

**REPLACING PAGE ADDENDUM**

*Filing Instructions:*

1. REMOVE FROM THE SECTION THE PAGES NUMBERED THE SAME AS THOSE ATTACHED TO THIS PINK SHEET.
2. INSERT THE ATTACHED PAGES INTO THE SECTION IN THEIR PLACE.
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**RECORDER-REPRODUCERS**  
**KS-12068 L4, L5, L6, AND L7**  
**REQUIREMENTS AND ADJUSTING PROCEDURES**

**1. GENERAL**

**1.001** This addendum supplements Section 034-351-701, Issue 7. The attached pages must be inserted in the section in accordance with the filing instructions above.

**2.002** This addendum is issued to replace SF-96-500 silicone fluid with SF-1147 silicone fluid.

**2. REQUIREMENTS**

The following change applies to Part 2 of the section:

202(e)—revised

**3. ADJUSTING PROCEDURES**

The following changes apply to Part 3 of this section:

3.001—revised

3.01(6)—revised

3.02(3)—revised

**Attached:**

Page 3 dated April 1973, revised  
Page 4 dated April 1973, revised  
Page 17 dated April 1973, reissued  
Page 18 dated April 1973, revised  
Page 21 dated April 1973, revised  
Page 22 dated April 1973, revised

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## RECORDER-REPRODUCERS

### KS-12068 L4, L5, L6, AND L7

### REQUIREMENTS AND ADJUSTING PROCEDURES

#### 1. GENERAL

**1.01** This section covers the KS-12068 L4, L5, L6, and L7 recorder-reproducers. The KS-12068 L5 and L6 recorder-reproducers are used with the No. 5A Announcement System for automatically announcing trunk delays. The KS-12068 L6 recorder-reproducer is used in the No. 1 Electronic Switching System (ESS) recorded announcement circuit. The KS-12068 L4 recorder-reproducer is used primarily for announcing quotations in the New York Stock Exchange Automatic Announcement System. The KS-12068 L7 recorder-reproducer is used in the 2A and 3A Automatic Call Distributing (ACD) Systems. (Reference should be made to 1.03 for information pertaining to the KS-12068 L7 recorder-reproducer.)

**1.02** This section is reissued for the following reasons:

- (a) To revise 1.04 and 3.04 to reflect additional information on cementing of recording band, KS-12076 L16, to recording drum
- (b) To revise Table A
- (c) To revise 2.11(a)(2) and (b)(2), 3.001, 3.01(a), and 3.02(e)(4)
- (d) To make other minor changes as required.

This reissue does not affect Equipment Test List.

**1.03** *KS-12068 L7 Recorder-Reproducer:* Mechanical adjustments on the L7 machine which depend upon electrical record and playback gain adjustments of the amplifiers in the associated announcement system are described in sections within Division 476 of the Bell System Practices covering the 2A and 3A ACD Systems.

**1.04** *Converted Machines:* These machines shall meet all the requirements of unconverted machines unless otherwise specified.

(a) *Drum Speed Conversion:* Some L5 machines have been converted to meet the recording drum speed requirement specified for the L6 machine. Converting to this requirement approximately doubled the message time originally provided. All converted machines are equipped with a driving pulley approximately 1/2 inch in diameter instead of the pulley, approximately 1 inch in diameter, provided on the unconverted machines. Converted L5 machines are the equivalent of L6 machines and should meet all requirements specified for L6 machines. The following designation is stamped above the nameplate on a converted machine:

CONVERTED TO LIST 6 PER X-4174

(b) *Oil Drain Conversion:* To facilitate the oil change procedure and to reduce the possibility of oil leak conditions, some machines in service have had changes introduced which incorporate a later design of the oil-drain valve assembly equipped with a 14-inch drain hose. All machines manufactured after March 1967 are fitted with the new oil drain system. Lubrication requirements and oil changing procedures are given in this section to cover both converted and unconverted machines. Machines in service that are not equipped with the oil drain valve fitted with a drain hose assembly *should be converted* to incorporate the improved lubrication system. Conversion can be accomplished by the on-site installation of No. 1A-KS-12068/KS-12055 modification kit which contains all the parts required and complete instructions for installation on KS-12068 (all lists) recorder-reproducers.

(c) *Elimination of the Cooling Fan:* The fan has been removed from the shaft of the motor on some machines in service. This was done to reduce flutter in the machine caused by unbalanced fan blades and to reduce the amount of dust drawn into the machine. Also included in this conversion was the removal of the fan guard and the blocking of the front

cover ventilation holes with a 5-inch square of thin sheet fiber (or other suitable material) secured with EC-1711 adhesive inside the cover over the holes. This design change has been incorporated by the manufacturer, and all machines made after March 1967 are delivered without fans and fan guards. Machines in service that are not modified in this respect **should be converted**. Instructions for removing the fan and fan guard are covered in Section 034-351-801.

(d) **Recording Band Wiper-Lubrication Assembly**

**Conversion:** This conversion, which adds a recording band wiper-lubrication assembly, has been incorporated on some machines in service. The wiper-lubrication assembly provides continuous cleaning and lubrication of the magnetic recording band and consists of a bracket, felt pad, and small reservoir for silicone lubricating fluid. All machines manufactured after October 1968 are equipped with the wiper-lubrication assembly. Machines in service that are **not** equipped with the wiper-lubrication assembly **should be converted**. Conversion can be accomplished by the on-site installation of No. 2A-KS-12068/KS-12055 modification kit which contains all the parts required for one complete wiper-lubrication assembly (B-992085), 1/2 pint of silicone fluid, and instructions for installation. This section describes procedures to be followed when cleaning and lubricating recording bands and gives maintenance instructions for servicing the wiper-lubrication assembly on converted machines. As of January 1971, this modification kit includes instructions for cementing the magnetic recording band, KS-12076 L16, onto the recorder drum. For recorder-reproducers modified prior to this time, reference should be made to Section 034-351-801 for procedure to cement the magnetic recording band to the recorder drum.

**1.05 Make-Busy Information**

**Warning: Hazardous voltage (117-volts 60-Hz) is supplied to the machine. Precautionary safeguards shall be observed to prevent injury to personnel or damage to the equipment.**

(a) **L5 and L6 Machines:** Before performing any work on a machine, the traffic department should be notified that it is necessary to remove the machine from service.

(b) **L4 and L7 Machines:** Before performing any work on a machine, the equipment should be removed from service in accordance with local instructions.

**1.06 Relay Requirements:** The apparatus requirements and adjusting procedure for the S1 relay are described in Section 040-670-701, which covers KS-15528 and KS-15756 control relays.

**1.07 Covers**

(a) The covers of the machine should be mounted in place at all times except when removal is necessary for performance of maintenance operations.

(b) The front cover, when provided with ventilation holes, should be mounted on the machine so that the ventilation holes are located at the lower left corner. [1.04(c) describes the modification on the front cover to block ventilation holes.]

(c) The rear cover of the machine should be mounted with the ventilation holes adjacent to the motor.

**1.08 Manual Rotation of Drum:** The recording drum should not be manually rotated without first relieving belt tension. This should be done by tilting the motor on its pivot bearing as required or by removing the driving belt.

**1.09 One drop of KS-16326 L1 oil,** for the purpose of this section, is the amount of oil discharged from the nozzle of a 486A oil can when the sides are depressed until a drop is released.

**1.10** 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.

**1.11** The requirements in Part 2 are given in the recommended sequence for a complete mechanical check of the recorder-reproducers. The procedures in Part 3 are numbered to correspond with the requirements in Part 2. Reference should be made to Part 3 when it is necessary to make adjustment.

## 2. REQUIREMENTS

**2.01 Cleaning:** The following parts shall be cleaned once a month. This interval shall be reduced to suit local conditions if periodic inspections indicate that cleaning more frequently is advisable.

(a) **General:** A general cleaning of the recorder-reproducer (Fig. 1 and 2) and mounting frame should be performed regularly to help prevent unscheduled downtime. The internal and external surfaces of the front and rear covers and the surfaces of the mounting plate, motor, motor mount, terminal strips, etc, shall be free of oil, grease, and dust. Oil or grease should always be removed from painted surfaces as soon as practical to prevent discoloration of the finish.

**Caution:** *When performing maintenance operations, exercise care to avoid damage to the magnetic head assemblies and the recording band.*

(b) **Record and Erase Heads:** The pole pieces of the record and erase heads shall be free of dirt or any other foreign matter. To check this requirement, lift each head assembly to its highest position and observe the surface of the pole piece.

(c) **Recording Band:** The recording band shall be free from dirt and foreign material, and the recording surface shall have a uniform wet, shiny appearance due to the presence of silicone lubricant.

(d) **Driving and Driven Pulleys:** The surface of the driving (motor) and driven (drum) pulleys (Fig. 2) on which the belt rides shall be free of dirt and gummy deposits.

**2.02 Lubrication:** The specified lubrication procedure shall be carried out at the time of installation. Thereafter, the following parts of the machine shall be lubricated as required at intervals of six months, unless otherwise specified.

**Caution:** *Care shall be exercised so that the KS-16326 L1 oil and KS-7860 petroleum spirits are used only for the purpose for which they are intended. Under no circumstances shall either the oil or the*

*petroleum spirits be put on the magnetic heads or recording band.*

(a) **Motor Bearings—Fig. 1(A) and 2(A):** Where applicable, apply three drops of KS-16326 L1 oil in each of the two oil cups on the motor.

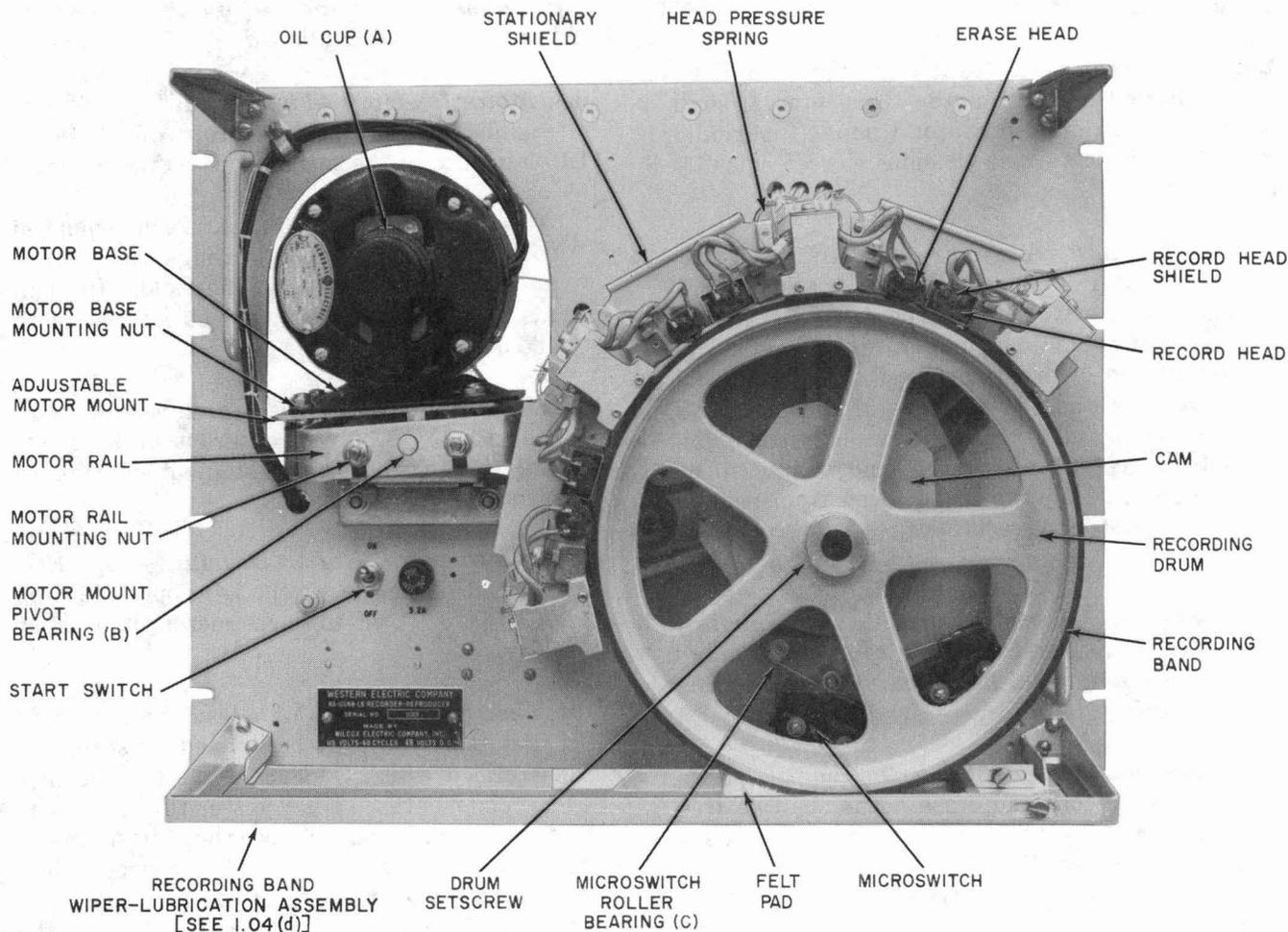
**Note:** Some machines in the field are equipped with motors having ball bearings that require no lubrication service in the field. In such cases, the motor housing is not equipped with oil cups.

(b) **Motor Mount Pivot Bearings—Fig. 1(B) and 2(B):** Apply three drops of KS-16326 L1 oil to each motor mount pivot bearing to prevent wear and squeaks.

(c) **Microswitch Roller Bearings—Fig. 1(C):** On all machines (except L4) apply one drop of KS-16326 L1 oil to each microswitch roller bearing.

(d) **Gear Case—Fig. 3(A):** Lubrication oil in the gear case shall be drained, flushed, and then refilled with KS-16326 L1 oil at least once every six months. Dirty oil in the gear case may cause variations in recording drum speed, resulting in voice flutter in the reproduction. The oil level in the oil cup of the gear case shall be maintained within 1/4 to 3/8 inch from the top of the cup. Gauge by eye. When checking, allow sufficient time (approximately 1/2 hour) after the machine has been stopped for the oil to reach its true level in the cup.

(e) **Recording Band—Fig. 1:** On machines not equipped with a recording band wiper-lubrication assembly, ◆SF-1147◆ silicone fluid lubricant shall be applied to the recording band at least once a month in accordance with the procedure described in 3.01(c). The band shall be sufficiently lubricated when the entire recording surface area is uniformly wet and shiny. Periodic manual lubrication of recording bands is not required on machines equipped with a recording band wiper-lubrication assembly. The felt wiping pad (Fig. 1) and the silicone fluid in the reservoir (slide) on the wiper-lubrication assembly should be inspected once monthly to ensure that the fluid is free of visible contamination. Proper positioning of the wiper-lubrication assembly shall be maintained so that the felt wiping pad fits snugly with **light pressure** against the magnetic recording



**Fig. 1—KS-12068 Recorder-Reproducer—Front View with Cover Removed—L6 Machine Shown Equipped with Recording Band Wiper-Lubrication Assembly**

band. Ensure that no metallic portion of the wiper-lubrication assembly comes in contact with the recording band. When the drum is rotating, silicone fluid shall be uniformly distributed over the entire recording surface. The felt wiping pad shall be replaced when excessive wear is evident or whenever the recording band is replaced. One teaspoonful of **SF-1147** silicone fluid should be added to the wiper reservoir every two months (if required). Do not add fluid if the recording band is being sufficiently lubricated and, if upon inspection, the felt wiping pad is adequately saturated with the fluid.

**2.03 Record of Lubrication:** During the period of installation, a record shall be kept by

date of the lubrication of the machine, and this record shall be turned over to the telephone company with the equipment. Thereafter a record of lubrication shall be kept in accordance with local procedure.

**2.04 Centering of Recording Band on Drum:**

The recording band shall be centrally located on the drum as determined by eye.

**2.05 Record and Erase Voltage and Record Levels:**

Satisfactory performance of record and erase heads and good quality recordings require adequate 20 to 23 kilohertz (kHz) bias and recording signal level during the recording cycle. To check this requirement, record a 1000-Hz test tone on the recording band and use the vacuum tube

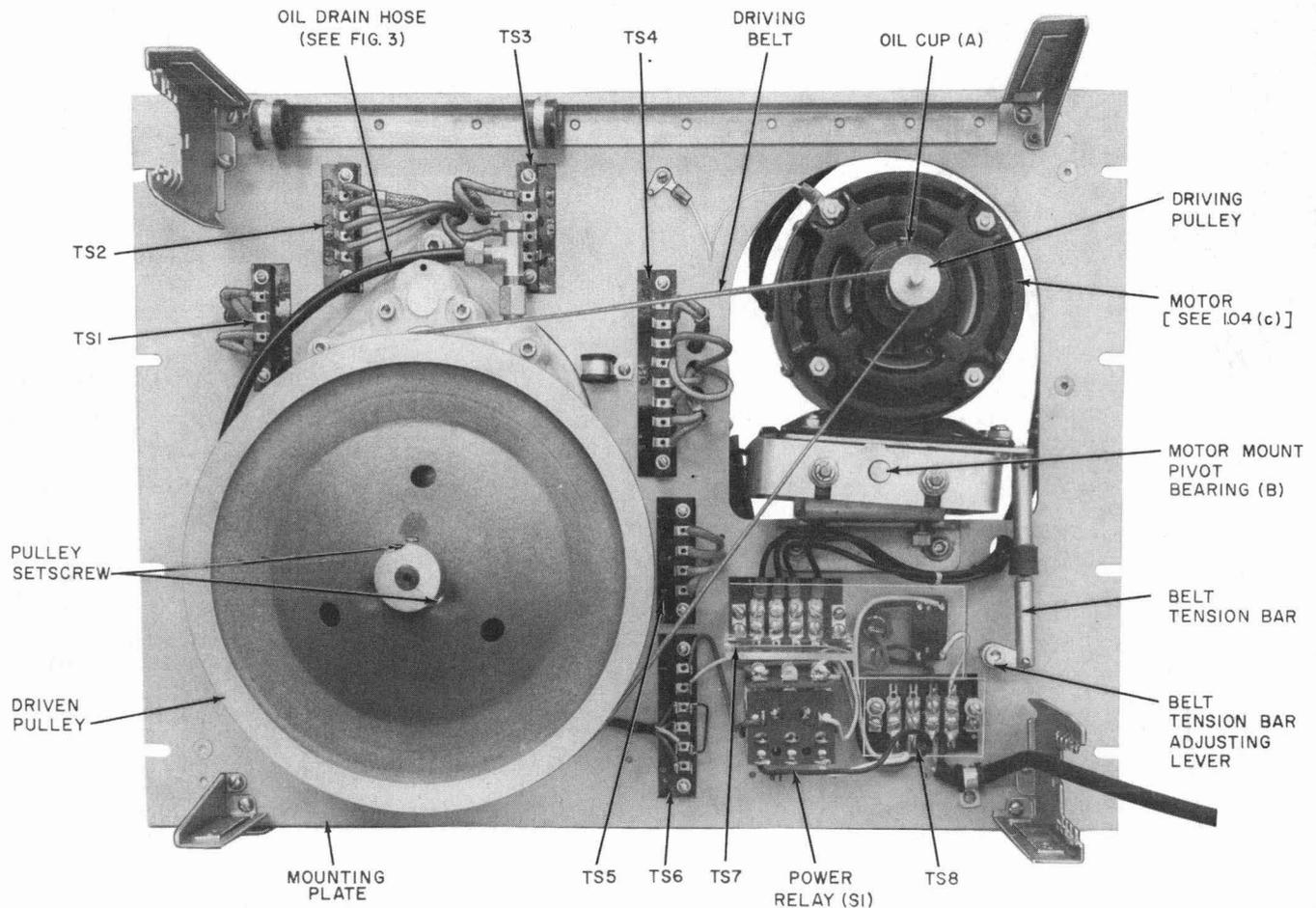


Fig. 2—KS-12068 Recorder-Reproducer—Rear View with Cover Removed—L6 Machine Shown

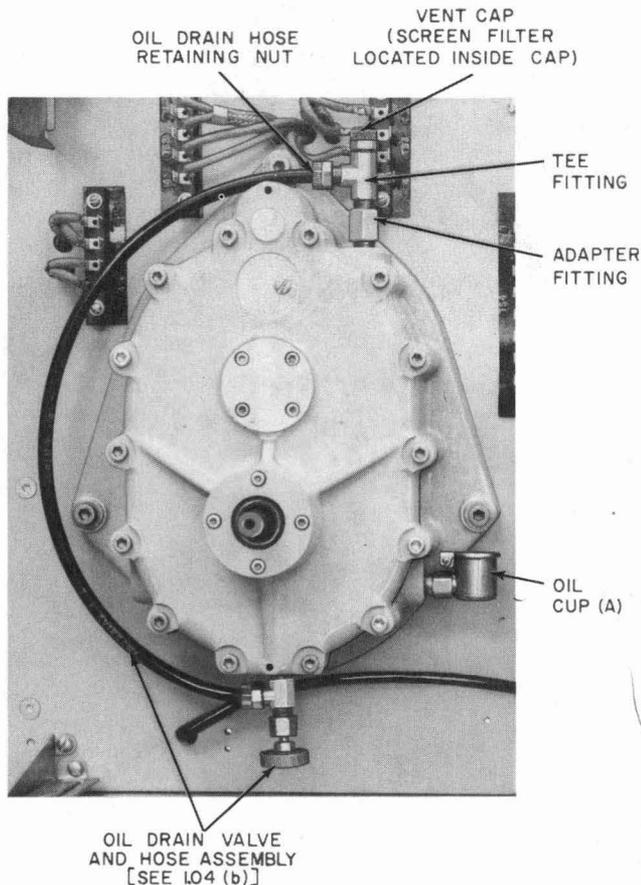
voltmeter (VTVM) to obtain voltage indications at each record head and erase head. Detailed methods for making this check are covered in (a) for L5 and L6 machines (except the L6 machine used in No. 1 ESS), in (b) for the L6 machine used in No. 1 ESS, and in (c) for the L4 machine. To check this requirement on L7 machines, refer to the appropriate section covering the 2A or 3A ACD System.

(a) **L5 and L6 Machines (Except the L6 Machine Used in No. 1 ESS):** Check typical voltage levels as follows.

**Note:** Systems using the KS-12068 recorder-reproducers have minor differences in the announcing trunk circuits. In some systems each trunk is provided with TST IN and TST OUT jacks numbered in sequence 0

through 5, and the recording of a 1000-Hz test tone is controlled by a REC POT key. In other systems, common TST IN and TST OUT jacks are associated with the channels by a CHAN SEL switch with selector positions numbered 0 through 5 and the recording of a 1000-Hz test tone is controlled by an RCD key.

- (1) Connect the 403B Hewlett-Packard VTVM (or equivalent) to recorder-reproducer terminals in accordance with Table A to obtain voltage indications in columns A and B for the channel selected.
- (2) Using a 3P7A cord, connect the  $-10$  dBm jack at the recorder-reproducer frame to the TST IN jack associated with the channel under test. (Announcing trunks are numbered



**Fig. 3—Partial Rear View of KS-12068 Recorder-Reproducer—Showing Gear Case Equipped with Oil Drain Valve and Hose Assembly**

0 through 5 and connect with recorder channels 1 through 6, respectively.)

(3) Operate the REC POT key or the RCD key (whichever is provided) and hold operated for two full revolutions of the recording drum. Meter indications shall be in accordance with columns A and B of Table A as the 1000-Hz tone is being recorded on the recording band.

(4) Remove the bias oscillator signal (oscillator tube or card) of the associated amplifier and connect the VTVM in accordance with Table A for voltage indications in column C.

(5) Hold operated the REC POT (or RCD) key while observing the VTVM. Voltage

indications for the 1000-Hz tone at the record head should be within the levels given in column C of Table A. It may be necessary to adjust the RECORD gain control of the associated amplifier to obtain proper voltage indications.

(6) After the voltage tests have been completed, restore the amplifier oscillator tube (or card).

(7) Disconnect the VTVM and remove the patching cord from the -10 dBm jack and the TST IN jack.

♦TABLE A♦

L4, L5, L6, AND L7 MACHINES

CHANNEL	VTVM (See Note) CONNECTED TO		A	B	C
	TERMINAL STRIP	TERMINAL NUMBERS	RMS 20V/30V (RECORD BIAS)	RMS 170 ± 17* (ERASE VOLTAGE)	RMS 0.2V/0.5V (RECORD LEVEL)
1	TS4	1,2	✓		✓
1	TS5	1,2		✓	
2	TS4	7,8	✓		✓
2	TS5	3,4		✓	
3	TS2	1,2	✓		✓
3	TS4	4,3		✓	
4	TS3	1,2	✓		✓
4	TS4	5,6		✓	
5	TS1	1,2	✓		✓
5	TS2	3,4		✓	
6	TS1	3,4	✓		✓
6	TS3	3,4		✓	

\* Nominal when arranged with KS-19219 L1 amplifier, but 90/120 volts when arranged with KS-16508 L1, L2 or KS-12056 L13A amplifier.

**Note:** VTVM (with isolated ground)  
Model 403B, Hewlett-Packard Co. (or equivalent)  
— Connect VTVM using isolated ground and verify that the common terminal of the meter is not connected to the ground terminal of the meter.

(b) **L6 Machine (Used in No. 1 ESS Only):**  
Check typical voltage levels as follows.

(1) Connect the 403B Hewlett-Packard VTVM (or equivalent) to recorder-reproducer

terminals in accordance with Table A to obtain indications in columns A and B for the channel selected.

- (2) Following the procedure given in Section 231-024-501, record a 1000-Hz tone on the channel being checked. (Announcing trunks are numbered 0 through 5 and connect with recorder channels 1 through 6, respectively.) Meter indications shall be in accordance with columns A and B of Table A as the 1000-Hz tone is being recorded on the recording band.
  - (3) Remove the bias oscillator signal (oscillator tube or card) of the associated amplifier and connect the VTVM in accordance with Table A for voltage indications in column C.
  - (4) Voltage indications for the 1000-Hz tone at the record head should be within the levels given in column C of Table A. Adjustment of the RECORD gain control on the associated amplifier may be necessary.
  - (5) After the voltage tests have been completed, restore the amplifier oscillator tube or card and disconnect the VTVM.
- (c) **L4 Machine:** Check typical voltage levels as follows.
- (1) Using a split patching cord, patch the channel under test to the TEST LINE jack provided at the patching bay for the machine under test.
  - (2) Connect the 403B Hewlett-Packard VTVM (or equivalent) to recorder-reproducer terminals in accordance with Table A to obtain voltage indications in columns A and B for the channel selector.
  - (3) Operate the TONE key at the test panel. Operate and hold operated the TONE REC key for at least two full revolutions of the recording drum while observing the VTVM. Meter indications shall be in accordance with columns A and B of Table A as the 1000-Hz tone is being recorded on the recording band.
  - (4) Remove the oscillator signal (oscillator tube or card) of the associated amplifier and connect the VTVM in accordance with Table A for voltage indications in column C.

- (5) Hold operated the TONE REC key while observing the VTVM. Voltage indications for the 1000-Hz tone at the record head should be within the levels given in column C of Table A. It may be necessary to adjust the RECORD gain control of the associated amplifier to obtain proper voltage indications.
- (6) After the voltage tests have been completed, restore the TONE key to normal, restore the amplifier oscillator tube or card, remove the patching cord from the TEST LINE jack at the patching bay, and disconnect the VTVM.

**2.06 Position of Record and Erase Heads on Recording Band:**

The record and erase heads shall be positioned so that the magnetic gap in the pole piece lies tangent to the cylindrical recording band while the head rests upon the band in its normal operating position as shown in Fig. 4(A) and 5(A). The erase head has a wider magnetic gap than the record head and is effective over a wider area. Its position is gauged by eye. The record head is aligned by means of a 1000-Hz test tone which is available at associated announcement systems. Detailed procedures are covered in (a) for L5 and L6 machines (except the L6 machine used in No. 1 ESS), in (b) for the L6 machine used in No. 1 ESS, and in (c) for the L4 machine. To check this requirement on L7 machines, refer to the appropriate section covering the 2A or 3A ACD system.

(a) **L5 and L6 Machines (Except the L6 Machine Used in No. 1 ESS):** Check for proper positioning of record heads by performing the following.

- (1) Using a 3P7A cord, connect the -10 dBm jack at the recorder-reproducer frame to the TST IN jack associated with the channel under test. (Announcing trunks are numbered 0 through 5 and connect with recorder channels 1 through 6, respectively.)
- (2) Using a 3P7A cord, connect the 23A transmission measuring set (TMS) to the TST OUT jack associated with the channel under test.
- (3) Allow 30 seconds for the tube-type amplifiers, where provided, to warm up.

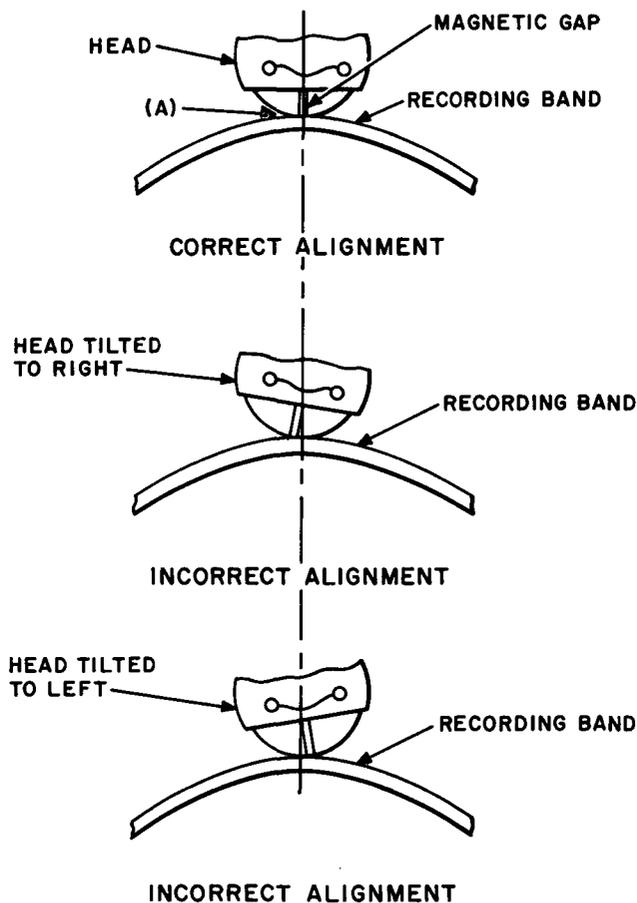


Fig. 4—Position of Magnetic Gap of Head on Recording Band

(4) Operate the REC POT key or the RCD key (whichever is provided) and hold operated for two full revolutions of the recording drum while observing the 23A TMS; adjust the RECORD gain control on the associated channel amplifier to obtain a  $-4$  dB indication on the meter.

**Note:** The tone recorded on the band is interrupted once during each revolution of the drum. Meter needle fluctuations at the end of each message cycle should be disregarded.

**Caution:** In the following steps do not attempt to turn the head adjusting screw locknut (Fig. 5) since this is a fixed nut secured to the head adjusting bracket.

(5) Set the REPRODUCE gain control of the associated amplifier to give a convenient TMS meter indication. Using the 245 wrench, partially loosen head mounting nut (Fig. 6) to permit slight rotation of the record head in its mounting. Using the R-2958 wrench, turn the head adjusting screw in or out, as required, to rotate the magnetic gap of the head into a position on the recording band that gives the maximum TMS meter indication. Then securely tighten the head mounting nut.

(6) Record a new tone on the band as described in (4) and readjust the amplifier REPRODUCE gain control until the TMS meter indicates  $-9$  dB.

(7) After the test has been completed, disconnect the 23A TMS and remove the patching cords from the TST IN, TST OUT, and  $-10$  dBm jacks.

(b) **L6 Machine (Used in No. 1 ESS Only):**  
Check for proper positioning of record heads as follows.

(1) Following the procedure given in Section 231-024-501, record a 1000-Hz tone on the channel under test. (Announcing trunks are numbered 0 through 5 and connect with recorder channels 1 through 6, respectively.)

(2) Connect a 23A TMS to the TMS jack.

(3) Connect a 52N telephone headset to the HS jack.

(4) Using the 245 wrench, partially loosen the head mounting nut (Fig. 6) to permit slight rotation of the record head in its mounting.

(5) While monitoring the test tone, use the R-2958 wrench to turn the head adjusting screw in or out, as required, until a maximum voltage indication is obtained on the meter. Then securely tighten the head mounting nut. Adjust the amplifier REPRODUCE gain control until the TMS meter indicates  $-9$  dB.

(6) After the test has been completed, remove the telephone headset plug from the HS jack and disconnect the 23A TMS from the TMS jack.

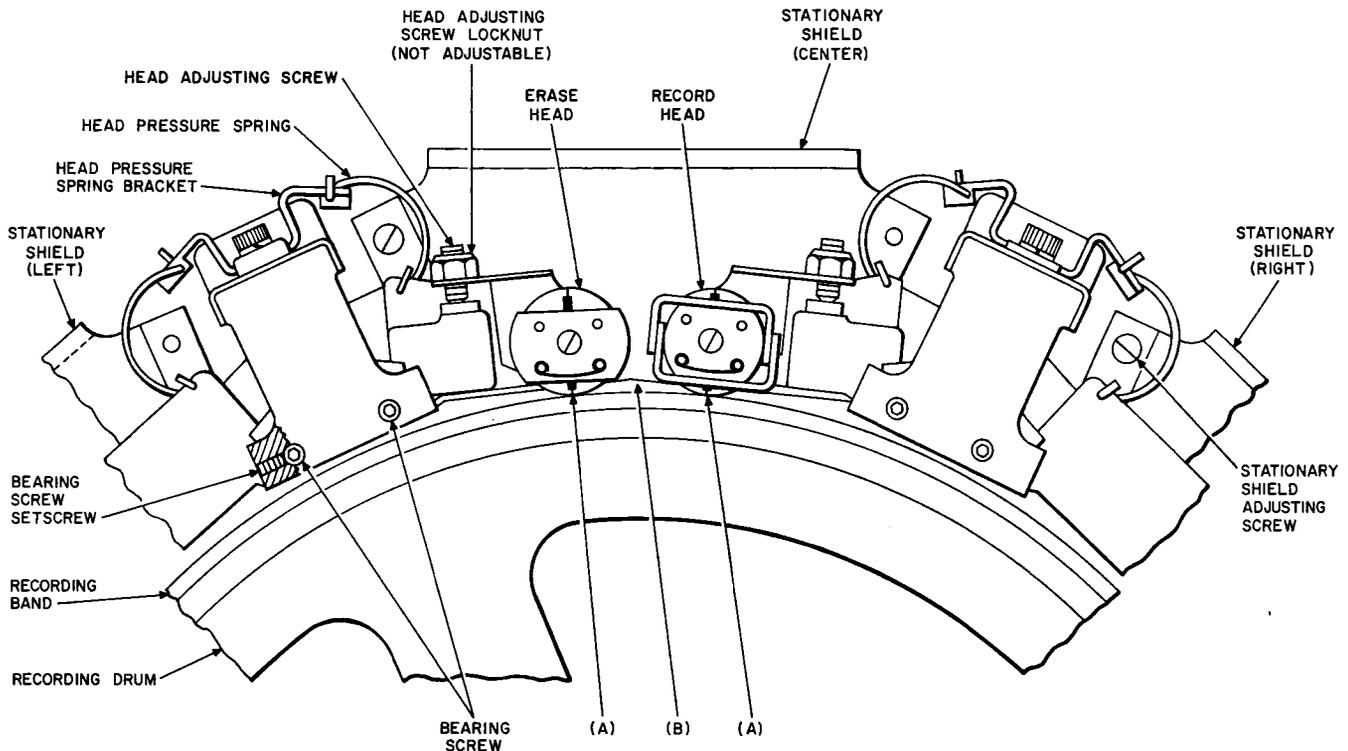


Fig. 5—Erase and Record Heads and Associated Parts

(c) **LA Machine:** Check for proper positioning of record heads by performing the following.

(1) Using the proper end of the split patching cord, patch the channel under test to the TEST LINE jack provided at the patching bay for the machine under test.

(2) Insert the plug of a cord provided locally into the AMPL TEST jack and connect the terminals of the cord to a KS-14510 volt-ohm-milliammeter.

(3) Record a tone on the channel as follows. Operate the TONE key at the test panel. Operate the AMPL TEST key. Operate and hold operated the TONE REC key and adjust the REC gain control to obtain an indication of 2.0 volts on the meter. Hold the TONE REC key operated until the P (pulse) lamp has flashed twice. Release the TONE REC key. A 1000-Hz tone is now recorded on the recording band.

**Note:** It should be possible to obtain a 2.0-volt indication on the meter with the REC gain control below the halfway point of full clockwise and full counterclockwise positions of adjustment. If this is not the case, the amplifier may not be functioning properly; check the amplifier in accordance with applicable maintenance practices covering the specific amplifier.

**Caution:** Do not attempt to turn the head adjusting nut since this nut is secured to the head adjusting bracket.

(4) Loosen the head mounting nut slightly. Operate the AMPL TEST key. Turn the head adjusting screw with the R-2958 wrench in or out, as required, until a maximum indication is obtained on the meter. Then securely tighten the head mounting nut.

**Note:** The tone recorded on the band is interrupted once during each revolution of the drum. The fluctuations of the meter

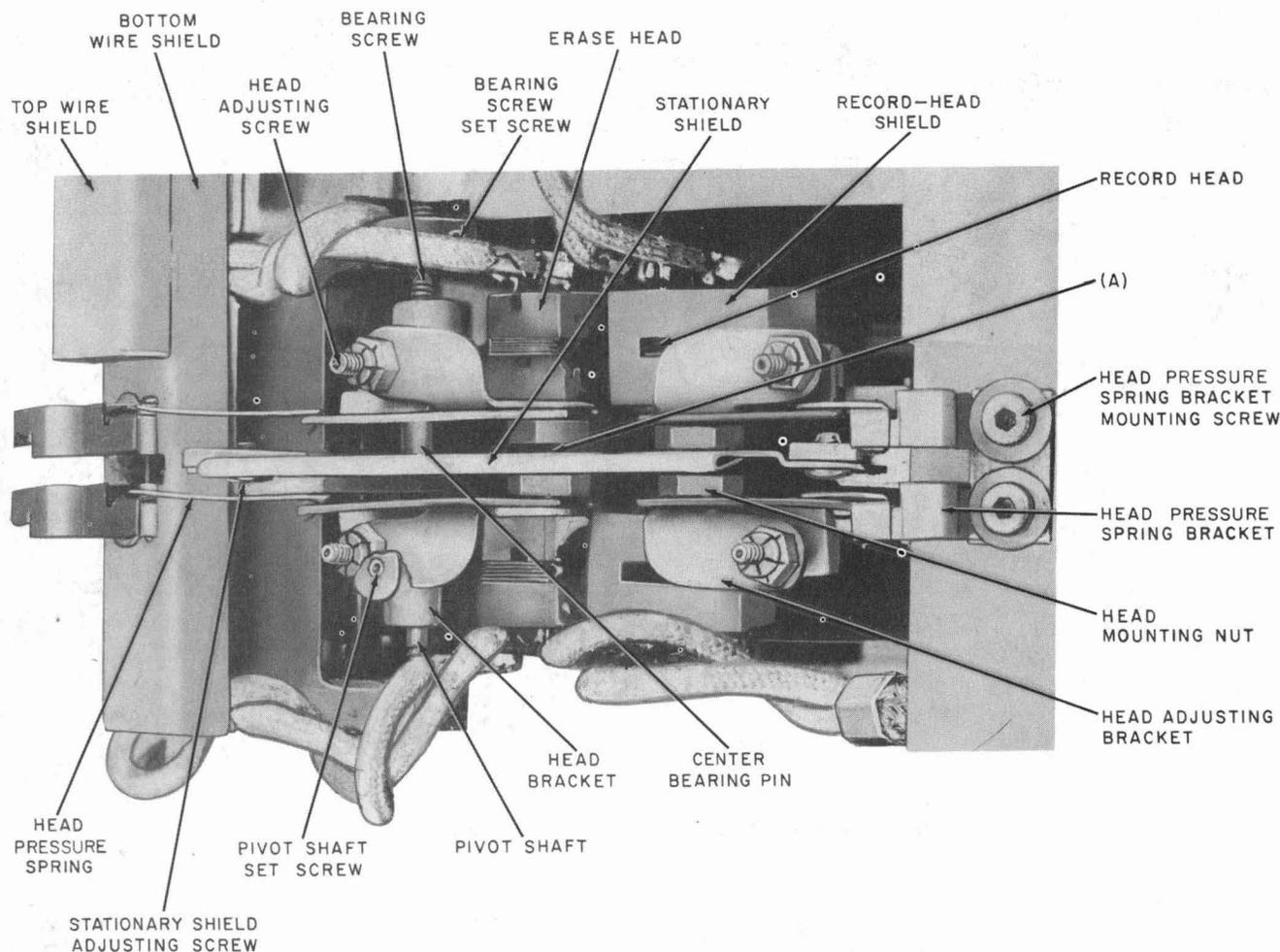


Fig. 6—Erase and Record Heads as Viewed from Top

needle due to this interruption should be disregarded.

(5) Again operate the TONE REC key until the P lamp has flashed twice; then release the TONE REC key. An indication of 2.0 volts should be obtainable on the meter when the AMPL TEST key is operated. If the 2.0 volt indication is not obtainable on the meter with the head adjusted for maximum output, check the head and amplifier in accordance with maintenance instructions on the amplifier and proceed as indicated.

(6) When these tests have been completed, operate the REC key until the P lamp has flashed twice. Remove the plug connecting the channel under test to the test line. Restore all keys to normal.

**2.07 Pressure of Record and Erase Heads Against Recording Band:** With the recording drum turning, the record and erase heads [Fig. 5 (A)] shall rest on the recording band with the following pressure:

Min 25 grams  
Max 35 grams

To check the requirement on erase heads, raise the head from the recording band and loop a piece of linen thread over the head mounting nut. Hook the tip of the reed of the 70D gauge through the thread loop. Lower the head onto the band. Measure the pressure just as the head contacts the band as gauged by eye and feel. To check this requirement on record heads, record a 1000-Hz tone on the channel for which the record head pressure is being checked. Then raise the head.

While listening for the tone in a receiver, slowly lower the head onto the band. Measure the pressure at the point where the tone can just be heard for approximately one complete revolution of the drum. Detailed methods for making this check are covered in (a) for L5 and L6 machines (except the L6 machine used in No. 1 ESS), in (b) for the L6 machine used in No. 1 ESS, and in (c) for the L4 machine. To check this requirement on L7 machines, refer to the appropriate section covering the 2A or 3A ACD System.

(a) **L5 and L6 Machines (Except the L6 Machine Used in No. 1 ESS):** Check for proper pressure between record head and recording band by performing the following.

- (1) Record a 1000-Hz tone on the channel whose record head pressure is to be checked by connecting a 3P7A cord between the -10 dBm jack and the TST IN jack of the channel under test. (Announcing trunks are numbered 0 through 5 and connect with recorder channels 1 through 6, respectively.) Operate the REC POT key or the RCD key (whichever is provided) and hold operated for a minimum of one complete recording cycle; then release the REC POT (or RCD) key.
- (2) Verify that the 1000-Hz tone is recorded on the band by listening for the tone in a 716E or 528 receiver. Using a 2W4A cord, connect the receiver to the TST OUT jack corresponding to the channel whose record head is under test.
- (3) If a stationary shield interferes with making the following check, remove the shield. Before removing a shield, mark the front to ensure remounting the shield in its original position. Raise the head from the recording band and loop a piece of linen thread over the mounting nut on the head. Hook the tip of the reed of the 70D gauge through the loop of thread. Lower the head while listening for the tone with the receiver. Measure the pressure at the point where the tone can just be heard for approximately one revolution of the drum.

**Note:** A brief interruption in the tone during each revolution of the drum should be disregarded.

(4) If a stationary shield was removed, remount the shield in its original position; check that it clears adjacent parts and meets the requirements of 2.10.

(5) Remove plugs from TST IN, TST OUT, and -10 dBm jacks.

(b) **L6 Machine (Used in No. 1 ESS Only):** Check for proper pressure between record head and recording band as follows.

- (1) Following the procedure given in Section 231-024-501, record a 1000-Hz tone on the channel associated with the record head under test. (Announcing trunks are numbered 0 through 5 and connect with recorder channels 1 through 6, respectively.)
- (2) Listen to the tone recorded on the band, using the 52N telephone headset connected to the HS jack.
- (3) Using the 70D gauge, proceed as described in (a)(3) and (4).
- (4) After the test is completed, disconnect the telephone headset.

(c) **L4 Machine:** To measure record head pressure, proceed as follows.

- (1) Using the proper end of the split patching cord, patch the channel under test to the TEST LINE jack provided at the patching bay for the machine under test. Connect the operator telephone set into the TEL CKT jack at the test panel.
- (2) Operate the TONE key at the test panel. Operate and hold operated the TONE REC key until the P lamp flashes twice. Release the TONE REC key. A 1000-Hz tone is now recorded on the recording band of the channel under test.
- (3) Operate the MON key and proceed as described in (a)(3) and (4).
- (4) Remove the telephone set from the TEL CKT jack. Operate and hold operated the REC key until the P lamp flashes twice. Remove the cord from the TEST LINE jack at the patching bay.

**2.08 Freedom of Movement:** Head assemblies (Fig. 6) shall move freely on their bearings. Check by eye and feel. To check this requirement, raise the head assembly about 1/4 inch and note if the head drops onto the recording band without hesitation.

**2.09 Record and Erase Head Mounting Bracket Sideplay:** The record and erase head mounting brackets shall have perceptible sideplay on their bearings. Check by eye and feel.

**2.10 Clearance Between Stationary Shield and Adjacent Parts**

(a) **Fig. 5(B):** The clearance between the stationary shield and the recording band at the closest point shall be

1/32 inch

Gauge by eye. This requirement shall be met in any position of the drum.

(b) **Fig. 6(A):** The stationary shield shall clear the mounting nuts of the adjacent heads.

**2.11 Interference Between Adjacent Channels:**

Erasure of a recording on one channel shall not affect the reproduction of a recording on an adjacent channel. Use the 23A TMS for L5 and L6 machines, and use the KS-14510 volt-ohm-milliammeter for the L4 machine. To check this requirement, record a 1000-Hz tone on one channel and measure the output of that channel. Then energize the erase head of each adjacent channel individually and again measure the output of the first channel. On L5 and L6 machines, the average output indication as observed on the TMS meter after energizing the erase heads of adjacent channels should not be over 1 dB less than the average output indication before energizing the erase heads. On the L4 machine, the average output indication as observed on the meter after energizing the erase heads should not be over 0.4 volt less than the average meter indication before energizing the erase heads. The detailed method of checking interference between the record head of channel 3 and the erase heads of channels 1 and 5 is covered in (a) through (c). To make similar checks for interference between the record and erase heads of other channels, proceed as described in (a) through (c), but make the necessary patching connections given in Tables B and C (whichever is applicable) for L5

and L6 machines, in Table D for the L6 machine used in No. 1 ESS only, and in Table E for the L4 machine. Refer to the appropriate section covering the 2A or 3A ACD System when checking the L7 machine.

(a) **L5 and L6 Machines (Except the L6 Machine Used in No. 1 ESS):** To check interference between adjacent channels, proceed as follows.

**Note:** In some announcement systems, each trunk is provided with separate TST IN and TST OUT jacks numbered in sequence 0 through 5 (corresponding to channels 1 through 6 on the machine). For these systems, Table B is applicable when checking for interference between channels. In other announcement systems, common TST IN and TST OUT jacks are associated with the channels by a CHAN SEL switch with numbered markings of 0 through 5 (corresponding to channels 1 through 6 on the machine). For these systems, Table C is applicable when checking for interference between channels.

(1) Record a 1000-Hz tone on channel 3 (Fig. 7) by connecting a 3P7A cord between the -10 dBm jack and TST IN 2 jack (corresponding to channel 3). Operate the REC POT (or RCD) key and hold operated for two full revolutions of the drum; release the key.

(2) Connect a 23A TMS to a TST OUT 2 jack (corresponding to channel 3) using a  $\phi$ 2W42A $\phi$  cord. Observe the level of the reproduced tone indicated on the TMS meter.

(3) Insert one plug of a 3P7A cord into the TST IN 0 jack (corresponding to channel 1) and ground its sleeve. (In systems where a CHAN SEL switch is provided, place the switch in position 0 and operate the RCD key.) This will energize the erase head of channel 1 and should be maintained for a full drum revolution. Remove the cord sleeve ground (or restore the RCD key) and check that the TMS meter indication for channel 3 has not been reduced more than 1 dB.

**Note:** The tone recorded on the band is interrupted once during each revolution of the drum. The fluctuations of the meter

needle due to this interruption should be disregarded.

(4) Note the results of (3) and repeat the test for other channels as outlined in Table B or Table C, whichever is applicable.

(5) Erasures on one channel affecting another greater than 1 dB shall be corrected in accordance with 3.12. After all testing has been completed, remove all patching cords.

TABLE B

L5 AND L6 MACHINES USED IN SYSTEMS PROVIDING SEPARATE JACKS FOR TEST IN AND TEST OUT FUNCTIONS

RECORD		ERASE		CHECK
ON CHANNEL	PATCH 3P7A CORD FROM 10-DBM JACK TO	ON CHANNEL	GROUND SLEEVE OF 3P7A JACK PLUGGED INTO	OBSERVE METER ON 23A TRANSMISSION MEASURING SET PLUGGED INTO
3	TST IN 2	1	TST IN 0	TST OUT 2
3	TST IN 2	5	TST IN 4	TST OUT 2
1	TST IN 0	3	TST IN 2	TST OUT 0
5	TST IN 4	3	TST IN 2	TST OUT 4
4	TST IN 3	2	TST IN 1	TST OUT 3
4	TST IN 3	6	TST IN 5	TST OUT 3
2	TST IN 1	4	TST IN 3	TST OUT 1
6	TST IN 5	4	TST IN 3	TST OUT 5

(b) **L6 Machine (Used in No. 1 ESS Only):**  
To check interference between adjacent channels, proceed as follows.

- (1) Following the procedure given in Section 231-024-501, record a 1000-Hz tone on channel 3 (Fig. 7).
- (2) To measure the output of channel 3, insert one plug of 3P12H cord into the TMS jack and the other plug into a 23A TMS.
- (3) Note the range of needle fluctuations of the meter on the TMS which is connected to channel 3. Hold operated the record-reproduce

TABLE C

L5 AND L6 MACHINES USED IN SYSTEMS PROVIDING A CHANNEL SELECTOR SWITCH FOR TEST IN AND TEST OUT FUNCTIONS

RECORD		ERASE		CHECK	
ON CHANNEL	ACTION A	ON CHANNEL	ACTION B	ON CHANNEL	ACTION C
3	2	1	0	3	2
3	2	5	4	3	2
1	0	3	2	1	0
5	4	3	2	5	4
4	3	2	1	4	3
4	3	6	5	4	3
2	1	4	3	2	1
6	5	4	3	6	5

**ACTION A** — Set CHAN SEL switch in position shown with -10 dBm jack patched to TST IN jack and 23A TMS to TST OUT jack. Operate RCD key for one drum revolution.

**ACTION B** — Set CHAN SEL switch in position shown. With patch cords removed, operate RCD key for one drum revolution.

**ACTION C** — Set CHAN SEL switch in position with 23A TMS patched to TST OUT jack.

transfer relay in the channel associated with channel 1 for one full revolution of the recording drum. This energizes the erase head of channel 1. Release the record-reproduce transfer relay and again note the range of needle fluctuations on the meter connected to channel 3. The average indication on the TMS meter after energizing the erase head of channel 1 should not be over 1 dB less than the average meter indication before energizing the erase head of channel 1.

**Note:** The tone recorded on the recording band is interrupted once during each revolution of the drum. The fluctuations of the meter

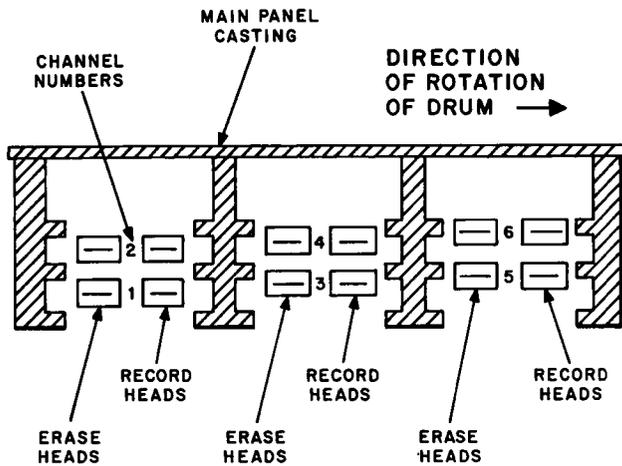


Fig. 7—Arrangement of Erase and Record Heads—Top View

needle due to this interruption should be disregarded.

(4) If the erasure on channel 1 has affected the recording on channel 3, erase and again record the tone on channel 3; then proceed as covered in (5). If the erasure on channel 1 has not affected the recording on channel 3, proceed directly as covered in (5).

(5) Note the range of needle fluctuations of the meter on the TMS which is connected to channel 3. Hold operated the record-reproduce transfer relay in the channel associated with channel 5 for one full revolution of the recording drum. This energizes the erase head of channel 5. Release the record-reproduce transfer relay and again note the range of needle fluctuations on the meter connected to channel 3. The average indication on the TMS meter after energizing the erase head of channel 5 should not be over 1 dB less than the average meter indication before energizing the erase head of channel 5. Depress the CHANNEL TEST NOR key.

(6) Note the results of (3) and (5) and repeat the test for other channels as outlined in Table D.

(7) Erasures on one channel affecting another greater than 1 dB shall be corrected in accordance with 3.12. After all testing has

been completed, remove the 23A TMS and patching cords.

TABLE D

L6 MACHINE (USED IN NO. 1 ESS ONLY)

RECORD		ERASE		CHECK
ON CHANNEL	DEPRESS CHANNEL TEST KEY. WAIT 36 SECONDS. DEPRESS RECORD TONE REC KEY	ON CHANNEL	MANUALLY OPERATE RECORD-REPRODUCE TRANSFER RELAY IN AMPLIFIER	OBSERVE METER ON 23A TRANSMISSION MEASURING SET PLUGGED INTO
1	0	3	2	TMS jack of frame
2	1	4	3	
3	2	1	0	
3	2	5	4	
4	3	2	1	
4	3	6	5	
5	4	3	2	
6	5	4	3	

(c) **L4 Machine:** To check interference between adjacent channels, proceed as follows.

(1) Using the proper end of the split patching cord, patch channel 3 to the TEST LINE jack provided at the patching bay for the machine under test.

(2) Insert the plug of a cord provided locally into the AMPL JK jack and connect the terminals of the cord to a KS-14510 meter.

(3) Record a tone on channel 3 as follows. Operate the TONE key at the test panel. Operate and hold operated the TONE REC key until the P lamp has flashed twice. Release the TONE REC key. A 1000-Hz tone is now recorded on the recording band.

(4) Operate the AMPL TEST key and note the range of needle fluctuations of the KS-14510 meter. Release the AMPL TEST key.

**Note:** The tone recorded on the band is interrupted once during each revolution of the drum. The needle fluctuations of the meter due to this interruption should be disregarded.

(5) Hold operated the record-reproduce transfer relay in the amplifier associated with channel 1 for one full revolution of the drum of the machine. This energizes the erase head of channel 1. Release the record-reproduce transfer relay. Again operate the AMPL test key and note the range of needle fluctuations of the meter. The average of the needle fluctuations after energizing the erase head of channel 1 should not be more than 0.4 volt less than the average meter indication before energizing the erase head of channel 1.

(6) If the erasure on channel 1 has affected the recording on channel 3, operate the REC key. This will erase the tone on channel 3. Again record the tone on channel 3 as described in (3), and then proceed as covered in (7). If the erasure on channel 1 has not affected the recording on channel 3, proceed directly as covered in (7).

(7) Hold operated the record-reproduce transfer relay in the amplifier associated with channel 5 for one full revolution of the drum of the machine. This energizes the erase head of channel 5. Release the record-reproduce transfer relay. Again operate the AMPL TEST key and note the range of needle fluctuations of the meter. The average of the needle fluctuations after energizing the erase head of channel 5 should not be more than 0.4 volt less than the average meter indication before energizing the erase head of channel 5.

(8) Note the results of (5) and (7) and repeat the test for other channels as outlined in Table E.

(9) Erasures on one channel affecting another greater than 0.4 volt shall be corrected in accordance with 3.12.

(10) When these tests have been completed, operate the REC key until the P lamp has flashed twice. Remove the plug connecting

the channel under test to the test line. Restore all keys to normal.

TABLE E

L4 MACHINE

RECORD		ERASE		CHECK
ON CHAN- NEL	PATCH TEST LINE TO TONES PLUG FOR CHAN- NEL	ON CHAN- NEL	OPERATE RECORD-REPRODUCE TRANSFER RELAY IN AMPLIFIER ASSOCIATED WITH CHANNEL	OBSERVE KS-14510 METER PLUGGED INTO
1	1	3	3	AMPL JK jack of test line
2	2	4	4	
3	3	1	1	
3	3	5	5	
4	4	2	2	
4	4	6	6	
5	5	3	3	
6	6	4	4	

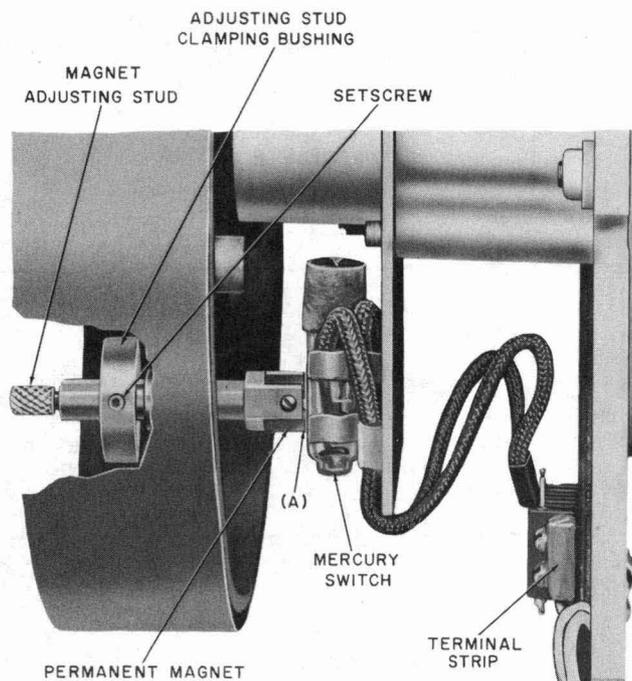
**2.12 Erasure of Message:** Each erase head in one revolution of the recording drum shall completely erase a message which has been recorded by the associated record head at normal voice levels. To check this requirement, make and erase a recording on each channel of the machine as previously described. Note that each recording is completely erased. Gauge by ear.

**2.13 Clearance Between Permanent Magnet and Mercury Switch (LA Machine Only)—Fig. 8(A):** The permanent magnet shall clear the mercury switch by

Min 0.010 inch  
Max 0.020 inch

Use the 85B and 85C gauges.

**2.14 Adjustable Motor Mount—Fig. 1(B) and 2(B):** The adjustable motor mount shall move freely on its bearings. Check by eye and feel.



**Fig. 8—Permanent Magnet, Mercury Switch, Associated Parts—KS-12068 L4 Recorder- Reproducer**

**2.15 Driving Belt Tension:** With the record and erase heads resting on the surface of the recording drum, the driving belt shall drive the recording drum without slipping and without vibration.

**2.16 Pulley and Driving Belt Alignment**

- (a) The driving belt shall ride approximately in the center of the driven pulley.
- (b) The driving belt shall clear the flanges of the driving pulley.

**2.17 Recording Drum Speed:** The recording drum shall make ten complete revolutions in the times shown.

	L4 MACHINE	L5 MACHINE	L6 AND L7 MACHINES (SEE 1.04)
Min	39 sec	58 sec	117 sec
Max	43 sec	68 sec	135 sec

Using the KS-3008 stopwatch, observe the time required for the recording drum to complete ten revolutions.

**2.18 Microswitches and Switch Cams:** The L5, L6, and L7 machines are equipped with cam and microswitch systems for control of recording time and interrelated sequence of operation. The L4 machine does not have the cams or microswitches but is equipped with a magnetically operated mercury switch (Fig. 8) for control of recording time. Microswitches shall be positioned in relation to the switch cams so that there is proper engagement of the microswitch rollers with the lobes of the associated cam.

- (a) **L5 and L6 Machines:** To check for proper positioning of D2 and D3 microswitches (Fig. 9), proceed as follows.

**Note 1:** Belt tension shall be relieved before manually rotating the record drum by removing the driving belt or tilting the motor on its pivot as required.

**Note 2:** Rotate the drum slowly and carefully, and always approach the switch operating point in a clockwise direction.

- (1) Slowly rotate the drum clockwise until lobe 1 closes switch D2. At this point place a pencil mark on the cam opposite line "0". Place the mark as near as possible to the edge of the cam.
- (2) Continue to rotate the drum clockwise until lobe 1 opens switch D2. The pencil mark should now fall either on line "1" or within the limits on either side of it.
- (3) At the point where lobe 1 opens switch L2, place a second pencil mark on the cam opposite line 2 and continue to rotate cam clockwise until lobe 2 closes switch D2. The second pencil mark should now fall on line 0 or within the limits on either side of it.
- (4) At the point where lobe 2 closes switch D2, place a third pencil mark on the cam opposite line 2 and continue to rotate cam clockwise until lobe 2 opens switch D2. The third pencil mark should now fall on line 0 or within the limits on either side of it.

(5) If in (2), (3), and (4) the pencil mark does not fall either on line 0 or 1 or within the limits on either side of them, loosen the mounting screws of switch D2, change its position, tighten these screws, and repeat the preceding steps until each of the requirements are satisfied.

(6) After switch D2 has been properly positioned, erase all pencil marks. Then turn the cam clockwise until lobe 2 opens switch D2. Lobe 3 should have previously closed switch D3. Again place a pencil mark on the cam opposite line 0. Continue to rotate cam clockwise until lobe 3 opens switch D3. The pencil mark should now fall on line 1 or within limits of the two small lines on either side of it. If this is not the case, loosen the mounting screws of switch D3, change its position, tighten these screws, and repeat (6) until switch D3 is properly positioned. Erase the pencil mark.

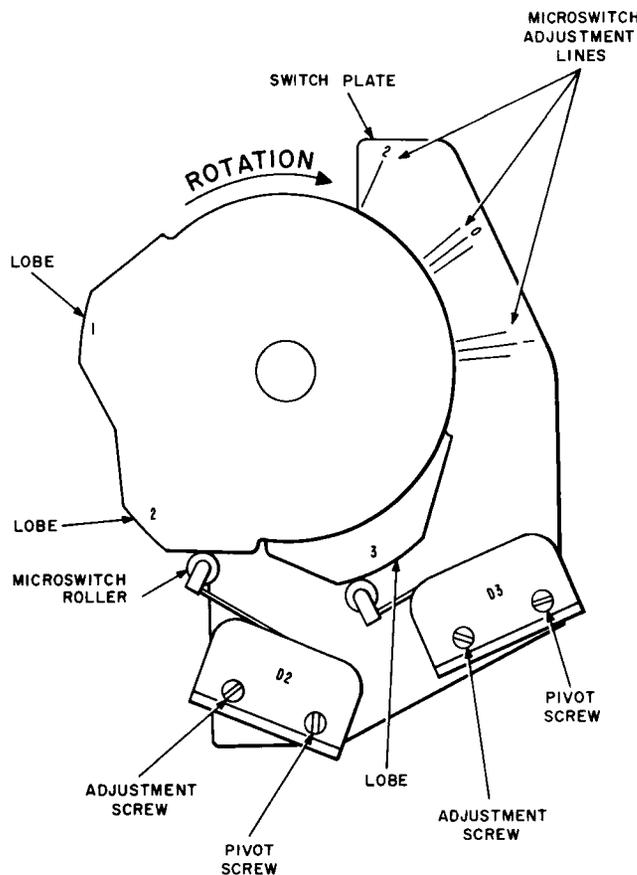


Fig. 9—Relationship of Cam Lobes to Microswitches—  
KS-12068 L5 and L6 Recorder-Reproducers

(b) **L7 Machine:** To check for proper positioning of D2 and D3 microswitches (Fig. 10) and switch cams, proceed as follows.

(1) Driving belt removal and manual rotation of the recording drum shall be in accordance with Notes 1 and 2 in (a).

(2) Microswitch D2 is actuated by each of the seven lobes of the front cam which is mounted stationary on the recording drum. Microswitch D3 is actuated by each of the seven lobes on the rear cam which is adjustable with relation to the front (stationary) cam. These cams are assembled on the recording drum, are properly adjusted by the manufacturer, and should require no further attention under normal operating conditions. However, if it becomes necessary to replace either the drum or the cams separately or if misalignment between the front and rear cams is suspected, the rear cam shall be adjusted by orienting it so that the lobes of the rear cam are positioned 10 degrees ahead of the front cam lobes.

(3) Slowly rotate the recording drum clockwise by hand until switch D3 is closed by one of the lobes of the rear cam. Continue to slowly rotate the drum clockwise until switch D3 is released and note that immediately thereafter switch D2 is closed by a lobe of the front cam. Further rotation of the drum will cause switch D2 to release.

(4) Repeat (3) for all seven lobes of the cams.

## 2.19 Operation Requirement

### (a) *Reproduction of Recording*

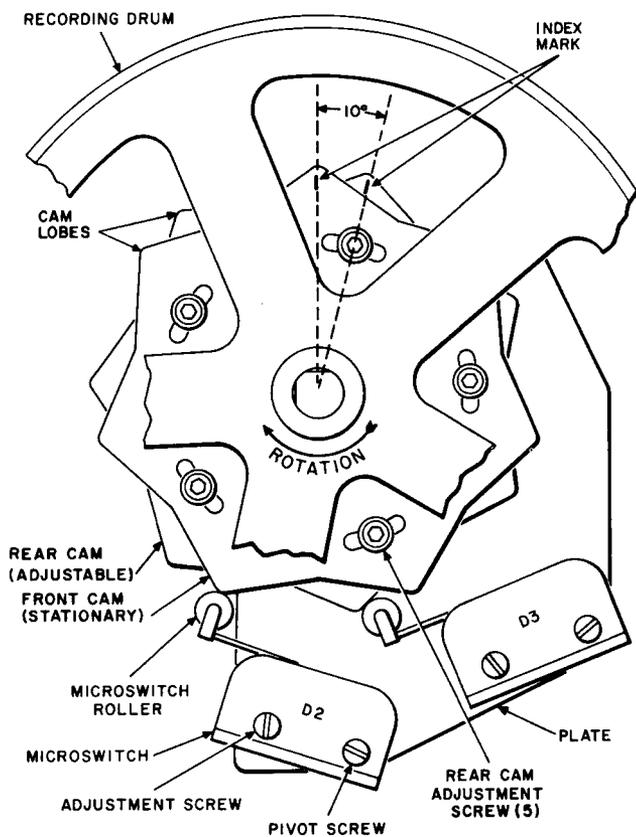
(1) A recording made on the machine at any recording drum speed shall be clearly reproduced at the same speed and free from extraneous sounds. Gauge by ear.

(2) To check this requirement, make a recording and listen to the reproduction.

(b) **Erasing of Recording:** Each erase head in one revolution of the drum shall completely erase a message which has been recorded by the associated record head at normal voice levels. To check this requirement, make and erase a

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recording on each channel of the machine. Note that each recording is completely erased. Gauge by ear using a receiver or telephone headset.



**Fig. 10—Relationship of Cam Lobes to Microswitches—KS-12068 L7 Recorder-Reproducer**

**3. ADJUSTING PROCEDURES**

**3.001 List of Tools, Gauges, materials, and Test Apparatus**

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS</b>	
245	3/8-Inch and 7/16-Inch Open Double-End Flat Wrench
486A	Oil Can
507A	Spring Adjuster
KS-14377 L5	Vacuum cleaner or equivalent equipped with a KS-14377 L30 Flexible Nozzle or equivalent
R-1051	Pillar File

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS (Cont)</b>	
R-2670	3/32-Inch Allen Socket Screw Wrench
R-2671	1/8-Inch Allen Socket Screw Wrench
R-2812	3/16-Inch Allen Socket Screw Wrench
R-2958	5/64-Inch Allen Socket Screw Wrench
R-2958	5/64-Inch Allen Socket Screw Wrench Modified per Fig. 11 (two required)
R-2959	1/16-Inch Allen Socket Screw Wrench
R-2961	0.050-Inch Allen Socket Screw Wrench
—	Medicine Dropper
—	1/2-Pint Oiler, Gem Division, Plews Oiler Co. No. 1706 (or equivalent)
—	4-Inch E Screwdriver
—	No. 555E Jewelers Screwdriver, L.S.Starrett Co.

**GAUGES**

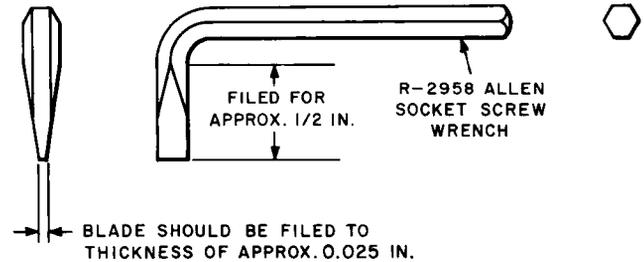
70D	50-0-50 Gram Gauge
85B	0.010-Inch Thickness Gauge
85C	0.020-Inch Thickness Gauge
KS-3008	Stopwatch
—	Protractor, Transparent, Small (obtain locally)

**MATERIALS**

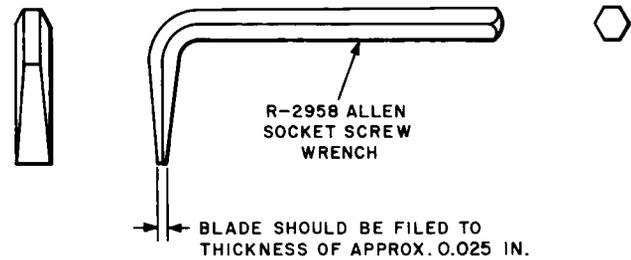
KS-2423	Twill Cloth
KS-7860	Petroleum Spirits
KS-16326 L1	Oil
KS-16328 L2	Cleaner-Lubricant
—	General Electric SF-1147 Silicone Fluid (200 Centistokes Viscosity) Silicone Products Dept, General Electric Co.

CODE OR SPEC NO.	DESCRIPTION
<b>MATERIALS (Cont)</b>	
—	Linen Thread
—	◆EC-1711 Scotch Grip Rubber Adhesive, 3M Company◆
<b>TEST APPARATUS</b>	
23A	Transmission Measuring Set (or equivalent)
1P6A	Cord (P1D cord, 6 feet long, equipped with two 310 plugs)
2W4A	Cord (R2CF cord, 6 feet long, equipped with 310 plug and two 130 cord tips)
2W10A	Cord (W2BC cord, 5-1/2 feet long, equipped with 304A plug and two 35 cord tips)
2W42A	Cord (W2DL cord, 5-1/2 feet long, equipped with 310 plug and two 35 cord tips)
3P7A	Cord (P3E cord, 6 feet long, equipped with two 310 plugs with red shells)
◆3P12H	Cord (P3F cord 8 feet long, equipped with one 310 plug and one 309 plug.◆
528 or 716E	Receiver
52N	Telephone Headset (or equivalent)
KS-14510	Volt-Ohm-Milliammeter
—	Patching Cords, Plugs, and Operator Telephone Set (provided locally for connecting to test line and spare channels)
—	Vacuum Tube Voltmeter, Model 403B, Hewlett Packard Co. (or equivalent)

**3.002 Special Offset Screwdriver:** Two special offset screwdrivers for use on bearing screws located behind the stationary shields can be made as follows. File two R-2958 Allen socket screw wrenches using an R-1051 pillar file so that screwdriver-type blades are provided on the short end of the wrenches as shown in Fig. 11.



A-ALLEN WRENCH FILED SO BLADE IS PARALLEL TO LENGTH OF WRENCH



B-ALLEN WRENCH FILED SO BLADE IS AT RIGHT ANGLES TO LENGTH OF WRENCH

TPA 484272

Fig. 11—R-2958 Allen Wrench (Modified)

**3.01 Cleaning**

**Caution:** Before using the KS-16328 L2 cleaner-lubricant as covered in (b)(5) and (c)(4), thoroughly shake its container. Do not permit any of the fluids used for cleaning to come in contact with any part of the machine other than the part being cleaned.

**Warning:** Care shall be exercised so that the KS-16328 L2 cleaner-lubricant and the silicone fluid lubricant are used only for the purpose for which they are intended.

***Under no circumstances shall either of the lubricants be put into the gear case.***

(a) **General:** Use the ♦KS-14377 L5♦ vacuum cleaner equipped with ♦KS-14377 L30♦ flexible nozzle to remove any loose dust from the external and internal surfaces of the front and rear covers and from the surrounding equipment frame members. The glass panel in the front cover shall be cleaned with a water-dampened KS-2423 twill cloth. Follow by wiping with a clean, dry KS-2423 twill cloth. The mounting plate, motor, motor mount, terminal strips, cover supports, and gear case (Fig. 1 and 2) shall be cleaned with a KS-2423 twill cloth lightly moistened with KS-7860 petroleum spirits.

(b) **Record and Erase Heads:** To clean the record and erase heads, proceed as follows.

(1) Lift the heads to their uppermost position and, using a clean KS-2423 twill cloth, gently wipe the pole pieces. If this does not remove stains or foreign matter from the surface of the pole pieces, proceed as follows.

(2) Remove the driving belt (Fig. 2) and, if applicable, remove the recording band wiper-lubrication assembly (Fig. 1) using the 4-inch E screwdriver to remove the four mounting screws securing the assembly to the mounting panel.

(3) Using the R-2670 wrench, loosen the setscrews in the hub of the recording drum.

***Caution: When removing the recording drum from the machine, ensure that the cam lobes clear the microswitch rollers.***

(4) Carefully draw the drum forward until it is free of the shaft and place it on a flat, clean surface.

(5) Clean the pole pieces of the record and erase heads with a clean KS-2423 twill cloth slightly moistened with KS-16328 L2 cleaner-lubricant. Then wipe them thoroughly dry with a clean, dry KS-2423 twill cloth.

(6) After cleaning, inspect the pole piece for any spread of the laminations or for excessive wear. A record head should be

replaced when the length of the worn surfaces on the pole piece is 3/16 inch.

***Caution: When remounting the drum, make certain that the record and erase heads are raised to their uppermost position. Care shall be exercised to ensure clearance between cam lobes and microswitches as the drum is being guided onto the drum shaft.***

(7) Carefully guide the drum onto the shaft so that the slot in the drum engages the pin on the shaft; rotate the shaft if necessary. Push the drum as far as possible to the rear until the hub of the drum bears against the snap ring on the shaft. Securely tighten the setscrews in the hub of the drum.

(8) Slowly rotate the drum and check that the cam lobes properly engage the rollers on the microswitches.

***Caution: After mounting the drum on the LA machine, carefully rotate the drum by hand and check that the permanent magnet clears the mercury switch.***

(9) Reinstall the driving belt.

(10) If applicable, remount the recording band wiper-lubrication assembly.

(11) Restore the record and erase heads to the surface of the recording band.

(c) **Recording Band:** Obstinate stains may be removed from the band with KS-16328 cleaner-lubricant as described below. Also, the recording bands on new machines should be initially cleaned as described below before being placed into service.

***Caution: Do not clean the band too vigorously. Do not use solvents, except those specified, or permit oil or grease to come in contact with the band.***

(1) If applicable, remove the recording band wiper-lubrication assembly by using the 4-inch E screwdriver to remove the four mounting screws securing the assembly to the mounting plate.

- (2) Lift the record and erase heads to their uppermost position.
- (3) Fold a clean, dry KS-2423 twill cloth into a pad. Remove loose dirt from the band by holding the pad lightly against the recording surface while rotating the drum.
- (4) Slightly moisten another clean pad of KS-2423 twill cloth with KS-16328 L2 cleaner-lubricant and hold the pad lightly against the rotating band.
- (5) After removing the stains, wipe the recording surface dry with a clean KS-2423 twill cloth.
- (6) After cleaning, apply a thin film of SF-1147 silicone fluid to the surface of bands on machines not equipped with the wiper assembly. On machines equipped with the wiper assembly, inspect the felt wiping pad and the silicone fluid in the slide for contamination. If visible contamination is detected, remove all the old silicone fluid from the wiper assembly using a clean KS-2423 twill cloth. Remount the wiper assembly on the machine; then add silicone fluid and adjust the slide as described in 2.02(e) and 3.02(e).
- (7) Restore the record and erase heads to the recording band.

(d) **Driving and Driven Pulleys:** Clean the surfaces of the pulleys (Fig. 2) on which the belt rides by using a KS-2423 twill cloth moistened with KS-7860 petroleum spirits. To do this, remove the driving belt, clean the pulleys, and remount the belt.

### 3.02 Lubrication

**Note:** Before lubricating the machine, clean surfaces to be oiled using a KS-2423 twill cloth slightly moistened with KS-7860 petroleum spirits.

(a) **Motor Bearings—Fig. 1(A) and 2(A):** Where applicable, use the 486A oil can to put the specified quantity of oil in each oil cup on the motor. Remove any excess oil with a KS-2423 twill cloth.

(b) **Motor Mount Pivot Bearings—Fig. 1(B) and 2(B):** Using the 486A oil can, apply the proper amount of oil to each motor mount pivot bearing. Put the oil between pivot bearing collars and motor rail. Ensure that the oil spreads into the two holes in the motor rail in which the pivot bearings rest. Remove excess oil immediately with a KS-2423 twill cloth.

**Caution:** Do not lubricate any surface of the cams.

(c) **Microswitch Roller Bearings—Fig. 1(C):** Using the 486A oil can, apply one drop of oil to each of the two bearings. Remove excess oil with a KS-2423 twill cloth. Wipe the switch cams with a clean, dry KS-2423 twill cloth.

(d) **Gear Case—Fig. 3(A):** To drain, flush, and refill the gear case, proceed as follows.

(1) On earlier-type machines, not equipped with a drain hose assembly, remove the driving belt (Fig. 2) and, using the proper size Allen wrench, loosen the two setscrews in the hub of the driven (drum) pulley and remove the pulley. Fully open the drain valve located at the base of the gear case to permit rapid draining of the oil into a suitable used oil container placed directly under the drain valve. On later-type machines, equipped with an oil drain valve and hose assembly as shown in Fig. 3, disconnect the upper end of the drain hose from the tee fitting located on top of the gear case. Direct the free end of the drain hose into a used oil container; then fully open the drain valve to permit rapid draining of the oil. Allow oil to drain at least 10 minutes.

(2) Close the drain valve.

(3) Where applicable, connect the free end of drain hose at the tee fitting and tighten hose retaining nut finger tight.

**Caution:** Make sure that the KS-16326 L1 oil is clean (contains no dirt, chips, or other foreign materials) and that the 1/2-pint oiler is thoroughly cleaned before using it to fill the gear case.

(4) Using a clean 1/2-pint oiler, slowly pour clean KS-16326 L1 oil into the oil cup

[Fig. 3(A)] located on the right side of the gear case. Allow sufficient time for oil to flow into the gear case. Correct level is established when final level remains 3/8 to 1/4 inch from top of oil cup.

(5) If removed, reinstall the driven pulley and driving belt. Run the machine for at least 5 minutes to thoroughly bathe the gears in clean oil. Stop the machine and allow 5 minutes for oil to settle to the bottom of gear case. Again rapidly drain the gear case as described in (1), (2), and (3).

(6) Refill the gear case with clean oil as described in (4).

(7) Repeat procedure as many times as necessary if drained oil shows any signs of contamination.

(e) **Recording Band—Fig. 1:** Lubrication of recording bands on machines not equipped with a recording band wiper-lubrication assembly shall be in accordance with the procedure described in 3.01(c). Machines equipped with a recording band wiper-lubrication assembly (Fig. 1) shall be adjusted to provide continuous lubrication to the band. Adjust the wiper assembly so that the felt wiping pad makes proper contact with the recording band.

(1) Using the 4-inch E screwdriver, loosen the two adjustment screws which secure the slide (reservoir) assembly in position on the wiper assembly; then push the slide assembly to the left as far as the slotted holes will permit.

(2) Visually inspect the felt wiping pad for excessive wear and for contamination. If the wiping pad needs to be replaced due to wear or contamination, refer to Section 034-351-801 for piece-part information and replacement procedure.

(3) If the wiping pad appears to contain an insufficient amount of  $\blacklozenge$ SF-1147 $\blacklozenge$  silicone fluid, additional fluid may be added in accordance with 2.02(e).

(4) Adjust the slide tray with the felt pad so that the pad is not forced against the magnetic band. The pad should just rest

against the band with *very light* pressure. Place the front cover onto the machine and visually inspect the assembly through the cover window to see that the bracket has not shifted, causing increased pressure from the pad against the band. Ensure that no metallic portion of the wiper assembly comes in contact with the recording band (Fig. 1). Secure the slide assembly by firmly tightening the two adjustment screws in the end of the slide. Manually rotate the drum clockwise as described in 1.08. As the drum is rotating, silicone fluid shall be uniformly distributed over the entire recording surface of the band.

**3.03 Record of Lubrication:** Records shall be kept in accordance with local procedure.

**3.04 Centering of Recording Band on Drum:** For drums which do not have the recording band cemented on the drums, raise all the record and erase heads to center the band. Shift the band by hand as required.

**Caution:** *When handling the band, make sure that the hands are free of dirt and grease and that they come in contact with the band as little as possible.*

**3.05 Record and Erase Voltage and Record Levels:** If the record bias and erase voltage or the recording signal level measurements are not satisfactory, check for loose or poor electrical connections at the record and erase head for the channel under test. Wide variation from the typical values shown in Table A indicates the possibility of a defective magnetic head; check for open or shorted record head (400 ohms) or erase head (165 ohms). If it is necessary to replace a record head or erase head, refer to Section 034-351-801 for instructions. The associated amplifier may not be functioning properly; check the amplifier in accordance with applicable maintenance practices covering the specific amplifier.

**3.06 Position of Record and Erase Heads on Recording Band**

(a) **Erase Head:** To change the position of an erase head in its relation to the recording band, slightly loosen the head mounting nut with the 245 wrench; then use the R-2958 wrench to turn the head adjusting screw in or out, as required, until the magnetic gap in the pole

piece lies tangent to the recording band as shown in Fig. 4. Gauge by eye. Tighten the head mounting nut securely.

(b) **Record Head:** Make adjustment as described in (a), except gauge head alignment by the electrical method as described in 2.06.

**3.07 Pressure of Record and Erase Heads Against Recording Band:** To change the pressure of the head against the recording band, bend the vertical part of the head pressure spring bracket by using the 507A tool as shown in Fig. 12.

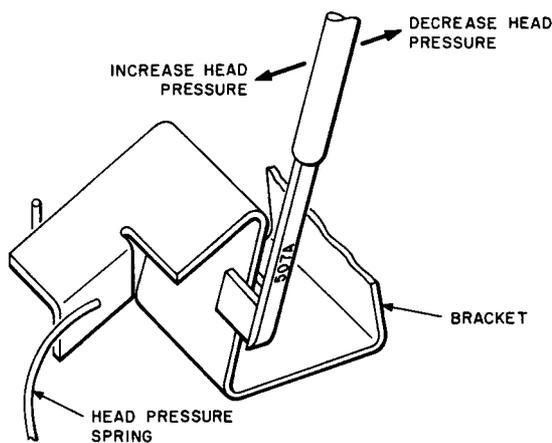


Fig. 12—Method of Adjusting Head Pressure

**3.08 Freedom of Movement:** If the head assembly does not move freely on its bearings and seems to bind when raised or lowered to the band, proceed as follows.

- (1) Loosen the bearing screw setscrew (Fig. 5 and 6) with the R-2961 wrench, and turn the bearing screw as required by using the R-2958 wrench or the jewelers screwdriver. On bearing screws located behind the stationary shield, use the R-2958 wrench or the modified wrenches.
- (2) If the condition is still not corrected, remove the drum as described in 3.01(b)(2) through (4). Flush the bearings with KS-7860 petroleum spirits applied with a medicine dropper. While doing this, hold a cloth under the bearing. Allow the parts to dry and then lubricate the bearing with one drop of KS-16326 L1 oil using the 486A

oil can. Remove excess oil with a KS-2423 twill cloth. Remount the drum as described in 3.01(b)(7) through (11).

**3.09 Record and Erase Head Mounting Bracket Sideplay:** If the sideplay is unsatisfactory, loosen the bearing screw setscrew (Fig. 5 and 6) using the R-2961 wrench. Turn the bearing screw as required, using the R-2958 wrench or jewelers screwdriver. On bearing screws located behind the stationary shield, use the modified wrenches.

**3.10 Clearance Between Stationary Shield and Adjacent Parts**

- (1) To adjust for clearance between the stationary shield and the recording band, loosen the shield adjusting screws (Fig. 5 and 6) with the 4-inch E screwdriver and shift the shield as required. Tighten the screws securely. On recorders where the screws are located behind the shield, it will be necessary to remove the shield from its slot first.
- (2) If the clearance between the stationary shield and the mounting nuts (Fig. 6) of adjacent record or erase heads is not satisfactory, check that the shield is properly mounted and that the correct shield is used.

**3.11 Interference Between Adjacent Channels:**

**3.12 Erasure of Message:** When a check of the requirement indicates that interference exists, determine whether a record or erase head should be shifted and in which direction as outlined in the following example.

**Example:** If, when checking the record head of channel 3 (Fig. 7) against interference from the erase heads of channels 1 and 5, the meter indications show that there is interference between the erase track of channel 5 and the record track of channel 3, proceed as follows. Check the requirement for the erasure of a message for channels 3 and 5. If the erase head of channel 5 does not completely erase a message in channel 5, shift the erase head of channel 5 slightly away from channel 3 as described in the following (a) and (b). If the erase head of channel 3 does not completely erase the message on channel 3, shift the record head of channel 3 slightly toward channel

1. After making any shifts, recheck the requirements.

**Note:** Interference may occur between the erase heads of channel 1 or 5 and the record heads of channel 3 even if the erasure requirements are met on channels 1 and 5. In this case, the channel 1 or 5 erase head is probably located on the extreme limit of alignment with respect to its record head, and should be shifted slightly away from channel 3.

If the message on any channel is not completely erased by its associated erase head, check for interference between adjacent channels. If interference exists, proceed as covered in the preceding note. If interference does not exist, shift either the erase or record head as described in the following (a) and (b), making sure that no interference exists between adjacent channels after the adjustment has been made. It may be possible by examining the tracks on the recording band to determine in which direction the heads are to be shifted to avoid interference.

(a) To change the front-to-rear location of a record or erase head, loosen the pivot shaft setscrew (Fig. 6) which holds the pivot shaft in position by using the R-2961 wrench. Slightly shift the head mountings on the pivot shaft forward or rearward as required, and tighten the pivot shaft setscrew. Recheck requirements 2.11 and 2.12 and, if necessary, repeat this procedure.

(b) After performing (a), check freedom of movement and head mounting sideplay in accordance with 2.08 and 2.09.

**3.13 Clearance Between Permanent Magnet and Mercury Switch (L4 Machine Only)—Fig. 8(A):** To change the clearance between the permanent magnet (Fig. 8) and the mercury switch, loosen the setscrew in the adjusting stud clamping bushing by using an R-2959 wrench. Move the magnet adjusting stud in or out as required. Tighten the setscrew securely and make sure that the screw contacts the flat surface of the stud.

**3.14 Adjustable Motor Mount—Fig. 1B and 2(B):** If the adjustable motor mount (Fig. 1) does not move freely on its bearings, check that the bearings are lubricated as covered in requirement

2.02. If this is not the cause of the trouble, shift the adjustable motor mount collars as required to permit the mount to move freely on its bearings. To shift a collar, loosen the collar setscrew with the R-2671 wrench. Retighten the setscrews securely.

### 3.15 Driving Belt Tension

(1) To change the tension of the driving belt (Fig. 2), turn the belt tension bar adjusting lever, as required, using the R-2812 wrench. The tension of the belt should be no higher than necessary to provide positive drive. When so adjusted, the belt should be free of *flutter* or *bounce*.

(2) If a satisfactory adjustment cannot be obtained as covered in (1), loosen the four motor base mounting nuts (Fig. 1) with the 245 wrench and slightly shift the motor laterally on the adjustable mount. Make sure that the motor shaft remains parallel to the shaft of the gear assembly. Tighten the mounting nuts and readjust the belt tension bar.

### 3.16 Pulley and Driving Belt Alignment

(1) If the driving belt does not ride satisfactorily on the pulleys, relocate the motor pulley as follows. Loosen the motor pulley setscrew with the R-2670 wrench and shift the pulley so that it is properly aligned with the driven pulley. Make sure that the fan blades, where provided, clear the guard. Tighten the setscrews securely. Also make sure that the motor pulley is clear of the motor housing. If a satisfactory position of the belt cannot be obtained in this way, proceed to (2).

(2) Use the 245 wrench to loosen the motor base mounting nuts at the front of the machine. Move the front of the motor up or down as required. Moving the front of the motor upward will tilt the motor and will shift the belt toward the outer flange of the motor pulley. If a satisfactory position of the belt still cannot be obtained, proceed to (3).

(3) Shift the adjustable motor mount in the motor mount rail. To do this, loosen the setscrews in the motor mount collars by using the R-2671 wrench; shift the motor mount slightly; and tighten the setscrews.

**3.17 Recording Drum Speed:** If the speed of the recording drum is not satisfactory, check requirement 2.15 covering the driving belt tension and 2.16 covering the pulley and driving belt alignment. Insufficient or dirty oil in the gear case can cause variations in drum speed. Drain, flush, and refill the gear case with clean oil as described in 3.02(d). If these requirements are met and the drum speed is still not satisfactory, consideration should be given to returning the machine for repair.

### 3.18 Microswitches and Switch Cams

(a) **L5 and L6 Machines:** To change the position of the microswitches (Fig. 9), slightly loosen the pivot screw and the adjustment screw with a 4-inch E screwdriver. Gently shift the switch as required to meet the requirements of 2.18, and then securely tighten the pivot and adjustment screws. Care should be exercised to avoid adjusting switch D2 or D3 in such a manner as to force the roller (actuator) arm of the switch against the case of switch by the action of the lobes of the cam. After the switches have been properly positioned, clearance shall exist between the roller arm and the plastic body of the switch when the cam has raised the arm to its highest position. The 3-lobe cam mounted on the rear of the recording drum is not adjustable. The lobes of the cam associated with the microswitches shall be free of burrs and sharp edges. Slight end mill marks on the surface of these lobes are permissible.

(b) **L7 Machine:** Adjusting the position of D2 and D3 microswitches (Fig. 10) is accomplished as described in (a). To adjust the position of the 7-lobe rear cam, proceed as follows.

- (1) Using the proper size Allen wrench, slightly loosen the five rear cam adjustment screws (Fig. 10) to permit rotational adjustment of the rear cam.
- (2) Using a small transparent protractor and gauging by eye, adjust the rear cam so that its lobes are positioned 10 degrees ahead of the front cam lobes. Use the index mark on each cam as a reference point when determining the 10-degree separation between the front and rear lobes. Secure the rear cam in position by firmly tightening the five

adjustment screws. Recheck the requirements in 2.18.

**3.19 Operation Requirement:** If the output of a channel is unsatisfactory, the condition may be due to one of the following causes and may be corrected as indicated.

(a) **No Output from Channel:** This may be due to the following.

- (1) The circuit from the head may be defective. Check for broken leads and loose connections.
- (2) The record head may not be touching the recording band. Check requirements 2.07 and 2.08 and readjust if necessary in accordance with 3.07 and 3.08. The record head may not rest properly on the recording band at the magnetic gap between the pole pieces. In this case, reposition the head in accordance with 2.06 and 3.06.
- (3) The amplifier associated with the channel may not be functioning properly. Check the amplifier in accordance with applicable maintenance practices covering the specific amplifier.

(b) **Low Output Level:** This may be due to the following.

- (1) The record head may not rest properly on the recording band at the magnetic gap between the pole pieces. In this case, reposition the head in accordance with 2.06 and 3.06.
- (2) The pressure of the record head against the recording band may be insufficient. Check requirement 2.07 and if necessary readjust as described in 3.07.
- (3) The head assemblies may be binding. Check requirements 2.08 through 2.10 as applicable.
- (4) There may be foreign matter on the laminations of the head preventing good contact between the pole piece and the surface of the recording band. To correct this, clean the pole piece as described in 3.01.

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- (5) The output of the associated amplifier may be too low. Check requirement 2.05. Check the amplifier in accordance with applicable maintenance practices covering the specific amplifier.
- (6) If the output level measures below the requirements after checking (1) through (5), replace the record head associated with channel under test. (Refer to Section 034-351-801.)
- (c) **Output Level Varies:** This may be due to the following.
- (1) The record head may chatter due to foreign matter on the outer surface of the recording band or to surface irregularities on the band. If there appears to be hard particles of dirt on the recording band, clean the band in accordance with 3.01. Ensure that the band is properly lubricated in accordance with 2.02(e). If this does not clear the trouble, it may be necessary to replace the band.
  - (2) The head assembly may be loose and require repositioning. In this case, reposition the head as covered in 2.06 and 3.06.
  - (3) The record head may rest against the recording band with insufficient pressure. Check requirement 2.07 and readjust the head pressure, if necessary, in accordance with 3.07.
  - (4) The head assemblies may be binding. Check requirements 2.08 through 2.10 as applicable.
  - (5) The head mounting bracket may have excessive sideplay. Check requirement 2.09 and readjust, if necessary, in accordance with 3.09.
  - (6) Either the head or its associated amplifier may have loose or poor electrical connections. Check the connections.
- (d) **Output Shows Traces of a Previous Recording or Is Noisy:** This may be due to the following.
- (1) The recording band or the pole piece of the erase head may be dirty. Clean the band and the pole piece as described in 3.01.
  - (2) The erase head may be misaligned with respect to the record head so that not all of the previous messages are erased. Check requirement 2.12 and readjust, if necessary, in accordance with 3.12.
  - (3) The erase head may not rest properly on the recording band at the magnetic gap between the pole pieces. Reposition the head in accordance with 2.06 and 3.06.
  - (4) The erase head may have insufficient pressure against the band. Check requirement 2.07 and readjust, if necessary, in accordance with 3.07.
  - (5) The associated amplifier may not be furnishing the proper voltage for erasing. The voltage at the erase head should be at least 100 volts while recording. Check requirement 2.05 and adjust associated amplifier if necessary in accordance with 3.05.
  - (6) The message may have been recorded at too low a level, and attempts may have been made to compensate for this by adjusting the gain control. Since any noise which might have been recorded on the band, as well as the message, would be amplified. The noise might be out of proportion with respect to the message. Erase and again record a message at the proper level.
- (e) **Output Shows Magnetic Noise:** Magnetic noise, a relatively strong background hiss, may be due to residual magnetism in the record or erase head. Erase and again record the message, and check whether the magnetic noise continues. If the noise has disappeared, it was in the erase head which has cleared itself. If the noise has not disappeared, it is due to the record head. To remove this noise, demagnetize the record head in the following manner. Remove the leads from the record and erase heads, and wire the record head with the leads from the erase head. On L5 and L6 machines (except the L6 machine used on No. 1 ESS), plug a 3P7A cord into the TST IN jack corresponding to the channel having the record head being demagnetized. Ground the sleeve of the cord

for a time equal to two revolutions of the drum. On the L4 machine and the L6 machine used in No. 1 ESS, operate the record-reproduce transfer relay in the associated amplifier. Remove the cord and rewire the record and erase heads.

(f) **Output Shows Excessive Hum:** This may be due to the following.

- (1) The equipment may be improperly grounded. **Check the ground connections.**
- (2) The amplifier may not be functioning properly. Check the amplifier in accordance with applicable maintenance practices covering the specific amplifier.
- (3) There may be strong ac fields in the vicinity of the recorder-reproducer. Turn off the adjacent equipment and note whether the hum disappears. Take whatever steps are necessary to remove the trouble if the hum disappears when the adjacent equipment is turned off.

(g) **Output Shows Flutter:** Flutter (a quavering quality in the reproduction, sounding like a shaky voice) may be due to the following.

- (1) Output flutter can be caused by instantaneous variations in drum speed due to improper belt tension or misalignment of the motor

pulley. Vertical bounce in a running belt indicates that the belt is too loose. Adjust the belt tension as described in 3.15. The belt may be riding up on the motor pulley flange. This condition can be corrected by making adjustments described in 3.14 through 3.16.

- (2) Vibration from surrounding equipment may result in output flutter in the recorded reproductions. Take the necessary steps to reduce vibration in the area near the machines.
- (3) Output flutter is sometimes caused by vibration of the record head on a **dry** recording band. Lubrication of the recording band shall be in accordance with 3.01(c) or 3.02(e), whichever is applicable.
- (4) There may be dirt or foreign material in the gear case. Drain, flush, and refill the gear case as described in 3.02(d). If repeated flushings (at **least** three) fail to reduce the flutter to acceptable levels, consideration should be given to returning the machine for repair.

**Note:** A small amount of flutter is not considered objectionable. Do not return the machine for repair unless it is reasonably certain that an objectionable flutter condition is present.