

RECORDER

KS-19325 L1

DESCRIPTION AND OPERATION

1. GENERAL

1.01 This section covers the physical and operational description and tape loading and removal on the KS-19325 L1 recorder used as a part of the traffic data summarizer No. 1A of the Traffic Data Recording System (TDRS) No. 1A.

1.02 Tape recording periods may vary in accordance with local office requirements. The time and reason for the tape to be loaded or removed depends upon system requirements and operating procedures.

2. PHYSICAL DESCRIPTION

2.01 The KS-19325 L1 recorder (Fig. 1) is a multichannel data recorder for recording only. It consists of a tape drive mechanism designed for continuous tape motion at a single recording speed. Relay switching facilities provide both local and remote control of the three tape motion functions of slow forward, fast forward, and rewind. Tapes produced by this recorder will be read by KS-19326 L1 recorders located in the traffic data summarizer.

2.02 The recorder contains a 20-track write head for digital recording. The recording is single-channel serial in the nonreturn-to-zero (NRZ) mode. The packing density is 960 bits per inch on 1-mil, polyester-base, 1-inch wide magnetic tape. Photoreflexive beginning-of-tape (BOT) and end-of-tape (EOT) sensors and a tape-break protective scheme are provided. No write electronics are furnished. An erase head is not required.

2.03 Power sources required for operation of the recorder are 117 volts (± 10 percent), single phase, 60 Hz ac; and 42-52 Vdc with positive side grounded.

2.04 The recorder accommodates 1-inch wide, 1-mil thick, mylar-base, 4600- or 4700-foot long, thin oxide magnetic tape (3M-551 magnetic

tape or approved equivalent). The tape is supplied on 10-1/2 inch diameter reels.

2.05 The recorder is designed for mounting in a 23-inch relay rack or cabinet and occupies 26 inches of vertical space. It has a total depth of 9 3/4 inches including dust covers and rear-mounted connectors. The recorder weighs 75 pounds.

2.06 A hinged dust cover with a large transparent area is provided for the front of the recorder and opens to the left to a 90-degree position but does not extend beyond the 23 inch width of the rack. A nonhinged, easily removable, protective rear cover (Fig. 2) is also provided. When the front dust cover is closed, a safety interlock switch (Fig. 3) is actuated. The purpose of the switch is to remove operating power from the recorder when the dust cover is opened. A manual override feature is provided for use when it is necessary to operate the recorder with the dust cover open.

3. FUNCTIONAL DESCRIPTION

3.01 *Tape Transport:* The tape transport mechanism contains tape drive and tape guiding components required to move tape across the recording head. Two methods are utilized for moving the tape: reel-to-reel drive and metered capstan drive.

(a) ***Reel-to-Reel Drive:*** The reel-to-reel drive is a fast, unregulated tape drive which is accomplished by electrically unbalancing the torque of the two reel motors. Tape is moved fast forward by reducing the torque of the supply reel (Fig. 3) and increasing the torque of the take-up reel. The take-up reel rotates in the direction of the applied torque and winds tape. The supply reel is rotated counter to the applied torque as tape is pulled from it maintaining tape tension. Rewind is similarly accomplished by applying full torque to the supply reel motor and reduced torque to the take-up reel motor.

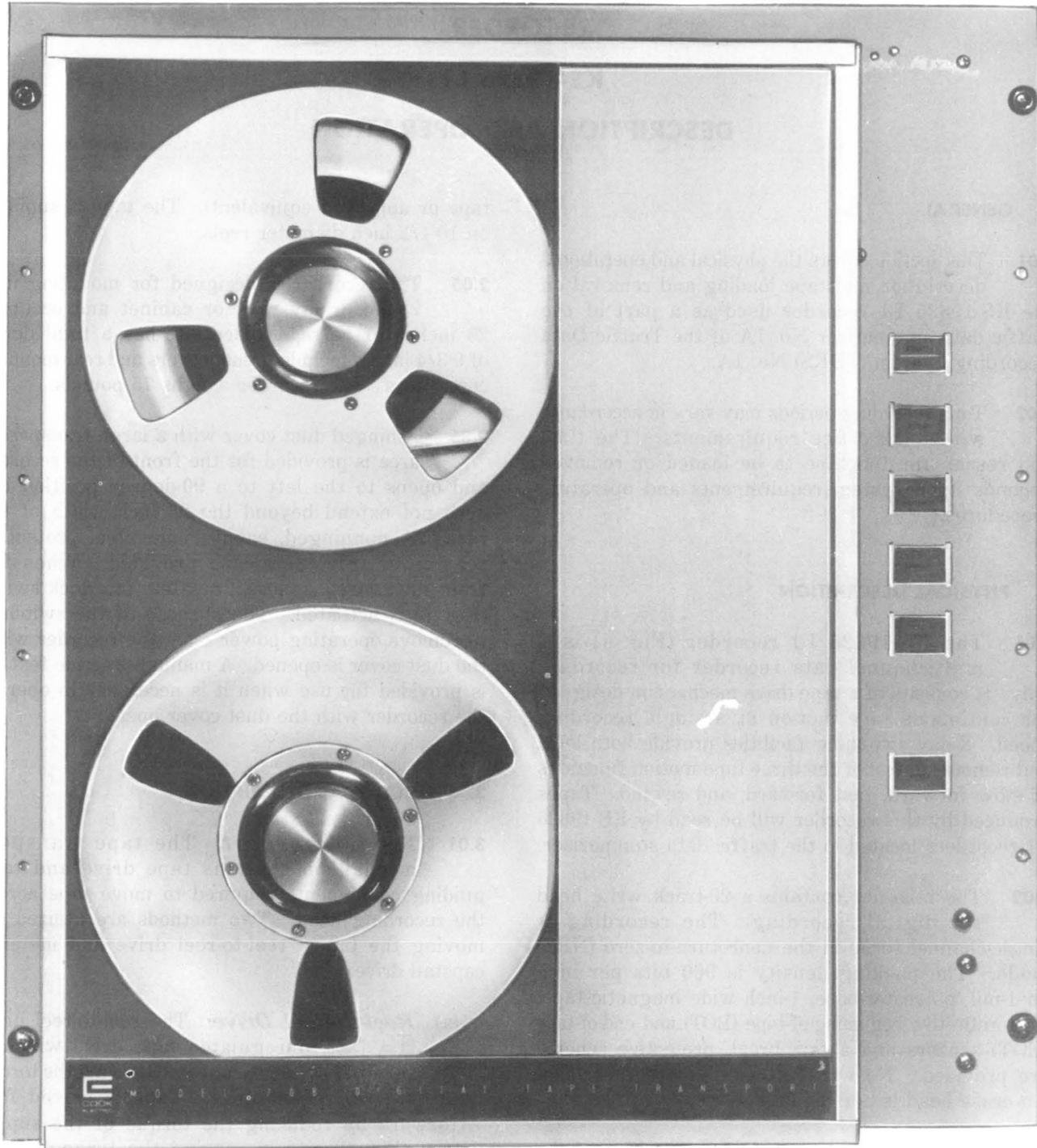


Fig. 1—KS-19325 L1 Recorder—Front View

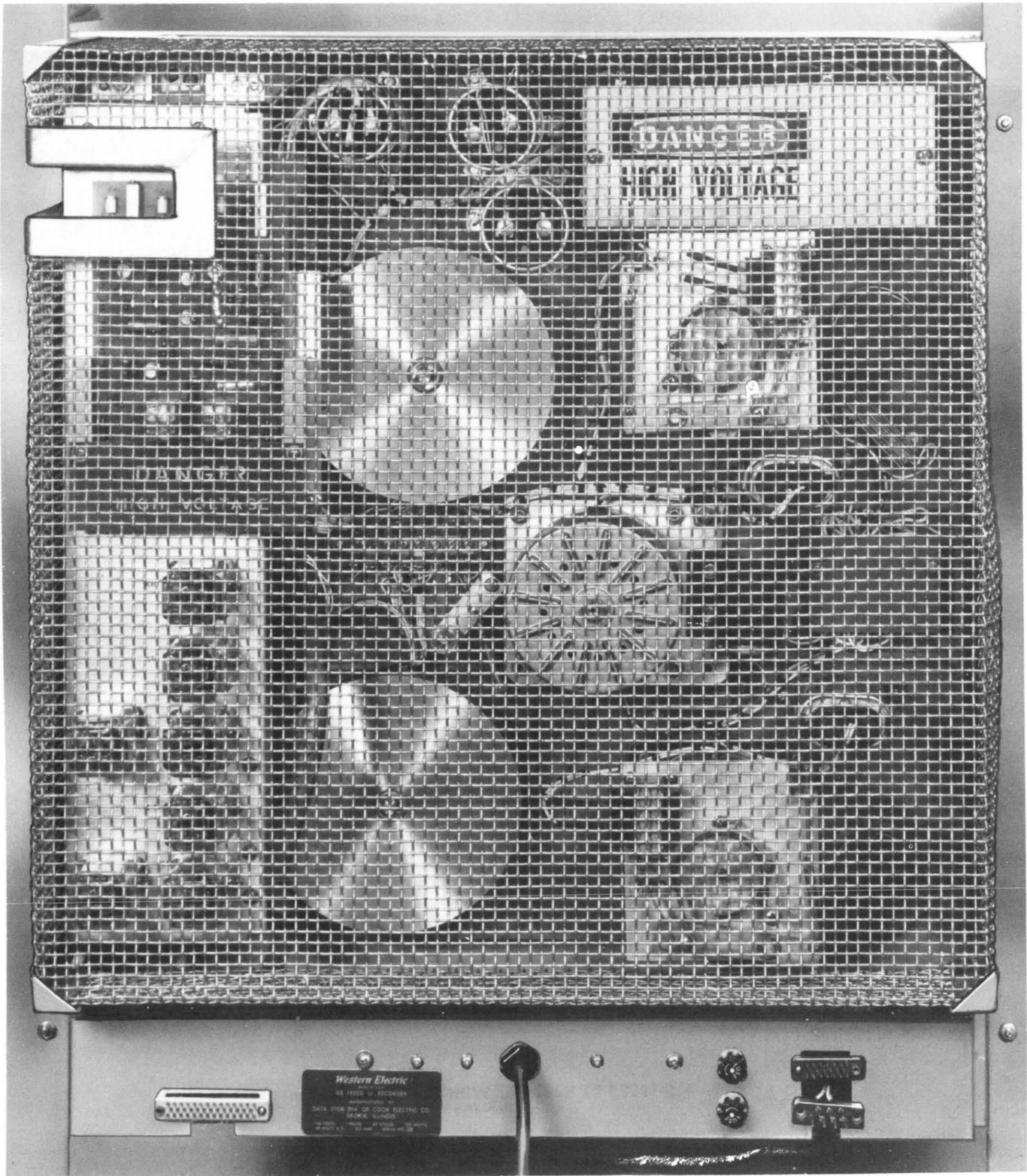


Fig. 2—KS-19325 L1 Recorder—Rear View

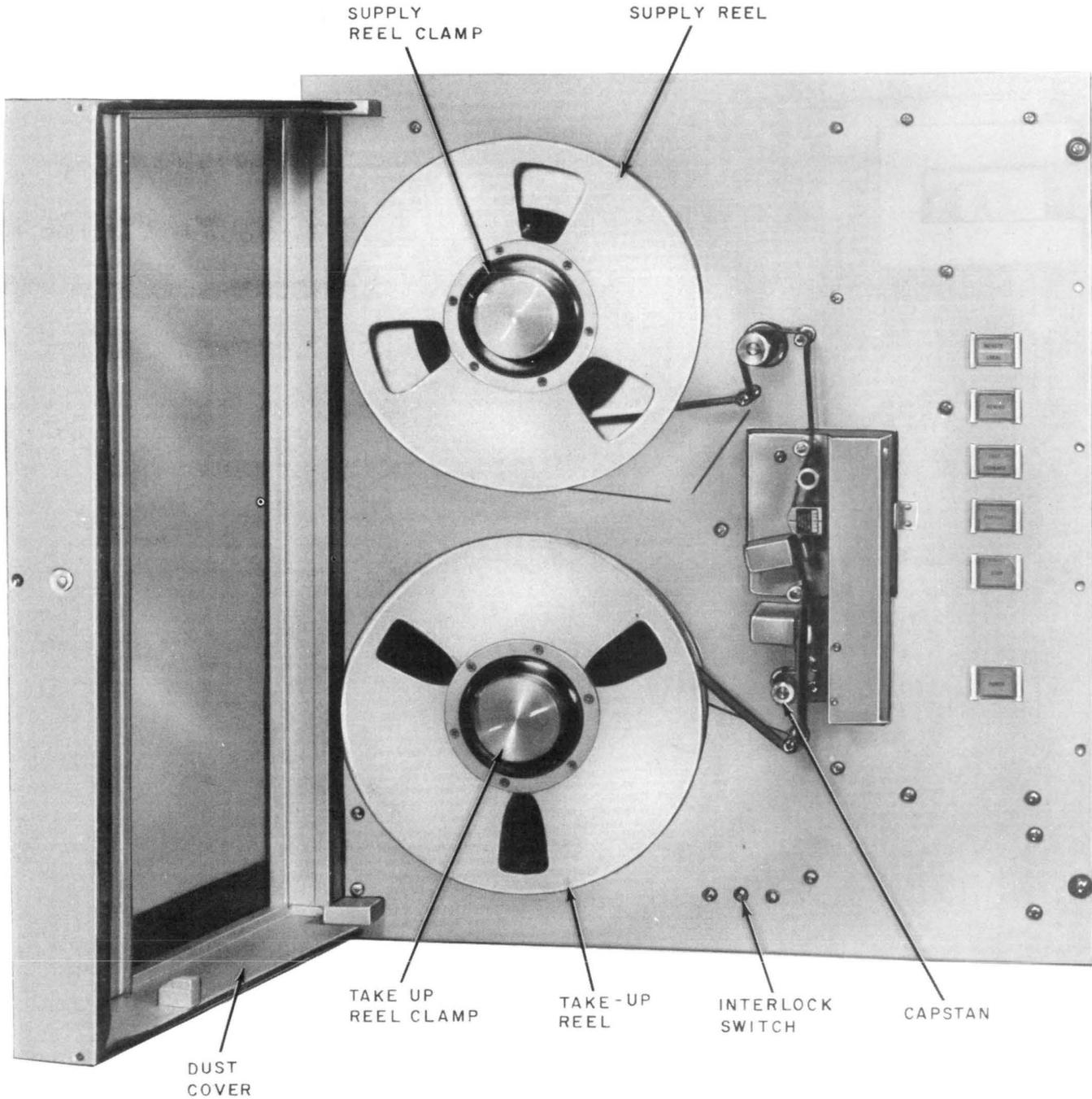


Fig. 3—KS-19325 L1 Recorder With Dust Cover Open

(b) **Metered Capstan Drive:** The metered capstan drive results in a regulated tape speed of 1 1/4 inches per second. In this mode of operation, the tape is held against a high-friction rotating capstan (Fig. 3) by a solenoid activated pressure roller. The capstan, which is driven

by a hysteresis synchronous motor, rotates with a constant tangential velocity of 1 1/4 inches per second. Actuation of the pressure roller solenoid holds the tape against the capstan with sufficient normal force to prevent slippage between the capstan and the tape. The tape is thus moved

at 1 1/4 inches per second. Reduced torque is applied to each of the reel motors in this mode of operation. The torque at the take-up reel motor rotates the take-up reel to wind tape as it is metered out by the capstan. The torque on the supply reel motor is counter to the rotation of the reel as tape is pulled from the reel. This torque provides the tape tension required.

3.02 Reel Brakes: A fail-safe, differential band brake (Fig. 4) is mounted to each reel motor. The brakes are spring actuated to provide braking with power off. Tape motion commands activate reel brake solenoids which override the brake springs to remove the braking action. The differential action of the brakes enables tape stoppage with no damage to the tape or recorder in case of a power failure. Tape is brought to a stop and is in a ready condition when power is removed. When tape is moving at fast speed and a stop command is received, reel braking is accomplished both electrically and mechanically. Electrical braking is accomplished by applying full dc voltage to the field of the motor acting as supply reel (reel feeding off tape). Mechanical braking is accomplished by releasing the band brake solenoids, setting both reel brakes. Stop from high speed is accomplished by the mechanical brakes alone in the case of power failure.

3.03 Head Tape Guides: As tape is moved from one reel to the other, it passes over the record head (Fig. 5). Spring-loaded tape guides mounted on the record head assembly accurately position the tape with respect to the 20 recording tracks. The spring-loaded guides always position the tape against the same edge which is used as a reference edge for location of the recording tracks. This is done to enable reliable machine-to-machine interchangeability.

3.04 Tape Guiding: Tape guides are also located adjacent to each of the reels. This guiding is required to prevent the tape from rubbing against the rotating reel flanges.

3.05 Inertia Idler Capstan: An inertia idler capstan (Fig. 5) is incorporated in the tape path to reduce instantaneous speed variations in the speed of the tape during recording (tape moving at 1 1/4 inch per second). This capstan is accelerated by the tape when tape motion is initiated. A flywheel (Fig. 4) is coupled to the inertia idler

through a viscous coupling. When the inertia idler capstan and a viscous-coupled flywheel are up to the speed of the tape, the capstan no longer appears as a load to the tape, but rather it appears as a high inertia driving element. During fast-speed operation, the inertia idler capstan performs no function.

3.06 Tape Cleaner: A tape cleaner (Fig. 5) is incorporated on the head assembly adjacent to the record head on the supply reel side of the head. The holes in this perforated piece are precision etched to provide sharp scraping surfaces. As the oxide of the tape passes over the cleaner, particles of dirt and foreign material are removed from the surface of the tape. The abrasive action of the magnetic tape acts to keep the cleaning edges sharp.

3.07 Magnetic Head: The magnetic head acts to transform electrical input signals to magnetized sections of tape. Twenty tracks, each 0.016 inch wide, are equally spaced across the active 1-inch wide portion of the head. The leads from each channel record coil terminate at the connector mounted to the head assembly plate. The spring-loaded guides position the tape against a fixed reference guide edge. Since all tapes are referenced to this same edge on all machines, tape width variations do not affect the location of the track positions with respect to the reference guide plane from machine to machine.

3.08 Control Circuits: The control circuits consist of relay logic indicator pushbutton switches, motor drive circuits, and tape end sensing circuits.

(a) **Local/Remote:** The recorder is alternately conditioned for remote control or for local (manual) control by actuation of the LOCAL/REMOTE pushbutton (Fig. 5) located on the front panel. When conditioned for local operation, tape motion is controlled by four indicator pushbutton switches, also located on the front panel of the recorder, while remote control signals are inhibited. When conditioned for remote, circuits are completed enabling remote signals to control the tape motion while local manual controls are inhibited.

(b) **Power:** The 117-Vac power to the recorder is controlled with an illuminated pushbutton switch on the front panel. Alternate activation of the switch results in alternate power off and

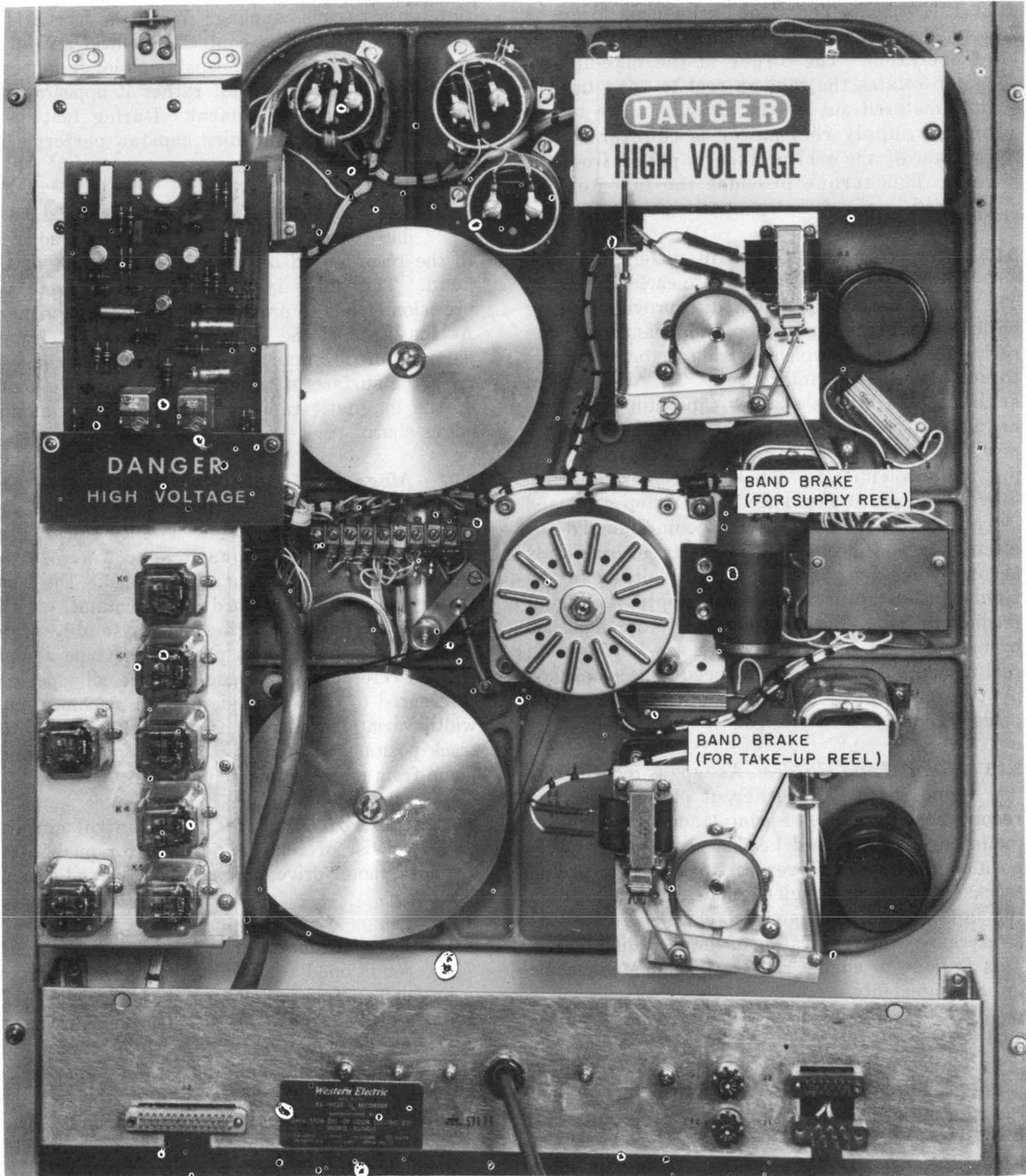


Fig. 4—KS-19325 L1 Recorder—Rear View With Cover Removed

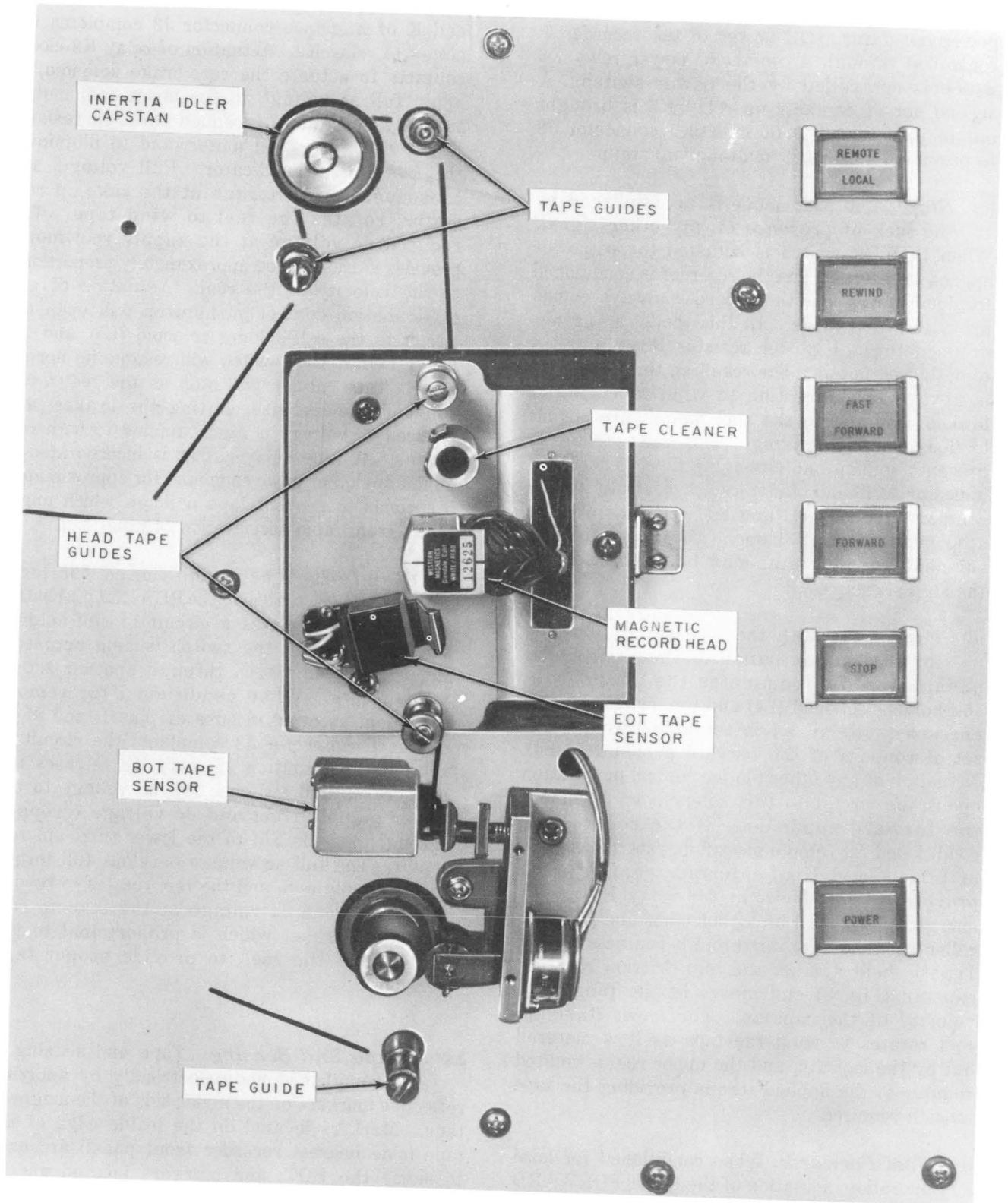


Fig. 5—Magnetic Head Assembly Area With Solenoid Cover Removed

power on status. DC power to the recorder is controlled through a contact of power relay K6 which is controlled by the power switch. A second set of contacts on relay K6 is brought out to pins E and D of interface connector J3 to provide a power off (malfunction) status.

(c) **Stop:** The stop mode is accomplished by the lack of presence of any other signal. When POWER switch is actuated to on (power applied to recorder) and the recorder is conditioned for local operation, the recorder always comes up in the stop mode. In this mode, ac power, dropped through power resistor R3, is applied to both reel motors. The resulting torque applied is always in a direction to wind tape. Band brakes mounted to the reel motors are spring loaded to apply braking. This fail-safe brake prevents spilling and damaging tape. The STOP indicator is illuminated through normally closed contacts of relays K1 and K7. Actuation of the stop pushbutton (S3) opens the circuit to any solenoid switches that may be energized and the stop status results.

(d) **Forward:** With the recorder conditioned for LOCAL, actuation of the FORWARD pushbutton (S4) completes the circuit to a self-holding solenoid (L4) and the switch remains energized. Relay K1 is actuated through one set of contacts of the forward pushbutton (S4). Actuation of any other motion control pushbutton opens the circuit to this solenoid to terminate the forward condition. If the recorder is conditioned for remote operation, external closure of pins F and H of interface connector J3 provides a closed circuit for relay K1 and it energizes. The reel brake solenoids and pressure roller solenoid actuate through contacts of K1. Tape is held against the high-friction rotating capstan (Fig. 3) and moves at the tangential velocity of the capstan. The lower (take-up) reel rotates to wind the tape as it is metered out by the capstan, and the upper reel is rotated counter to the applied torque providing the tape tension required.

(e) **Fast Forward:** When conditioned for local operation, actuation of the FAST FORWARD pushbutton switch (S5) completes a circuit to self-holding solenoid (L5) and the switch is held actuated. Relay K2 is energized through another set of switch (S5) contacts. When conditioned for remote operation, external closure of pins J

and K of interface connector J3 completes the circuit to relay K2. Actuation of relay K2 closes contacts to actuate the reel brake solenoid, to apply full ac voltage to the lower reel motor, to apply dc voltage (dropped through resistor R5) to the upper reel motor, and to illuminate the fast forward indicator. Full voltage, and consequently full torque at the take-up reel motor, rotates the reel to wind tape. The reduced dc voltage at the supply reel motor provides a drag torque approximately proportional to the velocity of the reel. Actuation of any other motion control pushbutton will open the circuit to the self-holding solenoid (L5), and the FAST FORWARD switch will resume its normal state. Tape motion will stop as the reel brake solenoids de-energize, setting the brakes, and reduced ac voltage is again applied to both reel motors. A time delay circuit is incorporated to inhibit any other move command for approximately 5 seconds to prevent tape damage which might result from rapid acceleration of tape.

(f) **Rewind:** When conditioned for local operation, actuation of the REWIND pushbutton switch (S6) completes a circuit of self-holding solenoid (L6) and the switch is held actuated. Relay K3 is energized through another set S6 contacts. When conditioned for remote operation, external closure of pins L and M of interface connector J3 completes the circuit to relay K3. Actuation of relay K3 releases the reel brakes and switches full ac voltage to the upper (supply) reel and dc voltage (dropped through resistor R5) to the lower (take-up) reel motor. The full ac voltage develops full torque at the supply reel, and the reel rotates to rewind the tape. The dc voltage at the take-up reel provides torque, which is proportional to the velocity of the reel, to provide proper tape tension.

3.09 Tape End Sensing: Tape end sensing is accomplished photoelectrically by applying reflective markers on the mylar side of the magnetic tape. Markers located on the inside edge of the tape (side nearest recorder front panel) are used to sense the EOT, and markers located on the outer edge are used to sense the BOT. When a tape marker passes under the tape sensor (Fig. 5), light from a lamp mounted in the sensor is reflected off of the marker onto a photoresistor which is also mounted in the sensor. The circuitry for both

the EOT and BOT is contained on a single-etched circuit board.

3.10 Sensing EOT/BOT Lamp Failure: Failure of either of the tape sensor light sources is detected, and power is removed from the unit. This is done by the associated circuitry causing relay K6 to drop with a resulting malfunction indication. Simultaneous EOT and BOT signals indicate a tape-break condition.

4. OPERATION

4.01 Controls and Indicators: Pushbutton indicators (Fig. 5) located on the front panel of the recorder are operated as follows.

- (a) **POWER:** Alternate actuation of the POWER pushbutton results in power on and power off status. Illumination of the pushbutton indicator is associated with power on. A slight time delay (approximately 1 second) is normal before other indicators are illuminated when power is turned on.
- (b) **STOP:** This pushbutton switch is inactive when the recorder is conditioned for remote operation. Operation of the switch in local control results in stopping tape motion. When the recorder is conditioned to stop mode, either local or remote, the STOP indicator is illuminated.
- (c) **FORWARD:** This pushbutton switch is inactive when the recorder is conditioned for remote operation. Operation of the switch, when the recorder is conditioned for local, results in forward tape motion at 1 1/4 inches per second. When the recorder is conditioned for forward, either local or remote, the FORWARD indicator is illuminated.
- (d) **FAST FORWARD:** This pushbutton switch is inactive when the recorder is conditioned for remote operation. Actuation of the switch, when the recorder is conditioned for local, results in movement of tape from upper (supply) reel to the lower (take-up) reel at the fast speed. When the recorder is conditioned for fast forward, either remote or local, the FAST FORWARD indicator is illuminated.
- (e) **REWIND:** This pushbutton switch is inactive when the recorder is conditioned for remote operation. Actuation of the switch, when the

recorder is conditioned for local, results in movement of tape from lower (take-up) reel to the upper (supply) reel at fast speed. When the recorder is conditioned for rewind, either local or remote, the REWIND indicator will be illuminated.

(f) **LOCAL/REMOTE:** This pushbutton switch is used to condition the recorder for local or remote control. Alternate actuation of the switch results in alternate local and remote conditions. The appropriate section of the indicator is illuminated to indicate the status.

4.02 Tape Loading

Warning: Power must be OFF when loading tape on the recorder. Do NOT handle reels when power is ON.

- (1) After insuring the power is off, open the dust cover (Fig. 3).

Note: The dust cover safety interlock switch is automatically actuated when the door is opened.

Caution: Handle reels with care. Do not hold or grasp in a manner such as to deflect the flanges towards or away from each other. Bent reel flanges can permanently damage tape.

- (2) Remove the reel clamps by turning the knurled knob counterclockwise. It may be necessary to hold the tape reel (by the periphery or reel adapter assembly) as appropriate when loosening the reel clamps.
- (3) If applicable, remove tape in accordance with 4.03.
- (4) Install the loaded tape reel on the supply (upper) reel adapter and secure with the reel clamp.
- (5) Install an empty reel on the take-up (lower) reel adapter and secure with the reel clamp.
- (6) Rotate the upper reel counterclockwise to unwind approximately 3 feet of tape.
- (7) Place the tape in tape path under the fixed guide adjacent to the upper reel, over the

inertia idler capstan, and over the flanged roller. Place it down and to the right of the head assembly tape guide, over the tape cleaner, over the head, between the EOT tape sensor and its reflector, to the right of the head assembly tape guide, between the BOT tape sensor and its reflector, between the capstan and the pressure roller, under the lower fixed tape guide, and onto the top of the empty take-up reel.

Caution: *Do not fold the end of the tape over or allow it to extend through the reel flange cutout.*

- (8) Rotate the take-up reel several turns to secure the tape to the reel and to take slack out of tape in tape path.
- (9) Close the dust cover and turn power on.

4.03 **Tape Removal**

Caution: *Recorded data will be erased from the tape during tape rewind operations if the recorder is programmed in the RECORD mode. The modes of recorder operation are remotely controlled via system write and control circuits. Conditioning the recorder to provide protection against tape erasure shall be in accordance with system operational procedures.*

- (1) After the system control has released the recorder for manual tape change service, **be**

sure the recorder is not in the record mode.

If the tape is to be rewound to the supply reel, operate the REWIND key at the recorder control panel. The tape shall rewind onto the supply reel until the BOT photoreflexive marker is detected by the BOT sensor. The tape stops with all the tape, except the tape leader, rewound onto the supply reel. If tape is not to be rewound onto the supply reel, operate the FAST FORWARD key at the recorder control panel. The tape stops on the EOT marker with all the tape except the leader wound on the take-up reel.

- (2) Operate the POWER key on the recorder control panel to remove operating power from the recorder.
- (3) Open the dust cover.
- (4) Manually rotate the supply reel clockwise (or take-up reel counterclockwise) to wind the remaining tape leader onto the reel.
- (5) Carefully hold the full reel by the hub or by the outer edge of the reel flange so the reel cannot rotate; then loosen and remove the reel clamp. Remove the reel of tape from the recorder. If the tape removed is to be filed, place the reel in a clean, dust-free container and file it in accordance with local office procedure.
- (6) Tape loading is covered in 4.02.