of lateral film guiding. Steadiness in the vertical direction, however, depends on the uniformity of sprocket holes and the adequacy of the intermittent movement in the camera.

b. Film Path.—For the flawless handling of film, particularly raw film, hardness and smoothness of the various parts of the gate which contact the film are of greatest importance. Any minute irregularity in the surface can serve as a collection point for particles of emulsion which form a hard scale. Once the process has started, a minute speck of emulsion gouges additional emulsion material from the film and grows rapidly. Before long the scratch on the film is quite visible. If the process continues the film may be unsatisfactory for use. To prevent this, GPL cameras are equipped with a gate of a very hard material and finished to a mirror-like surface.

To further minimize the possibility of film damage, all sprocket, gate and pad rollers are undercut in the region of sound and picture areas so that the minimum contact in the vital areas of the film is allowed. Of course, such undercutting is impossible at the sound scanning drum but film tension prevents slippage at this point.

c. Picture Resolution.—The GPL 16mm Recording Camera (see figure 1-1) uses a Cine Ektar f/1.6 lens. When properly focused this provides resolution of the original scanning lines except in areas of maximum density. A reference shoulder allows replacing the lens precisely in its original focus position when removed for cleaning.

d. Sound Reproduction.—The GPL-Maurer 16mm Sound Recording System is designed for high-fidelity tonal reproduction. Variable density sound is recorded by a galvanometer-type light modulator manufactured for GPL by J. A. Maurer, Inc. In flutter tests using this camera as a film phonograph with 3KC standard flutter test film, flutter measures a maximum of 0.14% r.m.s. Recording of mechanical noise is kept to an absolute minimum by shock-mounting the entire sound recording and stabilizing mechanism, with the exception of the viscous drag sprocket.

e. Reel Capacity.—The GPL 16mm Recording Camera is designed to use the Standard Wall or GPL magazine which provides storage and take-up facilities for 1200 feet. When used with a Rapid Film Processor, a larger magazine is available which has storage facilities up to 5000 feet.

SECTION II

INSTALLATION

1. GENERAL

The complete GPL Video Recording Camera Model PA-302 consists of the camera (including galvanometer), a 1200-foot magazine, the J. A. Maurer amplifier and power supply, a regulating transformer, a vacuum pump, an air hose and all interconnecting cables.

2. INSTALLATION SEQUENCE

CAUTION

Keep the regulating transformer and its a-c leads as far as possible from the sound recording amplifier, its power supply and the camera audio leads.

a. After all the units have been uncrated and inspected, the camera should be securely bolted to a flat, machined surface. When mounted on the GPL Video Recording Monitor Model PA-303, two dowel pins on top of the monitor console provide ease and accuracy in establishing the precise location for best performance. The amplifier and power supply should be mounted in a rack nearby and interconnected as shown on the cabling diagram, figure 2-1. The vacuum pump should be mounted as close as possible, following the instructions attached to the pump. (DO NOT MOUNT THE PUMP ON ANY PART OF THE GPL VIDEO RECORDING MONITOR.)

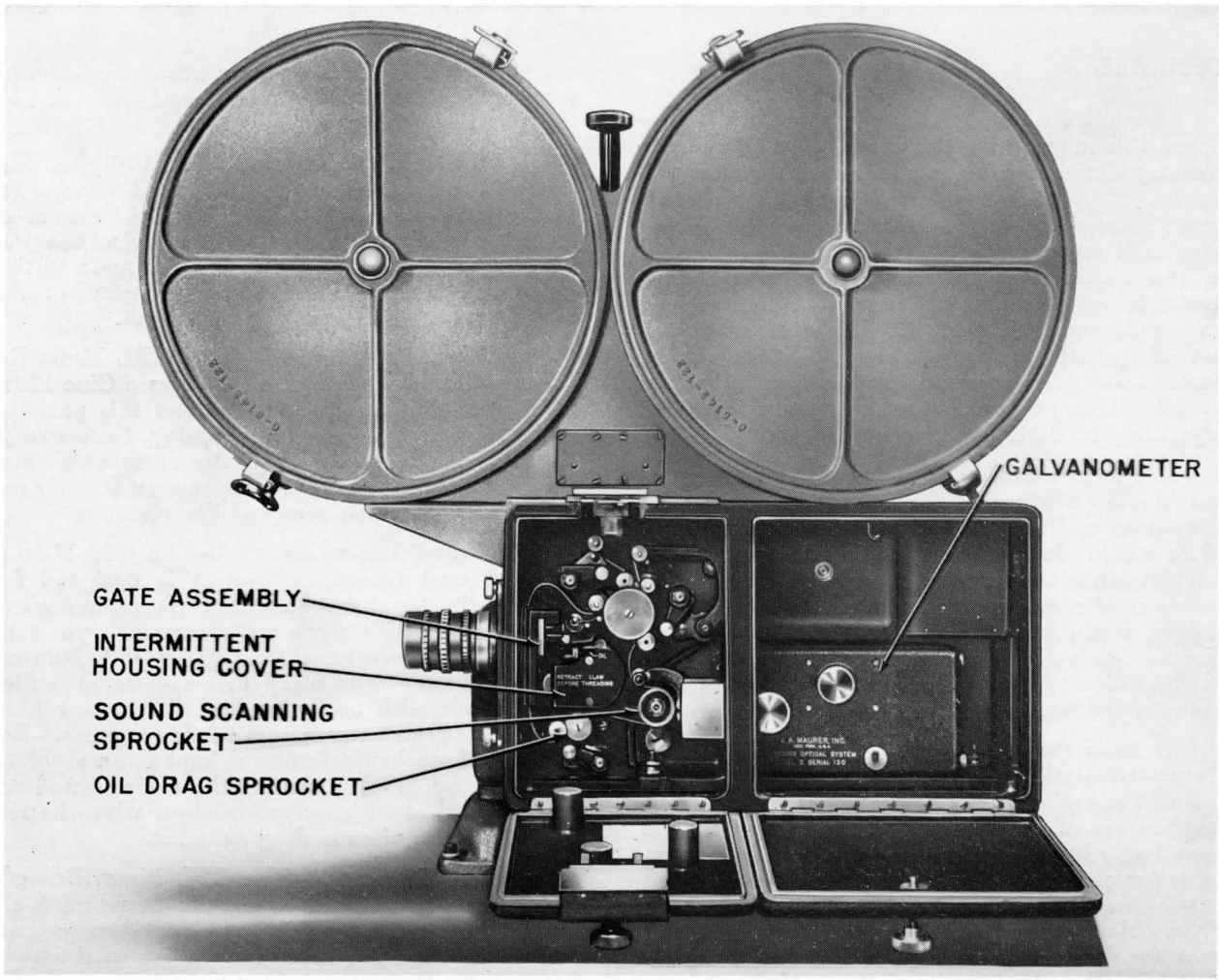


Figure 2-1. Video Recording Camera, Model PA-302, front view

b. Be sure that the packing material is completely removed from around the shock-mounted galvanometer so that it has complete freedom of movement.

c. Thread the vacuum hose, the power input cable and the pipper signal cable through the hole in the top of the GPL PA-303 (if this is the video recording monitor used) and connect each to its mating camera connector (see figure 2-3).

d. Thread the sound cable through the hole in the base of the camera and attach the wires to terminal strip E1 in the camera as indicated on the schematic diagram figure 6-5.

e. When the GPL Video Recording Camera Model PA-302 is used without the GPL Video Recording Monitor PA-303 and the GPL Rapid Film Processor Model PA-401, the power input connections to the camera must contain a jumper for pins 4 and 6 of the input receptacle P2 (see figure 7-1).

f. When the GPL Video Recording Camera Model PA-302 is used with the GPL Video Recording Monitor Model PA-303 but without the GPL Rapid Film Processor Model PA-401, a jumper must be connected between pins 4 and 6 of the power interlock chassis terminal strip E2 as shown on drawings C5129-99, Issue 2 and R5129-68.

3. MAGAZINES

As has already been mentioned, a 1200-foot magazine is supplied as part of the GPL Video Recording Camera Model PA-302. A 5000-foot feed-only magazine is also available. Film loading of both magazines is such that "B" wind film is required.

4. INITIAL ADJUSTMENTS

The GPL Video Recording Camera Model PA-302 is shipped with an accompanying instruction tag which contains equipment identification and test data, and a set of suggested values for initial adjustment of certain operating parameters. After gaining familiarity with the equipment, the oper-

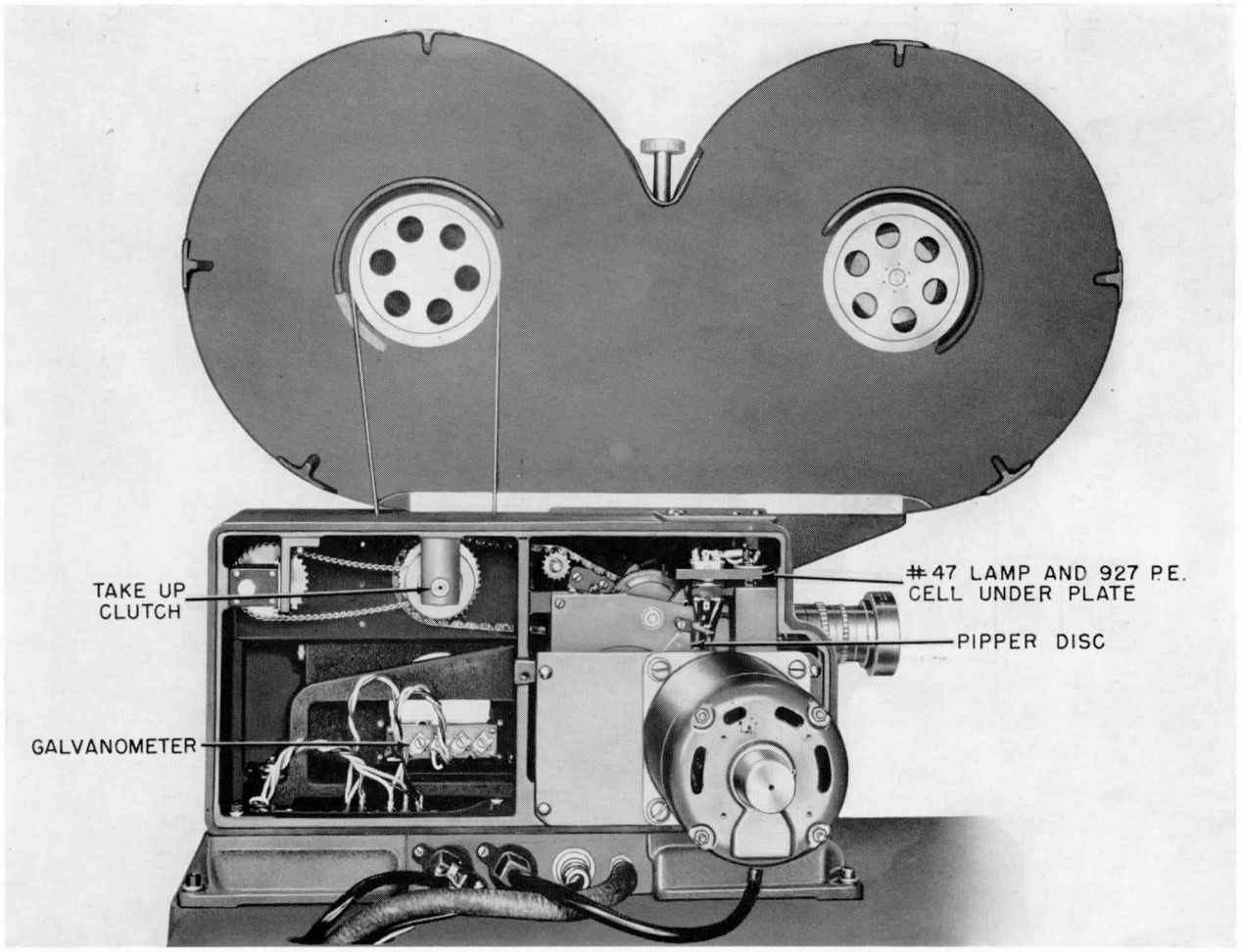


Figure 2-2. Video Recording Camera, Model PA-302, rear view

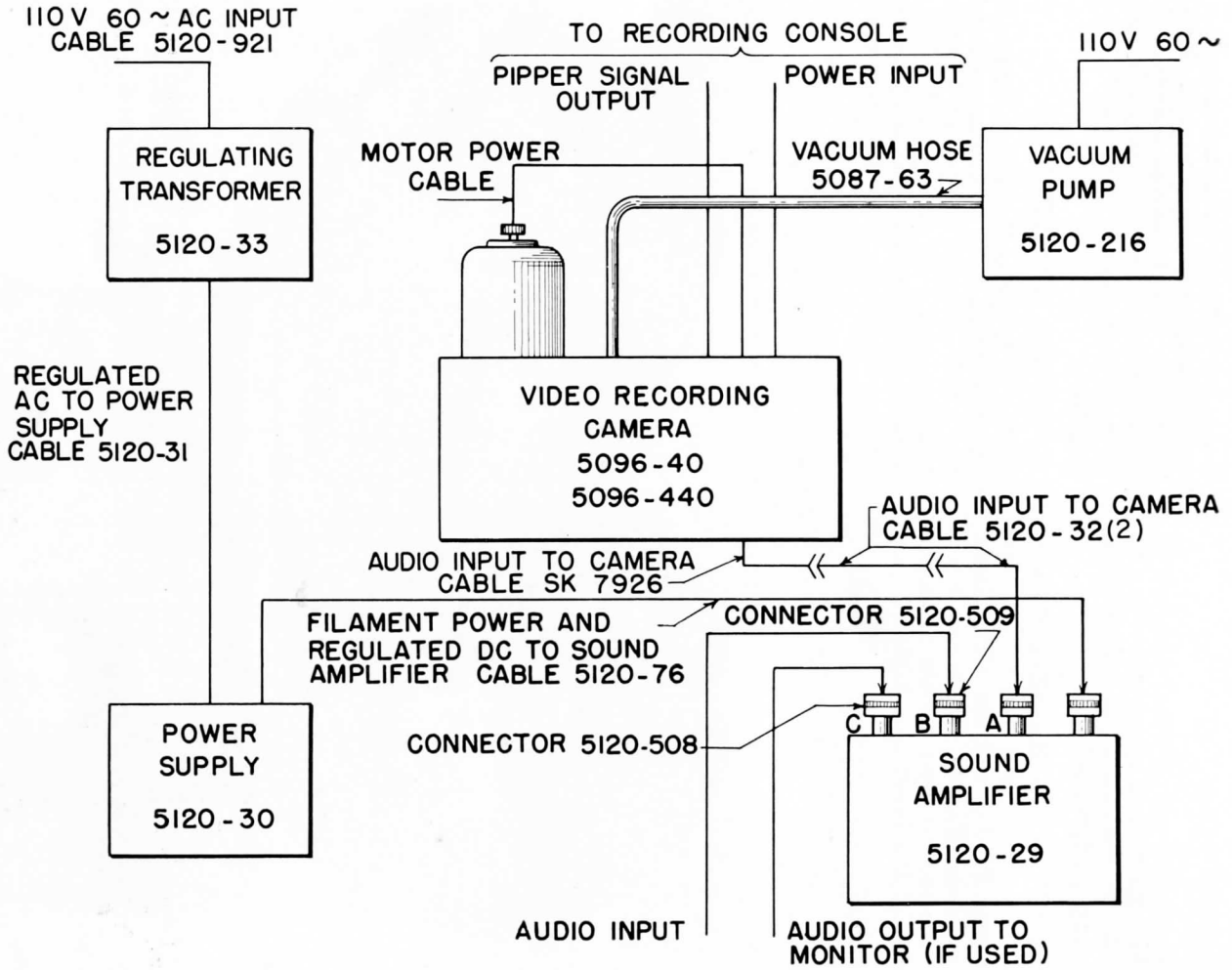


Figure 2-3. Video Recording Camera, Cabling Diagram

ator may be able to improve performance by slight variation from the suggested values. The tag presents the following:

a. Camera part number

b. Camera serial number

c. Lens serial number

d. Galvanometer serial number

e. Lens focus scale settings for optimum focus (determined at f/1.6)

f. Vacuum pressure for optimum steadiness

g. Percent intermodulation at a lamp current in amperes (variable over a wide range depending on processing conditions)

h. Percentage of flutter as measured on Furst Wow-meter, Model 115-RA, set on ½-cycle position

i. Date of test completion

j. Inspector's identification stamp

NOTE

GPL keeps a film record of the performance of each camera during its final test. These films are kept on file to aid the purchaser in keeping this equipment in perfect operating condition. Upon receipt of 100 feet or more of test film, GPL will promptly make the necessary diagnosis and transmit any needed instructions. It is suggested that specific instructions for making this test strip be obtained from the GPL Field Engineering Department.

SECTION III

THEORY OF OPERATION

General.—Video recording, being a relatively new art, presents many new problems. For obvious reasons of economy, 16mm film is used almost exclusively. However, the equipment used in the process must have the professional quality and ruggedness previously available only in the 35mm field. Although the camera operates at standard frame rate, the pulldown time must be extremely short, and a transition from 30 frames/sec film rate is required. It is also necessary that the camera be capable of operating without interruption or attention during recording for periods exceeding two hours. In addition, provision must be made for recording of program sound simultaneously with the picture, in correct synchronization. This new camera has been designed specifically for video recording, with adequate provision for the foregoing requirements.

a. Method of Operation.—Before describing in detail the camera's design and construction, it is necessary to describe briefly the basic method of recording for which this camera is intended. Figure 3-1 is a diagram showing one possible time relationship between television fields, recorded film frames and film pulldown. The diagram shows that one half of a television field is discarded during pulldown for every two full fields (or one full television frame) recorded. Since the picture to be photographed appears as successive lines on the face of a cathode ray tube, some means of preventing film exposure during pulldown must be incorporated. This might be an accurately timed mechanical shutter, or it might be an electronic shutter, by means of which the cathode ray tube is blanked out during pulldown. The latter method is the one used with the GPL camera. Referring to figure 3-1 again, it will be seen that since the television fields are continuous, the specific moment at which a film frame starts is immaterial, the main requirements being:

(1) that the electronic shutter remain open for the length of the time required for a full television frame and no more.

(2) that the pulldown action and shutter action are correctly timed with respect to each other as in the case of the conventional mechanical shutter.

Further study of the time diagram indicates that the time available for pulldown is that of one half of a television field, or 1/120 sec. However, this full time is not available in actual practice for several reasons, the major one being the persistence of the cathode ray tube phosphor. Because the picture is traced out on the face of the cathode ray tube in the form of lines, one after another, the film in the camera is exposed to the maximum decay time of the first line only. It is then exposed to each succeding line of that frame for a uniformly decreasing length of time. Unless the film is permitted to remain in the aperture for a reasonable period after the last scanning line appears and the electronic shutter closes, a very definite density difference, or splice line, is apparent, marking the join-up of the first and last portions of the frame.

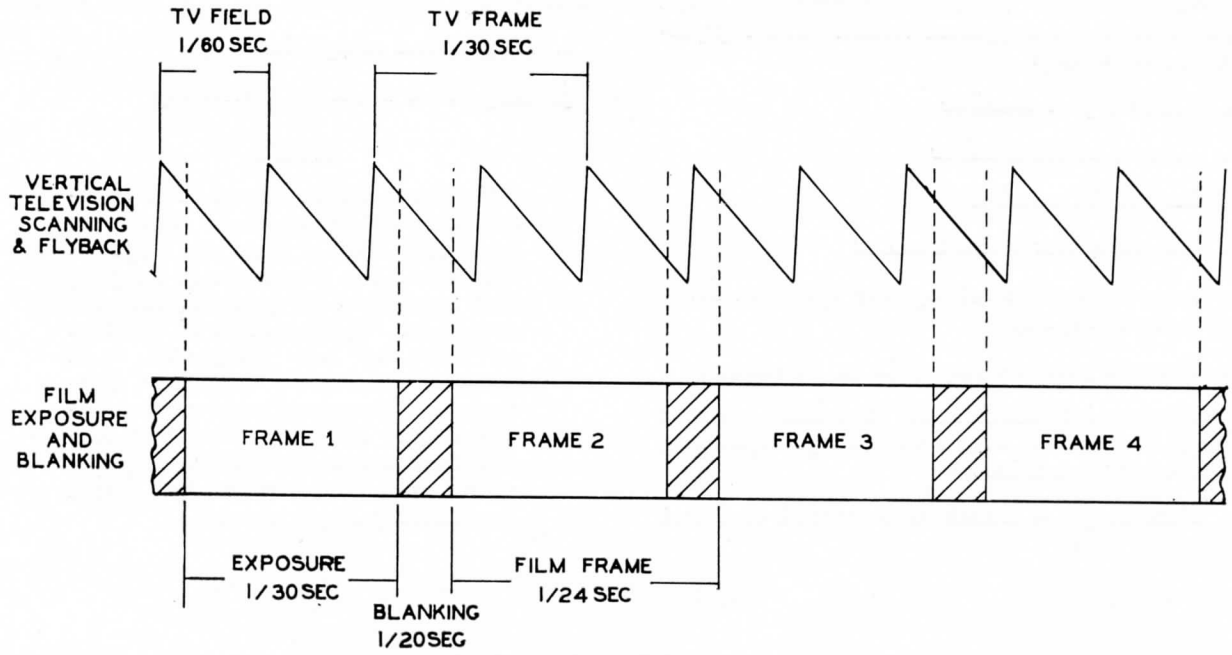


Figure 3-1. Time Relationships Between Scan and Film Exposure

b. Intermittent Design.—The one-half field or 1/120 sec maximum available pulldown time, translated into degrees, results in a figure of 72°, which is not an exceptionally fast pulldown. In practice, however, because of the phosphor persistence effect previously mentioned, it is necessary to decrease this time to less than half of the theoretical maximum.

A claw type intermittent is used, the main components of which are a vertical cam, a lateral cam and a shuttle assembly. The lateral cam is rotated at 1440 rpm, or once per film frame. A surface of the lateral cam drives the shuttle assembly forward, causing its claw to move forward and engage the film sprocket holes for pulldown. A second surface of the lateral cam actuates the shuttle assembly in the opposite direction to disengage its claw at the end of pulldown. There is one claw entry and one retraction per film frame. The vertical cam which, as the name implies, actuates the claw in an up-and-down action, is timed with the lateral cams through a pair of 3-to-1 ratio helical gears, and is rotated at three times frame speed. As a result of this multiple-skip design, the claw makes three excursions up and down for each frame, one out of every three downward excursions being used for pulldown. A high-speed pulldown is thereby obtained, while shaft and cam speeds remain uniform.

The actual pulldown time is only one-third of the vertical cam angle (1/3 of 85°), or 28.33°. Allowing some time for claw entry and retraction, the total time during which the claw is in contact with the film is on the order of 31°. The difference between the aforementioned 72° and the latter 31° is the time available for the film to remain stationary in the aperture after the last scanning line appears and thereby approach equalization of exposure to the phosphor's decay before the next pulldown occurs.

It was previously determined by experiment that movement of the film within the aperture in excess of 0.00007 in. (which is 0.025% of aperture height) during exposure would result in a noticeable pairing of picture line structure. It was believed, therefore, that even the most accurate register pins, entering or leaving the film during exposure, would cause more film movement than could be tolerated. Therefore, since there is insufficient time available before or after pulldown to actuate register pins fully, they are omitted.

The camera is powered by a 3600-rpm hysteresis synchronous motor, which drives the vertical cam shaft at 4320 rpm. Since a conventional lubrication system would not be practical at this speed, a wick lubrication system is incorporated. The wick continuously wipes the vertical surfaces, keeping them sufficiently lubricated. This is the only part of the camera requiring frequent replenishment of lubricant. Vibration is kept to a minimum by dynamically balancing both intermittent shaft assemblies, all cams and the motor armature. The items are individually balanced so that, in case of field replacement, balance is still maintained.

c. Shutter Action.—The electronic shutter, as such, is not a component part of the camera but

rather a part of the associated electronic equipment. The camera opens the electronic shutter which remains open for a full television frame, its closing being controlled by its own circuitry.

The timed electrical pulse is obtained by means of a light source, a light aperture, a photocell and a rotating disc. The rotating disc, known as a "pipper" disc since it produces pips or pulses, is mounted on the vertical cam shaft, at the opposite end of the shaft from the cam. It rotates at three time frame speed (or 4320 rpm) and, being 4 in. in diameter, has a high peripheral velocity. Near the periphery of the disc is a small radial slot about 1/16 in. wide and 3/16 in. long. Adjacent to the pipper disc is a member of the camera gear train which rotates at 1/5 frame speed and has five holes equally spaced around its periphery. Designated as the cycling gear, it overlaps the pipper disc so that the slot in the disc and one of the holes in the cycling gear rotate into line once per frame. From the light source, through a light aperture on one side of this assembly, a light pulse is impinged on a photocell located on the opposite side. The pulse occurs each time the slot in the disc and a hole in the cycling gear rotate into line with the light aperture. The high peripheral velocity of the pipper disc produces a steep wavefront pulse of short duration, while a pulse repetition rate of once per frame is obtained by the masking of the cycling gear, without which there would be three pulses per frame. The angular relation between the vertical cam and the slot in the pipper disc determines the time relation between film transport and shutter opening.

As previously mentioned, no motion of the film in the aperture can be tolerated during exposure. Therefore, the claw must be free of the film before the shutter opens. The camera is timed, therefore, to open the shutter the moment the claw is free of the film at the end of pulldown.

Figure 2-2 shows the removable assembly consisting of photocell and pipper lamp, designed for ready removal and rapid replacement of either photocell or pipper lamp. Replacement of either does not disturb shutter timing and can be done in a matter of seconds without the necessity of shutting down the camera should either fail during operation.

d. Film Gate.—During the early development of this camera, the usual spring-loaded pressure shoe was used in the film gate to hold the film in the focal plane in contact with the aperture plate, and to obtain the necessary film friction in the gate.

However, it was believed that if another means could be developed which would provide the necessary film friction during pulldown and retain the film securely at the aperture during exposure, without introducing sliding contact pressure on the emulsion surface of the film, long-time operating conditions would be more favorable. This led to the development of the vacuum-actuated film gate now in use in this camera.

The front half or film trap section of this device contains the aperture plate, side guide rollers at top and bottom, and a spring-retained shoe supporting the film against the claw during pulldown. The use of a spring-retained surface to back up the film is a desirable safety feature. Should the claw lose registry during a stand-by period, the spring permits the claw to ride over the film during the first pulldown stroke until it picks up the perforations. If there was a solid backing at this point, the claw, once out of registry, would tend to make its own perforations, and would not immediately get back into correct index. It should be understood, however, that the claw does not normally lose index with the film, but because there are no register pins, it can do so if the film is accidentally moved within the gate during a stand-by period, and proper threading will be lost.

The rear half is the hinged part of the gate, and is held closed (or opened for threading) by a toggle-action device. A rigidly fastened vacuum shoe replaces the usual spring-loaded pressure shoe directly behind the aperture in this rear half. When the gate is closed, there is a total of about 0.012 in. clearance between the surface of this vacuum shoe and the aperture plate, sufficient to allow the passage of a standard lap splice during operation. The vacuum shoe is a rectangular steel plate, about 1 in. wide and $\frac{7}{8}$ in. high. Its center portion, which is centered behind the aperture, is relieved for a depth of 0.010 to 0.015 in. over an area corresponding to the aperture image. This surface is finished with a flat black lacquer. The rest of the shoe surface is lapped and polished. Above, below and along each side of the image area is a series of small holes, connected to a continuously evacuated chamber just behind the vacuum shoe. When the film is in position for exposure, it tends to seal the vacuum holes and is thus held firmly in position in all directions.

CAUTION

Film having sprocket holes on both edges will not pass through this type of gate satisfactorily.

The vacuum holes in the area of the sprocket perforation, however, are so spaced that as a pulldown commences, the vacuum is partially relieved by the film perforations passing over these holes and opening the vacuum system to atmospheric pressure. But as pulldown nears completion, the vacuum holes are once again sealed. In this manner, film tension during the major part of pulldown is decreased, making for less wear and tear on the film, while providing ample friction just

prior to the completion of pulldown. Thus the "valve" for modulating the degree of vacuum is the film itself.

By the use of this system, it is possible to obtain ample gate friction and accurate film location. In addition, because the emulsion surface of the film does not come into sliding contact with the aperture plate, but instead clears it at all times by several thousandths of an inch, no scuffing of the film emulsion is encountered. As a result, long uninterrupted runs may be made, and only occasional cleaning of the film gate is necessary.

SECTION IV

OPERATIONAL CHECKS

The camera equipment described in this book requires the detailed care necessary to all precision instruments in order to insure peak performance and long life. Neglect of the equipment may cause cumulative minor damage that can result in operating time loss. A few minutes spent in performing the checks and adjustments described will insure the high type of performance life that has been designed and built into the GPL cameras.

a. Inspections.—First and foremost in the care of the camera is to clean the interior of the film compartment frequently. The drive side should be opened and cleaned occasionally. A clean, lint-free cloth and a soft brush should be used for this purpose. The black finish should not be nicked or scraped since damage may cause reflections of stray light onto the film. The inspections listed below are divided into two groups: items to be checked with the equipment inoperative and items to be checked with the camera running.

b. Sprockets and Pad Rollers.—Visually inspect all sprockets and pad rollers. Remove any foreign matter with a soft brush. Carefully check the sprockets for nicks or other damage. Very lightly turn the pad rollers on their shafts. The rollers should be free and rotate easily. Use a toothpick and apply one drop of light machine oil to each pad roller shaft every 250 hours. The pad roller levers, at all points, are each equipped with an adjustment screw to set correct roller position. Check to see that there is freedom of action and sufficient librication.

NOTE

Since pad roller adjustments may affect flutter, these adjustments are made in manufacture.

c. Lens System.—Remove the lens by unscrewing the captive nut at the rear of the lens and slide the lens out. Clean the lens with lens tissue. The end of the lens mount has been fabricated as an accurate register surface for the shoulder of the lens barrel. This insures the lens returning to its exact position. *Be sure to re-set the lens to the proper focus and f-stop.*

d. Gate Assembly.—The gate should be removed every half-hour for cleaning when possible. Reassemble gate, insert in position and reconnect vacuum line. Put a few drops of intermittent oil on the felt pad in the claw housing every one-half to one hour of operation.

e. Electrical.—Check the light source and photo cell to see that they are operating (see 2-2).

f. Sound Modulator.—See Section VI:2.

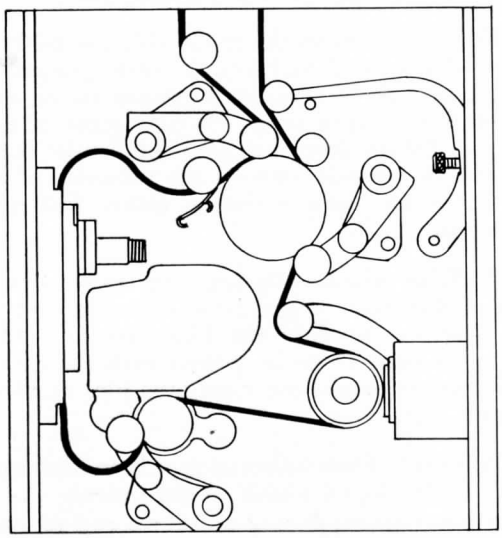


Figure 4-1. Threading Diagram

g. Threading the Camera.—Threading the GPL 16MM recording camera can be accomplished quickly and accurately by following the threading diagram shown in figure 4-1, a duplicate of which is pasted on the door of the film compartment.

(1) Open the pad rollers and gate with the claw up and retracted.

(2) Thread the film as shown in figure 3-1. Be sure the film is properly looped as indicated.

(3) Insert the tines of the claw in the film perforations, close the gate and turn on the vacuum so the film is held while it is passed around the sound stabilizing loop. Close the pad rollers as they are passed.

(4) Check for proper threading. At the same time check the mechanical operation, turning the camera motor over by means of the knob on the motor shaft.

SECTION V

MAINTENANCE

1. GENERAL

The critical tolerances that must necessarily be observed in all servicing procedures other than simple adjustments to the camera, make it necessary that the camera be returned to the factory when such servicing is considered necessary. Should operation under emergency conditions necessitate repairs or adjustments in the field, the services of a skilled instrument maker, accustomed to working with close mechanical tolerances, should be utilized.

2. CHECK POINTS

a. Sprockets.—Check the sprockets for wear and looseness.

b. Pad Rollers.—Check the rollers for grooves, flat spots and binding. Particularly check the spring action and freedom of rotation of the guide rollers in the gate. Clean and adjust as needed (see Paragraph 4, sub-paragraphs n, o and q).

NOTE

The fixed rollers in the gate (upper right and lower left as viewed from the film position) supply the lateral registration. Care must be taken to avoid misalignment. When properly adjusted, no play will be perceptible in the fixed rollers.

c. Cam and Claw Mechanism.—The only part requiring regular and frequent lubrication is the cam and claw mechanism. Aside from occasional lubrication of pad rollers, all other bearings are lifetime lubricated and sealed. Prior to the start of each operating period, check the felt pad on top of the claw housing. Keep this pad moist with high-quality light oil, e.g. sewing machine oil, at all times. Two or three drops every one-half hour of operation is preferable; a greater quantity of oil every one to one and one-half hour is permissible, however, if uninterrupted operation is absolutely necessary. If the camera has been out of use for several days, always soak this pad with several drops of oil before operating camera.

3. ISOLATION OF TROUBLES

The following table of trouble symptoms with their possible causes will greatly simplify localization of the components requiring adjustment or replacement. This table should be used in conjunction with the removal procedures which follow it, as the method of removing and replacing some items has a definite step sequence.

TROUBLE SHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
PICTURE UNSTEADINESS Side Weave	1. Sticky guide roller 2. Lateral play in guide rollers 3. End play in camshafts 4. Loose gate assembly 5. Claw misalignment 6. Guide roller misalignment
Vertical Jitter	1. Incorrect vacuum pressure 2. Plugged holes in vacuum shoe 3. Worn or loose claw 4. Improper threading 5. Loose gate assembly 6. Claw misalignment 7. Worn lateral or vertical cam
Fluctuating Focus	1. Gate partially open 2. Loose lens or lens elements 3. Loose gate assembly
No Sound Track on Film	1. Exciter lamp not lighted 2. Galvanometer internally misadjusted or damaged
Sound Track on Film No Modulation on Track	1. Faulty amplifier 2. Open circuit in internal or external wiring to galvanometer 3. Recording mask omitted to galvanometer 4. Poor galvanometer focus 5. Galvanometer faulty
POOR SOUND (lack of high frequencies)	1. Poor galvanometer focus 2. Poor azimuth 3. Galvanometer internally misadjusted 4. Faulty amplifier
DISTORTED SOUND	1. Incorrect lamp current 2. Improper processing 3. AGN polarity reversed 4. Faulty amplifier
EXCESSIVE FLUTTER	1. Tension arm roller sticking or too loose 2. Oil drag not functioning 3. Dirty or sticky bearing in sound drum assembly 4. Improper mesh between motor drive gear and vertical cam shaft gear 5. Takeup or oil drag pad rollers misadjusted 6. Tension arm misadjusted 7. Interference with flywheel motion 8. Drive sprocket damaged 9. Improper alignment of galvanometer mount 10. Drive sprocket misaligned
SPLICE-LINE PAIRING	1. Incorrect timing of pipper disc 2. Incorrect vacuum pressure setting 3. Incorrect positioning of film in gate 4. Faulty electronic operation of the monitor (generally not limited to the splice-line) 5. Incorrect lateral position of claw

4. REMOVAL AND REASSEMBLY PROCEDURES

To remove the assembly listed in the left column, it is necessary to follow the procedures detailed in the paragraphs of Section 4, cited in the center column. For reassembly, the pertinent paragraphs are listed in the right column. In both cases the reference paragraphs must be consulted in the order in which they are listed.

	Disassembly	*Reassembly*
Motor Assembly	Par. 4a	Par. 4b
Pipper Lamp and Phototube Assembly	Par. 4c	Par. 4d
Shield Assembly	Par. 4a, c, and e	Par. 4f
Sound Drum and Sound Drum Flywheel	Par. 4a, c, e and g	Par. 4h
Pipper Disc	Par. 4a, c, e, g, and i	Par. 4j
Drag Sprocket	Par. 4k	Reversal of Par. 4k
Oil Drag	Par. 4k and l	Par. 4m
Gate Assembly	Par. 4n	Reversal of Par. 4n
Film Guide Rollers	Par. 4n and o	Par. 4p
Kickout Shoe	Par. 4n, o and q	Reversal of Par. 4q
Cam Assembly and Claw	Par. 4n and r	Par. 4s
Takeup Clutch and Counter Assembly	Par. 4t	Par. 4u

NOTE

Where an assembly procedure merely involves a reversal of its disassembly procedure, the detailed step sequence is omitted.

a. Removal of Motor

(1) Remove power by disconnecting motor power cable from receptacle in camera housing.

(2) Loosen knurled captive screw which secures camera back cover and remove cover, rotating same to clear motor nameplate and power cable.

(3) Remove four fillister head screws securing motor mounting plate to camera housing.

(4) Remove motor and motor mounting plate as one assembly.

b. Reassembly of Motor

(1) Place motor in position and carefully engage drive gear of motor with vertical camshaft gear.

(2) Secure motor and motor mounting plate assembly with four fillister head screws, without tightening the screws.

(3) Shift position of motor vertically and horizontally until optimum position is obtained (indicated by a barely perceptible play in gear mesh) and tighten screws. If mesh is not quiet while motor is running, loosen screws slightly and readjust motor while running by tapping motor into quietest running position. Tighten screws securely.

(4) Replace back cover of camera and tighten one knurled captive screw.

(5) Reconnect power cable to receptacle in camera housing.

c. Removal of Pipper Lamp and Phototube Assembly

(1) Loosen two binding head captive screws on top front of camera housing.

(2) Remove pipper lamp and phototube assembly.

d. Reassembly of Pipper Lamp and Phototube Assembly

(1) Place assembly in position through top of camera housing, taking care to see that the electrical fittings mate properly without forcing.

(2) Tighten two binding head captive screws.

e. Removal of Shield Assembly

(1) Remove two 4-40 binding head screws, one from outside front of camera and one from inside camera housing, being careful to retrieve bushing.

(2) Remove two 6-32 fillister head screws from outside of camera housing.

(3) Remove shield assembly, rotating counterclockwise to clear internal gearing of camera.

f. Reassembly of Shield Assembly

(1) Install shield assembly in camera housing, rotating clockwise to clear internal gearing of camera.

(2) Replace and tighten two 6-32 fillister head screws outside camera housing.

(3) Replace and tighten two 4-40 binding head screws, one inside (replace bushing) and one outside camera housing.

g. Removal of Sound Drum and Sound Drum Flywheel

(1) Remove one ½″ hex head screw in center of flywheel.

(2) Remove flywheel, cup washer and shim washer.

(3) Remove sound drum.

h. Reassembly of Sound Drum and Sound Drum Flywheel

(1) Replace sound drum.

(2) Replace shim washer, cup washer (convex side out), flywheel and ½" hex head screw. Take care to see that the spring-loading is adequate and that spring-loaded endplay in the sound drum shaft assembly is present.

i. Removal of Pipper Disc

CAUTION

Before performing this disassembly step, the operator is cautioned that the rotational position of the pipper disc on its shaft is critical. Therefore, care should be taken during the reassembly procedure to see that the pipper disc is restored to its original timing position. The usual technique of marking adjacent parts will prove helpful in this instance.

(1) Remove three 4-40 binding head screws (4) and clamp (3).

(2) Remove pipper disc (2).

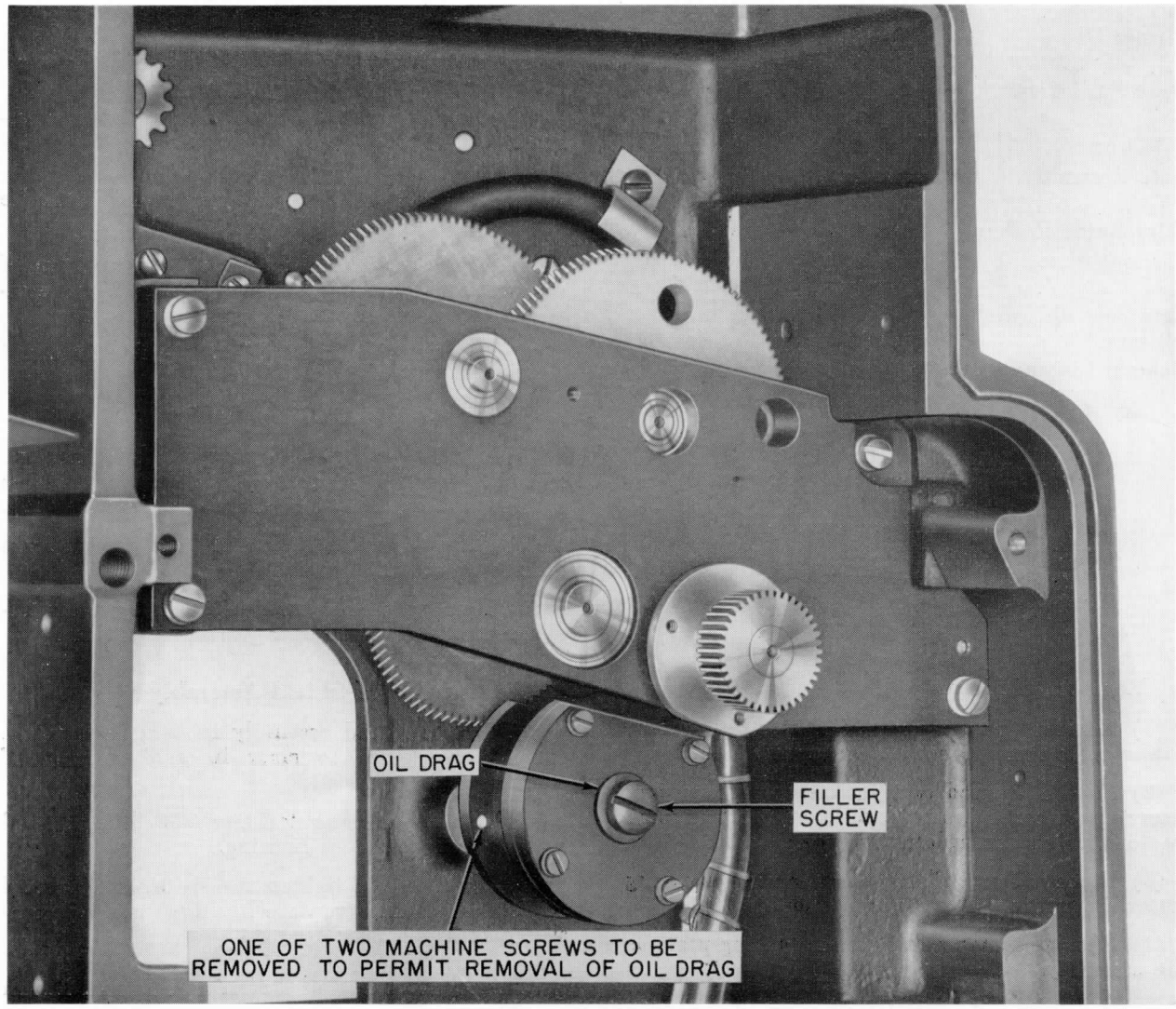


Figure 5-1. Removal of Oil Drag

j. Reassembly of Pipper Disc (see figure 7-8)

(1) Place pipper disc (2) on vertical camshaft (1), observing the precautions noted in paragraph i.

(2) Replace clamp (3) and secure with three 4-40 binding head screws (4).

k. Removal of Drag Sprocket (see figure 7-5)

(1) Remove one fillister head screw (16) located in center of drag sprocket.

(2) Lock associated pad roller (12) in its open position and remove drag sprocket (15).

l. Removal of Oil Drag (see figure 7-5)

(1) Remove two fillister head screws (17) from threading side of camera.

(2) Remove oil drag (1 through 11) from opposite side of camera, clearing the pipper disc hub and mechanism bearing plate by aligning the flat on the pipper disc hub and the flat on the oil drag with each other and with the edge of the mechanism bearing plate.

NOTE

The oil drag should not be subjected to any further disassembly. Items of the oil drag assembly are not individually procurable and must be ordered and replaced as a complete assembly. (See Parts List, Oil Drag Assembly.)

m. Reassembly of Oil Drag (see figure 7-5)

(1) Replace oil drag (1 through 11) through motor side of camera, noting that the flat on the oil drag clears the mechanism bearing plate and the pipper disc hub.

(2) Replace and tighten two fillister head screws (17) on the threading side of the camera.

n. Removal of Gate Assembly (see figure 7-9)

(1) Disconnect the vacuum line by unscrewing the knurled captive screw on back of the vacuum connector plate.

(2) Remove the gate by unscrewing the two knurled captive screws on the front of the camera (one above and one below the lens mount) and pulling out towards the front.

(3) Tighten the toggle stop knob (29) so that the housing and sleeve assembly (23) can be swung free of the film gate body (11).

(4) Remove hinge pin (21) and film gate body (11).

(5) Remove two screws (15), vacuum shoe gasket (13) and vacuum connector plate (14). Vacuum shoe can now be removed.

o. Removal of Film Guide Rollers and Pivots in the Gate Assembly (see figure 7-9)

(1) Remove four 4-40 binding head screws (10).

(2) The lens mounting assembly (2) will now separate from the film trap body (7).

(3) *Loosen* four 4-40 socket head screws (8).

(4) Film guide pivots 1 through 4 may be removed together with film guide roller assemblies (1). Notice that the upper right and lower left hand rollers are fixed; the others are under spring tension.

p. Replacement of Film Guide Rollers and Pivots.—For this operation the GPL Alignment Tool TL-49 should be utilized as follows:

(1) Place hinge pin (21) in film trap body (7).

(2) Place alignment tool on top of film trap body (7) so that the side marked "THIS SIDE UP" is up and the edge marked "HINGE PIN" is snug against the hinge pin (21). The edges of the alignment tool are used to position the film guide roller assemblies.

(3) The film guide pivots 1 through 4 (9) are inserted to hold the film guide roller assemblies (1) in place and are locked by means of the four set screws (8).

NOTE

The rollers (1) should rotate easily on pivots 1 through 4 (9) without binding and without endplay.

q. Removal of Kickout Shoe

(1) Remove two 4-40 flat-head screws (4), retaining plate (3) and claw kickout shoe springs (6).

(2) Claw kickout shoe (5) can now be removed.

r. Removal of Cam Assembly and Claw (see figure 7-4)

NOTE

Always remove gate before working on cam and claw assembly.

(1) Remove the intermittent housing cover by removing two 4-40 binding head screws.

(2) Remove four hex nuts (3), two each from the vertical and lateral camshafts.

(3) Remove the lateral cam counterweight (part of 1).

(4) Remove the intermittent housing by removing two 6-32 fillister head screws, one inside and one outside the intermittent housing.

(5) Remove the vertical and lateral cams (1 and 2).

CAUTION

In removing the claw (4), care should be taken not to remove the shims behind the claw. These shims may have a tendency to stick to the units being removed.

(6) Remove the claw and clamp block assembly (4).

s. Reassembly of Cam Assembly and Claw (see figure 7-4)

NOTE

While standard claws are obtainable locally, it is suggested that replacement claws be ordered exclusively from GPL since these items are carefully and precisely hand-finished to the close tolerances required in this particular application.

(1) Install the claw and clamp block (4) on the vertical and lateral camshafts.

(2) Install the vertical cam (1) on the vertical camshaft between the vertical gibs of the claw, aligning the flat on the cam with the flat on the shaft.

(3) Install the two lateral cams (part of 2), taking care to see that they are properly mated. (The smooth surface of both cams should face toward the operator.)

(4) Install the intermittent housing (9) and secure with two 6-32 fillister head screws.

(5) Replace the lateral cam counterweight (part of 2), aligning the flat and the pins.

(6) Replace the four hex nuts (3), two each on the vertical and lateral camshafts. Make sure they are locked tight.

(7) Lubricate all rubbing surfaces of cams and claw generously with a high quality, light oil, such as sewing machine oil.

CAUTION

At this point, provision should be made for protecting the galvanometer from flying oil. A small paper towel, properly positioned, has been found satisfactory for this purpose.

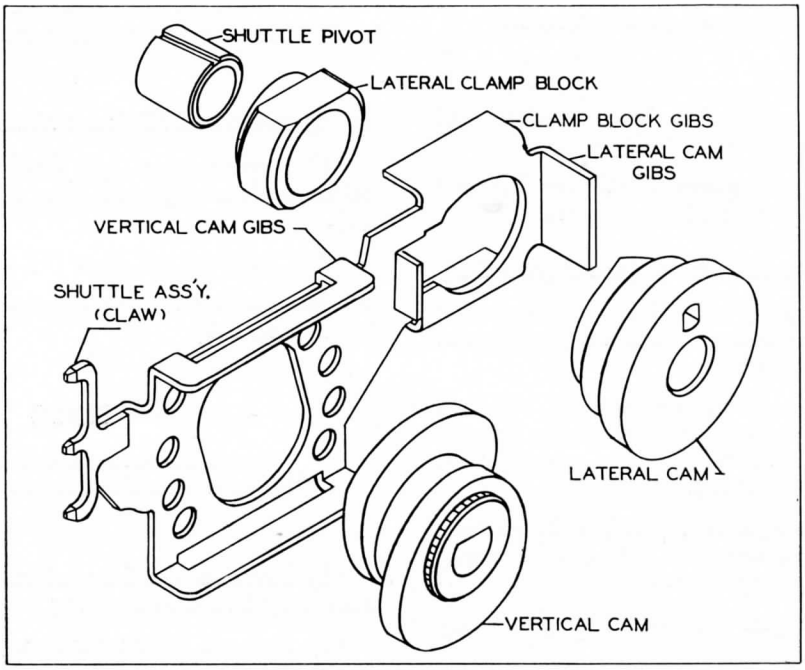


Figure 5-2. Intermittent Parts

(8) Run camera intermittently at five minutes "ON" and five minutes "OFF" intervals. Lubricate continuously, both directly and via felt oil pad during this operation.

(9) Continue this break-in procedure for ½ hour or until it is noted that the camera continues to "coast" for approximately one second after power is removed.

CAUTION

Power should be removed several times during the initial five minute period to permit the operator to ascertain that the claw is not being subjected to excessive frictional heat. If the claw is overheating, application of power should be interrupted at more frequent intervals.

(10) Replace intermittent housing cover and secure with two 4-40 binding head screws.

t. Removal of takeup Clutch and Counter Assembly (see figure 7-6)

(1) Remove four 4-40 binding head screws securing baffle plate and take off baffle plate.

(2) Remove four 6-32 fillister head screws holding takeup clutch and counter assembly mounting bracket.

(3) Disengage silent chain (2) and magazine spring belt (5).

(4) Remove takeup clutch and counter as one assembly, tilting the components to permit the takeup pulley (4) to clear the camera housing.

(5) Separate mounting bracket and clutch assembly by pulling takeup shaft (3) out of its bearing. Disengage ladder chain.

(6) Remove two hex nuts (11) from the end of the takeup shaft (3).

(7) Remove flat washer (10), coil spring (9) and second flat washer (10).

(8) Drive out clutch dowel pin (8) and remove oilite bronze clutch disc (7).

u. Reassembly of Takeup Clutch and Counter Assembly (see figure 7-6)

(1) Install oilite bronze clutch disc (7) on takeup shaft and secure to sprocket clutch assembly (1) with clutch dowel pin (8).

(2) Replace flat washer (10), coil spring (9) and second flat washer (10) on takeup shaft (3).

(3) Secure with two hex nuts (11).

(4) Insert takeup shaft in bearing of takeup clutch and counter assembly mounting bracket and engage ladder chain.

(5) Insert takeup clutch and counter assembly in camera housing (tilting the components to permit the takeup pulley to clear the camera housing) and engage the clutch drive gear with its silent chain (2), the counter drive gear with its ladder chain (14) and the takeup pulley (4) with its spring belt (5).

(6) Secure the mounting bracket with four 6-32 fillister head screws.

(7) Replace the baffle plate and secure with four 4-40 binding head screws.

5. CLEANING AND LUBRICATION

a. Takeup Clutch.—(See paragraph 4, sub-paragraph t)

(1) Wipe oilite bronze section and steel facing plate with a clean, dry rag.

(2) Soak the oilite bronze section thoroughly in hot oil (S. A. E. #10) at 120-130° F. for two hours, allowing it to cool in the same solution. Reassemble as per instructions in paragraph 4, sub-paragraph u.

b. Gate Assembly.—(See paragraph 4, sub-paragraphs n, o and q)

(1) Using an orange stick, clean all emulsion accumulations from the film trap, guide rollers, vacuum shoe and guide rails.

CAUTION

Do not use any lubricants or cleaners.

(2) If the holes in the vacuum shoe hold any deposits, they can be cleaned by removing the vacuum connector plate and pushing a very thin object (such as a toothpick) through the holes from the back, being careful that the face of the shoe is not touched.

c. Oil Drag.—(See paragraph 4, sub-paragraph m)

(1) Remove filler screw and fill the drag with oil (Dow-Corning type 200, 500 centistokes).

(2) Replace the filler screw before re-installing the oil drag in the camera.

NOTE

This type oil is specified because its characteristics permit maintaining constant viscosity and the desired drag over the range of temperatures encountered in normal operation of and camera.

6. OPERATING ADJUSTMENTS

a. Determination of Optimum Optical Focus

(1) Determine the correct optical focus for the lens by photographing a sharply focused blank raster using an aperture of f/1.6.

(2) Set the lens focus scale to the distance measured between the film plane and the kinescope face. Vary the lens focus above and below this value in small increments while photographing at each setting. Use care to avoid errors due to backlash in the focusing ring.

(3) After processing these films, they should be examined under a microscope to establish optimum focus setting.

b. Adjustment of Vacuum Pressure

(1) Vary the vacuum pressure over its complete range while photographing a blank raster with a black dot on the face of the display unit kinescope. The dot should be approximately one-quarter inch in diameter.

(2) After processing the test film, it should be projected using a projector with a known steadiness value. The correct operating pressure will be indicated by that section of film exhibiting the highest degree of steadiness.

SECTION VI

MAURER SOUND RECORDING SYSTEM

1. GENERAL

To record the audio accompanying the video on film, the video recorder employs a J. A. Maurer sound recording system which optically records sound on film in the form of a track of variable density, the density varying with the signal amplitude. The recording system consists of three major units, the sound modulator unit (electro-optical), the electronic amplifier unit and power supply. All of these units are designed and manufactured by J. A. Maurer, Inc. to General Precision Laboratory specifications.

2. SOUND MODULATOR UNIT

The sound modulator unit records a variable-density photographic sound track on the film. A cross-sectional representation of the unit is shown in Figure 6-1. The principal optical elements of

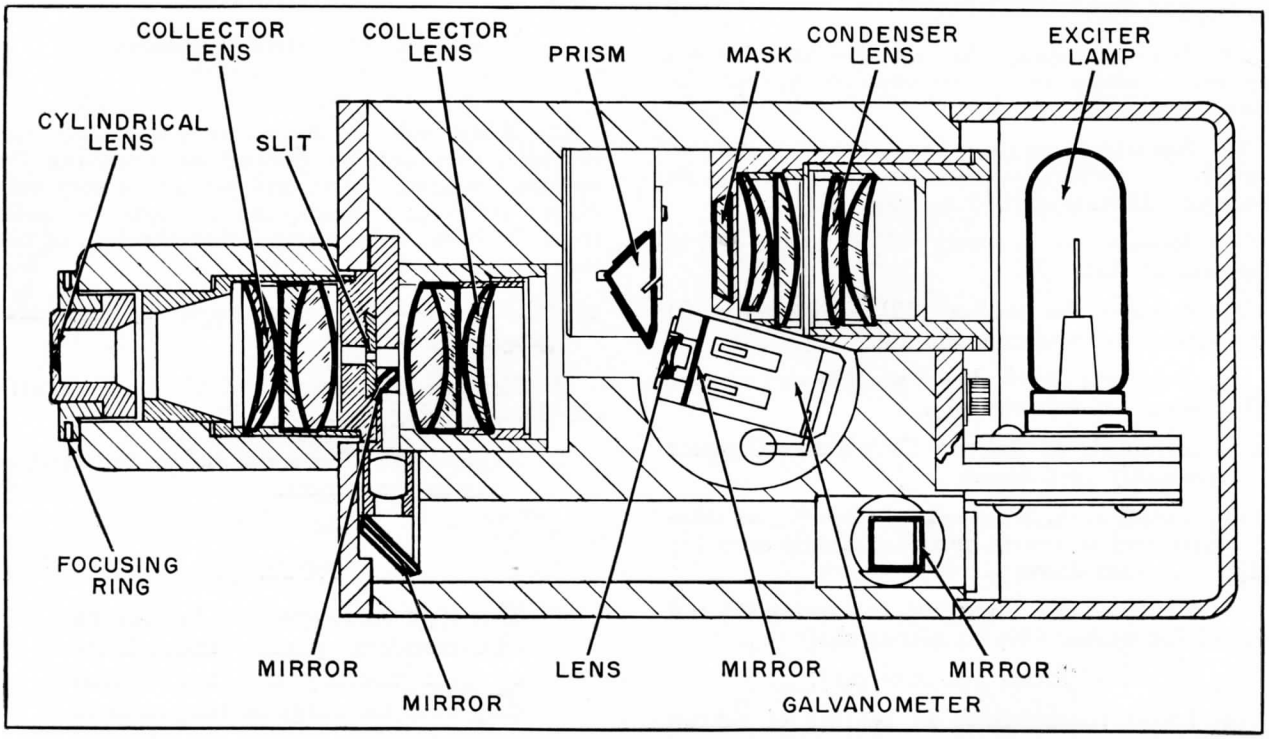


Figure 6-1. Cross Section Sound Modulator

the unit—the filament lamp, condenser lens, mask, prism, galvanometer, collector lens and slit, cylindrical condensing lens and aperture—are illustrated in the simplified optical schematic diagram, Figure 6-2. The illuminated aperture of the mask (illuminated by the filament lamp and condenser lens) is imaged on the slit by the galvanometer lens and the collector lens. Note that the light rays pass through the galvanometer lens twice; first, when incident on the mirror, and again when reflected by the mirror.

The axis of rotation of the galvanometer is in the plane of the mirror. As the galvanometer current fluctuates with the audio signal, the mirror rotates about its axis and causes the mask image to change its position on the slit causing more or less light to pass through the slit.

The movement of the mask image is a linear function of the amplitude of the incoming audio signal. The light passing through the slit may be either a linear or a non-linear function of the movement of the mask image, depending upon the exact shape of the illuminated aperture of the mask. The shape of the aperture is carefully controlled to provide compensation for non-linearities that are present in nearly all photographic processes. The standard mask is designed to work with the particular films and processing normally used in video recording. For other applications it may be necessary to obtain a special mask.

The collector lens forms an image of the slit in a plane past that of the film. This is necessary so that the areas of light and darkness from the

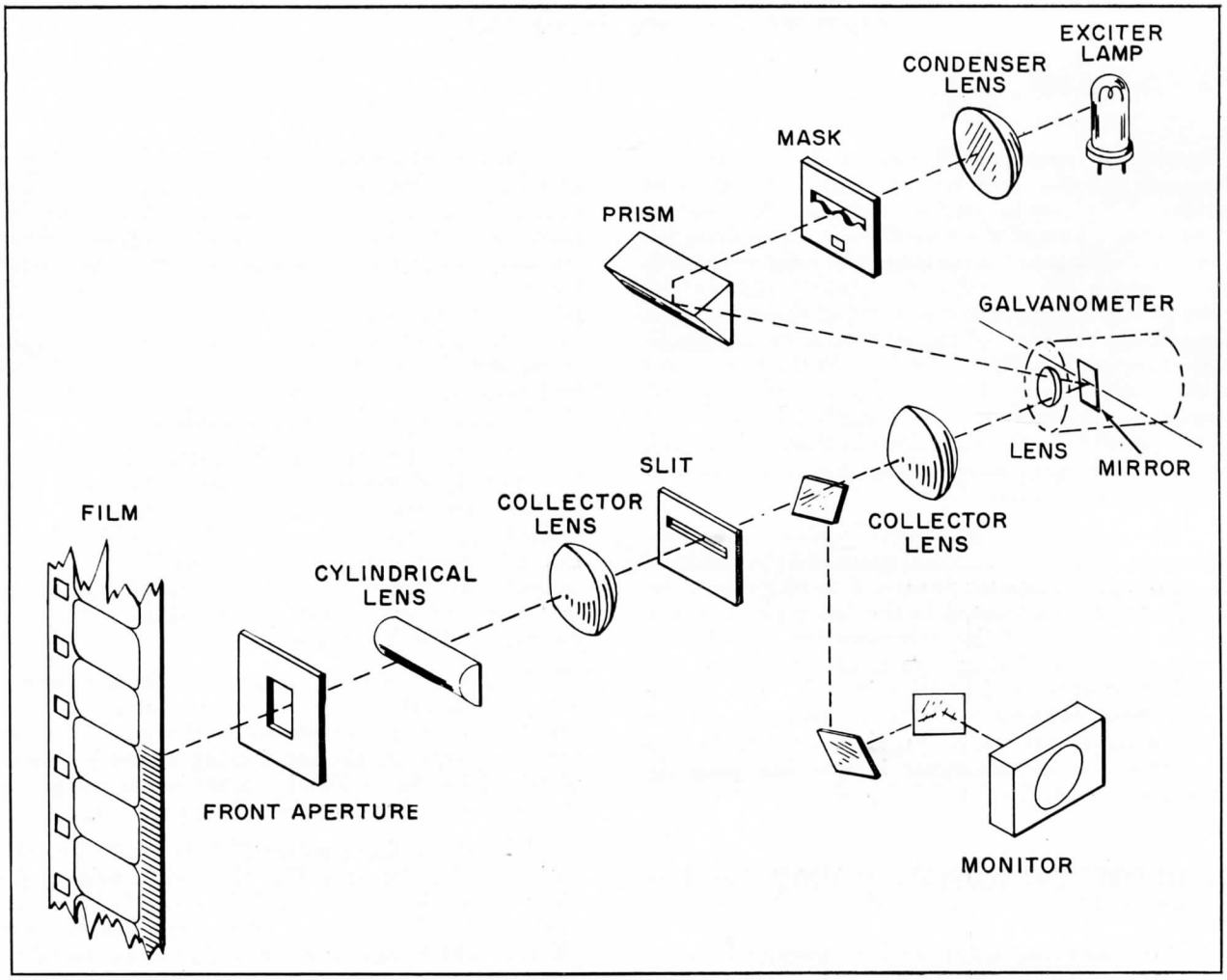


Figure 6-2. Simplified Optical Schematic

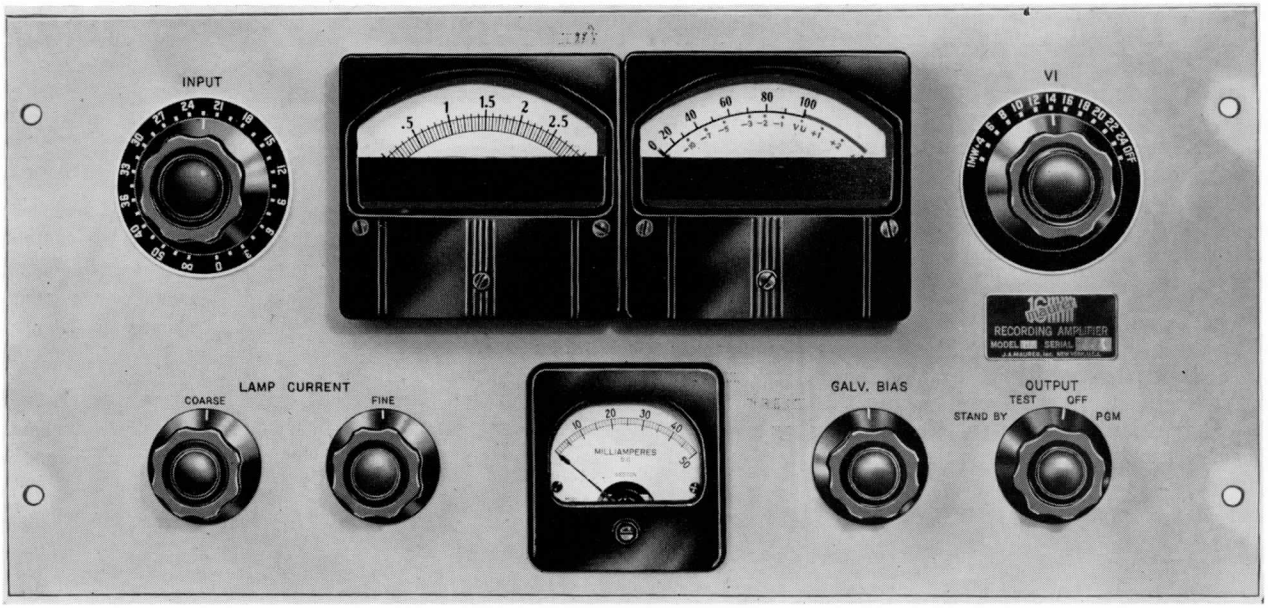


Figure 6-3. Recording Amplifier Control Panel

illuminated aperture of the mask, which pass through the slit, will be sufficiently out of focus at the film plane to produce uniform illumination across the width of the sound track. The cylindrical condenser lens concentrates the light rays vertically into a horizontal strip 0.0001″ high in the film plane. The aperture in front of the cylindrical lens masks the ends of the strip to form an illuminated rectangle 0.0001″ × 0.08″. As the film moves with constant velocity past the recording point, variations in exposure are recorded on the film corresponding to the variations in the audio signal. In the film processing, these are converted to variations in density.

By means of additional optical elements, shown in Figure 6-2, a second beam of light reflected from the galvanometer is caused to illuminate the viewing aperture located in the lower right corner of the front side of the galvanometer. In the absence of a modulating signal, about half of the viewing aperture will be illuminated. The illuminated area changes with the amplitude of the modulating signal and so provides a rough indication that the galvanometer is working properly (See par. h.(3), Section VI:5.)

3. RECORDING AMPLIFIER UNIT (see Figure 6-3)

The recording amplifier incorporates four interconnected sub-circuits: the pre-emphasis equalizer, main amplifier, de-emphasis equalizer and anti-ground noise (AGN) circuits (see schematic diagram).

The input signal is applied through the input transformer (600 ohm, 600 ohm bridging and 150 ohm bridging inputs) to the bridged-T filter equalizer. This network provides the high-frequency pre-emphasis, + 18 db at 10 kc, necessary to correct for the loss due to the film grain and finite slit width (equalization is correct for a playback slit of .0005″ effective width). The equalizer output is connected to the main amplifier through a T-pad and line-to-grid transformer. The T-pad serves as the input level-set or gain control.

The signal to the main amplifier is amplified by one half of the 6SL7GT tube. The other half of the tube operates as a phase inverter. The 6SL7GT feeds the push-pull 6SN7GT which drives the triode-connected push-pull 6F6 tubes. The output transformer matches the amplifier output to the sound modulator and provides a 600-ohm output for the VU meter.

Points Y-Y on the output transformer supply a signal for external monitoring. Because of the high-frequency pre-emphasis of the signal for recording purposes, the monitoring signal is de-emphasized by the bridged-T filter equalizer to restore the signal to its original frequency response.

The signal from points X-X is applied to the anti-ground noise amplifier through a voltage divider network. The signal is amplified by the push-pull 6SN7GT and then applied to the 6X5GT which operates as a full-wave rectifier. The rectified output is direct-coupled to two 6V6GT d-c amplifiers, one of which has the sound modulator galvanometer element connected in its cathode circuit.

RECORDING SOUND AMPLIFIER CONTROLS

"INPUT"	Controls recording level. Calibrated in 1½ db steps.
"VI"	Controls range of "VU" meter. Calibrated in 2 db steps.
"LAMP CURRENT"* ("COARSE" AND "FINE")	Controls lamp current. (Current indicated on d-c ammeter.)
"GALV. BIAS"	Controls sound modulator AGN bias. Current indicated on d-c milliammeter when "OUTPUT" switch is on "OFF" position. Average value of bias indicated when switch is on "PGM" position.
"OUTPUT"	
"STANDBY"	Warm-up position (low lamp current, no AGN bias, no modulation applied to galvanometer).
"TEST"	Lamp current set position (high lamp current, no AGN bias, no modulation applied to galvanometer).
"OFF"	AGN bias set position (high lamp current, AGN bias, no modulation applied to galvanometer).
"PGM"	Recording position (high lamp current, AGN bias, modulation *applied* to galvanometer).

* An additional—very coarse—current control is located in the power supply (2 ohm variable resistor).

The purpose of the anti-ground noise bias is to increase the sound track average film density during low level passages. This is accomplished as follows: Assume a condition of direct positive recording with 70 to 80% modulation. If the signal level drops to 20% modulation, the rectified output of the 6X5GT will decrease, causing the grid of the control 6V6GT to become less negative, increasing the plate current. The increased current through the galvanometer winding deflects the mirror so as to permit more light to pass through the modulator slit, increasing the film density for positive recording; the reverse is true for negative recording. (See h.(3), Section VI:5.) At the time the control 6V6GT plate current is increasing, the plate current of the other 6V6GT is decreasing because of the less positive voltage on its grid. In this way, the combined plate current of the two tubes remains at a fairly constant value. The AGN bias must be reversed when the modulator is used for recording negative sound tracks.

4. POWER SUPPLY UNIT

The power unit supplies all the operating voltages for the amplifier and sound modulator units.

The filament transformer supplies the full-wave bridge rectifier, the output of which is smoothed by the choke-input filter and applied to the lamp in the sound modulator. The heater of the 6SL7GT in the main amplifier is also supplied from this source in order to minimize hum.

The power transformer supplies the B+ and heated voltages for the tubes in the recording amplifier. The B+ voltage is obtained from the full-wave rectifier (5V4G) and condenser-input filter.

The entire system is operated from a regulating transformer in order to maintain constant lamp current under conditions of varying line voltages.

5. SYSTEM ALIGNMENT AND ADJUSTMENT

NOTE

The Maurer Sound Recording System is completely adjusted in manufacture and is intended to be placed in operation without any further adjustment. Should these factory adjustments be disturbed inadvertently, test strips will clearly indicate whether

alignment is necessary or not. The alignment procedure is described in the following paragraphs but is to be undertaken only if appreciable departure from performance standards indicates its necessity.

CAUTION

In all alignment steps noted below, observe the proper VU meter and associated multiplier (VI) settings to prevent overdriving the galvanometer and incurring costly repairs.

a. Set the "OUTPUT" switch on the sound amplifier in the "STANDBY" position.

b. Place the power switch on the power supply in the "ON" position and permit the system to warm up at least 10 minutes.

c. Check the focus.

(1) Set the "OUTPUT" switch on the "TEST" position.

(2) Using direct positive recording stock, set the lamp current at approximately 1.8 amperes with the "LAMP CURERNT" controls.

(3) Feed a 9,000 to 10,000 cps sine wave signal into the amplifier input.

(4) Place the "VI" switch on +22 and adjust the "INPUT" control so that the meter indicates 0 dbm.

(5) Place the "OUTPUT" switch in the "PGM" position and repeat step (4).

(6) Place a strip of masking tape on the side of the focusing nut and another strip on the side of the block immediately to its rear.

CAUTION

Keep the tape away from the lens.

(7) Mark a line on the tape on the nut. Mark a corresponding line on the tape on the block. Mark two more lines on the tape on the block, one on each side of the first line, each 1/16″ from the first.

(8) With the special spanner wrench provided, move the focusing nut counterclockwise a maximum of ¼ turn (90°) to remove backlash. (Some units have a set screw on the modulator lens barrel. This set screw must be loosened before focusing and tightened after the adjustment is made.)

CAUTION

Do not move the nut more than 90° as the lens may be brought into contact with the drum, ruining the lens.

Then turn the focusing nut clockwise (do not turn counterclockwise), recording a separate test strip for the single frequency input with the focusing nut marker set at each of the three marks on the tape.

(9) Develop the test strips and examine them under a microscope of at least 20 power. If the lens was properly focused, the second test strip will be in the sharpest focus. In this case, reset the lens by first eliminating backlash as described in step c.(8) and then turning the focusing nut clockwise and setting it on the center mark on the tape on the block. Remove the masking tape strips from the nut and block.

If lines are distinguishable in test strips one, two and three, but strip two is not in sharpest focus, it is only necessary to repeat steps c.(6) through c.(9) with more marks on the block tape, 1/16″ apart in the direction of the sharpest focus.

If there is no evidence of focus on any of the test strips (lines not distinguishable), focus the lens following the steps below.

(10) Lower the input signal frequency to 5,000 cps.

(11) Adjust the focusing nut with the special spanner wrench so that two thicknesses of film (film is approximately 0.006″ thick) will slip between the lens and the film on the sound drum. The distance from the film to the back plate should be a minimum of 1.938 + .002″; from drum to back plate, 1.944 + .002″. Any two smooth pieces of scrap film will suffice for this test. Be sure the film is clean so that no dirt can get on the front cylindrical lens.

(12) Replace the tape on the focusing nut and block. Mark a line on the tape on the nut. Mark a corresponding line on the tape on the block; two on each side of the first line, each ⅛″ from the other.

(13) With the special spanner wrench, move the focusing nut counterclockwise a maximum of ¼ turn (90°) to remove backlash. Then turn the focusing nut clockwise (do not turn counterclockwise), recording a separate test strip for the single frequency input with the focusing nut marker set at each of the five marks on the tape.

(14) Develop the test strips, and examine them under a microscope of at least 20 power to determine which strip is in the best focus. Move the focusing nut so that its marker is in line with the mark on the block that resulted in the best focused test strip.

(15) Subdivide the intervals on each side of the new focus mark of the block tape (1/16″ intervals result). Raise the input signal frequency to 10,000 cps and record test strips for each of the new marks. Develop the test strips and determine the final mark of best focus and set the focusing

nut at that mark, taking care to remove backlash. Remove the masking tape strips from the nut and block.

d. Check the image azimuth. (Image azimuth is the perpendicularity of the sound track modulation image to the edge of the film.)

NOTE

The final test strip from the focusing series may be used for steps 1 and 2 below.

(1) Repeat steps c. (1), (2), (3), (4) and (5).

(2) Record and develop a short test strip.

(3) Align one edge of an accurate toolmaker's square with the sound-track edge of the film.

(4) Using an unused razor blade, cut a fine line in the film emulsion along the edge of the square, parallel to the sound-track modulations.

e. View the film with a microscope of at least 20 power. Place the film under the microscope with the emulsion side up and oriented so that the sprocket holes, looking through the microscope, appear to be on the right side of the film. The razor line should appear parallel to the modulation images. If the line is not parallel to the modulation images, correct the azimuth in the following manner:

(1) If the modulation images cross the scribed line from the lower left to the upper right *(see figure 6-4A)*, loosen the bottom screw on the side of the modulator lens barrel (approximately 5°) and tighten the top screw.

(2) If the modulation images cross the scribed lines from the lower right to the upper left *(see figure 6-4B)*, loosen the top screw (approximately 5°) on the modulator lens barrel and tighten the bottom screw.

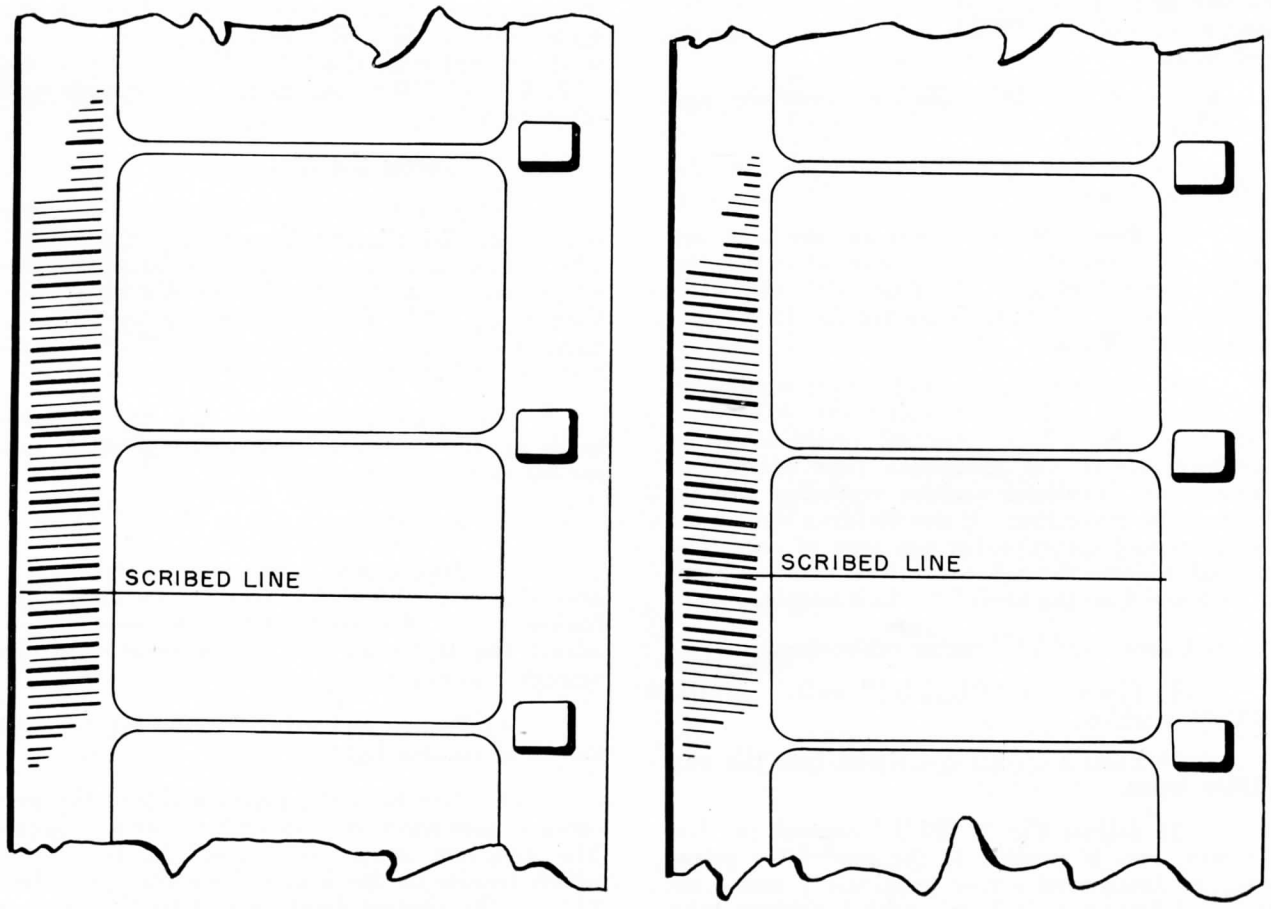


Figure 6-4. Modulation Images Crossing Scribed Line

CAUTION

This adjustment is critical.

f. Check the azimuth correction by recording and developing another test strip. Repeat this procedure until the image azimuth is correct.

g. Check the recording amplifier (see figure 6-3) pre-emphasis equalization (+1 db at 2,000 cps, +5 db at 5,000 cps, +18 db at 10,000 cps relative to 400 cps).

(1) Set the "OUTPUT" switch in the "TEST" position.

(2) Feed a 9,000 cps signal into the amplifier input.

(3) Set the "VI" switch on +18 and adjust the "INPUT" control so that the "VU" meter indicates 0 dbm.

(4) Set the "OUTPUT" switch on the "PGM" position and repeat step (3).

(5) Keeping the input signal level constant, change its frequency to 5,000 cps. With the "VI" switch set on +4, the "VU" meter should indicate +1 dbm.

(6) Keeping the input signal level constant, change its frequency to 2,000 cps. With the "VI" switch on +4, the "VU" meter should indicate —3 dbm.

h. Check the AGN bias performance and polarity.

(1) Set the "OUTPUT" switch on the "OFF" position.

(2) Feed a 400 cps signal into the amplifier input and adjust the "INPUT" control so that the "VU" meter indicates —1 dbm with the "VI" switch on +16. The milliammeter should indicate 1 ma of AGN bias.

(3) Observe the modulator view window on the modulator unit. Increasing the AGN bias with the "GALV. BIAS" control should cause the dividing line in the modulator view window to move down for direct positive recording and up for negative recording. If the dividing line moves in the wrong direction for the type of recording desired, reverse the red and yellow leads to terminals 3 and 4 on the modulator unit terminal strip.

i. Check the "VU" meter calibration.

(1) Place the "OUTPUT" switch in the "PGM" position.

(2) Feed a 10,000 cps signal into the amplifier input.

(3) Adjust the "INPUT" control so that 1.6 volts rms is applied to the modulator galvanometer (measured across terminals 3 and 4 on the modulator terminal strip with a vacuum tube voltmeter).

(4) Place the "VI" switch on +18. The "VU" meter should indicate 0 dbm ±1 dbm.

j. Set the lamp current. Several lamps should be tested at one time as outlined in par. k. and l. below to permit replacements to be available in case of sudden lamp failures.

k. For direct positive recording, use the positive mask in the modulator unit with the AGN bias set for positive recording.

(1) Place the "OUTPUT" switch in the "OFF" position.

(2) Set the "GALV. BIAS" control for 30 ma as indicated on the milliammeter.

(3) Feed the signal (60 to 100 cps and 2,000 to 5,000 cps at 4:1 ratio) from an intermodulation signal generator into the recording amplifier.

(4) Place the "VI" switch on +16 and adjust the "INPUT" control so that the meter indicates 0 dbm.

(5) Place the "OUTPUT" switch in the "PGM" position and repeat step (4).

(6) Make a recording varying the exciter lamp current over the range 1.6—1.9 amperes in increments of 0.025 ampere (½ division on ammeter scale). If a densitometer check is to be made, record with the "OUTPUT" switch in the "TEST" and "OFF" positions for 5 seconds each after each lamp current increment.

(7) Process the film.

(8) Play back the recording and plot the percentage distortion vs. the exciter lamp current. The optimum lamp current will be that value which gives the lowest value of distortion (less than 10%). The density for the optimum lamp current should be *0.3* ± .05 in the "TEST" position and *0.5* ± .05 in the "OFF" position.

l. For negative recording, use the negative mask in the modulator unit with the AGN bias set for negative recording.

(1) Repeat steps k.(1) to (5).

(2) Repeat step k.(6) varying the current over the range 1.8—2.2 amperes. To obtain the higher values of current, it may be necessary to adjust the slider on the 2-ohm resistor in the amplifier power supply.

(3) Process and print the film for different values of printer light.

(4) Play back the prints and plot the percentage distortion vs. the exciter lamp current. The optimum lamp current will be that value which results in the lowest distortion (less than 15%). The proper densities will be the same as those stated in k.(8).

m. Check the system frequency response.

(1) Place the "OUTPUT" switch in the "TEST" position.

(2) Feed a 400 cps signal into the amplifier input.

(3) Place the "VI" switch on +2 and adjust the "INPUT" control so that the "VU" meter indicates 0 dbm.

(4) Place the "OUTPUT" switch in the "PGM" position and repeat step (3).

(5) Keeping the input signal level constant, record a test strip through the frequency range of 100 to 7,000 cps.

(6) Play back the test strip through a projector whose response is known. The frequency response should be flat to 7,000 cps ± 2 db.

6. OPERATION

a. Set the "OUTPUT" switch in the "STAND-BY" position.

b. Place the power supply switch in the "ON" position.

c. Approximately five minutes before recording time, place the "OUTPUT" switch in the "TEST" position.

d. To record:

(1) Place the "VI" switch on +12.

(2) Set the "INPUT" for maximum attenuation.

(3) Set lamp current to value determined in par. 5j.

(4) Place the "OUTPUT" switch on "PGM" and adjust the "INPUT" control for an average peak reading of 0 VU with 2 or 3 peaks a minute greater than 0 VU.

e. At the end of a recording, record approximately a ½ minute of intermodulation test signal to permit checking intermodulation distortion.

7. MAINTENANCE

a. The modulator unit must be kept clean for satisfactory operation. The covers should be opened only when necessary and closed immediately thereafter. When the unit is out of the camera, the front lens should be covered with a clean, paper box. If the mask is removed, it should be wrapped in tissue and stored in a box. Above all, dirt and dust should not be allowed to collect on the edge of the mask.

b. The screws of the modulator unit should never be touched.

8. LAMP MAINTENANCE

a. The lamp should be kept clean at all times. To clean, breathe on the lamp, and wipe it with a clean handkerchief or lint-free rag.

b. Replace the lamp when the envelope starts to darken or the filament sags. (Average lamp life is 20 hours for negative recording and 40 hours for positive recording.)

9. OBJECTIVE CYLINDRICAL LENS MAINTENANCE

a. The lens must be kept clean at all times. Dust should be blown from the lens with a dental blower, but care should be taken that the blower itself is clean. The blower is cleaned by introducing carbon tetrachloride into the bulb, and then squeezing the bulb until all of the carbon tetrachloride has been removed. The dry blower may then be used to clean the lens.

b. Dirt and scum should be cleaned from the lens with carbon tetrachloride or acetone. It is extremely important that the lens be cleaned without using too much solution since the solution seeps behind the lens and dries leaving a scum. This scum, particularly in evidence with acetone, cannot be reached to be cleaned. It is recommended that the lens be cleaned as follows:

(1) Take ¼ of a sheet of Kodak lens cleaning paper being careful not to touch the center area of the paper and fold the sheet three times horizontally. Using a pair of clean tweezers, hold the resultant strip at the center, and fold it in half.

(2) Pour chemically-pure carbon tetrachloride or acetone into a container. Using the tweezers to hold the strip at the folded end, put the separated ends of the strip in the solution. Do not allow the strip to remain there for more than ten minutes.

(3) Fold another strip of Kodak lens cleaning paper in the manner described in step (1).

(4) Using the tweezers, hold the new strip, ends together, just above the folded end. Rapidly touch the folded end of the new strip to the end of the strip absorbing carbon tetrachloride or acetone. Run the tip of the new strip, now damp, over the lens with one stroke.

CAUTION

Do not scratch the lens with the tweezers.

(5) Fold another strip of Kodak lens cleaning paper in the manner described in step (1). Using the tweezers, hold the folded strip, ends together, just above the folded end. Wipe the lens with the tip of the dry strip, using one stroke.

NOTES

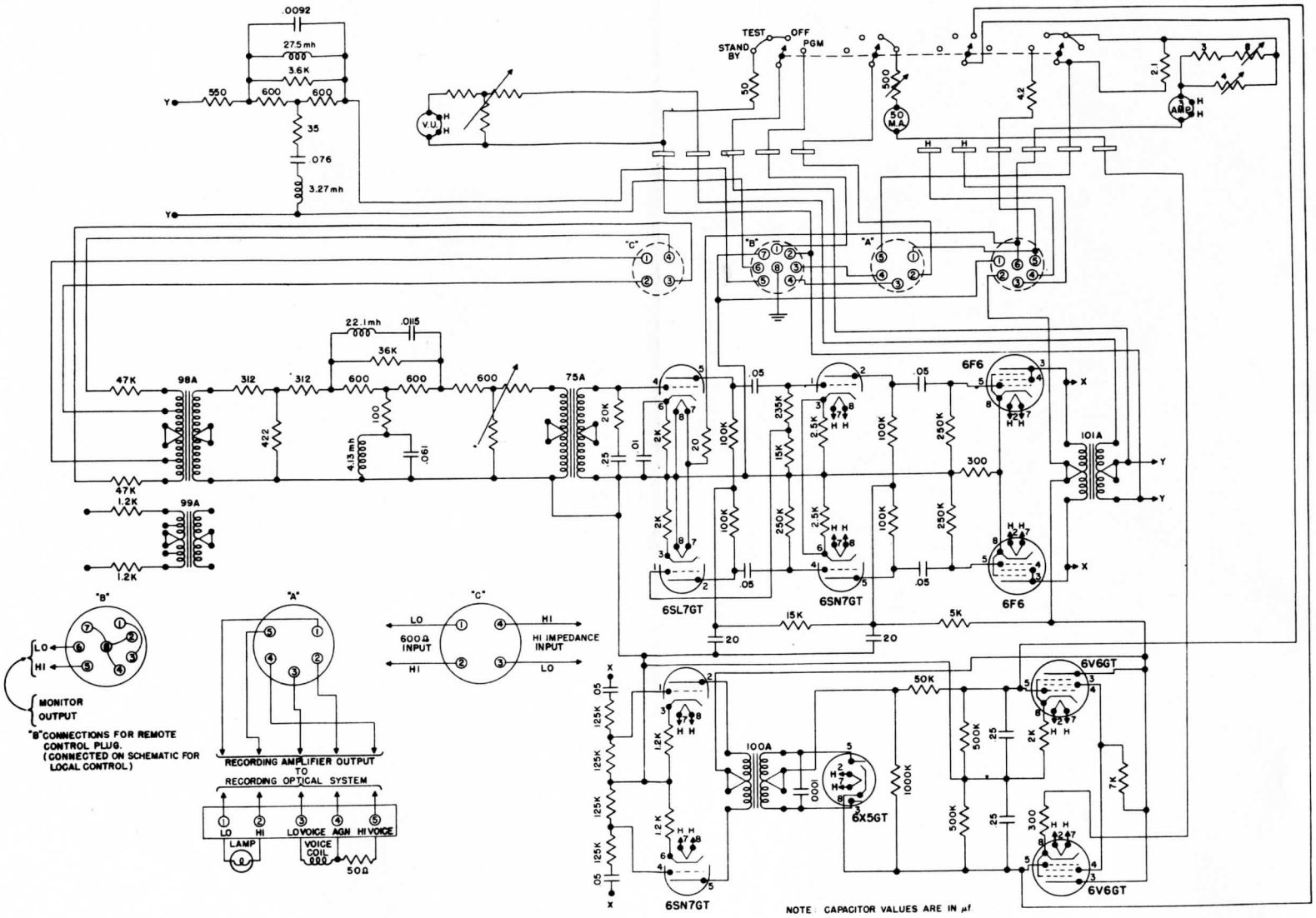


Figure 6-5. Sound Recording Amplifier, schematic diagram

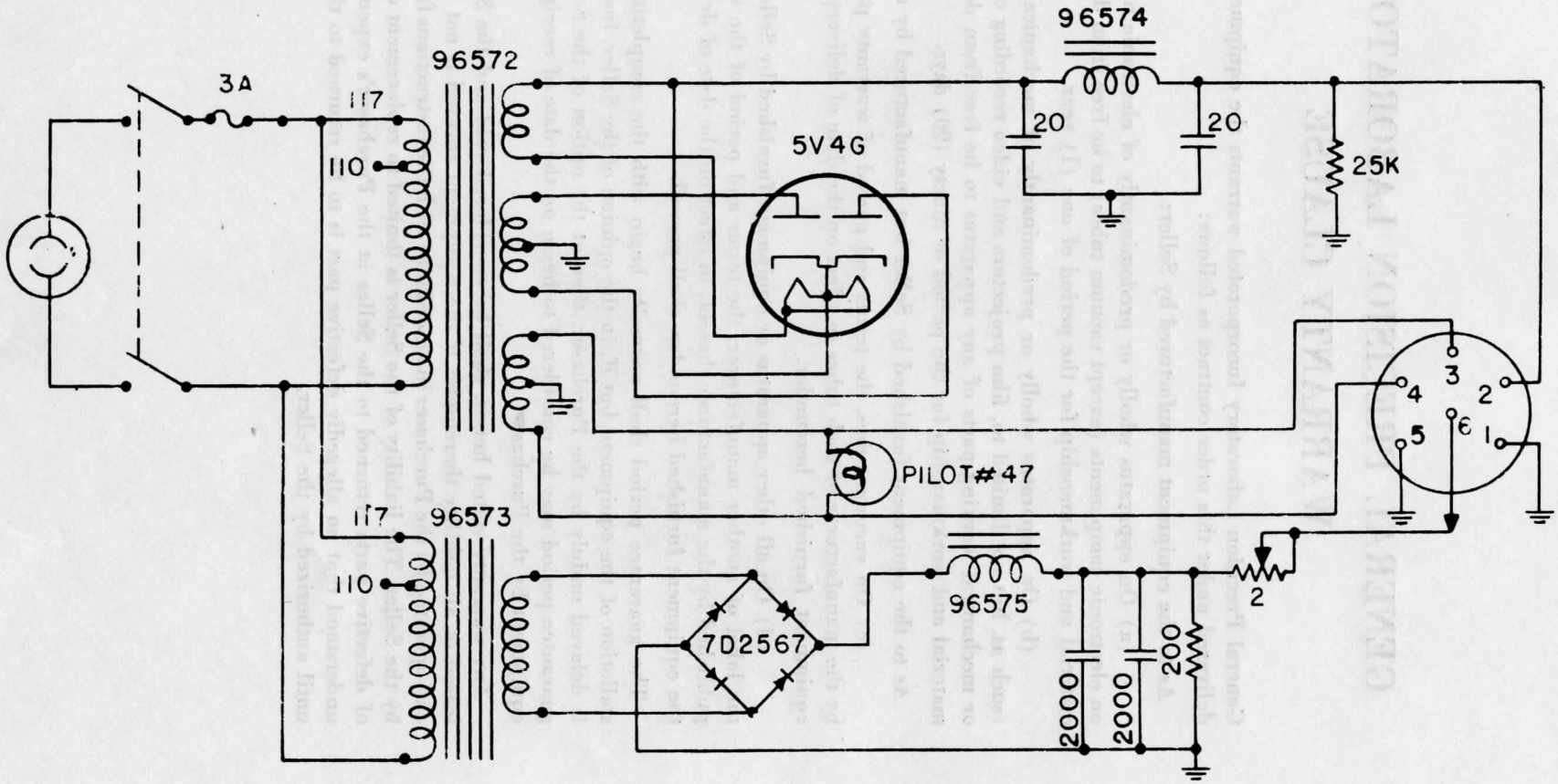


Figure 6-6. Sound Recording Amplifier Power Supply

GENERAL PRECISION LABORATORY WARRANTY CLAUSE

General Precision Laboratory Incorporated warrants the equipment to be delivered under this order contract as follows:

As to the equipment manufactured by Seller:

(a) On apparatus wholly or predominantly of electronic nature or on electronic components (except vacuum tubes) to be free from defects in material and workmanship for the period of one (1) year.

(b) On apparatus wholly or predominantly of mechanical nature (such as, but not limited to, film projectors and video recording cameras) or mechanical working parts of any apparatus to be free from defects in material and workmanship for the period of ninety (90) days.

As to the equipment furnished by Seller but manufactured by another:

(c) On vacuum tubes, the terms and period of warranty published by the manufacturer of such tubes in effect on the date of delivery of such equipment furnished hereunder.

(d) On all other apparatus or equipment furnished by Seller under the label of another manufacturer, the terms and period of the warranty published by the manufacturer thereof, in effect on the date of delivery of the equipment furnished hereunder, shall prevail.

The guarantee period shall normally begin with the completion of installation of the equipment but if, in the opinion of the Seller, installation is delayed unduly by the Purchaser, then at the option of the Seller, the guarantee period may be considered to begin on the date of receipt of the equipment by the Purchaser.

Any warranty stated herein shall be considered void and the Seller released of all liability thereunder if the equipment covered is not installed and operated by the Purchaser in accordance with the instructions furnished by the Seller. The liability of the Seller is limited to replacement or repair of defective parts returned to the Seller at the Purchaser's expense. It is understood that no allegedly defective part is to be returned to the Seller until authorized by the Seller.

SECTION VII

PARTS LISTS

The following parts lists have been compiled, and the exploded views provided, for your convenience. The ordering procedure will be greatly simplified through reference to these lists, which contain all the principle replacement parts.

The index numbers appearing in the first column of each list are the same as those appearing on the accompanying "exploded view" illustrations. These same illustrations are referenced in SECTION V. The index number is the key: When this has been determined, all the information necessary to order the required part can then be obtained from the other columns of the parts list.

Replacement parts may be ordered directly from the Sales Department, General Precision Laboratory Incorporated, 63 Bedford Road, Pleasantville, New York. When ordering, please state the model number and serial number of the camera, and give the part name, description and part number. This information will be found in the list opposite the index number of the item.

The standard GPL warranty applies to all replacement parts.

INDEX OF DRAWINGS

NOTES

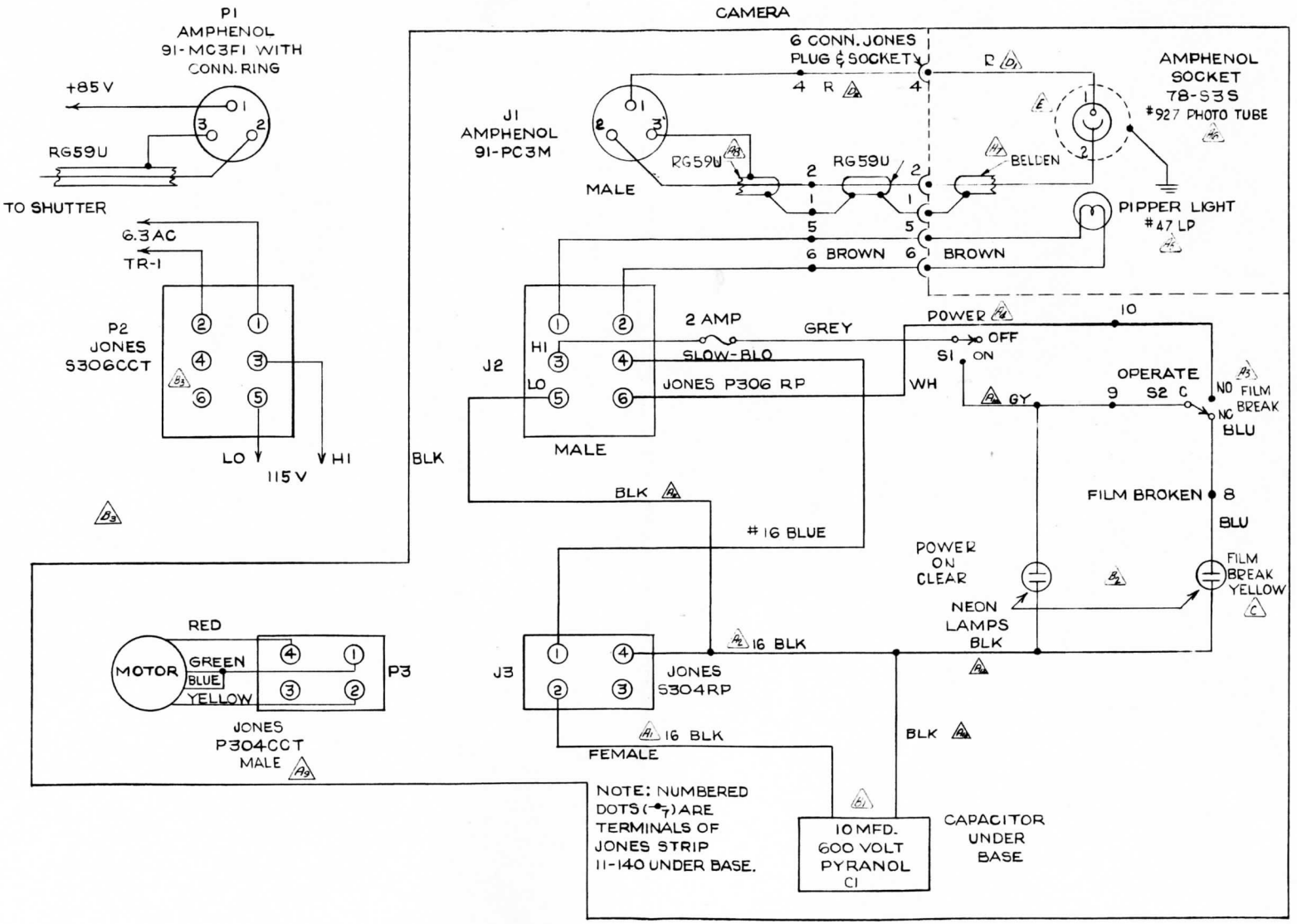


Figure 7-1. GPL Video Recording Camera, wiring diagram

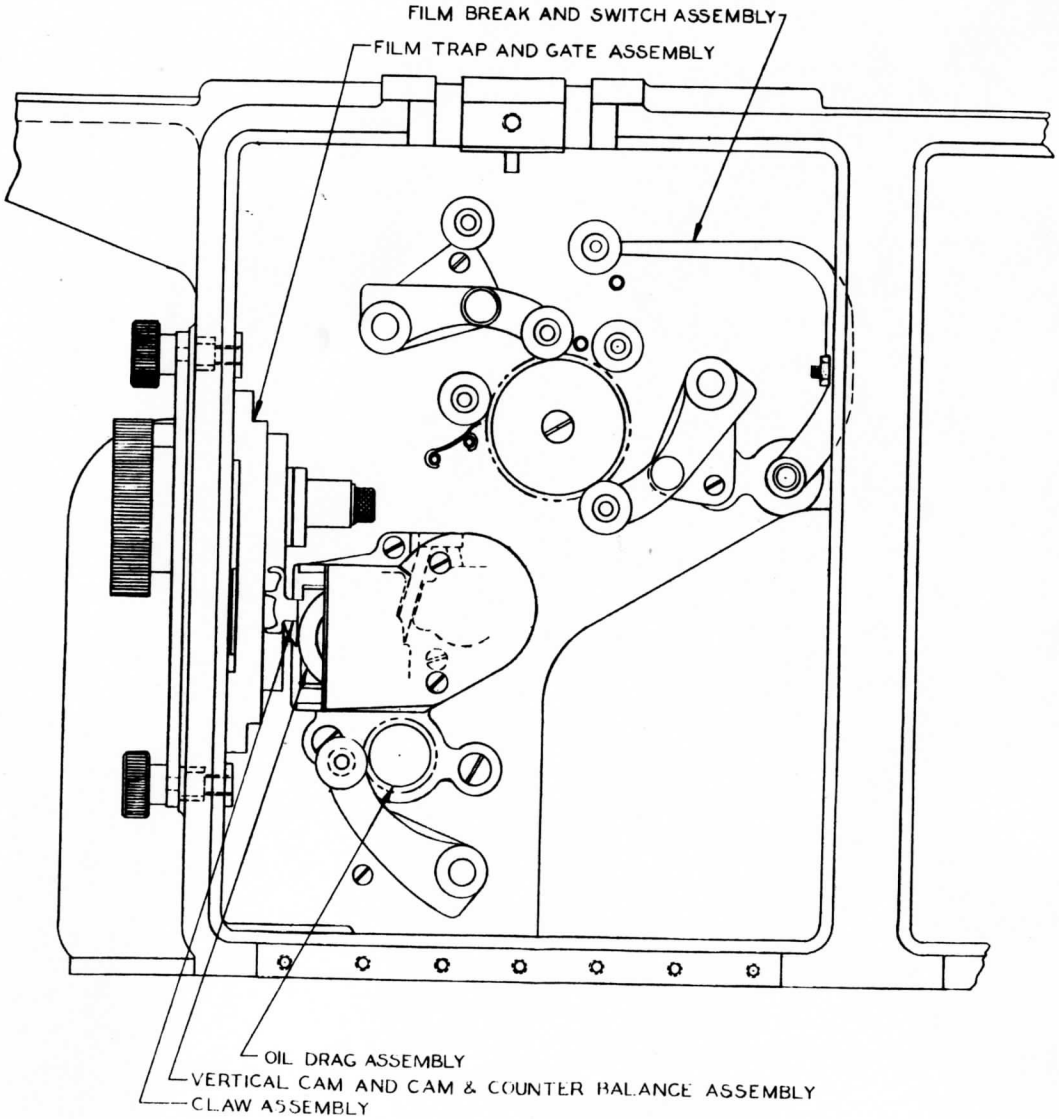


Figure 7-2. GPL Video Recording Camera, front view, line drawing

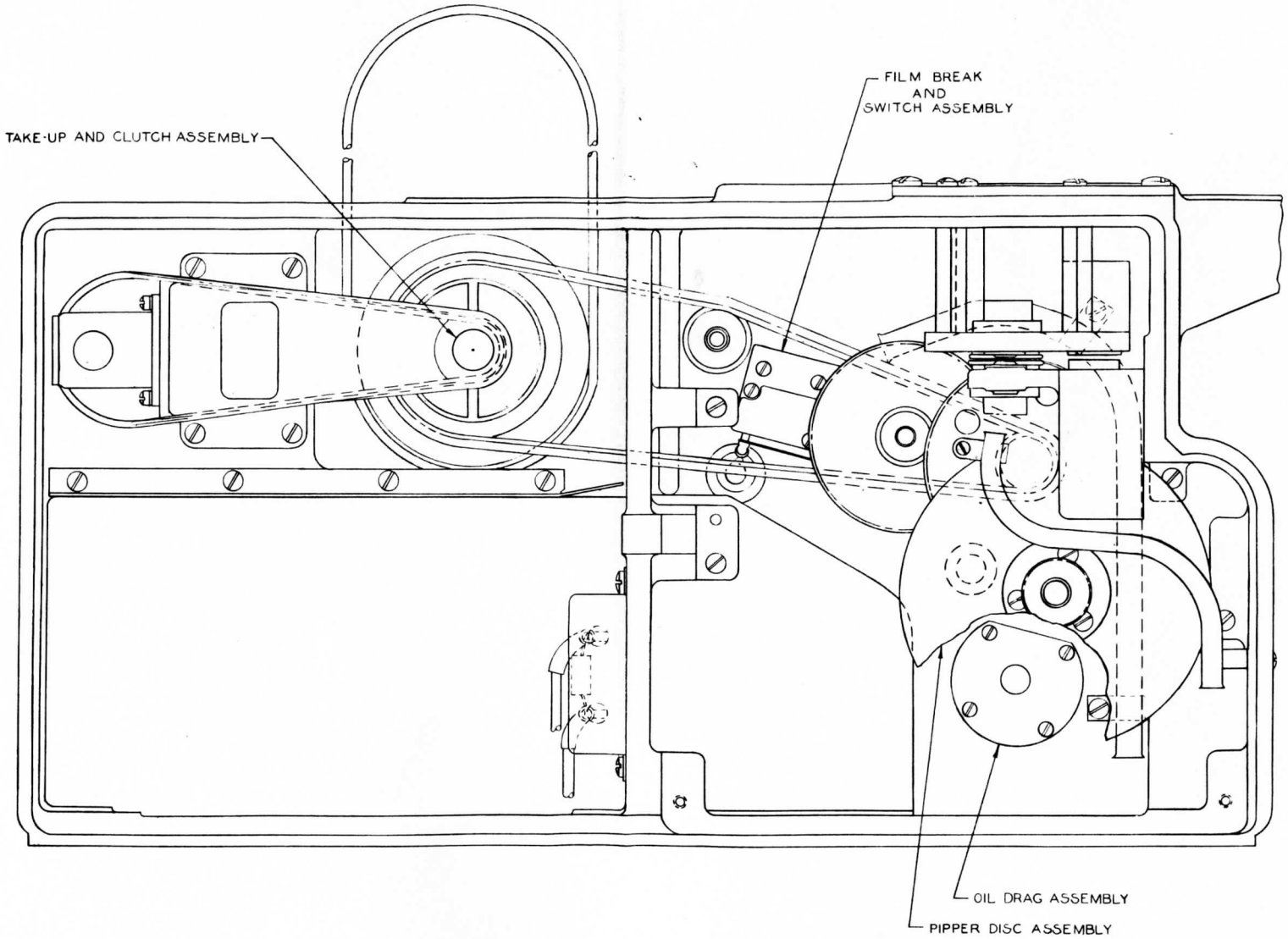


Figure 7-3. GPL Video Recording Camera, rear view, line drawing

Index No.	Part No.	Name and Description	Units Per Assembly

CAM ASSEMBLY

Figure 7-4

1	5096–23	Cam and counterbalance assembly	1
2	5096–32	Lateral cam assembly, matched and balanced	1
3	5096–151	Nut, lateral and vertical cam shaft	4
4	5096–550	Shuttle assembly	1
5	5096–567	Washer, vertical cam shoulder	1
6	5096–161	Washer, lateral cam shaft	1
7	5096–148	Washer, vertical cam shaft	1
8	5096–160	Shuttle pivot	1
9	5096–178	Intermittent housing	1
10	5096–180	Washer, felt	1
11	225–1–7	Cotton wicking	(As required)

	Units Per Assembly
. . . . .	1
nced	1
. . . . .	4
. . . . .	1
. . . . .	1
. . . . .	1
. . . . .	1
. . . . .	1
. . . . .	1
. . . . .	1
. . . . .	(As required)

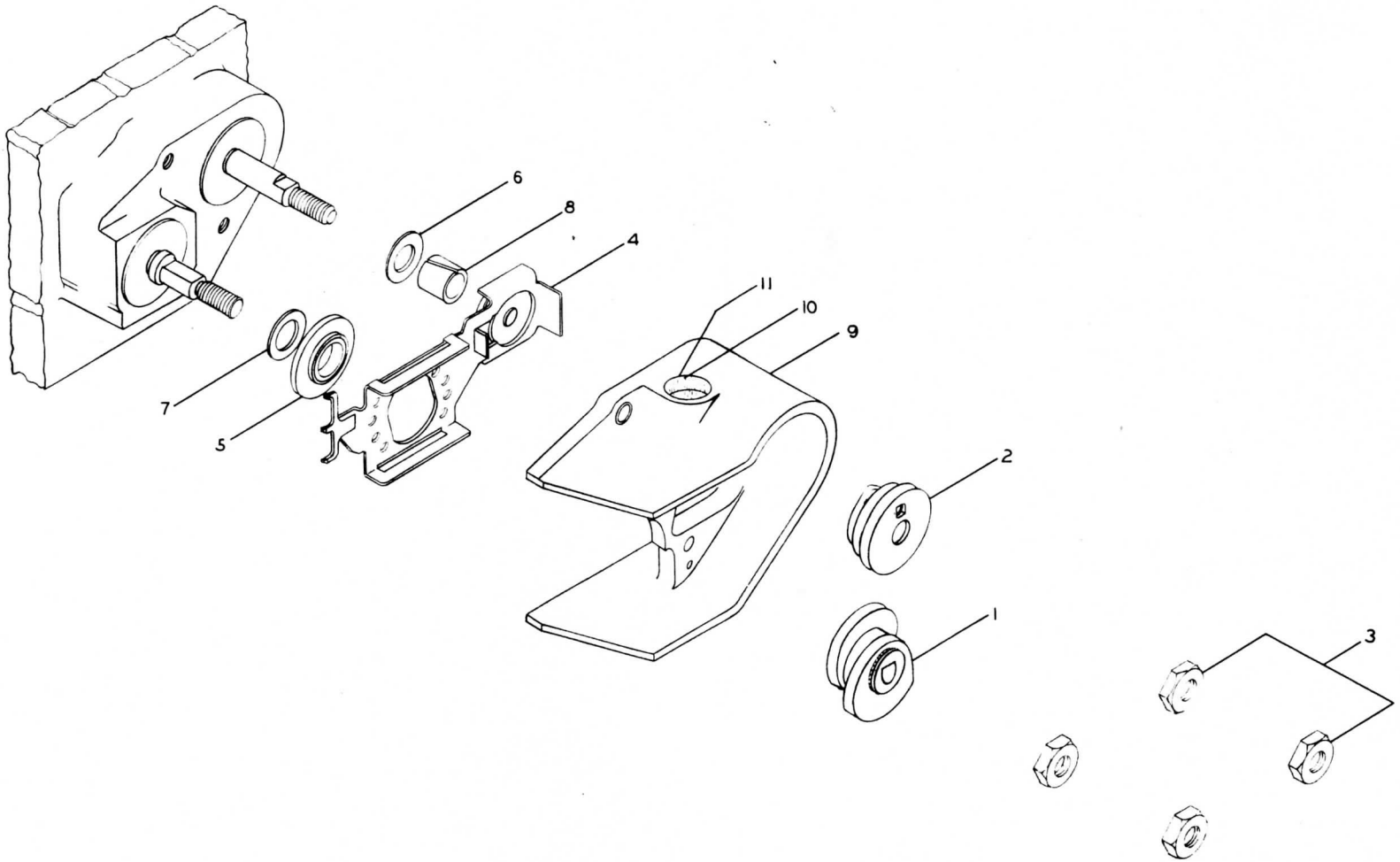


Figure 7-4. Cam Assembly, exploded view

Index No.	Part No.	Name and Description	Units Per Assembly

OIL DRAG ASSEMBLY

Figure 7-5

1	5096–48	Oil drag housing assembly	1
2	5096–47	Shaft assembly, oil drag	1
3	5096–274	Washer, thrust	1
4	5096–598	Washer, shim	1
5	5096–271	Gasket, oil drag	1
6	5096–275	Cover, oil drag	1
7	234–080–251	Fiber washer, #1/4	1
8	224–103–2504	Screw, NC-2, fil hd, blk ox., $\frac{1}{4}$–20 x $\frac{1}{4}$ in. lg	1
9	224–103–406	Screw, NC-2, fil hd, blk ox., 4-40 x $\frac{3}{8}$ in. lg	4
10	234–143–41	Washer, split ring, st stl, blk ox., #4	4
11	221–115–405	Pin, str, st stl, pass. (clear)	1
12	5096–50	Pad roller assembly	1
13	5096–265	Pivot, pad roller arm	1
14	238–2–250	Ring, retaining, Waldes-Kohinoor, (Cat. No. 1500–25)	1
15	5096–428	Drag sprocket assembly (8-tooth)	1
16	224–215–404	Screw, NC-2, bind. hd, st stl, pass., (clear), 4–40 x $\frac{1}{4}$ in. lg	1
17	224–215–617	Screw, NC-2, bind. hd, st stl, pass., (clear) 6–32 x $1\frac{1}{16}$ in. lg	2

Note: Index numbers 1 through 11 are not individually procurable. Order as one unit under Part No. 5096–47.

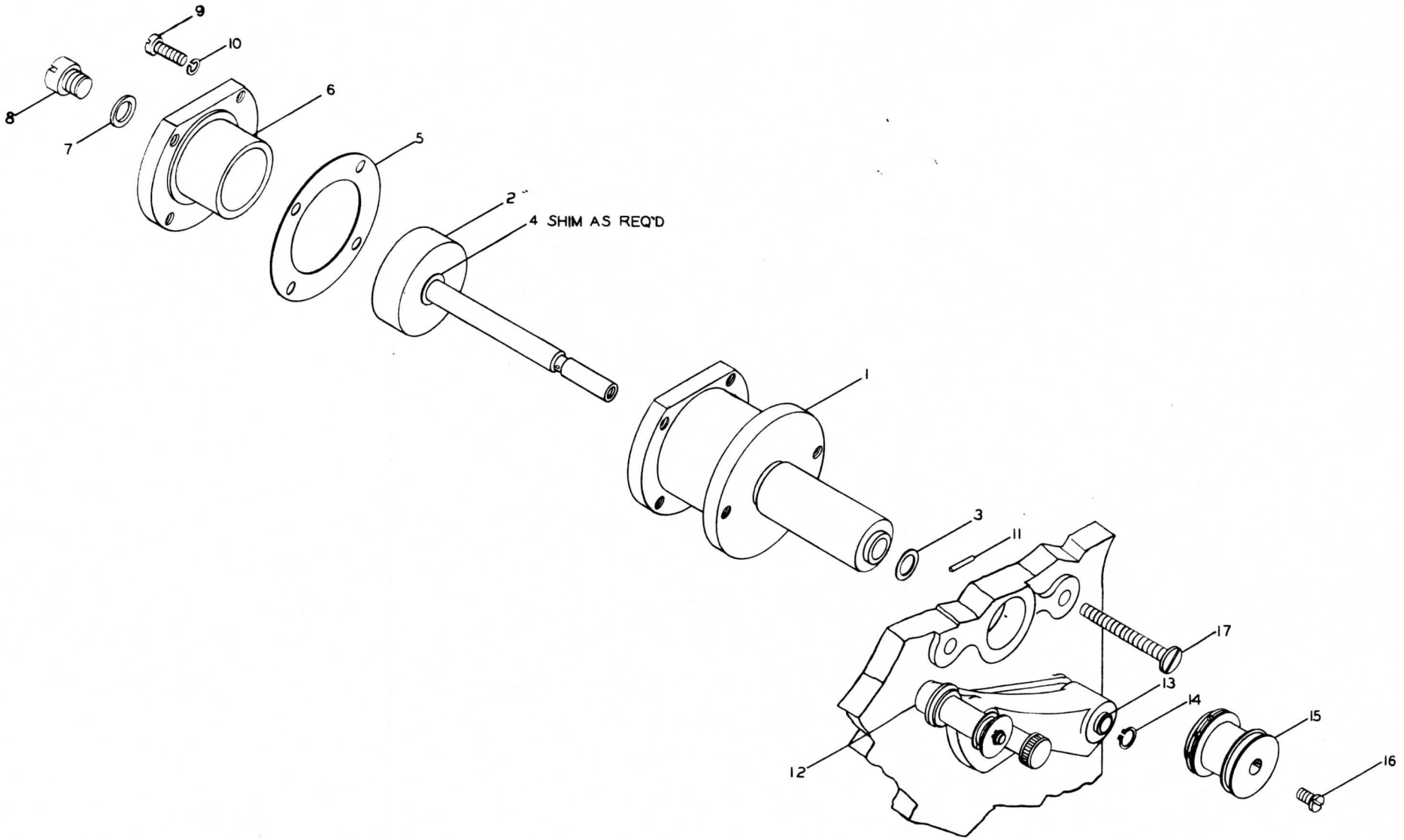


Figure 7-5. Oil Drag Assembly, exploded view

Index No.	Part No.	Name and Description	Units Per Assembly

TAKE UP CLUTCH ASSEMBLY

Figure 7-6

1	5096–415	Sprocket Clutch Assembly	1
2	5120–313	Silent Chain	1
3	5096–527	Shaft take up	1
4	5096–529	Pulley, magazine drive	1
5	5096–537	Spring belt	1
6	228–040–404	Screw, set, NC-2, cup pt, hex, soc hd, 4–40 x 1/4 in. lg	2
7	5096–121	Clutch disc	1
8	5096–133	Clutch pin	1
9	5096–117	Spring	1
10	234–001–311	Washer, plain, stl, cad. pl, 5/16 in. dia	2
11	215–001–315	Nut, hex., jam., NC-2, sf stl, cad. pl, 5/16–24	2
12	5096–43	Sprocket assembly (counter)	1
13	228–043–404	Screw, set, NC-2, rd hd, stl, blk ox., 4–40 x 1/4 in. lg	1
14	5120–311	Brass ladder chain, 15 in. lg	1
15	5120–290	Small reset single rev counter (5-figure knob reset)	1
16	234–115–41	Washer, spring lock, st stl, pass. (clear), #4	4
17	224–115–405	Screw, fil hd, st stl, pass. (clear), 4–40 x 5/16 in. lg	4

	Units Per Assembly
MBLY	
. . . . .	1
. . . . .	1
. . . . .	1
. . . . .	1
. . . . .	1
hd, 4–40 x ¼ in. lg	2
. . . . .	1
. . . . .	1
. . . . .	1
ı. dia	2
pl, 5/16–24	2
. . . . .	1
x., 4–40 x ¼ in. lg	1
. . . . .	1
igure knob reset)	1
clear), #4	4
4–40 x 5/16 in. lg	4

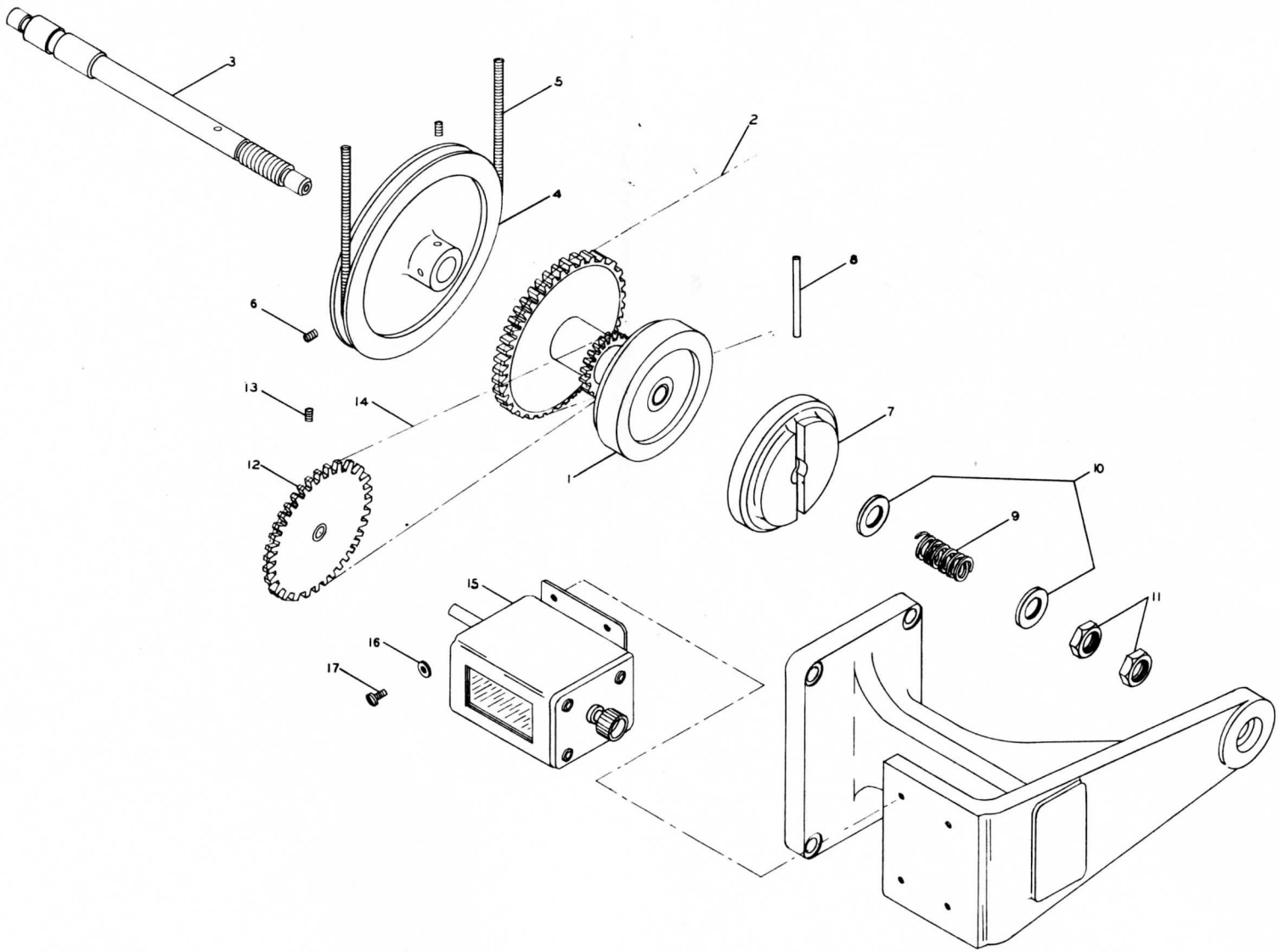


Figure 7-6. Take Up Clutch Assembly, exploded view

Index No.	Part No.	Name and Description	Units Per Assembly

FILM BREAK SWITCH ASSEMBLY

Figure 7-7

1	5096–41	Switch arm assembly	1
2	228–003–408	Screw, set, soc hd, cup pt, stl, blk ox., 4–40 x ½ in. lg	1
3	214–003–40	Nut, hex, st, blk ox., 4–40	1
4	228–043–402	Screw, set, stl hard., blk ox., 4–40 x ⅛ in. lg	1
5	5096–526	Spacer, switch arm (cam shaft)	1
6	5096–42	Guide roller assembly	1
7	235–2–410	Washer, shim	1
8	238–2–120	Ring, ext, retaining (Waldes-Kohinoor)	1
9	5096–200	Cam, switch arm	1
10	5120–278	Switch, sensitive, (Micro-Switch V-3) AN 3234–1	1
11	5120–279	Actuator	1
12	234–115–41	Washer, st stl, cad. pl, pass., (clear), #4, med	4
13	224–115–409	Screw, NC-2, fil hd, st stl, pass., (clear), 4–40 x 9/16 in. lg	4
14	5096–206	Plate, switch mounting	1

	Units Per Assembly
Y	
. . . . .	1
40 x ½ in. lg	1
. . . . .	1
n. lg	1
. . . . .	1
. . . . .	1
. . . . .	1
. . . . .	1
. . . . .	1
N 3234–1	1
. . . . .	1
4, med	4
4–40 x 9/16 in. lg . . .	4
. . . . .	1

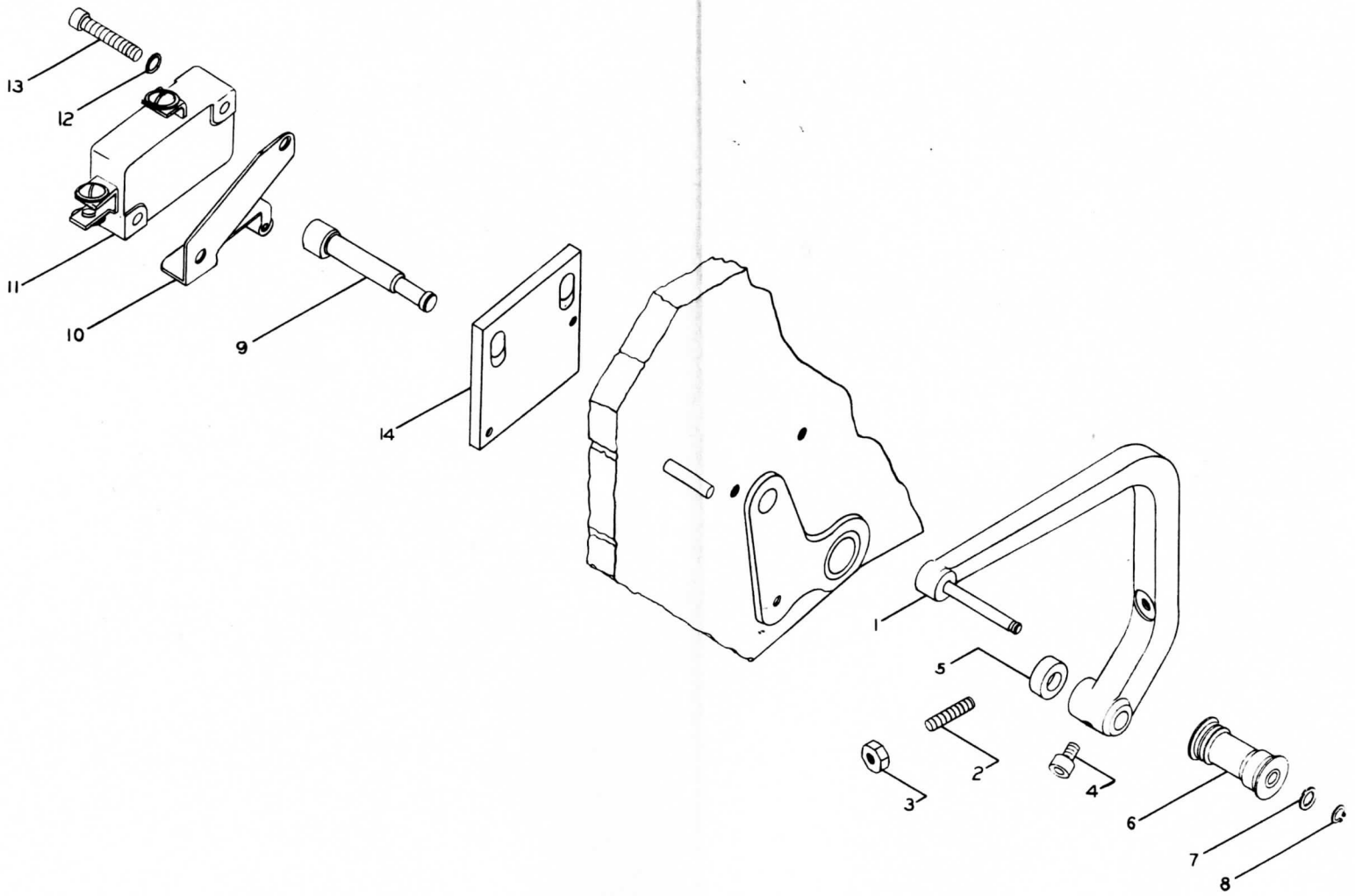


Figure 7-7. Film Break Switch Assembly, exploded view

Index No.	*Part No.*	*Name and Description*	*Units Per Assembly*

PIPPER DISC ASSEMBLY

Figure 7-8

1	5096–424	Vertical cam shaft assembly	1
2	5096–154	Pipper disc	1
3	5096–149	Washer, pipper disc	1
4	224–215–403	Screw, bind. hd, st stl, pass. (clear), 4–40 x $\frac{3}{16}$ in. lg	3

	Units Per Assembly
. . . . .	1
. . . . .	1
. . . . .	1
in. lg	3

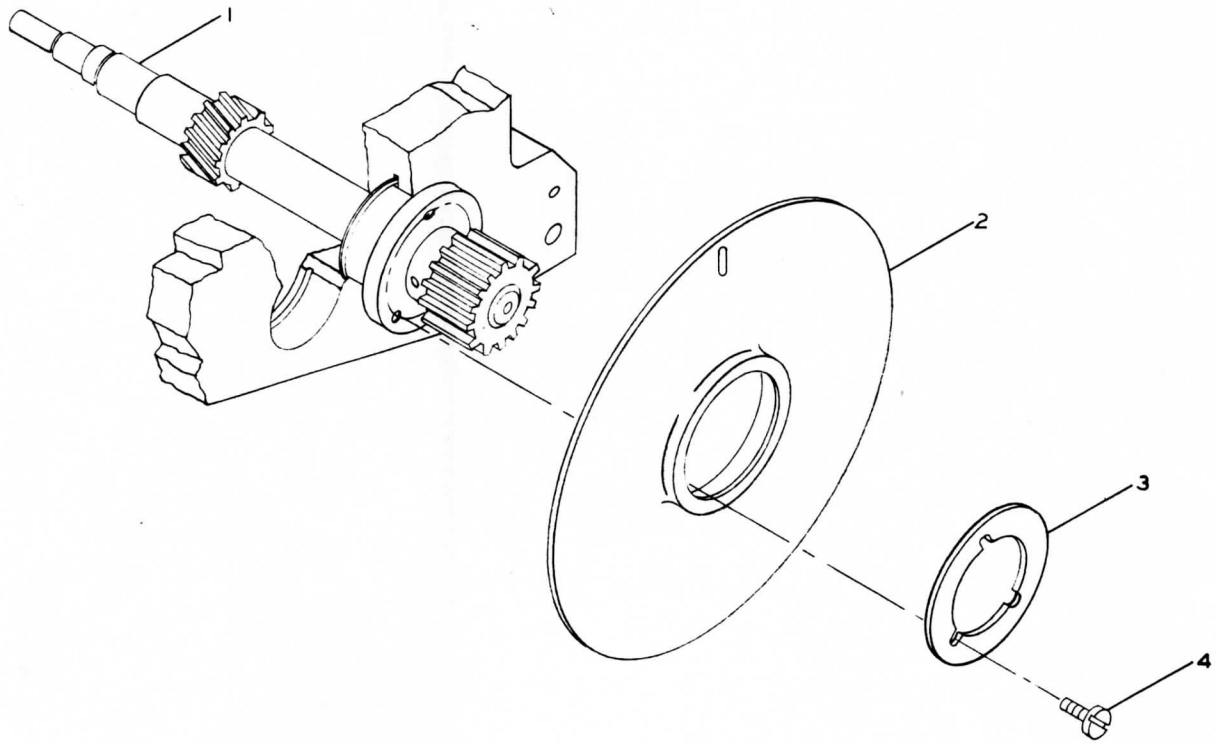


Figure 7-8. Pipper Disc Assembly, exploded view

GATE ASSEMBLY

Figure 7-9

Index No.	Part No.	Name and Description	Units Per Assembly
1	5096–458	Film guide roller assembly	2
2	5096–413	Lens mounting assembly	1
3	5096–548	Retaining plate	1
4	224–303–205	Screw, NC-2, flt hd, st, blk ox., 2–56 x 5/16 in. lg	2
5	5096–539	Shoe, claw kickout	1
6	5077–66	Spring, claw kickout	1
7	5096–540	Film trap body	1
8	228–243–403	Screw, set, NC-2, bind. hd, blk ox., 4–40 x 3/16 in. lg	4
9	5096–547	Film guide pivot, Pt. 1, Pt. 2, Pt. 3, Pt. 4	4
10	224–116–408	Screw, NC-2, fil hd, st stl, pass., blk, 4–40 x 1 in. lg	4
11	5096–565	Film gate body	1
12	5096–566	Shoe, vacuum	1
13	5096–563	Gasket, vacuum gate	1
14	5096–564	Plate vacuum connection	1
15	224–303–205	Screw, NC-2, fl hd, st, blk ox., 2–56 x 5/16 in. lg	2
16	5107–10	Hose connector, vacuum connection	1
17	5120–217	Gasket, rubber	1
18	5120–197	Fiber plastubing	1
19	5107–15	Toggle post	1
20	238–2–12	Ring, Truarc (Waldes-Kohinoor)	1
21	5096–545	Pin, hinge	1
22	224–103–305	Screw, NC-2, fil hd, stl, blk ox., #3048, 5/16 in. lg	1
23	5107–23	Housing and sleeve assembly	1
24	5107–27	Screw, set	1
25	5077–65	Spring, toggle	1
26	5107–19	Toggle	1
27	5107–21	Toggle cup	1
28	234–043–21	Washer, plain, stl, hd, blk ox., #2, med	1
29	5107–26	Toggle stop knob	1

	Units Per Assembly
	2
	1
	1
in. lg	2
	1
	1
	1
3/16 in. lg	4
	4
x 1 in. lg	4
	1
	1
	1
	1
in. lg	2
	1
	1
	1
	1
	1
	1
16 in. lg	1
	1
	1
	1
	1
	1
	1
	1

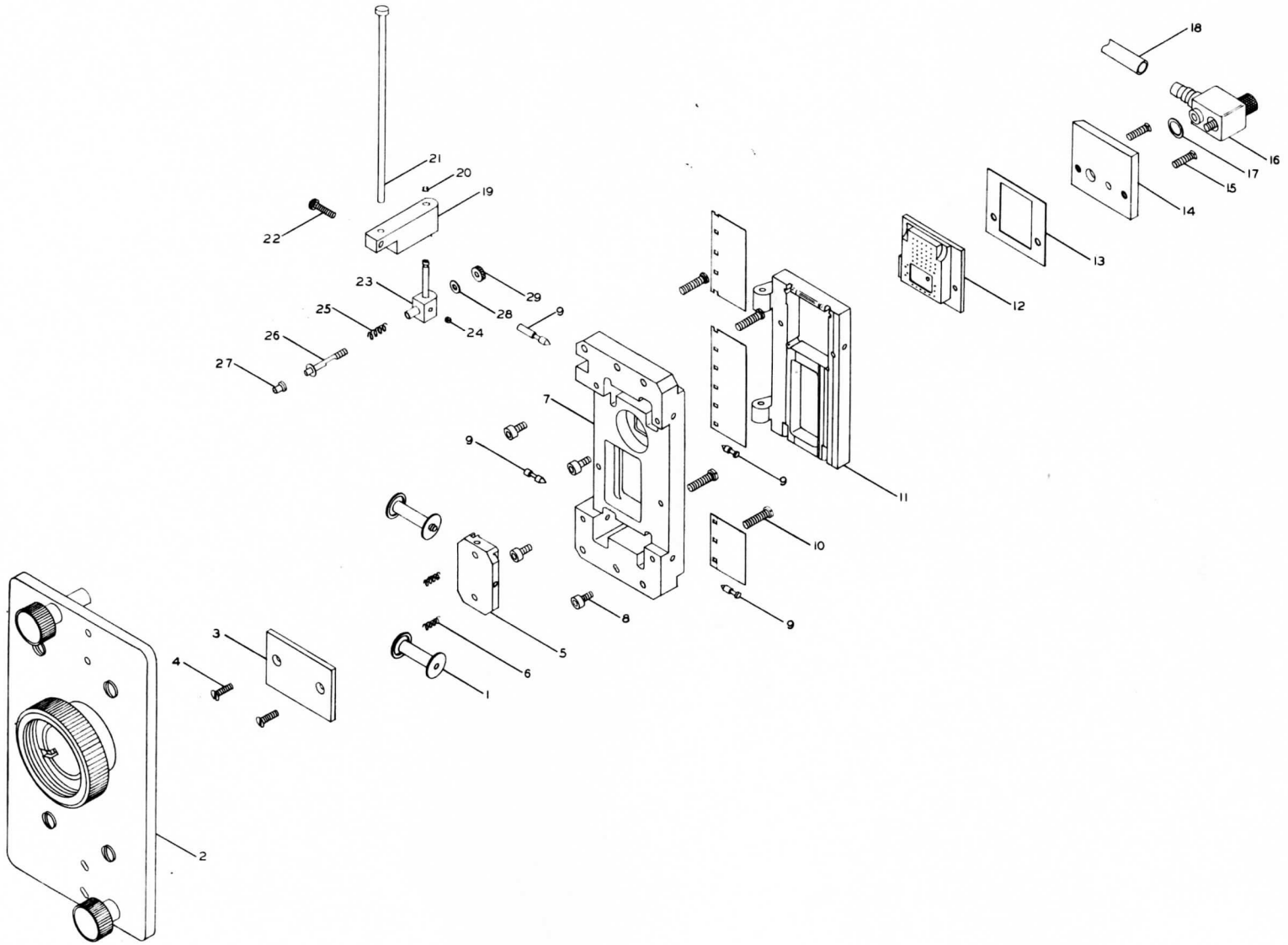


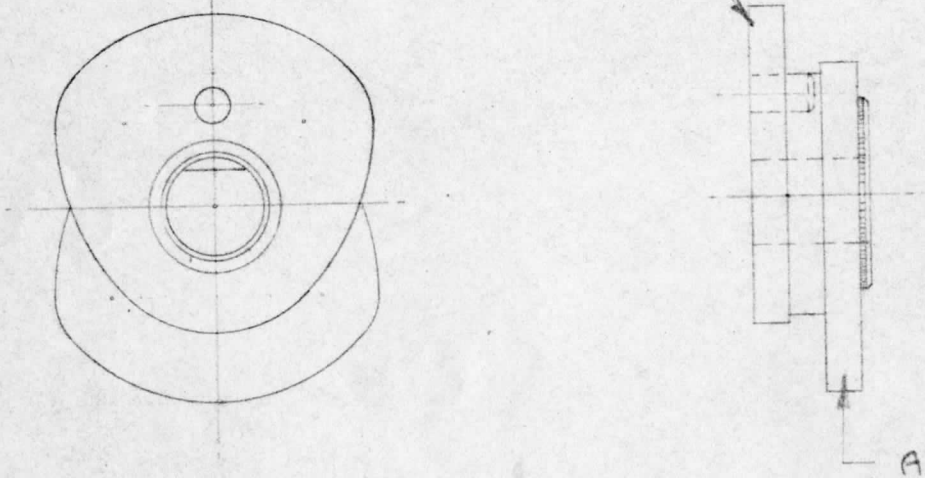
Figure 7-9. Gate Assembly, exploded view

A-5096-23

ISSUE 1 7-14-50

℄ OF PIN & COUNTERBALANCE

A-5096-22



AMPCO COUNTERBALANCE CAM #1304-A

5-5096-130
5-5096-30
NEXT ASS'Y

1
Q'TY

NOTE:
1) PRESS AMPCO COUNTERBALANCE CAM ON HUB IN ANGULAR RELATION SHOWN
2) THIS ASS'Y MUST BE DYNAMICALLY BALANCED

CAM & COUNTER-BALANCE ASS'Y

GENERAL PRECISION LABORATORY INCORPORATED
PLEASANTVILLE NEW YORK

UNLESS OTHERWISE SPECIFIED
REMOVE ALL BURRS BREAK SHARP CORNERS
TOLERANCE OF ALL FRACT. DIM. TO BE ± 1/64
TOLERANCE OF ALL DECIMAL DIM. TO BE ± .005
TOLERANCE OF ALL ANGULAR DIM. TO BE ± ½°

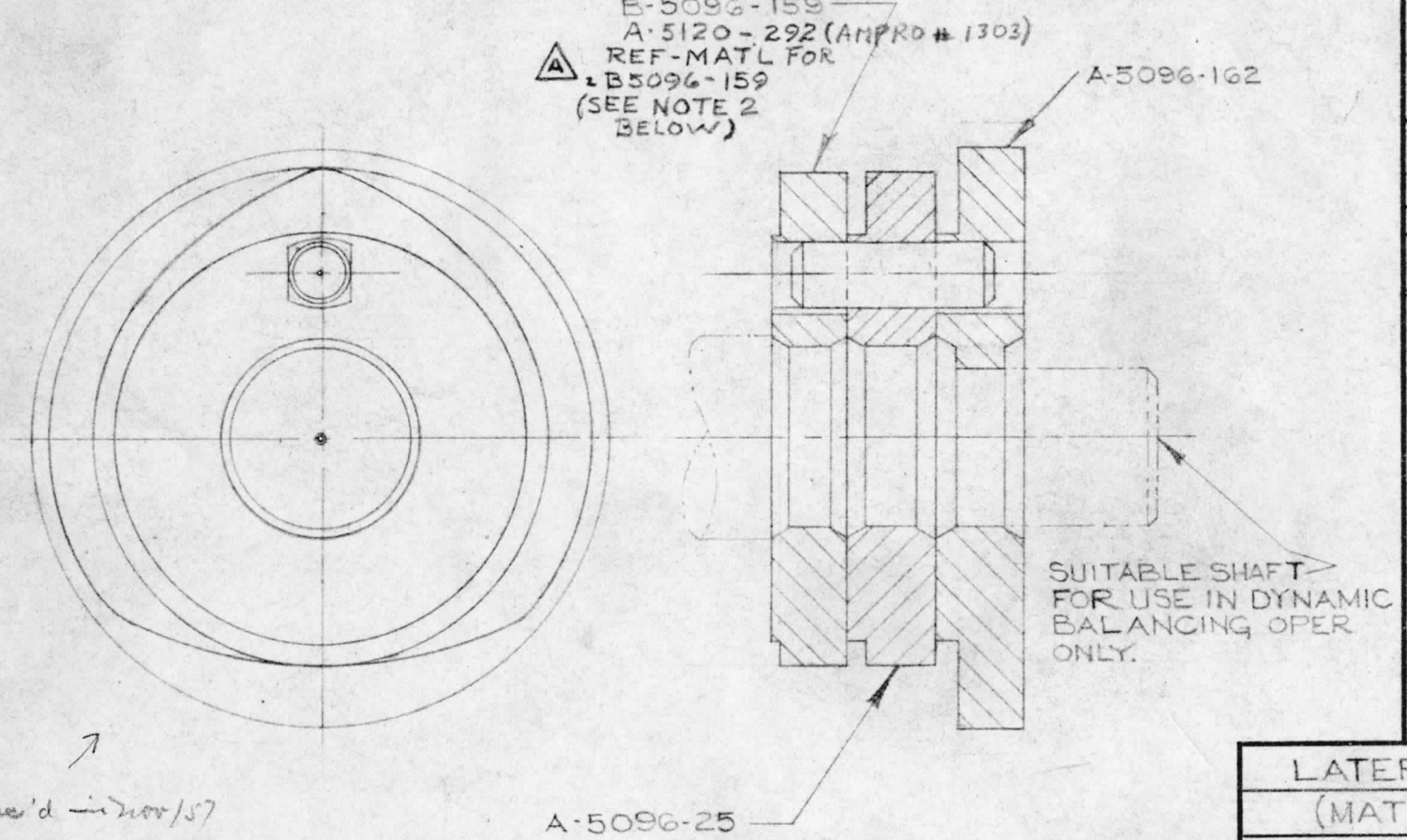
DR. JFM 6-23-50
CHK. RW 7/14/50
ENG.
APP'D.

SCALE 2-1
MAKE

A-5096-23

3- req'd in July.

A-5096-32



Rec'd in Nov/57

ISSUE 1 7-18-50

CHANGE PICTURE OF CAMS AND WASHER TO AGREE WITH DETAILS.

DR. FAS 10-25-50 CHK. RH

ENG. RD White

ISSUE 2 10-25-50

A = ADDED

DR. A Cheney	CHK. Howlett
ENG. R Miller	APP.
ISSUE 3	1-23-58

NEXT ASS'Y	Q'TY
55096-930	1
S-5096-30	1

LATERAL CAM ASSEMBLY
(MATCHED & BALANCED)

GENERAL PRECISION LABORATORY INCORPORATED
PLEASANTVILLE NEW YORK

UNLESS OTHERWISE SPECIFIED
REMOVE ALL BURRS BREAK SHARP CORNERS
TOLERANCE OF ALL FRACT. DIM. TO BE ± 1/64
TOLERANCE OF ALL DECIMAL DIM. TO BE ± .005
TOLERANCE OF ALL ANGULAR DIM. TO BE ± ½°

DR. RAF 7-18-50
CHK. RW 7/18/50
ENG. RD White
APP'D.

SCALE 4"=1"
MAKE

A-5096-32

NOTE:
1- CAMS TO BE ASSEMBLED IN MATCHED PAIRS - "CONSTANT DIA." DIM. TO BE .6804 ±.0001 MATCHED PAIR OF CAMS AND POSITIONING WASHER #A-5096-162 TO BE ASSEMBLED ON A SUITABLE SHAFT AND DYNAMICALLY BALANCED. REMOVE MATERIAL FROM POSITIONING WASHER FOR BALANCING.
WIRE CAMS AND BALANCED WASHER TOGETHER AND STOCK IN THIS CONDITION.

A 2- IF AMPRO 1303 IS USED IT MUST BE MADE TO THEIR SPEC. CHANGE "S" WHICH SPECIFIES THE CAM WITHOUT THE ADDITION OF TWO HOLES.