

PILOT WIRE MASTER TWIST CONTROLLER

KS-7781

REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the Pilot Wire Master Twist Controller KS-7781 for controlling transmission twist in Type K1 carrier telephone systems.

1.02 This section is reissued to remove replacement information now in 024-331-801 and to bring cleaning and adjusting procedures up to date.

1.03 Reference shall be made to Section 020-010-711 covering General Requirements and Definitions, for additional

information necessary for the proper application of the requirements listed herein.

1.04 Asterisk: Requirements are marked with an asterisk () when to check for them would necessitate the dismantling or dismounting of apparatus or would affect the adjustment involved or other adjustments. No check need be made for these requirements unless the apparatus or part is made accessible for other reasons or its performance indicates that such a check is advisable.

†1.05 Double Dagger: The equipment shall be considered satisfactory for service when it has met all requirements marked with a double dagger (†).

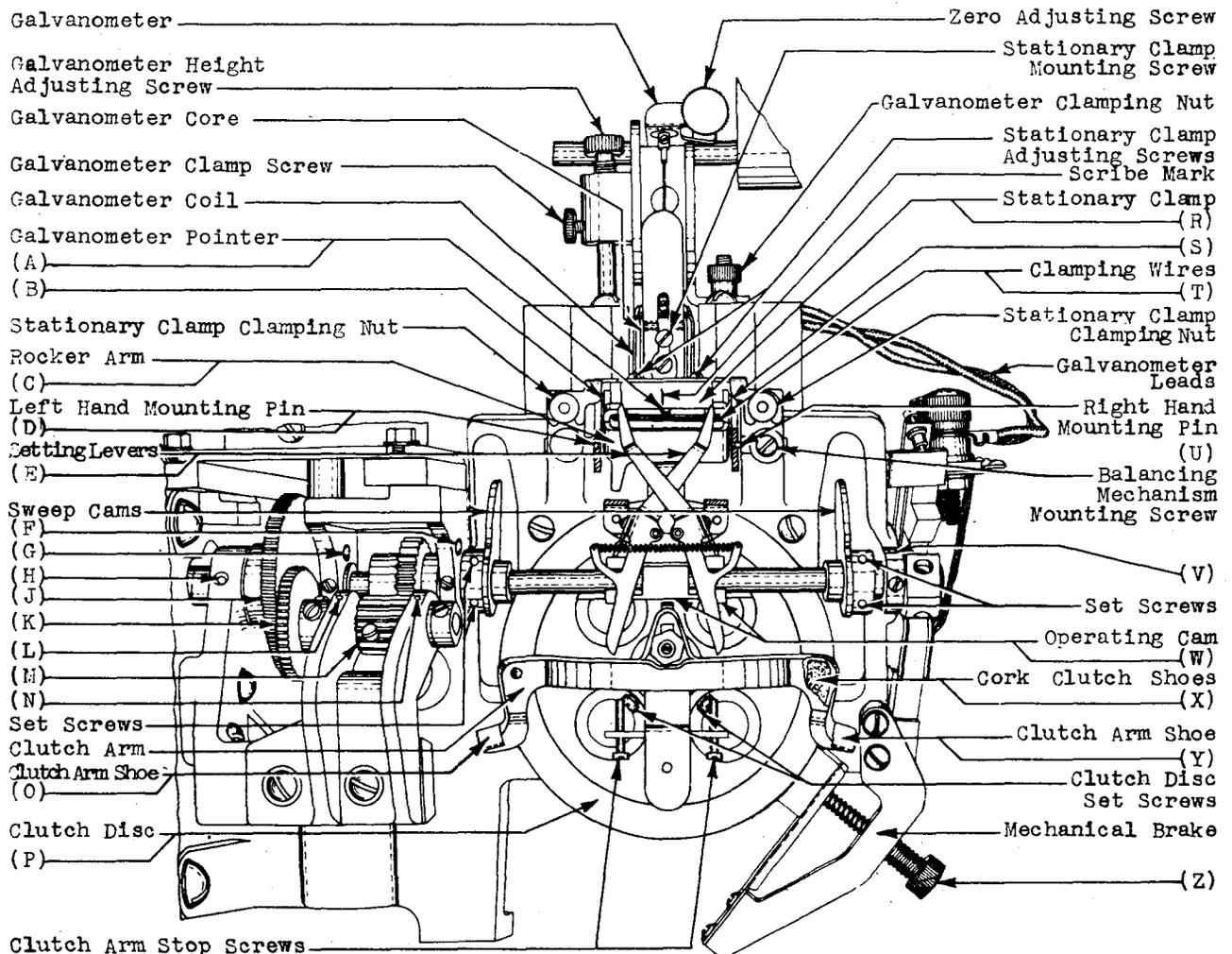


Fig. 1 - Control Mechanism

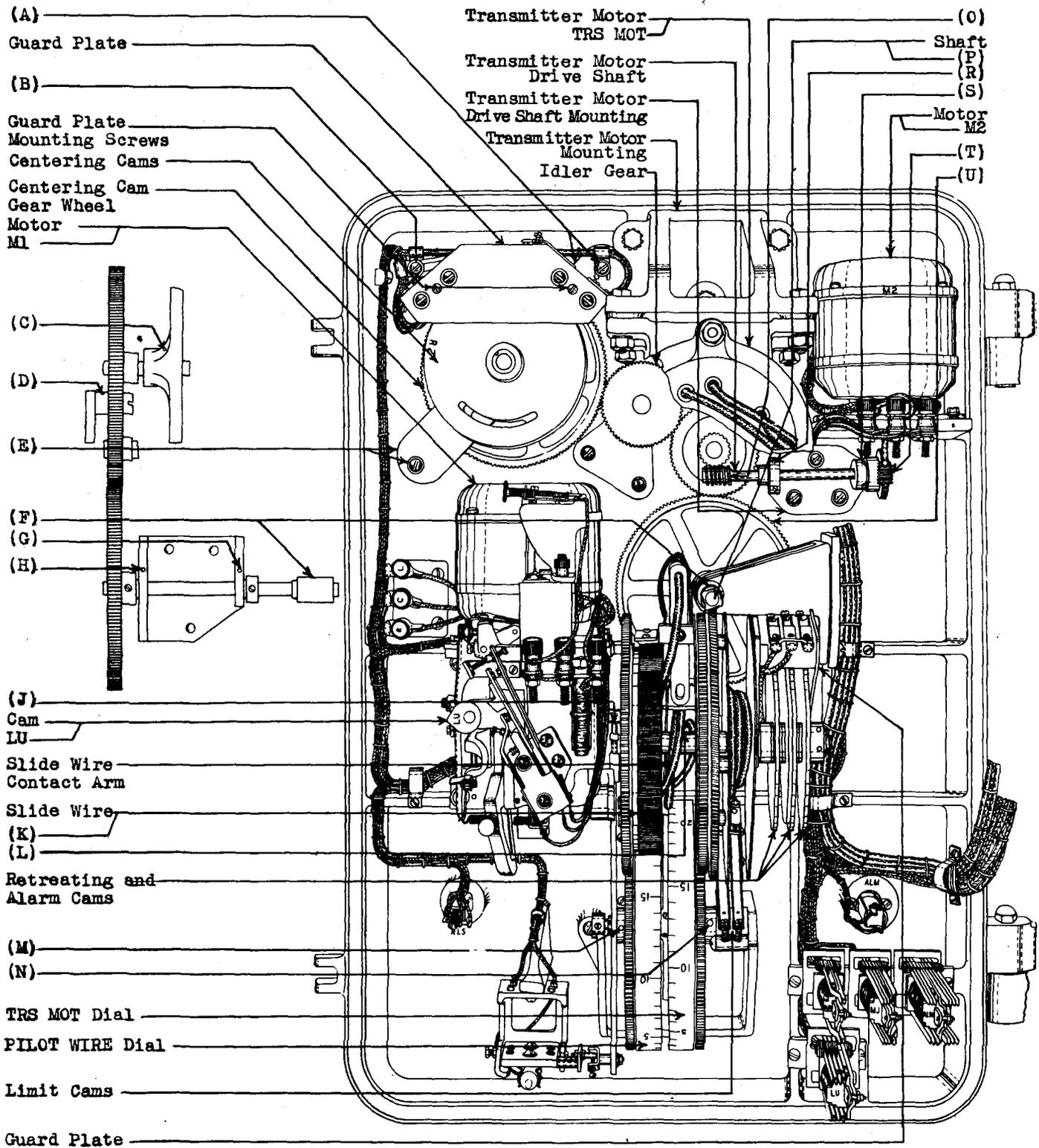


Fig. 2 - Master Twist Controller - Rear View

1.06 Controller lag may be defined as the difference in resistance between the value required in the pilot wire to cause the TRS MOT (Transmitter Motor) dial to move from a given position in either direction and the value required to move the TRS MOT dial in the opposite direction back to the given position.

1.07 Controller step may be defined as the difference between the resistance value in the pilot wire arm of the bridge circuit necessary to close a retreating cam contact and the value required to cause the next closing of the same contact when the pilot wire trend is in the same direction.

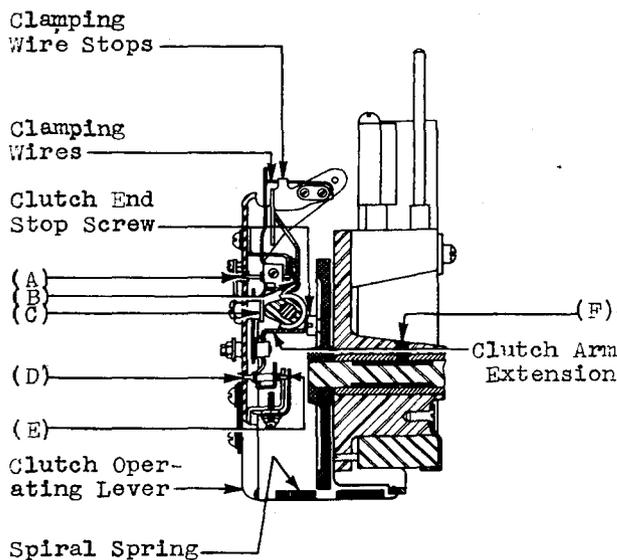


Fig. 3 - Balancing Mechanism and Clutch - Cross Section

1.08 Caution: Due to the important relation of this mechanism to associated circuits in the office, proper precautions shall be taken when working on this master controller to prevent unnecessary interference with service on working circuits.

1.09 Removing the master controller from service is described in Par. 3.002. This will allow the master controller to be operated for purposes of checking requirements and performing adjusting procedures without affecting the dial settings of the associated regulators. The master controller should not be removed from service during periods of large variations in attenuation nor for an extended period of time. Placing the master controller back in service is described in Par. 3.003.

2. REQUIREMENTS

2.01 Cleaning

- (a) The following parts shall be cleaned when necessary.
- (1) Clutch disc. Fig. 1 (P).
 - (2) Cork clutch shoes. Fig. 1 (X).
 - (3) Galvanometer pointer. Fig. 1 (A).
 - (4) Stationary clamp. Fig. 1 (R).
 - (5) Clamping wires. Fig. 1 (T).
 - (6) Setting levers. Fig. 1 (E).
 - (7) Shaft bearings. Fig. 1 (F), (G), (H), (L), (N) and (V). Fig. 2 (C) (D), (G), (H), (L), (M), (N), (R) and (S). Fig. 3 (F).
 - (8) Gears. Fig. 1 (J), (K) and (M). Fig. 2 (F), (O) and (T).
 - (9) Clutch arm shoes. Fig. 1 (O) and (Y).
 - (10) Relay contacts and cam contacts. These shall be cleaned in accordance with the section covering the cleaning of relay contacts and parts and for contacts in general.
- (b) The operating cam Fig. 1 (W), the slide wire Fig. 2 (K), and the balancing mechanism Fig. 3 shall be cleaned at 6 month intervals.
- (c) The collector rings of the transmitter motor TRS MOT shall be cleaned at 6 month intervals.

2.02 Lubrication: Lubrication has been provided by the manufacturer on the following parts. Additional lubrication shall be provided only after cleaning and at the intervals indicated in this section.

- (a) The following parts shall be adequately lubricated with KS-2245 oil.
- (1) Shaft bearings. Fig. 1 (F), (G), (H), (L), (N) and (V). Fig. 2 (C), (D), (G), (H), (L), (M), (N), (R) and (S). Fig. 3 (F).
 - (2) Gears. Fig. 1 (J), (K) and (M). Fig. 2 (F), (O) and (T).
 - (3) Clutch arm shoes Fig. 1 (O) and (Y).
 - (4) Socket and pivot bearings. Fig. 1 (B), (D), (S) and (U).

2.02 Lubrication: (Continued)

- (5) Socket and pivot bearings Fig. 3 (A), (B), (D) and (E).
- (6) Fibre buttons Fig. 3 (C).
- (7) Operating cam Fig. 1 (W).

Note: After turnover the following frequencies of lubrication are recommended for the parts listed in items (1) to (7):

2 Months - Gears and bearings of shafts turned by M1 motor.
Clutch arm shoes.
Socket and pivot bearings of item (4).
Operating cam.

6 Months - All gears, bearings and shoes listed in items (1) to (7) except those recommended to be lubricated at frequencies of two months.

These intervals may be extended if periodic inspections have indicated that local conditions are such as to insure that the requirements will be met during the extended interval.

2.03 Record of Lubrication: During the period of installation, a record shall be kept of the lubrication of the controller by dates and this record shall be turned over to the Telephone Company with the equipment. If no lubricating has been done, the record shall so state.

2.04 Rocker Arm

- (a) Clamping Wires: Fig. 1 (T) and Fig. 3 - The clamping wires shall be straight and parallel to each other. Gauge by eye.
- * (b) Clamping Wire Pressure: Fig. 3 - The pressure of each clamping wire on the clamping wire stops shall be:
Minimum - 50 grams
Maximum - 150 grams
Use the 62B gauge and measure at a point in front of the clamping wire stops.
- (c) The rocker arm shall move freely in its bearings with only a minimum amount of side play. Gauge by feel.

2.05 Setting Levers - Fig. 4

- (a) Balance: With the controller in operation and the galvanometer

removed, the PILOT WIRE dial shall remain at a fixed point. Gauge by eye.

- (b) Clearance: With the galvanometer mounted and its pointer in the center of the space between the setting levers, there shall be no clearance between the levers and the pointer or between the levers and the clutch arm split collar, when the setting levers are free from the operating cam. Gauge by eye.

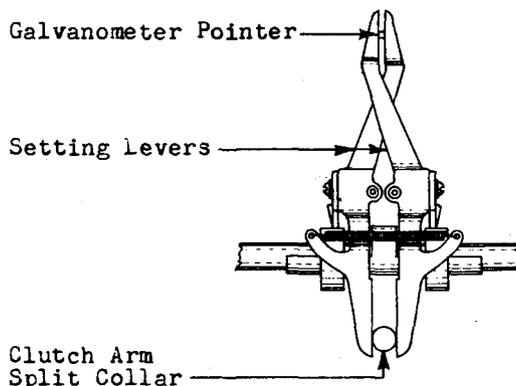


Fig. 4 - Setting Levers

- (c) Pressure: The pressure of the setting levers on the clutch arm split collar, when the clutch is disengaged and the clutch arm is held in a horizontal position, shall be:

Minimum - 20 grams

Maximum - 50 grams

Use 68B gauge and measure at a point on the levers as close as possible to the clutch arm split collar.

2.06 Galvanometer

- +(a) Coil Position: The galvanometer coil Fig. 1 shall be centrally located vertically and horizontally with respect to the galvanometer core, its front edge shall be approximately flush with the front face of the core, and it shall swing freely in both directions. Gauge by eye.
- * (b) Suspension Tension: Fig. 5 - There shall be no appreciable sag in the galvanometer suspension when the galvanometer system is laid in a horizontal position. Gauge by eye.
- (c) Suspension Torsion: Fig. 5 - With the galvanometer in a vertical position and the zero adjusting screw near its center of travel, the pointer shall come to rest at right angles to the face of the galvanometer core. Gauge by eye.

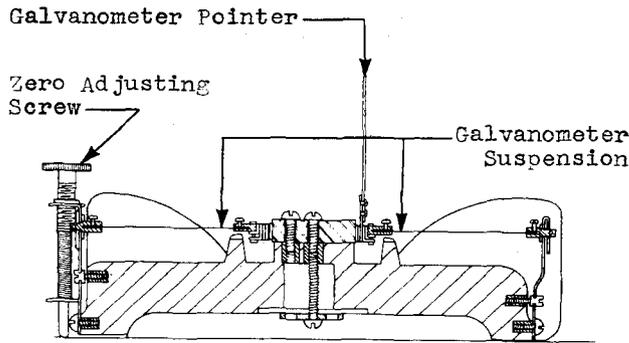
2.06 Galvanometer (Continued)

Fig. 5 - Cross Section of Galvanometer

- *(d) Balance: The end of the galvanometer pointer shall not move when the galvanometer system is tilted in any direction 10° or 15° from the vertical. Gauge by eye.
- *(e) Front and Rear Balance: The galvanometer pointer shall remain horizontal when the galvanometer is held with the suspension horizontal and the pointer horizontal to the left or right. Gauge by eye.
- *(f) Lateral Balance: The galvanometer pointer shall remain vertical when the galvanometer is held with the suspension horizontal and the pointer vertical downward. Gauge by eye.
- ‡(g) Galvanometer Clamping Nut: Fig. 1 - The galvanometer clamping nut shall be turned down until it touches the lug but shall not be tightened.
Caution: Care shall be taken that this nut is not tightened against the lug since this may throw the galvanometer system out of alignment and affect the zero adjustment.
- ‡(h) Pointer: Fig. 1 (A)
- (1) With the galvanometer winding connected to the test resistance the galvanometer pointer shall be centered between the stationary clamp (R) and the clamping wires (T) (Fig. 1) when the straight edges of the sweep cams extend vertically upward. Gauge by eye.
 - (2) The upper and lower faces of the galvanometer pointer shall be parallel to the horizontal planes of the stationary clamp and the rocker arm clamping wires. Gauge by eye.
 - (3) The galvanometer pointer shall not stick to the stationary clamp, the rocker arm clamping wires or the setting levers. Gauge by eye.
- ‡(j) Zero Adjustment: With the galvanometer winding connected to the test resistance and motor M1 in operation, the galvanometer pointer shall be in such a position that the PILOT WIRE dial shall not move. Gauge by eye.

2.07 Stationary Clamp: The scribe mark on the stationary clamp Fig. 1 (R) shall be centered above the center of the galvanometer pointer when the pointer is in its zero position. Gauge by eye.

2.08 Clutch

(a) Clutch Disc: The clutch disc Fig. 1 (P) shall be tight on its shaft. Gauge by feel.

(b) Torque of Slide Wire Shaft: When all tensions affecting the slide wire shaft have been adjusted and the clutch arm is released from the clutch disc, the force required to turn the PILOT WIRE dial shall be
 Minimum - 350 grams
 Maximum - 450 grams

Use the 62B gauge and measure at the gear teeth of the PILOT WIRE dial.

(c) Cork Clutch Shoes: The cork clutch shoes Fig. 1 (X) shall engage the clutch disc simultaneously and their surfaces shall be parallel to the plane of the disc. Gauge by mechanical test.

(d) Clutch End Stop: When the clutch end stop screw Fig. 3 is bearing against the clutch arm extension, the clutch arm shall not be deflected from the horizontal by the operation of the controller. Gauge by eye.

(e) Pressure of Clutch Operating Lever: The pressure of the clutch operating lever Fig. 3, when the clutch is engaged shall be:
 Minimum - 1150 grams or 2 1/2 lbs.
 Maximum - 1550 grams or 3 1/2 lbs.
 Use the 79E gauge and measure at the bottom of the clutch operating lever.

‡(f) The clutch arm shall turn the clutch disc without slipping. Gauge by eye.

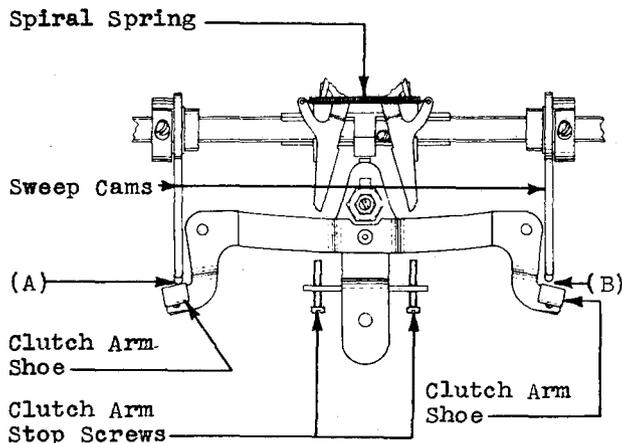
(g) Tightness of Clutch Arm: The clutch arm Fig. 1, when disengaged, shall be just tight enough in its bearings to remain in any position to which it is tilted. Gauge by eye.

2.09 Cams - General: All cams shall be tight on their shafts. Gauge by feel.

2.10 Sweep Cams

(a) Angular Position: Fig. 1 - The sweep cams shall be in such a position relative to the operating cam Fig. 1 (W) that when the operating cam just begins to move the clutch operating lever, Fig. 3, the straight edges of the sweep cams shall extend horizontally back into the casting. Gauge by eye.

(b) The sweep cams shall be in the same angular position relative to each other. Gauge by eye.

2.10 Sweep Cams (continued)

Touching at (A) Clearance at (B)
(or vice versa)

Fig. 6 - Sweep Cams

‡(c) Linear Position: Fig. 6 - The linear location of the sweep cams on the cam shaft shall be such that both cams shall clear the clutch disc by the same amount and when the high point of one cam is resting on a clutch arm shoe the high point of the other cam shall clear its associated clutch arm shoe by

Maximum - .002 inch

Use the 75F gauge.

‡2.11 Lockup Cam Contacts: Fig. 7

(a) Position of Spring (C): The position of spring (C) shall be such that when the machine is running, the point of the fibre shoe of spring (C) shall touch cam LU $3/16$ inch from the high point of the cam. Gauge by eye.

(b) Tension of Spring (C): The tension of spring (C) when cam LU is free from spring (C) and the break contacts are held open by pressing down on spring (D), shall be:

Minimum - 30 grams

Use the 68B gauge and measure upward at the make contact.

(c) Tension of Spring (B): With the make contacts open, the tension of spring (B) shall be:

Minimum - 30 grams

Use the 68B gauge and measure upward at the contact.

(d) Tension of Spring (D): With the break contacts held open by raising spring (C), the tension of spring (D) shall be:

Minimum - 20 grams

Maximum - 35 grams

Use the 68B gauge and measure downward at the contact.

(e) Make Contacts: With all springs normal, the separation of the make contacts shall be $1/32$ inch. Gauge by eye.

(f) Break Contacts: Immediately after the make contacts close, the break contacts shall open. Gauge by eye.

‡2.12 Cam LU: Fig. 7 - Immediately after the sweep cams have disengaged the clutch arm, cam LU shall close the associated make contact and open the associated break contact. Gauge by eye.

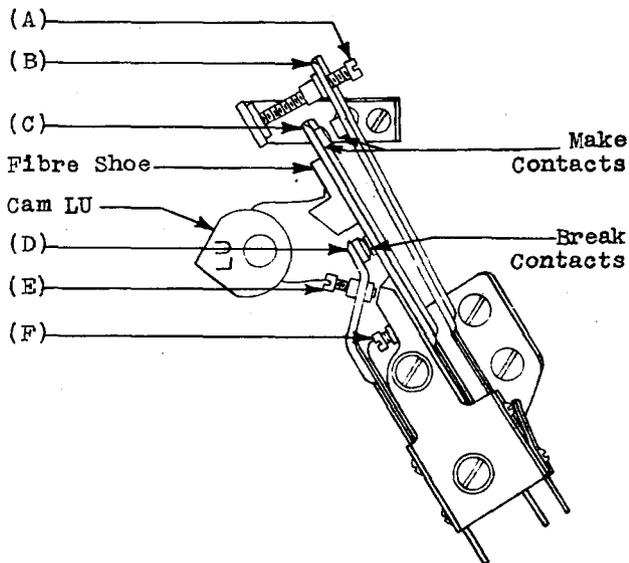


Fig. 7 - Cam LU and Contacts

‡2.13 Retreating and Alarm Cam Contacts: Fig. 8

(a) Links: The links associated with contact springs (A), (B) and (C) shall just clear the deepest point in the cam cutouts. Gauge by eye.

(b) Tension of Lower Spring: The tension of contact springs (A), (B) or (C), when the contacts are open, shall be:

Minimum - 30 grams

Use 68B gauge and measure upward at the contact.

(c) Tension of Upper Spring: The tension of contact springs (D), (E) or (F), when the contacts are open, shall be:

Minimum - 30 grams

Use 68B gauge and measure upward at both contacts.

‡2.14 Retreating Cam R1: Fig. 8 - With the PILOT WIRE dial set so that a division mark is opposite the correspondingly numbered division mark on the TRS MOT dial, a movement of the slide wire shaft which increases the reading on the PILOT WIRE dial 0.5 division shall cause contacts (R1) to close. Gauge by operation of relay R.

‡2.15 Retreating Cam Ll: Fig. 8 - With the PILOT WIRE dial set so that a division mark is opposite the correspondingly numbered division mark on the TRS MOT dial, a movement of the slide wire shaft which decreases the reading on the PILOT WIRE dial 0.7 division shall cause contacts (Ll) to close. Gauge by operation of relay L.

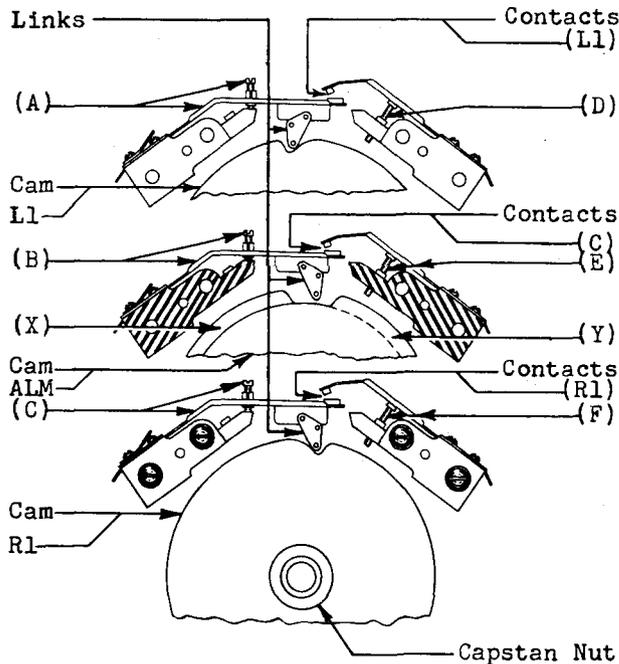


Fig. 8 - Retreating and Alarm Cams and Contacts

‡2.16 Out of Step Cam ALM: Fig. 8 - With the PILOT WIRE dial set so that a division mark is opposite the correspondingly numbered division mark on the TRS MOT dial, the cam ALM (alarm) cut-out shall be of such extent that contacts (C) will close when a movement of the slide wire shaft has increased or decreased the PILOT WIRE dial reading 1.5 divisions.

2.17 Centering Cam Contacts: Fig. 9

- (a) Tension of Contact Springs: The tension of contact springs (A), (D), (G) and (J), with the associated links in the cam cut-out, shall be:
Minimum - 30 grams
Use 68B gauge and measure upward at the upper contact.
- (b) The tension of contact springs (N), (O), (P) and (R) when the contacts are open, shall be:
Minimum - 30 grams
Use 68B gauge and measure upward at the contact.
- (c) When the links of springs (B) and (E) are free from the cams, when springs (A) and (D) are raised and when

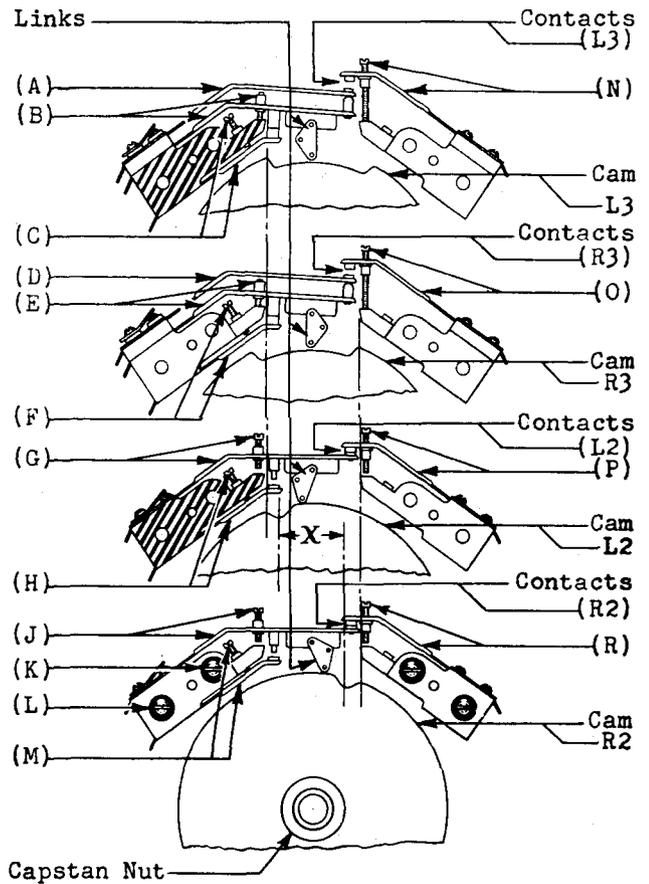


Fig. 9 - Centering Cams and Contacts

the contacts on springs (C) and (F) are held open, the tension of springs (B) and (E) shall be sufficient to hold the adjusting screws (B) and (E) against the support. Gauge by eye.

- * (d) The tension of contact springs (C), (F), (H) and (M), when the contacts are open, shall be:
Minimum - 20 grams
Maximum - 35 grams
Use 68B gauge and measure downward at the contact.
- (e) Contact Follow: The contacts on the lower contact springs (C), (F), (H) and (M) shall follow the contacts on springs (B), (E), (G) and (J) respectively 1/32 inch. Gauge by eye.
- (f) Links: The links of contact springs (G) and (J) shall just clear the deepest part of their respective cam cut-outs. Gauge by eye.
- (g) Contact Separation: When the link of contact spring (G) or (J) is in the center of its cam cutout, the separation of contacts (L2) or (R2) shall be .015 inch. Gauge by eye.

2.17 Centering Cam Contacts (continued)

(h) When the links of contact springs (B) and (E) are acting on the high part of the cam, the adjusting screws for springs (N) and (O) shall clear the mounting block 1/16 inch. Gauge by eye.

(j) When the links of contact springs (B) and (E) are free in the cam cut-out, the separation of make contacts (L3) and (R3) shall be .015 inch. Gauge by eye.

2.18 Centering Cams:

(a) The distance between the centers of the cutouts in cams L2 and R2 shall be 7/8 inch (dimension X Fig. 9). Gauge by sighting over a scale.

(b) With the TRS MOT dial set on a division mark the relative positions of cams L3 and R3 with respect to other cams and the associated contact links shall be as shown in Fig. 9. Gauge by eye.

(c) When the cams are turning in a clockwise direction and the link of contact spring (J) is entering its cam cutout, contact (R3) shall break just before the link of spring (J) reaches the center of the cam cutout. Gauge by eye.

(d) When the cams are turning in a counter-clockwise direction and the link of contact spring (G) is entering its cam cut-out, contact (L3) shall break just before the link of spring (G) reaches the center of the cam cutout. Gauge by eye.

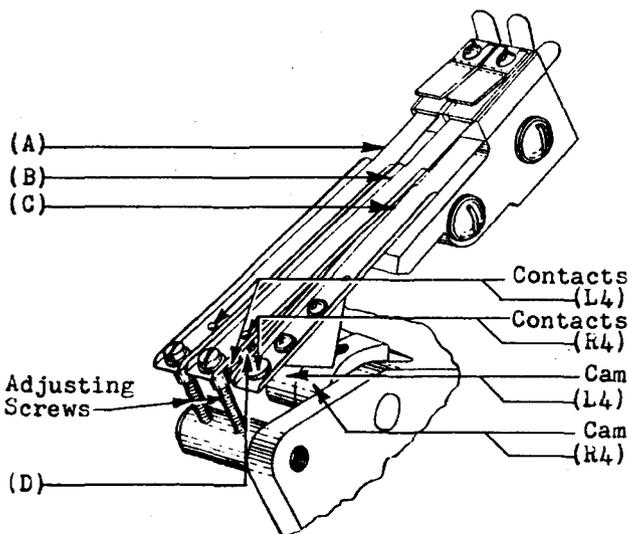


Fig. 10 - Limit Cams and Contacts

2.19 Limit Cam Contacts: Fig. 10

(a) The tension of contact springs (A) and (B) shall be:
Minimum 20 grams.
Use 68B gauge and measure upward at the contact.

(b) The tension of contact springs (C) and (D) shall be:
Minimum - 5 grams
Use 68B gauge and measure upward at the contact.

2.20 Limit Cams: When the 0 limit of the TRS MOT dial passes the index by more than .25 division, contacts (L4) (Fig. 10) shall close. When the 45 limit of the TRS MOT dial passes the index by more than .25 division contacts (R4) (Fig. 10) shall close. Gauge by eye.

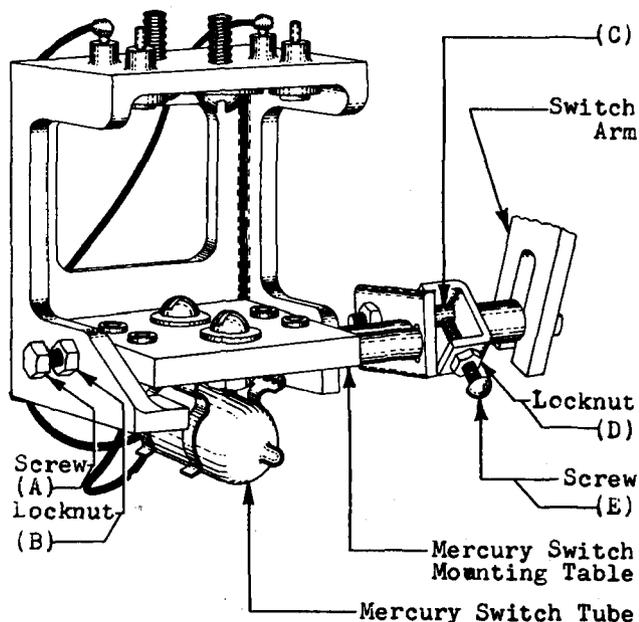


Fig. 11 - Mercury Switch

2.21 Mercury Switch: Fig. 11

(a) The mercury switch mounting table shall swing freely and shall remain in either tilted position until force is applied to move it to the opposite position. Gauge by eye and by feel.

(b) The force required to move the switch arm in either direction shall be
Minimum 20 grams
Maximum 40 grams
Use 68B gauge and measure at the lower end of the arm.

(c) The link connecting the switch arm to the table shall be adjusted to allow a movement of 1/32 inch at (C) before the table starts to move. Gauge by eye.

*2.28 Controller Lag: The controller lag shall be a maximum of 5 ohms. Gauge by electrical test.

2.29 Controller Step: A controller step shall be the amount shown in the following table, depending on the slide wire shunt resistance connected. Gauge by electrical test.

Terminal K Connected to Terminal	Controller Step Ohms	
	Min.	Max.
No Connection	52.5	56.5
D	50.5	54.5
C	48.5	52.5
B	46.5	50.0
A	44.5	48.0

2.30 Slide Wire Resistance: With the controller balanced so that the slide wire contact is on the mechanical center of the slide wire, an increase of pilot wire resistance, as shown in the following table depending on the slide wire shunt resistance connected, shall cause the controller to balance with a PILOT WIRE dial reading of 45 and a decrease of pilot wire resistance as shown in the following table, depending on the slide wire shunt resistance connected, shall cause the controller to balance with a PILOT WIRE dial reading of 0. Gauge by electrical test.

Terminal K Connected to Terminal	Change in Pilot Wire Resistance - Ohms
No Connection	1230 ± 5.0
D	1183 ± 5.0
C	1135 ± 4.5
B	1088 ± 4.5
A	1041 ± 4.0

2.31 Clutch Arm Travel: Fig. 1 - The maximum travel of the clutch arm from its normal horizontal position, for a maximum galvanometer deflection in either direction shall cause a change in the PILOT WIRE dial reading of an amount between 0.8 and 0.9 scale division. Gauge by eye.

*2.32 Alignment of the Transmitter Motor
TRS MOT: When the transmitter motor TRS MOT is set at its electrical zero position, an even numbered division mark on the TRS MOT dial shall be within 1/16 inch of the index. Gauge by eye.

Note: The Transmitter Motor will be at its electrical zero position when a 20-volt 60-cycle alternating current source is connected so that one wire connects to terminals P1, S2 and S3 and the other wire to terminals PG and S1.

3. ADJUSTING PROCEDURES

3.001 List of Tools, Gauges, Materials and Test Apparatus

Code No.	Description
<u>Tools</u>	
43	3/16" and 1/4" Hex. Open Double End Flat Wrench
129B	1/4" Hex. Open Double End Offset Wrench
179	Spring Adjuster
207	Offset Screw-driver
401A	Oil Gun (if available)
418A	5/16" and 7/32" Hex. Open Double End Flat Wrench
486A	Oil Can
-	1/8" Drill Rod
-	KS6015 Duck-bill Pliers
-	KS6320 Orange Stick
-	KS6854 3-1/2" Screw-driver
-	R1770 1/2" and 9/16" Hex. Open Double End Flat Wrench
-	3-1/2" Cabinet Screw-driver
-	4" Regular Screw-driver
-	Watchmakers Screw-driver Size 3 - William Dixon Inc., Newark, N.J.
-	Watchmakers Screw-driver Size 5 - William Dixon Inc., Newark N.J.
-	4-1/4" Tweezers No. 15 - Hammacher Schlemmer Co., New York
<u>Gauges</u>	
62B	0-700 Gram Gauge
68B	70-0-70 Gram Gauge
75F	.002" Thickness Gauge
79E	0-3000 Gram Push-Pull Tension Gauge
-	R8550 6" Steel Scale
<u>Materials</u>	
-	D98063 or KS-2423 Cloth
-	KS2245 oil

3.001 List of Tools, Gauges, Materials and Test Apparatus (continued)

- KS-8372 Trichloroethylene ←
- W.E.Co. Petrolatum (Unmedicated white vaseline may be used)
- Sandpaper No. 00
- Toothpicks, Hardwood, Flat at One End and Pointed at the Other

Test Apparatus

- (2 Req.) Leeds and Northrup Dial Decade Resistance Box 4780, 4746B or the Electrical Equivalent
- (1 Req.) Variac-General Radio Co. Cambridge, Mass. (175 VA. Min) or the Electrical Equivalent. Required only when a test for "Alignment of Transmitter Motor TRS MOT" is made

3.002 To remove the master controller from service proceed as follows. Remove the 55 volt power by removing the PW REG line fuse. Remove the S1, S2 and S3 alarm fuses and the S1, S2 and S3 fuse-trons. Remount the PW REG line fuse.

3.003 To place the master controller back in service proceed as follows. Remove the 55 volt power by removing the PW REG line fuse. Check that the PILOT WIRE dial and the TRS MOT dial read the same as the associated regulator dials. Remount the S1, S2 and S3 fuse-trons and the S1, S2 and S3 alarm fuses. Remount the PW REG line fuse.

3.004 In the following procedures D-98063 or KS-2423 cloth is referred to as cloth.

3.005 Where lubrication is required, an excess of lubricant is to be avoided as it will collect dust or dirt and interfere with satisfactory operation. If too little lubricant is used, sticking and a tendency to bind may result. Care shall be taken that no lubricant gets on the insulation.

3.006 When the direction of rotation of retreating or centering cams is referred to in the following procedures, it is assumed that the case will be open and the cams observed from the end of the shaft which takes the capstan nut.

3.007 Procedures for the adjustment of the R type relays are not covered herein as they are covered in other sections of this series of practices. Adjustments for the DUNCO relays are not critical.

3.01 Cleaning (Rq. 2.01)

- (1) Stop the controller by blocking relay MJ operated and then blocking

relay BB non-operated, so that the straight edges of the sweep cams extend vertically upward.

(2) Clutch Disc and Cork Clutch Shoes: Wipe the clutching surface of the clutch disc and the cork clutch shoes with a clean cloth moistened with trichloroethylene to be sure that they are free from oil. All of the clutching surface of the clutch disc can be made accessible for cleaning by turning the gear wheel associated with the slide wire.

(3) Galvanometer Pointer - Stationary Clamp - Clamping Wires - Setting Levers: Carefully clean the galvanometer pointer, the stationary clamp, the clamping wires and the setting levers with trichloroethylene applied with a toothpick, at the point where contacts are made with each other. Rub the toothpick lightly along the surface to be cleaned in order to loosen and remove any dirt or grease.

(4) Bearings and Gears: Wipe off any dust and dirt that may have accumulated around shaft bearings, socket and pivot bearings and gears, using a clean dry cloth.

(5) Clutch Arm Shoes: Wipe off any dust and dirt that may have accumulated on the clutch arm shoes, using a clean dry cloth.

(6) Contacts: All relay contacts and all cam contacts shall be cleaned in accordance with the section covering the cleaning of relay contacts and parts and for contacts in general.

(7) Operating Cam and Balancing Mechanism: In order to clean the operating cam and the balancing mechanism it is necessary to remove the balancing mechanism. To remove the balancing mechanism loosen the stationary clamp clamping nuts (Fig. 1) until the stationary clamp is free, then unhook the spiral spring (Fig. 3) from the clutch operating lever and loosen the balancing mechanism mounting screw (Fig. 1), using the 3-1/2 inch cabinet screw-driver. Move the balancing mechanism to the right thus pushing the right hand mounting pin out far enough to permit the clutch arm operating lever to clear the left hand mounting pin and lift the mechanism clear of the frame.

(8) To clean the operating cam, wipe off all accumulated oil and dirt with a clean dry cloth.

(9) Thoroughly clean the balancing mechanism by wiping with a clean dry cloth.

3.01 Cleaning (continued)

(10) Remounting Balancing Mechanism: To remount the balancing mechanism - slide it into position so that the bearing in the left side of the clutch operating lever fits on the left hand mounting pin. Then, holding the balancing mechanism so that the bearing in the right hand side of the clutch operating lever is in line with the mounting pin, push the mounting pin into its bearing. Do not push too hard on the pin after it is fully in its bearing as this may cause the pin to exert sufficient pressure against the bracket in which the rocker arm is mounted to prevent the rocker arm from moving freely and may even cause it to stick. If the pin is not moved in far enough there will be some lost motion to the left or right between the bearings and the mounting pin. Tighten the balancing mechanism mounting screw. Hook the spiral spring into place again. Push the stationary clamp down as far as it will go and tighten the stationary clamp clamping nuts.

(11) Slide Wire: When cleaning the slide wire, clean only the path of contact with the slide wire contact arm. The whole path of contact can be reached by rotating the gear wheel associated with the slide wire. Clean and lubricate in accordance with the section covering cleaning and lubricating of slide wire apparatus.

(12) Collector Rings: In order to clean the collector rings of the transmitter motor TRS MOT (Fig. 2), disconnect the transmitter motor from motor M2 as follows: Loosen the three screws in the transmitter motor drive shaft mounting, using the 4 inch regular screw-driver and lower the shaft and mounting until worm (O) (Fig. 2) is free. Remove the inspection plate from the under side of the transmitter motor, using the 4 inch regular screw-driver.

(13) Note the location of the numbers on the TRS MOT dial with respect to the index, or reference point, located in the center of the stationary section of the dial system.

(14) Hold a piece of clean dry cloth on the collector rings of the transmitter motor made accessible by the removal of the inspection plate. Rotate the collector rings by turning the centering cam gear wheel by hand, being careful that the TRS MOT dial does not move more than one half of a division from the reading noted in paragraph 3.01 (13).

(15) If the clean dry cloth does not clean satisfactorily, moisten a clean cloth with trichloroethylene and proceed as above repeating immediately afterward with another clean dry cloth.

(16) Turn the centering cam gear wheel by hand until the numbers on the TRS MOT dial are in the same location with respect to the index as noted in paragraph 3.01(13).

(17) Replace the inspection plate and raise the transmitter motor drive shaft mounting and shaft until the worms and gears are completely meshed. Tighten the three screws in the drive shaft mounting.

(18) Turn the gear wheel associated with the slide wire until the PILOT WIRE dial reads the same as the TRS MOT dial.

(19) Release the armature of relay BB and then release the armature of relay MJ.

3.02 Lubrication (Rq.2.02)

(1) When lubricating gears, shaft bearings, operating cam, clutch arm shoes and fibre contact buttons apply the oil with the 486A oil can. Wipe off all excess oil with a clean dry cloth. To gain access to the oil hole Fig. 3(F) it is necessary to remove the galvanometer.

Note: The nozzle of the 486A oil can will also fit the 401A oil gun, and where the latter is available the use of this combination will be found advantageous in lubricating points which are difficult to reach with the 486A oil can.

(2) Stop the controller as covered in paragraph 3.01 (1).

(3) Remove the galvanometer as follows: Disconnect the galvanometer leads (Fig. 1) at their screw terminals. Remove the galvanometer clamping nut. Loosen the galvanometer clamp screw and loosen the stationary clamp clamping nuts. Slowly lift out the galvanometer by the lug on the left hand side.

(4) Remount the galvanometer as follows: Be sure that the straight edges of the sweep cams extend vertically upward. Turn the galvanometer height adjusting screw (Fig. 1) in as far as it will go. Slide the galvanometer down the guide rods, unscrewing the height adjusting screw until the galvanometer pointer just clears the rocker arm clamping wires for a full deflection in either direction. Lower the stationary clamp as far as it will go and secure it in this position with the stationary clamp clamping nuts. Raise or lower the galvanometer system by means of the galvanometer height adjusting screw until the pointer is centered between the stationary clamp and the clamping wires. Tighten the galvanometer clamp screw and replace the gal-

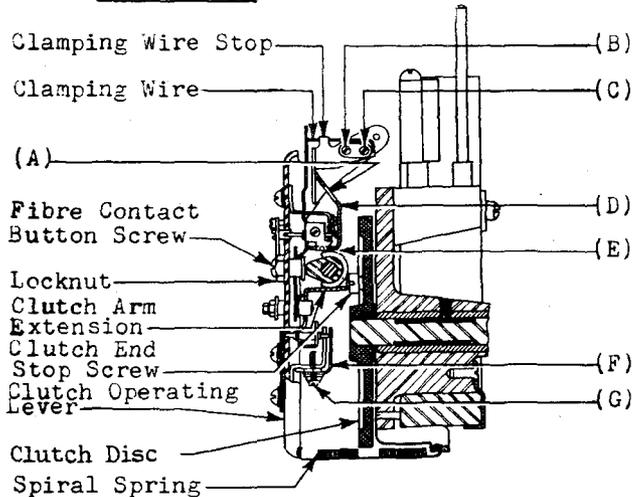
3.02 Lubrication (continued)

Fig. 15 - Balancing Mechanism Cross Section

vanometer clamping nut but do not tighten. Connect the galvanometer leads to their proper terminals. If the leads are reversed the controller will work away from balance instead of toward it.

(5) In order to lubricate the part of the operating cam which operates the rocker arm, place the spout of the 486A oil can at the lower edge of the slot (A) of Fig. 15 and allow the oil to run down the inside of the arm (D) so that the oil will flow through hole (E) to the cam which rotates under hole (E).

(6) When lubricating socket and pivot bearings apply the oil with the 486A oil can and wipe off all excess oil with a clean dry cloth. To gain access to the socket and pivot bearings in the balancing mechanism (Fig. 3 (A) and (B)), it is necessary to remove the balancing mechanism by proceeding as covered in paragraph 3.01 (7). After lubricating remount the balancing mechanism as covered in paragraph 3.01 (1C). Release the armature of relay BB and then release the armature of relay MJ.

3.03 Record of Lubrication (Rq. 2.03)
(No Procedure)3.04 Rocker Arm (Rq. 2.04)

(1) Stop the controller as covered in paragraph 3.01(1). Remove the galvanometer as covered in paragraph 3.02(3).

(2) Remove the balancing mechanism as covered in paragraph 3.01(7). Measure the pressure of the clamping wires against the clamping wire stops (Fig. 15). If necessary to adjust the pressure proceed as follows: Loosen screws (B) and (C) (Fig. 15), using the KS-6854 screw-

driver. To increase the pressure, push the adjusting bar up under screw (B) and tighten screws (B) and (C). To decrease the pressure, allow the adjusting bar to slip down under screw (B) and tighten screws (B) and (C). Repeat until the requirement is met.

(3) If the clamping wires become bent, they shall be straightened using a pair of duck-bill pliers. Recheck the pressure of the wires.

(4) Remount the balancing mechanism as covered in paragraph 3.01(10). Remount the galvanometer as covered in paragraph 3.02(4). Release the armature of relay BB and then release the armature of relay MJ.

(5) Freedom of Movement of Rocker Arm:

If the rocker arm does not move freely in its bearings the trouble may be caused by the right hand mounting pin (Fig. 1 (R)) having been pushed in too far so that it exerts pressure against the bracket in which the rocker arm is mounted. To overcome this loosen the balancing mechanism mounting screw (Fig. 1) using the 3-1/2 inch cabinet screw-driver, thus freeing the pin so that it can move back into a position in which its pressure against the rocker arm mounting bracket is relieved, and then retighten the screw. If the rocker arm still does not move freely in its bearings remove the balancing mechanism as described in 3.01(7). Spread the arms of the rocker arm mounting bracket away from each other a very slight amount by exerting pressure on them with the fingers exercising care in doing this so as not to spring them too far apart. Remount the balancing mechanism as described in 3.01(10).

3.05 Setting Levers (Rq. 2.05)

(1) Balance: Stop motor M1 when the straight edges of the sweep cams extend vertically upward. Motor M1 shall be stopped by removing heat coil M1 and fusetron M1. Remove the galvanometer as covered in paragraph 3.02 (3) and operate the controller by remounting fusetron M1. If the PILOT WIRE dial moves during three rebalancing movements, proceed as follows: Stop the controller by removing fusetron M1. If the PILOT WIRE dial moved toward zero, loosen screw (A) (Fig. 16) a slight amount, using the KS-6854 screw-driver. Turn screw (B) a very slight amount in a counter-clockwise direction and screw (C) the same slight amount in a clockwise direction. Tighten screw (A). If the PILOT WIRE dial moved away from zero, loosen screw (A) a slight amount. Turn screw (C) a very slight amount in a counter-clockwise direction, and screw (B) the same slight amount in a clockwise direction. Tighten screw

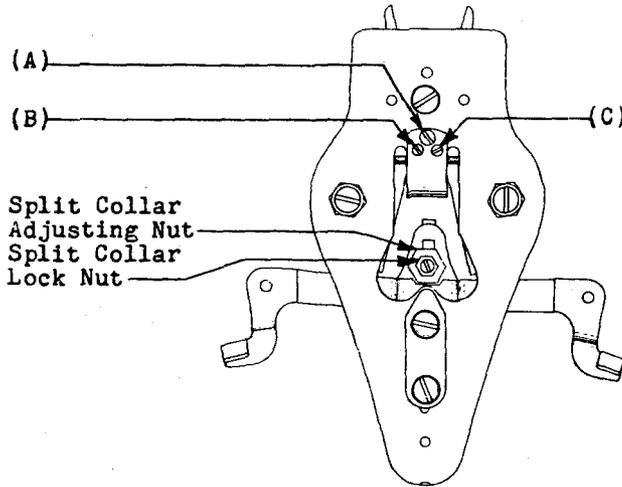
3.05 Setting Levers (Continued)

Fig. 16 - Balancing Mechanism

(A). Start the controller and repeat the test for balance. Repeat the adjustments as directed until no movement of the dial is observed. In making the final adjustment, it may be found necessary to turn only screw (B) or (C) as both screws may give too great a change.

(2) Clearance: Mount the galvanometer as covered in paragraph 3.02 (4). Start the controller and when the straight edges of the sweep cams extend vertically upward stop it by means of fusetron M1. Adjust the galvanometer pointer by turning the zero adjusting screw (Fig. 1), until it is approximately in the center of the space between the setting levers. Start the controller and stop it when the setting levers are free from the operating cam. If there is any clearance between the setting levers and the pointer or between the setting levers and the clutch arm split collar, loosen the split collar locknut (Fig. 16), using the 43 tool and turn the split collar adjusting nut, using the 418A tool, until there is no clearance between the setting levers and the pointer or the split collar. Tighten the locknut. Repeat the test for balance as covered in paragraph 3.05(1). If any readjustments are necessary, recheck for clearance.

(3) Pressure: If the setting levers fail to meet the pressure requirements, remove the balancing mechanism as covered in paragraph 3.01(7) and remount the spiral spring (Fig. 6) using the tweezers. Remount the balancing mechanism as covered in

paragraph 3.01(10). Remount the M1 fusetron and the M1 heat coil.

3.06 Galvanometer (Rq.2.06)

(1) Care should be taken in working with the galvanometer to insure that the small parts are not strained and that everything is kept clean.

(2) Removing Galvanometer: Fig. 1 - Stop the controller as covered in paragraph 3.01(1). Remove the galvanometer as covered in paragraph 3.02(3). Loosen the stationary clamp mounting screw (Fig. 1) using the 3-1/2 inch cabinet screw-driver, and remove the stationary clamp from the galvanometer.

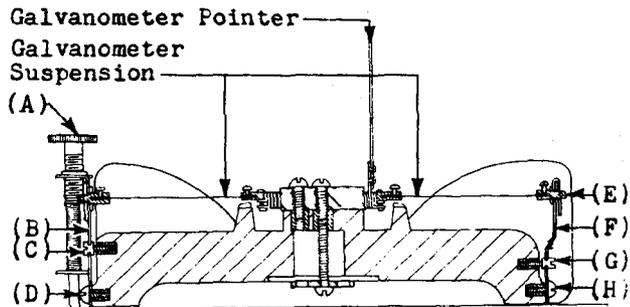


Fig. 17 - Cross Section of Galvanometer

(3) Coil Position: Fig. 17 - If the galvanometer coil is not vertically central with respect to the core, the coil may be lowered by turning the tension screw (C) in a clockwise direction and screw (G) in a counter-clockwise direction, using the size 3 watch-makers screw-driver. The screws should be turned in the reverse direction to raise the coil. If the coil is not horizontally central with respect to the core use the 3-1/2 inch cabinet screw-driver and loosen (very slightly) the screws (D) and (H) which hold the flat springs (B) and (F) and shift the position of these flat springs sufficiently to bring the coil into the desired position. Tighten the screws, being careful not to let this affect the position of the flat springs. If the front edge of the coil is not approximately flush with the front face of the core, loosen (very slightly) the screws (D) and (H) and shift the zero adjusting screw (A) and the flat springs (B) and (F) either backward or forward as required. Retighten the screws, being careful not to let this affect the position of the flat springs.

3.06 Galvanometer (Continued)

(4) Suspension Tension: Fig. 17 - The galvanometer suspension tension should be such that there is very little sag, if any, when the galvanometer is laid in a horizontal position. The tension is increased by using the size 3 watchmakers screw-driver and turning the tension screws (C) and (G) in a counter-clockwise direction and is decreased by turning the screws in a clockwise direction. A very fine adjustment is required as one-eighth of a turn causes a large change in tension when nearly taut. Care should be taken that the tension put on the system is not too great as this will break the suspension strip. If the suspension tension is not correct the pointer may vibrate excessively when the galvanometer system is in place in the controller. Usually the remedy is to increase the tension slightly.

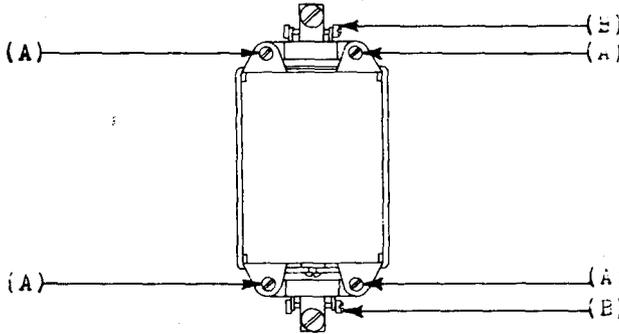


Fig. 18 - Galvanometer Coil Assembly

(5) Suspension Torsion: Fig. 17 - If the pointer does not come to rest at right angles to the face of the core when the galvanometer is held in a vertical position proceed as follows: Set the zero adjusting screw (A) near its center of travel. Set the galvanometer on a flat surface so the suspensions are approximately vertical. If the pointer is not approximately at right angles to the face of the core after it comes to rest, turn the suspension binding post by pin (E) until it comes to rest in this position.

(6) Balance: Tilt the galvanometer 10 or 15 degrees in all directions. If this does not cause the pointer to move, the galvanometer shall be considered as sufficiently balanced. If tilting the galvanometer 10 or 15 degrees causes the pointer to move, tests shall be made for front and rear and lateral balance.

(7) Front and Rear Balance: Hold the galvanometer with the suspensions horizontal and the pointer to the left or right. If the tip of the pointer falls below or rises above the horizontal, the galvanometer system is not balanced front to rear. Hold the galvanometer with the flat back of the moulding against the palm of one hand. Extend the thumb and fingers around the moulding and hold the coil. If the pointer tip moved downward during the test, turn each screw (A) (Fig. 18) an equal amount in a clockwise direction, using the size 5 watchmakers screw-driver. If the pointer tip moved upward during the test, turn each screw (A) Fig. 18 an equal amount in a counter-clockwise direction. Test and repeat until a balance is obtained.

(8) Lateral Balance: Hold the galvanometer with the suspensions horizontal and the pointer downward. If the pointer moves to either side of the vertical the left and right sides of the galvanometer system are not balanced. Hold the galvanometer with the flat back of the moulding against the palm of one hand. Extend the thumb and fingers around the moulding and hold the coil. If the pointer moved to one side of the vertical during the test, the galvanometer system is heavier on the opposite side. If the galvanometer system is heavier on the side where screw heads (B) are located, turn each of these screws an equal amount in a clockwise direction, using the size 5 watchmakers screw-driver. If the galvanometer system is heavier on the opposite side turn each screw (B) an equal amount in a counter-clockwise direction. Test and repeat until a balance is obtained.

(9) Remounting Galvanometer: Fig. 1 - Place the stationary clamp on the galvanometer core and tighten the stationary clamp mounting screw so that the edges of the support clamped under the screw are parallel to the edges of the galvanometer moulding. Mount the galvanometer as covered in paragraph 3.02(4), except connect the + lead to the 0 binding post.

(10) Pointer: Fig. 1 - The galvanometer pointer should be located between the stationary clamp and the clamping wires as follows: Remove the galvanometer clamping nut and loosen the galvanometer clamp screw. Turn the height adjusting screw until the pointer is in the required position. Tighten the galvanometer clamp screw and replace the galvanometer clamping nut but do not tighten.

3.06 Galvanometer (Continued)

(11) If the horizontal planes of the upper and lower faces of the pointer are not parallel to the horizontal planes of the stationary clamp and the rocker arm clamping wires, this may cause the pointer to deflect or to vibrate as the rocker arm leaves it. To correct replace the pointer.

(12) If the pointer sticks to the stationary clamp, to the rocker arm clamping wires or to the setting levers, the cause usually is dirt and oil on the pointer and on the parts which the pointer touches. To remedy this, carefully clean the different parts as covered in procedure 3.01(3).

(13) Zero Adjustment: Release the armature of relay BB and then release the armature of relay MJ. Adjust the zero adjusting screw until three successive revolutions of the sweep cams will not cause the clutch arm to move. Since the galvanometer is very sensitive to air currents it may be necessary to make several adjustments before the correct result is obtained, closing the controller case after each trial. If the pointer cannot be brought to the zero position in this way, it will be necessary to remove the galvanometer and to turn the lower suspension binding post by pin (E) (Fig. 17) so that when the galvanometer is re-mounted the final adjustment can be made by means of the zero adjusting screw (A). After this adjustment, remove galvanometer lead + from binding post 0 and clamp it under post +.

3.07 Stationary Clamp (Rq.2.07)

(1) Stop the controller as covered in paragraph 3.01(1). Remove the galvanometer lead + from its binding post and clamp it under binding post 0 on the same plate. Check the galvanometer zero adjustment as covered in paragraph 3.06(13).

(2) Loosen the stationary clamp adjusting screws (Fig. 1) using the KS-6854 screw-driver and move the stationary clamp until the scribe mark is centered above the galvanometer pointer. Tighten the stationary clamp adjusting screws.

(3) Remove galvanometer lead + from binding post 0 and clamp it under binding post +. Release the armature of relay BB and then release the armature of relay MJ.

3.08 Clutch (Rq.2.08)

(1) Clutch Disc: Stop the controller as covered in paragraph 3.01(1). Turn

the clutch disc a small amount in each direction being careful not to touch the face of the disc with the hands. If the disc is loose on its shaft, it may be seen to move before the slide wire begins to move. If the disc is very loose on the shaft it may rotate without moving the slide wire at all. To correct the trouble, tighten the clutch disc set screws (Fig. 1), using the 3-1/2 inch cabinet screw-driver. If the clutch disc was found to be loose on its shaft, check the position of the clutch end stop screw as covered in paragraph 3.08(4).

(2) Torque of Slide Wire Shaft: Measure the force required to turn the PILOT WIRE dial. If this force is outside the limits given, adjust the pressure of the mechanical brake by turning screw (Z) until the requirement is met.

(3) Cork Clutch Shoes: To check if the two cork clutch shoes (Fig. 1) engage the clutch disc simultaneously turn the shaft of motor M1 (Fig. 12) by hand until the corks are almost engaging the clutch disc. Insert a piece of paper between each cork and the clutch disc. Turn the motor shaft slowly until the corks touch the paper. By moving the pieces of paper up and down between the corks and the clutch disc it is possible to determine after every slight turning movement of the motor shaft, just when each clutch cork engages the clutch disc and also if the two corks engage the clutch simultaneously. If the corks do not engage simultaneously, the high cork should be refaced with fine sandpaper. To reface the corks use two strips of No. 00 sandpaper 1 inch wide and about 5 inches long. Insert the sandpaper between the corks and the clutch disc with the rough side of the sandpaper toward the corks and move the sandpaper up and down until the corks meet the requirement.

(4) Clutch End Stop: Stop the controller so that the straight edges of the sweep cams are approximately 1/8 inch in front of the back edges of the clutch arm shoes by blocking relay MJ operated and then blocking relay BB non-operated. Hold the clutch operating lever disengaged from the clutch disc (Fig. 15) and turn the PILOT WIRE dial to 0. Release the clutch operating lever. The clutch end stop screw (Fig. 15) should be touching the left side of the clutch arm extension looking at the face of the clutch disc. If the end stop screw is not touching the clutch arm extension loosen the clutch disc set screws (Fig. 1), using the 3-1/2 inch cabinet screw-driver. Hold the clutch operating lever disengaged from the clutch disc and rotate

3.08 Clutch (Continued)

the clutch disc in a clockwise direction, being careful not to touch the face of the disc, until the clutch stop screw touches the clutch arm extension. Release the operating lever and tighten the set screws so that the hub of the clutch disc is flush with the end of the slide wire shaft. Set the PILOT WIRE dial to read the same as the TRS MOT dial.

(5) Pressure of Clutch Operating Lever:

Measure the pressure of the clutch operating lever. If the pressure needs to be increased, it will be necessary to replace the spiral spring (Fig. 15).

(6) If the cork clutch shoes slip on the clutch disc, clean as covered in paragraph 3.01(2).

(7) Release the armature of the BB relay and then release the armature of the MJ relay.

(8) Tightness of Clutch Arm: Stop the controller as covered in paragraph 3.01(1). Tilt the clutch arm to various positions and notice whether it remains in those positions. If the clutch arm is too tight or too loose in its bearings, remove the balancing mechanism as covered in paragraph 3.01(7). Loosen screw (G) (Fig. 15), using the 3-1/2 inch cabinet screw-driver. Push flat spring (F) farther under screw (G) and tighten the screw to increase the pressure on the shaft. Remount the balancing mechanism as described in 3.01(10).

(9) Replacement of Clutch Arm: If the corks on the clutch arm become so worn or oil soaked that the clutch arm slips on the clutch disc and cannot be adjusted, the clutch arm should be replaced as covered in Section 024-331-801. After replacement of a new clutch arm make a check in accordance with procedures 3.05(1) and(2), 3.08(3) and (8) and 3.10(1).

(10) Release the armature of relay BB and then release the armature of relay MJ.

3.09 Cams - General (Rq.2.09)

If the cams are loose on the shaft they can be tightened by means of the set screws or capstan nuts holding them to their shaft. Care should be exercised that the cams are not shifted from their correct position while doing this.

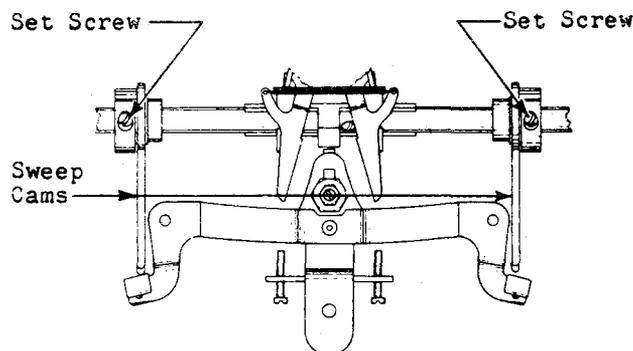


Fig. 19 - Sweep Cams

3.10 Sweep Cams (Rq.2.10)

(1) If the sweep cams do not have the correct angular position relative to each other or to the operating cam or as regards their linear position on the shaft, stop the controller as covered in paragraph 3.01(1). Loosen the set screws (Figs. 1 and 19) holding the cams to the shaft, using the KS-6854 screw-driver. Then shift the cams into their correct position and tighten the set screws. Care shall be taken while correcting the position of a cam in one respect that the adjustment of the cam in other respects is not disturbed. The sweep cams are in the correct position relative to each other when both cams leave the extensions of the clutch arm at exactly the same time. Special attention is called to the fact that the highest point on the cam with respect to its own center is not only at the end point of the cam but extends back about 1/4 inch from the straight edge.

Note: The blade of the KS-6854 screw-driver is too wide for the sweep cam set screws. Modify this screw-driver locally by grinding until the end of the blade is 7/64 inch wide tapering off gradually to the original width of the blade.

(2) Release the armature of the BB relay and then release the armature of the MJ relay.

3.11 LU Cam Contacts (Rq.2.11) Fig. 7

(1) On the older type controllers, the contact spring assembly is mounted in a horizontal position instead of at an angle as shown in Figure 7 for the later type controllers.

3.11 LU Cam Contacts (Continued)

(2) If spring (C) is not in the proper position with respect to cam LU, adjust its position by turning screw (F), using the KS-6854 screw-driver until the requirement is met.

Note: The blade of the KS-6854 screw-driver is too wide to pass through the hole in spring (D) to reach screw (F). Modify this screw-driver locally by grinding until the end of the blade is $7/64$ inch wide, tapering off gradually to the original width of the blade.

(3) When cam LU is free from spring (C), stop the controller by blocking relay MJ operated and then blocking relay BB non-operated.

(4) When the tension of spring (B), (C) or (D) is outside the limits given, the tension may be adjusted by grasping the spring as near the mounting block as possible with the 179 tool and bending it until the requirement is met.

(5) When the separation of the make contacts is incorrect, adjust screw (A), using the KS-6854 screw-driver, until the requirement is met.

(6) When the break contacts do not open at the proper time, adjust screw (E), using the KS-6854 screw-driver, until the requirement is met.

(7) Release the BB relay and then release the MJ relay.

3.12 Cam LU (Rq.2.12) Fig. 7

(1) If the cam LU does not operate the associated contacts at the proper time, stop the controller as covered in paragraph 3.01(1). Loosen the set screws holding the cam to the shaft, using the KS-6854 screw-driver, and shift the cam to the proper position. Tighten the set screws making sure that there is clearance between the cam and the shaft bearing.

(2) Release the armature of the BB relay and then release the armature of the MJ relay.

3.13 Retreating and Alarm Cam Contacts (Rq.2.13)

(1) Stop the controller as covered in paragraph 3.01(1). Remove the guard plate Fig. 2 by removing the guard plate mounting screws, using the 3-1/2 inch cabinet screw-driver.

(2) Turn the cams by hand so that the links pass through the cam cutouts.

(3) When the position of the retreating and alarm cam contacts make the adjusting screws and contact springs inaccessible proceed as follows: Remove alarm fuses S1, S2 and S3 and then remove fusetrans S1, S2, and S3. Note the reading of the TRS MOT dial. Loosen the three screws in the transmitter motor drive shaft mounting (Fig. 2), using the 4 inch regular screw-driver, and lower the shaft until worm (O) (Fig. 2) is free. Turn the centering cam gear wheel until the retreating and alarm cam contacts have moved to a position where the adjusting screws and contact springs are accessible.

(4) When the links associated with the contact springs are not in the proper location with respect to the cam cutouts, adjust screws (A), (B) or (C) (Fig. 8), using the KS-6854 screw-driver until the requirement is met.

(5) When the tensions of the contact springs are outside the limits given, the springs may be adjusted by grasping the spring as near the mounting block as possible with the 179 tool, and bending the spring until the requirement is met.

(6) When it has been necessary to move the retreating and alarm cam contacts, return the TRS MOT dial to the reading noted above, by turning the centering cam gear wheel. See that the centering cams, contacts and links are in the relative positions shown in Fig. 9. Raise the transmitter motor drive shaft and adjust until the gears are lined up and centered without appreciable backlash or binding. Tighten the three mounting screws. Remount fusetrans S1, S2 and S3 and alarm fuses S1, S2 and S3.

(7) Release the armature of relay BB and then release the armature of relay MJ.

3.14 Retreating Cam R1 (Rq.2.14) Fig. 8

(1) When the make contacts associated with cam LU are closed, disconnect motors M1 and M2 by removing heat coil M1 and then removing fusetrans M1 and M2.

(2) When the position of the retreating and alarm cam contacts make the adjusting screws inaccessible proceed as covered in paragraph 3.13(3).

(3) Turn the PILOT WIRE dial until a division mark is opposite the

3.14 Retreating Cam R1 (Continued)

corresponding division mark on the TRS MOT dial. Turn the PILOT WIRE dial to increase the reading 0.5 division. Relay R should operate indicating that contacts (R1) have closed. After relay R has operated and the PILOT-WIRE dial has been returned to its initial position, release relay R by breaking contacts (R2) (Fig. 9). If contacts (R1) fail to close or close before the 0.5 division point is reached proceed as follows: Adjust screw (F), using the KS-6854 screw-driver, and repeat the above procedure. If the contacts cannot be adjusted sufficiently by means of screw (F) loosen the capstan nut, using a piece of 1/8 inch drill rod and rotate cam R1 in a clockwise direction if the relay failed to operate or in a counter-clockwise direction if the relay operated too soon. Tighten the capstan nut. Repeat adjustments of the cam and screw (F) until the requirement is met. When a cam adjustment is made, check the position of other cams on the slide wire shaft as their adjustments may have been disturbed.

- (4) When it has been necessary to move the retreating and alarm cam contacts, proceed as covered in paragraph 3.13(6).
- (5) Turn the PILOT WIRE dial until it reads the same as the TRS MOT dial and release Relay R by opening contacts (R2) (Fig. 9).
- (6) Remount fusetrans M1 and M2 and heat coil M1.

3.15 Retreating Cam L1 (Rq. 2.15) Fig. 8

- (1) When the make contacts associated with cam LU are closed, disconnect motors M1 and M2 by removing heat coil M1 and then removing fusetrans M1 and M2.
- (2) When the position of the retreating and alarm cam contacts make the adjusting screws inaccessible, proceed as covered in paragraph 3.13(3).
- (3) Turn the PILOT WIRE dial until a division mark is opposite the corresponding division mark on the TRS MOT dial. Turn the PILOT WIRE dial to decrease the reading 0.7 division. Relay L should operate, indicating that contacts (L1) have closed. After relay L has operated and the PILOT WIRE dial has been returned to its initial position, release relay L by breaking contacts (L2) (Fig. 9). If contacts (L1) fail to close, or close before the 0.7 division point is

reached proceed as follows: Adjust screw (D), using the KS-6854 screw-driver and repeat the above procedure. If the contacts cannot be adjusted sufficiently by means of screw (D) loosen the capstan nut, using a piece of 1/8 inch drill rod, and rotate cam L1 in a counter-clockwise direction, if relay L failed to operate or in a clockwise direction if relay L operated too soon. Tighten the capstan nut. Repeat adjustments of the cam and screw (D) until the requirement is met. When a cam adjustment is made, check the position of other cams on the slide wire shaft as their adjustment may have been disturbed.

- (4) When it has been necessary to move the retreating and alarm cam contacts, proceed as covered in paragraph 3.13(6).
- (5) Turn the PILOT WIRE dial until it reads the same as the TRS MOT dial and release relay L by opening the contacts (L2) (Fig. 9).
- (6) Remount fusetrans M1 and M2 and heat coil M1.

3.16 Out of Step Cam ALM (Rq. 2.16) Fig. 8

- (1) When the make contacts associated with cam LU are closed, disconnect motors M1 and M2 by removing heat coil M1 and then removing fusetrans M1 and M2. Block the relay MJ operated.
- (2) When the position of the retreating and alarm cam contacts make the adjusting screws inaccessible, proceed as covered in paragraph 3.13(3).
- (3) Adjust screw (E), using the KS-6854 screw-driver until contact spring (E) is at approximately the same level as contact springs (D) and (F).
- (4) Turn the PILOT WIRE dial until a division mark is opposite the corresponding division mark on the TRS MOT dial. Turn the PILOT WIRE dial to increase the reading by 1.5 division. Relay ALM should operate indicating that contacts (C) have closed. If the relay does not operate or operates too soon, loosen the capstan nut, using a piece of 1/8 inch drill rod, and proceed as follows: Turn disc (X) of cam ALM in a clockwise direction if relay ALM did not operate and in a counter-clockwise direction if the relay ALM operated too soon. Repeat until the requirement is met.
- (5) Turn the PILOT WIRE dial until a division mark is opposite the corresponding division mark on the TRS MOT dial. Turn the PILOT WIRE dial to

3.16 Out of Step Cam ALM (Continued)

decrease the reading by 1.5 division. Relay ALM should operate indicating that contacts (C) have closed. If the relay does not operate or operates too soon, loosen the capstan nut, using a piece of 1/8 inch drill rod, and proceed as follows: Turn disc (Y) of cam ALM in a counter-clockwise direction if relay ALM did not operate and in a clockwise direction if the relay ALM operated too soon. Repeat until the requirement is met.

- (6) When any adjustments are made, check the position of the other cams on the same shaft, as their adjustments may have been disturbed.
- (7) When it has been necessary to move the retreating and alarm cam contacts, proceed as covered in paragraph 3.13(6).
- (8) Turn the PILOT WIRE dial until it reads the same as the TRS MOT dial and release relays R and L by opening contacts (R2) and (L2) (Fig. 9).
- (9) Release the armature of relay MJ. Remount fusetrons M1 and M2 and heat coil M1.

3.17 Center Cam Contacts (Rq.2.17) Fig. 9

- (1) When the centering cams are at rest, stop the controller by blocking relay MJ operated and then blocking relay BB non-operated. Remove the guard plate by removing the guard plate mounting screws (Fig. 2) using the 3-1/2 inch cabinet screw-driver.
- (2) Tension of Contact Springs: When the tension of spring (A), (B), (D), (E), (N), (O) or (M) does not meet the requirement given, the tension of the spring may be adjusted by grasping the spring as near the mounting block as possible with the 179 tool, and bending the spring until the requirement is met.
- (3) Disconnect the transmitter motor TRS MOT from motor M2 by loosening the three screws in the transmitter motor drive shaft mounting (Fig. 2), using the 4 inch regular screw-driver, and lower the shaft and mounting until worm (O) (Fig. 2) is free.
- (4) In order not to change the TRS MOT dial reading by as much as 1 division, the centering cam assembly should be returned to its normal position, as shown in Fig. 9, after each test requiring a change in the position of the cams.

(5) Turn the cams until the link associated with spring (G) or (J) is in the center of the associated cam cutout and measure the tension of springs (G) and (P) or (J) and (R). When the tensions are not within the limits given, grasp the spring with the 179 tool as near as possible to the mounting block and bend the spring until the requirement is met.

(6) Remove the left-hand contact spring mounting assembly by removing screws (K) and (L); using the 4 inch regular screw-driver. Check the tension of springs (C), (F) and (H) and adjust as required by grasping the spring, with the 179 tool, as near as possible to the mounting block and bending the spring until the requirement is met. Remount the contact spring assembly so that the links and contact springs are in approximately the positions shown in Fig. 9. Tighten screws (K) and (L).

(7) Contact Follow: Turn the cams so that each link rides from the deepest part of the cam cutout to the high part of the cam and observe the follow of the lower contact on spring (C), (F), (H) or (M). If the follow does not meet the requirement, adjustment may be made by turning the screws in the mounting block associated with spring (C), (F), (H) or (M), using the KS-6854 screw-driver.

(8) Links: Turn the cams until the link associated with spring (G) or (J) is in the center of the cam cutout. If the position of the link does not meet the requirement, adjustments can be made by turning the screws associated with springs (G) or (J), using the KS-6854 screw-driver.

(9) Contact Separation: When the link of contact spring (G) or (J) is in the center of the cam cutout, the separation of contacts (L2) or (R2) can be adjusted by turning the screws associated with springs (P) or (R), using the KS-6854 screw-driver.

(10) Turn the cams so that the link of contact spring (B) or (E) is acting on the high part of the cam. Turn in a clockwise direction for spring (E) and in a counter-clockwise direction for spring (B). Turn the adjusting screw associated with spring (N) or (O), using the KS-6854 screw-driver, until the end of the screw clears the mounting block by the required amount.

(11) Turn the cams so that the links associated with springs (B) and (E) are free in the cam cutout. Turn the

3.17 Centering Cam Contacts (Continued)

adjusting screws associated with springs (B) and (E), using the KS-6854 screw-driver until the separation of the make contacts (L3) and (R3) meet the requirement.

(12) Set the cams to approximately the positions shown in Fig. 9.

(13) Raise the Transmitter Motor drive shaft until the gears are lined up and centered without appreciable backlash or binding. Tighten the three mounting screws. Release the armature of relay BB and then release the armature of relay MJ.

(14) Remount the guard plate (Fig. 2).

3.18 Centering Cams (Rq.2.18)

(1) When the centering cams are at rest, stop the controller by blocking relay MJ operated and then blocking relay BB non-operated. Remove the guard plate by removing the guard plate mounting screws, using the 3-1/2 inch cabinet screw-driver.

(2) If the cams, contacts and links are not in the relative positions shown in Fig. 9, when the TRS MOT dial is set on a division mark, disconnect the transmitter motor TRS MOT from motor M2 by loosening the three screws in the transmitter motor drive shaft mounting (Fig. 2) using the 4 inch regular screw-driver, and lowering the shaft and mounting until worm (O) is free.

(3) Loosen the capstan nut using a piece of 1/8 inch drill rod, and set the cams in accordance with Fig. 9. Tighten the capstan nut.

(4) In order not to change the TRS MOT dial reading by as much as 1 division, the centering cam assembly should be returned to its normal position, as shown in Fig. 9, after each test.

(5) Turn the cams slowly in a clockwise direction. As the link of contact spring (J) is passing through the associated cam cutout, contact (R3) should break just before the link of spring (J) reaches the center of the cam cutout. If contact (R3) does not operate at the proper time, loosen the capstan nut, using a piece of 1/8 inch drill rod, and turn the cam R3 as required. Tighten the capstan nut.

(6) Turn the cams slowly in a counter-clockwise direction. As the link of contact spring (G) is passing through the associated cam cutout,

contact (L3) should break just before the link of spring (G) reaches the center of the cam cutout. If contact (L3) does not operate at the proper time, loosen the capstan nut, using a piece of 1/8 inch drill rod and turn cam L3 as required. Tighten the capstan nut.

(7) Check to see that all cams are in the relative positions shown in Fig. 9, when the TRS MOT dial is set on a division mark. If it was necessary to change cams R3 to L3, recheck the positions of cams R2 and L2 to make sure that their adjustments have not been disturbed. Tighten the capstan nut.

(8) Raise the transmitter motor drive shaft until the gears are lined up and centered without appreciable backlash or binding. Tighten the three mounting screws. Release the armature of relay BB and then release the armature of relay BB and then release the armature of relay MJ.

(9) Remount the guard plate (Fig. 2).

3.19 Limit Cam Contacts (Rq.2.19) Fig. 10

(1) When the tension of spring (A), (B), (C) or (D) is outside the limits given, the tension of the spring may be adjusted by grasping the spring as near the mounting block as possible, with the 179 tool, and bending the spring until the requirement is met.

3.20 Limit Cams (Rq.2.20) Fig. 10

(1) Stop the controller so that the straight edges of the sweep cams extend vertically upward, by removing heat coil M1 and then removing fuses M1 and M2. Block relay MJ operated and note the reading of the TRS MOT dial. Remove alarm fuses S1, S2 and S3 and then remove fuses S1, S2 and S3.

(2) Disconnect the transmitter motor TRS MOT from motor M2 by loosening the three screws in the transmitter motor drive shaft mounting (Fig. 2), using the 4 inch regular screw-driver and lowering the shaft and mounting until worm (O) is free.

(3) Turn the centering cams in a clockwise direction until the TRS MOT dial reads 45. Turn the PILOT WIRE dial until it reads 45. Turn the centering cams in a clockwise direction until the TRS MOT dial passes the 45 division and relay ALM operates indicating that the (R4) contact has closed. If the reading on the TRS MOT

3.20 Limit Cams (Continued)

dial does not meet the requirement, turn the adjusting screw in spring (B) as required, using the KS-6854 screw-driver. If the requirement still cannot be met, loosen the set screws in cam (R4) using the KS-6854 screw-driver, and turn the cam on the shaft as required. Tighten the set screws. Repeat the test and adjust cam (R4) and the screw in spring (B) until the requirement is met.

(4) Turn the centering cams in a counter-clockwise direction until the TRS MOT dial reads 0. Turn the PILOT WIRE dial until it reads 0. Turn the TRS MOT dial past the 0 division until relay ALM operates indicating that contact (L4) has closed. If the reading on the TRS MOT dial does not meet the requirement, turn the adjusting screw in spring (A) as required, using the KS-6854 screw-driver. If the requirement still cannot be met, loosen the set screws in cam (L4), using the KS-6854 screw-driver, and turn the cam on the shaft as required. Repeat the test and adjust cam (L4) and the screw in spring (A) until the requirement is met. Set the TRS MOT dial on the reading it had before the test. Set the PILOT WIRE dial to read the same as the TRS MOT dial.

(5) Raise the transmitter motor drive shaft and adjust until the gears are lined up and centered without appreciable backlash or binding. Tighten the three mounting screws.

(6) Release the armature of the relay MJ. Remount fusetrans S1, S2 and S3 and alarm fuses S1, S2 and S3. Remount fusetrans M1 and M2 and heat coil M1.

3.21 Mercury Switch (Rq. 2.21) Fig. 11

(1) If the mercury switch mounting table does not swing freely, loosen locknut (B) using the 43 tool and turn screw (A) as required. Tighten locknut (B). If the table does not meet the tilt requirement, shift the mercury switch tube in its support until the requirement is met.

(2) If the force required to move the switch arm is not within the limits given, adjust screw (J) (Fig. 2), using the KS-6854 screw-driver until the requirement is met.

(3) If the switch arm does not move the proper distance before the table starts to move, loosen locknut (D), using the 43 tool and adjust

screw (E), using the KS-6854 screw-driver until the requirement is met. Tighten locknut (D).

3.22 Slide Wire Contact Arm (Rq. 2.22)

(1) If the pressure of the contact is not within the limits given, the pressure may be adjusted by turning the adjusting screw in the contact arm mounting, until the requirement is met.

3.23 Motor Bearings (Rq. 2.23)

(1) The bearings of new M1 and M2 motors should require no attention for at least a year and possibly two years. When these bearings become objectionably noisy they should be replaced by new ones. Detailed instructions for removal of old bearings and replacing them with new ones are covered in Section 024-331-801.

3.24 Transmitter Motor TRS MOT (Rq. 2.24)

(1) Remove fusetron M2 and check the brush length and pressure.

(2) Motor Brush Length: Replace any short brushes.

(3) Motor Brush Pressure: If this requirement is not met, lengthen the coil brush spring by hand until the requirement is met.

(4) Remount fusetron M2.

3.25 Reduction Gears (Rq. 2.25)

(1) Stop the controller by blocking relay MJ operated and then blocking relay BB non-operated.

(2) To line up gear (C) and worm (D) (Fig. 13) loosen the three mounting screws in the transmitting motor drive shaft mounting, using the 4 inch regular screw-driver. This will permit shifting the position of the worm so that it can be correctly located with respect to the fibre gear. Tighten the mounting screws.

(3) To line up worm (A) and gear (B) (Fig. 12) and worm (E) and gear (F) (Fig. 13) loosen the screws which hold the motor to its mounting base, using the 129B tool or the 4 inch regular screw-driver. This will permit shifting the position of the motors so that the worm can be correctly located with respect to the fibre gear. Tighten the motor mounting screws.

(4) To line up worm (J) and gear (K) and gears (G) and (H) (Fig. 14) loosen the three mounting screws in the shaft mounting, using the 4 inch regular

3.27 Bridge Balance (Continued)

TRS MOT dial. Remove the short circuit from resistance (R2). Remove the resistance box and reconnect the pilot wire. Release relay ALM. Release relays R and L by breaking contacts (R2) and (L2) (See Fig. 9). Remount fusetrons M1 and M2 and heat coil M1.

3.28 Controller Lag (Rq. 2.28)

(1) Stop the controller so that the straight edges of the sweep cams extend vertically upward, by removing heat coil M1 and then remove fusetrons M1 and M2. Remove alarm fuses S1, S2 and S3 and fusetrons S1, S2 and S3.

(2) Arrange the circuit as shown in Fig. 20 as follows: Short-circuit resistance R1. Remove the pilot wire from the PW terminals T and R and connect the resistance box to these terminals.

(3) Note the reading of the TRS MOT dial. Balance the bridge circuit by adjusting the resistance in the resistance box. Remount the fusetrons M1 and M2. Close the controller case.

(4) Slowly decrease the resistance in the resistance box until motor M2 starts. (As the resistance is being decreased the movement of the PILOT WIRE dial should be observed and when its reading is mid-way between two scale divisions the changes in resistance should be made only 2 ohms at a time waiting for a rebalancing movement after each change). When motor M2 stops, again decrease the resistance in the resistance box in the manner covered above until motor M2 starts. Note the reading on the resistance box. This value will be referred to as (a).

(5) When motor M2 stops, decrease the resistance by 20 ohms. After the circuit has assumed a balance, slowly increase the resistance in the resistance box until motor M2 starts. (As the resistance is being increased the movement of the PILOT WIRE dial should be observed and when its reading is mid-way between two scale divisions the changes in resistance should be made only 2 ohms at a time waiting for a rebalancing movement after each change). Note the reading of the resistance box. This value will be referred to as (b).

(6) Subtract (a) from (b). Strap resistance R1 so its value will be equal to (b)-(a).

(7) Repeat paragraphs (4) and (5). The new value for (b) should be greater than the new value for (a) by

5 ohms or less. If this requirement is not met an attempt at readjusting R1 should be made and if this does not overcome the difficulty a careful and accurate readjustment of the retreating cams as described in 3.14 and 3.15 should be done.

(8) Adjust the resistance box until the TRS MOT dial reads the same as it did at the start of this test. Remove fusetrons M1 and M2. Remove the resistance box and reconnect the pilot wire. Remount fusetrons S1, S2, and S3 and alarm fuses S1, S2 and S3. Remount fusetrons M1 and M2 and heat coil M1.

3.29 Controller Step (Rq. 2.29)

(1) Stop the controller so that the straight edges of the sweep cams extend vertically upward, by removing heat coil M1 and fusetrons M1 and M2. Remove alarm fuses S1, S2 and S3 and fusetrons S1, S2 and S3.

(2) Arrange the circuit as shown in Fig. 20 as follows: Remove the pilot wire from the PW terminals T and R and connect the resistance box to these terminals.

(3) Note the reading of the TRS MOT dial. Set the PILOT WIRE dial to read the same as the TRS MOT dial. Balance the bridge circuit by adjusting the resistance in the resistance box. Remount fusetrons M1 and M2. Allow the controller to assume a balance when a division mark on the PILOT WIRE dial is opposite the index.

(4) Slowly decrease the resistance in the resistance box until motor M2 starts (when the PILOT WIRE dial reads midway between two scale divisions, decrease the resistance 2 ohms at a time waiting for a rebalancing movement after each change). Note the reading of the resistance box. After motor M2 stops, again decrease the resistance in the resistance box in the manner covered above until motor M2 starts. Repeat until motor M2 has started five times including the first time. Note the reading of the resistance box. The difference between the present resistance box reading and the previous reading shall be as shown in the following table, depending on the slide wire shunt resistance SH connected.

Terminal K Connected To Terminal	Difference in Resistance Box Readings - Ohms
No Connection	218 ± 8
D	210 ± 8
C	202 ± 8
B	193 ± 7
A	185 ± 7

3.29 Controller Step (Continued)

(5) Gradually increase the resistance in the resistance box until the TRS MOT dial reads the same as at the start of the test. Remove fusetrons M1 and M2. Remove the resistance box and reconnect the pilot wire. Remount fusetrons S1, S2 and S3 and alarm fuses S1, S2 and S3. Remount fusetrons M1 and M2 and heat coil M1.

3.30 Slide Wire Resistance (Rq.2.30)

(1) Stop the controller as covered in paragraph 3.26(1).

(2) Arrange the circuit as shown in Fig. 20 as follows: Short circuit resistance (R1). Remove the pilot wire from PW terminals T and R and connect the resistance box to these terminals.

(3) Set the PILOT WIRE dial at 24. Adjust the resistance box until the bridge circuit is balanced. Remount fusetron M1. Decrease the resistance in the resistance box until the PILOT WIRE dial reads 23. Read the value of resistance in the resistance box. Decrease the resistance in the resistance box until the PILOT WIRE dial reads 22. Read the value of the resistance in the resistance box. Add these resistance box readings and divide by 2. The result will be the resistance box reading for a PILOT WIRE dial reading of 22.5. Stop the controller when the straight edges of the sweep cams extend vertically upward by removing fusetron M1. Set the PILOT WIRE dial to read 2. Adjust the resistance box until the bridge circuit is balanced. Replace fusetron M1. Decrease the resistance in the resistance box until the PILOT WIRE dial reads 1. Read the value of the resistance in the resistance box. The difference between the resistance box readings when the PILOT WIRE dial is set at 1 and 22.5 shall be as shown in the following table depending on the slide wire shunt resistance SH connected.

Terminal K Connected To Terminal	Difference in Resistance Box Readings - Ohms
None	1175 ± 7
D	1131 ± 7
C	1085 ± 7
B	1040 ± 6
A	995 ± 6

(4) Stop the controller when the straight edges of the sweep cams extend vertically upward, by removing fusetron M1. Set the PILOT WIRE dial at 43. Adjust the resistance box until the bridge circuit is balanced. Remount

fusetron M1. Increase the resistance in the resistance box until the PILOT WIRE dial reads 44. Read the value of the resistance in the resistance box. The difference between the resistance box reading when the PILOT WIRE dial is set at 44 and 22.5 shall be as shown in the table of paragraph 3.30 (3) depending on the slide wire shunt resistance SH connected.

(5) Remove fusetron M1 when the straight edges of the sweep cams extend vertically upward. Set the PILOT WIRE dial to read the same as the TRS MOT dial. Remove the short circuit from resistance (R1). Remove the resistance box and reconnect the pilot wire. Release relay ALM. Release relays R and L by breaking contacts (R2) and (L2) (Fig. 9). Remount fusetrons M1 and M2 and heat coil M1.

3.31 Clutch Arm Travel (Rq.2.31)

(1) Stop the controller as covered in paragraph 3.26(1).

(2) Open the pilot wire. Remount fusetron M1 and notice the amount the PILOT WIRE dial increases for each rebalancing operation. If the movement of the PILOT WIRE dial is outside the limits given, turn the right hand clutch arm stop screw (Fig. 6), using the KS-6854 screw-driver until the requirement is met.

(3) Restore the pilot wire, short circuit the PW terminals T and R and notice the amount the PILOT WIRE dial decreases for each rebalancing operation. If the movement of the PILOT WIRE dial is outside the limits given, turn the left hand clutch arm stop screw (Fig. 6), using the KS-6854 screw-driver until the requirement is met.

(4) Remove fusetron M1. Set the PILOT WIRE dial to read the same as the TRS MOT dial. Release relay ALM and release relays R and L by breaking contacts (R2) and (L2) (See Fig. 9). Remount fusetrons M1 and M2 and heat coil M1.

3.32 Alignment of Transmitter Motor TRS MOT (Rq.2.32)

(1) When the transmitter motor TRS MOT has been removed for any reason or when the gears between the transmitter motor and the TRS MOT dial have been unmeshed, proceed as covered in the following paragraphs.

(2) Stop the controller by blocking relay MJ operated and then blocking relay BB non-operated. Unmesh the worm (O) (Fig. 2) by loosening the three

3.32 Alignment of Transmitter Motor TRS
MOT (Continued)

screws in the transmitter motor drive shaft mounting, using the 4-inch regular screw-driver, and lowering the shaft until the worm is free.

(3) Remove the alarm fuse and the 10 amp fuse in the 55 volt supply lead. Remove the straps between terminals \pm and $P\pm$ and between terminals G and PG. Remove alarm fuses S1, S2 and S3 and fusetrans S1, S2 and S3. Connect the terminal $P\pm$ to the transmitter motor side of alarm fuse blocks S2 and S3 and connect terminal PG to the transmitter motor side of alarm fuse block S1. Connect a 20-volt 60-cycle alternating current source to terminals $P\pm$ and PG. The transmitter motor will assume its electrical zero position.

(4) Unmesh the worm (F) (Fig. 2) by loosening the three screws in the mounting of shaft (P), using the 4-inch regular screw-driver. Set the TRS MOT dial to an even numbered division. Mesh worm (F) and gear (U) (Fig. 2) so that there is no appreciable backlash or binding and tighten the three screws in the mounting of shaft (P).

(5) Remove the 20-volt 60-cycle alternating current source from terminals $P\pm$ and PG. Remove connections from terminal PG to alarm fuse block S1 and from terminal $P\pm$ to alarm fuse blocks S2 and S3. Read the dials of the associated regulators and set the TRS MCT dial to read the same as the regulator dials.

(6) Raise the transmitter motor drive shaft until the gears are lined up and centered without appreciable backlash or binding. Tighten the three mounting screws.

(7) If the centering cams are not in the position shown in Fig. 9, unmesh the centering cam gear wheel (Fig. 2) from the idler gear as follows: Remove screws (B) and (E) from the mounting arms (B) and (E) (Fig. 2), using the 4 inch regular screw-driver. Loosen the screw in arm (A) using the 4 inch regular screw-driver and pull the mounting forward until the pins in arms (A) and (E) are free. Then rotate the whole cam assembly in a clockwise direction around screw (A) until the gears are free. Set the cams so they are in position, with respect to the associated links and contacts, as

shown in Fig. 9. Rotate the centering cam assembly to its original position so that the centering cam gear wheel and the idler gear are meshed. Remount the screws in arms (B) and (E) and tighten all screws.

(8) Replace the straps between the terminals \pm and $P\pm$ and between terminals G and PG. Remount fusetrans S1, S2 and S3 and alarm fuses S1, S2 and S3. Remount the 10 amp. fuse and the associated alarm fuse in the 55 volt supply lead.

(9) Check the positions of the retreating cams and the alarm cam as covered in paragraphs 3.14, 3.15 and 3.16.

REASONS FOR REISSUE

1. To add 1.09 describing how to avoid affecting the dial settings of the associated regulators when working on the master controller.
2. To remove the note from 2.23.
3. To substitute KS-8372 trichloroethylene for KS-6815 C.P. carbon tetrachloride under list of materials and in 3.01(2) and (3).
4. To add 3.002 in regard to removing the master controller from service.
5. To add 3.003 in regard to placing the master controller back in service.
6. To remove 3.06(3) and (4) on replacing galvanometer suspension strips and galvanometer pointer and to change the letter designations for figure 17 accordingly.
7. To change letter designations in paragraphs on coil position, suspension tension and suspension torsion to agree with figure 17.
8. To reword 3.08(9) in regard to replacement of clutch arm.
9. To remove 3.08(10) and (11) in regard to replacement of fibre shoe.
10. To remove from 3.23 the paragraphs having bearing replacement information.
11. To reword 3.23(1) to contain the information formerly in the note under 2.23.
12. To remove from 3.25 the paragraphs having gear replacement information.