



MODEL 409 OSCILLOGRAPH
OPERATION INSTRUCTION
MANUAL

SN-650



ELECTRONICS & INSTRUMENTS, INC.

TULSA, OKLAHOMA

Warranty

The equipment described herein is guaranteed by Century Electronics & Instruments, Inc. for a period of one year after date of delivery, subject to the following condition: this warranty does not cover shipment which has been subjected to abuse or unusual service, nor does it cover equipment upon which unauthorized repairs or alterations have been attempted.

The Corporation guarantees to repair or replace any equipment covered by this warranty, found to be defective in materials or workmanship, provided said equipment is returned, prepaid, to the factory, or factory authorized service organization.

Time required for repairs and shipment will not be considered as part of the warranty period.

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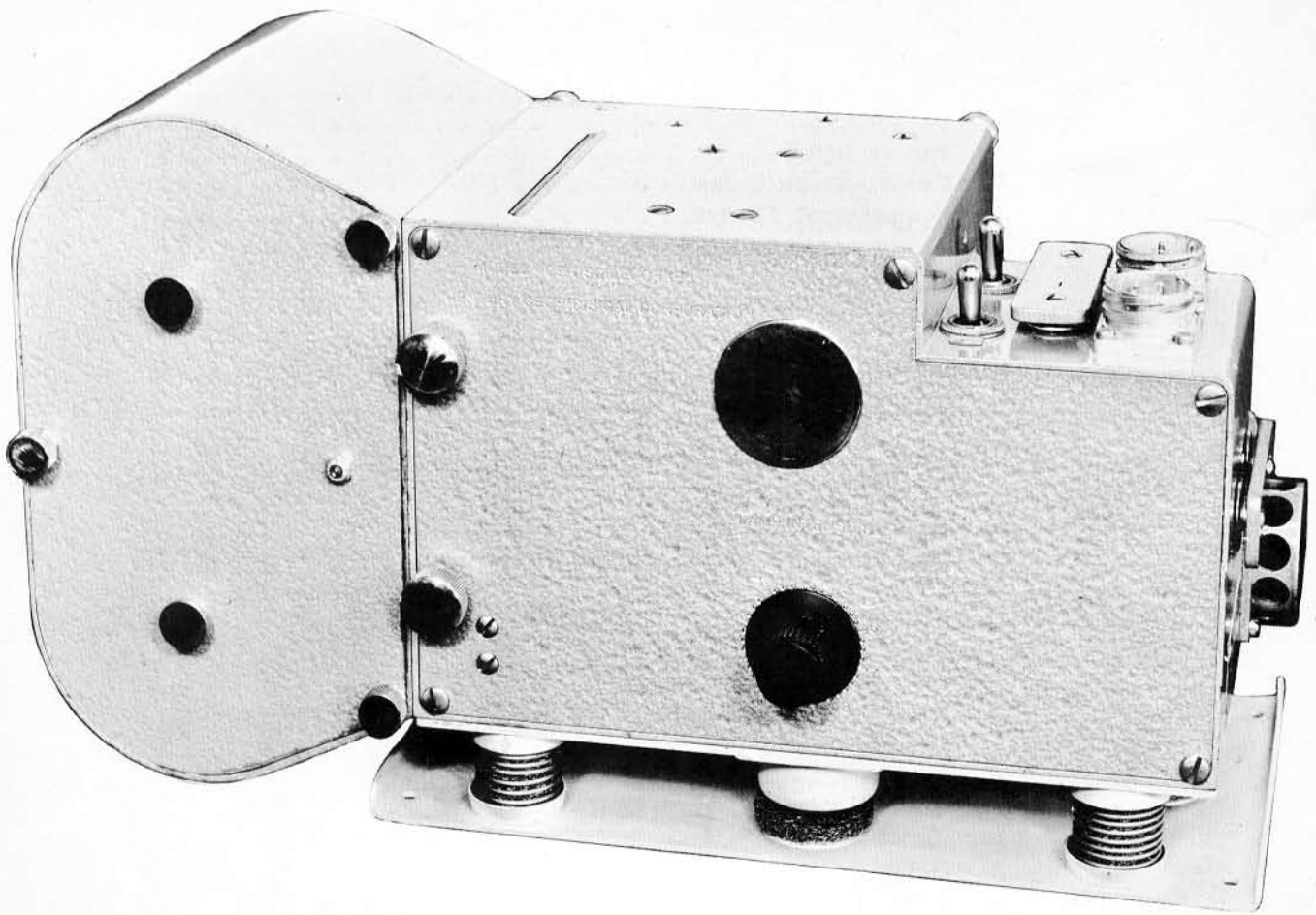


FIG. 1 MODEL 409 RECORDING OSCILLOGRAPH

MODEL 409 RECORDING OSCILLOGRAPHS

PART I - GENERAL DESCRIPTION

A. USE

The Century Model 409 Recording Oscillographs have been designed for use in applications such as guided-missile and fighter-aircraft where space and weight requirements must be kept at a minimum, but where, at the same time, the versatility of laboratory equipment must be incorporated. The units are extremely rugged and may be used under adverse conditions of shock and vibration as well as wide temperature extremes. Specifically, the oscillographs will operate during and after accelerations in excess of 20 G's, and over a temperature range of -40° F. to 120° F.

B. PHYSICAL CHARACTERISTICS

The Model 409 Recording Oscillographs have the following physical characteristics:

1. With 50-foot Magazine

Length	11-1/2 "
Height	5"
Width	5"
Weight	12 lbs. (including recording paper but exclusive of shockmount)

2. With 100-foot Magazine

Length	12"
Height	6-15/16"
Width	5"
Weight	13 lbs. (including recording paper but exclusive of shockmount)

3. External Finish - gray hammertone baked enamel

4. Internal Finish - optical black

5. Basic Construction of Oscillographs and Magazines - Cast aluminum alloy

C. POWER INPUT REQUIREMENT - 22/28 volts D.C. at 3 amps.

D. CONTROLS AND CONNECTORS

The Model 409 Oscillographs have the following operational controls and connectors:

1. Power switch
2. Recording lamp viewing switch
3. Paper traverse speed control
4. Recording lamp intensity control
5. Timer frequency selector switch
6. Power input connector - Cannon WK-M2-32S
7. Remote control connector - Cannon WK-4-32S
8. Galvanometer input connectors - Cannon GK-12-32S

E. OPERATIONAL FEATURES

1. Magazines

a. Capacity

- (1) Assemblies 409D6 and 409D11 - 50 feet
- (2) Assemblies 409D9, 409D12, and 409D280 - 100 feet

b. Paper traverse speed range

- (1) Assemblies 409D9 and 409D11 - 1/2 to 6 inches per second when used with Model 409X Oscillograph (Assembly 409E4) - 2 to 12 inches per minute when used with Model 409B Oscillograph (Assembly 409E17)
- (2) Assemblies 409D6 and 409D12 - 2 to 24 inches per second when used with Model 409X Oscillograph (Assembly 409E4)
- (3) Assembly 409D280 - 3/4 to 4 1/2 inches per minute when used with Model 409C Oscillograph (Assembly 409E19)

2. Number of recording channels - 12 plus 2 timing traces

3. Internal timing unit - three or four frequencies of timing are available from the self-contained electronic timer, depending upon oscillograph model:

Model 409X - 100, 10, 1 c.p.s.
Model 409B & C - 10, 1, 0.1 c.p.s.

The timing impulses are recorded on the two outside galvanometer traces. The frequency of the timing impulses is selected by a four-position rotary switch accessible through an opening in the side of each oscillograph.

4. Trace Identification - individual galvanometer traces are identified by periodic and sequential interruption of every trace. The rate of interruption is directly proportional to the rate of paper traverse so that interruption occurs over the same length of record regardless of the rate of traverse, for a given magazine.

5. Remote Control - the oscillographs may be operated from a remote position using a two wire cable terminated in a Cannon connector. Hence, in a given situation, the units need not be accessible during recording.

F. COMPONENTS AND ACCESSORIES

1. Model 409X Oscillograph

The Model 409X Oscillograph (Assembly No. 409E4) consists of a basic oscillograph assembly for recording media transport rates of 1/2 to 24 inches per second when used with appropriate magazine assemblies as shown in paragraph 4, below.

2. Model 409B Oscillograph

The Model 409B Oscillograph (Assembly No. 409E17) consists of a basic oscillograph assembly for recording media transport rates of 2 to 12 inches per minute when used with appropriate magazine assemblies as shown in paragraph 4, below.

3. Model 409C Oscillograph

The Model 409C Oscillograph (Assembly No. 409E19) consists of a basic oscillograph assembly for recording media transport rates of 3/4 to 4 1/2 inches per minute when used with the appropriate magazine assembly as shown in paragraph 4, following.

4. Recording Magazines

The following recording magazines are available for use with the Model 409 oscillographs:

<u>Ass'y No.</u>	<u>Capacity</u>	<u>Speed Range</u>	<u>Used With</u>
409D6	50 feet	2-24"/sec.	409E4
409D9	100 feet	1/2-6"/sec.	409E4
		2-12"/min.	409E17
409D11	50 feet	1/2-6"/sec.	409E4
		2-12"/min.	409E17
409D12	100 feet	2-24"/sec.	409E4
409D280	100 feet	3/4-4 1/2"/min.	409E19

5. Shockmount Base

The shockmount base (Assembly No. 409A282) is optional for oscillograph assemblies with 50 feet capacity magazines. It is necessary for oscillograph assemblies with 100 feet capacity magazines.

6. Spare Parts and Operating Accessories Kit

A spare parts kit (Assembly No. 409A190) is furnished with each basic oscillograph assembly. This kit contains all necessary operating cables, adjusting tools, spare belts and lamps, and a spot adjusting screen.

7. Model 210 Galvanometers

Two galvanometers are required for timing purposes in the Model 409 oscillographs. These may be Assembly No. 210C50-2 or 210C56-2. The remaining twelve of the galvanometer elements may be any of the following:

<u>Ass'y No.</u>	<u>Nat. Freq.</u>	<u>Coil Res.</u>	<u>D. C. Sensitivity at 6.5"</u>		<u>Resistance Req. for 64% Damp.</u>
			<u>IN/MA (Damped)</u>	<u>MA/IN</u>	
210C50-2	100 cps	60 ohms	23.5	.0426	120 ohms
210C56-2	100 cps	60 ohms	39.0	.0256	350 ohms
210C51-2	200 cps	60 ohms	5.73	.175	120 ohms
210C52-2	500 cps	60 ohms	.45	2.22	27 ohms
210C53-2	850 cps	40 ohms	.168	5.95	Fluid
210C54-2	2000 cps	40 ohms	.0294	34.0	Fluid
210C55-2	3300 cps	40 ohms	.0117	85.5	Fluid

PART II OPERATING INSTRUCTIONS

A. INSTALLATION AND INSPECTION

All components of Model 409 Recording Oscillographs have been inspected before shipment. The equipment should be checked, however, for damage during transit. The packing list should be compared with the equipment received to ascertain that components have not been lost enroute.

To install the oscillograph, it is necessary only to connect the external cabling and to load the magazine. The cabling is terminated in polarized Cannon connectors so that there is no possibility of cross-connection. The polarity of the power cable is clearly marked and must be followed to prevent damage to the unit. The galvanometer connections are made through two 12-pin Cannon connectors and are wired as shown in Figure 7. The remote control cable is terminated in a 4-pin Cannon connector.

The galvanometers are installed in the unit when shipped and are ready to be used. Occasionally, during transit, the galvanometer traces are jarred out of position, making it necessary to readjust them. Adjustment and replacement of galvanometers are covered in Part III, Section C, below.

B. OPERATION

1. Loading of Magazines

- a. Loading and unloading of the magazine should be conducted in a photographic dark-room under light conditions appropriate to the type of recording paper being used.

To load the magazine, proceed as follows:

- (1) Remove the magazine assembly from the oscillograph body by backing out the two 1/4 inch knurled screws located along the left edge of the front panel, about 1/4 inch, and pulling the magazine away from the oscillograph body.
- (2) In the darkroom, remove the three knurled-head bolts from the magazine cover and disengage the cover. The supply and takeup spools will lift out of the magazine with the cover. These may be disengaged from the cover by pulling the spool directly away from the cover.

- (3) Place a full roll of 3-5/8 inch wide recording paper (such as Eastman #809, Spec. #1, Linagraph Paper) on one of the spools such that the paper unwinds with a clockwise rotation of the spool, as viewed from the flange end. Occasionally, there will be found as much as 10 or 15 feet of extra paper on a fresh roll of paper. On these occasions it will be noted that the roll will not freely enter the magazine, whereupon it will be necessary to remove and discard the excess paper.

- (4) Unwind several inches of paper and tear the free end in a V-shape as shown in Figure 2.

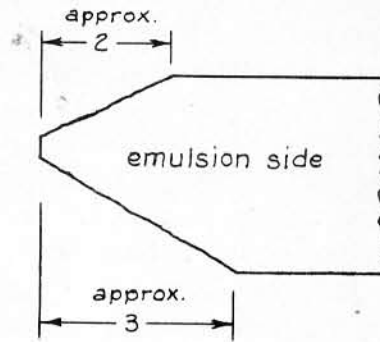
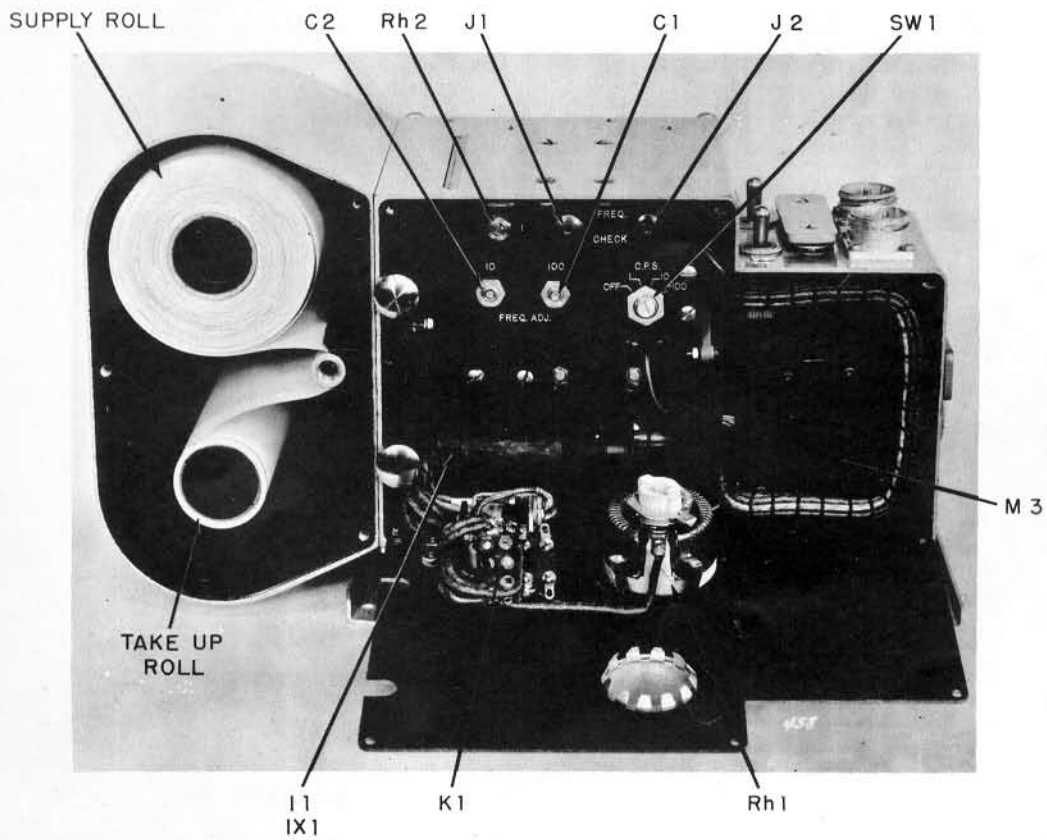
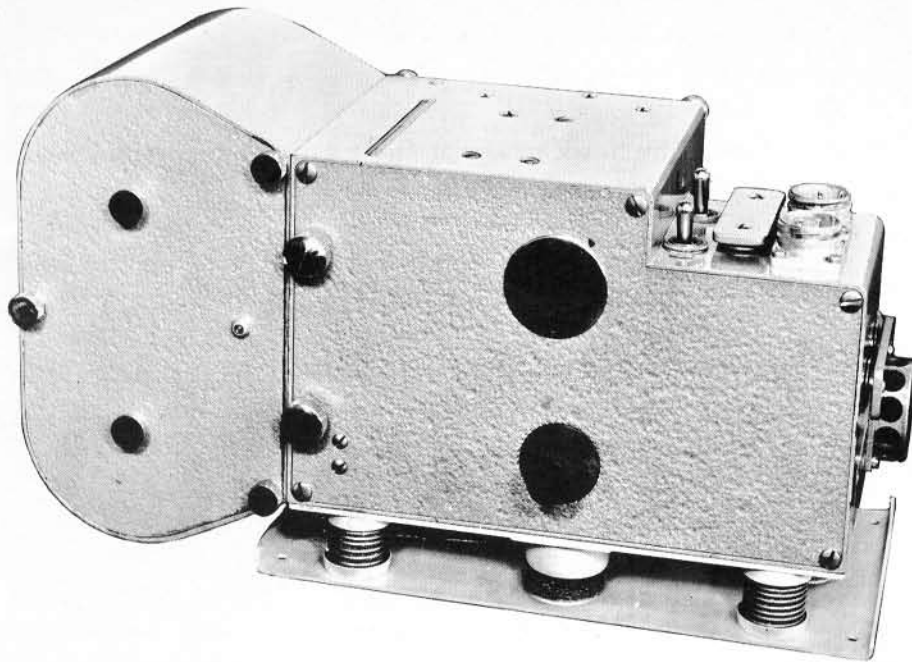


Fig. 2 - Correctly torn leader

- (5) Place the point of the "V" in the slot of the take-up or lower spool and rotate this spool in a clockwise direction (as viewed from the flanged end) sufficiently to insure that the paper will not slip off the takeup spool.
- (6) Lower both spools, flanges downward, into the magazine with the recording paper being guided between the exposure slot and the rubber drive roller, until the spools rest upon their stops. The takeup spool should be rotated until the drive spindle tangs engage the spool slots. During the process of lowering the paper into the magazine, it may be found that rotating the jaw-clutch back and forth about a half-revolution will allow the paper to be inserted around the drive roller more easily. The inserted paper should follow the path shown in Figure 3.
- (7) Replace cover and re-assemble magazine to oscillograph.
- (8) To observe, at any time, the amount of unexposed paper remaining, rotate the knurled knob, located in the upper left-hand corner of the rear of the magazine, as far as possible; a wire pointer will appear in the window (to the right of the knob) indicating the amount of paper on the supply roll.



2. Recording

To record, after installing the oscillograph, proceed as follows:

- a. Remove the back plate of the camera by withdrawing the six knurled head screws.
- b. Adjust the paper traverse speed by turning the knurled knob located on the speed changer. CAUTION: THE OSCILLOGRAPH MUST BE RUNNING (WITHOUT MAGAZINE, IF DESIRED) WHILE SPEED CHANGER IS ADJUSTED. The settings for various paper speeds are given in Table I. Do not attempt to attain a higher paper traverse speed than those given in the table. The motor sheave which is to be used for the particular magazine being used is also given in the table. To change sheaves, it is necessary to loosen the set screw holding the sheave, remove the sheave and reverse it on the shaft taking care that the belt runs in a vertical plane. After adjusting the paper traverse speed, replace the back cover plate. Note that O-Ring AN6230-1 (the small diameter ring) is used with the small sheave. Conversely, O-Ring AN6230-2 is used with the large sheave.
- c. Adjust the lamp intensity setting to the value shown in Table I. Note that lamp intensity settings are given for two values of input voltage.

TABLE I - PAPER TRAVERSE SPEED SETTINGS (MODEL 409X)
(for Eastman #809 Recording Paper)

<u>Magazine</u>	<u>Sheave</u>	<u>Paper Traverse Speed (in/sec.)</u>	<u>Metron Setting</u>	<u>Lamp Inten. Setting 24 V.</u>	<u>28 V.</u>
409D9					
409D11	Small	1/2	6-1	1.0	-
409D9					
409D11	Small	3/4	4-1	1.6	0
409D9					
409D11	Small	1	3-1	2.0	.5
409D9					
409D11	Small	1-1/2	2-1	2.6	1.25
409D9					
409D11	Small	3	1-1	3.75	2.5
409D9					
409D11	Small	6	1-2	4.8	3.6

TABLE I (Continued)

<u>Magazine</u>	<u>Sheave</u>	<u>Paper Traverse Speed (in/sec.)</u>	<u>Metron Setting</u>	<u>Lamp Inten. 24 V.</u>	<u>Setting 28 V.</u>
409D6					
409D12	Large	2	6-1	3.	1.75
409D6					
409D12	Large	3	4-1	3.75	2.5
409D6					
409D12	Large	4	3-1	4.2	3.0
409D6					
409D12	Large	6	2-1	4.85	3.6
409D6					
409D12	Large	12	1-1	6	4.8
409D6					
409D12	Large	24	1-2	7.1	5.9

- d. If timing pulses are desired, set the four-position rotary Switch (Sw1) - accessible through the round hole cover on the front of the oscillograph - to the frequency desired. The oscillator drives galvanometers #1 and #14 thus placing timing pulses on the edges of the record. The galvanometers are driven 180° out of phase to facilitate drawing of timing lines across the record. The OFF position of Switch (Sw1) removes the timing pulses though the oscillator supply voltages remain on.
- e. To make a recording, place switch (Sw3) in the ON Position. Depressing the remote control button starts the paper drive and illuminates the recording lamp to the preset intensity; release of the button reverses the process.
- f. Galvanometer traces may be viewed during recording by looking directly down upon the lucite viewing-screen located on top of the oscillograph. To observe the traces while not recording, hold the spring-loaded toggle switch (Sw2) located adjacent to the power socket (P1) ON. This switch energizes the recording lamp without energizing the paper drive.

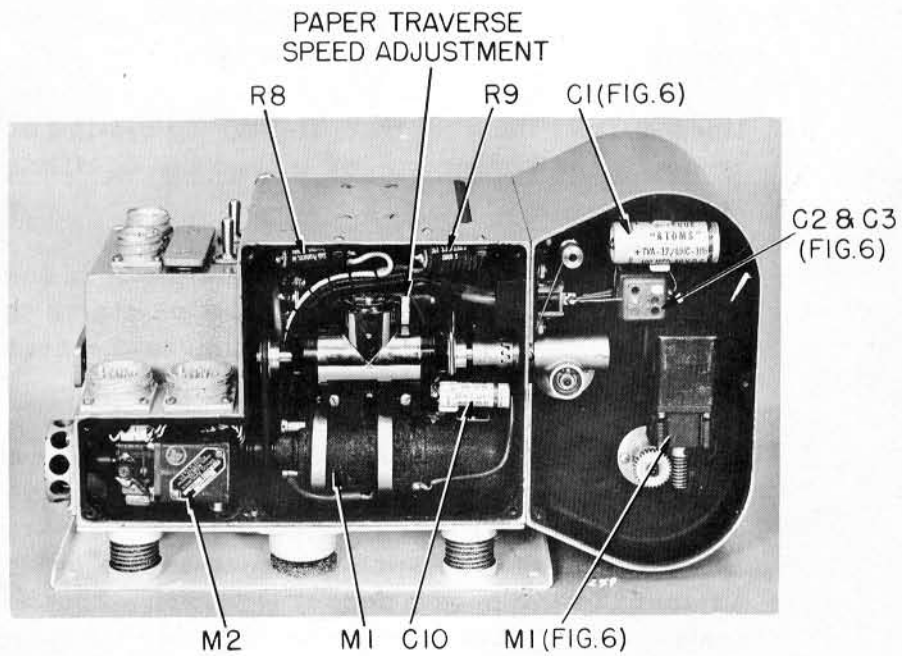
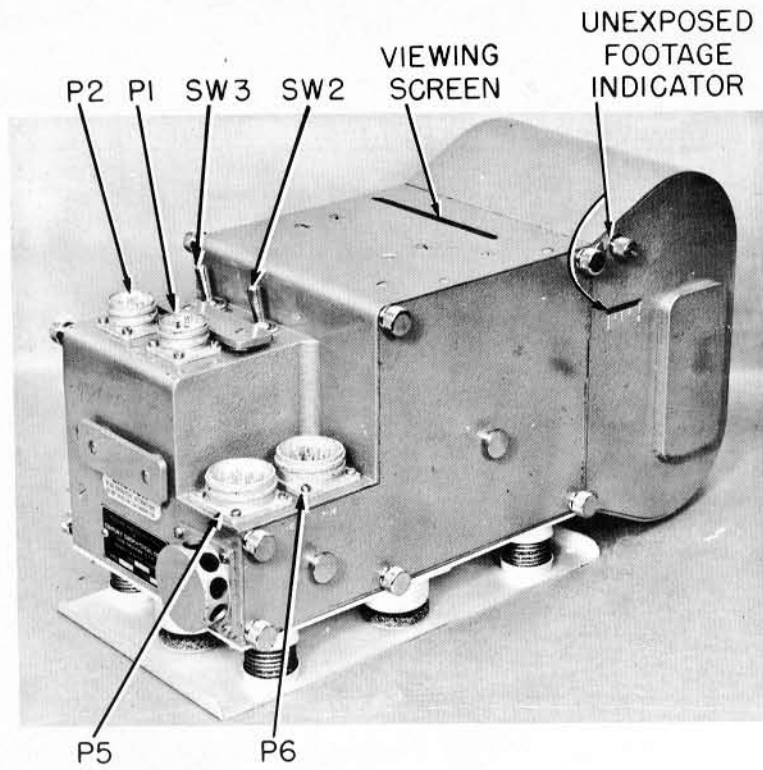


FIG. 4 REAR VIEWS

PART III

MECHANICS AND OPTICS OF OSCILLOGRAPH

A. BASIC OSCILLOGRAPH

1. Paper Drive System

The paper drive in the Model 409 oscillographs is accomplished by the action of a friction roller, in the magazine, running against the paper. As the roller turns, the paper is drawn from the upper, or supply, roll past the exposure slot, and re-reeled on the lower, or takeup, roll. The takeup roll is driven by a small motor located in the magazine (in low range magazines, the takeup spindle is belt driven from the friction roller). This takeup motor does not contribute to the progression of the paper, but simply assures that the paper is taken up evenly and smoothly on the lower roll.

The friction roller, which is the sole determinant of the rate of paper progression, is driven by motor (M1) through a system of belt drive, variable transmission and worm gear. The worm gear assembly is connected to the output of the variable transmission by a jaw clutch which is automatically engaged when the magazine is attached to the oscillograph. The variation in the rate of paper progression is accomplished by means of a Metron 3A-S variable transmission.

2. Trace Identification

Trace identification is accomplished by momentarily interrupting the light path of each galvanometer trace in sequence. Since the sequence of interruption is independent of position of the trace on the recording paper, it is always possible to determine which galvanometer is responsible for a particular trace. This feature is of particular value where the traces become "tangled" on the record. Interruption of the traces is caused by momentarily intercepting, mechanically, the light beam directed to each galvanometer mirror. The rate of interruption varies with paper speed such that, regardless of paper speed, a trace is interrupted the same number of times in a given length of record.

3. Optical System

The optical system of the Model 409 oscillographs is shown in Figure 5. It can be seen that the light beam is collimated twice: the galvanometer mirrors, being curved about a vertical axis, collimate or bunch the light rays horizontally while the collimator lens, with a horizontal axis of curvature, collimates the light vertically. The result is a very small spot of light from each galvanometer falling on the recording paper.

a. Focusing of the optical system is done at the factory and will not ordinarily require adjustment. The occasion will arise, however, for re-focusing the lamp assembly when the recording lamp is replaced. This is accomplished as follows:

- (1) With the lamp assembly removed from the oscillograph, remove the lamp socket from the assembly and replace the recording lamp, taking care that, when the socket and lamp are replaced in the housing, the lamp filament is nominally vertical, i. e., parallel to the mounting flange of the assembly. Replace the assembly in the oscillograph without the barrel.
- (2) Place a piece of white paper just in front of the collimator lens and observe the light slits falling on this surface. While observing the slits rotate only the lamp socket slightly until the slits appear as distinct and narrow as possible.
- (3) Insert the barrel into the lamp assembly and rotate and translate it until the light emanating from the aperture just covers the lower mirror.
- (4) While observing the light beam at the galvanometer note whether the beam is symmetrically located, horizontally, with respect to the galvanometer array. If not, adjust the two screws which hold the lamp assembly to the oscillograph until the beam covers all traces equally well.

- b. The alignment of the mirrors is not critical if the light from the recording lamp falls on the galvanometer mirrors.

4. Trace Viewing

Trace viewing is accomplished by the interception of a portion of the light reflected from the galvanometers by a lucite plate located at right angles to the light path. This is shown in Figure 5.

B. GALVANOMETERS AND MAGNETIC ASSEMBLIES

The model 409 oscillographs use Model 210 galvanometers mounted in a Model 109 magnetic assembly. These are described in Century Electronics and Instruments Bulletin CGC-301. The characteristics of the particular galvanometer installed in the oscillograph accompanying this manual will be found at the end of Part 1.

The galvanometer channels are numbered as shown in Figure 5. The individual elements are accessible through openings in the top and right-hand end of the case which are covered by "snap-button" covers. Elements may be installed, removed and adjusted through these openings. Each element is secured by a set screw accessible through the opening in the right-hand end of the case.

To install, adjust, or remove a galvanometer, loosen the appropriate set screw about four full turns. Never attempt to adjust or remove an element without loosening the set screw. **UNDER NO CIRCUMSTANCES SHOULD THE SET SCREW BE TIGHTENED UNLESS A GALVANOMETER IS IN PLACE.**

To align the galvanometer element, proceed as follows:

1. Remove the magazine and place spot-adjustment screen, furnished with the oscillograph, in the opening in the left-hand end of the oscillograph body. This permits observation of the galvanometer traces as they appear at the recorded position.
2. Insert galvanometer, as far as it will go, into the appropriate position in the magnetic assembly; insert the galvanometer adjusting wrench into the element cap to serve as an adjusting handle.
3. Illuminate the recording lamp by holding toggle switch (Sw2) ON.

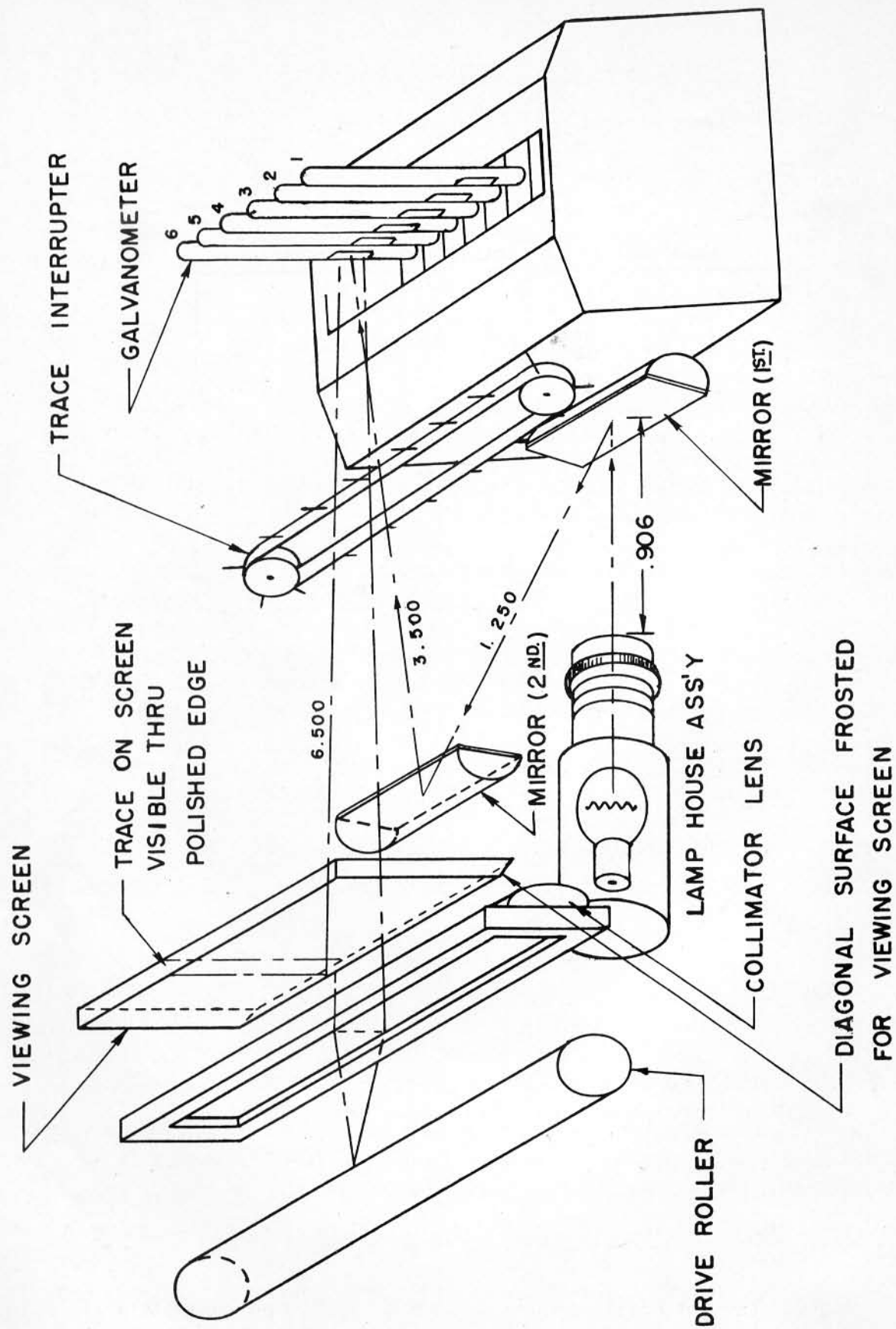
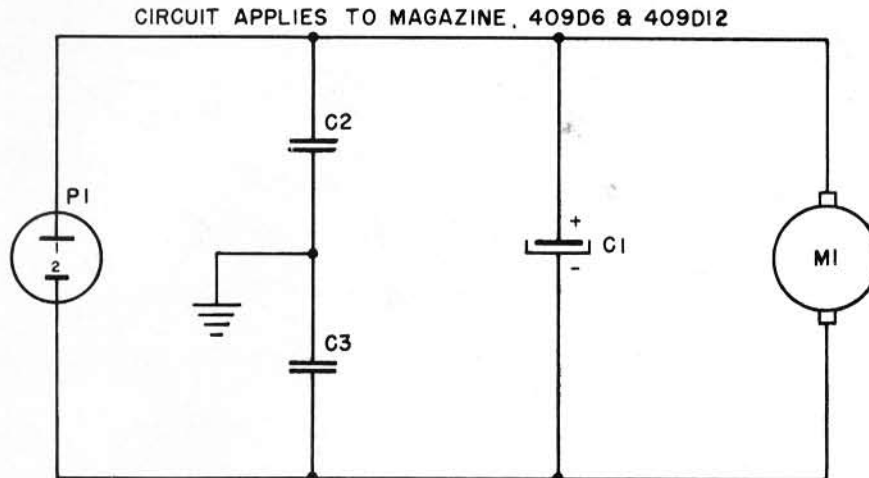


FIG. 5 OPTICAL SYSTEM

CIRCUIT DIAGRAM - MAGAZINE

409X OSCILLOGRAPH

FIG. 6



ITEM NO.	COMPONENT DESCRIPTION 409 MAGAZINE
C1	CONDENSER 100 Mfd. 50V. SPRAGUE TVA 1310
C2	" .005 Mfd. AEROVOX #1467
C3	" " " " "
M1	MOTOR-TAKEUP (CENTURY 409A81)
P1	CONNECTOR JONES P 302AB

4. Turn the galvanometers until the light from the recording lamp strikes the mirror. While observing the spot adjusting screen, turn the galvanometer until its spot is located in the desired position on the screen. It may be found necessary to "rock" the galvanometer back and forth as well as to rotate it until the spot falls on the screen.

5. Observe the lower edge of the trace viewing screen after removing the front cover; it should extend at least 1/16" into the light beam from the galvanometer. If not, rock the galvanometer back slightly until this condition exists.

6. Tighten the set screw securely; then back out approximately 1/2 turn. This will permit final, horizontal adjustment of the element without disturbing its vertical adjustment. When the galvanometer has been finally positioned, re-tighten the set screw and remove the Allen wrench from the galvanometer cap.

GALVANOMETER COLOR CODE

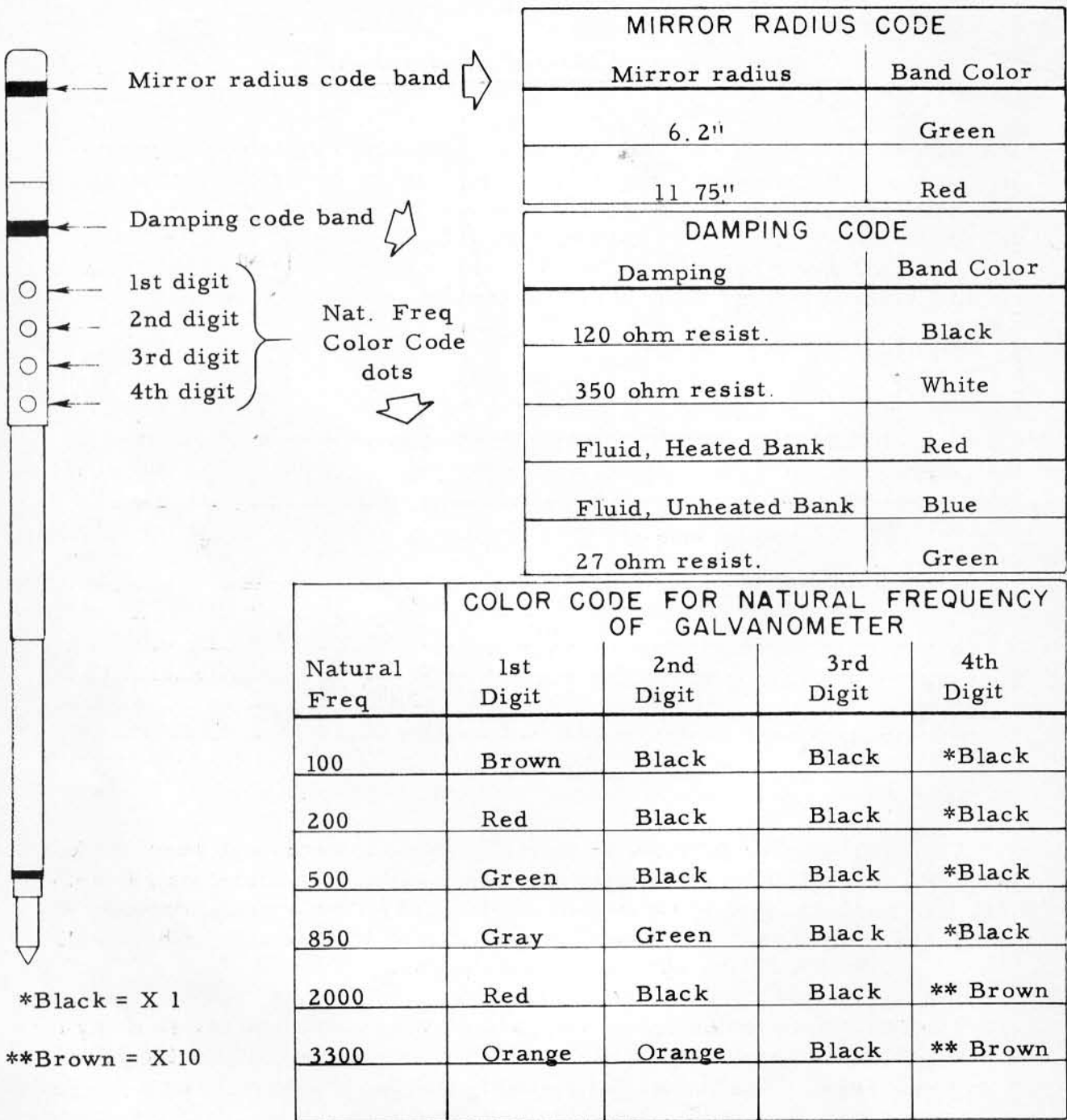


FIG. 7

PART IV

ELECTRICAL CIRCUIT OF MODEL 409X OSCILLOGRAPH (Refer to Figure 7)

A. PAPER DRIVE AND LAMP CIRCUITS

The paper drive motor (M1) is energized, and recording lamp(I1) is raised to a pre-set brilliance through Relay (K1), which in turn is energized by closing the remote control circuit. In the case of magazines 409D6 and 409D12 (2-24 inches/second paper speed), the takeup motor is also energized through Relay (K1). Switch (Sw2) is provided so that the recording lamp may be energized without operating the paper drive.

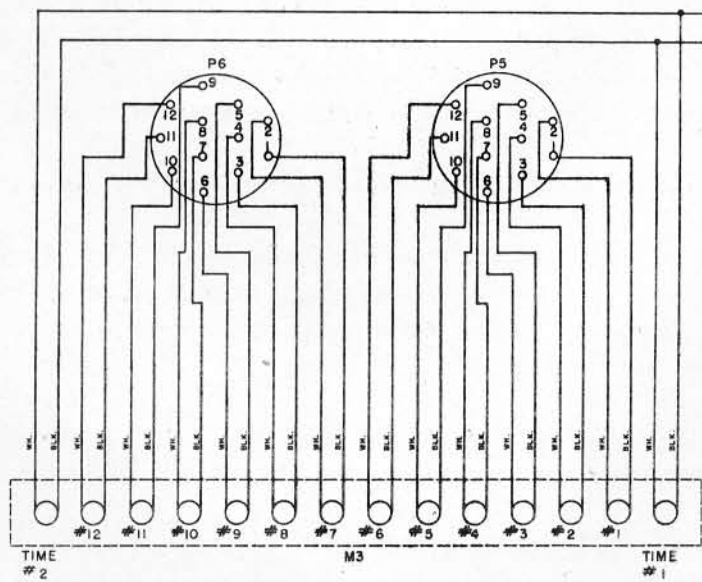
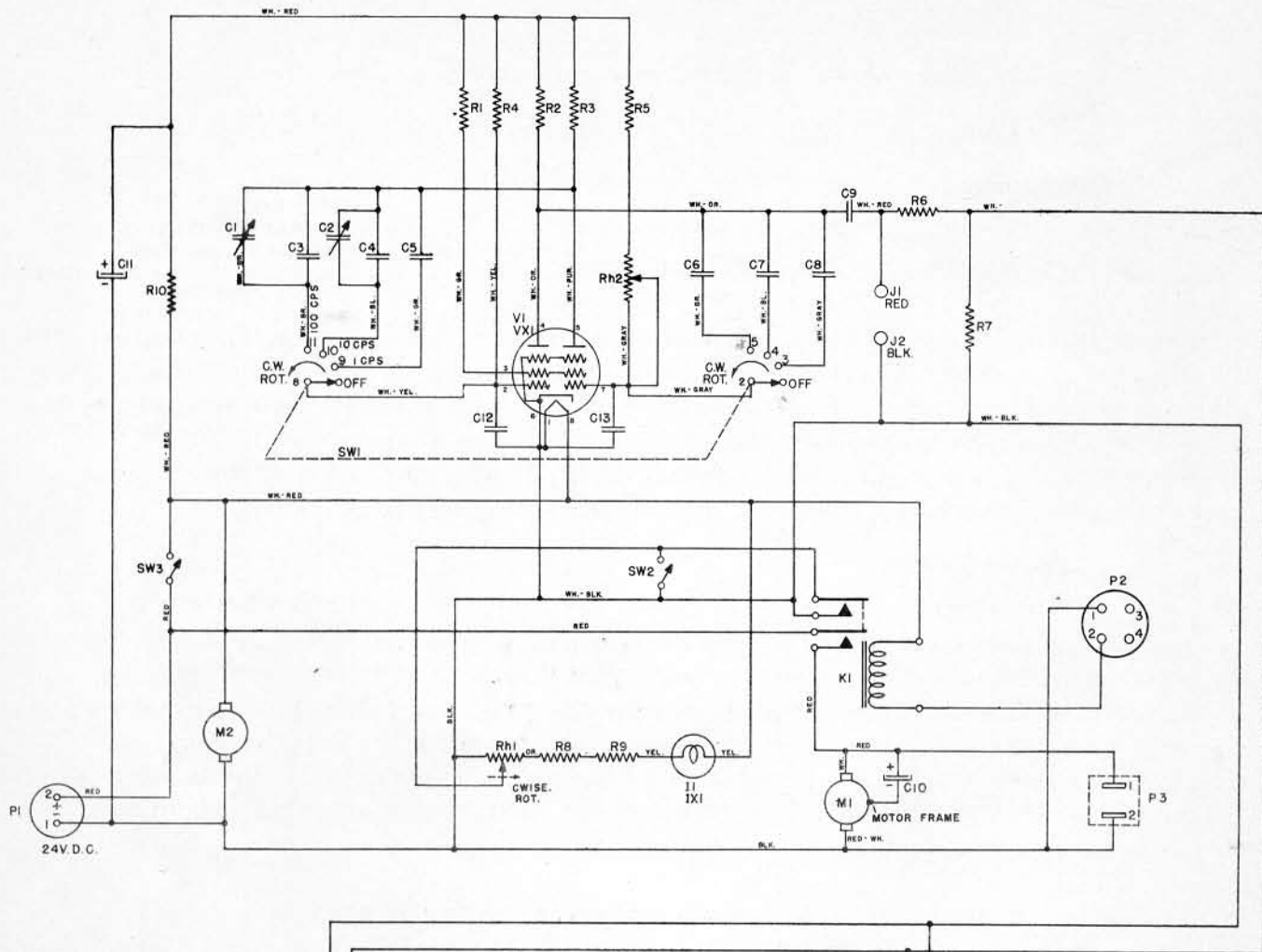
B. TIMING CIRCUIT

The timing unit consists of a type 28D7 vacuum tube operating as a precision oscillator. The output frequency of the oscillator is determined by the setting of switch (Sw1) which selects the proper condenser combination for a given frequency. Small changes in the frequencies may be made by adjusting rheostat (Rh2), condenser (C2), and condenser (C1); these vary the 1 cps, 10 cps, and 100 cps frequencies, respectively. The adjustment procedure is outlined below.

The output of the oscillator is a square wave, differentiated by condenser (C9) and resistor (R7), fed to galvanometers #1 and #14, and appears as a pip on these traces. Resistor (R7) also serves as the damping resistor for these galvanometers. Resistor (R6) limits the amplitude of the traces.

To make slight adjustments in the output frequencies, proceed as follows:

1. Connect the vertical plates of an oscilloscope to the pin jacks on the panel of the oscillator, connect a frequency standard to the horizontal plates of the oscilloscope. (Use an oscilloscope with a vertical-input impedance of at least 1 megohm.)
2. Connect the oscillograph to a stable source of 25 volts d.c., turn switch (Sw3) ON and allow the unit to warm up at least fifteen minutes.
3. Set the frequency selector switch (Sw1) to 1 cps (Refer to Figure 3). Adjust rheostat (Rh2), until the Lissajous pattern on the oscilloscope ceases to rotate.
4. Set switch (Sw1) to 10 cps and adjust condenser (C2), marked "10 cps", until the oscilloscope pattern indicates that the output frequency is exactly 10 cps.
5. Repeat step 4 for 100 cps, adjusting condenser (C1).



CIRCUIT DIAGRAM
MODEL 409X OSCILLOGRAPH

FIG. 8

COMPONENTS DESCRIPTION MODEL 409X OSCILLOGRAPH

ITEM No.	NAME	DESCRIPTION	MFG'R
C1	CONDENSER	TRIMMER	ARCO #306
C2	"	"	" #315
C3	"	.00056 Mfd. + 2%	PROKAR 75P-56153
C4	"	.0068 " " 5%	SPRAGUE 65P-68252
C5	"	.10 " " 10%	150 V GUDEMAN #1826 or EQUIV.
C6	"	.001 " " 1%	PROKAR 75P-10293
C7	"	.01 " " 1%	PROKAR 65P-10352
C8	"	.10 " " 10%	150 V GUDEMAN #1826 OR EQUIV.
C9	"	.01 " " 1%	PROKAR 65P-10352
C10	"	25 "	25 V SPRAGUE #TVA-1205
C11	"	25 "	25 V SPRAGUE #TVA-1205
C12	"	.0005 "	AEROVOX #1468
C13	"	.0005 "	AEROVOX #1468
I1	LAMP-RECORDING		G. E. #1613
IX1	SOCKET-LAMP		CENTURY #409A75
J1	JACK-INSULATED	PHONE TIP RED	H. H. SMITH #202
J2	" "	" " BLACK	H. H. Smith #202
K1	RELAY	24 V	POTTER & BRUMFIELD #KR11D
M1	MOTOR-DRIVE		CENTURY #409A72
M2	" FAN		" #409A207
M3	MAGNETIC ASSEMBLY		" #109C100-1
P1	CONNECTOR		CANNON #WK-M2-32S
P2	"		" #WK-4-32S
P3	"		JONES S-302 CCT
P5	"		CANNON # GK-12-32S
P6	"		" # GK-12-32S
R1	RESISTOR	43K ohm 1/2 WATT	I. R. C. OR A. B. 5%
R2	"	20 K ohm 1/4 WATT	ELECTRA # DC 1/4 2%
R3	"	20 K " 1/4 WATT	" # DC 1/4 2%
R4	"	10 meg. 1, "	" #DC-1 2%
R5	"	8.2 " 1 "	" #DC-1 2%
R6	"	.75 " 1/4 "	" #DC 1/4 2%
R7	"	100 ohm 1/2 "	I. R. C. OR A. B. 5%
R8	"	7.5 " 25 "	DALE # RH-25 1%
R9	"	5.0 " 25 "	DALE # RH-25 1%
R10	"	240 " 1/2 "	I. R. C. OR A. B. 5%
Rh1	RHEOSTAT-MODIFIED		CENTURY #409A139
Rh2	"	2 Meg.	CLAROSTAT 48-9-2 meg.
SW1	SWITCH		GRIGSBY ALLISON #5455-4 MLW-1
Sw2	"	S. P. S. T. MOMENTARY	BIRNBACH #6241 OR EQUIV.
SW3	"	S. P. S. T.	I. C. A. #1296 OR EQUIV.
V1	TUBE	28D7W	
X1	SOCKET LOCTAL		AMPHENOL #88-8X

PART V
MODEL 409B OSCILLOGRAPH

A. DRIVE SYSTEM

The drive system of the Model 409B Oscillograph has been modified to provide a recording speed range of 2 to 12 inches per minute when used with appropriate recording magazines.

B. OPTICAL SYSTEM

An aperture has been provided on the recording collimator lens to prevent the ambient light level in the oscillograph body from fogging the recording media.

C. TIMING SYSTEM

The timing system has been modified to provide 0.1 cps timing in the 100 cps position (Refer to Figure 8). Other timing frequencies are as engraved on the timer panel.

D. SPEED AND LAMP SETTINGS

The following table provides Metron and Lamp Intensity settings:

TABLE II - PAPER TRAVERSE SPEED SETTINGS (MODEL 409B)
(for Eastman #809 Recording Paper)

<u>Paper Traverse Speed (in/min)</u>	<u>Metron Setting</u>	<u>Lamp Intensity Setting</u>	
		<u>24 V</u>	<u>28 V</u>
2	6:1	3.0	0.0
3	4:1	3.6	1.1
4	3:1	3.9	1.5
6	2:1	4.4	2.0
8	1.5 :1	4.7	2.9
12	1:1	5.5	3.5

E. OTHER FEATURES

All other features of the Model 409B oscillograph are identical with those of the standard Model 409X oscillograph.

PART VI
MODEL 409C OSCILLOGRAPH

A. DRIVE SYSTEM

The drive system of the Model 409C Oscillograph has been modified to provide a recording speed range of 3/4 to 4 1/2 inches per minute when used with the appropriate recording magazine.

B. OPTICAL SYSTEM

An aperture has been provided on the recording collimator lens to prevent the ambient light level in the oscillograph body from fogging the recording media.

C. TIMING SYSTEM

The timing system has been modified to provide 0.1 cps timing in the 100 cps position (Refer to Figure 8). Other timing frequencies are as engraved on the timer panel.

D. SPEED AND LAMP SETTINGS

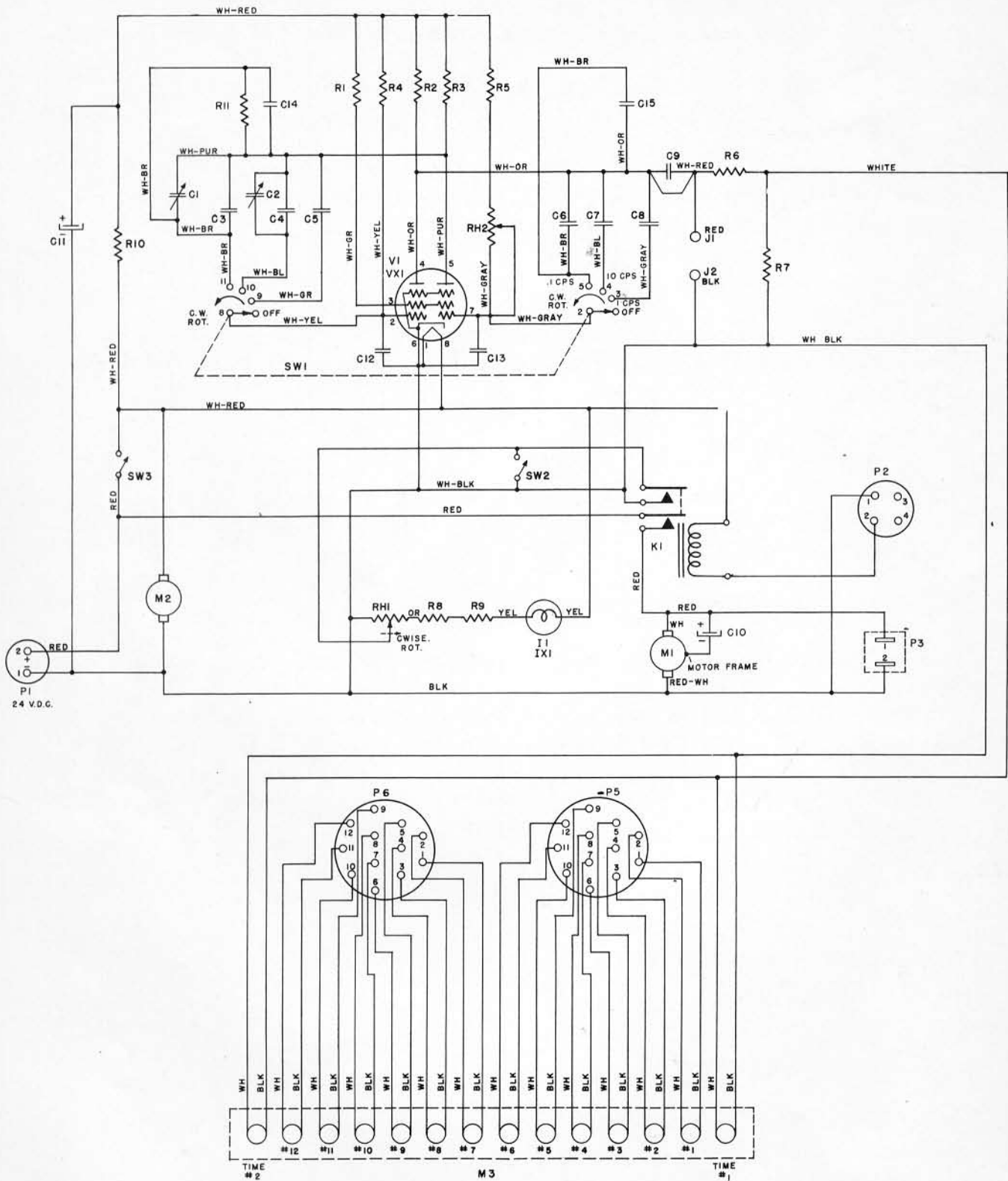
The following table provides Metron and Lamp Intensity settings:

TABLE III-PAPER TRAVERSE SPEED SETTINGS (Model 409C)
(for Eastman #809 Recording Paper)

<u>Paper Traverse Speed (in/min)</u>	<u>Metron Setting</u>	<u>Lamp Intensity Setting</u>	
		<u>24 V</u>	<u>28 V</u>
3/4	6:1	1.5	0.0
1 1/8	4:1	2.0	0.0
1 1/2	3:1	2.5	0.0
2 1/4	2:1	3.2	0.3
3	1.5:1	3.6	1.1
4 1/2	1:1	4.0	1.6

E. OTHER FEATURES

All other features of the Model 409C oscillograph are identical with those of the standard Model 409X oscillograph.



CIRCUIT DIAGRAM
 MODEL 409B - C OSCILLOGRAPH

FIG. 9

COMPONENTS DESCRIPTION MODEL 409B and 409C OSCILLOGRAPH

ITEM NO.	NAME	DESCRIPTION	MFG'R
C1	CONDENSER	TRIMMER	ARCO #306
C2	"	"	" #315
C3	"	.00056 MFD +2%	PROKAR 75P-56153
C4	"	.0068 " +5%	SPRAGUE 65P-68252
C5	"	.10 " +10%	150 V. GUDEMAN #1826 OR EQ.
C6	"	.001 " +1%	PROKAR 75P-10293
C7	"	.01 " +1%	" 65P-10352
C8	"	.10 " +10%	150 V. GUDEMAN #1826 OR EQ.
C9	"	.01 " +1%	PROKAR 65P10352
C10	"	25 "	25 V. SPRAGUE # TVA-1205
C11	"	25 "	25 V. " # TVA-1205
C12	"	.0005 "	AEROVOX #1468
C13	"	.0005 "	" #1468
C14	"	1 "	200 V ASTRON MQCF- 'M OR EQ.
C15	"	1 "	200 V. " " " " " "
I1	LAMP-RECORDING		G. E. #1613
IX1	SOCKET-LAMP		CENTURY #409A75
J1	JACK-INSULATED	PHONE TIP RED	H. H. SMITH #202
J2	" "	" " BLACK	" " " #202
K1	RELAY	24 V	POTTER-BRUMFIELD #KR11D
M1	MOTOR-DRIVE		CENTURY 409B275
M2	MOTOR-FAN		" 409A207
M3	MAGNETIC ASSY		" 109C100-1
P1	CONNECTOR		CANNON WK-M2-32S
P2	"		" WK-4-32S
P3	"		JONES S-302 CCT
P5	"		CANNON GK-12-32S
P6	"		" GK-12-32S
R1	RESISTOR	43K OHM 1/2 W	I. R. C. OR A. B. 5%
R2	"	20 K " 1/4 W	ELECTRA #DC-1/4 2%
R3	"	20 K " 1/4 W	" #DC-1/4 2%
R4	"	10 MEGOHM 1 W	" #DC-1 2%
R5	"	8.2 " 1W	" #DC-1 2%
R6	"	.75 " 1/4 W	" #DC-1/4 2%
R7	"	100 OHM 1/2 W	I. R. C. OR A. B. 5%
R8	"	7.5 " 25 W	DALE # RH-25 1%
R9	"	5.0 " 25 W	" # RH-25 1%
R10	"	240 " 1/2 W	I. R. C. OR A. B. 5%
R11	"	(SELECTED) 1 W	ELECTRA 2%
RH1	RHEOSTAT-MODIFIED		CENTURY 409A139
RH2	"	2 MEGOHM	CLAROSTAT 48-9-2 MEG.
SW1	SWITCH		GRIGSBY-ALLISON #5455-4 MLW-1
SW2	"	S. P. S. T. MONENTARY	BIRNBACH #6241 OR EQ.
SW3	"	S. P. S. T.	I. C. A. # 1296 OR EQ.
V1	TUBE	28D7W	
VX1	SOCKET-LOCTAL		AMPHENOL #88-8X

WEIGHT LESS SHOCKBASE 12.9#
 WEIGHT WITH SHOCKBASE 13.7#
 CENTER OF GRAVITY LOCATION ●

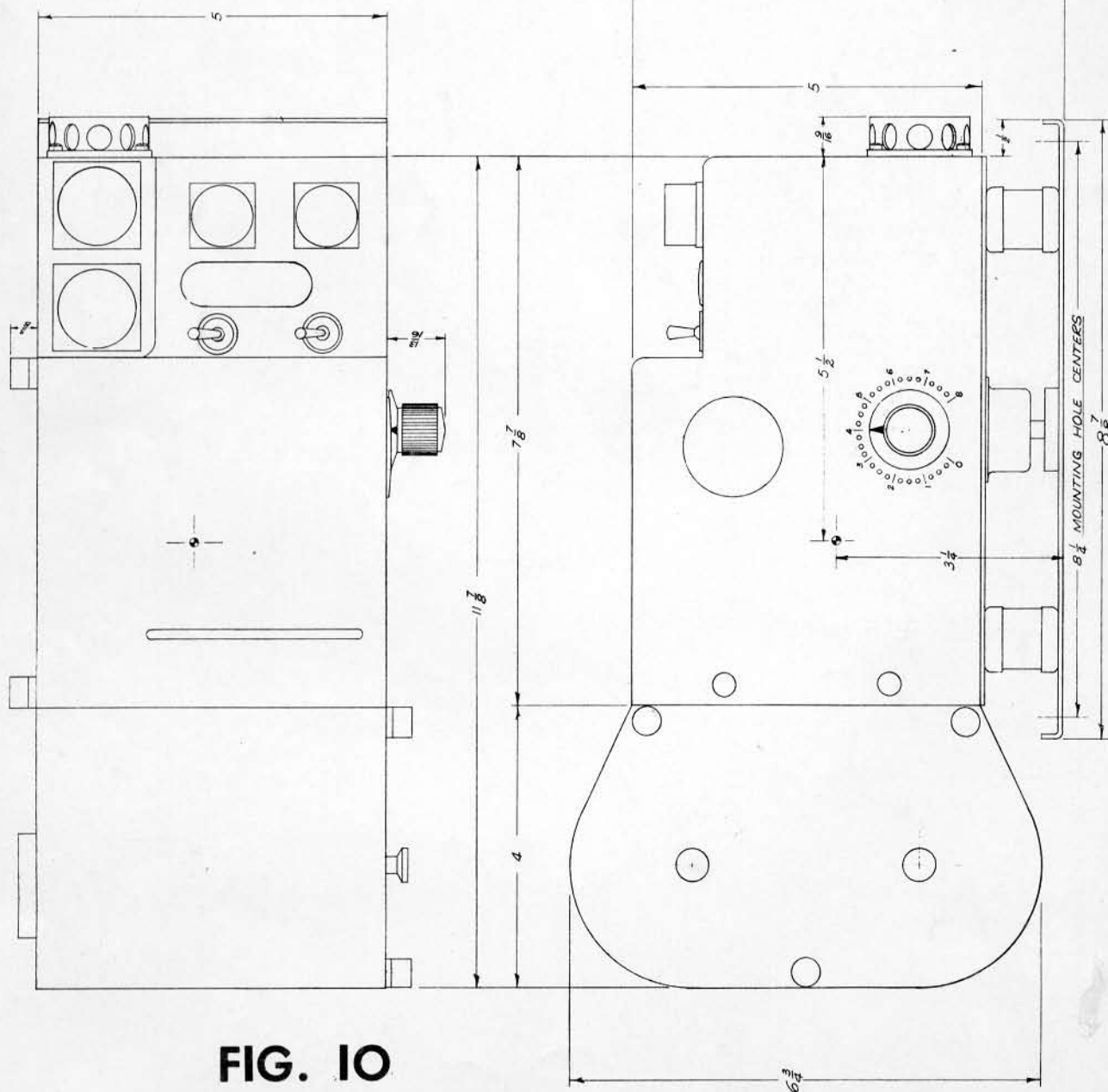


FIG. 10

OUTLINE DRAWING