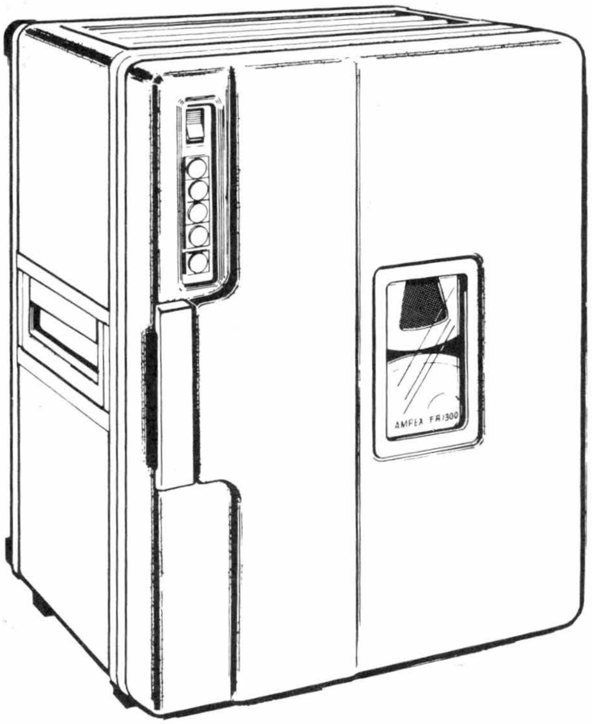
PRELIMINARY MANUAL



FR1300

RECORDER/REPRODUCER

AMPEX CORPORATION REDWOOD CITY, CALIFORNIA

CATALOG NO. 24030-10

103190

103191

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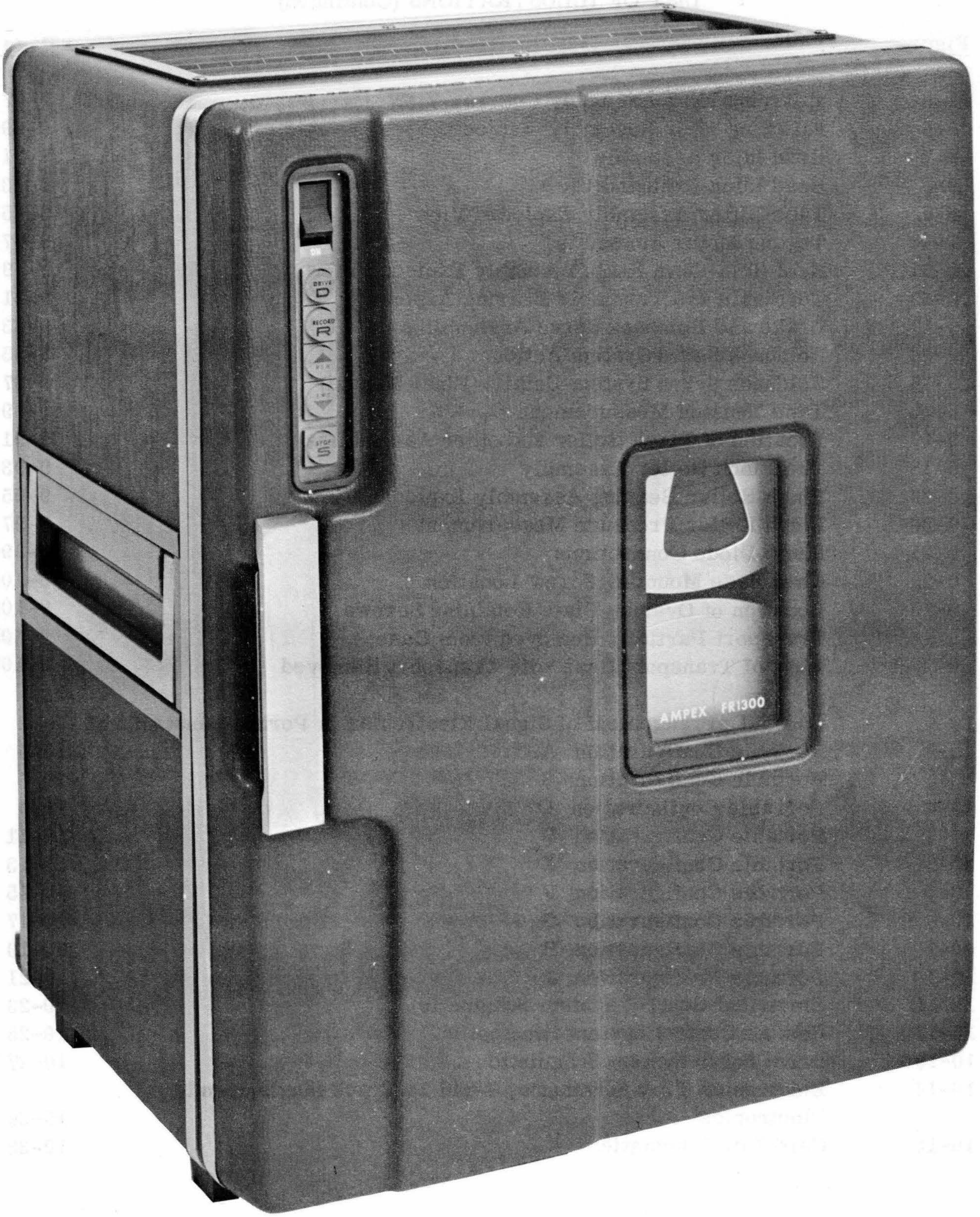

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Figure 1-1. THE PORTABLE FR-1300 RECORDER/REPRODUCER

CHAPTER 1

DESCRIPTION AND SPECIFICATIONS

1. 1. This manual describes the installation, operation, and maintenance of the portable and rack-mounted instruments designated AMPEX Model FR-1300, having serial numbers from 101 to 130 inclusive. The model, catalog number, and serial number appear on an identification plate located on the lower back panel of the portable instrument. In the rack -mounted instrument, this plate is located at the rear on the exposed portion of the transport power panel.

1-2. DESCRIPTION. See figures 1-1 through 1-4.

1-3. The AMPEX Model FR-1300 Recorder/Reproducer is a compact, reliable instrument intended principally for instrumentation service. The FR-1300 has 14-track direct or FM recording and reproducing capability on magnetic tape of one inch width, or 7-track capability on one-half inch tape, and features six easily selected tape speeds, solid-state electronics, and an advanced capstan drive system. The portable instrument is contained in an aluminum -framed case two feet high, one and one-half feet in width and slightly over a foot in depth. The case is provided with a dust cover which encloses the front of the instrument. Operating controls located in a cluster at the upper left side of the instrument, are exposed through an opening in the dust cover so that the instrument may be operated with the cover closed. The FR-1300 may be moved about by means of large handles which fold out from the sides of the case. These handles, large enough for a two-handed grip, are so located that the instrument remains upright, in the operating attitude while being transported. Signal connections are made to connectors on the signal connector panel at the top of the instrument. Power is applied to the instrument through a connection on the power panel at the right side of the case. A hinged back panel covers the rear of the instrument. The lower half is provided with a small access plate. The upper half is louvered and secured in place by means of two captive screw type fasteners. Plastic feet on the bottom of the portable case elevate the instrument to permit air to flow into a fan located in the bottom of the case. The fan is provided with a removable filter.

1-4. With the dust cover opened, figure 1-4, the open loop tape path between reels can be seen. The path is formed by slots between three removable plastic covers, the control cover at the top, the centrally located head cover, and the capstan cover at the bottom of the panel. A red-colored tape threading lever located on the inner side of the control cover is used in the tape threading operation. The instrument is controlled by means of a power switch and five back-lighted pushbuttons vertically arranged in a control cluster. The cluster is partially enclosed by the control cover. By operating the pushbuttons, the instrument may be made to reproduce or record signals to transport tape rapidly between the tape reels, and to conduct a search at high tape speeds. These functions, called modes, are: DRIVE, RECORD, FORWARD, REWIND, STOP, and SEARCH. The uppermost reel is the supply reel. In recording or reproducing, tape moves from the supply reel, across the record/reproduce heads and onto the take-up reel below. Tape lifters are employed to elevate the tape above the heads when the tape is transported rapidly between reels. The lifters are retracted in the search mode.

1-5. The six tape speeds, 60, 30, 15, 7-1/2, 3-3/4 and 1-7/8 inches per second (ips) are selected by means of the tape speed selector located to the right of the capstan cover. The speed selected appears in an adjacent window as the selector is turned. Tape speed is controlled by a drive servo system associated with the selector. Circuits of this system set the speed of the capstan which pulls the tape. The capstan and an associated pinch roller are located below the capstan cover. To the right of the cover are the phase meter and the phase adjustment. The phase meter indicates correct operation of the drive servo system.

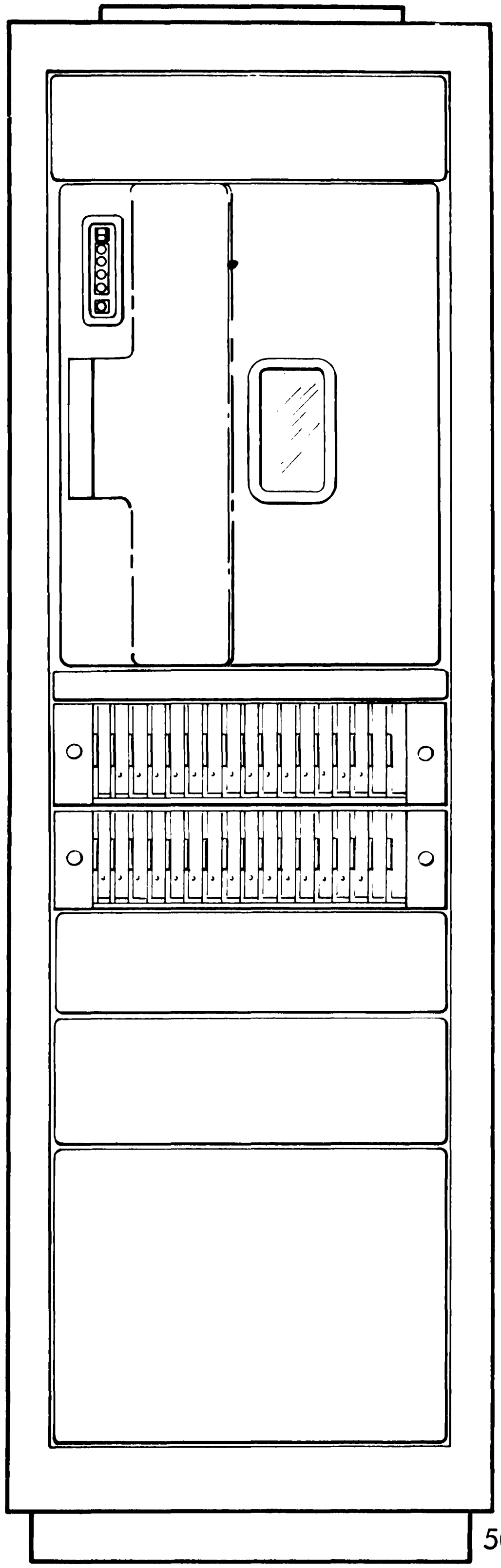

Figure 1-2. THE RACK MOUNTED FR-1300 RECORDER/REPRODUCER

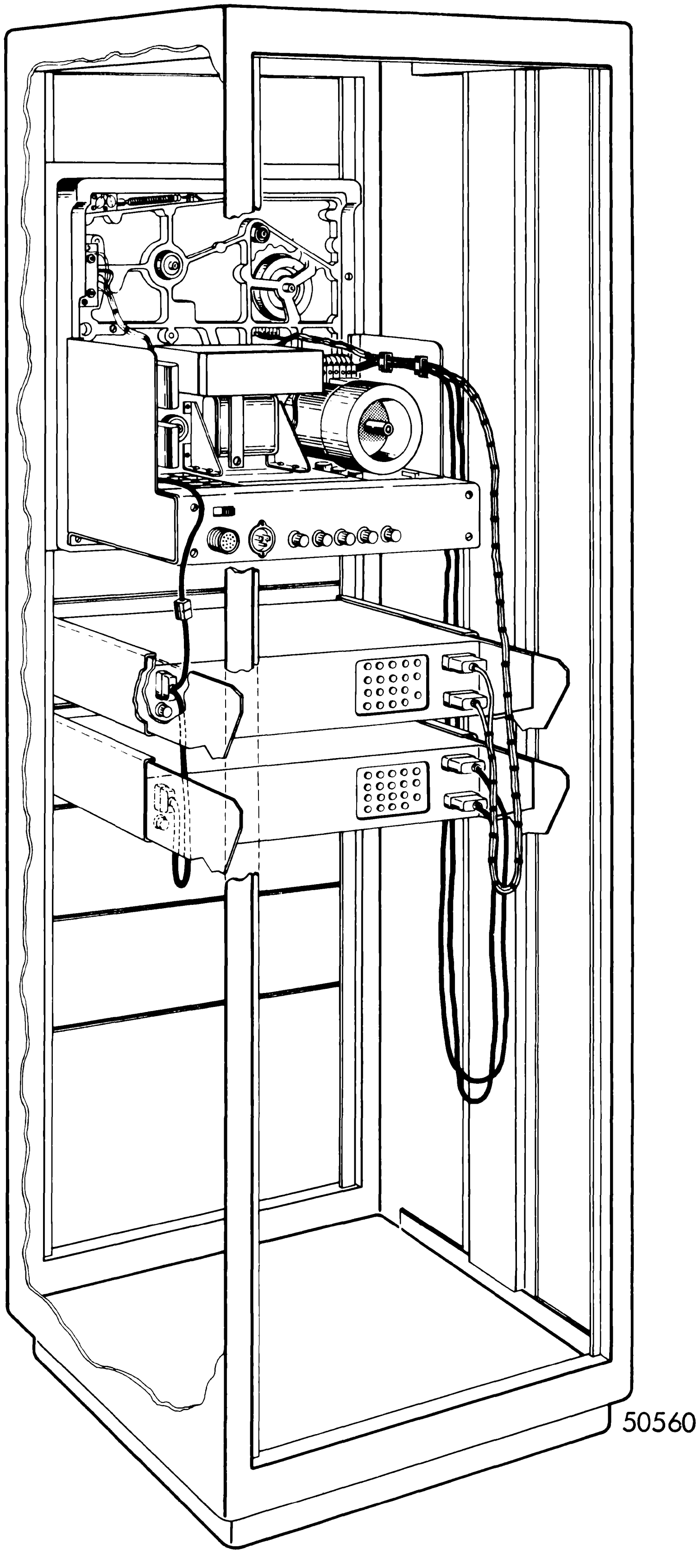

Figure 1-3. REAR VIEW OF THE RACK MOUNTED FR-1300 RECORDER/REPRODUCER

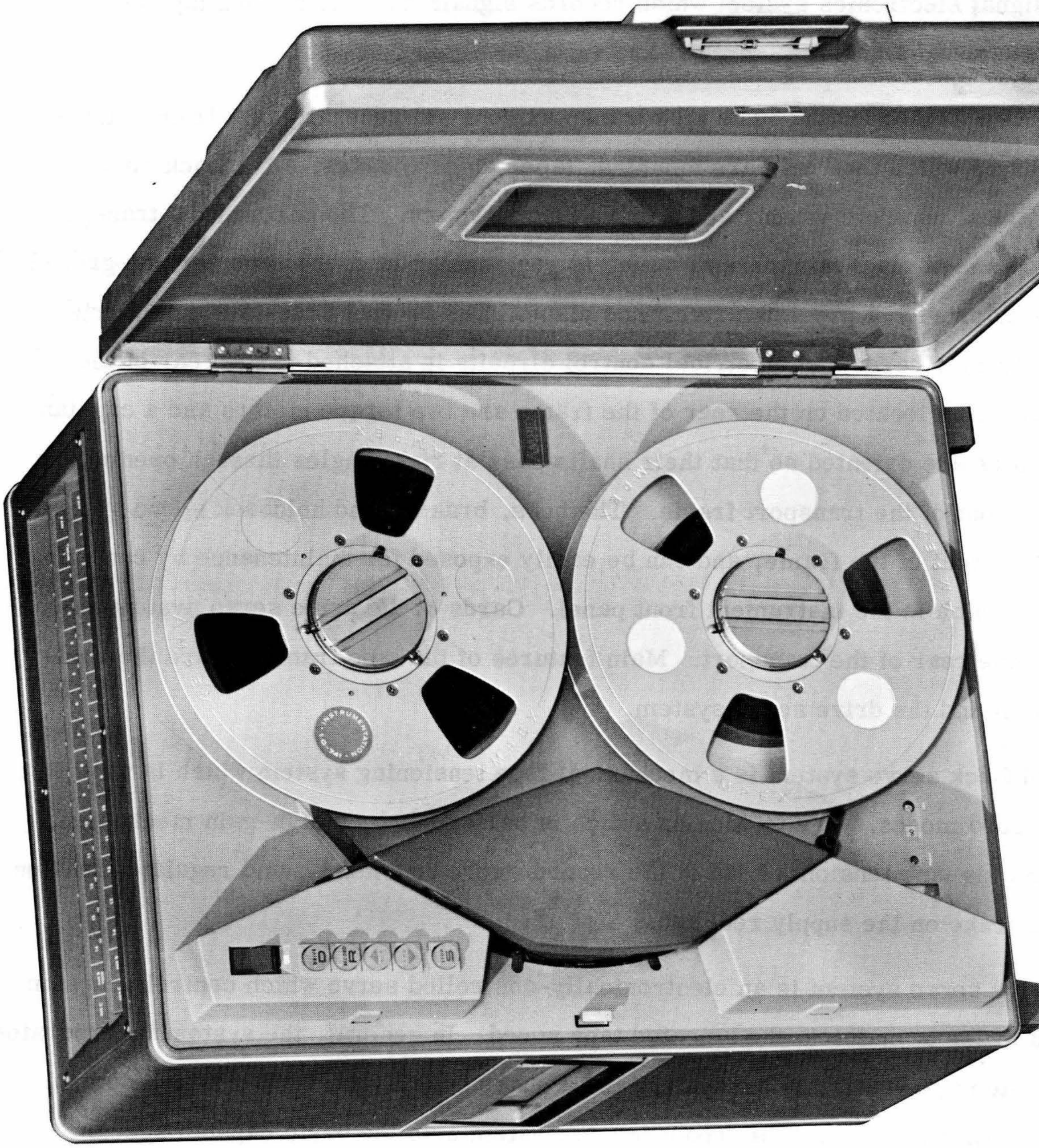

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Figure 1-4. PORTABLE INSTRUMENT WITH DUST COVER REMOVED

1-6. FUNCTIONAL SYSTEMS.

1-7. Functionally, the FR-1300 consists of a tape transport which provides uniform tape motion, and a signal electronics system which records signals onto the moving tape and reproduces the recorded signals.

1-8. THE TAPE TRANSPORT. The tape transport consists generally of a frame, three motors, two hubs on which the reels are mounted, tape guides, brakes, a holdback servo system, an electrical control system, and a drive servo system. The parts of the transport are assembled on a cast magnesium frame which is rectangular in shape, and surface-ground on its front face to provide a precision reference plane. The control chassis which carries drive servo electronics cards and electrical control circuits is attached to the rear of the transport frame. Also located on the rear of the frame are two torque motors and a capstan motor. The motors are oriented so that their shafts pass at right angles through openings in the frame to the front of the transport frame. The hubs, brakes, and holdback servo system are located on the front of the frame, and can be easily exposed for maintenance by removing the overlay plate which is the instrument front panel. Cards of the drive servo system are accessible from the rear of the transport. Main features of the tape transport are the holdback servo system and the drive servo system.

1-9. The holdback servo system is a mechanical tape tensioning system which is used in the drive and record modes. The tensioning action is performed by a high-gain mechanical servo which samples tape tension a head of the record/reproduce heads, and regulates tension by controlling a brake on the supply reel hub.

1-10. The drive servo system is an electronically-controlled servo which controls capstan motor torque in order to maintain the selected tape speed. In general, the system incorporates two servo subsystems; a frequency subsystem and a phase subsystem, both of which control the torque of the capstan motor. The frequency subsystem sets the basic capstan speed. Finer control is achieved through the phase subsystem which locks the speed of capstan rotation to the phase of a frequency reference. The frequency reference may be the line frequency, or a special 60 cycle frequency reference. Capstan speed is monitored by means of a tachometer on the capstan motor.

1-11. THE SIGNAL ELECTRONICS SYSTEM. The FR-1300 uses the AMPEX ES-100 signal electronics system, which consists generally of the magnetic head group, card files, electronics modules, and a power supply. The head group, located under the head cover, consists of four magnetic heads mounted on a one-piece head base. The heads are so arranged that in the drive or record modes the tape passes first over the record heads then over the reproduce heads. Thus, signals recorded on the tape in the record mode can be monitored through the reproduce heads as the tape moves across the heads. The signal electronics consists of individual record and reproduce modules for each of the 14 tracks. The modules are carried in two card files accessible from the rear of the instrument. Each file has space for fourteen modules plus three additional modules. The upper half of the rear panel, when released and hinged downward, exposes the modules. See figure 1-7. Modules are pressed into place in the card files, and can be removed by pulling straight out on the raised portion of the module panel. A locator strip above the upper file, and at the bottom edge of the lower file identifies the type of module, either record or reproduce, and the tape track with which it is associated. This identification system is used also on the signal connector panel on the top of the case to relate tracks and associated input and output connectors.

1-12. A preamplifier assembly consisting of seven dual preamplifier cards in a magnetically shielded housing is mounted to the rear of the transport frame below the lower card file. The preamplifier is used to amplify signals reproduced from the tape. Power for operation of the preamplifiers and the record and reproduce modules is provided by a small power supply attached to the inside of the lower rear panel.

1-13. SINGLE AND SIX-SPEED SIGNAL ELECTRONICS MODULES. When tape speeds are changed in the tape transport, certain of the electronics modules must be converted for operation at the new speed. In the case of single-speed modules, this conversion requires replacement of plug-in equalizers in the direct-reproduce modules, and filters in the FM reproduce modules. In addition, a switch must be positioned on the side of the FM record modules. Where tape speeds are frequently changed, a six-speed version of the direct and FM modules may be employed to advantage. These modules perform the required operations automatically as the speed is changed at the tape speed selector, and do not require further attention. The addition of the six-speed feature on the direct-reproduce and FM record and reproduce modules doubles the width of the modules. Thus in the portable FR-1300 having a record and reproduce capability, a limit of seven tracks can be utilized. No such limitation, however, exists in the rack-mounted instrument, where extra card files can accomodate the required number of modules for a full 14 track, six-speed record and reproduce configuration.

1-14. THE RACK-MOUNTED FR-1300. See figures 1-2 and 1-3.

1-15. The rack-mounted FR-1300 consists of an FR-1300 transport mounted in a standard rack above separately-mounted ES-100 signal electronics card trays which hold the signal electronics modules. The transport is held in an adapter which in turn is secured to the rack. A power panel is provided for the transport which has the same features as the power panel of the portable instrument. The adapter and power panel are parts of a rack-mount adapter kit, catalog number 23825-10. The dust cover hinges from the front of the adapter and when closed, protects the front of the transport. The electronic trays occupy the full rack width and are approximately five inches in height. The front of each tray is occupied by a card file which has a capacity of 14 single-width electronic modules and three additional modules. Signal and power connections are made to the rear of the tray by cables. A power supply and a fan are provided in certain trays. These items are located under an access cover behind the card file. Each card tray is supported within the rack by brackets at either side, attached to the rack. This construction allows the tray to be extended forward (see figure 2-4) for access to the cable connections, and to the power supply and fan. A tray may be removed from the front of the rack once cables have been disconnected.

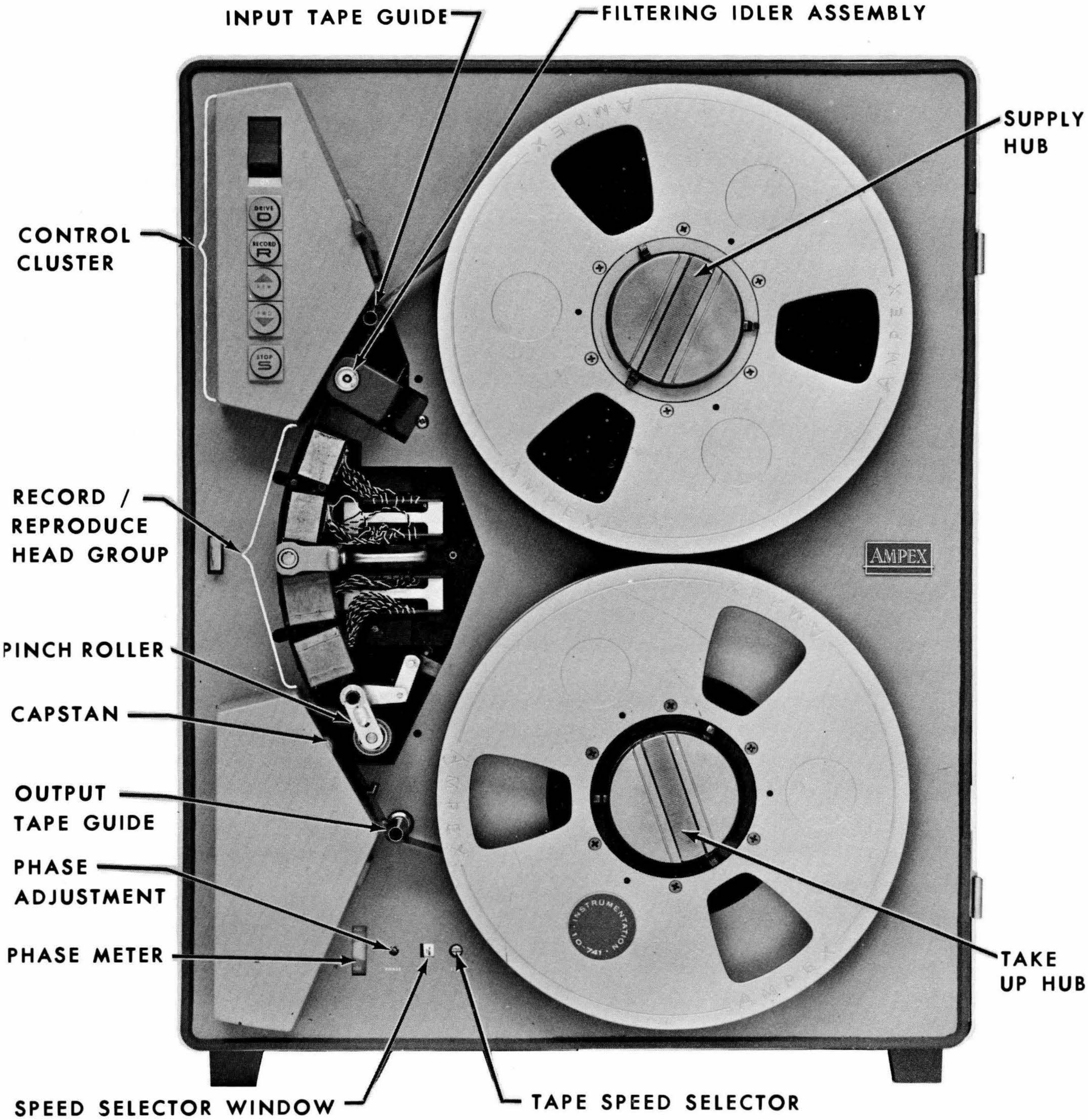

Figure 1-5. PORTABLE INSTRUMENT WITH HEAD COVER REMOVED

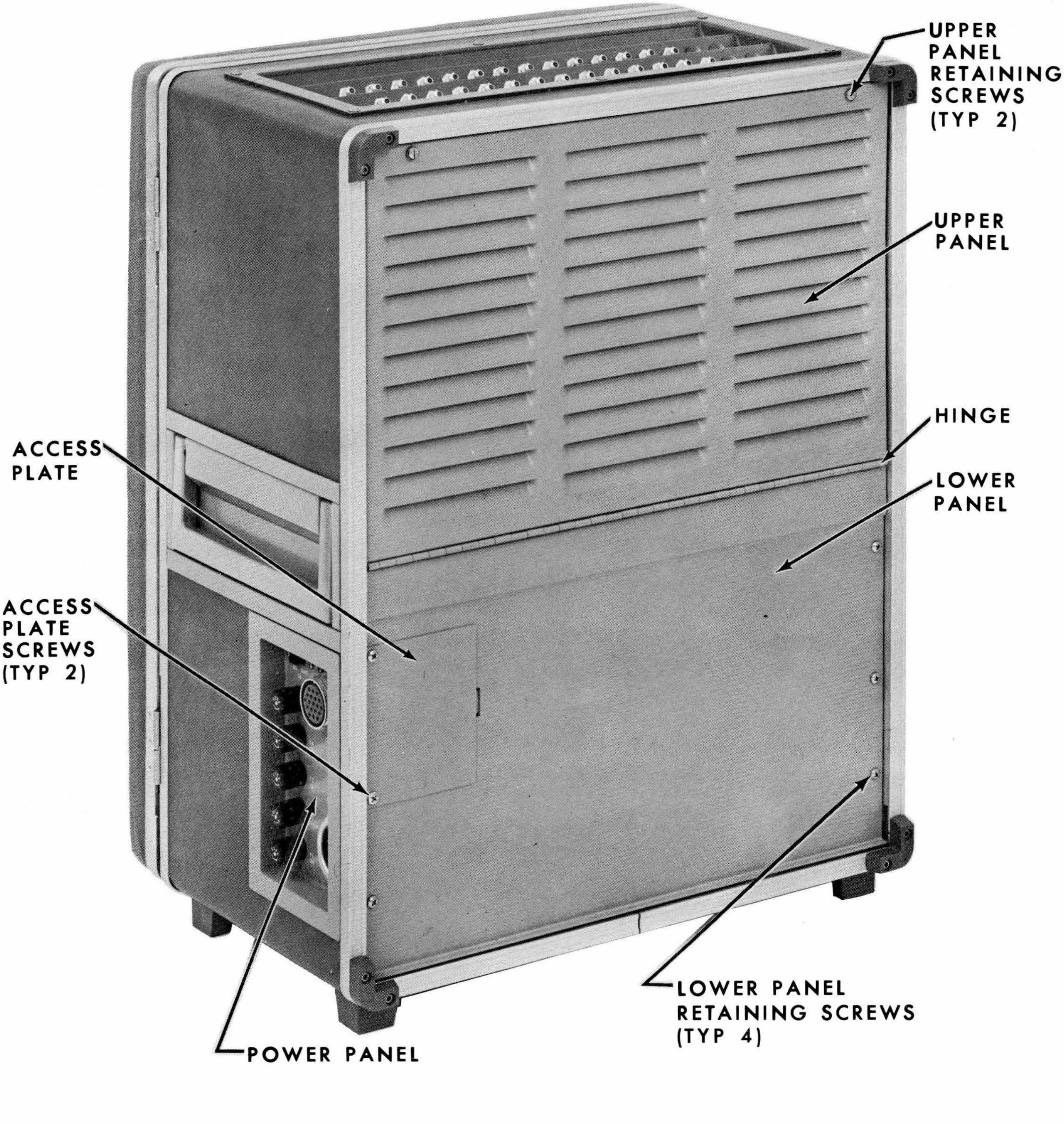

Figure 1-6. REAR VIEW OF PORTABLE INSTRUMENT

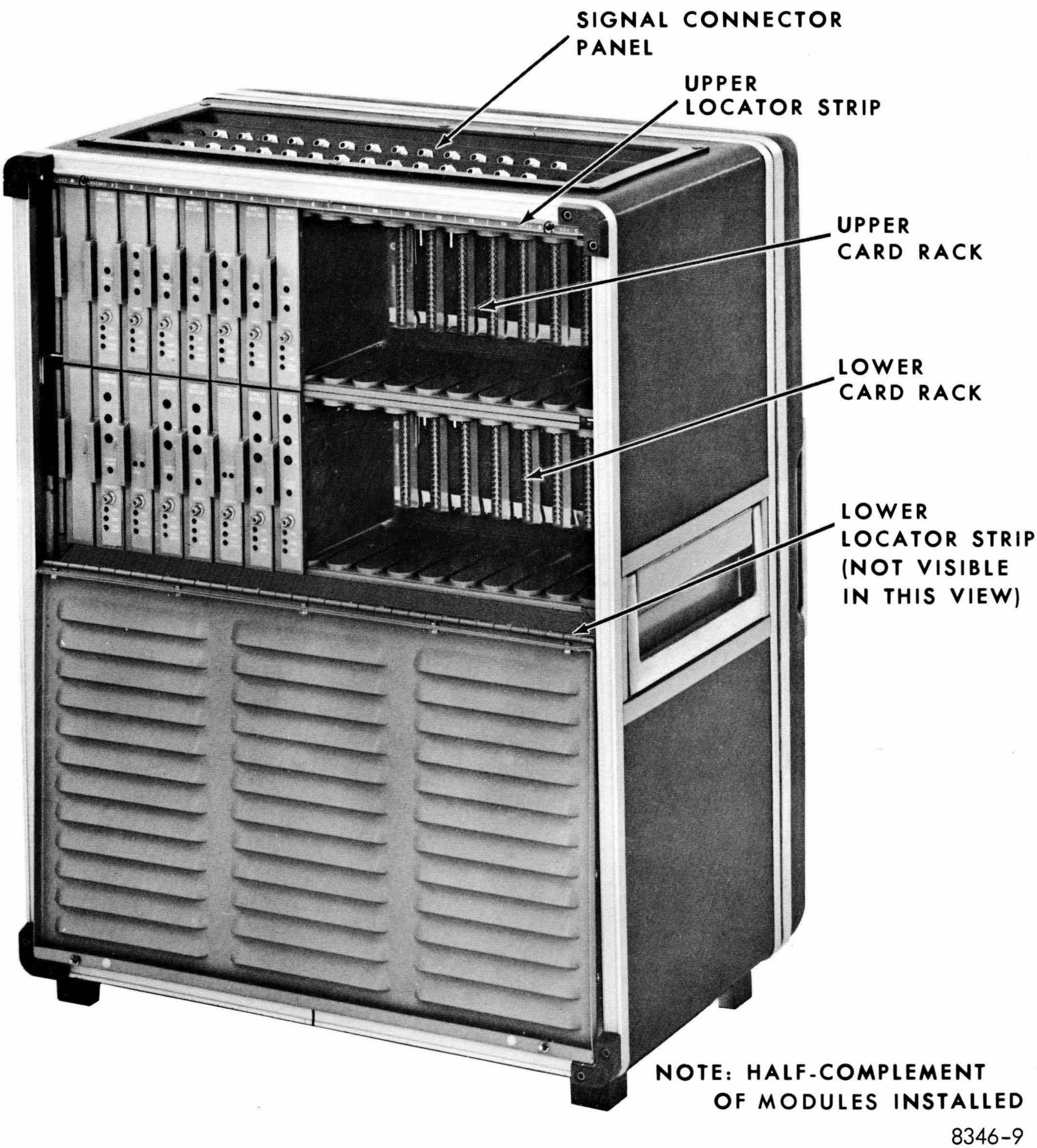

Figure 1-7. PORTABLE INSTRUMENT WITH UPPER REAR PANEL LOWERED

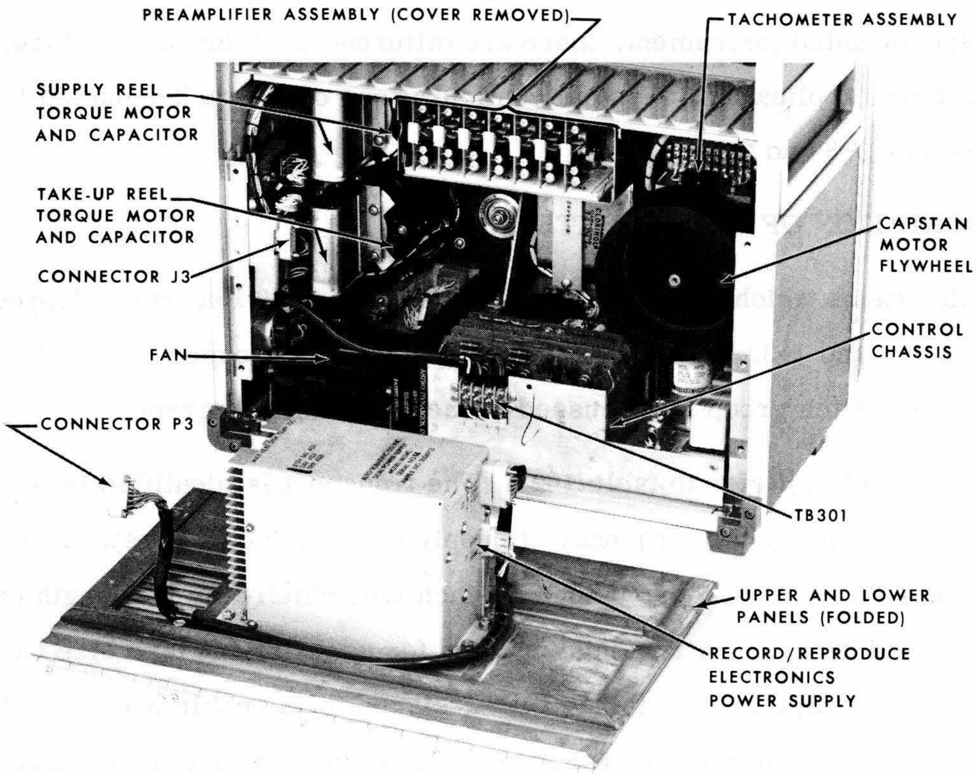

Figure 1-8. PORTABLE INSTRUMENT WITH REAR PANELS REMOVED

1-16. INSTRUMENT CONFIGURATIONS.

1-17. The specific configuration of signal electronics within the portable and rack-mounted FR-1300 varies with the intended application of the instrument. In the portable instrument, differences are in the presence or absence of a preamplifier, use of dummy heads in the head group, one or two card files, and accompanying variations in cabling between the card files, signal connector panel, preamplifier and heads. Typical configurations for the portable instrument are listed in table 1-1, and depicted in figures 10-1 through 10-10 in chapter 10. In the rack-mounted instrument, there are differences of the same nature, depending upon the instrument application. Typical configurations of the rack-mounted instrument are depicted in figures 2-8 and 2-9.

1-18. DESCRIPTION OF CATALOG ITEMS.

1-19. Catalog items which are a part of the model FR-1300 Recorder/Reproducer are listed in tables 1-2 and 1-3. In these tables, the items are grouped by function under descriptive titles. Each group is discussed in the following paragraphs.

1-20. TRANSPORT. (Refer to table 1-2.) The transport is identified in terms of the width of tape it uses and by the frequency of supply power (50 or 60 cps). Instruments using one-half inch tape differ from those using one-inch tape chiefly in the length of tape guides, and the type of head group. Instruments supplied for use with one tape size can be converted for use with the other tape size. Instruments designed for 60 cycle operation differ from instruments operating on 50 cycle power principally in the values of capacitors used with the torque and capstan motors. An instrument intended for 50 cycle operation requires a 60 cps frequency reference. Instruments designed for operation at one frequency can be converted to operation at the other frequency.

1-21. PORTABLE CASE. The portable case is comprised of a welded aluminum enclosure provided with handles, a signal connector panel, a power panel, rear panels, a fan with filter, and power and signal harness. The dust cover is a separate item, which closes the front of the case. The dummy card file is installed in the portable case in place of a card file when only one card file is required. Such an installation would exist in portable seven track instruments having single-speed electronics.

TABLE 1-1. CONFIGURATIONS OF THE PORTABLE FR-1300

Configurations Note 3	Card Arrangement	Signal Electronics: Single Speed	Signal Electronics: Electrically Switched	Number of Tape Tracks: Record	Number of Tape Tracks: Reproduce	Card File and Preamplifier Identification: Upper Card File Part No. 69102-	Lower Card File Part No. 69102-	Preamplifier Assembly Part No. 69244-
A	Record cards in lower file Reproduce cards in upper file	X	—	1-14	1-14	-2	-1	-1
B	Record cards in lower file Upper file space vacant	X	—	1-14	Record only	Blank Panel Note 2	-1	Not installed
C	Lower file space vacant Repro. cards in upper file	X	—	Reproduce only	1-14	-2	Blank Panel Note 2	-1
D	Record and Reproduce cards Alternated (key given on file)	X	—	1-7	1-7	-3	Blank Panel Note 2	-2
E	Record Cards in lower file Reproduce cards in upper file	—	X	1-7	1-7	-5	-4	-2
F	Record cards in both upper and lower files	—	X	1-14	Record only	-6	-6	Not installed
G	Record cards in lower file Upper file vacant	—	X	1-7	Record only	Blank Panel Note 2	-4	Not installed
H	Reproduce cards in both upper and lower files	—	X	Reproduce only	1-14	-5	-5	-1
J	Repro. cards in upper file Lower file vacant	—	X	Reproduce only	1-7	-5	Blank Panel Note 2	-2

NOTES

1. Power supply provided for all configurations is AMPEX Part No. 69121-1.
2. Blank panel AMPEX Part No. 24175-10.
3. See figures 10-1 through 10-10.

1-22. RACK-MOUNT ADAPTER KIT. See figure 1-3. The rack-mount adapter kit includes a frame adapter, power panel, side panel, and power harness necessary for placing an FR-1300 transport in a rack-mount. Additional information is provided on this item in chapter 2.

1-23. REMOTE CONTROL. (See figure 1-9.) The remote control consists of a remote control assembly, and separate harness to adapt the portable and rack-mounted instruments for remote control operation. The remote control assembly, consisting of the remote control unit and a cable, can be used with any FR-1300 instrument which is provided with the harness. Installation of the remote control harness and connection of the remote control unit are described in chapter 2.

1-24. FREQUENCY REFERENCE. (See figure 1-10.) The frequency reference, contained in a small, sealed, plug-in housing, provides an accurate 60 cycle reference frequency used in the phase subsystem of the drive servo system. The frequency reference is used in place of the power line where best accuracy is required. The frequency reference is required in instruments operated on 50 cycle power.

1-25. SERVICING ITEMS. Servicing items include an accessory kit and four servo extension cards. The accessory kit is composed of an eight foot power cord, a can of head cleaner, a short length of plastic tubing for removing pushbutton lamps, and three colored test tip plugs for use with the signal electronics modules. The servo extension cards are used in maintenance of the drive servo system to bring one servo card at a time into a more accessible position for troubleshooting without removing the card from the circuit.

1-26. RECORD/REPRODUCE HEAD GROUP. (Refer to table 1-3.) The record/reproduce head group includes four head stacks arranged on a one-piece head base. In record-only configurations, the reproduce heads are replaced by dummy heads. Dummy heads are provided in place of the record heads in the reproduce-only configurations. In seven-track head groups, four-tracks are recorded by one head and three by the second record head. Similarly, four tracks are reproduced by the first reproduce head, and three-tracks by the second reproduce head. Connections to the individual head stacks may be according to AMPEX format, or IRIG format. The difference between these formats is shown in figure 1-11.

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Figure 1-9. THE REMOTE CONTROL UNIT

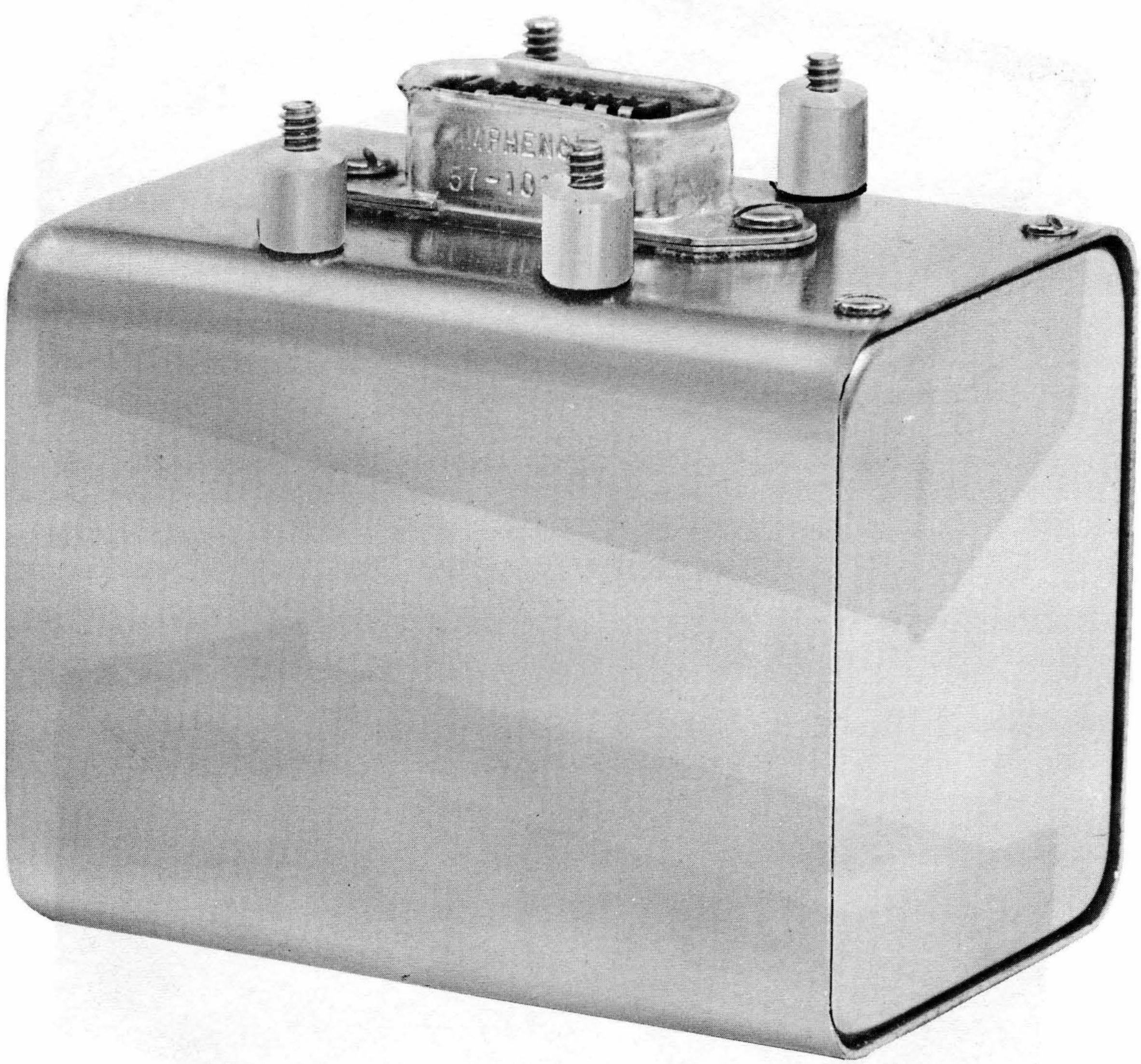

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Figure 1-10. THE FREQUENCY REFERENCE

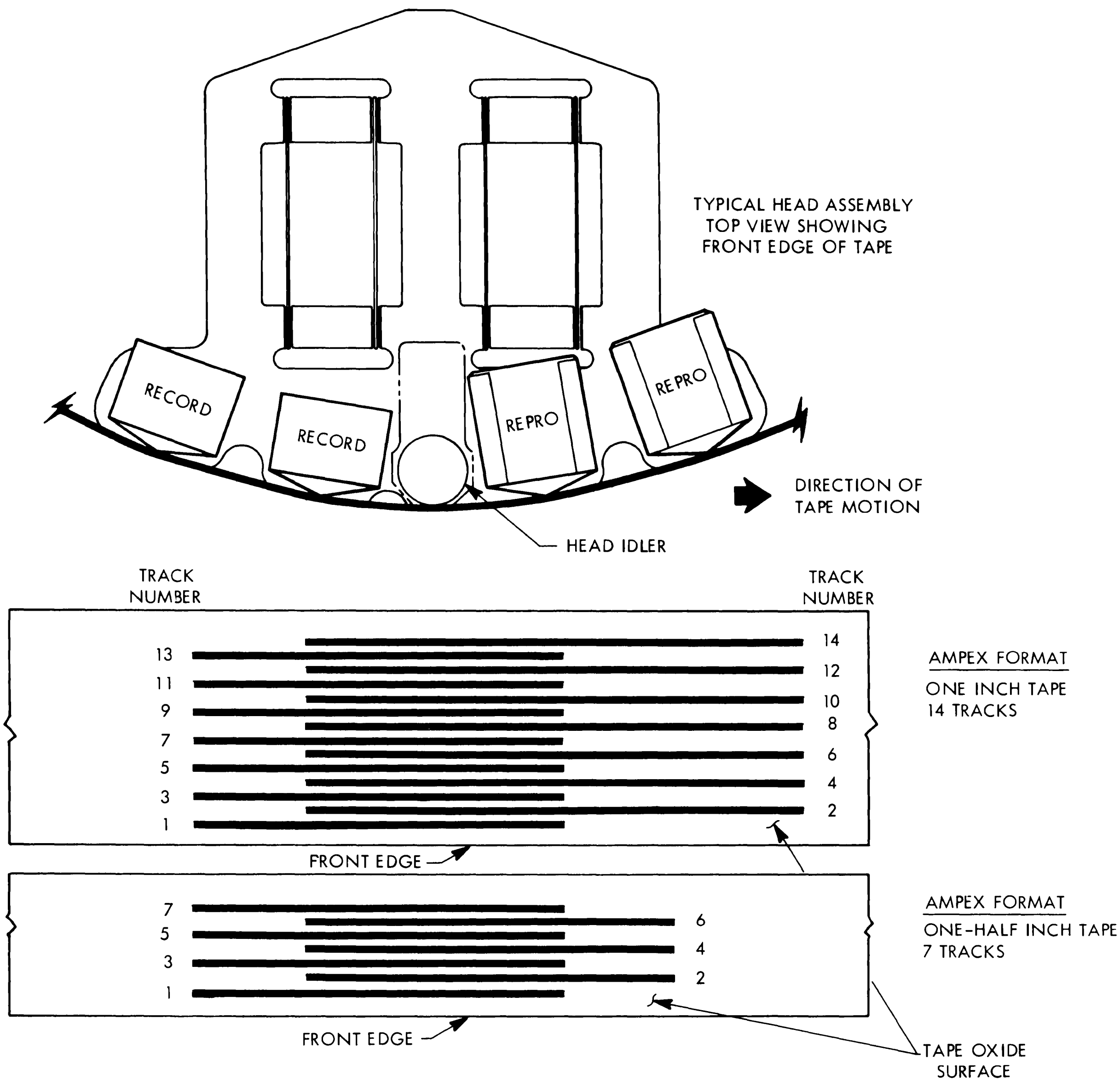

TABLE 1- IRIG TRACK NUMBERING							
ONE INCH TAPE 14 TRACKS				ONE-HALF INCH TAPE 7 TRACKS			
AMPEX	IRIG	AMPEX	IRIG	AMPEX	IRIG	AMPEX	IRIG
13	2	14	1	7	1	6	2
11	4	12	3	5	3	4	4
9	6	10	5	3	5	2	6
7	8	8	7	1	7		
5	10	6	9				
3	12	4	11				
1	14	2	13				

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Figure 1-11. TAPE TRACK NUMBERING

1-27. FR-1300 PORTABLE PREAMPLIFIER HOUSING. See figure 5-2. The preamplifier housing used in the portable instrument consists of a rectangular mu-metal box provided with internally mounted card connectors into which preamplifier cards are inserted, and external signal input and output connectors. In instruments having 14-track reproduce capability, the housing accomodates seven dual-preamplifier cards. Signals from the reproduce heads reach cards in the housing through two cables. Signals amplified by the preamplifiers are routed to the reproduce modules through two output connectors on the side of the housing. In instruments having seven-track reproduce capability, provision exists to accomodate four dual preamplifier cards within the housing. As in the 14-track version, two input cables are used, however, only one output connector is required.

1-28. FR-1300 RACK-MOUNT PREAMPLIFIER HOUSING. See figure 2-7. The rack -mount preamplifier housing is identical to the housing used in the portable. As in the portable housing, seven cards are used for 14-track capability and four cards are used for seven -track capability. Input cables are identical. In the rack-mount preamplifier housing, the output signal is routed through cables to end connectors which mate with connections on the trays. A single output cable is used in instruments having seven-track recording capability. Fourteen-track output signals are routed through two cables to the trays, however, two versions exist. In the -10 version, signals from the odd-numbered tracks are routed to one cable-end connector and signals from the even-numbered tracks are routed to the second cable-end connector. In the -30 version, signals from tracks 1 through 7 are routed through one cable-end connector and signals from tracks 8 through 14 are routed through the second cable-end connector.

1-29. FR-1300 RACK-MOUNT RECORD HEAD CABLE. See figure 2-7. The rack-mount record head cable carries signals (to be recorded) from the record modules to the record heads. In instruments having a seven-track recording capability, the cable has two connectors at the record head end, and a single connector at the other end which mates with a connector on the electronics tray. In instruments which have a fourteen-track recording capability, two versions of the cable exist. Both have two connectors which connect to the heads, and two tray connectors at the other end, but differ in the arrangement of the tracks. In the -10 version, one cable-end connector at the tray receives signals to be recorded on odd numbered tracks. The other connector receives signals to be recorded on even-numbered tracks. In the -30 version, one cable-end connector receives signals for tracks 1 through 7 and the second connector receives signals for tracks 8 through 14.

1-30. FR-1300 RACK-MOUNT POWER AND CONTROL CABLE. See figure 2-6. In the rack-mounted FR-1300, power for the preamplifier and record/reproduce module is provided by a single power supply located in one of the trays, usually the bottom tray if two trays are used. The power and control cable carries power from the power supply to other trays and the supply itself receives primary power through the cable from the transport. In addition, the cable carries voltages which control the application of power to the record electronics modules.

1-31. PORTABLE CARD FILE. Refer to table 1-1. The portable card file is a holder for the signal electronics modules. The file consists of a rectangular metal enclosure open on one side, provided with strip-connectors in the bottom which mate with connectors on the modules. Sufficient positions exist in each file to accomodate a total of 17 modules. Normally, fourteen single-width modules are installed in the file, and vacancy panels are used to fill the remaining three spaces. Wiring at the rear of the files, and cabling between the files varies with the capability of the instrument.

1-32. RACK-MOUNT ELECTRONICS TRAYS. See figure 2-4. Refer to paragraph 1-15 and to the second part of this manual for a description of the electronics trays.

1-33. PREAMPLIFIER CARD. Preamplifier cards used in the portable and rack-mount FR-1300 are identical. Each card contains two separate solid-state preamplifier circuits which provide initial amplification of taped signals reproduced by the heads. The same cards are used to perform initial amplification of signals recorded by the direct or FM method.

1-34. DIRECT RECORD MODULE. See figure 1-12. The direct record module used in the portable and rack-mount FR-1300, amplifies the signal to be recorded, and applies the amplified signal to a single recording element of a record head. The direct record module is single width, whether used in a single, or a six-speed configuration.

1-35. DIRECT REPRODUCE MODULE. See figure 1-12. The direct reproduce module used in both the portable and rack-mount FR-1300, receives and amplifies a signal reproduced from a single tape track. Two versions of the direct reproduce module exist. They are the single-speed module, and the six-speed electrically switched module. The single-speed module occupies only one space in a card file, however, plug-in equalizers must be changed to adapt it to different tape speeds. In the six-speed module, equalizers are electrically changed to match changes in tape speed. A six-speed module, due to the switching mechanism, occupies two spaces in a card file.

1-36. **FM RECORD MODULE.** The FM record module used in both the portable and rack -mount FR-1300 converts the signal to be recorded into a frequency modulated analog which is applied to a single recording element of the record head. Two versions of the FM record module exists, a single-speed module and a six-speed module. The single-speed module is adapted to different tape speeds by means of a switch on the side of the module which is manually turned to each new tape speed. The six speed version performs the switching operation automatically as each new tape speed is selected. Two card file spaces are required to accommodate the six-speed version.

1-37. **FM REPRODUCE MODULE.** The FM reproduce module receives and demodulates the signal reproduced from a single tape track. Two versions of the FM reproduce module exist. They are the single-speed module, and the six-speed module. The single-speed module occupies one space in the card file, and must be adapted to each tape speed by changing plug-in filters. In the six-speed version, filters are electrically changed to match changes in tape speed. The six-speed module occupies two spaces in the card file.

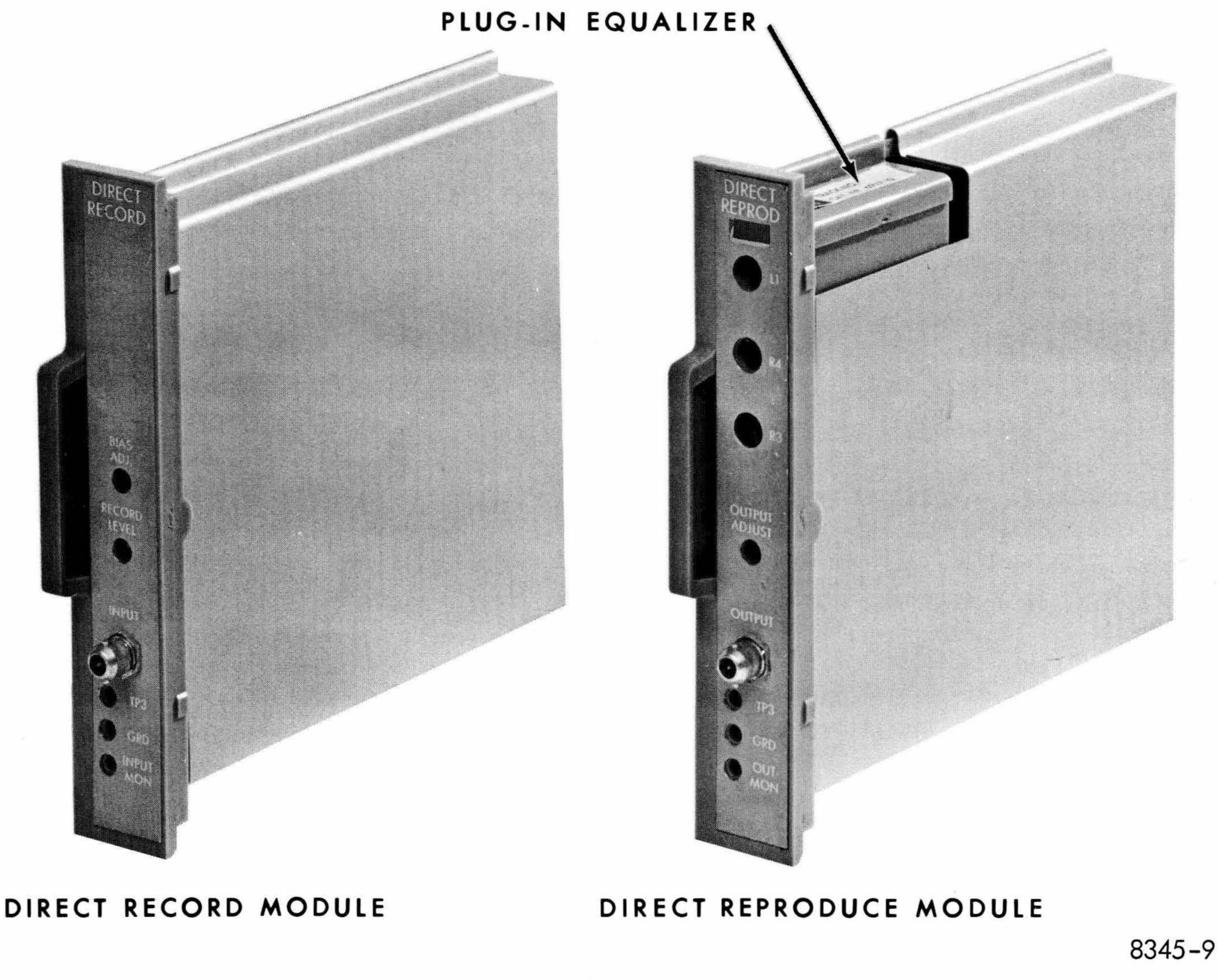


Figure 1-12. SINGLE SPEED DIRECT RECORD AND REPRODUCE MODULES

TABLE 1-2. LIST OF CATALOG ITEMS FOR FR-1300 RECORDER/REPRODUCER

	CATALOG NO.
TRANSPORT	
One-inch Tape, 105 to 125 volts, 58 to 62 cps power	23875-10
One-half-inch Tape, 105 to 125 volts, 58 to 62 cps power	23875-20
One-inch Tape, 105 to 125 volts, 48 to 52 cps power	23875-40
One-half-inch Tape, 105 to 125 volts, 48 to 52 cps power	23875-50
PORTABLE CASE	
Case Assembly for Portable	24100-11
Dust Cover for Portable	24085-10
Dummy Card File for Portable	24175-11
RACK-MOUNT ADAPTER KIT	
Rack-mount Adapter for Transport	23825-10
REMOTE CONTROL	
Remote Control Assembly	24110-10
Harness to Adapt Portable for Remote Operation	24115-10
Harness to Adapt Rack-mounted FR-1300 to Remote Operation	24114-10
FREQUENCY REFERENCE	
60 cps Frequency Reference	23882-10
SERVICING	
Accessory Kit	24090-10
Servo Extension Card for Power Supply Card (24018)	24189-10
Servo Extension Card for Tachometer Amp. Card (24015)	24189-20
Servo Extension Card for Time Base Comparator Card (24021)	24189-30
Servo Extension Card for Phase Comparator Card (24024)	24189-40
INSTRUCTION MANUAL	
FR-1300 Recorder/Reproducer Manual	24030-10

RECORD/REPRODUCE HEAD GROUP

Record/Reproduce 300 KC 7-Track Ampex Format	120165-020
Record/Reproduce 300 KC 7-Track IRIG Format	120165-050
Record/Reproduce 300 KC 14-Track Ampex Format	120170-020
Record/Reproduce 300 KC 14-Track IRIG Format	120170-050

RECORD-ONLY HEAD GROUP

Record-only 300 KC 7-Track Ampex Format	120165-030
Record-only 300 KC 7-Track IRIG Format	120165-060
Record-only 300 KC 14-Track Ampex Format	120170-030
Record-only 300 KC 14-Track IRIG Format	120170-060

REPRODUCE-ONLY HEAD GROUP

Reproduce-only 300 KC 7-Track Ampex Format	120165-080
Reproduce-only 300 KC 7-Track IRIG Format	120165-070
Reproduce-only 300 KC 14-Track Ampex Format	120170-080
Reproduce-only 300 KC 14-Track IRIG Format	120170-070

TABLE1-3. LIST OF CATALOG ITEMS FOR SIGNAL ELECTRONICS

	CATALOG NO.
FR-1300 PORTABLE PREAMPLIFIER HOUSING	
Preamplifier Box and Cable 1-7 track	69244-20
Preamplifier Box and Cable 1-14 track	69244-10
FR-1300 RACK-MOUNT PREAMPLIFIER HOUSING	
Preamplifier Box and Cable 1-7 track, single, and six-speed	69631-20
Preamplifier Box and Cable 1-14 track, single-speed	69631-10
Preamplifier Box and Cable 1-14 track, six-speed	69631-30
FR-1300 RACK-MOUNT RECORD HEAD CABLES	
Record Head Cable 1-7 track, single, and six-speed	69632-20
Record Head Cable 1-14 track, single-speed	69632-10
Record Head Cable 1-14 track, six-speed	69632-30
FR-1300 RACK-MOUNT POWER AND CONTROL CABLE	
Power and Control Cable	69633-10
Power and Control Tray Interconnecting Cable	69193-10
FR-1300 PORTABLE CARD FILE	
Card File, Record/Reproduce 1-7/1-7 track, single-speed	69102-3
Card File, Record-only 1-14 track, single-speed	69102-1
Card File, Record-only 1-7 track, six-speed	69102-4
Card File, Reproduce-only 1-14 track, single-speed	69102-2
Card File, Reproduce-only 1-7 track, six-speed	69102-5
Card File, Record-only odd or even track, six-speed	69102-6
RACK-MOUNT ELECTRONICS TRAYS	
Tray, Record, Single-speed, 1-14 track, power supply, fan	69570-10
Tray, Record, Single-speed, 1-14 track, power jumper	69570-20
Tray, Record, Six-speed, 1-7 track, power supply, fan	69570-30
Tray, Record, Six-speed, 1-7 track, power jumper	69570-40

RACK-MOUNT ELECTRONICS TRAYS (continued)

Tray, Record, Six-speed, 8-14 track, power jumper	69570-50
Tray, Reproduce, Single-speed, 1-14 track, power supply, fan	69571-10
Tray, Reproduce, Single-speed, 1-14 track, power jumper	69571-20
Tray, Reproduce, Six-speed, 1-7 track, power supply, fan	69571-30
Tray, Reproduce, Six-speed, 1-7 track, power jumper	69571-40
Tray, Reproduce, Six-speed, 8-14 track, power supply, fan	69571-50
Tray, Record/Reproduce, Single-speed, 1-7/1-7, power supply,fan	69572-10

PREAMPLIFIER CARD

Preamplifier, Dual Track (Direct and FM)	69101-10

DIRECT RECORD MODULE

Direct Record, Single-speed and Six-speed	69103-10

DIRECT REPRODUCE MODULE

Direct Reproduce, Single-speed (equalizers required)	69105-10

DIRECT REPRODUCE EQUALIZERS

Direct Reproduce Equalizer for 60 ips	69117-10
Direct Reproduce Equalizer for 30 ips	69117-20
Direct Reproduce Equalizer for 15 ips	69117-30
Direct Reproduce Equalizer for 7-1/2 ips	69117-40
Direct Reproduce Equalizer for 3-3/4 ips	69117-50
Direct Reproduce Equalizer for 1-7/8 ips	69117-60

DIRECT REPRODUCE MODULE, SIX-SPEED

Direct Reproduce, Six-speed (automatically switched)	69106-10

FM RECORD MODULE

FM Record, Single-speed (hand switched)	69107-10
FM Record, Six-speed (automatically switched)	69109-10

FM REPRODUCE MODULE FOR PORTABLE AND RACK-MOUNT	
FM Reproduce, Single-speed (filters required)	69108-10
FM REPRODUCE FILTERS	
FM Reproduce Filter for 60 ips	46390-10
FM Reproduce Filter for 30 ips	46390-20
FM Reproduce Filter for 15 ips	46390-30
FM Reproduce Filter for 7-1/2 ips	46390-40
FM Reproduce Filter for 3-3/4 ips	46390-50
FM Reproduce Filter for 1-7/8 ips	46390-60
FM REPRODUCE MODULE	
FM Reproduce, Six-speed (automatically switched)	69110-10
MISCELLANEOUS ITEMS	
Calibration Module	69116-10
Module Extension Assembly	69118-10

1-38. SPECIFICATIONS

1-39. The AMPEX FR-1300 is a compact, reliable instrumentation recorder designed and built to high commercial standards for material, workmanship and finish. Both portable and rack-mounted versions are available.

1-40. TAPE TRANSPORT.

1-41. TAPE SPEEDS. 60, 30, 15, 7-1/2, 3-3/4, and 1-7/8 ips standard. All six transport speeds are selected by a single front panel control. All speeds are accurately controlled by a phase-locked servo system on the capstan drive motor.

1-42. CAPSTAN SPEED ACCURACY. Capstan speed accuracy is nominal ±.05% measured relative to the servo frequency reference (AMPEX part number 23882-10). The signal generated by the frequency reference is accurate to within ±.02% of nominal frequency (60 cps) over a one-year period.

1-43. REELS. The FR-1300 Tape Transport accommodates 10-1/2 inch reels, AMPEX Precision or NAB.

1-44. TAPE SPECIFICATIONS. Available in versions for 1/2 or 1-inch tape of 1 mil or 1-1/2 mil Polyester, or 1-1/2 mil Acetate. The AMPEX FR-1300 is normally checked out using AMPEX Type 743, 1.0 mil Polyester instrumentation tape. Type 743 is recommended for optimum performance. Stated performance guaranteed only when using AMPEX Instrumentation Tape.

1-45. CONTROLS. Illuminated pushbuttons for RECORD, DRIVE, STOP, FORWARD, and REWIND; these functions may be remotely controlled.

1-46. FAST WIND TIME. For 10-1/2-inch reel, with 2,500 feet of tape, approximately 2.5 minutes.

1-47. START TIME. Time required from start command to meet flutter specifications is 8.0 seconds or less at all tape speeds.

1-48. STOP TIME. Maximum of 1.5 seconds at 60 ips tape speed; shorter stop times with lower tape speeds.

1-49. FLUTTER. Below 0.6% peak-to-peak, cumulative from 0.2 cps to 10 Kc at 60 ips.

1-50. HEADS.

1-51. GAP SCATTER. Trailing edges for record heads (or gap centers for reproduce heads) within a band 100 microinches wide (0.0001 inch).

1-52. GAP AZIMUTH. All stacks within ±1 minute of arc perpendicular to head base plate.

1-53. TRACK DIMENSIONS. Track width is 0.050 inch; tape track spacing 0.070 center (IRIG Standard). Other heads on special order.

1-54. NUMBER OF TRACKS. 7 on 1/2-inch; 14 on 1-inch (IRIG Standard). Other heads on special order.

1-55. INTERSTACK SPACING. 1.5 ±0.0005-inches, gap-to-gap.

1-56. DIRECT RECORD/REPRODUCE SYSTEM.

1-57. FREQUENCY RESPONSE.

TABLE 1-4. DIRECT RECORD/REPRODUCE FREQUENCY RESPONSE

Tape Speed (ips)	Bandwidth (cps)	Signal-to-Noise Ratio (db)	
		Bandpass Filtered*	Unfiltered
60	300 cps to 300 Kc ±3 db	32	28
30	150 cps to 150 Kc ±3 db	32	28
15	100 cps to 74 Kc ±3 db	30	25
7-1/2	50 cps to 38 Kc ±3 db	26	18
3-3/4	50 cps to 19 Kc ±3 db	25	18
1-7/8	50 cps to 10 Kc ±3 db	25	18

* Measured at output of bandpass filter having 18 db/octave attenuation beyond limits stated.

1-58. RMS SIGNAL-TO-NOISE RATIO. (See table.)

1-59. HARMONIC DISTORTION. Less than 1.0% total of a 1 Kc signal recorded at 60 ips.

1-60. INPUT LEVEL. 1.0 volt rms nominal (0dbv) to produce normal recording level; adjustable from 0.1 to 10 volts rms by input potentiometer.

1-61. INPUT IMPEDANCE. Minimum 20 K ohms resistive.

1-62. OUTPUT LEVEL. 1.0 volt rms nominal (0dbv), across a 600 ohms or greater impedance.

1-63. OUTPUT IMPEDANCE. Less than 50 ohms.

1-64. FM RECORD/REPRODUCE SYSTEM.

1-65. FREQUENCY RESPONSE.

TABLE 1-5. FM REPRODUCE FREQUENCY RESPONSE

Tape Speed	Frequency Response (within 1.0 db)	S/N Ratio RMS	Total Harmonic Distortion
60 ips	0 to 20,000 cps	44 db	1.5%
30 ips	0 to 10,000 cps	44 db	1.5%
15 ips	0 to 5,000 cps	42 db	1.5%
7-1/2 ips	0 to 2,500 cps	42 db	1.5%
3-3/4 ips	0 to 1,250 cps	40 db	2.0%
1-7/8 ips	0 to 625 cps	40 db	2.0%

1-66. RMS SIGNAL-TO-NOISE RATIO (at center carrier). (See table.)

1-67. HARMONIC DISTORTION. (See table.)

1-68. DC DRIFT. Less than ±0.5% of full deviation over a four hour period after warmup (10 minutes). Less than 2% in 8 hours with temperature variations between +40°F and +125°F.

1-69. RECORD/REPRODUCE VOLTAGE LINEARITY. ±1.0% of full band, of a zero-based straight line.

1-70. INPUT LEVEL. Input of 1 volt rms (0 dbv) to produce ±40% deviation; adjustable from 0.5 to 25 volts rms by input potentiometer.

1-71. INPUT IMPEDANCE. Minimum 20,000 ohms resistive.

1-72. OUTPUT LEVEL. 1.0 volt rms (nominal) into 10 K ohms or greater load impedance.

1-73. OUTPUT IMPEDANCE. 1,000 ohms, unbalanced to ground.

1-74. POWER REQUIREMENTS.

1-75. VOLTAGE. 105 to 125 volts, single phase, 58 to 62 cps AC (48 to 52 cps AC on special order).

1-76. POWER CONSUMPTION. Approximately 500 watts for a 14-track record/reproduce system.

1-77. ENVIRONMENT.

1-78. TEMPERATURE. Operating: +40°F to +125°F.
Storage/non-operating: -20°F to +160°F.

1-79. ALTITUDE. Operating: 15,000 feet
Non-operating: 50,000 feet

1-80. RELATIVE HUMIDITY. 5 to 95% non-condensing, both operating and non-operating.

1-81. VIBRATION. Operating: nil
Non-operating: normal handling and transportation only.

1-82. PHYSICAL CHARACTERISTICS.

1-83. SIZE. Portable case 24 inches high, by 18 inches wide, by 12-1/2 inches deep, for complete 14-track record/reproduce system and capstan servo.

1-84. VERTICAL RACK SPACE REQUIRED. Rack-mounted version: Transport 24-1/2 inches, electronic tray 5-1/4 inches; each electronics tray accommodates up to 14-record or reproduce modules, plus 3 auxiliary modules.

1-85. WEIGHT. Portable version: approximately 110 lbs. for 14-track system.

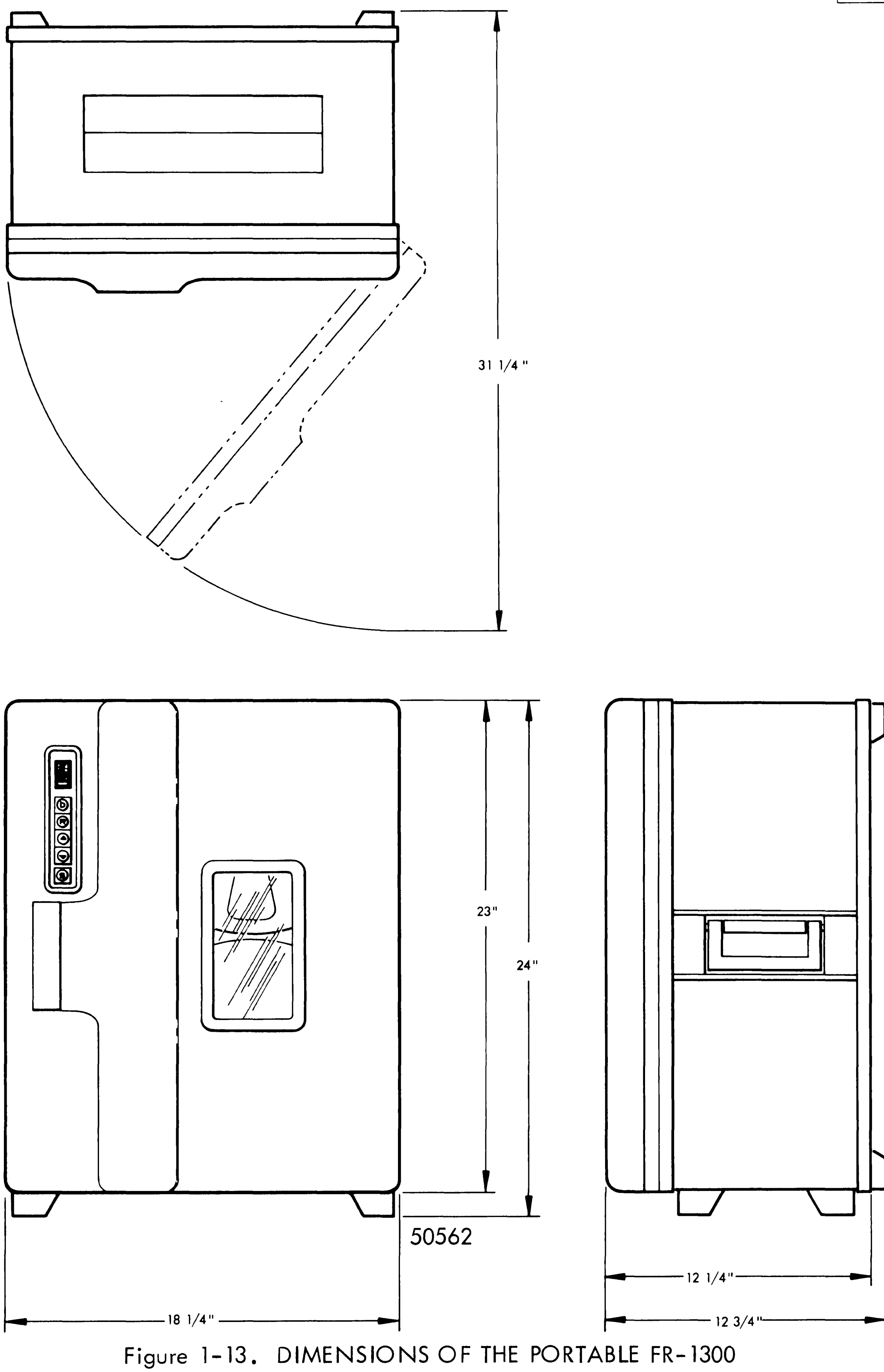


Figure 1-13. DIMENSIONS OF THE PORTABLE FR-1300

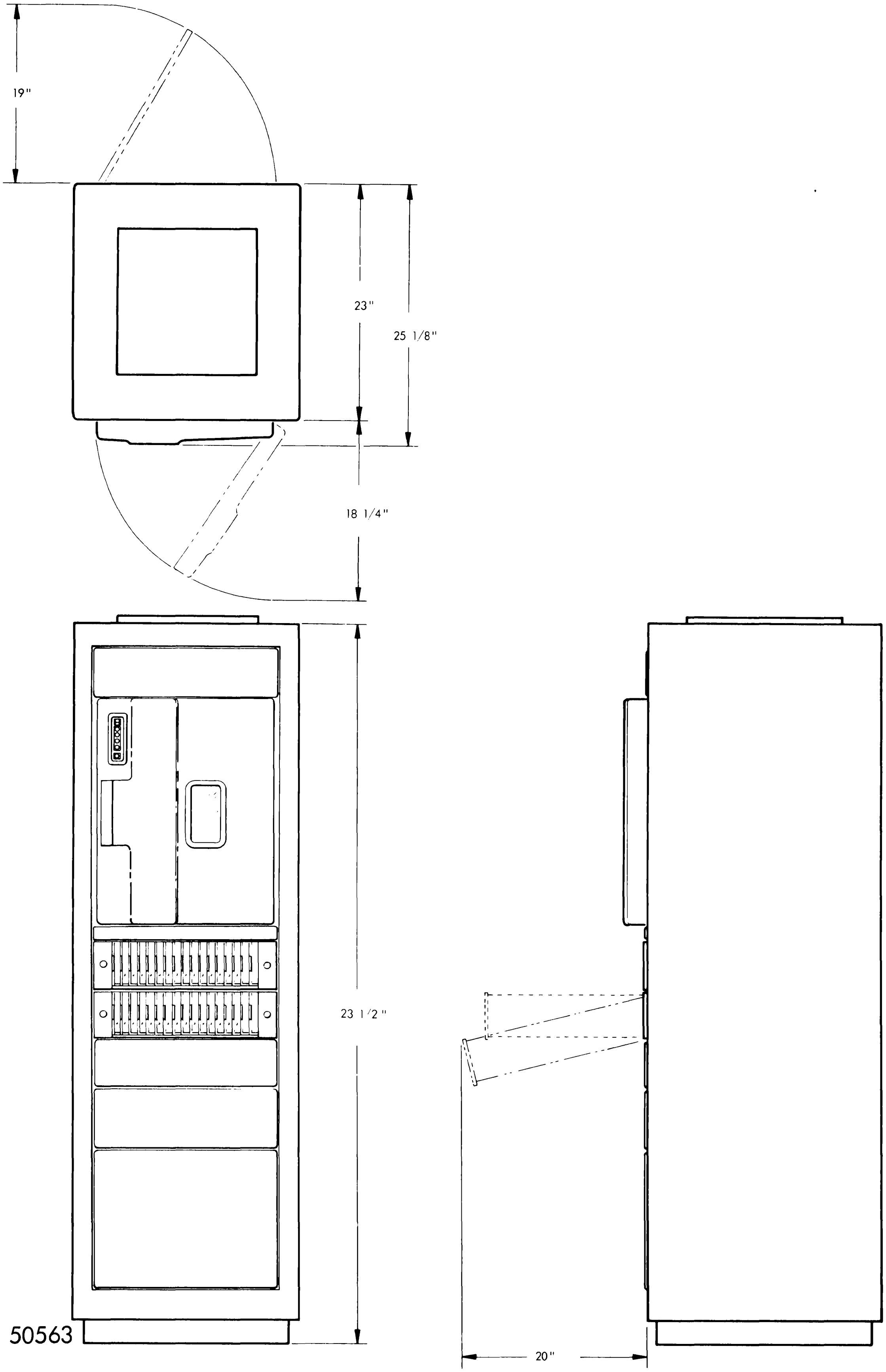


Figure 1-14. DIMENSIONS OF A TYPICAL RACK MOUNTED FR-1300

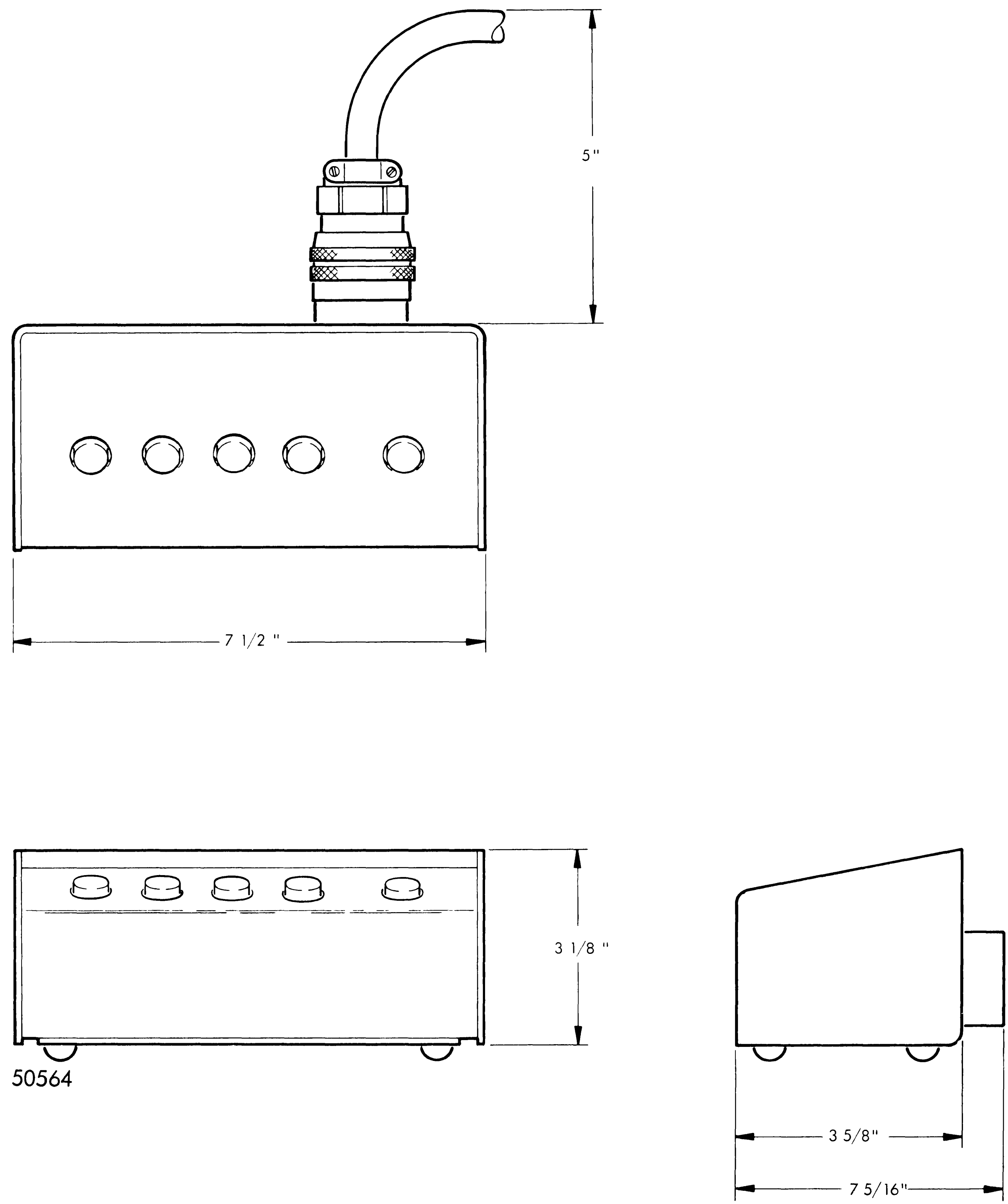


Figure 1-15. DIMENSIONS OF THE REMOTE CONTROL UNIT

CHAPTER 2

INSTALLATION

2-1. The initial consideration in the installation of the recorder/reproducer involves choice of an operating site, then assembly of the instrument in preparation for use. In this chapter, siting considerations are first given, followed by assembly instructions applicable first to the portable FR-1300, then to the rack-mounted FR-1300.

2-2. SITING CONSIDERATIONS.

2-3. A suitable site for either the portable or rack-mounted FR-1300 should be a sheltered location having electrical power available which is adequate to meet the requirements of the instrument. The environment of the chosen location should ideally be vibration -free, dust-free, devoid of magnetic influences, and have an even, moderate temperature and humidity. Sufficient open floor space should exist above the rack-mounted instrument to facilitate servicing.

2-4. ASSEMBLY OF PORTABLE FR-1300.

2-5. The portable FR-1300 is shipped intact, ready for use in an upright position, that is, with the control cluster and supply reel uppermost. Installation is completed when the instrument is located in accordance with the siting considerations, and power and signal connections are made.

2-6. POWER CONNECTIONS. Power is supplied to the portable instrument through a grounded male receptacle located on the power panel (figure 2-1) at the right side of the case. Apply power to the instrument by inserting the connector of the power cord (AMPEX Part No. 084-010 or equivalent) into the receptacle, and connecting the connector at the other end of the cord into a power source which meets the requirements of the instrument. At the control cluster of the instrument, press the lower half of the power switch. When power is on, the STOP (S) button will illuminate. Power should be turned off until after signal connections have been made.

2-7. SIGNAL CONNECTIONS. Signal connections are made at the signal connector panel at the top of the portable instrument. Connectors, shown in figure 2-2 are miniature male coaxial connectors of the bayonet type and are numbered to indicate the tape track with which they are associated, for example, to record on track 5, apply the signal to be recorded to the connector marked RECORD 5. The signal, when reproduced, will be present on the connector marked REPRODUCE 5. Connections which duplicate those on the signal connector panel can be made directly to connectors on the individual record or reproduce modules. Cables for record and reproduce signals are to be supplied by the user. One cable-end connector to be used in making up such cables is supplied with each record and each reproduce module. Refer to table 2-1 for connector identification. Cables which carry record and reproduce signals should be limited in length to less than ten feet for optimum signal handling. In the direct system, input impedance of the record electronics is 20,000 ohms, and output impedance of the reproduce electronics is less than 50 ohms. In the FM system, input impedance of the record electronics is 20,000 ohms, and the output impedance of the reproduce electronics is 1,000 ohms.

TABLE 2-1 SIGNAL CONNECTOR INFORMATION

ITEM	SERVICE	IDENTIFICATION	ALTERNATE SOURCE
1.	Cable-end to mate with FR-1300 signal connectors.	Coaxial RF subminiature female bayonet plug connector AMPEX Part Number 144-166.	Automatic Metal Products Corp. Part RF 0701-847.
2.	Adapter to unite BNC male cable-end connector with FR-1300 signal connectors.	Adapter, BNC male-to -subminiature female bayonet plug connector. AMPEX Part Number 169-172.	Automatic Metal Products Corp. Part RF 0756.
3.	FR-1300 signal connectors on signal connector panels of portable and rack-mounted instruments.	Coaxial RF subminiature male bayonet connector, rear mounting. AMPEX Part Number 147-141.	Automatic Metal Products Corp. Part RF 0705-819B.

2-8. ASSEMBLY OF THE RACK-MOUNTED FR-1300.

2-9. The rack-mounted FR-1300 may be supplied either as a complete instrument or as a selected group of major items intended for assembly by the user. In this chapter, instructions are given for assembly of a typical instrument. Cabling plans are given for each of several configurations. Table 2-2 lists the various major items which are part of the typical rack-mounted FR-1300 chosen as an example for assembly. This instrument employs a 14 track direct record and reproduce system with electrically-switched electronics, and includes a remote control. In the assembly example which follows, the assumption is made that the FR-1300 has been received for assembly into the user's standard cabinet. In such instances, the transport is shipped mounted to the frame adapter (figure 2-3), with other parts of the rack-mount adapter kit installed, and the remote control harness in place. See figure 2-3. The heads, record head cables and preamplifier are secured in place on the transport. Two precision tape reels, one provided with tape, are shipped with the instrument. Record and reproduce tray assemblies, figure 2-4, are shipped with electronics modules in place (figure 2-4). Cables, remote control, and filler panels are packaged separately. In assembling the instrument, the transport is mounted first, followed by electronics trays and filler panels. Cabling is installed last.

2-10. TRANSPORT INSTALLATION. See figure 2-5.

2-11. PREPARATION. Insure that the cabinet selected to house the FR-1300 is drilled at correct intervals to receive the mounting screws of the transport frame adapter, electronics trays, and the filler panels. If the holes are tapped, be certain that the screws thread easily into the holes. Provide a sturdy table on which to rest the transport when the transport is removed from shipping package. Installation of the transport requires the services of two persons.

TABLE 2-2. COMPOSITION OF TYPICAL RACK-MOUNT FR-1300

Ref. No.	Part Description	Req'd. Qty.	AMPEX Part Number	Remarks
	TRANSPORT			
1.	Tape Transport		23875-10	1" 60 cps catalog item
	REMOTE CONTROL			
2.	Remote Control Unit and Cable	1	24110	Catalog item
3.	Remote Control Harness for rack	1	24114	Catalog item
	RECORD/REPRODUCE ELECTRONICS			
4.	Head Group, 14 track. IRIG* Standard Record/Reproduce	1	120170-050	Catalog item
5.	Preamplifier Box with cables	1	69631-30	Catalog item
6.	Preamplifier module	7	69101-10	Catalog item
7.	Record tray assembly	1	69570-2	(No power supply) catalog item
8.	Record electronics modules	14	69103-10	Direct record (electrically-switched) catalog item
9.	Reproduce tray assembly	1	69571-4	(No power supply) catalog item
10.	Reproduce tray assembly	1	69571-5	(Power supply, fan) catalog item
11.	Reproduce electronics modules	14	69106-10	Direct Reproduce (electrically-switched) catalog item **
12.	Record head cable	1	69632-10	Catalog item
13.	Power and control cable	1	69633-10	Catalog item

* Inter-Range Instrumentation Group

** Six-speed (electrically-switched) direct-reproduce electronics modules each occupy a double space in card files.

TABLE 2-2 (continued)

Ref. No.	Part Description	Req'd. Qty.	AMPEX Part Number	Remarks
14.	Power and control tray interconnecting cable	1	69193-10	Catalog item
15.	Power cable, 8 ft. 3 conductor	1	084-010	Included in accessory kit 24090-10
	<u>HARDWARE</u>			
16.	Rack-mount adapter kit includes	1	23825	Catalog item
	Power panel	1	23858	
	Side panels	2	23857	
	Frame adapter	1	24080	
	Cover plate	1	23859	(Supplied in place of remote control switch and connector)
	Cable clamp	2	302046	
	Cable clamp	2	302043	
17.	Dust cover assembly	1	24085	Catalog item
18.	Cabinet	1	103060-01	Catalog item
19.	Filler panels (4 required)	2	103052-03	Catalog item
		1	103052-05	Catalog item
		1	103052-01	Catalog item

2-12. INSTALLATION. Carry out the following steps to install the transport in cabinet.

1. Remove packing from transport.
2. With assistant, grasp the frame adapter.
3. Lift the transport clear of packing and place it upright on table.
4. Assemble screws, washers and screwdriver on table.
5. Move cabinet and transport together in the relationship for mounting. (See figure 2-5.)
6. Lock, or block rollers on cabinet if it is so provided.
7. With assistant reaching through cabinet, both grasp the frame adapter and lift the transport into position.
8. With assistant steadying the transport, mount the transport in place with four screws through the frame.

2-13. TRAY INSTALLATION.

2-14. The electronics trays slide into position on fixed brackets within the cabinet. To install brackets, hold bracket in place from front of cabinet and insert mounting screws. When all six brackets are installed, lift each tray into position and slide it straight-in on brackets. Secure tray with captive screws at either end of tray.

2-15. FILLER-PANEL INSTALLATION.

2-16. The filler-panels are held in place with threaded studs extending from the back of each panel. When a panel is in place, the studs pass through and are secured to individual clips which are fastened by screws to the cabinet. To install a filler-panel, first attach the clips to the cabinet by means of screws. Then, press the panel into place, and fasten it to the clips by turning nuts (with washers) down on the studs.

2-17. CABLE INSTALLATION. (See figures 2-6 through 2-9.)

2-18. Cables are installed from the rear of the cabinet in accordance with a connection plan which varies with different equipment configurations. The cabling instructions given in the following paragraphs are specific for the 14 track direct record and reproduce system having electrically-switched electronics shown in part C of figure 2-9. Cabling instructions are generally valid for other configurations when modified to meet requirements of the applicable cabling plan.

2-19. POWER AND CONTROL CABLE INSTALLATION. The power and control cable, and the connecting cable, both shown in A and B, figure 2-6, are installed in accordance with the plan shown in figure 2-9C. To install these cables, carry out the following steps:

1. Straighten out cables, and identify the end connectors in accordance with A and B, figure 2-6.
2. At the rear of the transport, insert connector P308 of the power and control cable into J308. The location of J308 is shown in figure 2-10.
3. Dress the cable through plastic clamps A and B as shown in figure 2-10, and close clamps snugly.
4. Connect end connector P4 to end connector J4-Tof the power and control interconnecting cable.
5. Insert P4-2 of the interconnecting cable into connector J4 at the left side of the record tray, as seen from the rear.
6. Connect P4 of the first interconnecting cable to J4-T of the second interconnecting cable.
7. Insert P4-2 of the second interconnecting cable into J4 of the upper reproduce tray.
8. Insert P4 of the second interconnecting cable into J4 of the lower reproduce tray.

2-20. POWER CORD INSTALLATION. The power cord shown in C, figure 2-6, is inserted into the power connector marked J1 POWER on the rear of the transport power panel. See figure 2-11.

2-21. SIGNAL CABLE INSTALLATION. The instrument is shipped with the record head connectors J401 and J402 installed on the transport and the attached cable packaged. The preamplifier is likewise installed, with reproduce connectors J403 and J404 in place. The preamplifier signal output cables, a part of the preamplifier housing assembly, are packaged next to the preamplifier. These cables are identified in the cable connection plan, figure 2-9C, and are depicted together with cables for other configurations in figure 2-7. Installation of signal cables is carried out from the rear of the cabinet, connections are made in accordance with the plan shown in figure 2-9C. To install signal cables, carry out the following steps:

1. Remove packaging from record head cable and preamplifier signal output cables.
2. Straighten cables, and identify cable end connectors.
3. Dress record head cable and preamplifier output cables through clamps C and D as shown in figure 2-10. Close clamps snugly.
4. At the record tray, insert record head connector marked RECORD ODD NO. TRACKS, (PA in figure 2-9C) into connector J5 shown in figures 2-9C and 2-8.
5. At the record tray, insert second record head connector marked RECORD EVEN NO. TRACKS (PB in figure 2-9C) into connector J6 shown also in figure 2-8.
6. At the upper reproduce tray (figure 2-9C) insert preamplifier signal output connector marked REPRODUCE TRACKS 1 THRU 7 (PA in figure 2-9C) into tray connector J5 shown also in figure 2-8.
7. At the lower reproduce tray (figure 2-9C), insert preamplifier signal output connector marked REPRODUCE TRACKS 8 THRU 14 (PB in figure 2-9C) into tray connector J5 shown also in figure 2-8.

2-22. SIGNAL CONNECTIONS. See figure 2-8.

2-23. Signal connections to the rack-mounted FR-1300 may be made on the signal connector panel at the rear of each tray, (figure 2-8) or directly to the individual cards at the front of the instrument. Connectors on the front panel of each card and on the signal connector panel at the rear of each tray are of the miniature coaxial type described in Table 2-1. Four different connector arrangements exist at the signal connector panel.

These arrangements, identified A, B, C, and D, in figure 2-9 are shown in figure 2-8. Referring again to the instrument selected for description, (figure 2-9C), the record card tray has a connector panel identified as B. The upper reproduce tray has a connector panel identified as C, and the lower reproduce tray has a connector panel identified as D. In making signal connections to the rack mounted FR-1300, the considerations given for the portable instrument apply. Refer to paragraph 2-7.

2-24. REMOTE CONTROL INSTALLATION.

2-25. The remote control assembly permits operation of either the portable, or rack -mounted FR-1300 in all modes, from a location removed from the instrument. The assembly consists generally of a remote control unit, an interconnecting cable of 25 ft. length, and a harness installed within the instrument. The remote control and interconnecting cable are the same for use with either the portable or rack-mounted FR-1300. The harness, however, differs physically between the portable and rack-mounted instrument. Although instruments may be ordered with the harness installed, harness may be ordered separately and installed by the user. Instructions are given in the following paragraphs for installation of the harness in the portable and rack-mounted FR-1300, and for preparing the remote control for use. Information is also given for those users who may wish to prepare their own interconnecting cable.

2-26. HARNESS INSTALLATION IN PORTABLE AND RACK-MOUNTED FR-1300.

2-27. HARNESS INSTALLATION IN PORTABLE FR-1300. The harness supplied for adapting the portable FR-1300 to remote control operation consists of a short cable with connectors P306 and P307 on one end and a local-remote switch and connector at the other end. All portable instruments are provided with holes on the power panel (figure 2-1) for installation of the switch and connector. These holes are covered by a plate in instruments not having the harness installed.

2-28. In instruments supplied without the harness, a dummy plug P307A is inserted in J307, a connector located behind the front panel of the control chassis. See figure 5-1. To install remote control harness in the portable instrument, carry out the following steps:

1. Remove the rear panels of the instrument in the following sequence:

   a. At rear panel, remove 2 screws holding access plate, then remove access plate.

   b. Disconnect power supply connector P3.

   c. Remove 4 remaining screws around edge of lower panel, while supporting panel.

   d. Release, and fold the upper panel over the lower panel.

   e. Pull top of lower panel out far enough to grasp folded panels by their edges.

   f. Carefully remove panels with attached power supply.

2. Remove plate from power panel exposing holes of switch and connector.

3. Remove dummy plug P307A from J307 (figure 5-1) located on rear of the control chassis front panel. Removal is accomplished by pulling on plug.

4. Install remote connector J2 in hole on power panel. Use four 4-40 screws with lockwashers and nuts.

5. Install remote-local switch (S2) in hole on power panel using two 6-32 screws with lockwashers and nuts.

6. Lace remote harness to form a rigid cable which is routed clear of fan. Using lacing cord.

7. Insert P306 into J306 located adjacent to J307 on rear of the control chassis front panel.

8. Insert P307 into J307.

9. Replace rear panel.

10. Reconnect power connector P3 to J3.

11. Replace access plate.

2-29. HARNESS INSTALLATION IN RACK-MOUNTED FR-1300. The installation of remote control harness in the rack-mounted FR-1300 is similar in most respects to the installation described for the portable instrument. Rack-mounted instruments are provided with cut-outs on the power panel for the remote local switch and remote control connector. In instruments not having remote control harness installed, these cut-outs are covered by a metal shield. As in the portable instrument, a dummy plug, P307A is inserted in J307 (figure 5-1). To install remote control harness in the rack-mounted FR-1300, carry out the following steps:

1. Remove shield from power panel, exposing cut-outs.
2. Remove dummy plug P307A from J307, a connector located behind the front panel of the control chassis.
3. Install remote connector J2 in cut-out, using four 4-40 screws with lockwashers and nuts.
4. Install local-remote switch (S2) in cut-out using two 6-32 screws with lockwashers and nuts.
5. Insert P306 and J306 located adjacent to J307 on rear of the control chassis front panel.
6. Insert P307 and J307.
7. Clamp cable to inside of power panel. Use nylon clamp and secure with screw which also retains the power cable clamp.

2-30. PREPARATION FOR USE. The remote control is easily connected for use with either the portable or rack-mounted FR-1300, preparation is the same for both instruments. To prepare remote control for use, carry out following steps:

1. Insert interconnecting cable end connector P2 into remote control receptacle on rear of remote control unit, rotate collar on connector in a clockwise direction to seat connector. See figure 2-12.
2. Insert interconnecting cable end connector P602 into remote control connector J2 on power panel. Rotate connector collar in a clockwise direction to seat connectors.
3. Move local-remote switch to RMTE position.

2-31. MANUFACTURE OF INTERCONNECTING CABLE. A remote control interconnecting cable may be prepared by the user by following the wiring plan given in figure 2-12.

The cable length is not critical, however, conductors used in the cable should be at least number 22 AWG.

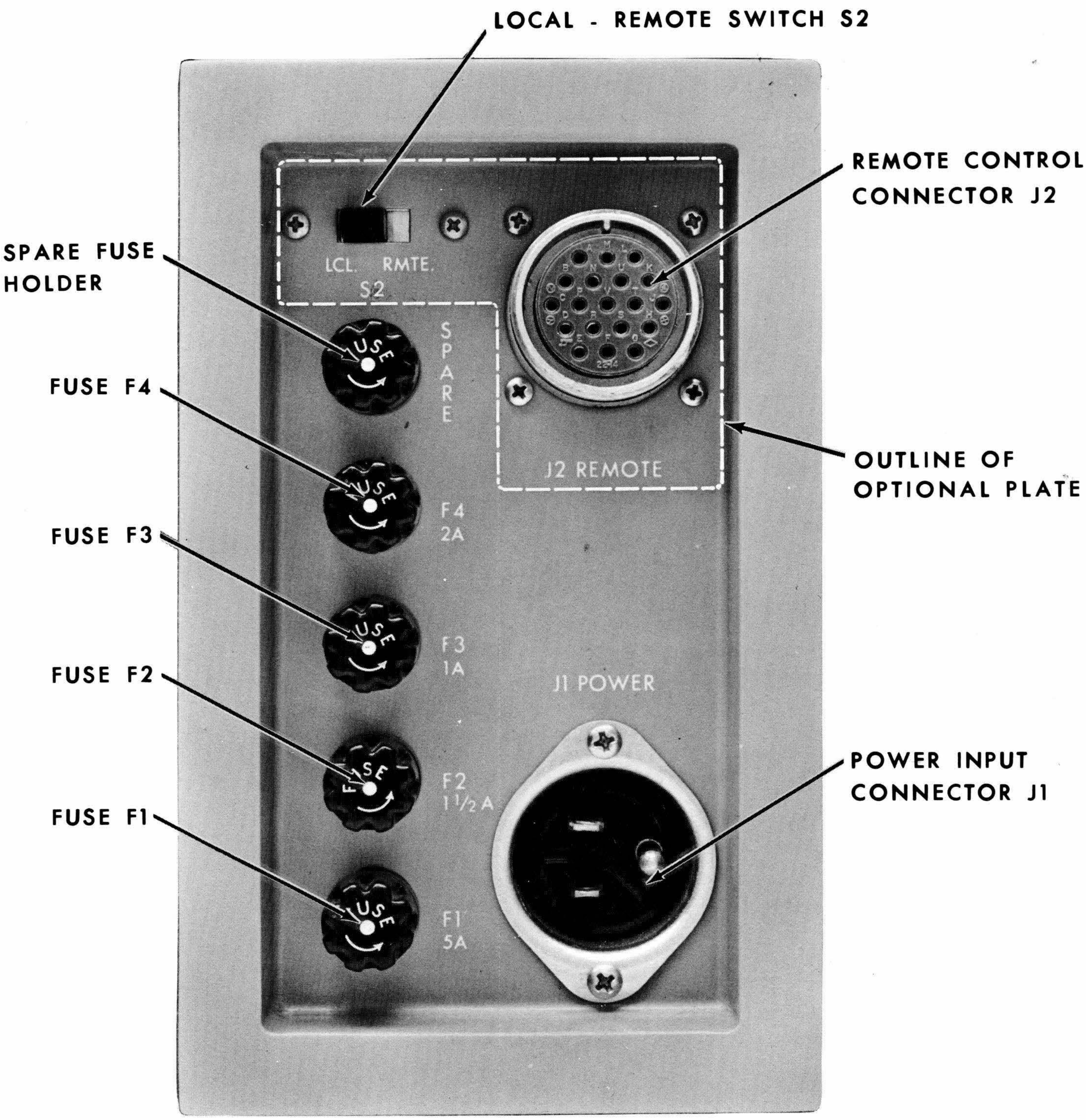
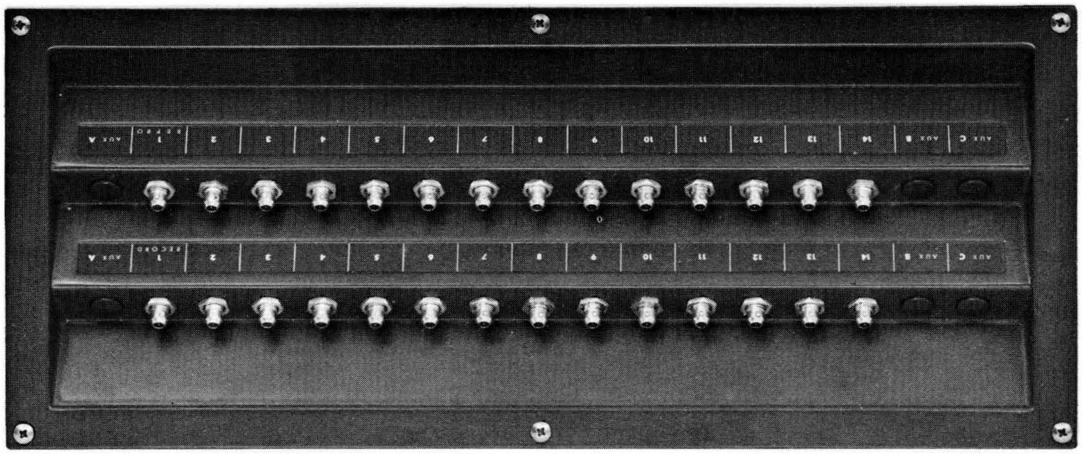
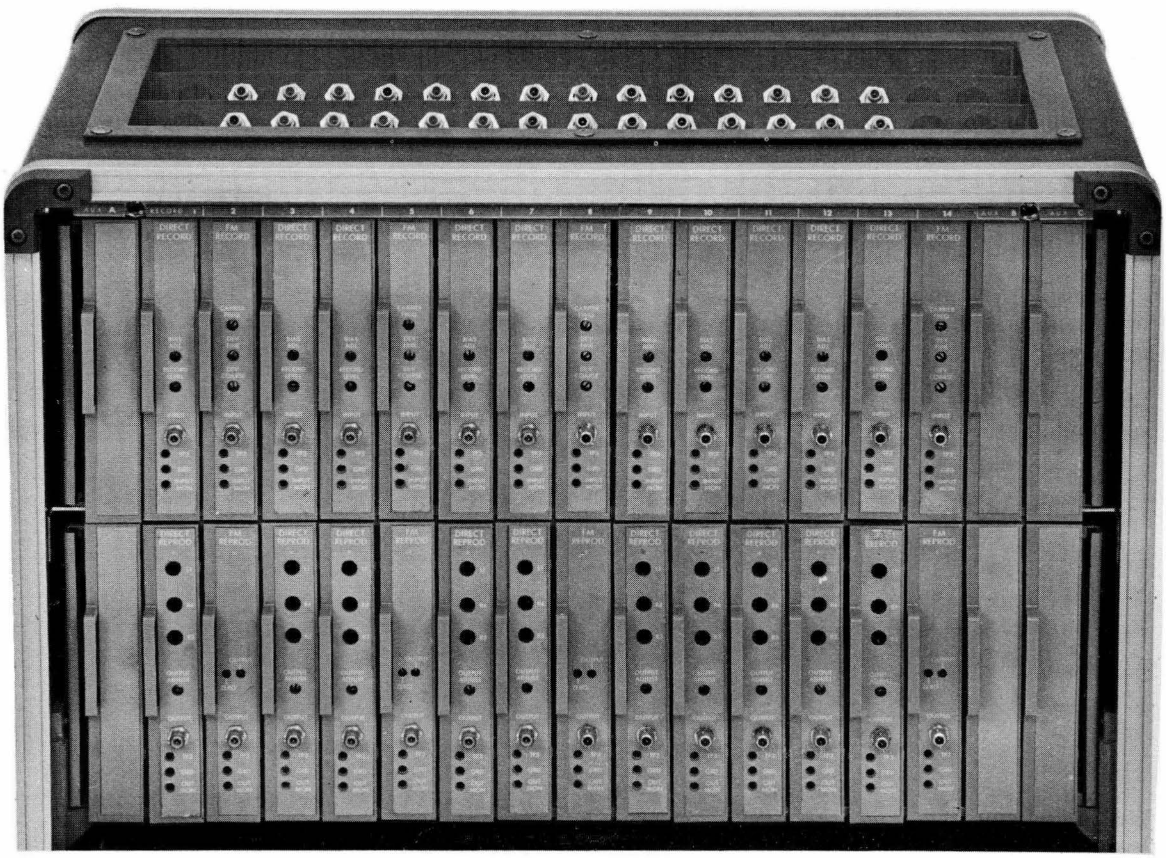


Figure 2-1. POWER PANEL ON PORTABLE INSTRUMENT



TOP VIEW SHOWING SIGNAL CONNECTOR PANEL



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8346-18

REAR VIEW SHOWING RECORD/REPRODUCE ELECTRONICS MODULES

Figure 2-2. TYPICAL SIGNAL CONNECTOR PANEL ON PORTABLE FR-1300

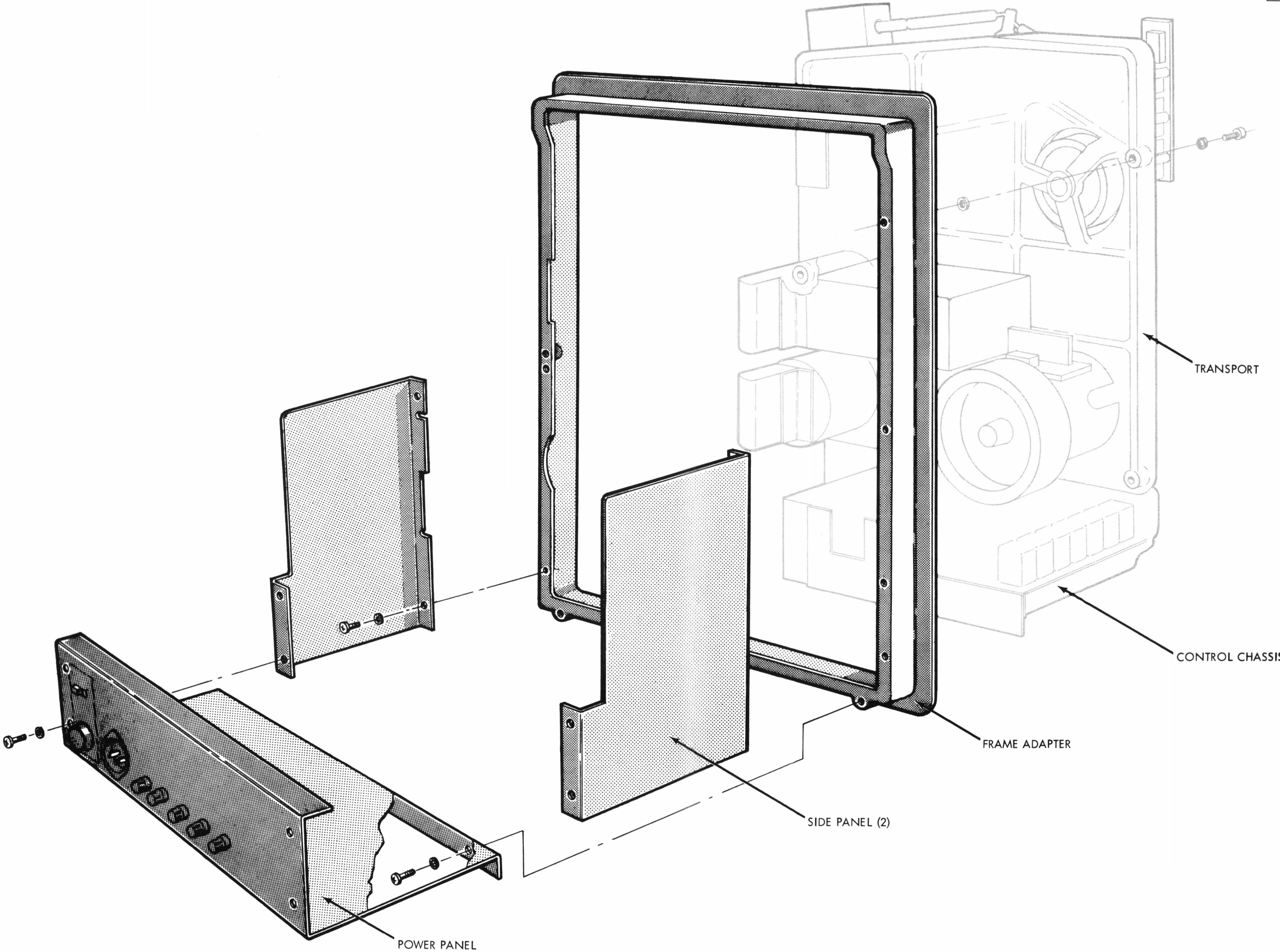


Figure 2-3. RACK MOUNT ADAPTER ASSEMBLY

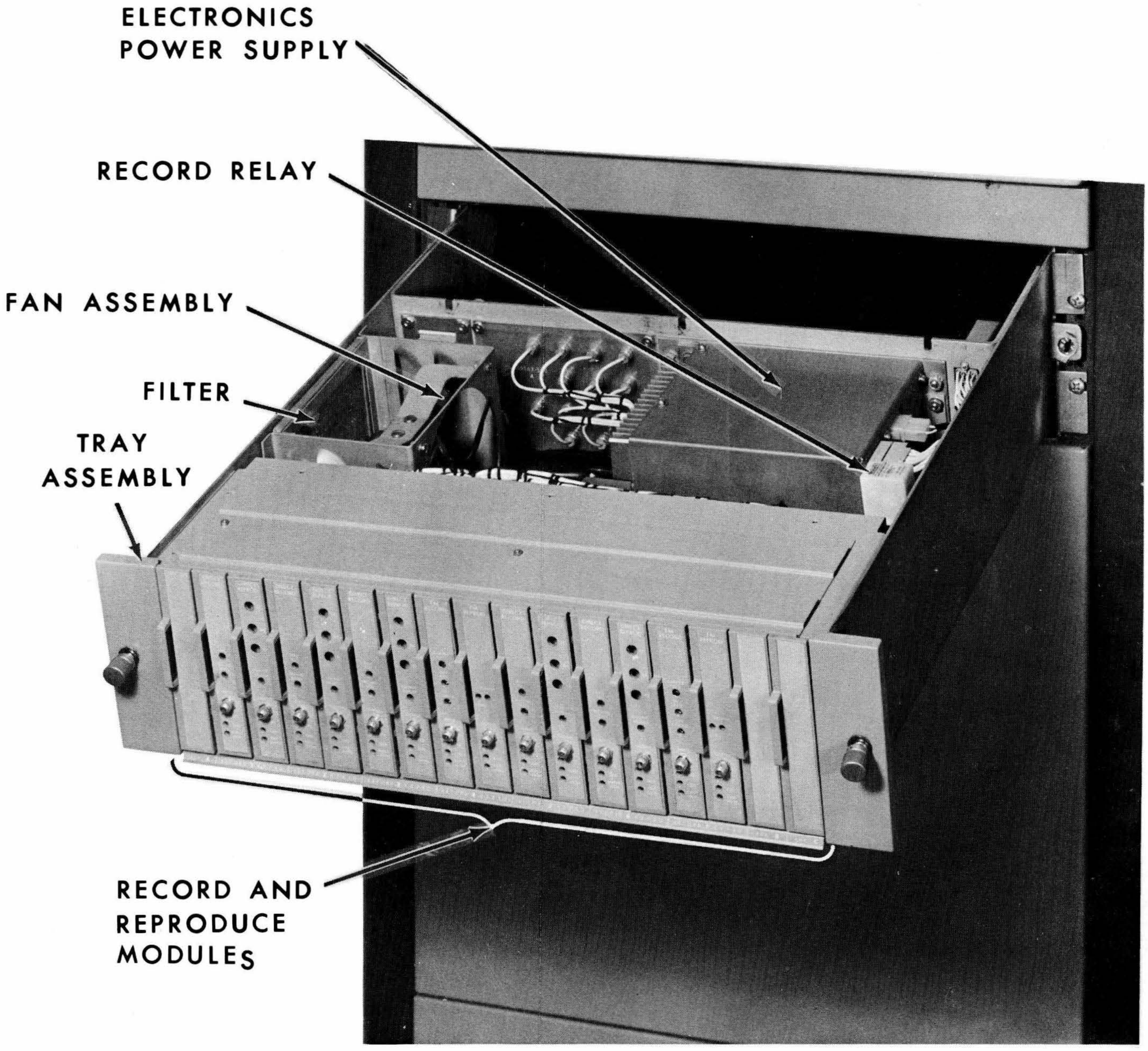


Figure 2-4. ELECTRONICS TRAY EXTENDED

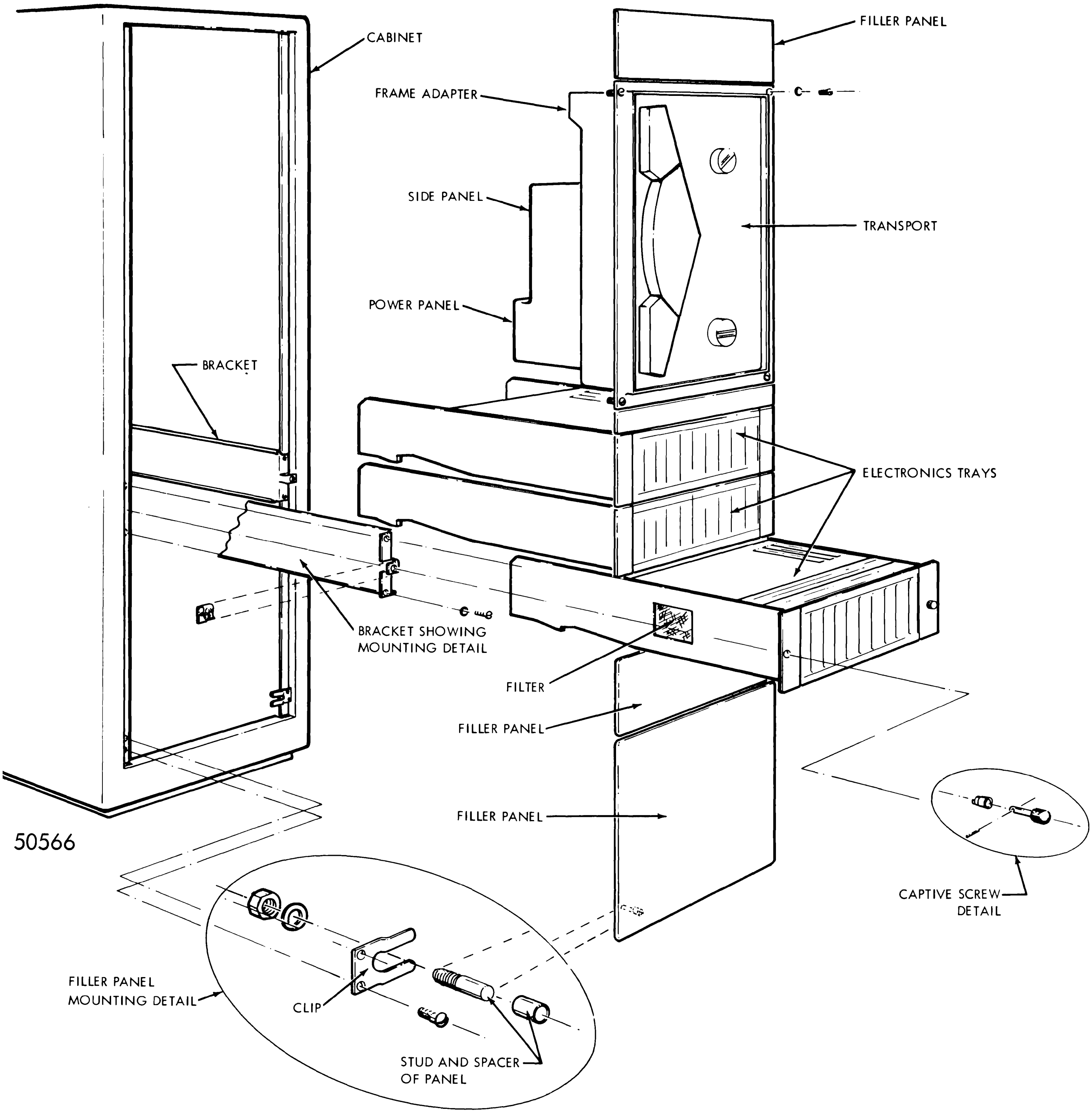
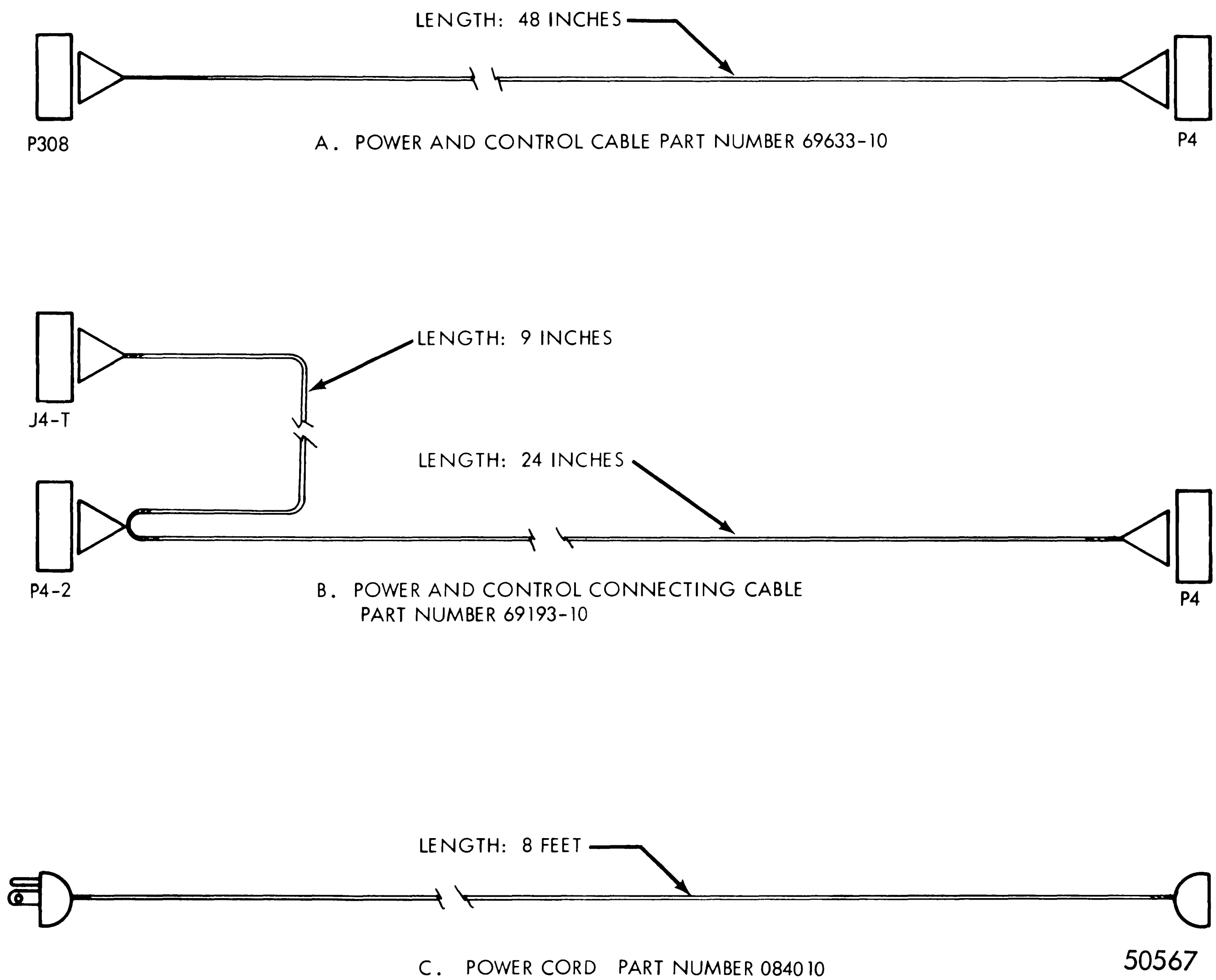


Figure 2-5. TYPICAL RACK MOUNT INSTALLATION



NOTE: LENGTHS INCLUDE CONNECTORS

Figure 2-6. POWER CABLES FOR RACK-MOUNTED INSTRUMENT

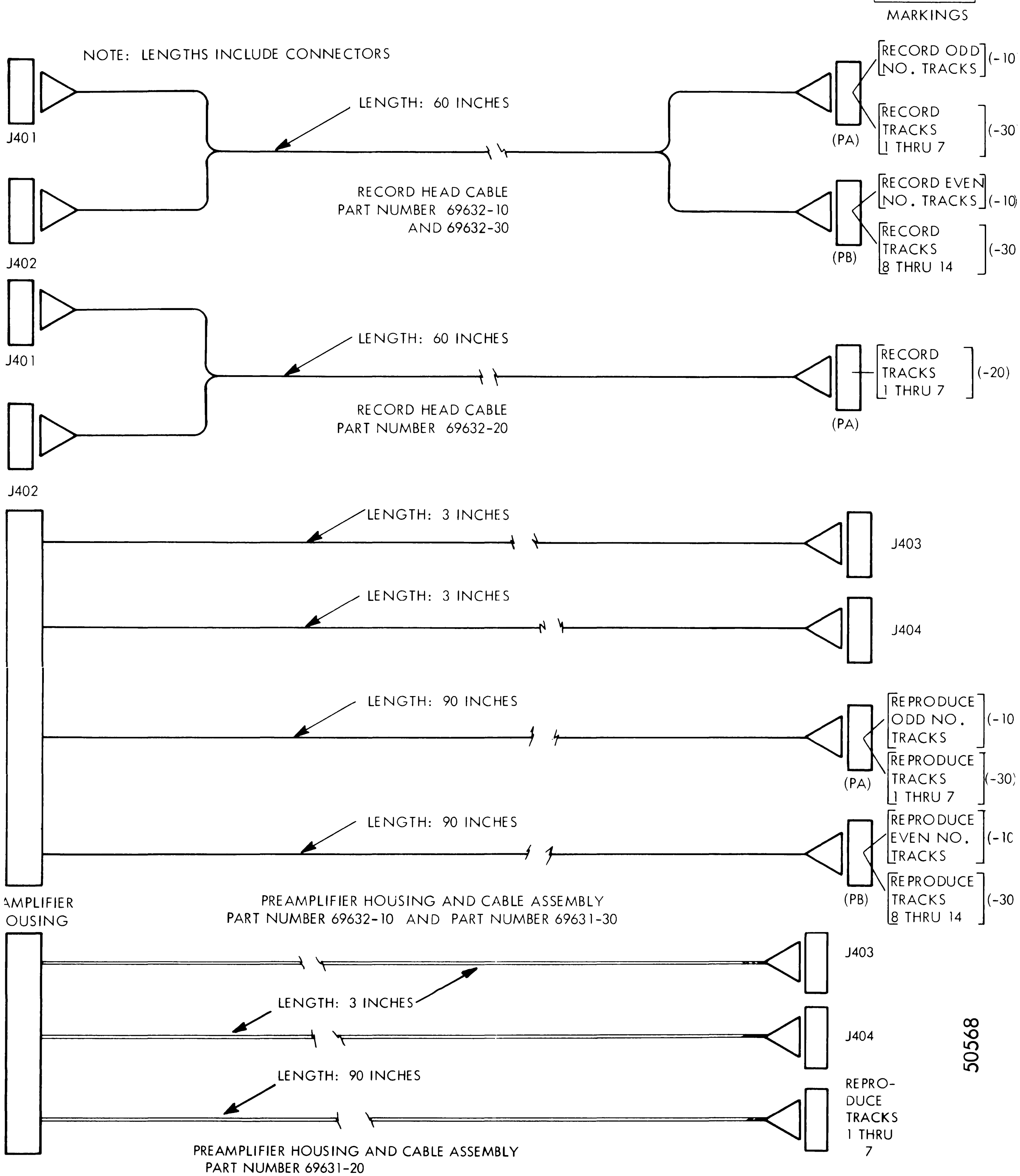
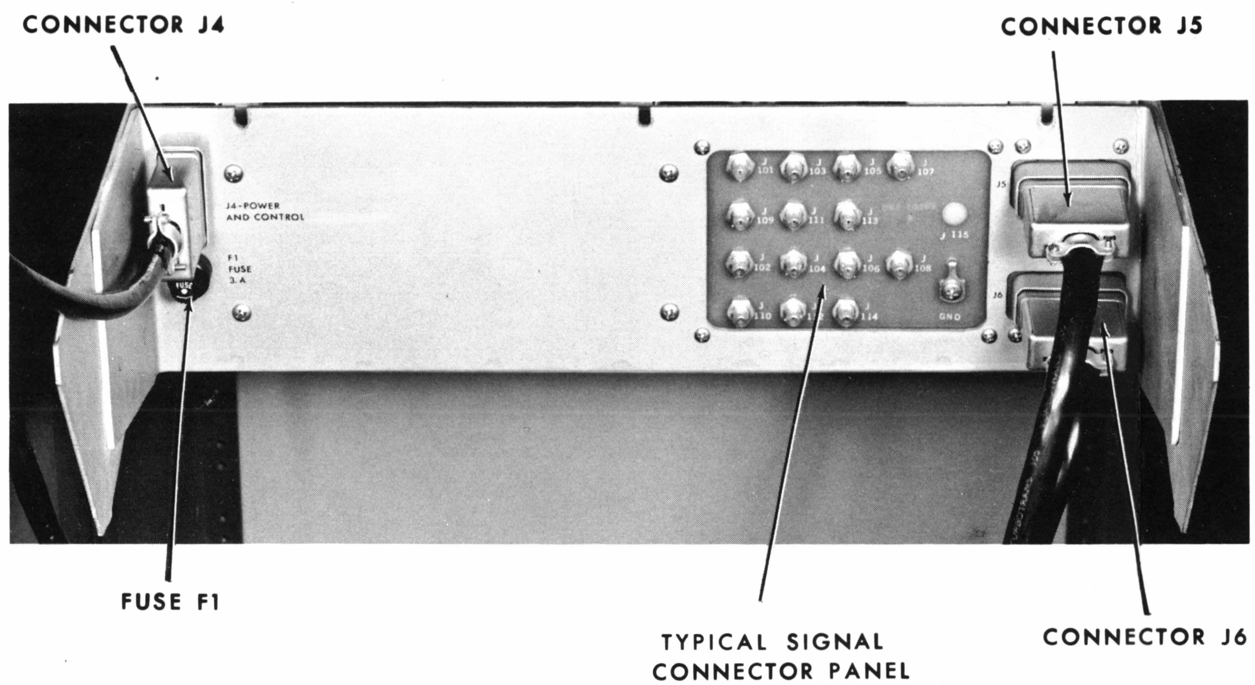
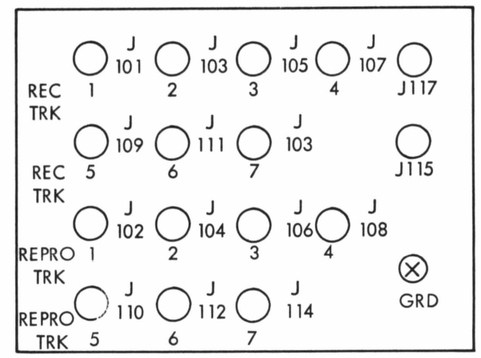


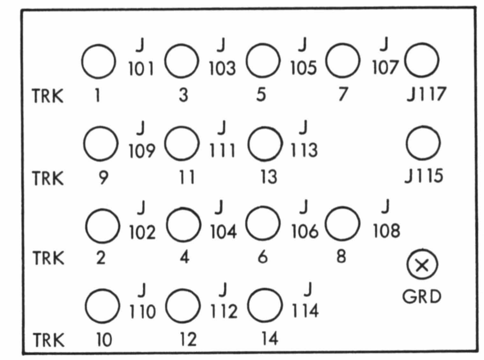
Figure 2-7. SIGNAL CABLES FOR RACK-MOUNTED INSTRUMENT





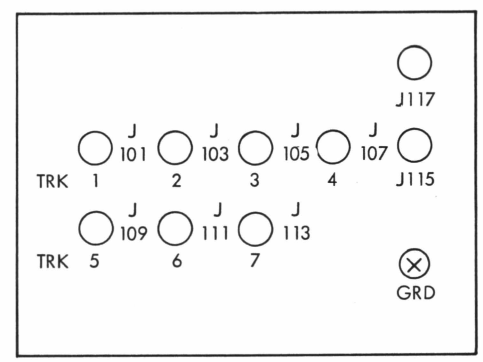
-A-

7 TRACK SINGLE SPEED TRAY
RECORD SIGNAL IN OR REPRODUCE SIGNAL OUT



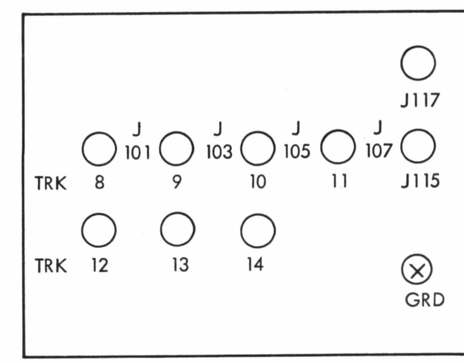
-B-

14 TRACK SINGLE SPEED TRAY
RECORD SIGNAL IN OR REPRODUCE SIGNAL OUT



-C-

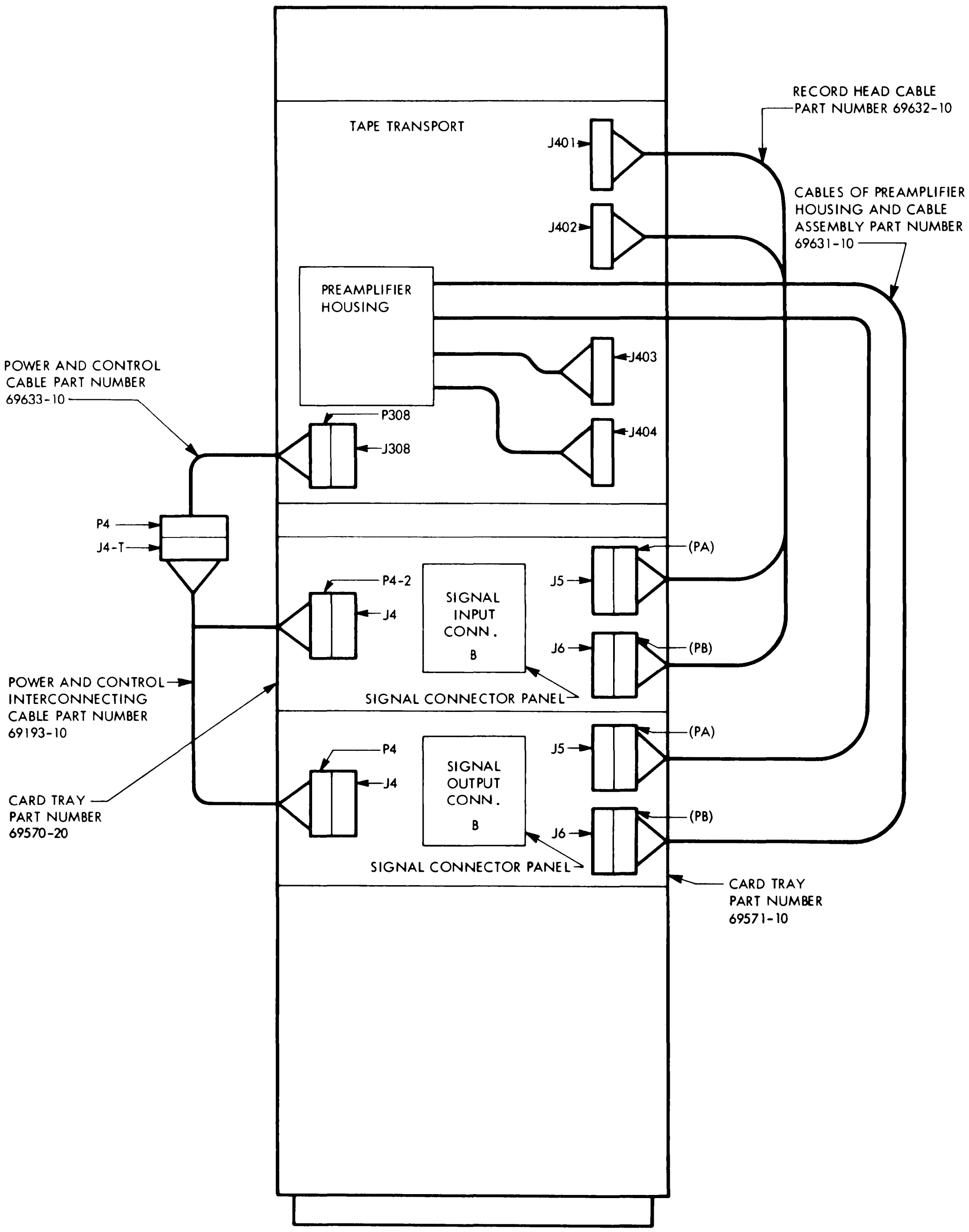
MULTISPEED TRAY (TRACKS 1 THRU 7)
RECORD SIGNAL IN AND REPRODUCE SIGNAL OUT



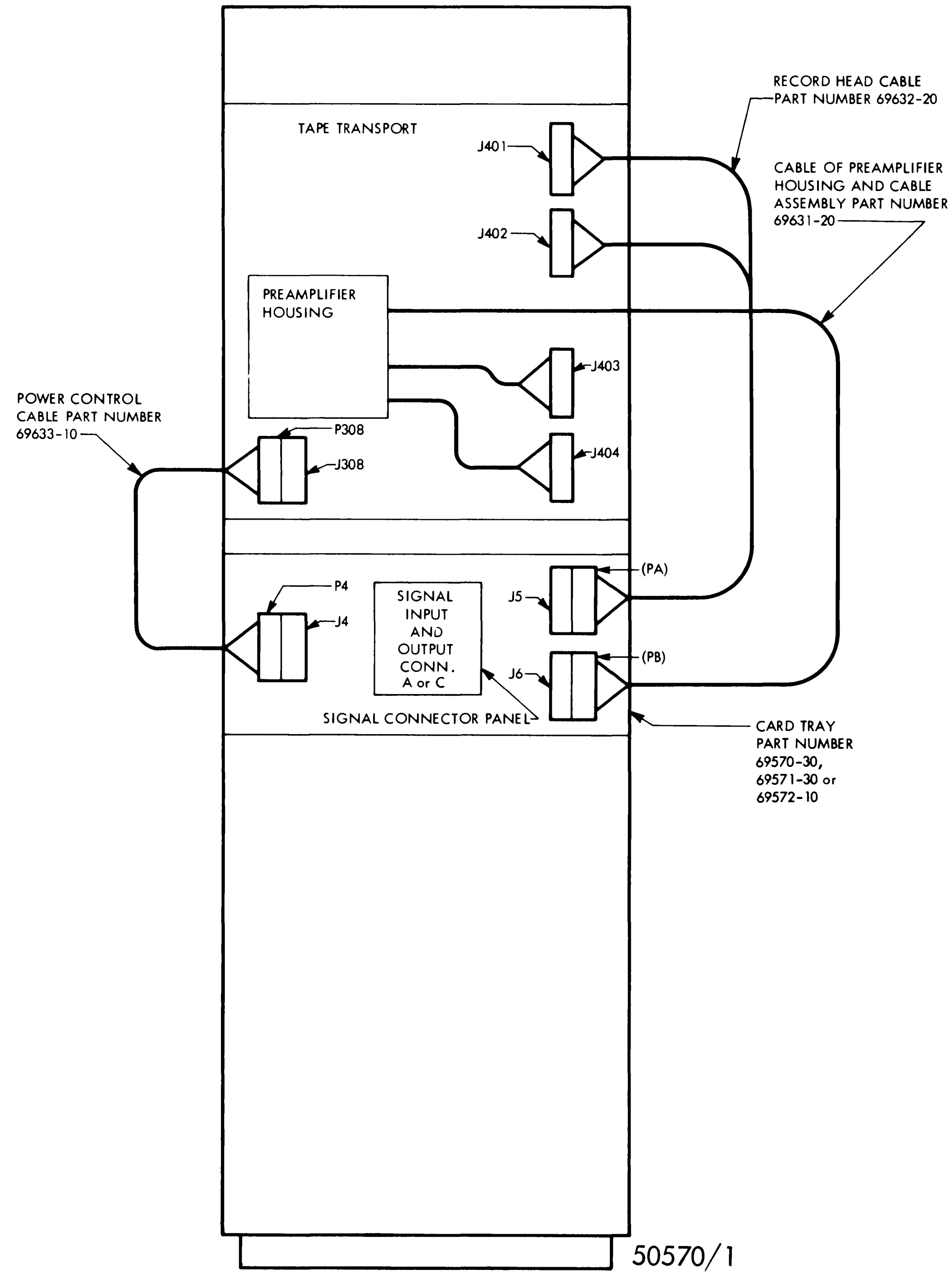
-D-

MULTISPEED TRAY (TRACKS 8 THRU 14)
RECORD SIGNAL IN OR REPRODUCE SIGNAL OUT

Figure 2-8. ELECTRONICS TRAY CONNECTIONS



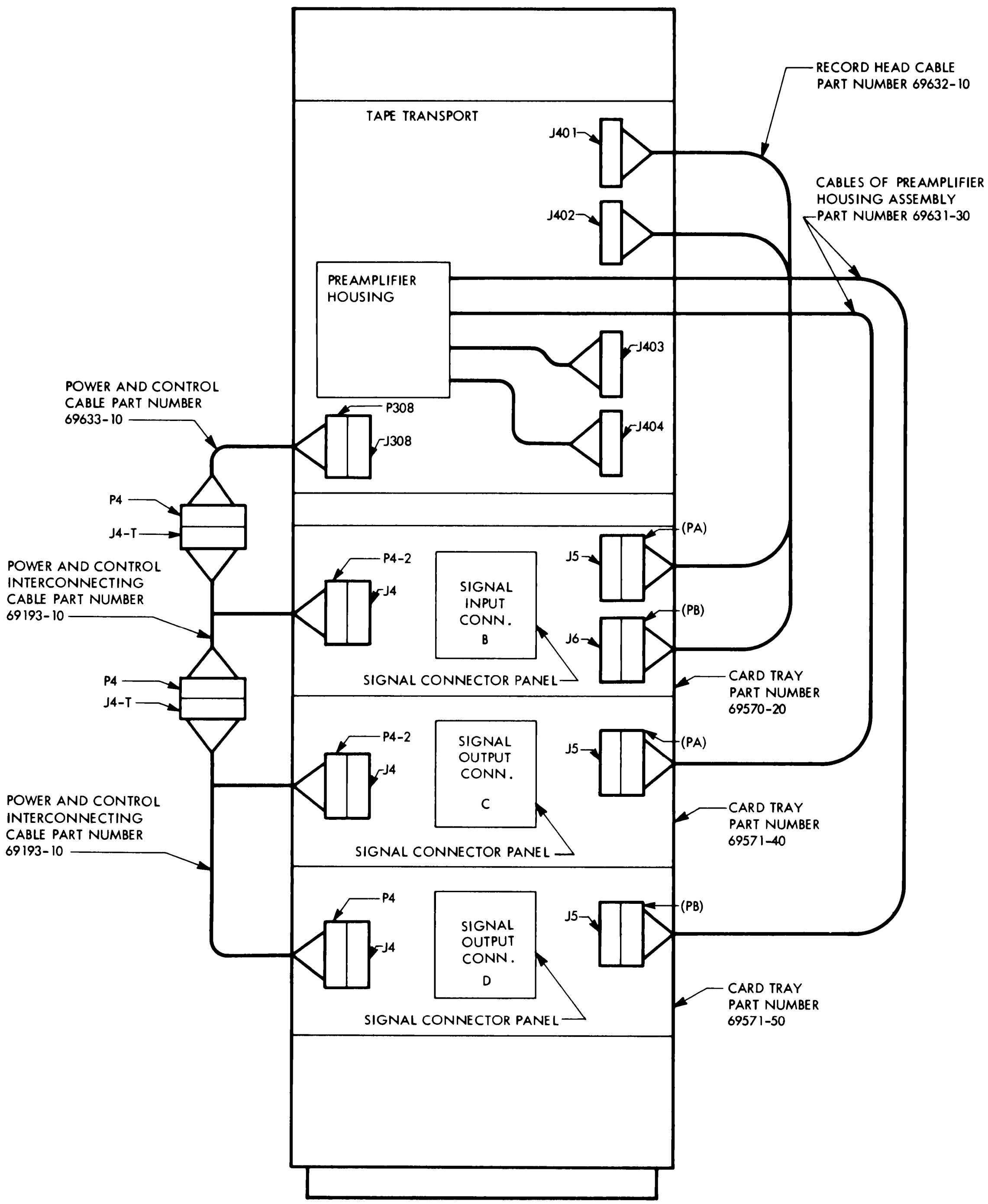
CABLE CONNECTIONS FOR 14 TRACK SINGLE SPEED RECORD AND REPRODUCE CONFIGURATION



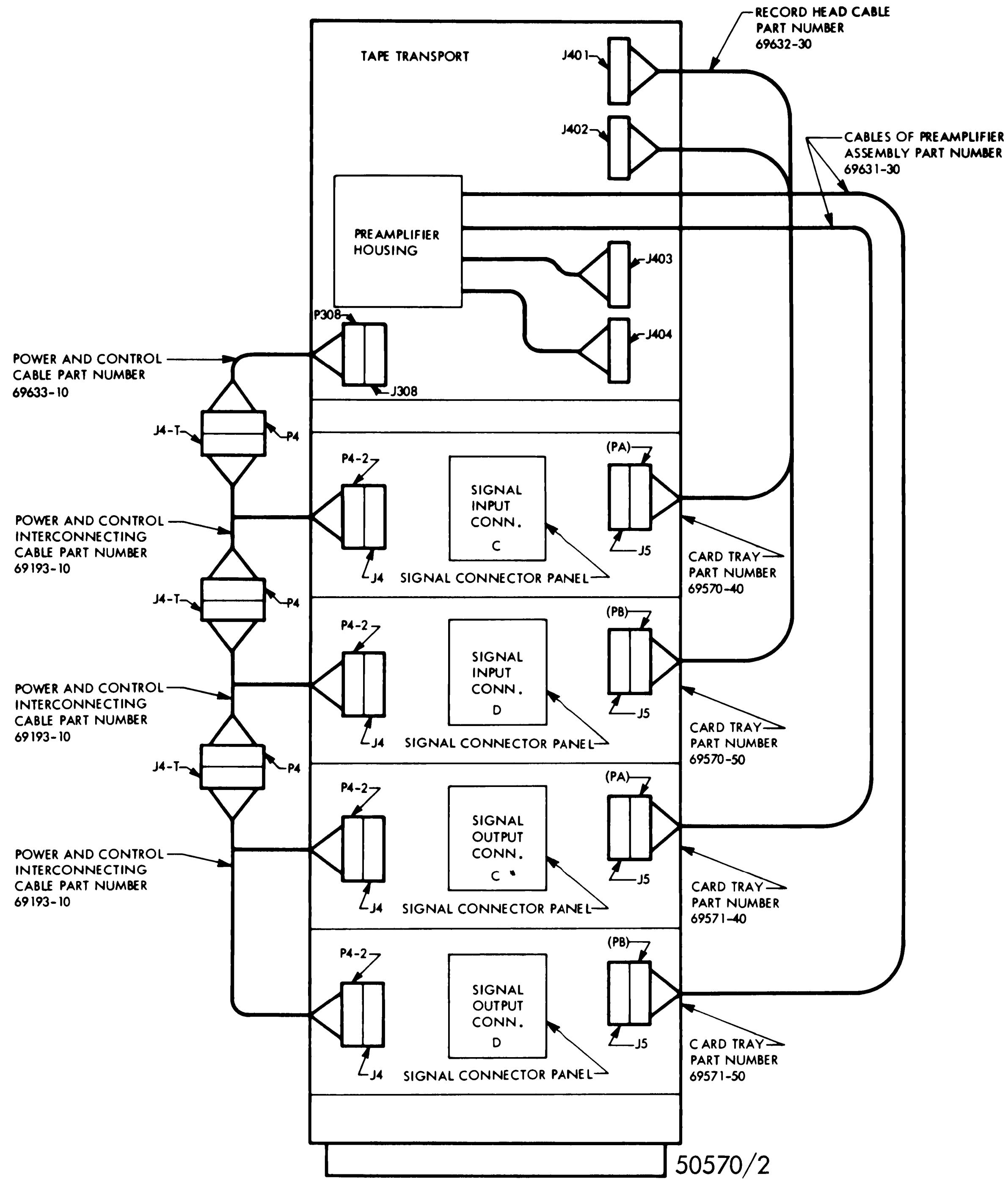
CABLE CONNECTIONS FOR 7 TRACK SINGLE SPEED RECORD AND REPRODUCE CONFIGURATION

CABLE CONNECTIONS FOR 7 TRACK SIX SPEED RECORD OR REPRODUCE CONFIGURATION

Figure 2-9. CABLE CONNECTION PLANS FOR THE RACK-MOUNTED INSTRUMENT
(Sheet 1 of 7)

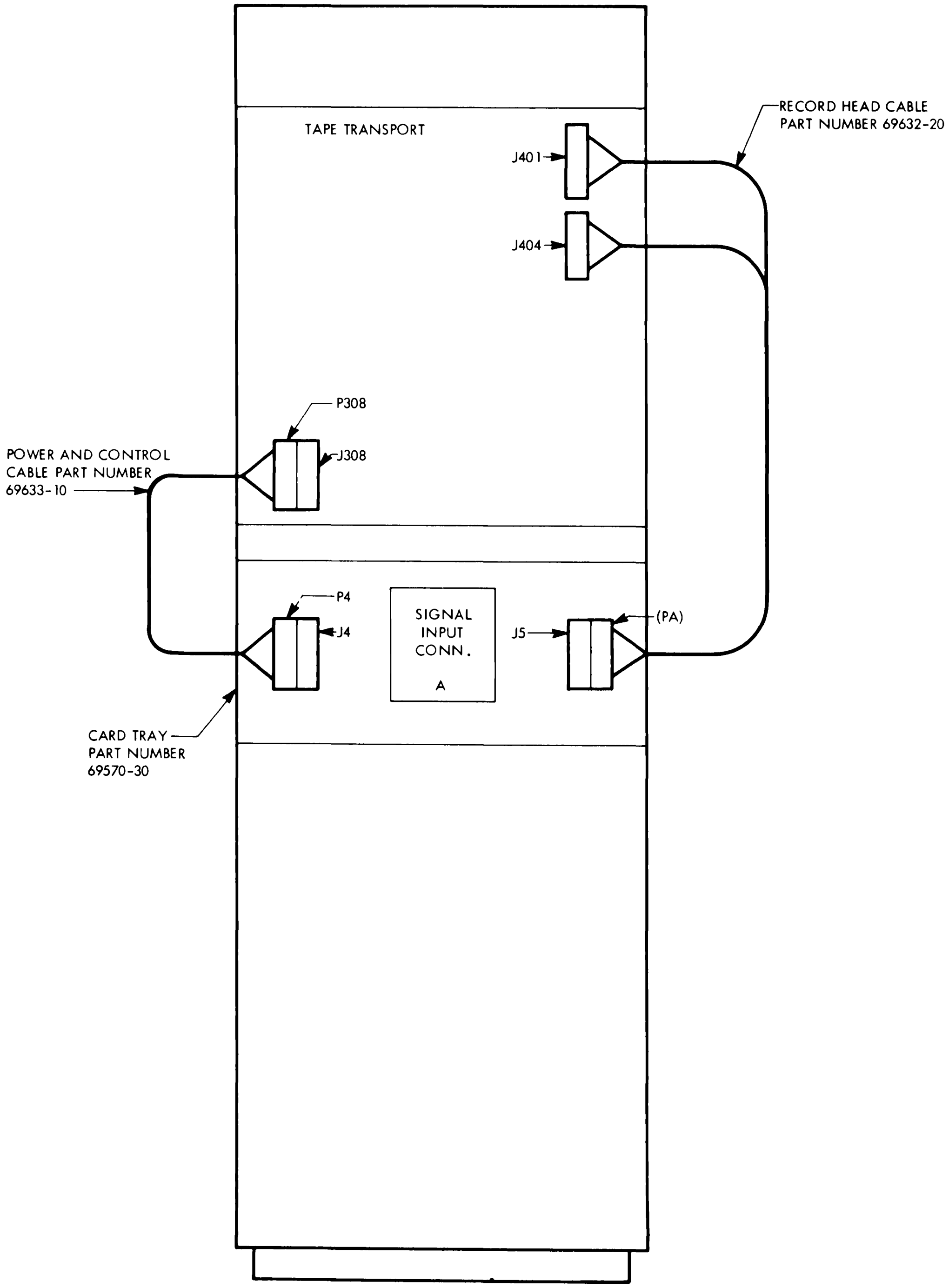


CABLE CONNECTIONS FOR 14 TRACK DIRECT SIX SPEED RECORD AND REPRODUCE CONFIGURATION

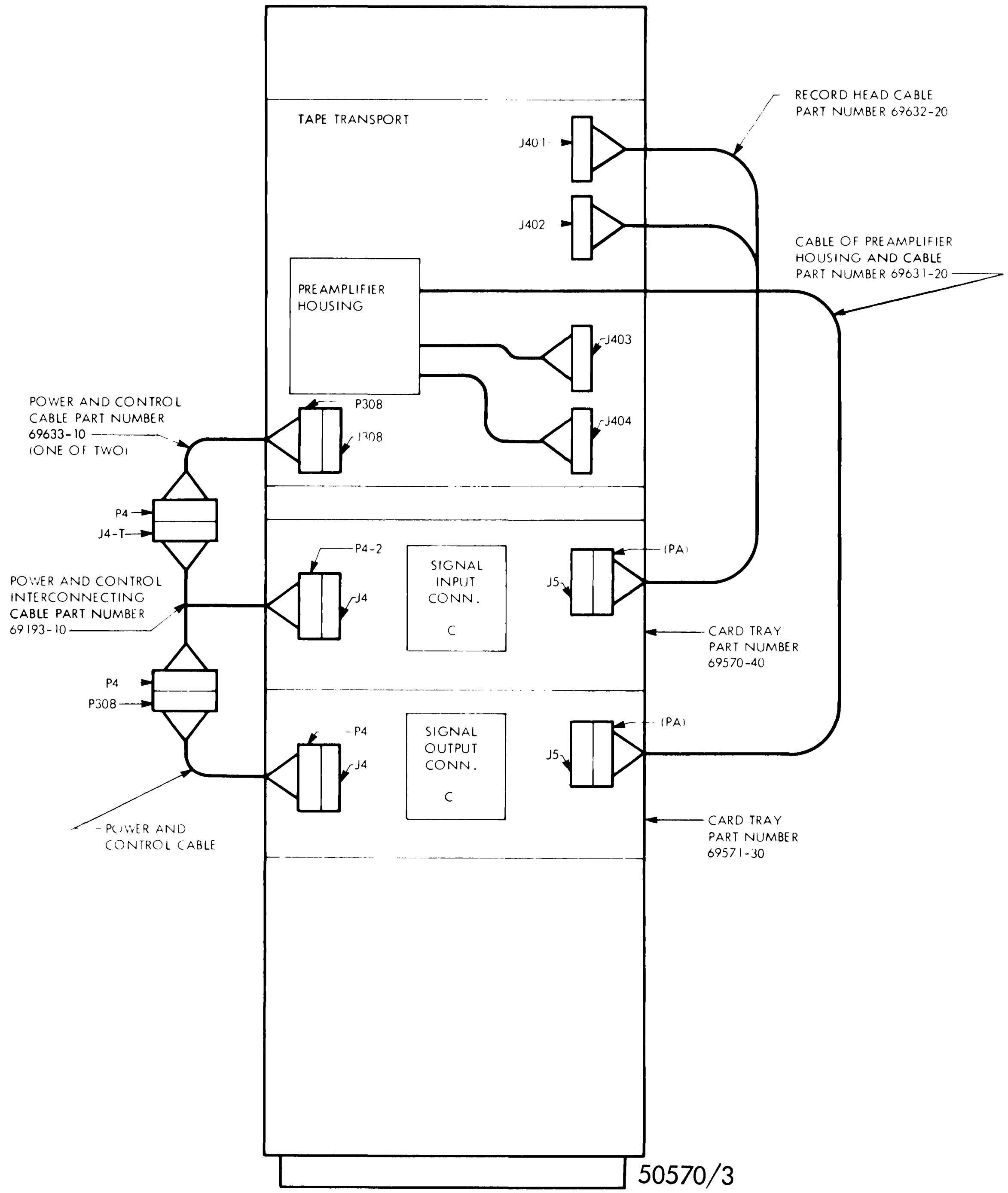


CABLE CONNECTIONS FOR 14 TRACK FM SIX SPEED RECORD AND REPRODUCE CONFIGURATION

Figure 2-9. CABLE CONNECTION PLANS FOR THE RACK-MOUNTED INSTRUMENT (Sheet 2 of 7)

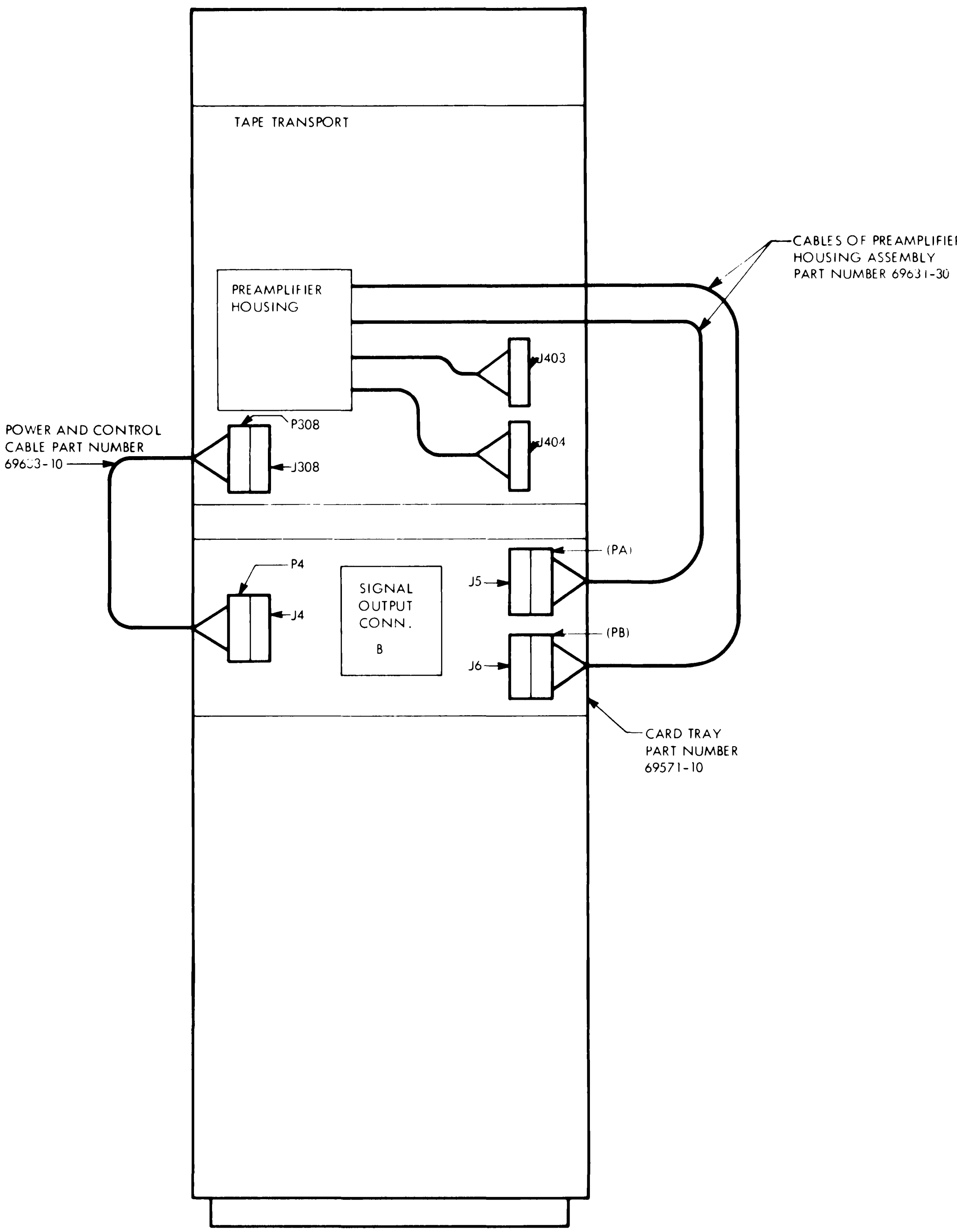


CABLE CONNECTIONS FOR 7 TRACK SINGLE SPEED OR SIX SPEED RECORD ONLY, FM OR DIRECT OR FM AND DIRECT

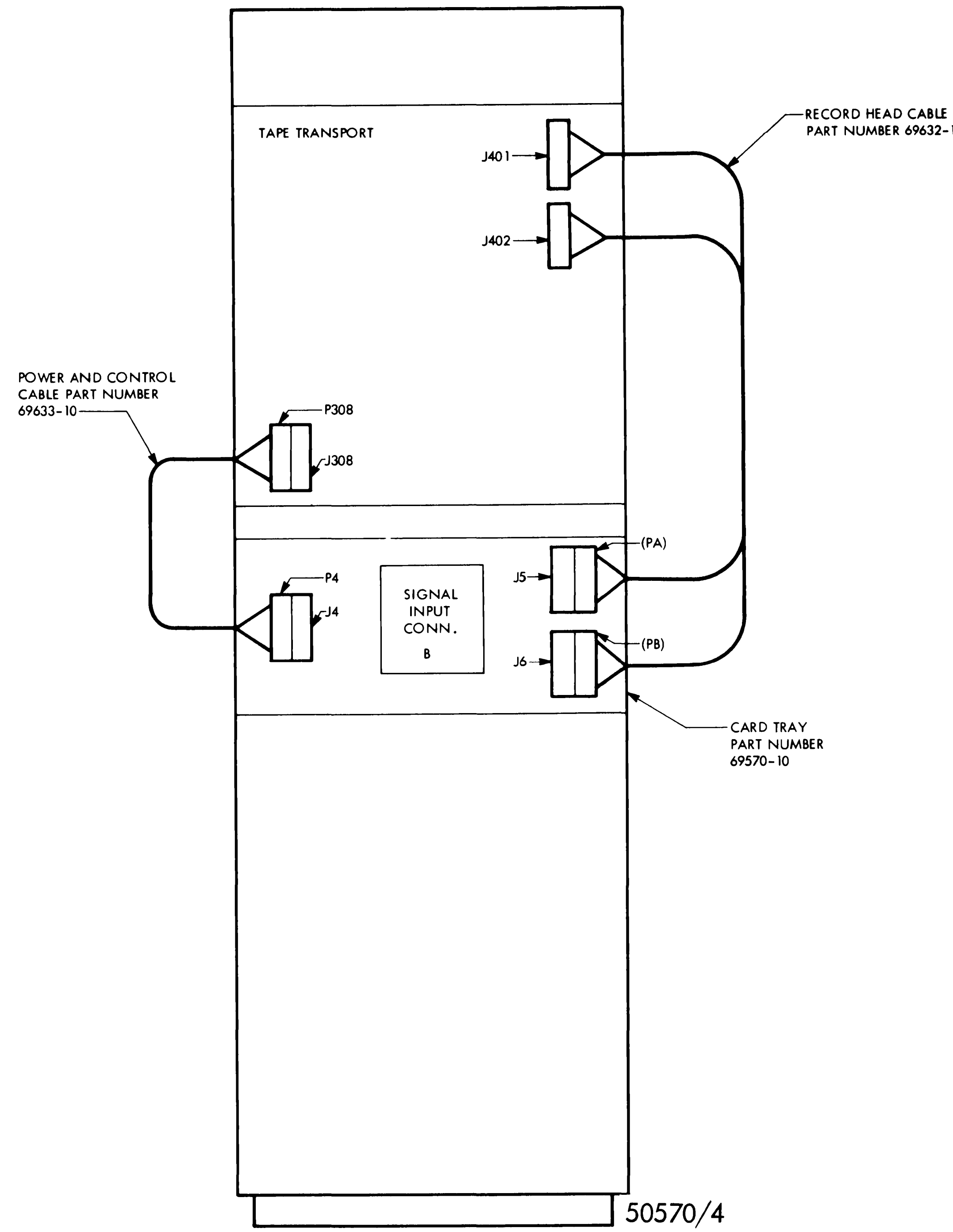


CABLE CONNECTIONS FOR 7 TRACK SIX SPEED RECORD AND REPRODUCE CONFIGURATION FOR FM OR DIRECT OR FM AND DIRECT

Figure 2-9. CABLE CONNECTION PLANS FOR THE RACK-MOUNTED INSTRUMENT (Sheet 3 of 7)



CABLE CONNECTIONS FOR 14 TRACK SINGLE SPEED REPRODUCE ONLY CONFIGURATION
FOR FM OR DIRECT OR FM AND DIRECT



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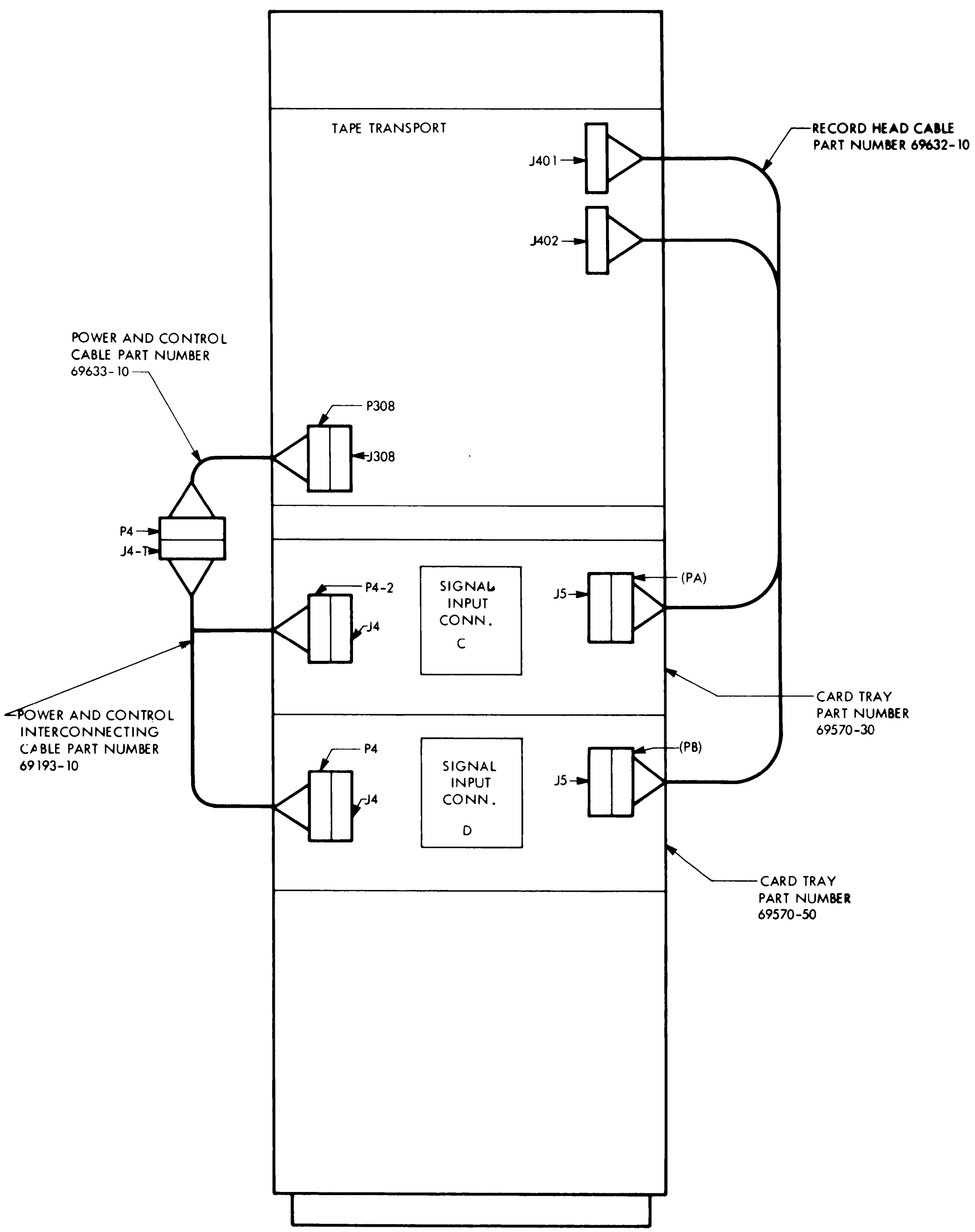
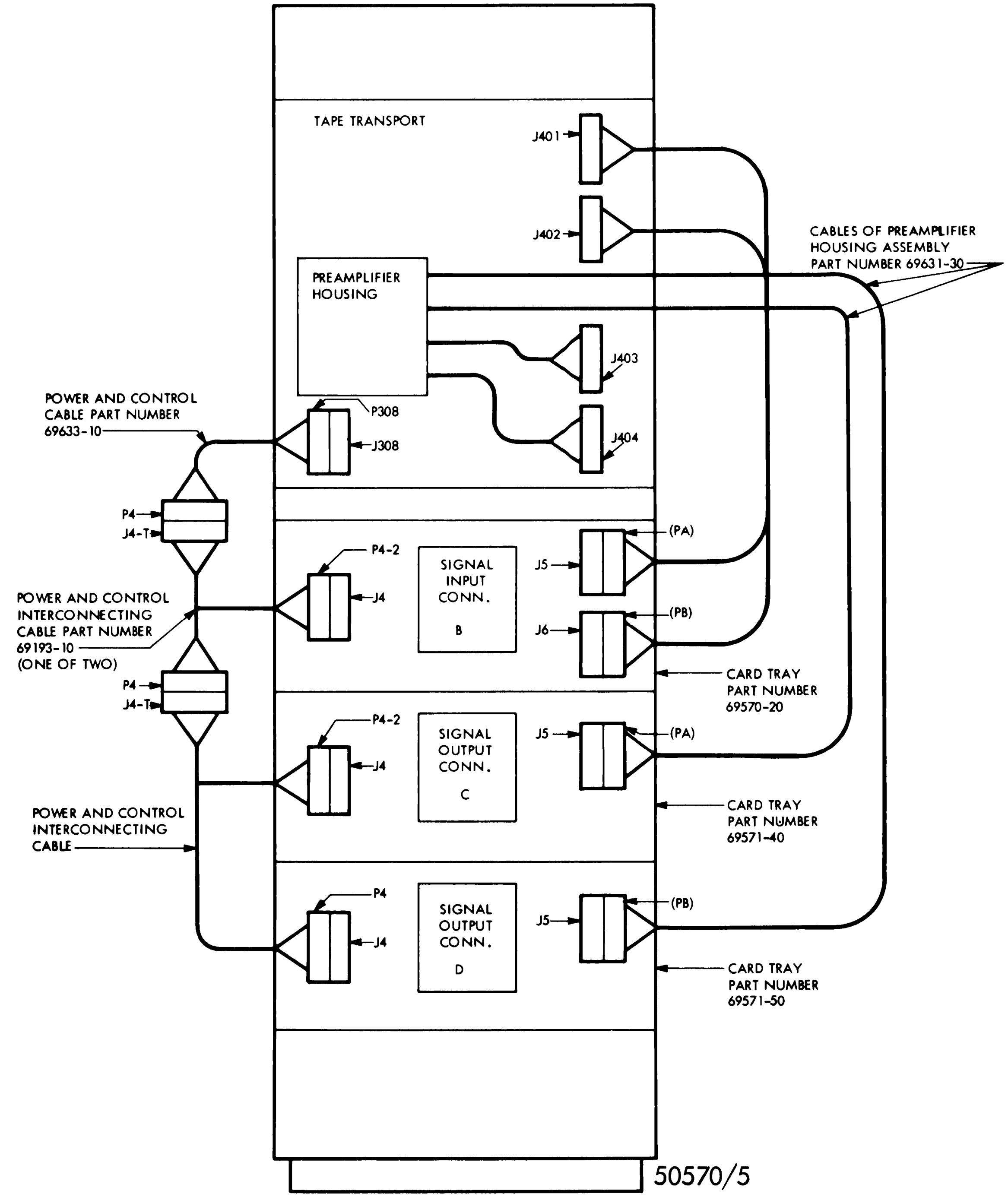
CABLE CONFIGURATION FOR 14 TRACK SINGLE SPEED RECORD ONLY CONFIGURATION
FOR FM OR DIRECT OR FM AND DIRECT

Figure 2-9. CABLE CONNECTION PLANS FOR THE RACK-MOUNTED INSTRUMENT
(Sheet 4 of 7)

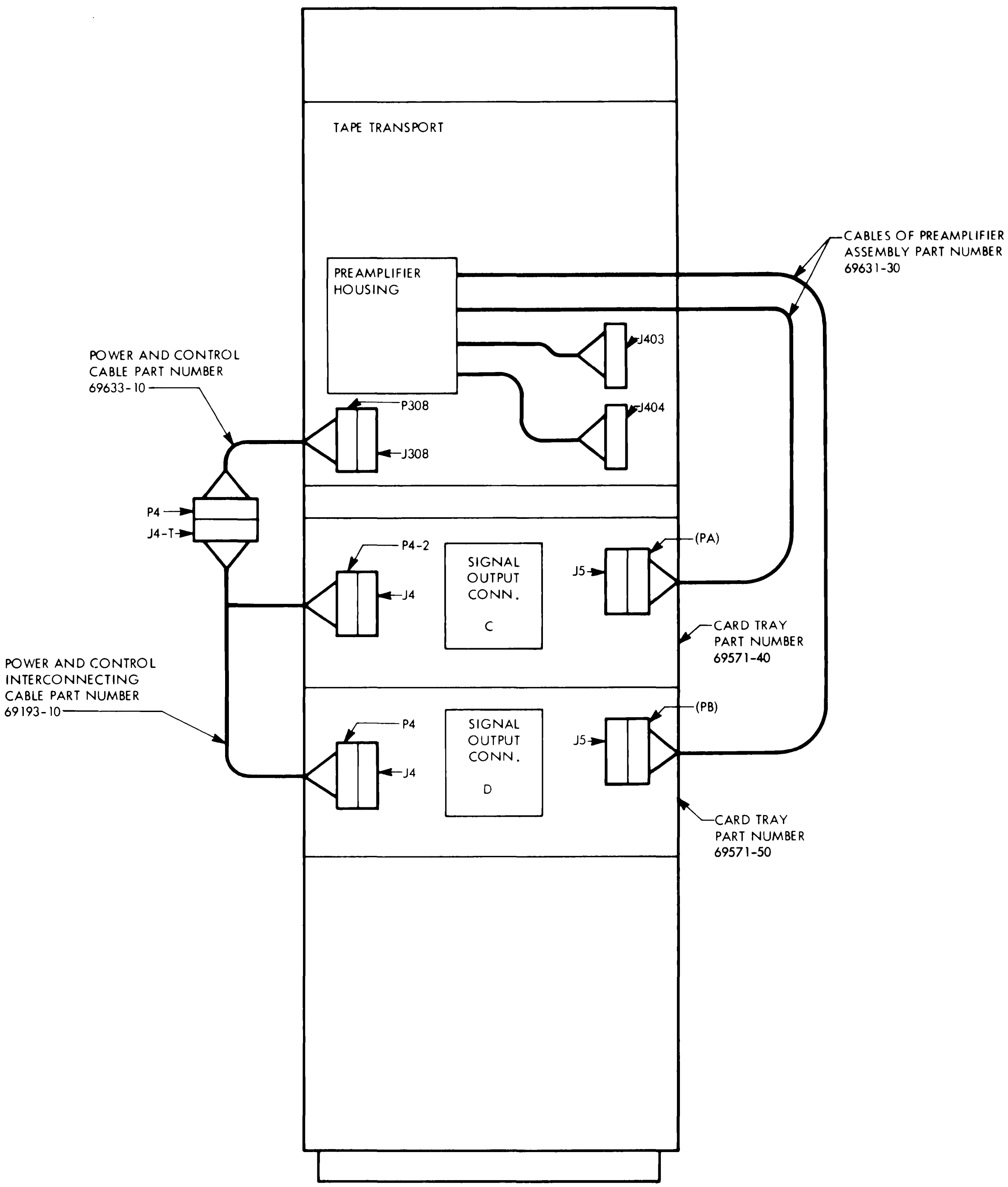


CABLE CONNECTIONS FOR 14 TRACK SIX SPEED FM RECORD CONFIGURATION

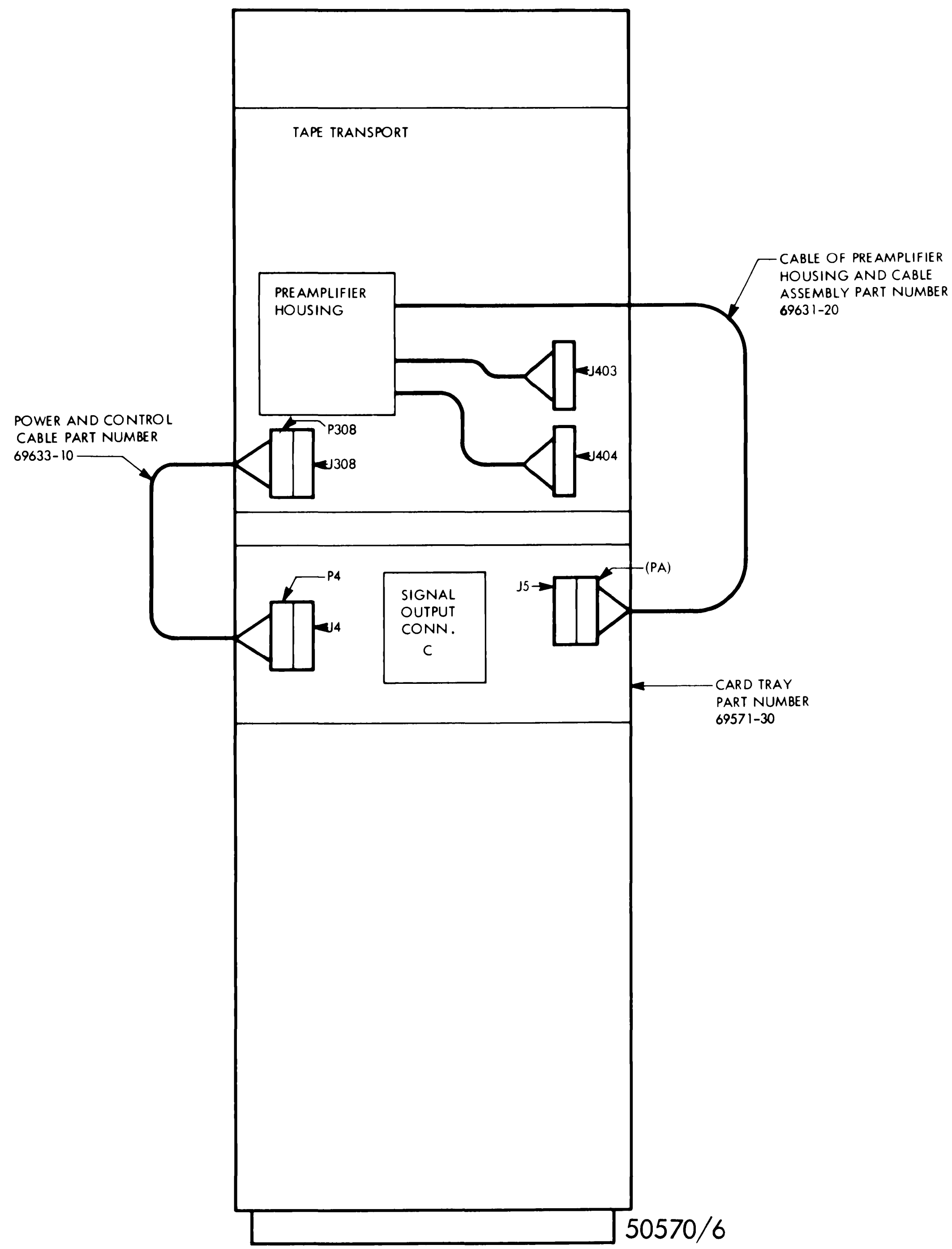


CABLE CONNECTIONS FOR 14 TRACK SIX SPEED DIRECT RECORD AND REPRODUCE CONFIGURATION

Figure 2-9. CABLE CONNECTION PLANS FOR THE RACK-MOUNTED INSTRUMENT
(Sheet 5 of 7)

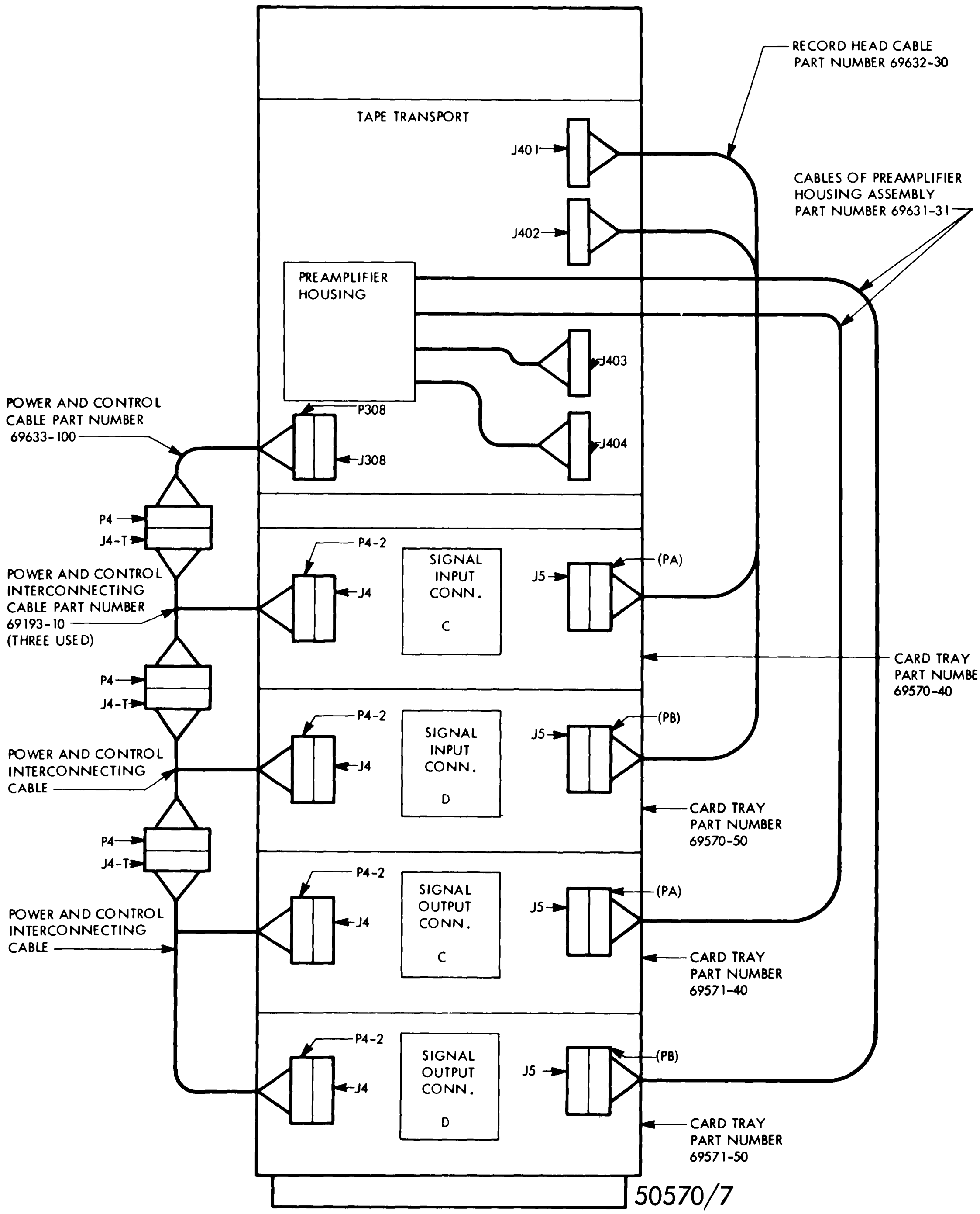


CABLE CONNECTIONS FOR 14 TRACK SIX SPEED REPRODUCE CONFIGURATION FOR FM OR DIRECT OR FM AND DIRECT



CABLE CONNECTIONS FOR 7 TRACK SINGLE SPEED OR SIX SPEED REPRODUCE CONFIGURATION FOR FM OR DIRECT OR FM AND DIRECT

Figure 2-9. CABLE CONNECTION PLANS FOR THE RACK-MOUNTED INSTRUMENT (Sheet 6 of 7)



CABLE CONNECTIONS FOR 14 TRACK SIX SPEED FM RECORD AND REPRODUCE CONFIGURATION

Figure 2-9. CABLE CONNECTION PLANS FOR THE RACK-MOUNTED INSTRUMENT (Sheet 7 of 7)

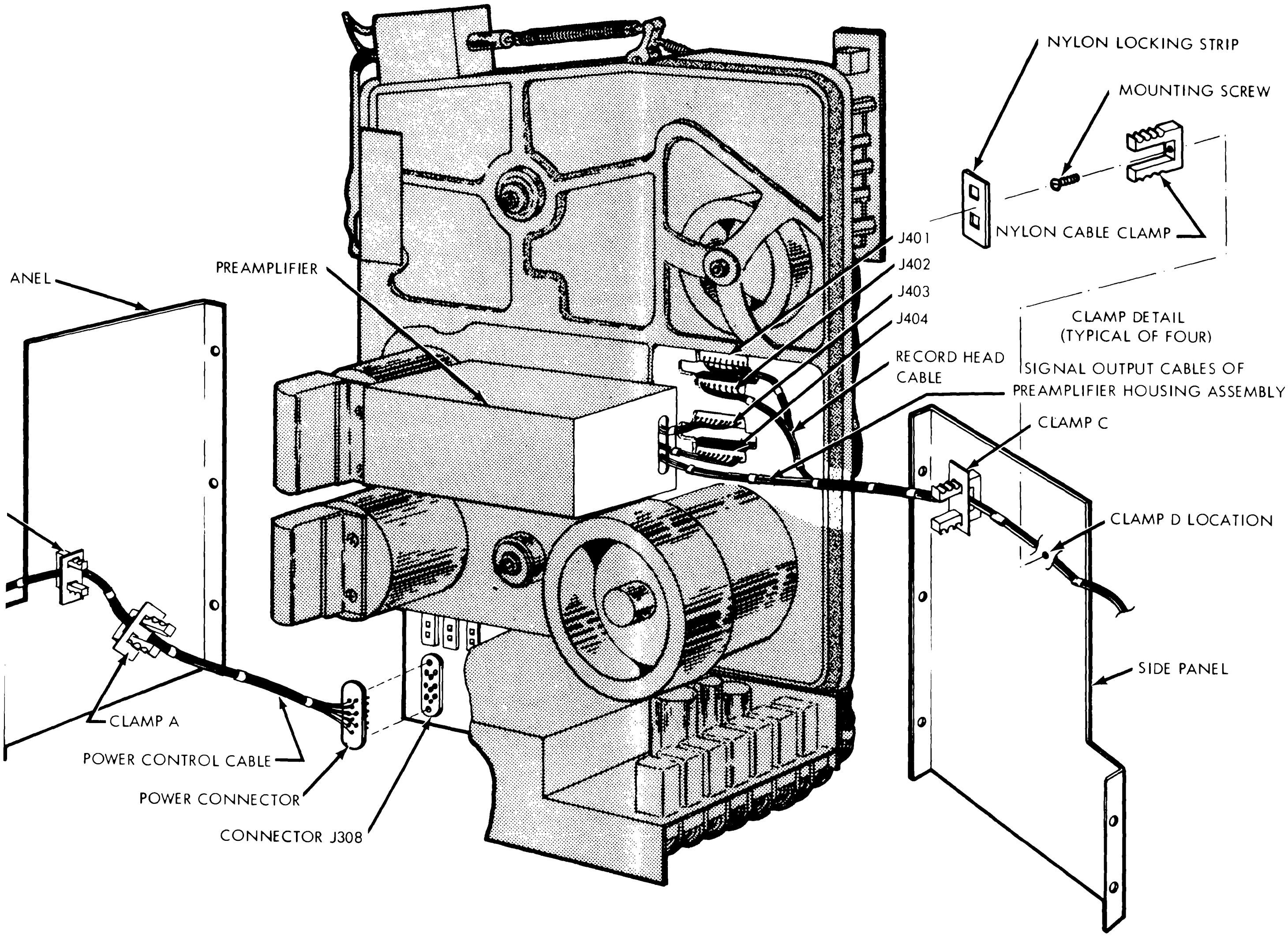


Figure 2-10. REAR VIEW OF TRANSPORT SHOWING CABLE DRESS

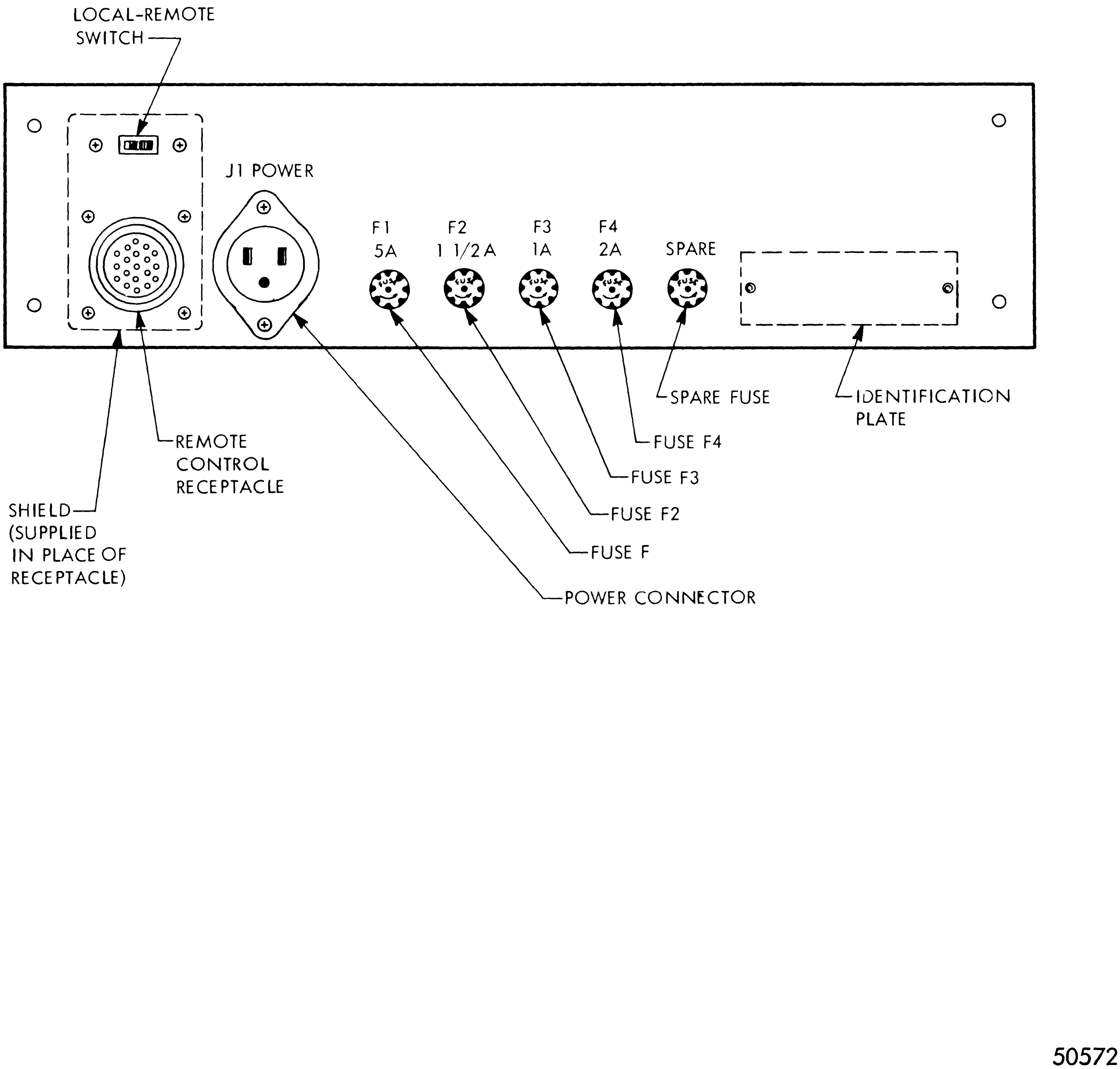


Figure 2-11. POWER PANEL OF RACK-MOUNTED INSTRUMENT

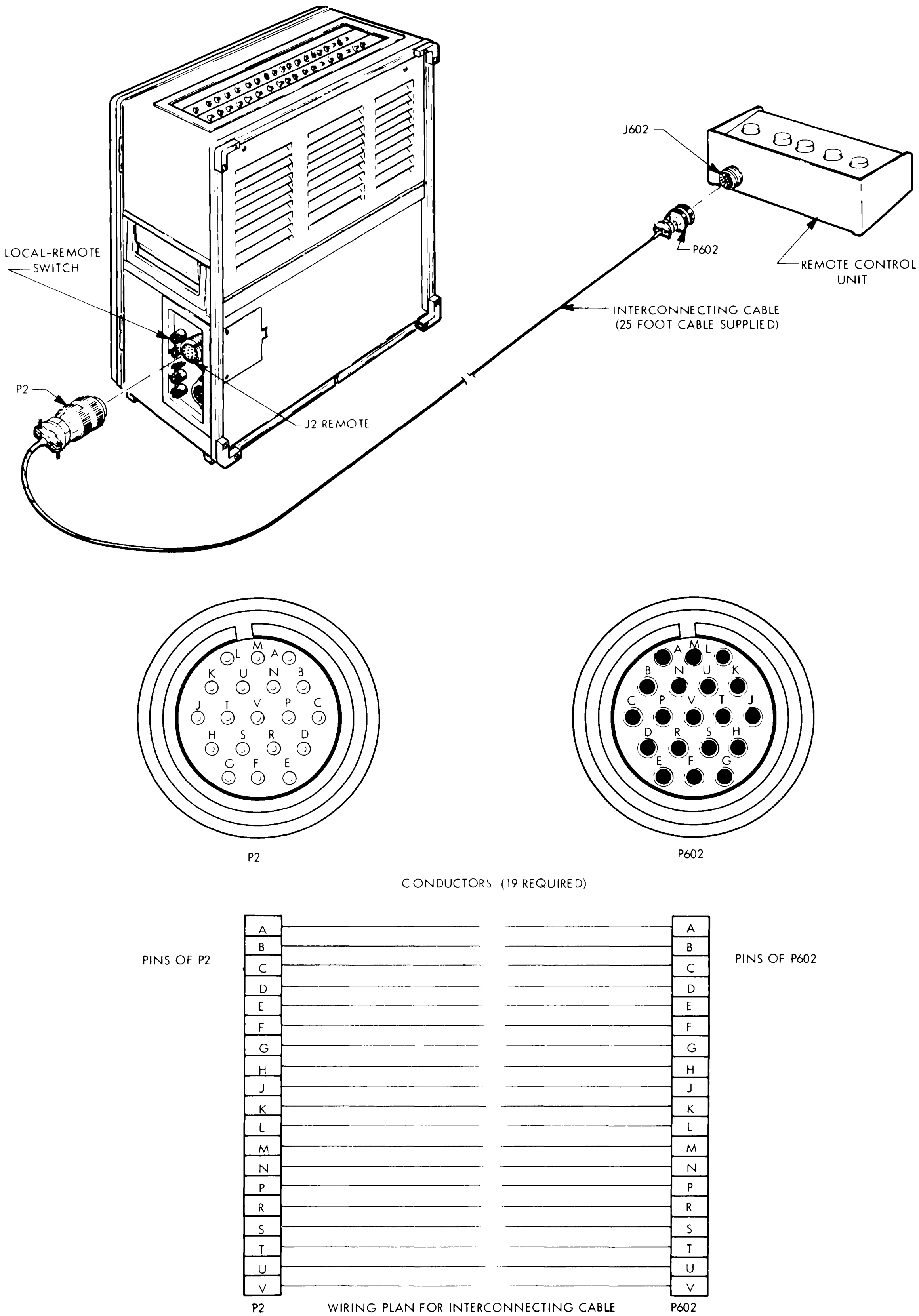


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Figure 2-12. REMOTE CONTROL INTERCONNECTIONS

CHAPTER 3

OPERATION

3-1. The FR-1300 recorder/reproducer may be operated in five different modes at each of six selected tape speeds. In this chapter, the modes of operation are first discussed, followed by instructions for selection of tape speeds, tape installation, and operation of the instrument. The connection of electrical power and signal cables to the instrument is described in the preceding chapter and should be completed before operating the recorder/reproducer.

3-2. MODES OF OPERATION.

3-3. The recorder/reproducer is controlled locally from a power switch and five back-lighted pushbuttons in the control cluster. In remote control operation, the instrument is controlled from five buttons on the remote control unit which are identical in function, appearance, and arrangement, to the buttons on the control cluster. No power switch is provided on the remote control. Six different modes of operation may be selected by manipulation of the control buttons. These modes, described in the following paragraphs are: STOP; DRIVE; RECORD; REWIND; FORWARD; and SEARCH.

3-4. THE STOP MODE.

3-5. The stop mode is standby condition, indicated by illumination of the STOP pushbutton. In this mode, power is supplied to the transport and to the record/reproduce electronics, but there is no movement of tape. The tape lifters are extended holding the tape off the heads, the capstan motor is operating at selected speed, the pinch roller is disengaged, the brakes are applied and the holdback servo system is not activated. The instrument automatically goes into the stop mode when the power switch is first turned on or when the end-of-tape switch is activated. The stop mode may be selected while operating in other modes by momentarily pressing the STOP button. The STOP button lamp extinguishes when other modes are selected.

3-6. THE DRIVE MODE.

3-7. The drive mode is a "playback" or reproducing condition, indicated by illumination of the DRIVE pushbutton. In this mode, signals previously recorded on the tape are reproduced. The capstan motor is operating at selected speed, the pinch roller is engaged, the tape lifters are retracted, the holdback servo system is activated, and tape passes at selected speed over the heads from the supply reel. The take-up torque motor is energized but the drive torque motor is not energized. The brakes are released in this mode and in any other mode by momentarily pressing the DRIVE button. If the drive mode is selected from either the fast forward or the rewind mode, a four second delay will be experienced (while reels are braked) before the drive mode is effective.

3-8. THE RECORD MODE.

3-9. The record mode is a condition in which signals may be recorded on the tape by the RECORD heads, then reproduced as the tape continues on its path over the reproduce heads. The record mode is indicated by illumination of the RECORD button. In the record mode, both the record and the reproduce electronics groups are enabled. The mechanical status, however, remains the same as described for the drive mode. The record mode is selected from the stop mode by momentarily pressing the RECORD button, after first pressing the DRIVE button, or if the instrument is already operating in the drive mode, then simply by pressing the RECORD button. In going from the rewind mode to the record mode, the instrument must first be switched to the drive mode. The RECORD button is not effective until the instrument is operating in the drive mode. Note that the RECORD button requires application of a 5 lb. pressure to actuate its switch, as compared to a 1 lb. pressure required on the other control buttons. This is a safety feature to prevent accidental loss of taped signals by inadvertent recording on the tape.

3-10. THE FORWARD MODE.

3-11. The forward mode, one of two fast modes, is a condition in which tape is transferred at a high rate of travel from the supply reel to the take-up reel. This mode is indicated by illumination of the FWD button. In the forward mode, the tape lifters are extended, holding the tape off the heads, the pinch roller is disengaged, and the holdback servo system is not activated. The take-up torque motor is fully energized and rotates counterclockwise, pulling tape at an average speed of 250 inches per second from the supply reel. The supply torque motor is energized at low power to provide tension on the tape. The forward mode is selected by momentarily pressing the FWD button.

3-12. THE REWIND MODE.

3-13. The rewind mode, the second fast mode, is a condition in which tape is transferred at a high rate of speed from the take-up reel to the supply reel. This mode is indicated by illumination of the REW button. The mechanical status existing while in this mode is the same as for the forward mode except that the supply torque motor is energized at low power. The rewind mode is selected by momentarily pressing the REW button while in any other mode.

3-14. THE SEARCH MODE.

3-15. The search mode is a reproduce condition in which the tape is brought into contact with the heads while the tape is being transferred at high speed between reels in the forward or rewind modes. The search mode is selected during the forward or rewind mode by pressing, and holding down the FWD or REW button, then pressing and holding down the DRIVE button. This action will defeat the tape lifters, allowing tape to come into contact with the heads. When search operations are completed, the instrument may be placed in the DRIVE MODE by first releasing the FWD or REW button, or allowed to continue in the forward or rewind mode by first releasing the DRIVE button.

3-16. TAPE SPEED SELECTION. See figure 3-1.

3-17. Six different tape speeds may be selected by a simple screwdriver adjustment made at the front of the FR-1300. This adjustment controls the speed at which the drive servo system operates, and in the case of instruments having electrically-switched signal electronics modules, the adjustment automatically adapts the modules for operation at each speed. Single-speed electronics modules must in some instances be removed from the card files and be converted by hand each time a different tape speed is selected.

3-18. DRIVE SERVO SPEED SELECTION.

3-19. The drive servo system transports tape at the following speeds: 60; 30; 15; 7-1/2; 3-3/4; or 1-7/8 inches per second. The speed is shown by the tape speed indicator adjacent to the tape speed selector switch. (See figure 3-1.) To the left of each speed marking is a color band of a color characteristic for the speed. Tape speed may be changed by inserting a screwdriver into the slotted shaft-end of the tape speed selector marked IPS, and turning the shaft in the direction which causes the desired tape speed indication to appear in the window of the indicator. Speed changes may be made while tape is moving, or stopped, or when the instrument is turned off. In instruments having six speed, electrically-switched signal electronics modules, switching within certain modules, is performed automatically as the drive servo speed selection is made, at times when power is supplied to the instrument.

3-20. RECORD/REPRODUCE ELECTRONICS SPEED SELECTION.

3-21. Certain of the record and reproduce modules must be converted to match changes in tape speeds. Such conversion is accomplished automatically in instruments having electrically-switched signal electronics modules. In instruments having single-speed signal electronics modules, equalizers must be changed in the direct-reproduce modules each time a speed change is made. No changes are required in the direct record modules. In FM systems, the reproduce filters must be changed, and a speed selection made manually by turning a switch on the side of the FM record modules. Before removing modules from the instrument, turn off power at the power switch.

3-22. DIRECT SYSTEM USING SINGLE-SPEED ELECTRONICS. In the direct system, equalizers must be changed in the reproduce modules to match each change in tape speed. The equalizers are plugged into a receptacle in the top of the module, immediately back of the front panel of the module. Markings on each equalizer indicate the tape speed for which it is to be used. These markings are supplemented by a color-coded strip on the equalizer which is characteristic for the speed, and which matches the color band visible in the tape speed indicator (figure 3-1) for each speed. Table 3-1 gives the identity of equalizers for each speed. When the equalizer is in place, it may be identified by markings and color visible through a slot near the top of the module front panel.

3-23. FM SYSTEM USING SINGLE SPEED ELECTRONICS. In the FM system filters must be changed on the reproduce modules to match each change in tape speed, and on the record modules, a speed switch must be turned to each new speed.

3-24. Filters on the FM reproduce modules are plugged into a receptacle in the top of the module immediately back of the front panel in the same manner as are equalizers of the direct system. Filters are marked with the speed for which they are to be used, and color-coded for additional identification. The identity of the filters to be used for each speed is given in table 3-1.

3-25. The FM record modules are converted to match tape speed changes by manipulation of a speed switch located on the side of the module. The speed switch knob may be turned in either direction by finger pressure to align the pointer on the knob with speed indications marked on the metal housing.

TABLE 3-1. EQUALIZER AND FILTER IDENTIFICATION

Tape Speed (ips)	Color Code	AMPEX Part Number	
		Direct Reproduce Equalizer	FM Reproduce Filter
60	Blue	69117 - 10	46390 - 10
30	Green	69117 - 20	46390 - 20
15	Yellow	69117 - 30	46390 - 30
7	Orange	69117 - 40	46390 - 40
3-3/4	Red	69117 - 50	46390 - 50
1-7/8	Brown	69117 - 60	46390 - 60

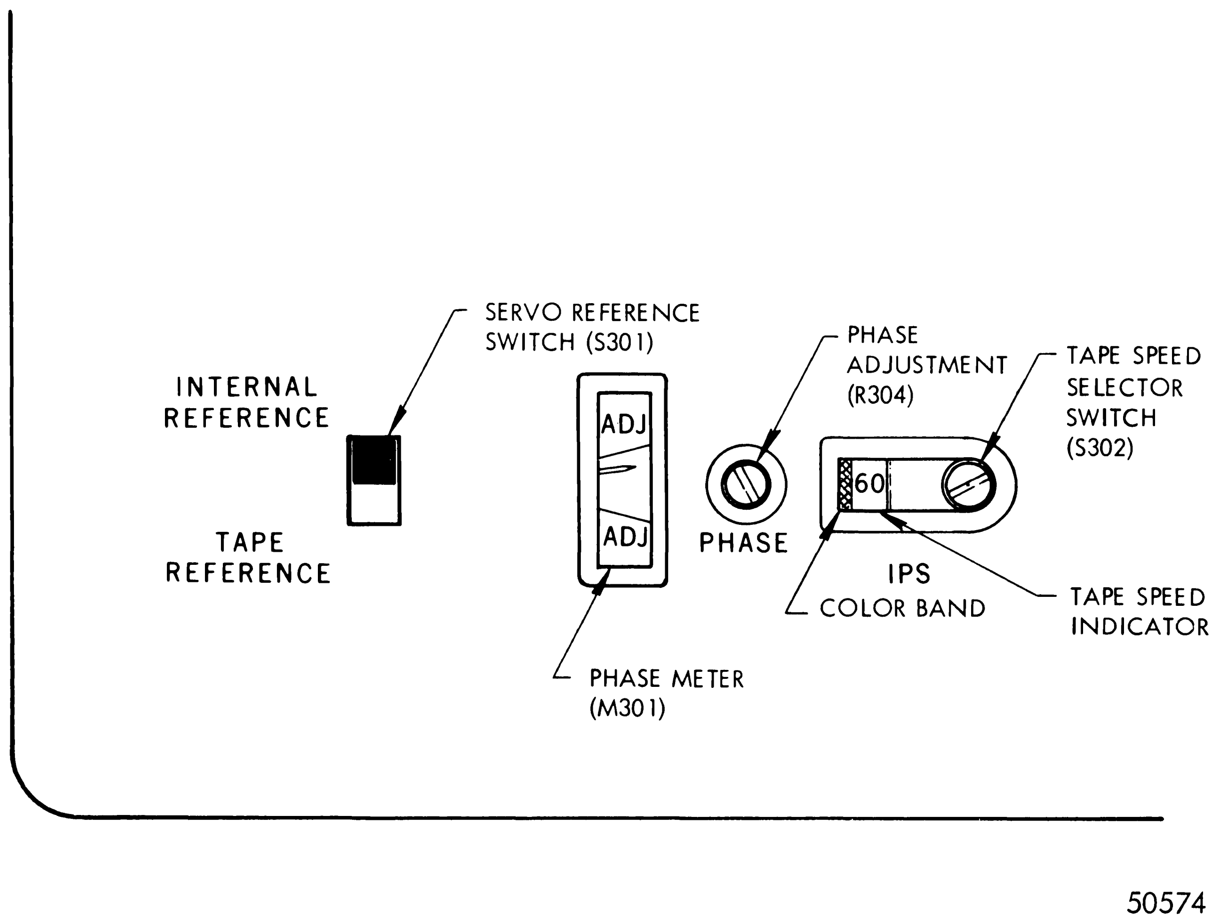

Figure 3-1. DRIVE SERVO SPEED CONTROLS

3-26. TAPE REEL LOADING AND TAPE THREADING.

3-27. TAPE REEL LOADING. See figures 3-2 and 3-3. In normal operation, a full reel of tape is placed on the supply hub of the instrument, and an empty reel is placed on the take-up hub. The tape reels are held in place on both the supply and the take-up hub by identical hold-down knobs which are a part of the hub. Tape reel loading and tape threading may be accomplished with the instrument in stop mode, or with the power off. To load a tape reel on either hub, carry out the following steps:

1. Pick up reel with hands holding the outer rim, and align the cut-out in the center of the reel with the hub on the instrument.
2. Turn the reel about its axis of rotation to align slots in the cut-out with keys on the hold-down knob.
3. Slide the reel onto the hub.
4. Fold out both halves of handle on hold-down knob.
5. Grasp rim of reel with one hand to keep reel from turning.
6. Turn handle clockwise to lock reel onto hub. To remove reel, unlock by turning the handle counterclockwise.

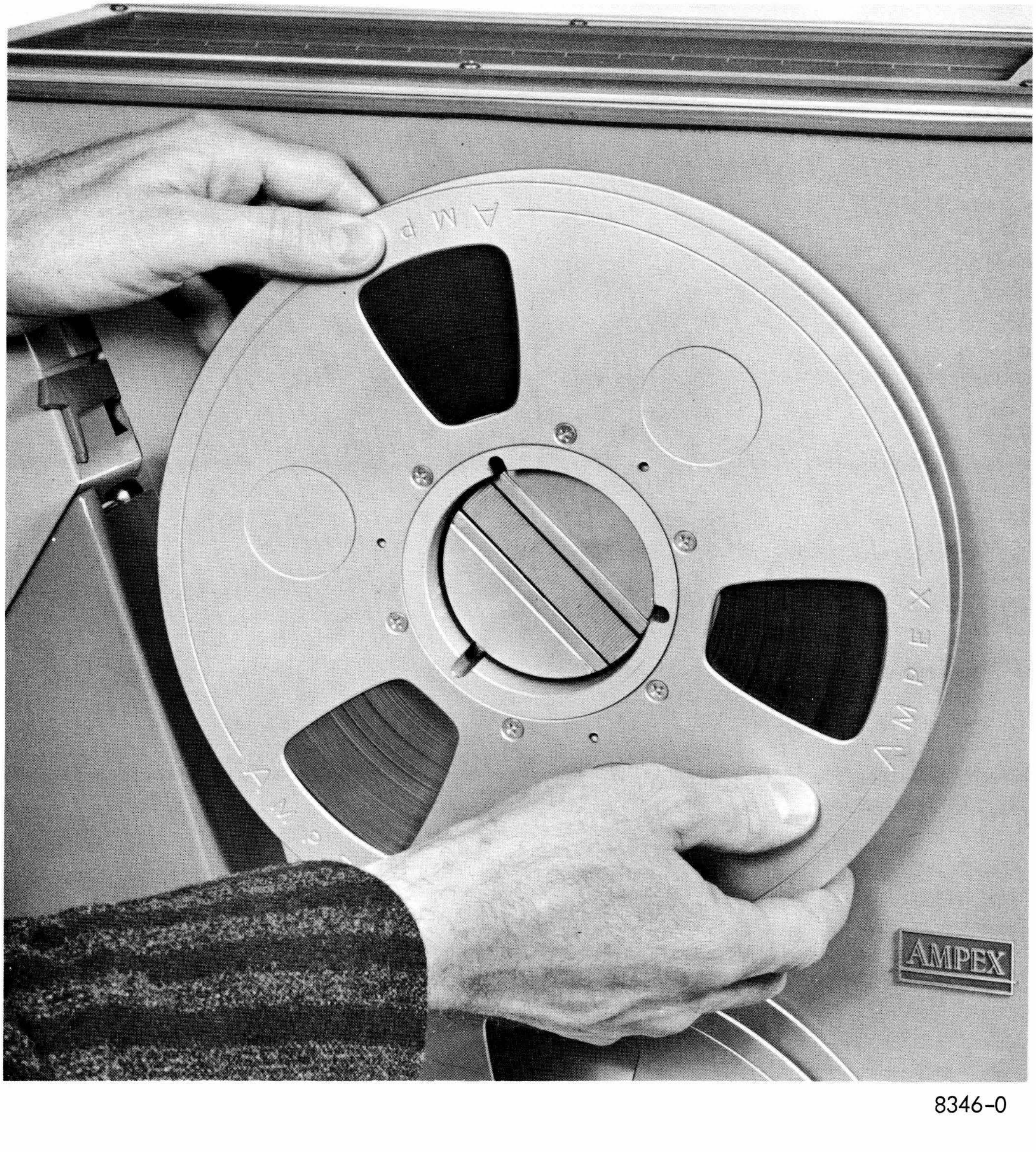

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Figure 3-2. PLACING REEL ON HUB

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Figure 3-3. LOCKING REEL TO HUB

3-28. TAPE THREADING. See figures 3-4 through 3-6. With a full tape reel loaded on the supply hub, and an empty reel on the take-up hub, carry out the following steps to thread the instrument:

1. Lift tape threading lever to the point where it locks in place. See figure 3-4.

2. Grasp end of tape leader and pull a length of tape from the supply reel.

3. Route the portion of tape closest to the supply reel through the slot formed by the junction of the control cover and the head cover. See figure 3-5.

4. Route tape around heads and through slot formed by lower part of head cover and the capstan cover. See figure 3-6.

5. Route the tape end into the empty take-up reel and wrap it in a counterclockwise direction about the spool by turning the reel.

6. Turn take-up reel two turns in a counterclockwise direction to tighten tape across heads and to ensure that the take-up reel has a satisfactory purchase on the tape.

NOTE

Failure to tighten tape sufficiently on take-up reel during threading may result in tape damage when instrument is operated.

CAUTION

BEFORE THREADING OR ADJUSTING INSTRUMENTS HAVING A REMOTE CONTROL UNIT INSTALLED, PLACE LOCAL-REMOTE SWITCH IN LOCAL POSITION TO PREVENT ACCIDENTAL OPERATION OF THE INSTRUMENT.

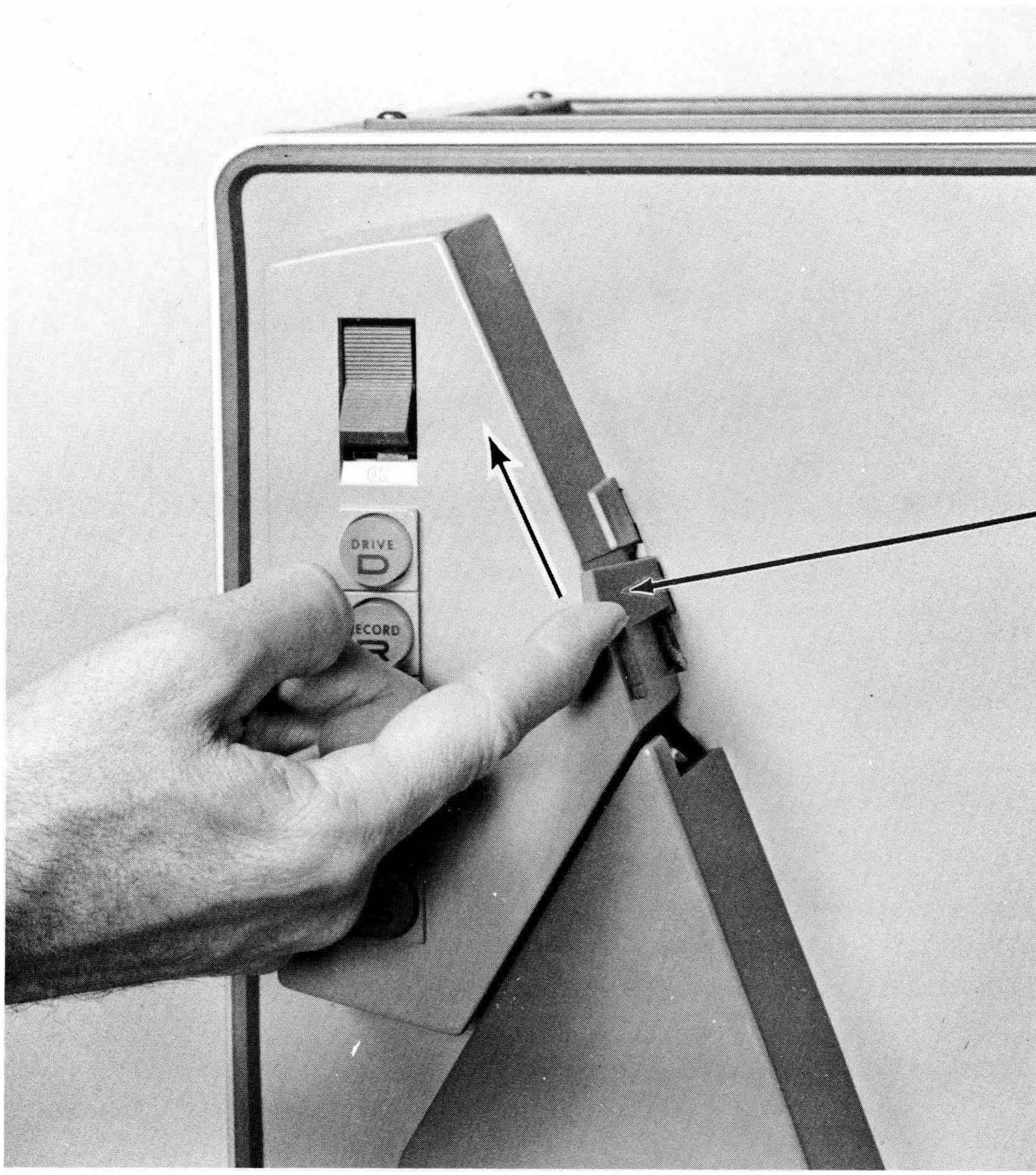

Figure 3-4. LIFTING THE TAPE THREADING LEVER

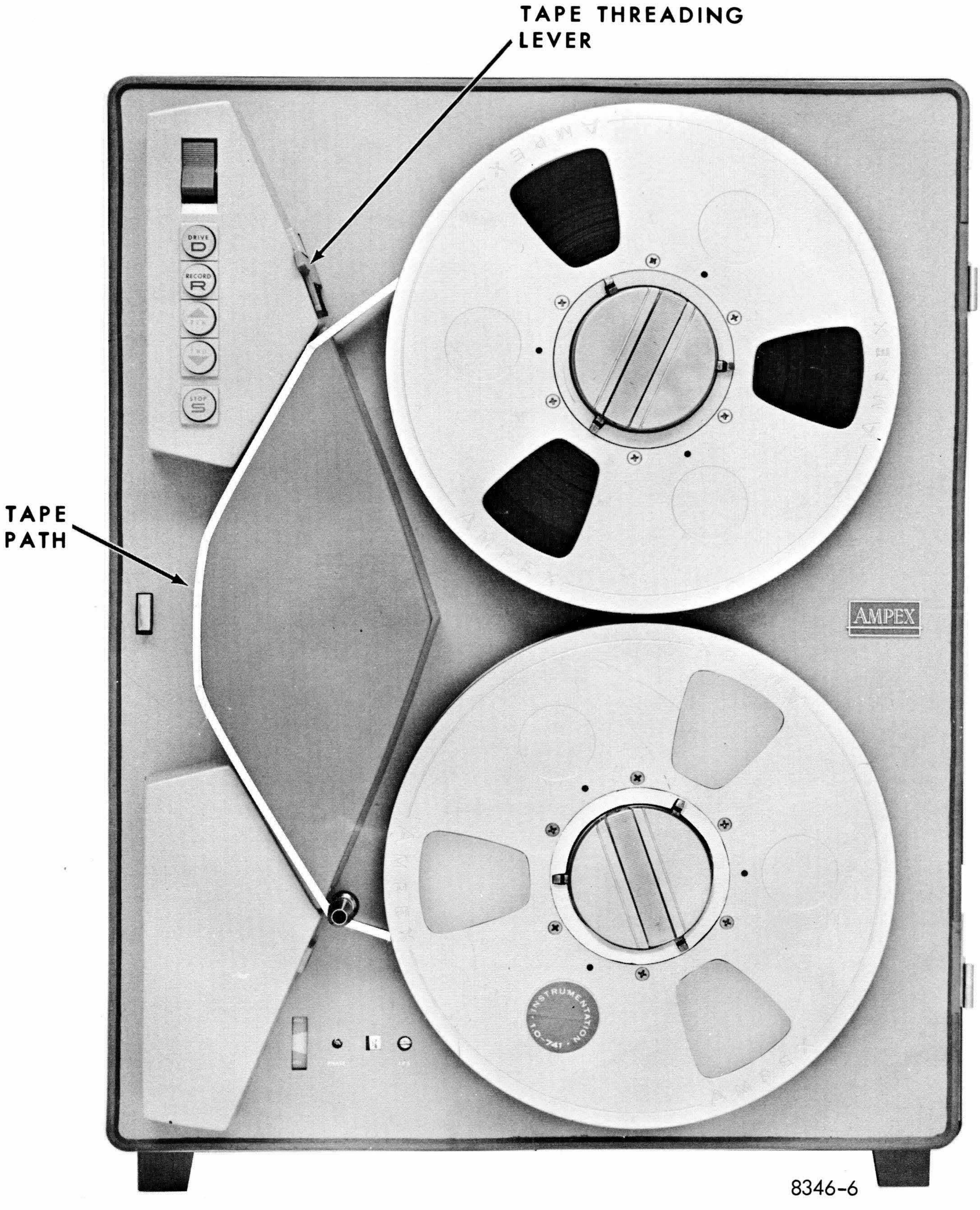

Figure 3-5. THE TAPE PATH

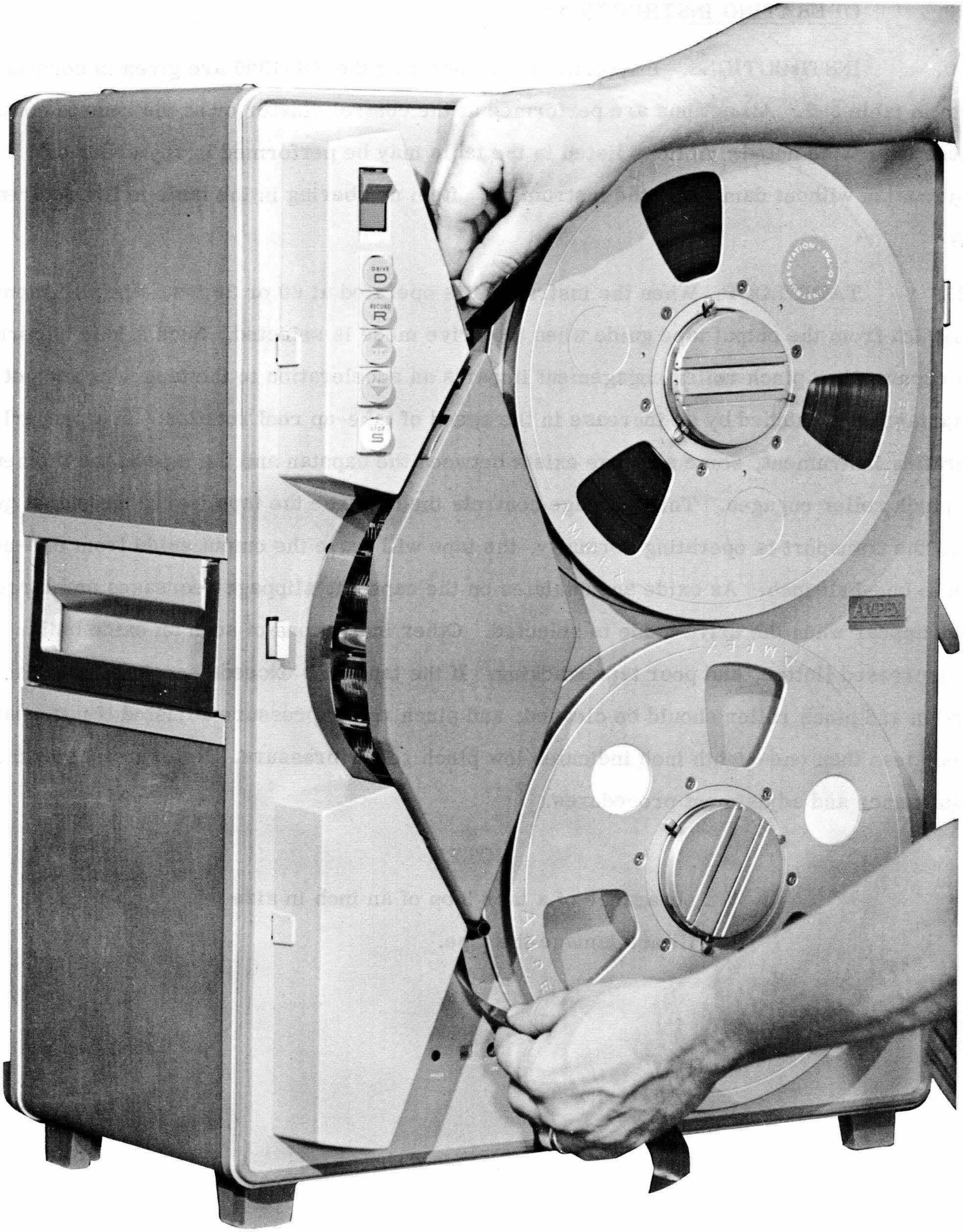

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Figure 3-6. THREADING TAPE

3-29. OPERATING INSTRUCTIONS.

3-30. INSTRUCTIONS. Instructions for operating the FR-1300 are given in condensed form in table 3-2. All actions are performed at the control cluster or at the remote control unless otherwise noted. Actions listed in the table may be performed in any order or combination without damage to the instrument. Item numbering in the table is for reference only.

3-31. TAPE LOOP. When the instrument is operated at 60 or 30 ips, tape will momentarily lift from the output tape guide when the drive mode is selected. Such a loop is normal, and occurs when pinch roller engagement imparts an acceleration to the tape which is not instantaeously matched by an increase in the speed of take-up reel rotation. In a properly operating instrument, some slippage exists between the capstan and the tape at the moment the pinch roller engages. This slippage controls the distance the tape leaves the output guide. When the transport is operating normally, the tape will leave the output guide from one-eighth inch to one-half inch. As oxide accumulates on the capstan, slippage decreases and larger loops appear when the drive mode is selected. Other indications of such an oxide buildup are increased flutter, and poor tape tracking. If the tape loop exceeds one-half inch, the capstan and pinch roller should be cleaned, and pinch roller pressure adjusted if necessary. A loop less than one-eighth inch indicates low pinch roller pressure. Refer to chapter 9 for maintenance and adjustment procedures.

NOTE

Appearance of a tape loop of an inch in size will not damage the tape.

TABLE 3-2. CONDENSED OPERATING INSTRUCTIONS

Item	Desired Function	Action	Remarks
1.	To turn power on.	Depress lower half of power switch.	Power on to transport and record/reproduce electronics. STOP button illuminates.
2.	To turn power off.	Depress upper half of power switch.	Power off to transport and record/reproduce electronics.
3.	To transfer control.	At power panel, move local-remote switch to RMTE.	Control may be exercised from either the control cluster or remote control unit.
4.	To transfer control from remote control.	At power panel, move local-remote switch to LCL.	Control exercised only from control cluster.
5.	To reproduce signals previously recorded on tape.	Press DRIVE button.	Drive button illuminates, tape passes over heads at selected speed. If instrument was operating in a fast mode when selection was made, a four second delay will be experienced.
6.	To record signals on tape.	Press DRIVE button, then when DRIVE button illuminates, press RECORD button.	RECORD button illuminates, record function enabled. Instrument must be operating in DRIVE mode before RECORD button is effective.
7.	To transport tape from supply to take-up reel.	Press FWD button.	FWD button illuminates, tape moves at 200-300 ips from supply to take-up reel. Tape held off heads.
8.	To stop reel motion.	Press STOP button.	STOP button illuminates, reels braked.
9.	To transport tape from take-up to supply reel.	Press REW button.	REW button illuminates, tape moves at 200-300 ips from take -up to supply reel. Tape held off head.
10.	To search for recorded signals with tape moving at high speed.	Depress and hold either FWD or REW button, then press DRIVE button.	DRIVE button only illuminates. Tape lifters are defeated and tape moves at 200-300 ips across heads.

3-32. ADJUSTMENT OF DRIVE SERVO (See figure 3-1.) Correct operation of the drive servo is indicated by the phase meter when its pointer is visible and steady. Should the pointer oscillate slowly or rapidly, while the instrument is in operation, adjustment of the servo is required. To adjust, insert a small screwdriver into the control marked PHASE, located to the right of the meter, and turn the adjustment to produce a steady meter indication. If the meter pointer cannot be brought into view, check that the servo reference switch (S301) located under the capstan cover, is in the INTERNAL REFERENCE position.

NOTE

Phase meter indication will be erratic when changing tape speeds.

3-33. TAPE DEGAUSSING. Tape degaussing, or erasure should be performed using a bulk degausser such as the AMPEX Model SE-10 which is available in a table mounted version, catalog number 22070-10 and in a rack-mounted version, 22070-02. To degauss tape using this equipment, perform the following operations:

1. Transfer all tape onto one reel.
2. Remove reel from FR-1300 and secure tape end with masking tape.
3. Open door of degausser and load the reel onto the turntable.
4. On degausser power panel, turn POWER switch to ON.
5. Close door. Amber colored POWER lamp should be visible from front of degausser.
6. When green ERASED lamp (located above the POWER lamp) comes on, tape has been degaussed.
7. Open door and remove tape.
8. Remove masking tape.

3-34. TAPE SPLICING. See figure 3-7. Tape splicing may be necessary in order to provide a desired arrangement or continuity to recorded signals. A satisfactory splice will cause little loss of recorded information adjacent to the splice and will not introduce appreciable noise into the system during reproduction. Such a splice can be made easily by hand. A few general precautions are:

- Avoid excessive handling of tape at the point where it is to be spliced. Oils from the skin, if introduced onto the tape will prevent proper adhesion of the splicing tape.
- Use a splicing tape having an adhesive which will not flow. AMPEX Splicing Tape (AMPEX Part Number 761-024) is recommended.
- To avoid erasure of tape, demagnetize scissors before bringing them into contact with tape. Use either a hand-held degausser or an open-type bulk degausser to demagnetize scissors.

3-35. To splice magnetic tape by hand, perform the following operations:

1. Overlap the tape ends a short distance, taking care to align the edges.
2. Hold the tape in alignment, then with demagnetized scissors, cut diagonally across the tape in a straight line.
3. With the uncoated side of the tape turned up, butt the tape ends together and align the edges of the tape.
4. Apply a strip of splicing tape across the diagonal cut while holding the tape ends in alignment.
5. Burnish the splicing tape from the center outward to remove air bubbles and to improve adhesion.
6. With scissors, trim excess splicing tape from the sides of the splice. Be careful not to cut into the magnetic tape.

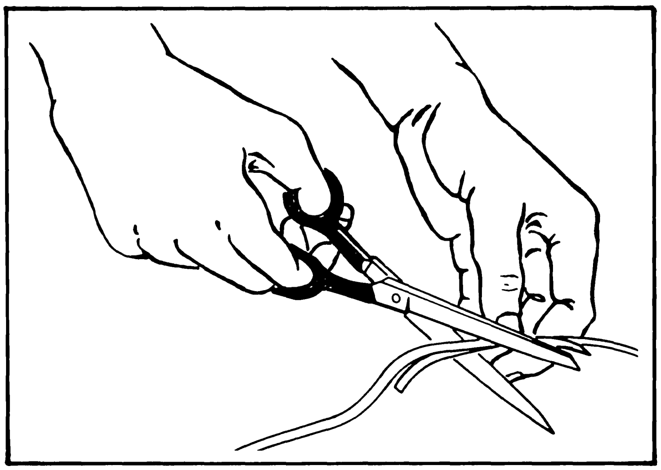
3-36. TAPE DEVELOPMENT. The magnetic pattern of the signal recorded on tape can be made visible by a procedure of tape development. This procedure, which does not erase the recorded signal or damage the tape, utilizes a suspension of magnetic powder which is placed on the oxide surface of the tape. Particles of the suspension orient themselves in accordance with the magnetic pattern of the recorded signal, thus providing a visible outline of the pattern. Tape is developed using the EDIVUE TAPE DEVELOPMENT KIT, AMPEX part number 50495-01. Instructions for use accompany each kit, and are presented for convenience in the following paragraph.

3-37.

NOTE

Tape development procedure will be presented in the final manual.

3-38. PREVENTIVE MAINTENANCE. Preventive maintenance measures should be applied to the FR-1300 in accordance with an established schedule in order to consistently realize the best performance of the instrument. These measures, together with a recommended schedule, are described for the transport in the chapter entitled: TRANSPORT MAINTENANCE, and for the record/reproduce electronics in the chapter entitled: RECORD /REPRODUCE ELECTRONICS.



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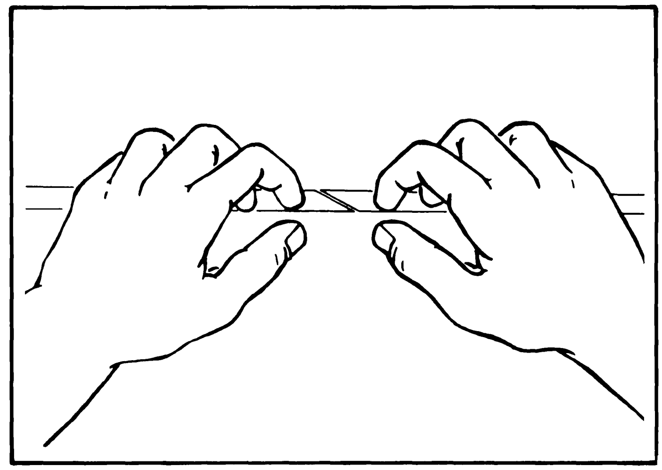

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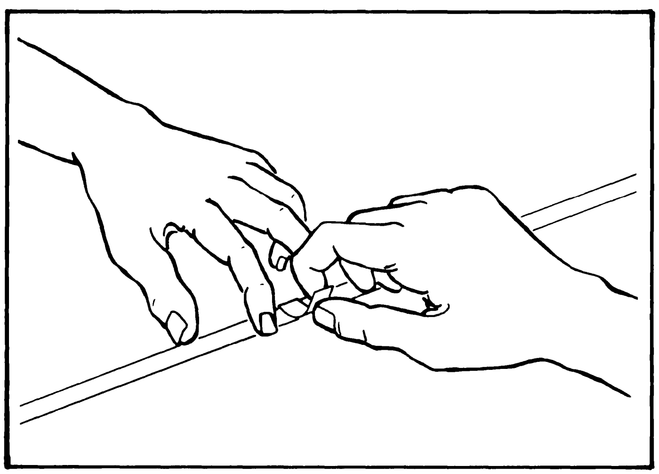

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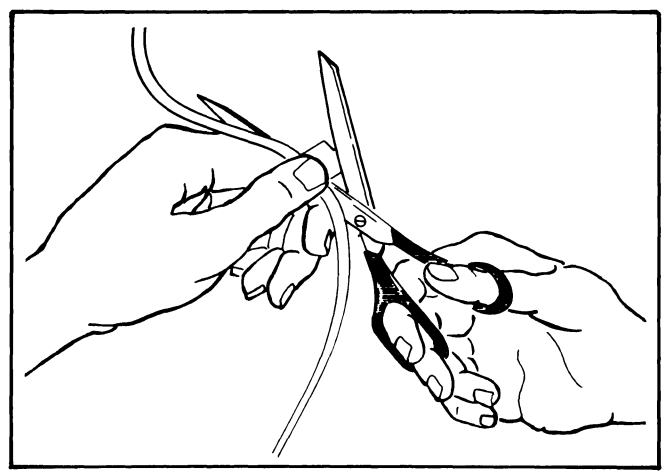

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Figure 3-7. SPLICING TAPE

CHAPTER 4

TAPE TRANSPORT MECHANICAL SYSTEMS

4-1. INTRODUCTION. The tape transport mechanical systems are mechanisms which operate together to move magnetic tape at a constant speed across the record/reproduce heads. These systems are arranged for purposes of description into the following functional groups:

- Tape Guide Assemblies
- Tape Lifter Assembly
- Threading Lever Assembly
- Reel Drive Assembly
- Stopping Brake Assembly
- Holdback Servo System
- Pinch Roller Assembly
- Capstan Motor

4-2. THE TAPE GUIDE ASSEMBLIES. See figure 4-1 and 4-2, both located at end of chapter.

4-3. Five tape guides are used in the FR-1300 to route tape in a prescribed path between reels while accurately maintaining lateral tape alignment with the record/reproduce heads. Additionally, certain guides mechanically damp longitudinal vibrations in the tape, thereby reducing flutter. Guides used are cylindrical or tubular in form, and are oriented with their longitudinal axis perpendicular to the transport reference plane. Guides are classed by physical characteristics as rotating, non-rotating, flanged, and non-flanged. In the discussion of the assemblies, guides are considered in the following order:

1. Input Tape Guide Assembly
2. Output Tape Guide Assembly

3. Servo Arm Tape Guide Assembly
4. Filtering Idler Assembly
5. Head Idler Assembly

4-4. INPUT AND OUTPUT TAPE GUIDE ASSEMBLIES.

4-5. INPUT TAPE GUIDE ASSEMBLY. See figure 4-1 and 9-2. The input tape guide assembly consists primarily of a flanged, non-rotating guide secured to a pedestal. The assembly is located above the servo arm guide where it provides a fixed point about which tape from the supply reel is routed. Thus, tape leaving the guide is unaffected by varying amounts of tape on the reel. A tape support rod mounted on the pedestal is an aid in threading tape, and is adjusted to clear the edge of the tape. Different tape guides are used with one inch and one-half inch tape. Guide height above the transport reference plane is accurately set during manufacture by means of shims between the guide and the pedestal.

4-6. OUTPUT TAPE GUIDE ASSEMBLY. See figures 4-1 and 9-3. The output tape guide is fixed to the transport frame below the pinch roller. In this location it maintains the lateral alignment of the tape. The output tape guide assembly consists primarily of a flanged, non-rotating guide mounted on a standoff. A tape support bracket fastened to the standoff is an aid in threading tape. Different guides are used with one inch and one-half inch tape. Guide height above the transport reference plane is accurately set during manufacture by means of shims between the guide and the standoff.

4-7. SERVO ARM TAPE GUIDE ASSEMBLY. See figure 4-1 and 9-4.

4-8. The servo arm tape guide assembly is a flanged, rotating guide mounted on the end of the holdback servo arm. This guide aids in maintaining lateral alignment of tape, while transferring the pressure of the tape to the servo arm. The assembly consists principally of a post fastened to the servo arm, two ball bearings, and a tape guide. The height of the guide above the transport reference plane is accurately set during manufacture by means of shims between the post and the servo arm.

4-9. THE FILTERING IDLER ASSEMBLY. See figures 4-1, 4-2, 9-5, and 9-6.

4-10. DESCRIPTION. The filtering idler assembly is a mechanical filter which serves also as a tape guide. The idler consists generally of a flywheel on a shaft set in ball bearings and provided with a non-flanged pulley of larger diameter than the shaft. The flywheel is turned by friction of tape moving across the pulley when the instrument is operated in the drive or the record mode. At such times, the surface of the pulley moves at the same speed as the tape, and inertia of the flywheel, transferred through the shaft to the tape, damps out longitudinal vibrations in the tape before the tape passes over the record/reproduce heads. Such vibrations, if undamped, would cause flutter in the 200 - 400 cycle-per -second region. In the fast modes, tape-wrap around the pulley is reduced almost to zero and the pulley is not driven by the tape.

4-11. CONSTRUCTION. The flywheel of the filtering idler is held in place on the shaft by two collars between which the flywheel is free to turn. The flywheel is coupled to the shaft by a viscous film of silicone oil. Such coupling increases damping. Hardened and ground cone points on the ends of the shaft provide the inner race for ball bearings located in holders at either end of the shaft. Each bearing consists of four balls in a semi -enclosed outer race. A hole in one side of the outer race assembly admits the cone point of the shaft. The front bearing rests in a holder which in turn is held by an idler support. The rear bearing is housed in an adjustable bearing holder threaded into the center of a spider on the main frame casting. Bearings are spring-loaded by springs within the holders. These springs serve additionally to protect the bearings from shock. In case of severe shock, the rear collar will come into contact with the inner edge of the bearing holder before bearing damage is caused. Shocks in the opposite direction cause the edge of the pulley to contact the bearing holder, thus preventing bearing damage. Adjustments provided are the threaded rear bearing holder, and two setscrews on the idler support which position the front bearing holder. These setscrews are sealed with beeswax, and should not be turned under any circumstance except in accordance with the instructions for corrective maintenance.

4-12. THE HEAD IDLER ASSEMBLY. See figures 9-7 and 9-8.

4-13. The head idler assembly, located between the record and reproduce heads, is a rotating, non-flanged guide which damps tape flutter in the region above 300 cycles per second. The idler is a part of the head base assembly, and is removed from the transport with the head group. The head idler assembly consists mainly of an idler roller, a front and a rear bearing assembly, and an idler support. The idler roller is supported at each end by the bearings, one located in the head base, and the other, the front bearing, located in the idler support. The idler roller is provided with an integral longitudinal shaft having cone shaped points at either end which are ground and hardened. These points form the inner race of the ball bearing. Bearings of each bearing assembly consist of four balls in a semi-enclosed outer race as in the filtering idler assembly. The cone point of the roller shaft is admitted to the balls through a central hole in one side of the bearing. The rear bearing assembly, mounted in a recess in the head base, consists of the bearing, a spring, and a cone-point setscrew. The setscrew provides a means of loading the bearings and adjusting the end-play of the roller. The front bearing consists of a bearing in a bearing holder. The bearing holder is set into an oversized hole in the outer end of the idler support, and is held in place by two setscrews working against a spring-loaded ball. The two setscrews are adjusted to bring the longitudinal axis of the idler roller into a perpendicular relationship to the reference plane of the head base. This alignment is performed to close limits during manufacture, and the hex sockets of the setscrews are then filled with beeswax to discourage inadvertent misalignment. Under normal circumstances, these adjustments should never be changed. A rubber dust shield is provided for the rear bearing. This shield, a tubular shape, surrounds the rear portion of the roller shaft but does not touch the shaft. The shield is held in place by a sheetmetal clamp.

4-14. **THE TAPE LIFTER ASSEMBLY.** See figures 4-3 and 9-9.

4-15. **DESCRIPTION.** The tape lifter assembly operates during the fast modes of instrument operation by lifting the fast-moving tape off the record/reproduce heads, thereby reducing head wear. The lifter assembly operates also in the stop mode. When the mode is shifted from the forward mode to the search mode, lifters are inactivated, thus allowing the tape to contact the heads. The lifting function is performed by two rod-like lifter fingers of the assembly which are oriented at right angles to the transport reference plane. One finger is located between the record heads, and the other is located between the reproduce heads. The fingers are retracted below the tape path when the instrument is in the drive, record, or search modes. When the assembly is activated, lifter fingers extend in unison into the tape path, elevating the tape clear of the heads.

4-16. CONSTRUCTION. The tape lifter assembly consists generally of two identical bellcranks, interconnecting linkage, a solenoid and two springs. Lifter fingers are located at the ends of each bellcrank. The bellcranks are each fastened to the transport frame by a fixed pivot pin, and joined by linkage to the solenoid. In the inactive condition, the springs hold the fingers in the retracted position. When the solenoid is energized, bellcranks are turned on their pivots, extending the fingers into the tape path. The height above the heads to which the tape is lifted is adjusted by changing the position of the solenoid.

4-17. THE THREADING LEVER ASSEMBLY. See figures 4-1 and 4-4.

4-18. DESCRIPTION. The threading lever assembly is a manually operated device used to facilitate threading tape on the instrument. The assembly is operated by lifting the tape threading lever, a part of the assembly, which cams the servo arm clear of the tape path. The threading lever and servo arm lock in the raised position when lifted. Both are released when a mode other than stop is selected.

4-19. CONSTRUCTION. The threading lever assembly consists of the tape threading lever, a threading lever slider and a pivot arm. Components of the assembly operate in conjunction with the servo arm and the stopping brake assembly. The tape threading lever is attached to the top of the slider, a flat inverted -L- shaped metal form having three long slots of similar orientation, a cam cut-out and a detent mechanism. The slider is loosely attached to the transport frame by three guide pins staked to transport frame, which pass through each of the long slots in the slider. Thus, the slider is free to move a limited distance on the guide pins. A pin on the servo arm engages the lower edge of the cam cut-out on the slider. Action of the cam cut-out is shown in A and B of figure 4-4. As the slider is lifted, the servo arm is raised by means of the cam action. The arm and slider are locked at the upper end of the travel by the detent mechanism shown in views C and D of the same figure.

4-20. The slider is locked by the detent mechanism consisting of a pin on the slider and a detent arm which pivots about the lower guide pin. The arm is released by movement of the pivot arm, activated by motion of the brake rod as it releases the stopping brake on the take-up reel drive assembly. Motion of the brake rod is transferred to the pivot arm by means of an adjustable collar on the brake rod. At the other end of the pivot arm, the motion is transferred to the detent arm, releasing the slider.

4-21. THE REEL DRIVE ASSEMBLY. See figures 4-5, 4-6, and 9-10 through 9-12.

4-22. The reel drive assembly is a means of physically supporting and rotating the tape reel. Two similar assemblies are used in the FR-1300, one to drive the supply reel, and the other to turn the take-up reel. In the description which follows, only the supply reel drive assembly will be considered. The reel drive assembly consists generally of a turntable, a turntable bearing assembly, a hub group attached to the turntable, a reel drive belt and a torque motor provided with a pulley. In operation, the torque motor rotates the turntable at one-half motor speed by means of the drive belt which runs between the pulley and a groove in the larger diameter turntable. A precision tape reel installed on the hub rotates with the turntable. The hub consists of a spacer, a hold-down knob assembly, a resilient pad, a dust cover and shims. Each major group of the assembly is described in the following paragraphs.

4-23. THE TURNTABLE. The turntable is a machined one-piece casting symmetrical about an axis of rotation, having a large drum-like portion approximately four inches in diameter and a shaft of one-half inch diameter extending from one end. The shaft is joined to the drum by a web at the front face of the drum. Machined surfaces on the turntable include the face of the drum and two places on the shaft which mate with the turntable bearing assembly. Three grooves, a deep groove and two shallow grooves of different widths are turned in the outer surface of the drum. The deep groove receives the V-type drive belt, and the wider shallow groove receives the stopping brake cord. The remaining groove receives the holdback servo brake cord. The cast web at the front face of the drum is drilled and tapped at three equally spaced points to receive mounting screws of the hub. The turntable is held in the bearing housing by means of a nut installed on a screw thread provided at the end of the shaft.

4-24. TURNTABLE BEARING ASSEMBLY. The turntable and hub rotate about the symmetrical axis on two ball bearings of the turntable bearing assembly. The assembly consists of the two bearings held in a flanged housing. The housing is secured onto a machined face on the transport frame, and the shaft of the turntable is passed into the bearings and secured in position with a locking nut. Such construction holds the axis of turntable rotation perpendicular to the transport reference plane within close limits. The bearing housing is provided with three mounting holes spaced equally about the flange. Internal surfaces of the housing are bored to receive the bearings at either end, and provided with two annular grooves within the bore. Locking rings installed in the grooves limit the depth to which the bearings are seated in the housing.

4-25. HUB GROUP. The hub group, mounted on the front face of the turntable holds the tape reel in correct alignment with the transport reference plane and at a fixed distance from the plane. The hub is generally symmetrical about its axis of rotation and consists of a dust-shield which covers the face of the turntable, a spacer which is next in order, then the reel hold-down knob on the front of the hub. Shims are inserted between the turntable and the dust-shield to adjust the distance of the reel above the reference plane. The parts of the group are sandwiched together and attached to the turntable face by three long screws extending from the hold-down knob into the face of the turntable. The spacer gives the hub the necessary depth required to accommodate the reel. In instruments using one-inch tape, the width of the reel covers the spacer and rests against a resilient pad on the dust cover. Construction of the spacer differs for instruments using one-half inch tape. In these instruments, the spacer is the same thickness, but is turned from round stock nearly the diameter of the dust shield, leaving a shoulder against which the narrower one-half inch tape reel rests. The shoulder is of such thickness that the centerline of the one-half inch tape coincides with the centerline of the one inch tape. This design, known as centerline -held-constant construction, allows the pinch roller to apply maximum pressure symmetrically about the center of the tape regardless of the width of tape used. Tape threading is also facilitated by this contruction.

4-26. The reel hold-down knob assembly, located on the front of the hub, is a manually operated locking device used to fasten the precision reel to the hub. The knob assembly shown in figure 9-11, has three hold-down keys equally spaced about, and extending slightly from the hub. As a reel is placed on the hub, three transverse slots in the reel cut-out loosely engage the three keys. A portion of each key is exposed at the front of the cut-out. The reel is locked firmly to the hub by rotation of a nylon cam in the knob assembly which forces the keys outward a short distance. As the keys move outward, a beveled surface on each key works against the mating slot, forcing the reel rearward against the resilient pad.

4-27. The reel hold-down knob assembly consists generally of a base, three keys, a nylon cam, a pivot-screw and a two part hinged handle. The keys rest in three radial slots in the base. Small springs located in recesses adjacent to the slots provide tension on the keys, tending to pull them inward. The keys are enclosed except for their outer ends, by the nylon cam which is placed over the front of the base and held in position by a pivot screw of large diameter. The pivot screw is threaded into a central hole in the center of the base and is adjusted to permit the nylon cam to turn. The underside of each key rests on a spiral-cut edge of the nylon cam. As the cam is rotated in relation to the base, its spiral-cut edges force the keys outward. Serrations on the edges of the cam and the natural resiliency of nylon provide a detent action which locks the keys and cam when the reel is tightened on the hub. The nylon cam is provided with two folding handles in the form of half-circles separated by a cover. The handles are hinged to the nylon cam along their inner edges by means of retaining pins. Springs operate in conjunction with the pins to hold the handles flat against the cam when they are not being used. When a reel is placed on the hub, the handles are hinged outward to provide a grip for twisting the cam. At this time, the hub is restrained by hand pressure on the reel.

4-28. TORQUE MOTORS. See figure 9-10. The torque motors each turn one tape reel at a 2:1 speed reduction through a drive belt. Motors are identical in construction and are each secured to the rear of the transport frame with their shafts extending through openings in the frame. Pulleys fitted to the exposed shafts are coupled to the turntables by means of rubber V-belts. Each motor is non-synchronous, and is provided with permanently lubricated ball bearings. Motors are designed specifically for their application, and operate on 117 volts ac in the fast modes of transport operation only. A somewhat lower voltage is applied to the motors in the drive mode. The motors require a capacitor for starting and running. The value of this capacitor differs for instruments supplied for operation on 60 cycles and those supplied for 50 cycle operation.

4-29. Torque motors are powered for rotation in one direction only, although they are frequently turned in the opposite direction. In the drive and record modes of instrument operation, the supply motor receives no power, while full power is applied to the take-up motor. In these modes, the hold-back servo system is active and provides tape tension as tape is pulled across the record/reproduce heads at a constant rate by action of the capstan. Torque provided by the take-up motor in this mode simply winds tape onto the take-up reel as it passes from the capstan. In the fast modes, the holdback servo system is inactive, the pinch roller is disengaged, and the tape lifter fingers are extended, providing a clear path for tape travel between reels. In the forward mode, full power is applied to the take -up torque motor, to transport tape from the supply reel to the take-up reel at high speed. Tape tension in this mode is provided by the supply torque motor operating on reduced voltage. This motor is powered to turn in a clockwise direction as viewed from the front of the instrument, thus opposing, but not overcoming the torque produced by the tape being drawn from the supply reel by the take-up torque motor. In the rewind mode, the roles are reversed, full power is applied to the supply reel and reduced power is applied to the take-up reel.

4-30. THE STOPPING BRAKE ASSEMBLY. See figures 4-1 and 4-6.

4-31. GENERAL. Two stopping brakes operate in conjunction with the turntables of the reel drive assembly to stop the rotation of the reels. Both brakes are applied when the stop mode is selected while the instrument is operating in one of the other modes. Brakes are also applied when low tape tension activates the end-of-tape switch or when power is turned off to the instrument. Braking is accomplished in the FR-1300 by a patented differential braking system. This system insures desired ratio between leading and trailing reel brake torques regardless of the direction of tape travel, thus maintaining tension on the tape at all times. Brakes are controlled by a brake solenoid which releases the brakes when it is energized and applies them when it is de-energized.

4-32. CONSTRUCTION. The stopping brake assembly consists generally of a solenoid and a bellcrank, two brake rods and stopping brakes at each turntable. The brake solenoid is located on the upper right side of the transport frame next to the supply hub. Motion of the solenoid plunger as it is energized and de-energized rocks the bellcrank about its pivot, transferring longitudinal motion through the brake rods to the brakes. Brakes are similar in construction and operation, therefore, the supply reel brake is described first then differences between the two brakes are discussed.

4-33. The supply reel stopping brake consists principally of a brake cord, the turntable, a brake anchor assembly, and a brake arm assembly. The brake cord (figure 4-6) is composed of many fine strands of wire running the length of the cord, covered by a fabric sleeve. Flat metal connectors are provided at each end of the cord. The anchor connector, a roughly rectangular form, is attached to the brake cord at one end and provided with a square hole near its other end. At the point of attachement to the cord, the connector is enlarged, giving it an overall T-shape. The brake arm connector at the other end of the cord is a rectangular metal form, rounded at its free end and provided with a round hole near the end.

4-34. The brake cord is fastened to the lower end of the brake arm by the brake arm connector, and is wrapped in a clockwise direction through one and one-quarter turns about the turntable then fastened to the anchor assembly using the anchor connector. The cord rests in the wide groove of the turntable. Tension is applied to the brake from both ends. The brake cord anchor assembly consists of an L-shaped anchor bracket, a high torque brake spring and a spring retainer. The anchor bracket is an L-shaped metal form having mounting slots on its long side and a narrow slit through the upturned end. The bracket is mounted on the transport frame near the turntable. The anchor connector at the end of the brake cord is passed part-way through the slit, coming to rest on the enlarged portion which will not pass through the slit. The high torque brake spring is placed over the end of the connector which passes through the slit. The spring retainer is then passed transversely through the square hole in the connector, thus confining the spring to the space between the bracket and the end of the connector yet allowing the anchor connector limited movement against spring tension. The brake arm assembly consists generally of an arm, a pivot pin, a stop pin, a low torque brake spring and a connector pin. The arm, a sheet metal stamping having a U-shaped cross section, is pivoted near one end to the transport frame and is limited in its movement about the pin by a stop-pin projecting from the frame. The low torque brake spring is of lighter construction than the high torque brake spring and is fastened at one end to an anchor pin in the transport frame and at its other end to a projecting portion of the brake arm. Spring tension is applied through the arm to the brake cord fastened to the other end of the arm. The brake cord connector is held to the brake arm by means of a connector pin. The brake rod is attached to the brake arm at a point midway between the connector pin and the pivot pin. In this position, motion of the rod when the solenoid is energized is transmitted to the brake arm and opposes the tension of the low torque brake spring.

4-35. OPERATION. The brake is applied when the brake cord is tightened about the turntable, and released when the cord is loosened. The brake is released during normal operation of the instrument in modes other than the stop mode. At these times, the solenoid is energized and its plunger is bottomed. Plunger movement in the direction A noted in figure 4-6 is transferred through the bellcrank, causing the brake rod to move in the direction C . Such movement is transferred through an upset end on the brake rod to the brake arm causing the arm to move in direction E . Arm movement in this direction overcomes the tension of the low torque brake spring, and at the same time transmits the motion through the brake cord. Initial cord movement is taken up by the high torque brake spring which pulls the anchor connector through the slit in the anchor bracket. When the shoulder limits the spring expansion, further movement of the brake arm then slackens the brake cord. The action of the stopping brake assembly in stopping reel rotation differs with direction of reel rotation. The supply reel is braked more sharply when it is rotating clockwise. The opposite condition exists at the take-up reel, thus providing a means of maintaining tape tension regardless of the direction of tape motion when the brakes are applied. Stopping brake action for both directions of rotation of the supply reel is described in the following paragraphs.

4-36. When the instrument is operated in modes in which tape travels from the supply reel, to the take-up reel, the supply reel rotates in a counterclockwise direction F in figure 4-6. Rotation of the reel is not hindered by the slackened brake cord resting in the turntable groove. If the stop mode now is selected, power is turned off to the torque motors and the brakes are applied, bringing the reels to rest. When the stop mode is selected, power is removed from the brake solenoid, allowing the plunger to move in direction B . As a result, the brake rod moves in direction D , allowing the low torque brake spring to apply tension through the brake arm to the brake cord. Such tension tightens the cord about the rotating turntable. Friction between the turntable and the cord carries the cord in direction F , and the slack is taken up by movement of the brake arm in the same direction. The high torque brake spring, however, resists such movement of the brake cord. The resistance increases as the high torque brake spring is compressed due to slight movement of the brake cord, until the brake arm reaches the stop pin, limiting the braking force. Braking so applied causes the supply reel to decelerate rapidly and come to rest. Through the tape joining the reels, the less sharply braked leading reel is also slowed.

4-37. In the rewind mode, the supply reel is the leading reel and rotates in the clockwise direction. Maximum braking force in this case is applied to the take-up reel, both reels are slowed. The supply reel is braked while rotating in the clockwise direction by tension of the low torque brake spring acting on the brake cord through the brake arm. The low torque brake spring is limited in its braking effect both by its tension characteristics and by the mechanical arrangement. As the brake solenoid is de-energized, the brake rod moves in direction D (figure 4-6) and the brake arm moves about its pivot in direction F due to tension of the low tension brake spring. This action tightens the brake cord about the turntable, producing a certain frictional force between cord and turntable. This force, transferred through the brake arm, opposes the spring tension. If spring tension is overcome momentarily, the arm moves slightly in direction E , loosening the cord and reducing the friction. This balance between spring tension and the force of friction on the cord produces the braking effect. This effect is complemented by the braking force on the trailing reel transferred through the tape to the leading reel.

4-38. The take-up brake differs from the supply brake only in the arrangement of components and the direction of reel rotation for which maximum braking force is produced. The take-up brake cord is attached to an anchor bracket adjacent to the turntable, and is wrapped about the turntable in a clockwise direction as seen from the front of the transport.

The connector at the cord end is fastened to the brake arm as in the supply brake. To maintain the correct relationship for this union, the brake arm is turned over on its pivot pin (as compared with the supply brake arm). The low torque brake spring is secured about an anchor pin at one end and its other end is attached to the arm between the cord connector pin and the pivot. The brake rod extends through a hole at the extreme end of the arm extension where it is provided with an upset end which acts on the arm. Thus by comparison with the supply brake arm, the points of attachment of the spring and brake rod to the arm have been interchanged. The brake is applied by longitudinal motion of the brake rod toward the brake arm, and released by movement in the opposite direction when the brake solenoid is energized. When brakes are applied, the braking force is provided by the high torque brake spring if the reel is rotating in the clockwise direction, and by the low torque brake spring if reel rotation is counterclockwise. The mechanism of braking action in each case is the same as described for the supply brake. The supply brake and the take-up brake are applied and released simultaneously by action of the brake solenoid. When the brakes are applied while the instrument is operating in the drive, record, forward, or search mode, the high torque brake spring rapidly brakes the supply reel. Lesser braking force is applied to the take-up reel by the low torque brake spring. When brakes are applied while the instrument is in the rewind mode, the high torque brake spring of the take-up reel provides the major braking force and the low torque brake spring applies lesser force to the supply reel.

4-39. THE HOLDBACK SERVO SYSTEM. See figures 4-7, 4-8, and 9-13 through 9-15.

4-40. INTRODUCTION. The holdback servo system is a high-gain mechanical servo which regulates the tension of tape passing over the record/reproduce heads. This system is active when the instrument is operated in either the drive or the record mode. In simplest form, the servo system consists of a tape-tension sensor, a tension reference, and a variable brake on the supply turntable. The desired tape tension is set by the tension reference. As tape tension decreases below the reference level, the sensor transfers a mechanical analog of this condition to the brake, thereby increasing the braking effect, and returning tape tension to the desired value. A condition of high tape tension is corrected by decreasing the braking effect. Such a system is shown in figure 4-7. In this figure, the brake arm is the sensor, and is free to move about a pivot at its upper end except for a spring reference. Tape is threaded from the reel on the drum, over the upper fixed post, around the arm post and over the lower fixed post. Tape moves from the supply reel, around the posts and over the heads. Thus tension on the tape is opposed by tension of the spring reference. A brake cord is attached to the upper end of the brake arm above the pivot. The cord passes over the drum in a clockwise direction and is fastened to a fixed anchor. In operation, the arm remains at position A as long as the tape tension equals the reference tension. If the reference tension is overcome by increased tape tension, the arm moves in direction B , loosening the brake cord, thereby reducing tape tension. As tape tension is reduced, the arm returns to position A . A condition of low tape tension causes the arm to swing in direction C , tightening the brake cord, thus increasing the tape tension.

4-41. SYSTEM DESCRIPTION. See figures 4-8 and 9-13. The holdback servo system contains the three elements of the simplified system described in the introduction. In addition, it includes provisions for facilitating tape threading, and for activating and inactivating the system. Tape tension is controlled by means of a brake cord wrapped around the turntable. The cord rests in the narrow groove adjacent to the stopping brake cord. The cord used in the holdback servo system is similar in construction to the stopping brake cords except that it is shorter. Ends of the cord terminate in identical flat metal connectors each having a rectangular shape and provided with a hole near the free end. The cord is attached at one end to a projecting pin on an adjustable brake anchor, and passes from the anchor counterclockwise about the turntable. The connector at the other end of the cord is fastened to one end of a brake link, a flat metal strip provided with two longitudinal slots. The link rides on two pins, a limit pin, and pin B , which protrude through the slots, loosely holding the link to the transport while allowing it limited longitudinal movement about the pins. Movement of the link, transferred to the brake cord, tightens or loosens the cord about the turntable, thereby controlling the degree of braking.

4-42. Tension is applied to the brake through pin B , acting against the left end of the brake link slot as shown in figure 9-14. The pin is set into one end of a rocker arm pivoted at its center to the transport frame. The opposite, or upper end of the rocker arm is attached through a prestressed tape tension spring to the plunger of the holdback servo solenoid. When the servo system is activated, as shown in the figure, the plunger is drawn into the solenoid. This motion transferred through the spring and rocker arm brings pin B against the end of the brake link slot. Movement of the brake link removes slack from the brake cord. As the cord tightens, it opposes the movement of the solenoid plunger, causing the tape tension spring to stretch slightly as the plunger reaches the limit of its travel (bottom).

4-43. The force exerted by the tape tension spring is opposed by a mechanical analog of tape tension sampled by the holdback servo arm acting through an arm link. The holdback servo arm is pivoted to the transport frame near its upper end and provided with a rotating guide at its lower end. A pin designated A in figure 9-14 projects from the front of the arm above the pivot. Pin A rides in an elongated longitudinal slot in the arm link. The opposite end of the arm link is provided with a hole through which pin B of the rocker arm protrudes. At the lower end of the servo arm, the tape is routed over the fixed input guide, around the servo arm guide then across the filtering idler pulley. This configuration places the servo arm guide in a tape loop between two stationary points. As in the simplified example, the tension of the tape is sensed by the arm.

4-44. When the system is active, and tape passing from the supply reel is at correct tension, the tension of the tape, transferred through the servo arm and pin A, partially counteracts the force of the tape tension spring, thus reducing the braking effect to a value less than maximum. A decrease in tape tension is then reflected in application of a greater braking force by the tape tension spring, resulting in a tightening of the tape. If tape tension increases above the correct value, the force of the tape tension spring is counteracted to provide a lower force on the brake cord, thus lowering tape tension to the correct value.

4-45. The holdback servo system is inactivated when the instrument is operated in the fast modes, or in the stop mode. When a fast mode, either forward or rewind, is selected, power is removed from the holdback servo solenoid, relieving force on the brake cord. A light-tension return spring fastened to the upper end of the rocker arm, then pulls the top of the arm to the left. This action, transferred through the tape tension spring, withdraws the plunger from the solenoid. At the lower end of the arm, the movement brings pin A against the right end of the slot in the brake link, pressing the link to the right against the limit pin. The arm link is carried to the right along with pin A . The existing tape tension which is opposed only by the weight of the servo arm and a light-tension servo arm spring moves the arm to the left where it rides lightly on the tape. When the end of the tape is reached, the arm is moved to the right by the spring and operates the end-of-tape switch.

4-46. Tape is threaded on the instrument when the instrument is in the stop mode or without power. At these times, the holdback servo system is inactive, and the servo arm rests against the stop pin and holds the end-of-tape switch in the off condition. When the full reel has been placed on the supply reel, the tape threading lever is raised and locks in the raised position. This action cams the holdback servo arm in a clockwise arc and locks it in a position to the left of the threading slot formed by the junction of the control cover and the head cover. This action facilitates tape threading. When a mode other than stop is selected, the servo arm is released and swings onto the tape. If the drive or the record mode is selected, the holdback servo system is simultaneously energized and the arm is forced into operating position as pin B moves to the left.

4-47. The limit pin assembly consists of a limit pin set into the lower end of a rectangular block. The block is fastened to the transport frame by a cap screw. The limit pin guides the brake link and limits its travel in a longitudinal direction. When the holdback servo system is inactivated, the return spring acting through pin B , forces the brake link to the right, loosening the servo brake cord. The limit pin stops the movement of the link, thus preventing the brake cord from becoming unduly loose. When the link moves to its extreme left position, the stopping action of the pin acts through the brake cord and brake anchor assembly to limit the maximum braking force applied by the system.

4-48. The adjustable brake anchor assembly consists of a rectangular metal block identical to the block used in the limit pin assembly, a clevis pin, a relief spring and an adjustment disc. The block is held to the transport, yet allowed limited turning movement, by a pivot-pin projecting from the transport frame through the block. The pivot pin passes through the block to one side of center. The servo brake cord is attached to the end of the shorter portion of the block. On the other side of the pivot, a relief spring is attached to the block by means of a clevis pin. Tension of the spring holds the block against an adjustment disc located on the frame below the spring. Under conditions of normal operation of the holdback servo system, the assembly acts as a relief only when the system is subject to sharp braking action as might occur when the end of the tape is reached in the drive mode. At this time, maximum braking is provided for an instant from the time tape tension drops to zero until the arm strikes the end-of-tape switch. During this instant, increased friction of the cord on the turntable counteracts the tension of the relief spring of the anchor assembly, and the block pivots, lifting off the adjustment disc and allowing the cord to be carried a short distance around the turntable. As the block pivots, relief spring tension increases until, at the other end of the cord, the slot in the brake link comes against the limit pin. This action eliminates the application of further braking force.

4-49. THE PINCH ROLLER ASSEMBLY. See figures 9-17 through 9-19.

4-50. The pinch roller assembly is a clamping device which, when engaged, presses the tape against the rotating capstan, thereby causing capstan motion to be imparted to the tape. The assembly consists in general of a solenoid, an actuator arm, a connecting link, a bellcrank and a pinch roller. When the solenoid is energized, solenoid plunger motion is transferred through a spade bolt on the plunger to one end of the actuator arm. The arm, pivoted near its center, transfers the motion through a link at its opposite end. Motion of the link rocks the bellcrank and pinch roller on a pivot, forcing the tape threaded between roller and capstan into contact with the capstan. When the solenoid is de-energized, a return spring attached to the actuator arm lifts the pinch roller and withdraws the plunger from the solenoid. When the pinch roller is engaged, the plunger is bottomed in the solenoid. Pressure of the pinch roller on the tape is then controlled by the pressure of a compression spring located at the junction of the spade bolt and the actuator arm. This spring is held in partial compression at times when the roller is not engaged, thus limiting the distance through which it must be compressed by action of the solenoid plunger when the roller is engaged.

4-51. THE CAPSTAN MOTOR. See figures 4-2 and 4-9.

4-52. DESCRIPTION. The capstan motor, a part of the drive servo system, provides the means whereby tape is moved at a constant rate over the record/reproduce heads at one of six selected tape speeds. Tape is moved by the motor when the instrument is operated in the drive or the record mode. The front shaft of the motor is the capstan. A flywheel fitted to the shaft at the rear of the motor is a part of the tachometer assembly. The motor is mounted to the rear of the transport frame, and the capstan extends from the front of the transport through an opening in the frame casting. The axis of capstan rotation is perpendicular to the transport reference plane. The capstan motor consists of an ac motor and a dc brake contained within the motor housing. The motor is designed for operation on 50 or 60 cycle ac current at a maximum voltage of 105 V ac. The motor shaft and rotor are supported on ultra-precision ball bearings to provide the best possible shaft alignment. The capstan is precision-ground and sandblasted after the motor is assembled.

4-53. **OPERATION.** The flywheel on the rear shaft of the motor damps longitudinal vibrations in the tape as the tape passes over the capstan, and provides a means of monitoring capstan speed. The front edge of the flywheel is reduced in thickness to form a skirt. A total of 192 windows or slots evenly spaced around the skirt form a part of the tachometer assembly. The tachometer assembly monitors the speed of capstan rotation, and enables the servo amplifier to maintain this speed by controlling the voltages applied to the motor and the brake.

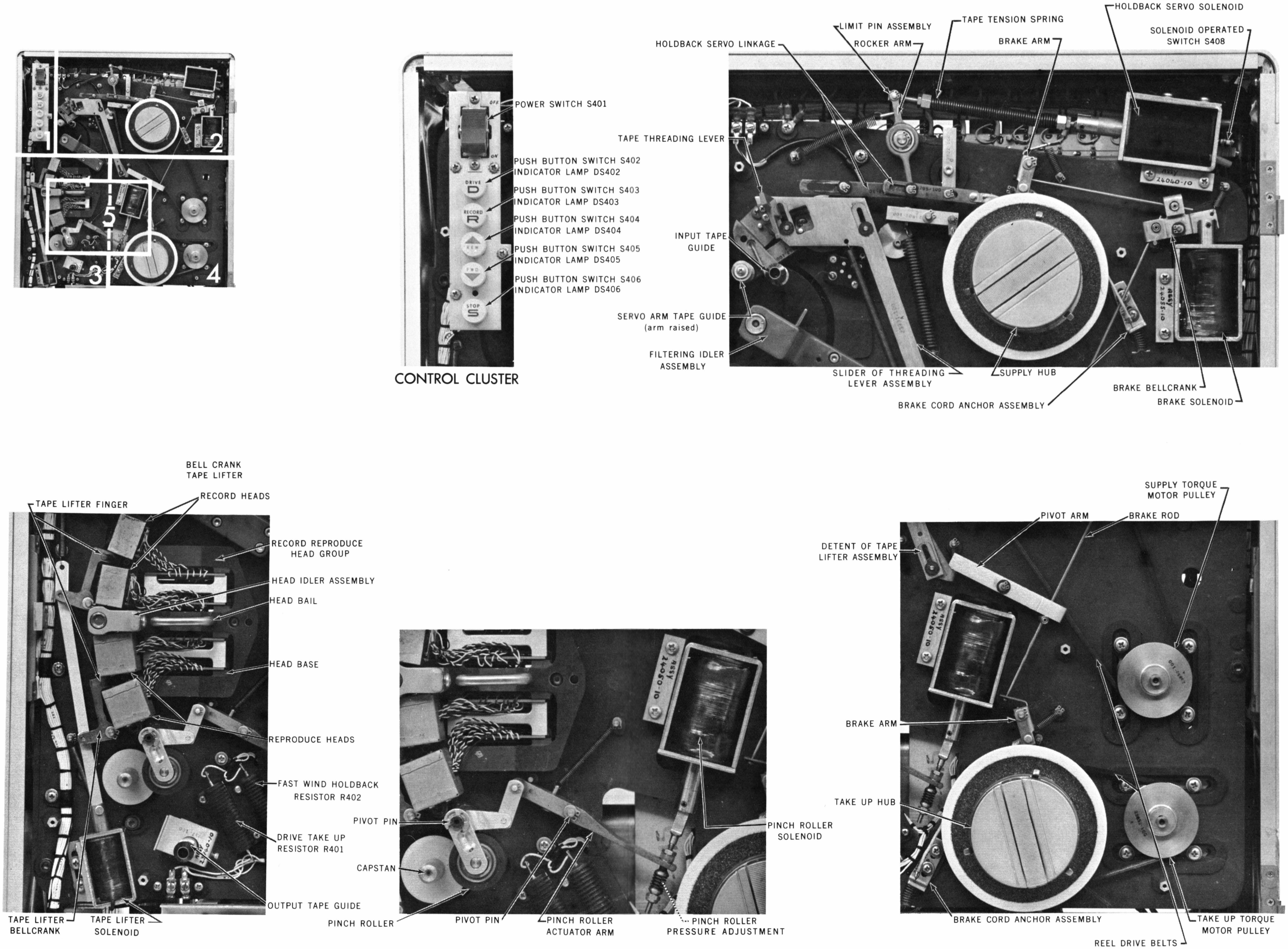


Figure 4-1. FRONT VIEW OF TRANSPORT SHOWING MECHANICAL ASSEMBLIES

8346-19

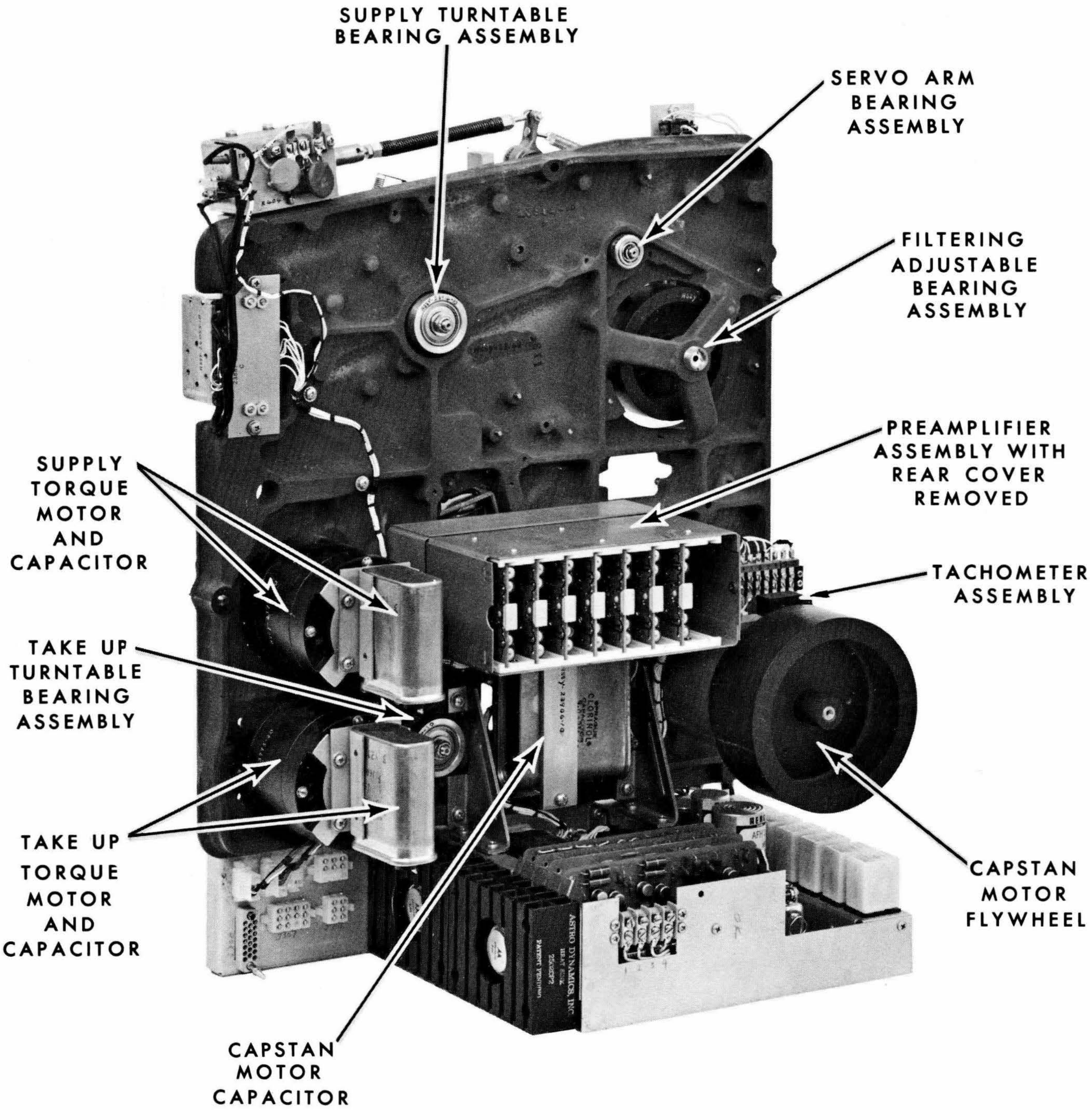
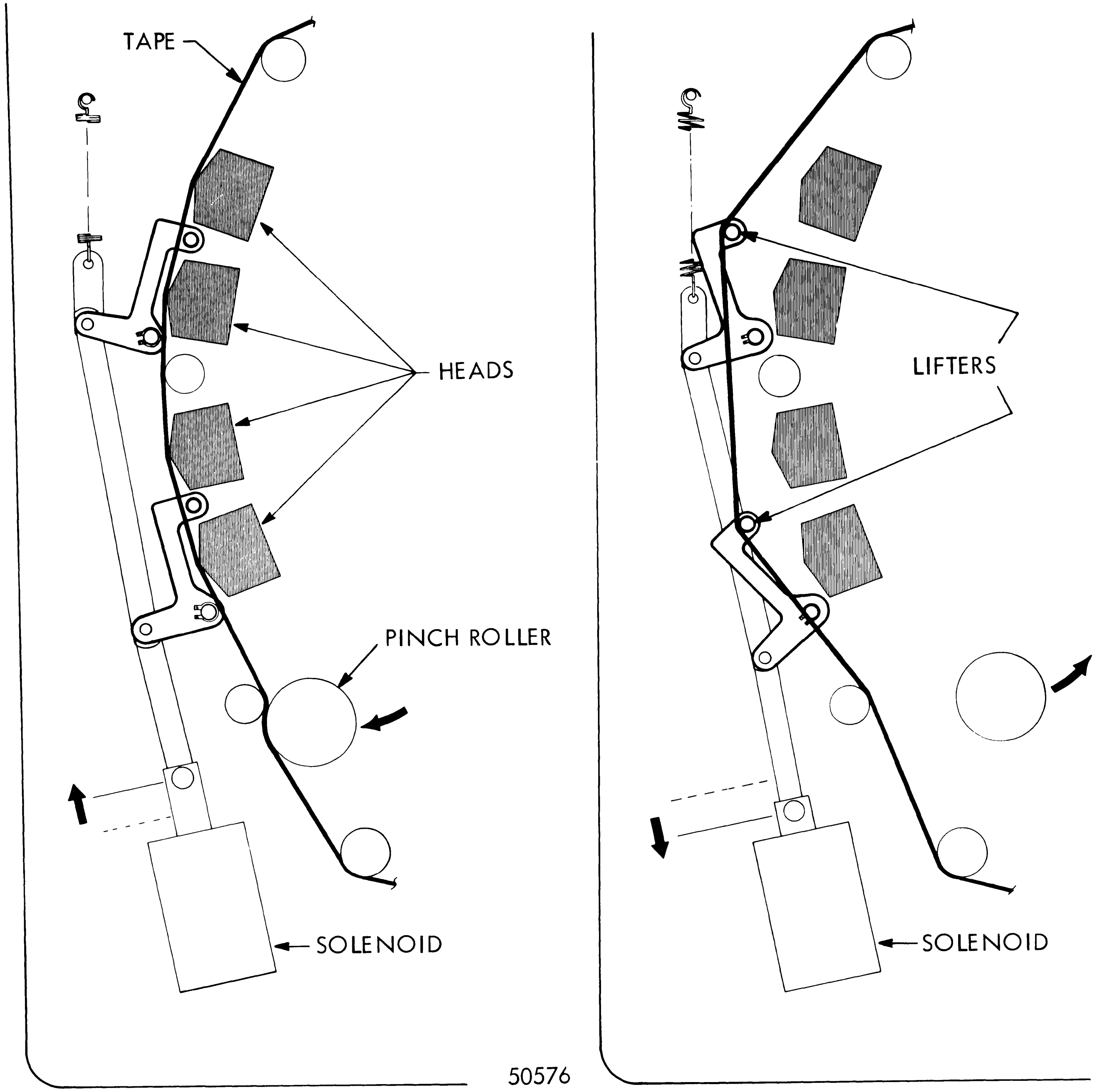


Figure 4-2. REAR VIEW OF TRANSPORT SHOWING MECHANICAL ASSEMBLIES



A. SOLENOID DEENERGIZED, TAPE IN CONTACT WITH HEADS

B. SOLENOID ENERGIZED, TAPE LIFTED FROM HEADS

Figure 4-3. TAPE LIFTER ASSEMBLY ACTION

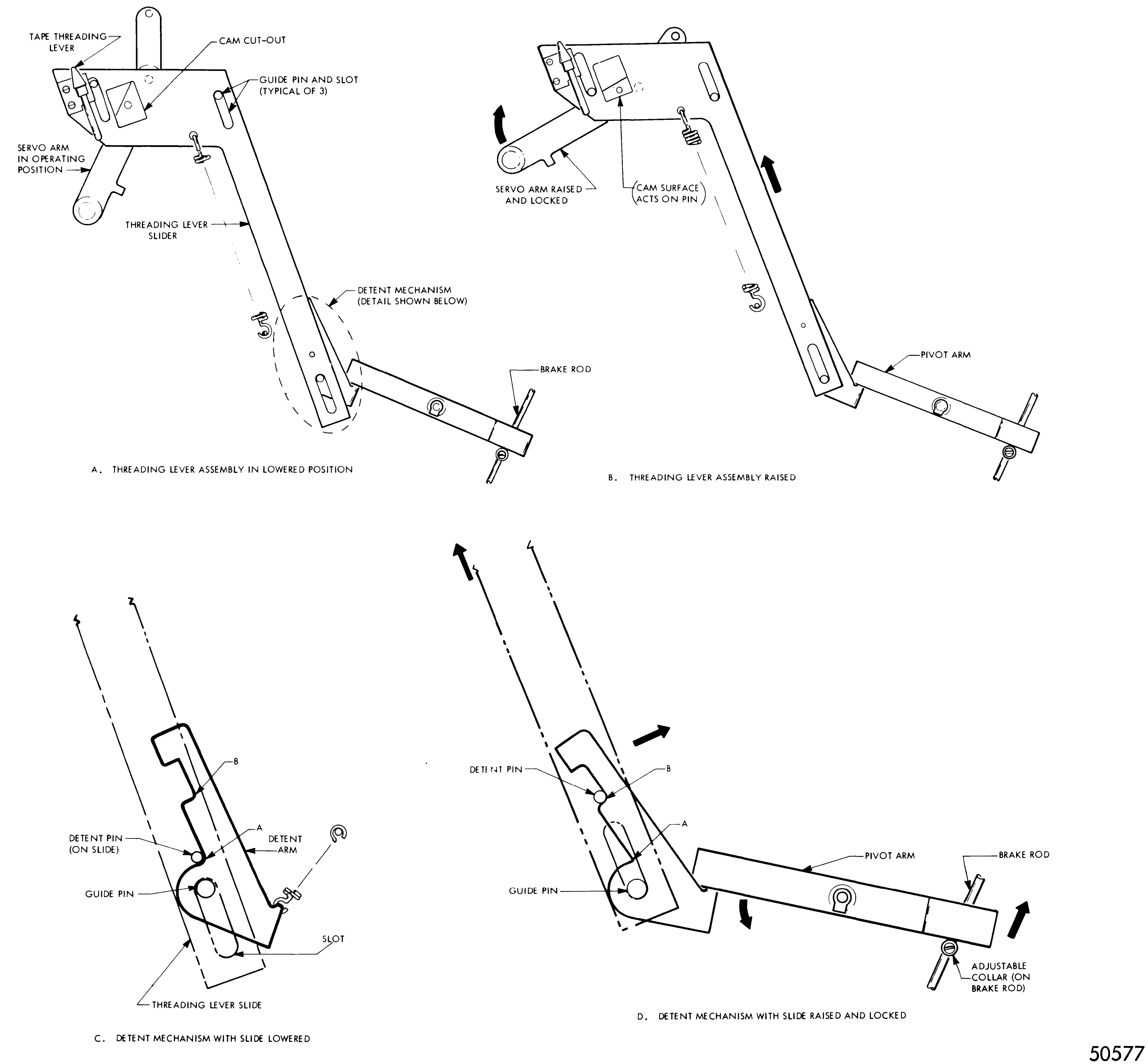


Figure 4-4. THREADING LEVER ASSEMBLY ACTION

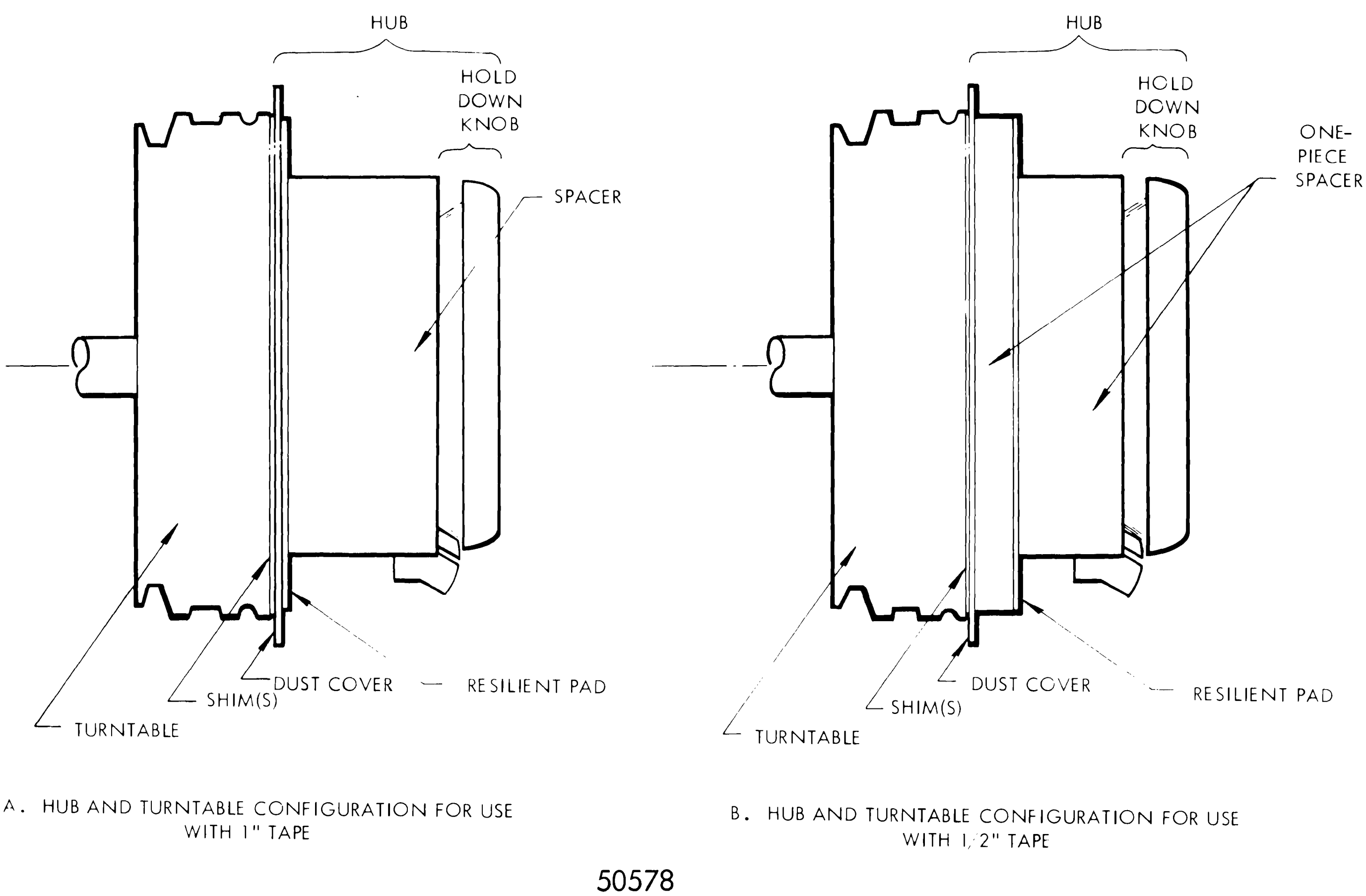
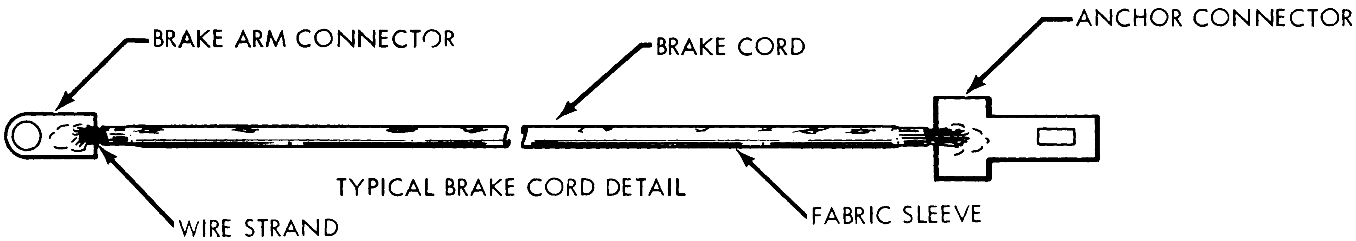
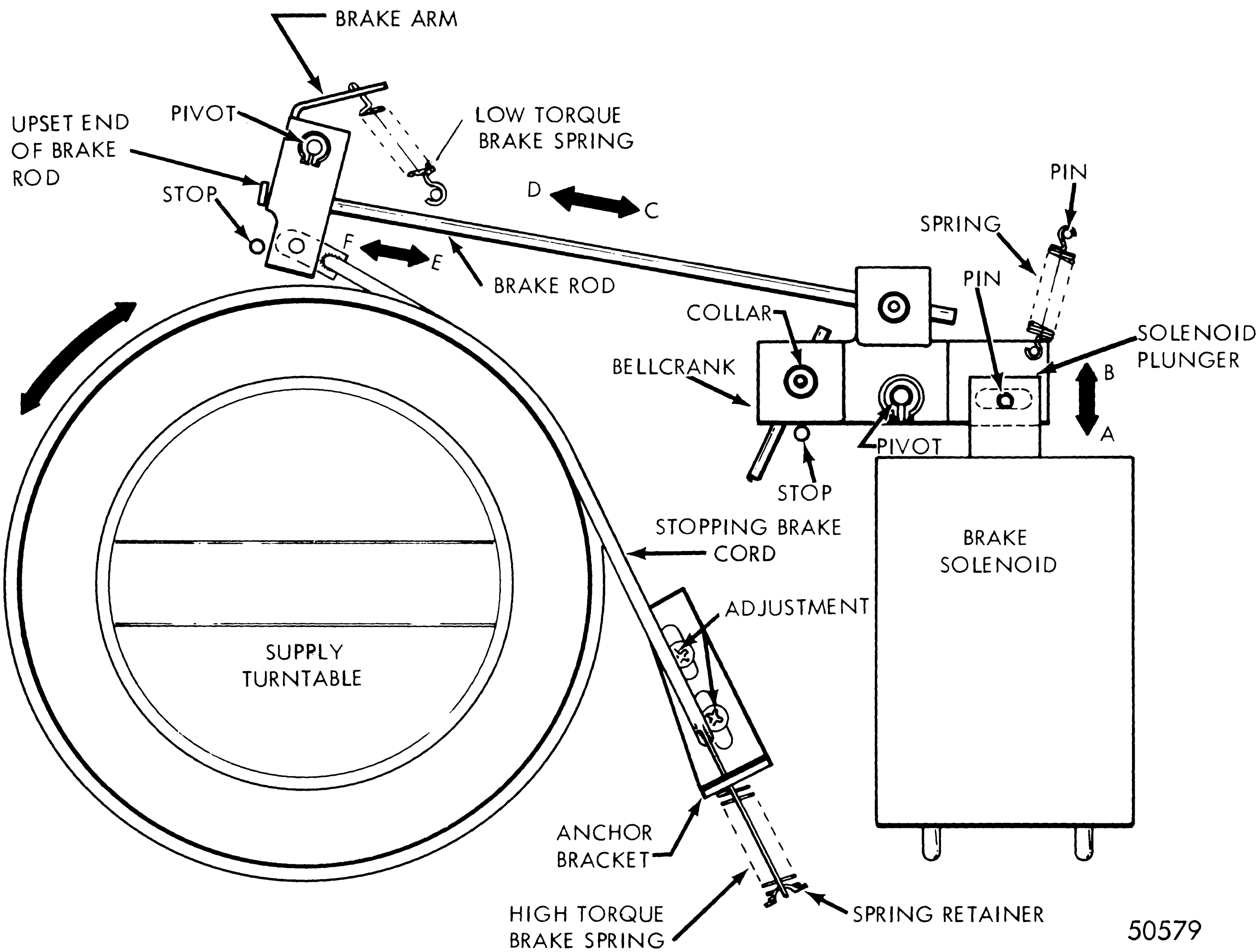


Figure 4-5. THE HUB GROUP AND TURNTABLE



STOPPING BRAKE ASSEMBLY



NOTE: SUPPLY BRAKE ONLY IS DEPICTED
TAKEUP BRAKE IS SIMILAR IN CONSTRUCTION AND OPERATION

Figure 4-6. STOPPING BRAKE ACTION

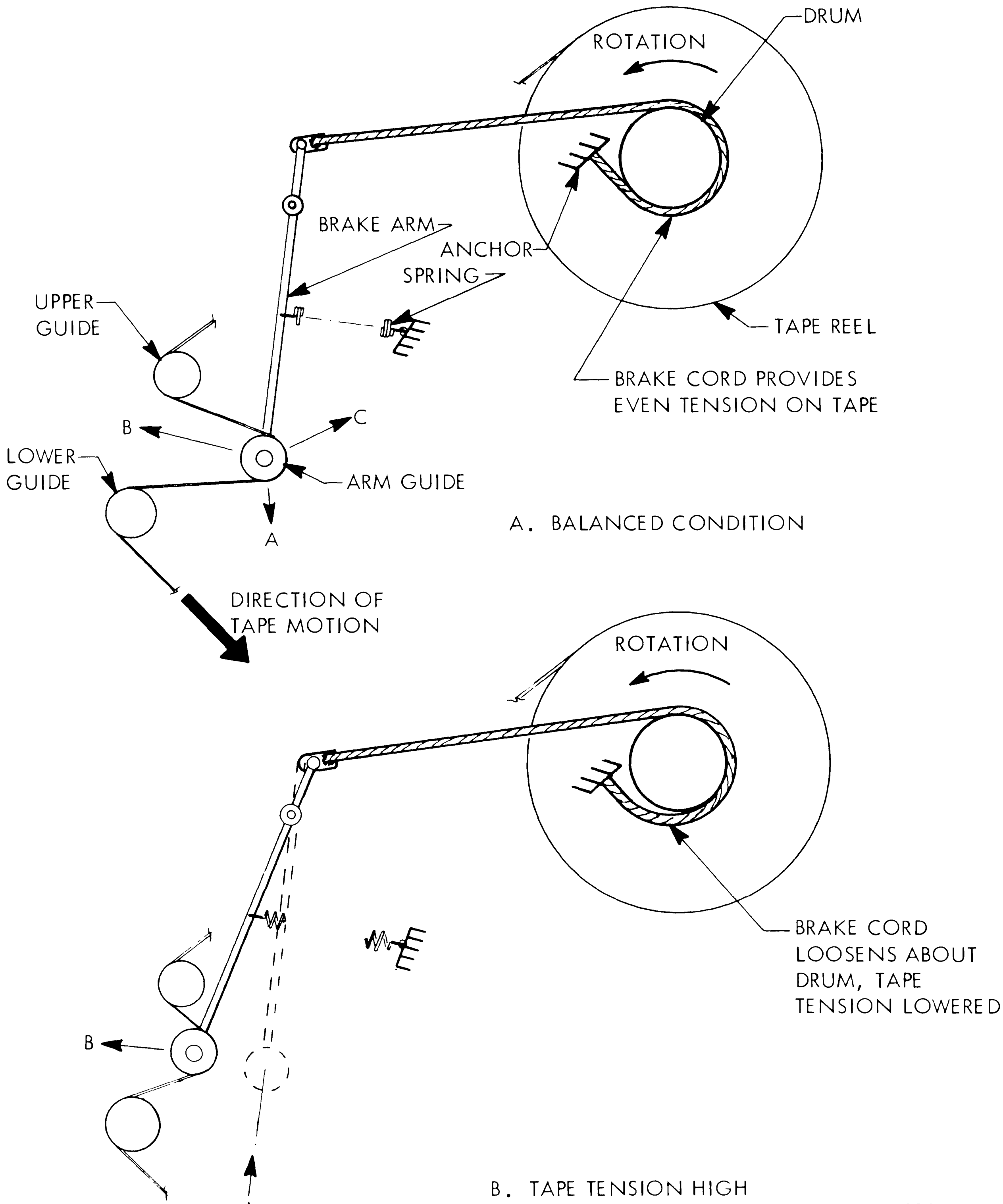


Figure 4-7. SIMPLIFIED TAPE TENSIONING SYSTEM

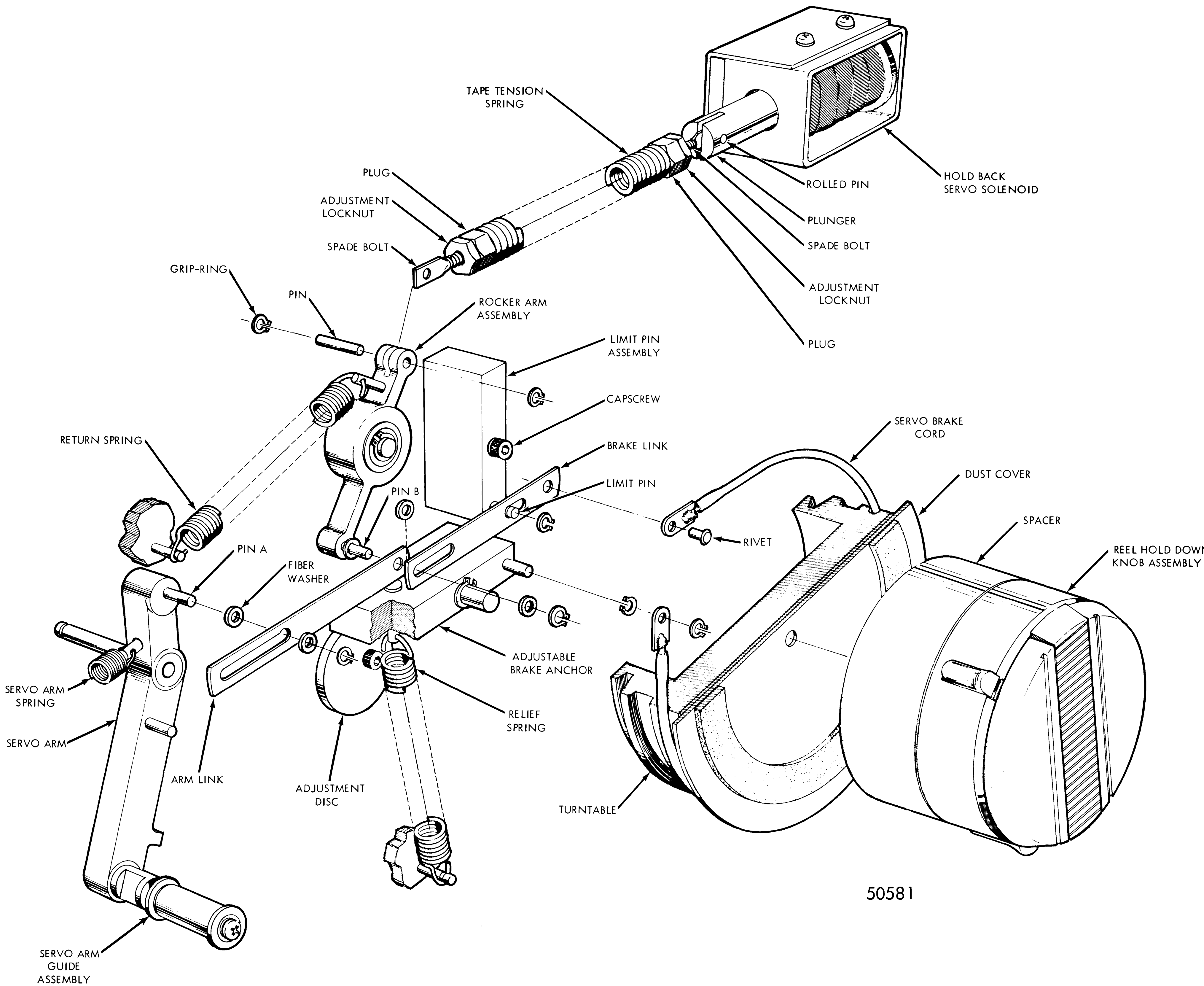


Figure 4-8. THE HOLDBACK SERVO SYSTEM

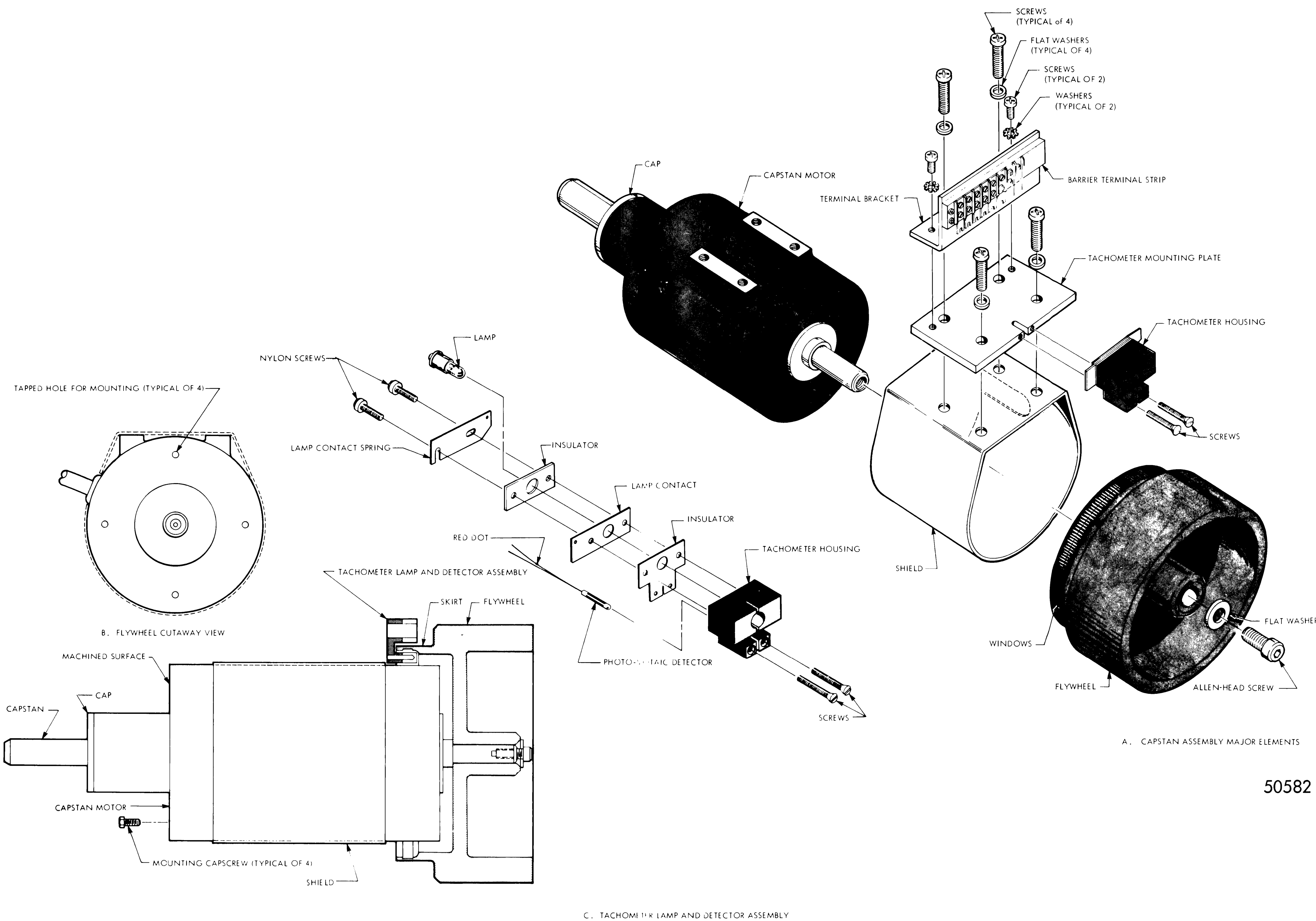


Figure 4-9. CAPSTAN MOTOR ASSEMBLY DETAILS

CHAPTER 5

THE TRANSPORT ELECTRICAL CONTROL SYSTEM

5-1. The tape transport electrical control system is a related group of electrically operated components which together set the mode of instrument operation in accordance with the selection made by the operator. Mode selection is made through five pushbuttons at the control cluster, or on the remote control unit. The remote control unit, an optional means of controlling the instrument, is discussed following the circuit description of the transport electrical control system.

5-2. INTRODUCTION TO THE TRANSPORT ELECTRICAL CONTROL SYSTEM.

5-3. IDENTIFICATION OF COMPONENTS. See figures 5-1 and 5-2.

5-4. The transport electrical system consists principally of the control cluster pushbutton switches and lamps, seven relays, a transformer, a rectifier and resistor card, a capacitor, the torque motors, and four actuating solenoids of the transport mechanical systems. The relays, transformer, capacitor, and the resistor and diode card are grouped together on the control chassis. A small group of components is located on terminal board TB405 located on the side of the holdback servo solenoid L404. These components work in conjuntion with switch S408 which is operated by the solenoid plunger. Two resistors which limit current to the torque motors are located together on the front of the transport frame near the output tape guide. The pushbutton switches, each electrically identical, are single -pole, double-throw, two-circuit, momentary-contact type. The pushbutton of each switch encloses a small lamp which, when energized, illuminates the button.

5-5. FUNCTIONAL DESCRIPTION. See figure 5-3.

5-6. GENERAL. Power for the control system is 117 volts at a frequency of 50 or 60 cycles per second. The frequency is fixed for a given configuration of instrument principally by the value of the torque motor capacitors. The supply power to the control system is switched on and off by the power switch S401 which also controls power to the other instrument systems. The torque motors operate generally on full supply voltage. This voltage is dropped for relays by series resistors associated with easy relay. Relays and solenoids are operated on direct current at approximately 150 volts. This voltage is provided by a transformer T301 and a bridge rectifier circuit located on the rectifier and resistor card (card 24027), figure 5-1 . The transformer further provides 12. 6 volts ac used in the pushbutton lighting circuit, and power for the drive servo system. Relays of the control system, numbered K301 through K307, are plastic-encased plug-in units, replaceable from the top of the control chassis. Relays are named for their characteristic funtion. Each relay is of the four-pole double-throw configuration. The poles and contacts of each relay are numbered for identification. Pole 9 rests on contact 1 when the relay solenoid is de-energized, and moves into contact with contact 5 when the solenoid is energized. Similarly, pole 10 rests on contact 2 and moves to contact 6; pole 11 rests on contact 3 and moves to contact 7; and pole 12 rests on contact 4 and moves to contact 5. In the simplified schematic, only those poles and associated contacts used in the circuit are shown. All relays in the schematic are shown in the de-energized condition. Modes of instrument operation are set by circuitry controlled from one of the five pushbutton switches: S402 (DRIVE), S403 (RECORD), S404 (REWIND), S405(FORWARD), or S406 (STOP). In the functional description which follows, each mode is considered separately, and circuits which support the mode are traced on the simplified schematic diagram. The conditions of major control elements are listed for each mode in table 5-1.

5-7. THE STOP MODE. The recorder/reproducer operates in the stop mode when power is first applied to the instrument and at other times when the STOP pushbutton is momentarily depressed. In the stop mode, the capstan motor is rotating at selected speed, the pinch roller is disengaged, the holdback servo system is inactive, the brakes are applied, no power is applied to the torque motors, and the tape lifter fingers are extended. This mode is indicated by illumination of lamp DS406 located behind the STOP pushbutton. No other mode can be entered until tape is threaded on the instrument, thereby lifting the servo arm from the end-of-tape switch S407. When tape is threaded and power switch S401 is turned on, 12. 6 volt power from transformer T301 passes through normally-closed contacts 12 and 4 of K303, 12 and 4 of K304, and 12 and 4 of K305 to stop lamp DS406. The circuit completed to ground at the lamp, causes the lamp to light. With the end-of-tape switch (S407) closed, direct current is applied through the switch to contact 10 of K303, contacts 11 and 12 of K306 and to the normally-open contacts of pushbutton switches S404 and S405. Current from contact 11 of K306 is available through contact C3 of K306 to one normally -open contact of pushbutton S402. The tape lifter solenoid and relay K307 are energized by rectifier current flowing through closed contacts 1 and 3 of holdback servo solenoid switch S408. Current flows directly from S408 to the solenoid of relay K307, and to the tape lifter solenoid L401 by way of the normally-closed contacts of pushbutton switch S402. An alternate path exists through the normally closed contacts of pushbutton switches S405 and S404.

5-8. THE DRIVE MODE. The drive mode may be entered from any of the other modes by depressing the DRIVE pushbutton. When the drive mode is entered from the stop mode, full supply voltage is momentarily applied to the take-up torque motor, and at the same time, the brakes are released, the holdback servo system is activated, the tape lifters are retracted, and the pinch roller is engaged. The initial acceleration of the take-up reel is provided by the take-up torque motor operating on an over-voltage. This voltage is lowered as soon as reel rotation at the correct speed is established.

5-9. When the drive pushbutton is pressed, the button illuminates (DS402), and drive relay K303 is initially energized by current from relay K306 contacts 11 and 3 which is routed through pushbutton contacts to K303 solenoid. Relay K303 is locked in the energized condition by current from K306 contacts 12 and 4 which passes through the now-closed contacts 11 and 7 of relay K303 to K303 solenoid. The torque motors are connected in common to one side of the power source. When drive relay K303 is energized, current from the other side of the power source flows through K303 contacts 9 and 5 and the closed contacts 12 and 8 of surge delay relay K307 to the take-up torque motor. The full supply voltage applied to the take-up torque motor is reduced through drive take-up resistor R401 when relay K307 de-energizes. Relay K307 is provided with a large capacitor (C301 B) across its solenoid. This capacitor is charged when the solenoid is energized in the stop mode. When the drive mode is selected, contacts 1 and 3 of the holdback servo solenoid switch S408 open, removing power from the surge delay relay solenoid K307, and the tape lifter solenoid. The capacitor, however, discharges through the windings of K307 solenoid, holding the relay contacts 12 and 8 closed for a fixed period of time after the drive mode has been selected. When drive relay K303 is energized, the power which locks it in the energized condition is also transferred from K303 contact 7, through drive delay relay K302 contacts to the pinch roller solenoid and to the holdback servo solenoid. Full power is initially applied to the holdback servo solenoid through S408 contacts 2 and 4, thus accelerating movement of the solenoid plunger. Bottoming of the plunger opens the contacts, placing a resistor R404 in series with the solenoid, thus lowering the voltage applied to the solenoid. Resistor R403 and capacitor C401 in series across resistor R404 suppress arcing at S408 contacts 2 and 4 when the contacts open. The brake solenoid is energized and the brakes thereby released when drive relay K303 contacts 10 and 6 close. Current flows from contact 6 through normally-closed contacts 2 and 10 of K302 to the brake solenoid.

5-10. THE RECORD MODE. The record mode of operation is a variation of the drive mode in which the record function is enabled. The record mode can be entered only from the drive mode, by pressing the **RECORD** pushbutton S403. When the instrument is operating in other modes, the pushbutton is not effective. When the record mode is selected, both the **RECORD** and **DRIVE** pushbuttons are illuminated. Momentary closure of pushbutton switch S403 applies power to the solenoid of the record relay, closing the relay contacts. The record relay K301, locks in the energized condition as its contacts 5 and 9 close, thereby routing current from contacts 4 and 12 of the drive relay K302 to the solenoid of K301. Closure of K301 contacts 10 and 6, and 11 and 7 route -12 volts and +12 volts respectively from the electronics power supply to the record electronics, thus enabling the recording function. In the record mode the reproduce function of the electronics remains unchanged from the drive mode. The pressure required to operate the **RECORD** pushbutton is five lbs., as compared with one lb. for the other buttons of the control cluster. This pressure difference reduces the likelihood that the record mode will be accidentally selected. Current which energizes the solenoid of relay K301 flows through contacts of the servo reference switch S301. In the absence of an installed tape speed servo control system, the switch is left in the **INTERNAL REFERENCE** position. In instruments having such a system, the switch is moved to the **TAPE REFERENCE** position when reproducing, then shifted to **INTERNAL REFERENCE** for recording. To return to the drive mode while the instrument is operating in the record mode, the stop mode must first be selected followed by the drive mode. This sequence allows the locked-in solenoid of the record relay K301 to become de-energized.

5-11. **THE FORWARD MODE.** The forward mode may be selected while the instrument is operating in any other mode by pressing the **FWD** pushbutton (S405). When the forward mode is selected, the pinch roller is disengaged, the tape lifter fingers are extended, the brakes are released and the holdback servo system is inactive. Full supply voltage is applied to the take-up torque motor and reduced voltage is applied to the supply motor. The higher torque of the take-up motor overcomes the torque of the supply motor, and tape moves under tension at high speed from the supply reel to the take-up reel. If the drive mode is selected while the instrument is operating in the forward or the rewind mode, a four second delay is experienced before the newly-selected mode is effective. This delay allows the brakes to slow the reels before the pinch roller is engaged and the holdback servo system activated.

5-12. When the forward mode is selected while the instrument is in the stop mode, power is momentarily transferred through the normally-open contacts of the pushbutton switch S405 to the solenoid of the fast-forward relay K304, energizing the relay. The relay locks in the energized condition with power drawn through the end-of-tape switch, contacts 10 and 2 of drive relay K303, contacts 11 and 3 of the rewind relay K305, and the contacts 11 and 7 of the fast-forward relay K304 itself. As K304 energizes, power on K304 contact 10 is routed through contact 6 to the solenoids of relays K306, (fast mode auxiliary) and K302, (drive delay relay). Both relays energize at once. The brakes are released when power is applied through K306 contacts 11 and 7 to the brake solenoid L403. No power is applied to either the pinch roller solenoid or to the holdback servo solenoid. The tape lifter solenoid is energized by power drawn from closed contacts 1 and 3 of S408 on the holdback servo solenoid. The same power energizes surge delay relay K307, closing its contacts 12 and 8, thereby shorting the drive take-up resistor R401. The take-up torque motor receives full power through K306 contacts 10 and 6 and K304, contacts 9 and 5. Power for the supply motor is also drawn from K304 contact 5, but passes through closed K306 contacts 9 and 5, into a fast-wind holdback resistor R402, then to the motor. The resistor reduces the voltage applied to the supply motor. Motor torque is correspondingly reduced and its natural direction of rotation is overcome by the greater torque of the take-up motor acting through the tape between the reels.

5-13. When the drive mode is selected while the instrument is operating in the forward or rewind mode, the drive relay K303 is locked in the energized condition by power from K306 contacts 12 and 4 passing through K303 contacts 11 and 7 to K303 solenoid. The contacts 10 and 6 of K303 open, removing power from relays K304, K306, and K302. Relay K302, however, remains energized for a short period of time determined by the time taken for capacitor C301 A to discharge through the solenoid windings. In this period of about 4 seconds, the brakes are applied by the opening of K306 contacts 11 and 7 which removes power to the brake solenoid L403. At the end of this period, relay K302 de-energizes and power is again applied to the brake solenoid, releasing the brakes. Power reaches the solenoid L403 through K303 contacts 10 and 6 and K302 contacts 2 and 10. The holdback servo solenoid and the pinch roller solenoid are energized at this same time by power from K306 contacts 12 and 4 which passes through K303 contacts 11 and 7 and K302 contacts 4 and 12.

5-14. THE REWIND MODE. The rewind mode may be selected while the instrument is operating in any other mode by pressing the REW button (S404). When the rewind mode is selected, the pinch roller is disengaged, the tape lifter fingers are extended, the brakes are released and the holdback servo system is inactive. Full supply voltage applied to the supply torque motor moves tape at high speed from the take-up reel to the supply reel. Low voltage is applied to the take-up torque motor to provide tension on the tape. When the rewind mode is selected while the instrument is in the stop mode, power is momentarily transferred to the solenoid of the rewind relay K305, then the relay is locked in the energized condition by power drawn from K303 contacts 10 and 2 through K304 contacts 10 and 2, and through K305 contacts 10 and 6. Power on K304 contact 10 is transferred through K305 contacts 11 and 7, thus energizing relays K306 and K302. The brake solenoid is energized by the closing of K306 contacts 11 and 7. No power reaches the pinch roller solenoid or the holdback servo solenoid, leaving S408 contacts closed. The tape lifter, solenoid and the surge delay relay K307 are energized by power from S408 contact 1 and 3. K307 contacts 12 and 8 are thus closed, shorting the drive take-up resistor R401. The supply torque motor receives full power. Power to this motor passes from K306 contacts 10 and 6 through K304 contacts 9 and 1, and K305 contacts 9 and 5 to the motor. Power to the take-up torque motor passes from K305 contact 5 through the fast-wind holdback resistor R402, then through contacts 5 and 9 of K306 to the motor. Resistor R402 lowers the voltage applied to the take-up torque motor.

5-15. THE SEARCH MODE. The search mode is a variation of the forward mode or the rewind mode. In the search mode, the tape lifter fingers are retracted, allowing the fast-moving tape to come into contact with the record/reproduce heads. This action permits the tape to be scanned for recorded signals. The search mode is selected while the instrument is in either fast mode by pressing and holding the FWD or REW button and the DRIVE button. When the instrument is operating in either fast mode and the search mode is selected, power to the tape lifter solenoid only is interrupted, thus retracting the lifter fingers.

5-16. THE REMOTE CONTROL ASSEMBLY.

NOTE

Data on the remote control assembly will be presented in the final manual.

TABLE 5-1. CONDITION OF CONTROL ELEMENTS FOR EACH MODE

CONTROL ELEMENTS	STOP MODE	DRIVE MODE	RECORD MODE	FORWARD MODE	REWIND MODE	SEARCH MODE
Relays (Energized)	K307	K307 (until C301B discharges) K303	K303, K302	K307, K304 K306, K302	K305, K306 K302, K307	
Holdback Servo System	Inactive (solenoid de-energized)	Active	Active	Inactive	Inactive	Inactive
Pinch Roller	Disengaged (solenoid de-energized)	Engaged	Engaged	Disengaged	Disengaged	Disengaged
Brakes	Applied (solenoid de-energized)	Released	Released	Released	Released	Released
Tape Lifter Fingers	Extended (solenoid energized)	Retracted	Retracted	Extended	Extended	Extended
Supply Torque Motor Power	Off	Off	Off	On (reduced voltage)	On (full voltage)	On*
Take-up Torque Motor Power	Off	On full voltage then normal operating voltage	On	On (full voltage)	On (reduced voltage)	On*
Pushbutton Lighted	STOP button	DRIVE button	RECORD button	FWD button	REW button	FWD or REW and DRIVE

* The SEARCH mode is a variation of either the FWD or REW mode.

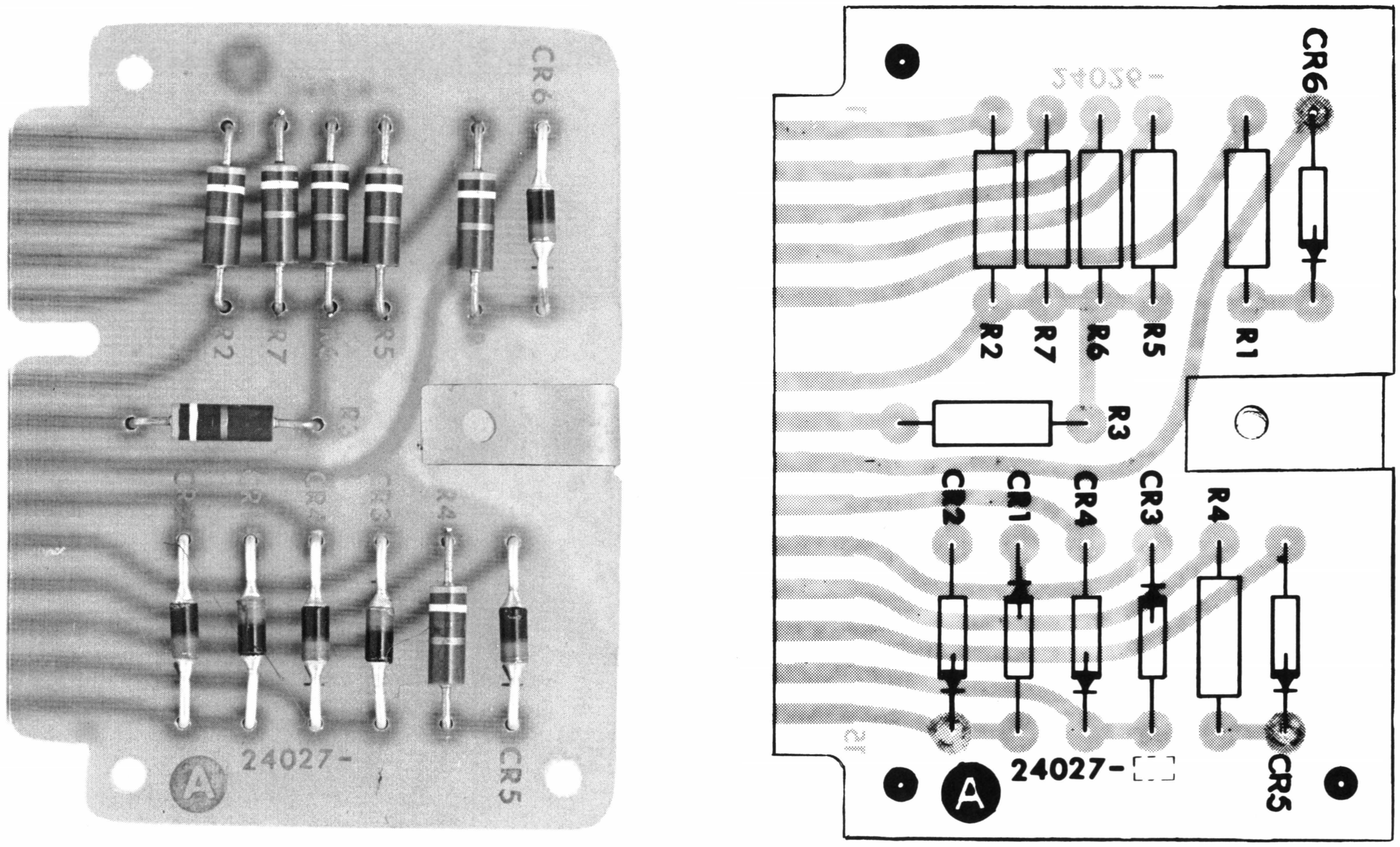
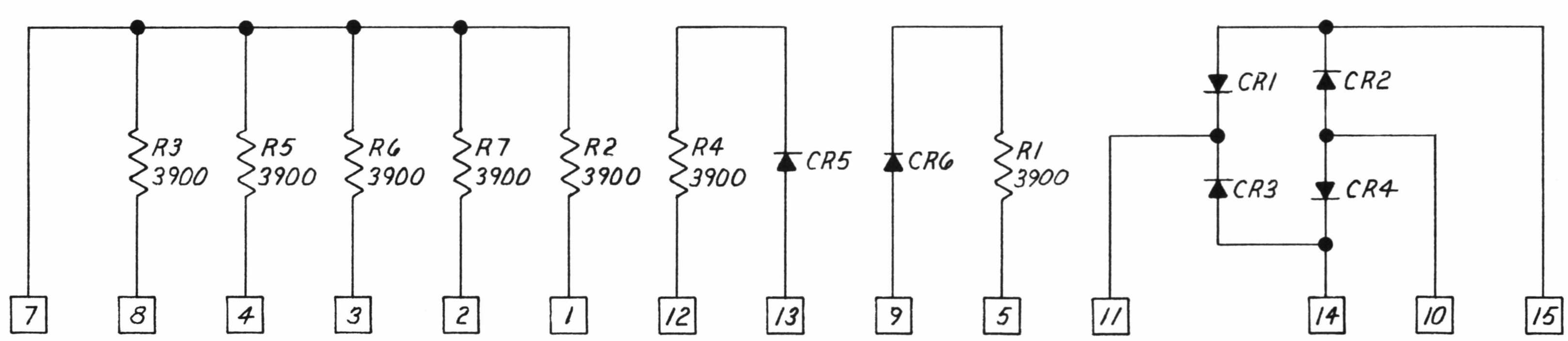


Figure 5-1. RECTIFIER AND RESISTOR CIRCUIT CARD

8346-41

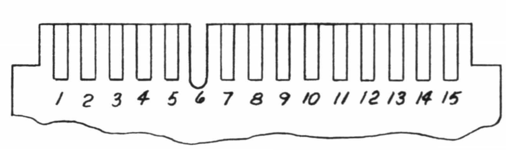


NOTES:

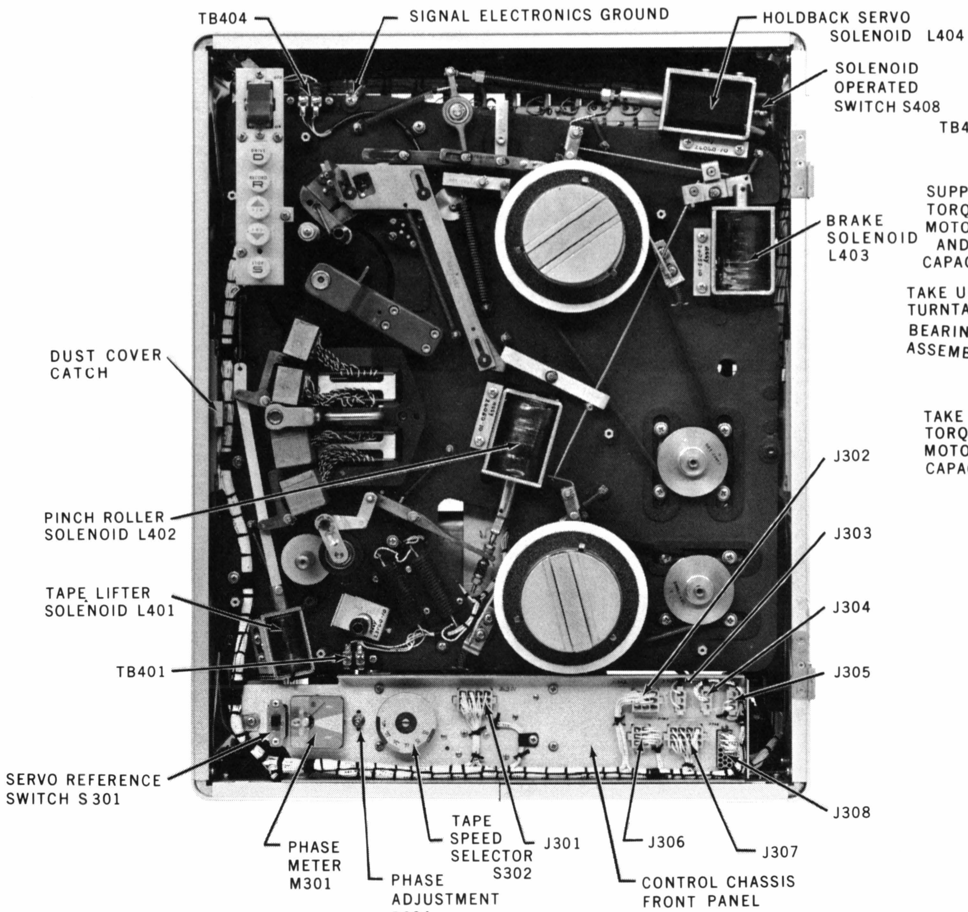
1.- UNLESS OTHERWISE SPECIFIED;
ALL RESISTOR VALUES ARE IN OHMS, 1/2 W. 5%.
ALL DIODES DI-56.

2.- USED WITH ASS'Y NO. 24027.

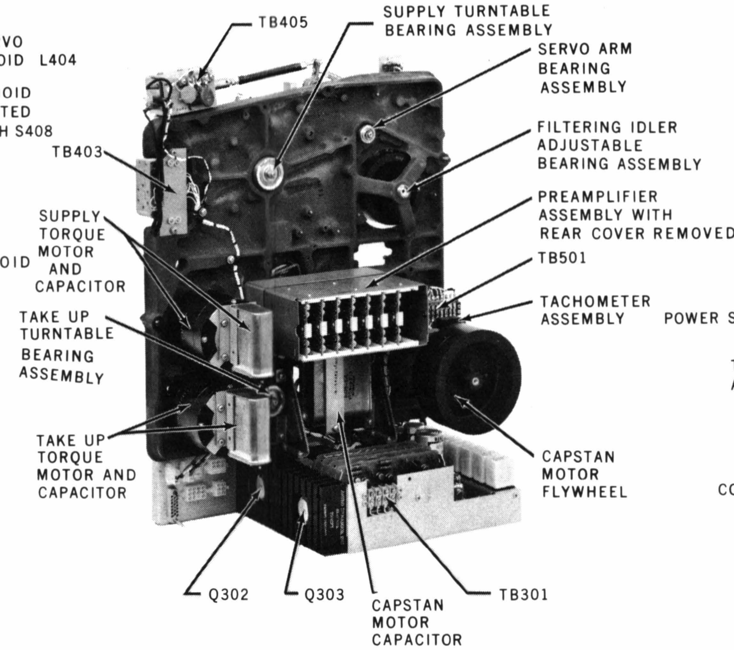
3.- NUMERALS WITHIN ☐ SYMBOL, INDICATE CORRESPONDING PIN CONNECTIONS ON CONNECTOR J313.



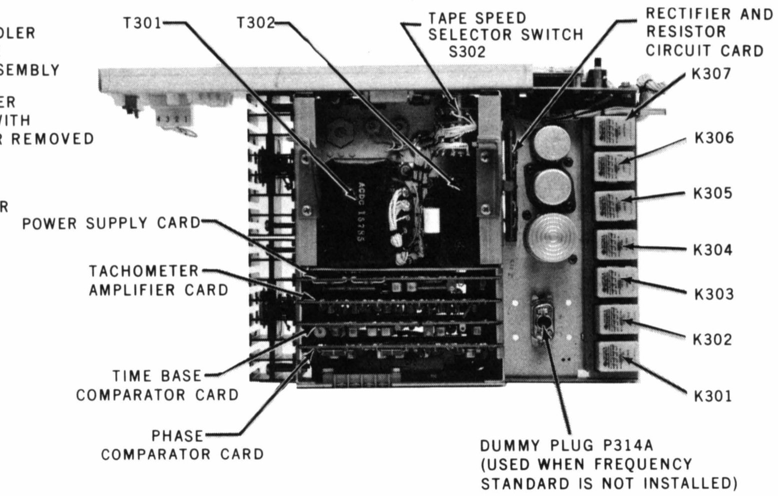
CONDUCTOR SIDE



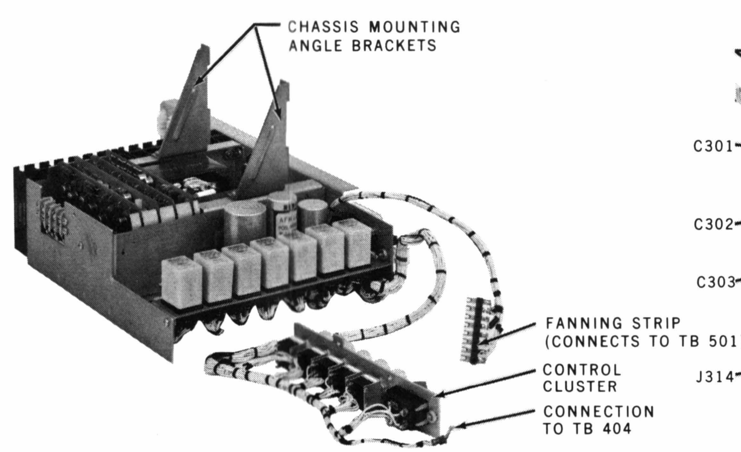
FRONT VIEW OF TRANSPORT AND CONTROL CHASSIS



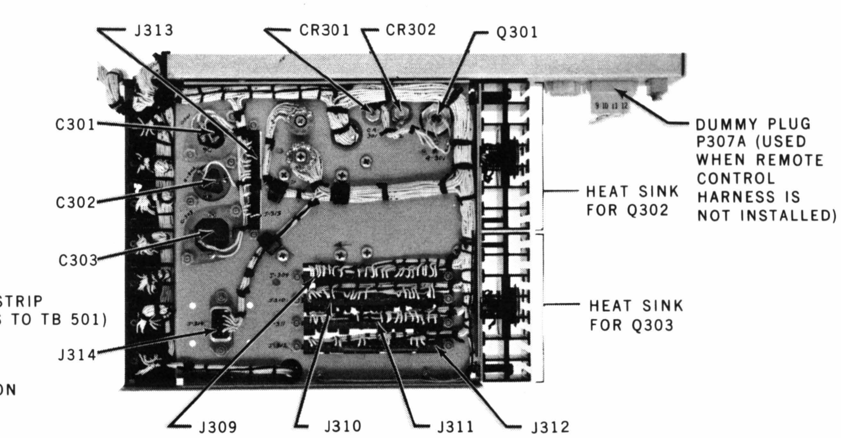
REAR VIEW OF TRANSPORT AND CONTROL CHASSIS



TOP VIEW OF CONTROL CHASSIS



VIEW OF CONTROL CHASSIS SHOWING CABLES



BOTTOM VIEW OF CONTROL CHASSIS

8346-19
8346-35
8346-34
8346-33

Figure 5-2. LOCATION OF ELEMENTS OF THE ELECTRICAL CONTROL AND DRIVE SERVO SYSTEMS

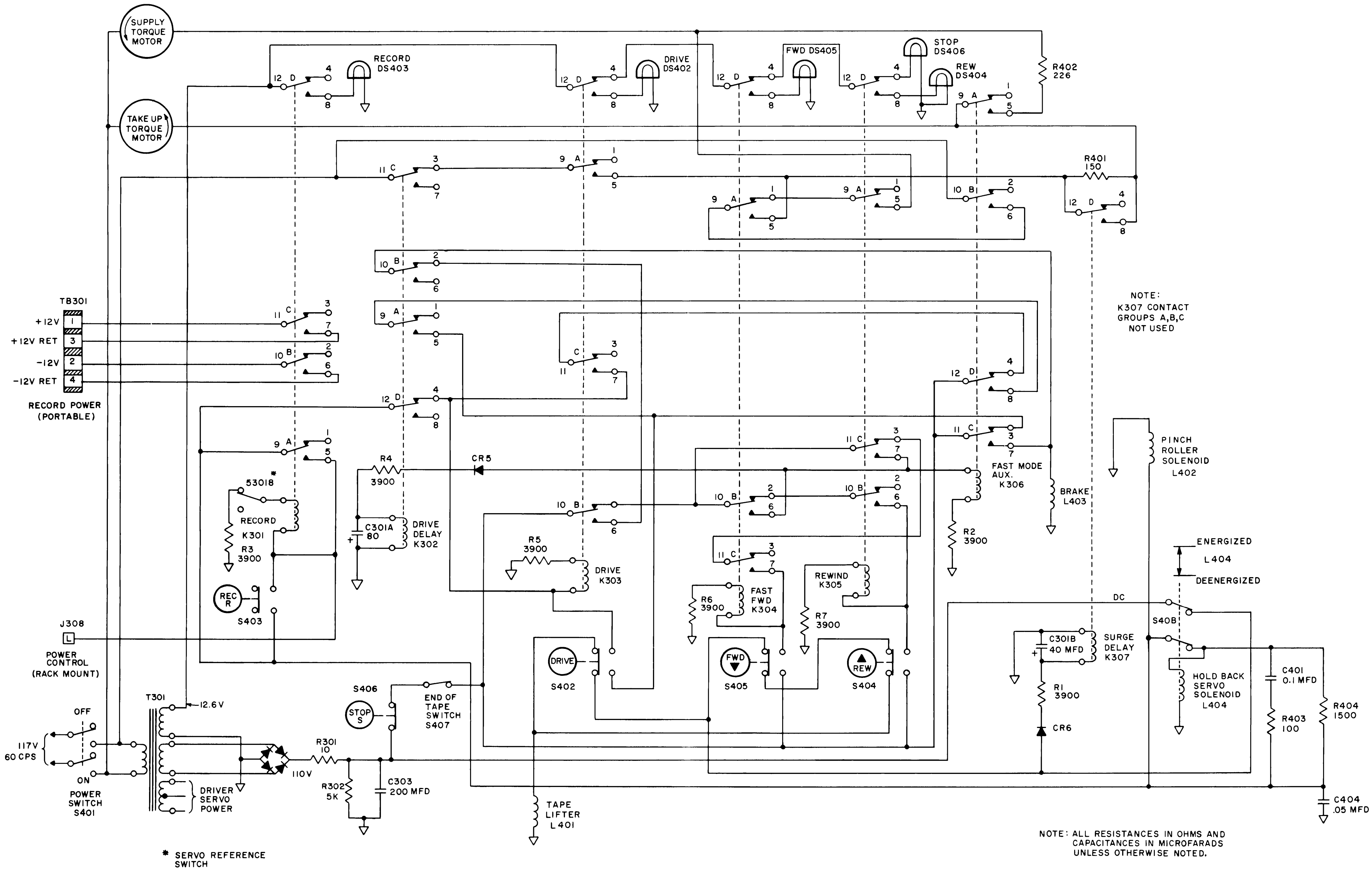


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Figure 5-3. SIMPLIFIED FR-1300 CONTROL CIRCUIT

CHAPTER 6

TAPE TRANSPORT DRIVE SERVO SYSTEM

6-1. INTRODUCTION. See figure 5-2.

6-2. The tape transport drive servo system consists principally of the capstan motor and tachometer assembly, and transistorized circuitry located on the control chassis. Circuitry on the control chassis is largely confined to four printed circuit cards: the tachometer amplifier and binaries card; the power supplies, 60 cycle reference, and Schmitt trigger card; the time base comparator and dc amplifier card; and the phase comparator and filters card. Three power transistors are mounted in heat sinks on the control chassis, and two transformers are located on the top of the chassis. Controls for the system are located on the front panel of the control chassis, they are: the tape speed selector switch; the phase meter; the phase adjustment; and the reference selector switch. From a functional standpoint, the system elements are organized into two relatively independent control subsystems; a frequency control subsystem, and a phase control subsystem. These subsystems are each described in general terms in the simplified functional description in the first part of this chapter. This description is followed by a detailed functional description which is the basis for corrective maintenance of the system.

6-3. SIMPLIFIED FUNCTIONAL DESCRIPTION.

6-4. GENERAL. The tape transport drive servo system is divided by function into a frequency control subsystem and a phase control subsystem. The frequency control subsystem determines the speed of capstan rotation for each selected tape speed, and can alone control the tape speed with a fair degree of accuracy. The phase control subsystem supplements the action of the frequency control subsystem by locking the capstan rotation to the phase of a frequency standard or the phase of the ac power source. In figure 6-1, the arrangement of the systems is shown in block form. Blocks are arranged in the order in which each contributes to operation of the subsystems. Arrows on interconnections between the blocks indicates direction of signal flow. By tracing the signal flow, it is seen that a closed loop exists in each subsystem.

6-5. THE FREQUENCY CONTROL SUBSYSTEM.

6-6. THE CAPSTAN MOTOR. The capstan motor is an ac type motor, having a current-controlled brake within the motor housing. The motor shaft extends from either end of the motor. The front shaft is the capstan, and the flywheel is mounted on the rear shaft. Tape speed is a function of the speed of capstan rotation, and is fixed at one of the six selected speeds by means of electronic circuitry of the drive servo system. At each selected tape speed, a combination of current applied to the motor and brake generates a torque which exactly balances the load torque. If the load torque increases, it is matched by an equal motor torque which maintains constant motor speed. When a faster tape speed is selected, motor torque is increased over the load torque, and the net difference in torque causes the motor to accelerate. As the new speed is approached, the imbalance between the load torque and motor torque is diminished until an exact balance is reached at the selected speed. Deceleration to a lower tape speed is accomplished by creation of a temporary imbalance in favor of the load torque.

6-7. MOTOR TORQUE CONTROL. Motor torque is controlled by changing the current applied to the motor windings and to the brake. Torque is increased by increasing motor current and decreasing brake current. A lowering of motor torque is accomplished by decreasing motor current and increasing brake current. This action is performed in the control subsystem by transformer T302, a bridge rectifier, and a shunt control amplifier. The motor and the primary of transformer are in series across a 115V power source. The bridge rectifier across the secondary of T302 provides dc current to the brake, and to a power transistor of the shunt control amplifier. The power transistor is connected across the brake circuit.

6-8. When the motor is in operation at a constant speed, current flows from the 115 volt source through the primary of T302 to the motor windings. Current rectified from the secondary of T302 is divided between the brake circuit and the power transistor of the shunt control amplifier. Motor torque is increased by an error signal to the shunt control amplifier which makes the power transistor more conductive. The effects of this change in conductivity are twofold, and occur simultaneously. An increased current flowing from the bridge rectifier into the shunt control amplifier is diverted from the brake circuit and flows instead through the power transistor. This action lessens the effect of the brake. At the same time, the increased current through the transformer secondary causes a reflected effect on the transformer primary which allows the motor to draw increased current. The decrease in brake effect coupled with increased motor current causes the motor to accelerate.

6-9. Motor torque is decreased by an error signal to the shunt control amplifier which makes the power transistor less conductive. The effects of this action are the reverse of those occurring for a torque increase. Less current is drawn through the bridge rectifier, however brake circuit receives an increased share of the current, and thereby becomes more effective. The reflected effect on the transformer primary results in less current flowing in the motor circuit. Both effects combine to decrease motor torque. Thus, through the two means described, the tape speed is maintained constant at one of the six selected speeds by means of a signal applied to the shunt control amplifier. The origin and nature of this signal are the subject of further description.

6-10. THE TACHOMETER ASSEMBLY. See figure 4-9. The tachometer assembly is a capstan-speed monitoring device in which a signal is generated by photoelectric means. This signal, roughly a sine wave, varies in frequency in direct relation to the speed of capstan rotation.

6-11. The tachometer assembly consists principally of a light source, a photo-voltaic detector, and a means of interrupting or gating the light falling on the photo-voltaic detector. The light source is a small lamp operating on 24 volt dc , located adjacent to the detector in a tachometer housing mounted on top of the capstan motor, next to the flywheel. A slot divides the housing into an upper part which houses the lamp, and a lower part containing the detector. Light from the lamp passes through the slot and falls on the detector, causing the detector to generate a small current. Light passing through the slot is gated to the

amplitude in proportion to the difference in lengths of the negative and positive portions of the overall waveform. The dc voltage passes from the filter through an equalization network to a differential amplifier.

6-16. **DIFFERENTIAL AMPLIFIER.** The differential amplifier compares the dc voltage from the filter with a fixed reference potential. The amplified difference between the fixed reference potential and the dc level from the filter is the error voltage which, following amplification, is applied to the shunt control amplifier where it controls the capstan motor speed. Refer to paragraph 6-7.

6-17. **OPERATION AT DIFFERENT SELECTED SPEEDS.** When a tape speed of 3-3/4 ips is selected, capstan speed doubles as does the frequency of the tachometer output signal. The time base comparator, however, operates only on a narrow range of frequencies centered about 240 cps. Therefore, the tachometer frequency is divided in half by use of a binary counter which generates one waveform for every two that it receives. In figure 6-1, the schmitt trigger output signal is routed to the first binary. When the speed selector is turned to the 3-3/4 ips position, the output signal from the first binary is selected and applied to the time base comparator. If a speed of 7-1/2 ips is selected, the tachometer output frequency of 960 cps is counted down to 480 cps by the first binary, and to 240 cps by the second binary, then, as before, applied through the selector switch to the time base comparator.

6-18. When a higher capstan speed is selected, full power is applied to the motor to bring it up to speed. For example, when the selector switch is moved from the 1-7/8 ips position to the 3-3/4 ips position, the motor speed is for a moment still at 1-7/8 ips, and the time base comparator receives only 120 cps through the first binary. The error signal generated by the comparator action is maximum, resulting in the application of full power to the motor. Such acceleration of the motor lasts only until the comparator receives a signal within its range of operation, then the motor torque is lowered to match the load torque, and constant speed operation commences at the new tape speed. A similar situation occurs when switching from a high speed to a lower speed. The time base comparator momentarily receives a signal of twice the desired frequency, causing the motor current to drop and the brake current to increase.

6-19. THE PHASE CONTROL SUBSYSTEM. See figure 6-1.

6-20. GENERAL. The phase control subsystem synchronizes the capstan motor speed with a frequency reference thereby offsetting the effects of changes in load or temperature and aging of system components on motor speed. The phase control subsystem has as its reference either the 60-cycle line or a 60 cps frequency standard. The frequency standard is a sealed unit, plugged into receptacle J314, figure 5-2, on the control chassis. If the frequency standard is not used, a plug P314-A is inserted in the connector. This plug completes a circuit which applies the line frequency as the reference to the phase comparator.

6-21. CIRCUIT OPERATION. The signal applied to the time base comparator is also the input signal to the phase control subsystem. This signal is a square wave which varies in frequency about a center frequency of 240 cps. In the phase control subsystem, the frequency of the signal is divided by a factor of 4 by the sixth and seventh binary counters (figure 6-1). The output signal of the seventh binary is a square wave with a frequency of approximately 60 cps. The phase of the waveform is compared in the phase comparator with the phase of the 60 cps line or 60 cycle frequency standard, and a symmetry-modulated waveform is developed. This waveform, when integrated by filter number 2, provides a dc voltage level which varies with the existing phase relationship detected by the comparator. When the two signals to the comparator are in phase, a reference dc level is produced. Variations in the phase relationship are reflected in rising or falling of the dc level in relation to the reference level. These departures, termed "error voltages", are combined with the time base comparator output signal and thereby aid in controlling motor torque.

6-22. The phase meter M301 indicates the presence or absence of phase synchronism between phase comparator input signals. Synchronism is indicated by a steady on-scale meter indication. Absence of synchronism is evidenced by small or large oscillations of the meter pointer. Motor torque is controlled to return the system to synchronism by adjustment of the phase control (R304) on the front panel of the instrument. This adjustment changes the reference potential of the differential amplifier, thus establishing a new point in voltage about which the error signal is developed. This action results in the motor slowing or increasing speed to match the new reference. If the new reference is correct, the input signals to the phase comparator will be in phase, and the meter will show a steady on-scale indication.

6-23. DETAILED FUNCTIONAL DESCRIPTION.

6-24. INTRODUCTION. The drive servo system is composed of a large number of pulse-type circuits in which transistors are operated alternately at full conduction, and at minimum conduction. These states, referred to as ON and OFF, are controlled by changes in voltage applied to the base of the transistor. A majority of the transistors used in the servo circuits are of the PNP type which require negative voltage on the collector and positive or return voltage on the emitter for proper operation. The PNP transistor is turned on by an input voltage applied to the base which is negative with respect to the emitter. The PNP transistor is turned off by a voltage similarly applied which is positive with respect to the emitter.

6-25. The NPN transistor, used in a few circuits of the servo system, requires a positive voltage on the collector and a negative or return voltage on the emitter for correct operation. The NPN transistor is turned on by an input voltage applied to the base which is positive with respect to the emitter. A voltage so applied which is negative with respect to the emitter turns the transistor off. A few transistors in the system are operated as amplifiers. In this service, the transistor output signal, taken generally from the collector, is an amplified duplicate of a waveform applied to the base. In certain types of circuit the output waveform is inverted. Amplification without distortion is accomplished by controlling the voltage excursions of the input waveform so that the transistor is not turned on or off as in pulse applications, but operated in a zone between the two states.

6-26. The detailed functional description which follows is intended to acquaint the user with the operation of the various transistorized circuits of the system. In the simplified description, electrical control of the capstan motor speed was described in some detail, as was the tachometer assembly and its operation. These portions of the circuit are again mentioned only as necessary to an understanding of associated transistorized circuitry. The detailed functional description is organized in the same manner as the simplified description, and follows the block-by-block development depicted in figure 6-1. This description together with the card layout given in chapter 11 and schematic diagrams included in chapter 10, form the basis for corrective maintenance of the system. Waveforms appearing in this description have identifying numbers which correspond to circuit points from which they were obtained. These circuit points are identified on the accompanying schematic diagram and on the composite schematic for the drive servo system. Voltages given are approximate.

6-27. TACHOMETER, AMPLIFIER, AND SCHMITT TRIGGER. The tachometer, amplifier, and schmitt trigger cooperate to generate a square wave which varies in frequency with changes in the speed of capstan rotation.

6-28. The tachometer, described in the simplified functional description, is composed of a light source, a photo-voltaic detector, and a means of gating the light falling on the detector. Gating is accomplished by the use of 192 windows evenly spaced about the flywheel skirt. The width of each window is identical, and equals the width of the solid interconnecting portion of the skirt. As the flywheel rotates, the source light directed toward the detector is alternately obscured, then admitted, as windows pass between the light and the detector. Current is generated by the detector only when it receives light. In the circuit shown in figure 6-3, the anode of the detector is connected to a voltage of +11.7 volts provided by resistors R1 and R2 across the power source. The cathode of the detector is returned to the base of transistor Q1 where the voltage is +11.5 volts when no light falls on the detector. When light falls on the detector, current generated by the detector lowers Q1 base voltage to 11.3 volts. When the FR-1300 is operated at a selected tape speed of 1-7/8 ips, light is interrupted at a rate of 240 times per second. The waveform generated by the tachometer is shown in figure 6-3, test point 1. This waveform is symmetrical and has a period of approximately 4 milliseconds. The amplitude of the waveform however, is low, and the transition between the two voltage levels is not sharply defined.

6-29. The amplifier, composed of transistor Q1 and associated components, amplifies the weak signal of the tachometer to a level usable by the schmitt trigger which follows. Amplification provides a twenty-fold increase in the signal amplitude, and inverts the waveform. The amplifier output signal is shown in figure 6-3, test point 2. In this figure it is seen that the amplified waveform varies from -8v when no light falls on the photo diode, to -4v when light falls on the detector. Amplification alone has not improved the sharpness of transition between the two voltage levels. The amplifier output signal is coupled through capacitor C1 to the schmitt trigger.

6-30. The schmitt trigger generates a square waveform which has a period identical to the period of the input waveform. This action in effect "squares" the input waveform. The schmitt trigger, a pulse type circuit, is composed of transistors Q2 and Q3 and associated components. The input waveform, essentially identical to the signal output of the amplifier shown in figure 6-3, test point 2, is applied to the base of Q2. In the initial state, Q2 is off, and Q3 is on. Q2 is held in the off state by a bias developed by R3 return to ground, and by Q3 current passing through the common emitter resistor R24. Voltage at the collector Q3 is -6 volts. As the input waveform becomes increasingly negative, a point is reached where the bias on Q2 is overcome and Q2 begins to conduct. This trigger point is A on test point 2 waveform figure 6-3. As Q2 begins to conduct, a positive-going waveform generated at Q2 collector is coupled to the base of Q3, turning Q3 off. The voltage at the collector of Q3 drops to -12 volts. Transistor Q2 remains on until the input waveform again return to the same voltage at which it triggered. At this point, B in the figure, Q2 again turns off as its self bias overcomes the input voltage. Transition between states in the schmitt trigger is rapid due to regenerative action through the common emitter resistor. Bias on Q2 is set to cause triggering at the halfway point in the voltage excursions of the input waveform, thus producing a symmetrical square wave output at the collector of transistor Q3. The output waveform is applied to both the time base comparator and to the first binary.

6-31. TIME BASE COMPARATOR. The time base comparator generates an asymmetrical waveform which changes its shape as the speed of the capstan motor rotation deviates from the selected speed. The time base comparator consists of two monostable multivibrators and an amplifier. In the circuit of figure 6-6, transistors Q1 and Q2 with associated components form the first monostable multivibrator, or the first stage. The second stage is formed of transistors Q4 and Q5. Transistor Q3 is the output amplifier. In the description of circuit operation which follows, the system is operated at a selected tape speed of 1-7/8 ips which, if accurately maintained, provides a 240 cps signal from the schmitt trigger.

6-32. COMPARATOR WAVEFORMS. The first stage of the time base comparator receives the square waveform from the schmitt trigger, and produces two related waveforms which are applied to the second stage. These waveforms shown in figure 6-4 are the trigger pulse, and the early reset pulse. The second stage generates the comparator output signal which is applied to filter no. 1 and equalization network. The time relationship of these waveforms are shown in three sequences for no error, slow error, and fast error, in figures 6-5A, 6-5B, and 6-5C. The first stage waveforms are exaggereated for clarity.

6-33. COMPARATOR ACTION. In figure 6-5A, when the capstan motor is at correct speed, the schmitt trigger waveform (A) has a period of 1/240 second. This waveform is differentiated and the positive-going pulse clipped, providing a negative-going pulse (B), which marks the beginning and the end of a complete input waveform. These pulses trigger the first stage causing a 220 microsecond pulse to be formed by the stage. This action generates the early reset pulse (C) and a negative-going square wave shown at (D). The waveform of (D) is differentiated and clipped to provide a positive trigger (E) for the second stage. Second stage action generates a negative-going square wave when triggered by (E). The square wave, shown at (F) has a period of approximately 3 milliseconds. At the end of this period it reverts to its quiescent state until again triggered.

6-34. The waveform of (F), figure 6-5A, is then characterized by a total period of

1/240 second, or roughly 4 milliseconds, which includes a negative-going waveform having a fixed maximum duration of 3 milliseconds. Referring now to the corresponding group of waveforms for capstan motor speed slower than the correct speed, (figure 6-5B), it is seen that the period of the schmitt trigger input signal has increased (A), as has the trigger to the first stage (B). The periods of the first and second stage monostable multivibrators remain unchanged, resulting in generation of an output waveform (F). By comparing (F) of figure 6-5A with (F) of figure 6-5B, it is seen that they differ in the total period. With the period of the second stage, a constant 3 milliseconds, the time between the end of the 3 millisecond wave and the end of the total period has increased. The differences between these lengths are the key to comparator action. In subsequent circuits, the total waveform is integrated, and a dc is level as generated which directly reflects such changes in geometry of the total waveform.

6-35. When the motor speed increases above the correct speed, the first stage is triggered at increasingly shorter intervals. Except for the early reset feature, a point would be reached where the second stage would be continuously triggered, and the control system rendered ineffective. When the interval between triggers to the first stage becomes shorter than the 3 millisecond period of the first stage, the first stage is prematurely reset to its quiescent state by the early reset pulse. In figure 6-5C, the motor speed has been increased so that the time between trigger pulses is less than the 3 millisecond period of the second stage. The early reset pulse (C) arrives at the second stage 220 microseconds earlier than the trigger (E) to the second stage, and resets the second stage. The trigger (E) then triggers the second stage in a normal manner, resulting in generation of waveform (F).

6-36. COMPARATOR CIRCUIT DESCRIPTION. The comparator circuit shown in figure 6-6 receives the schmitt trigger signal at point 3. This number is keyed to waveforms of figure 6-7. The incoming waveform is differentiated by capacitor C1 and resistor R3 (point 4) and the positive peaks clipped by diode CR1, leaving negative-going pulses which mark the beginning and end of a complete input waveform. These pulses (point 5) trigger the first stage. The first stage monostable multivibrator has a period of approximately 220 microseconds, determined by capacitor C2 and resistor R24. In the stable or quiescent state, transistor Q2 is off, and Q1 is on. Q1 is held in the conducting state by negative voltage from R24 on its base. When the negative trigger pulse arrives at the base of transistor Q2, (point 5), it turns Q2 on. The collector voltage of Q2 rises from -12 V toward a ground potential. This voltage change, transferred through capacitor C2 to the base of transistor Q1, turns Q1 off. The voltage at the collector of Q1 drops from ground potential toward -12 volts. This change in voltage is coupled to the base of Q2, through R18, a regenerative action which increases the sharpness of Q2 transition from the OFF to the ON state. Transistor Q1 remains off until capacitor C2 is discharged, a period of 220 microseconds. At the end of this period, transistor Q1 reverts to the ON state, driving Q2 to the OFF state. The positive-going 220 microsecond pulse generated by such action at the collector of Q2 becomes the early-reset pulse (point 6). The negative-going equivalent pulse at the collector of Q1 (point 9) is differentiated by capacitor C4 (point 10) and clipped by diode CR3 to become the trigger to the second stage (point 11).

6-37. The second stage consists of a monostable multivibrator having a period of approximately 3 milliseconds, followed by a single stage of amplification. The multivibrator consists of a PNP transistor Q5, and an NPN transistor Q4. The amplifier is transistor Q3. A 24 volt supply is used in the second stage. In the stable or quiescent condition, both transistors are on. The collector at Q5 is at a +12 volt level. When a positive trigger (point 11) is applied to the base of Q5, the transistor is turned off and its collector voltage drops from +12 V to +7 V. This voltage change applied to the base of transistor Q4 through capacitor C304, turns Q4 off. Voltage at the collector of Q4 rises. This rise, coupled through R14 to the base of Q5, forms a regenerative circuit which insures that Q5 is turned off sharply. Transistor Q4 remains off until capacitor C304 charges through fixed resistor R12 and adjustable resistor R5. The period of approximately 3 milliseconds can be varied by changing the resistance of R5. When capacitor C304 has charged, the base of Q4 again becomes positive with respect to the emitter, and Q4 turns on. A negative-going waveform applied to the base of Q5 through R14, turns Q5 on. Early reset of the transistor pair is accomplished by means of the positive-going reset pulse (point 6) which is applied through capacitor C3 to the base of transistor Q4. The second stage can be reset early, up to one-half of its normal period.

6-38. The multivibrator output signal, taken from the junction of resistors R13 and R6, is applied to the base of transistor Q3 (point 14) in which it is amplified and inverted (point 15) to provide the comparator output, an asymmetrical square wave having a voltage excursion from +10 volts to -12 volts. This signal is applied to filter no. 1 then an equalization network.

NOTE

The detailed functional descriptions of the following circuit groups will be provided in the final manual.

- Filter Number One and Equalization Network
- Differential Amplifier and Emitter Follower
- The Phase Comparator
- The 60 CPS Frequency Standard
- The Line-sync Schmitt Trigger
- Filter Number Two
- A Typical Binary Stage

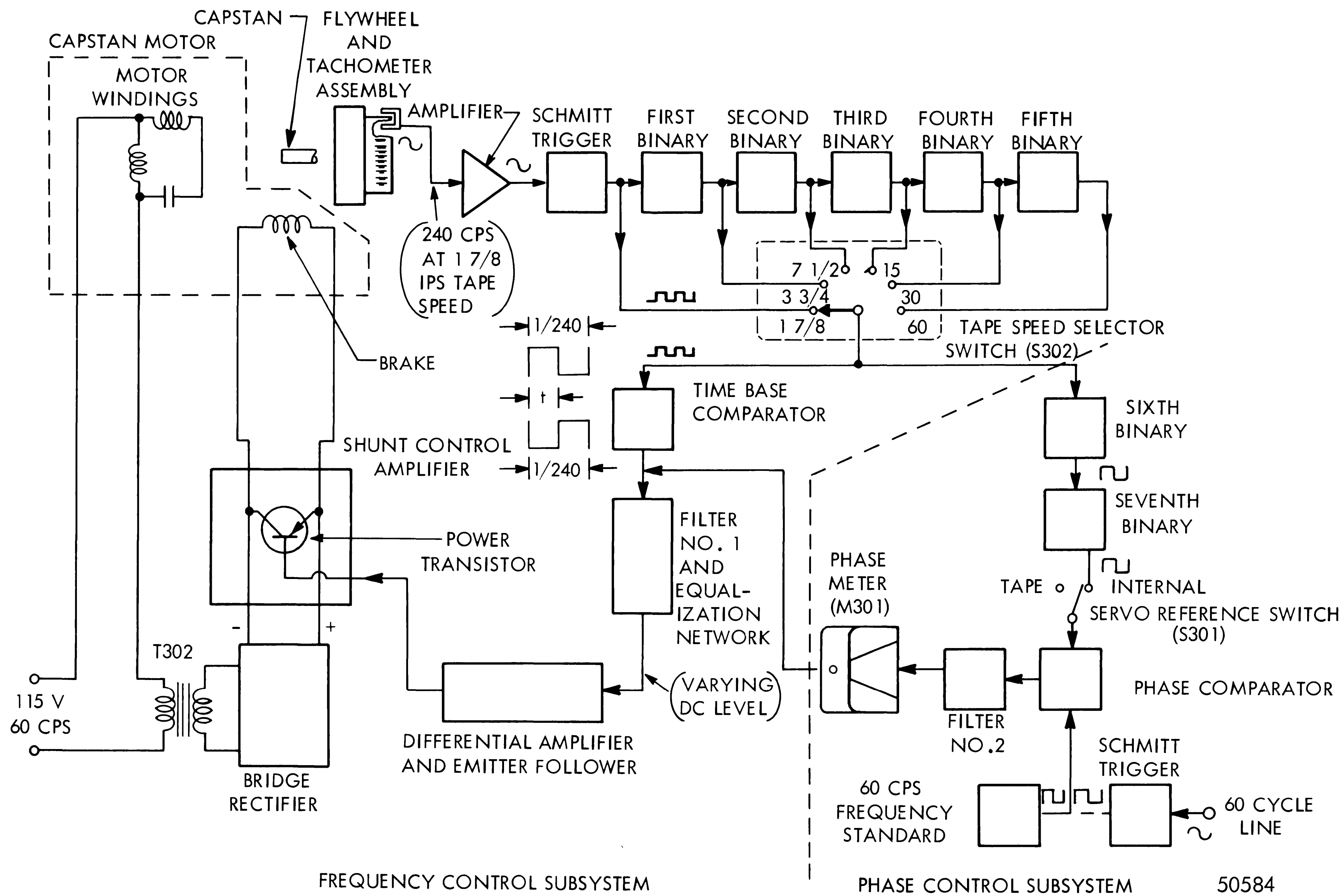


Figure 6-1. DRIVE SERVO BLOCK DIAGRAM

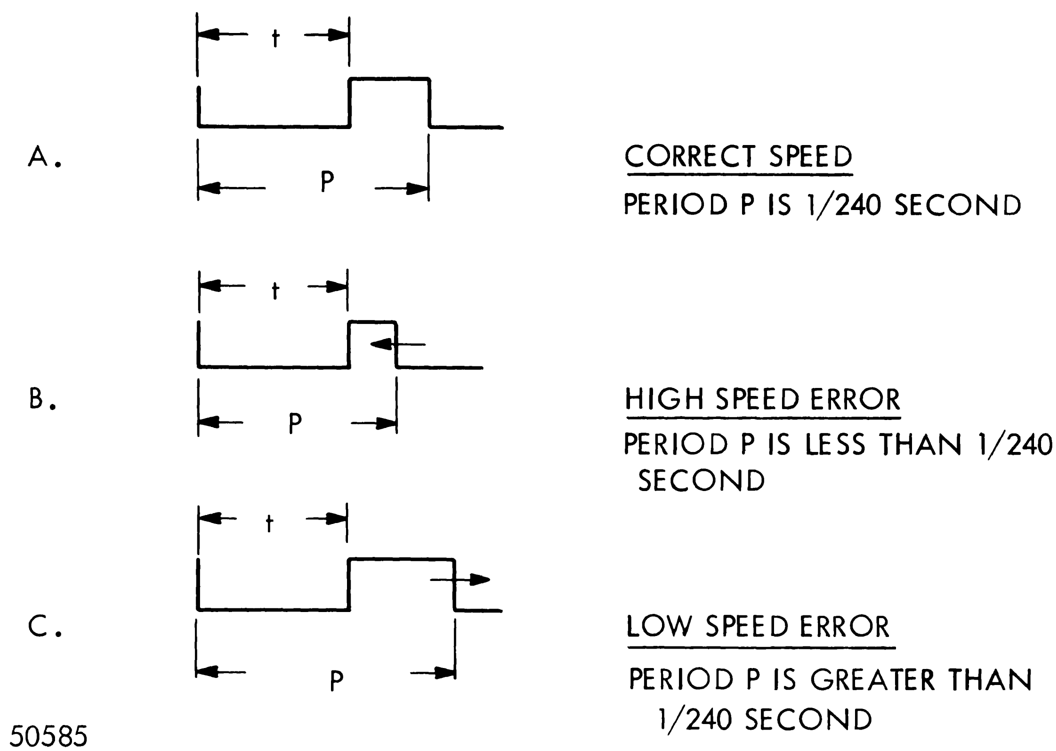


Figure 6-2. COMPARATOR OUTPUT WAVEFORMS

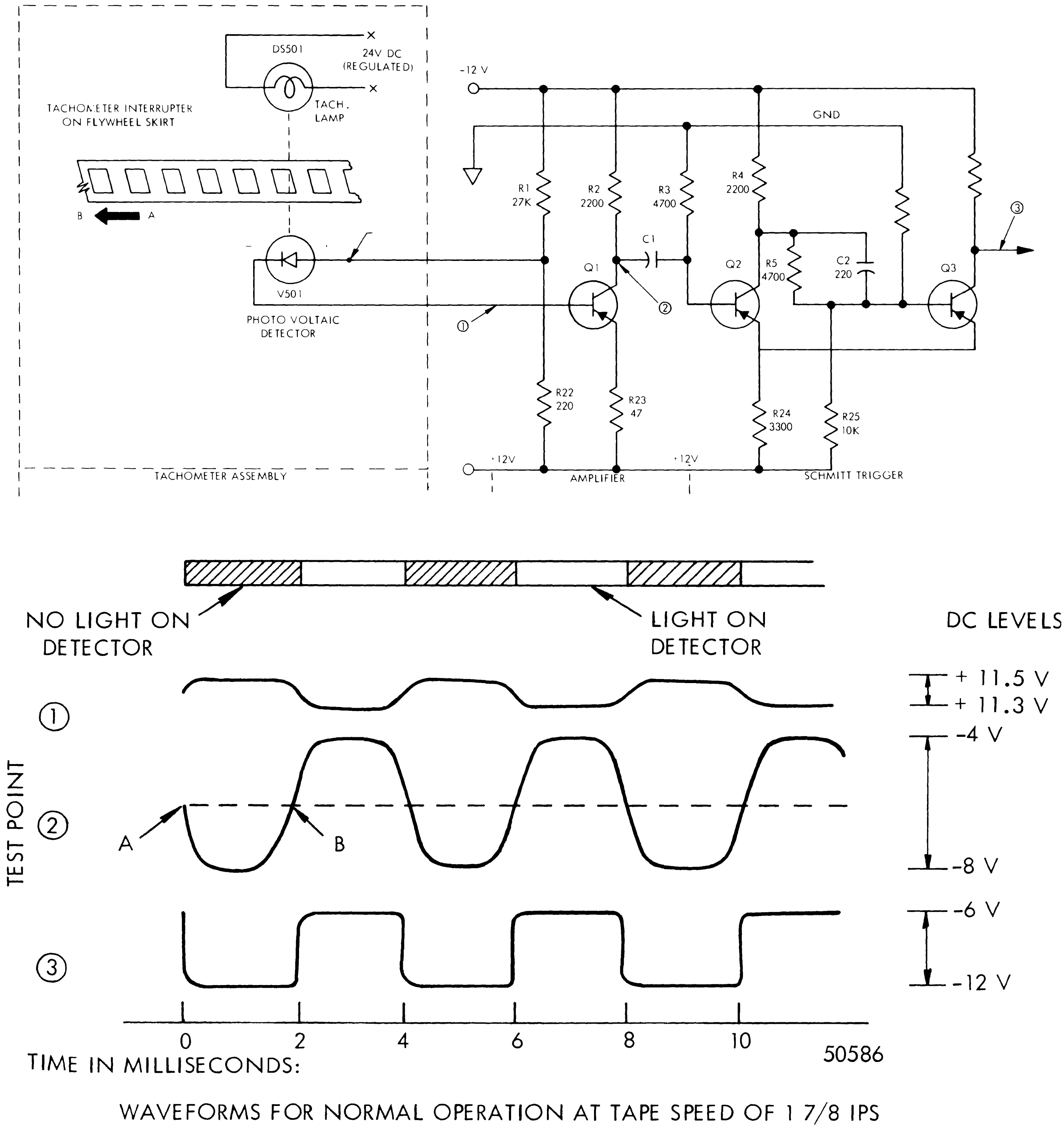


Figure 6-3. CIRCUIT AND WAVEFORMS OF TACHOMETER, AMPLIFIER AND SCHMITT TRIGGER

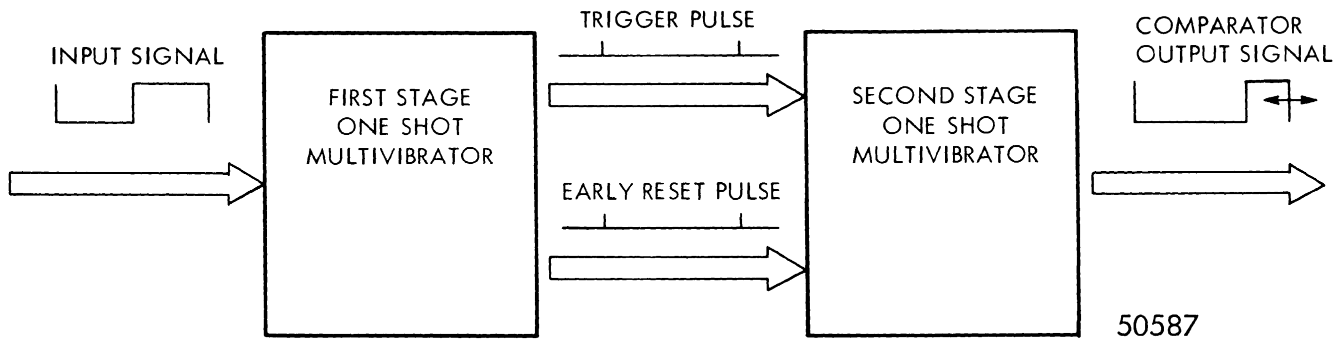


Figure 6-4. OVERALL SIGNAL FLOW IN TIME BASE COMPARATOR

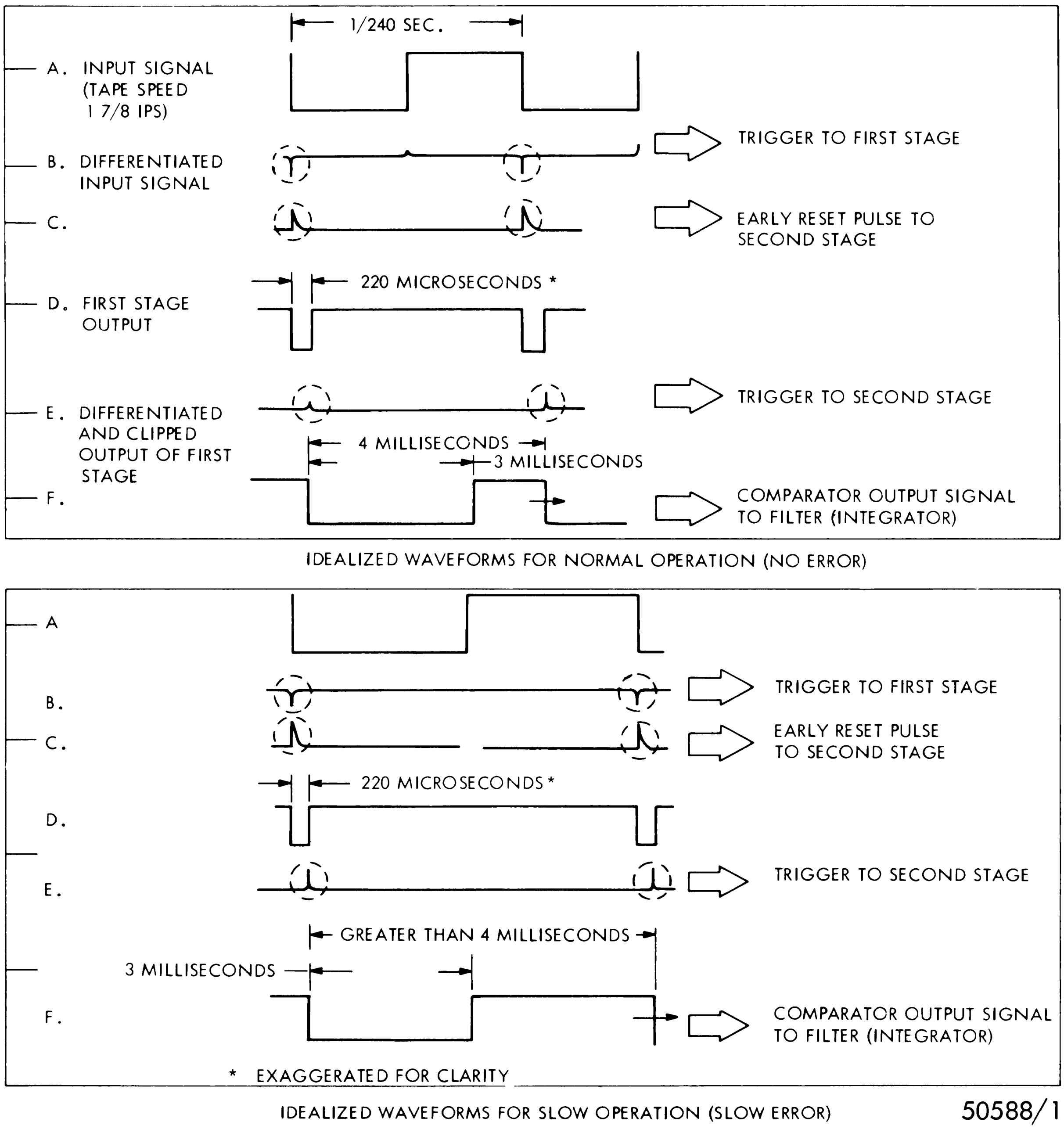
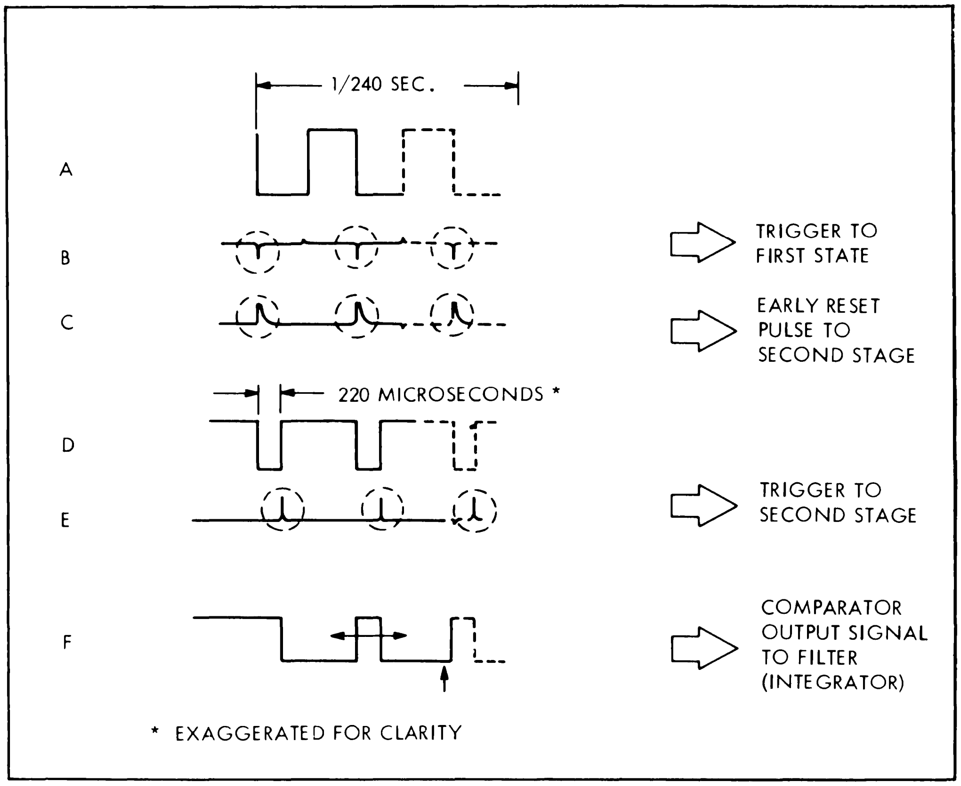


Figure 6-5. IDEALIZED WAVEFORMS OF THE TIME BASE COMPARATOR (Sheet 1 of 2)



50588/2 IDEALIZED WAVEFORMS FOR FAST OPERATION (FAST ERROR)

Figure 6-5. IDEALIZED WAVEFORMS OF THE TIME BASE COMPARATOR (Sheet 2 of 2)

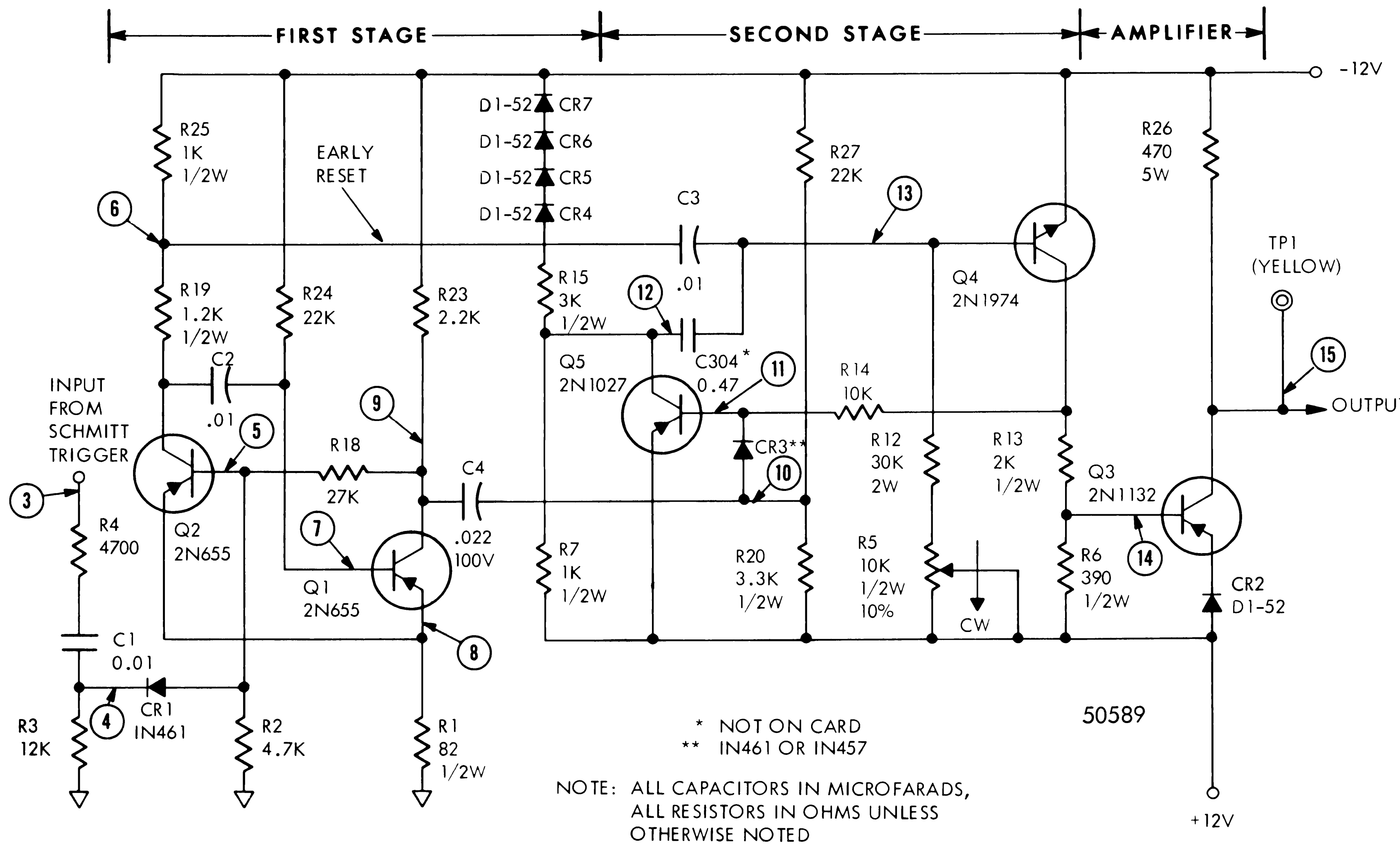


Figure 6-6. CIRCUIT OF THE TIME BASE COMPARATOR

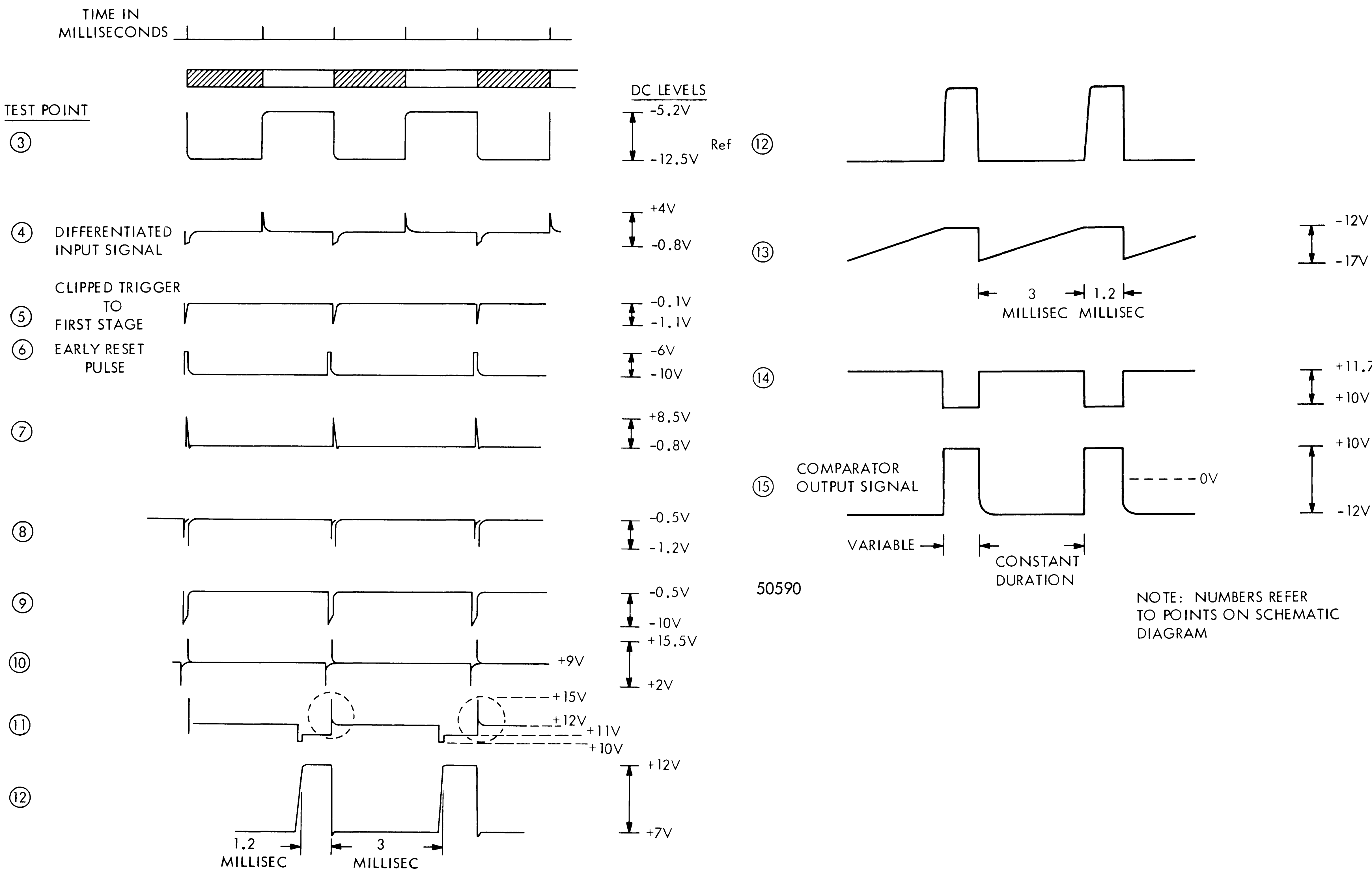


Figure 6-7. WAVEFORMS OF TIME BASE COMPARATOR

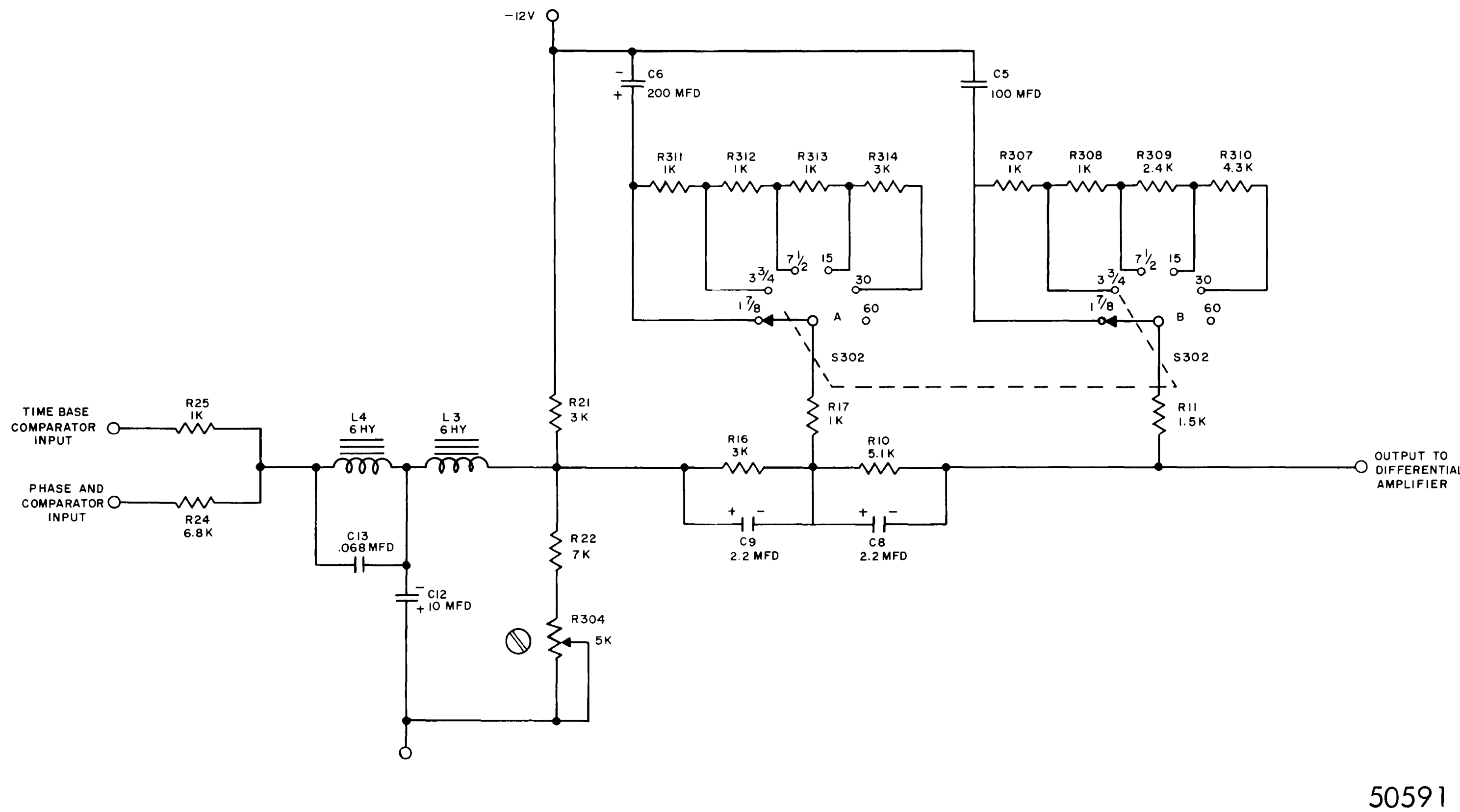
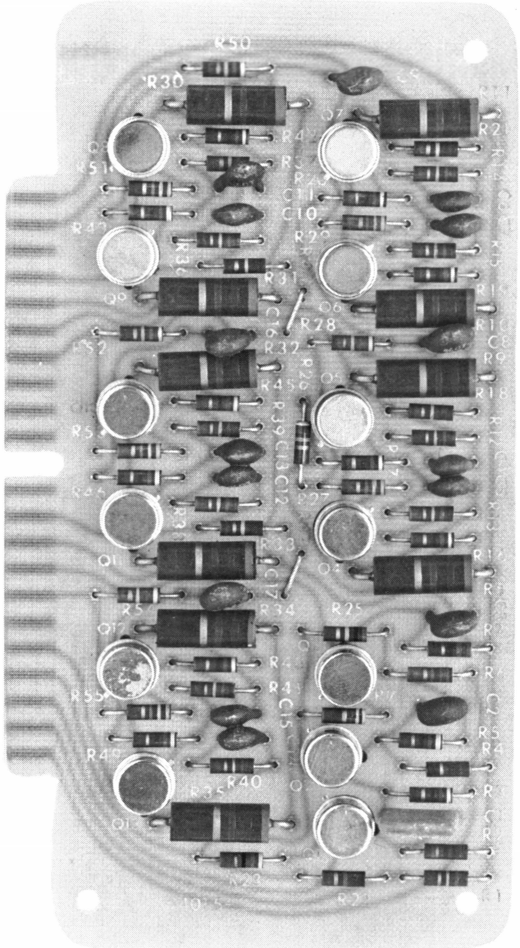
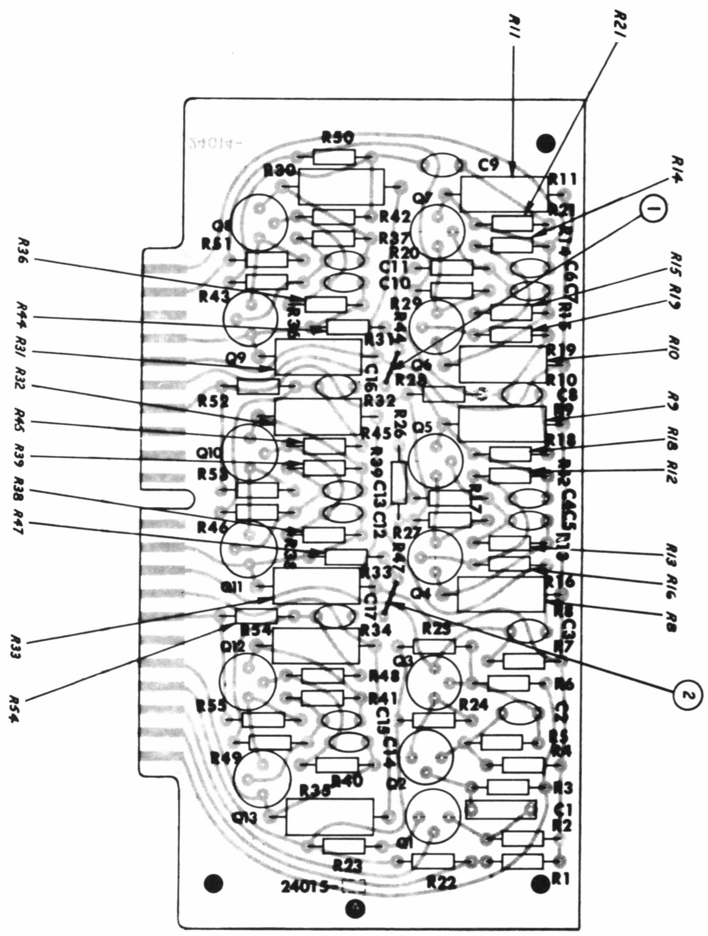


Figure 6-8. FILTER AND EQUALIZATION NETWORK





①② BARE WIRE CONNECTIONS

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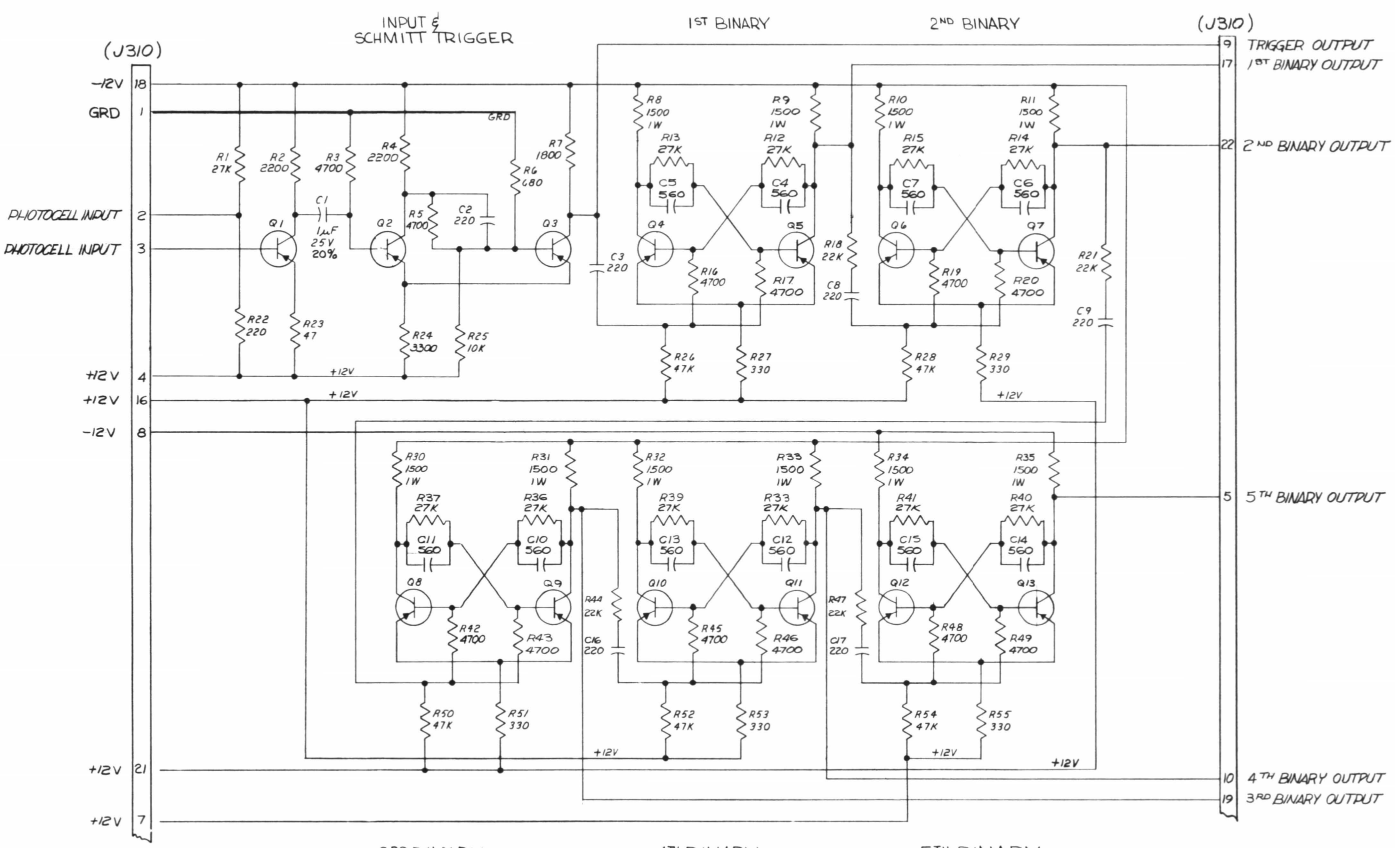
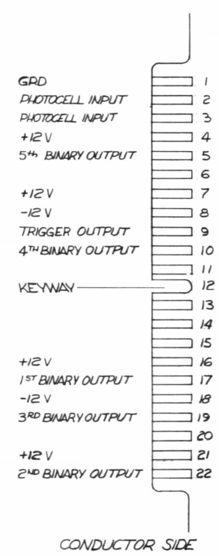
Figure 6-9. TACHOMETER AMPLIFIER CARD

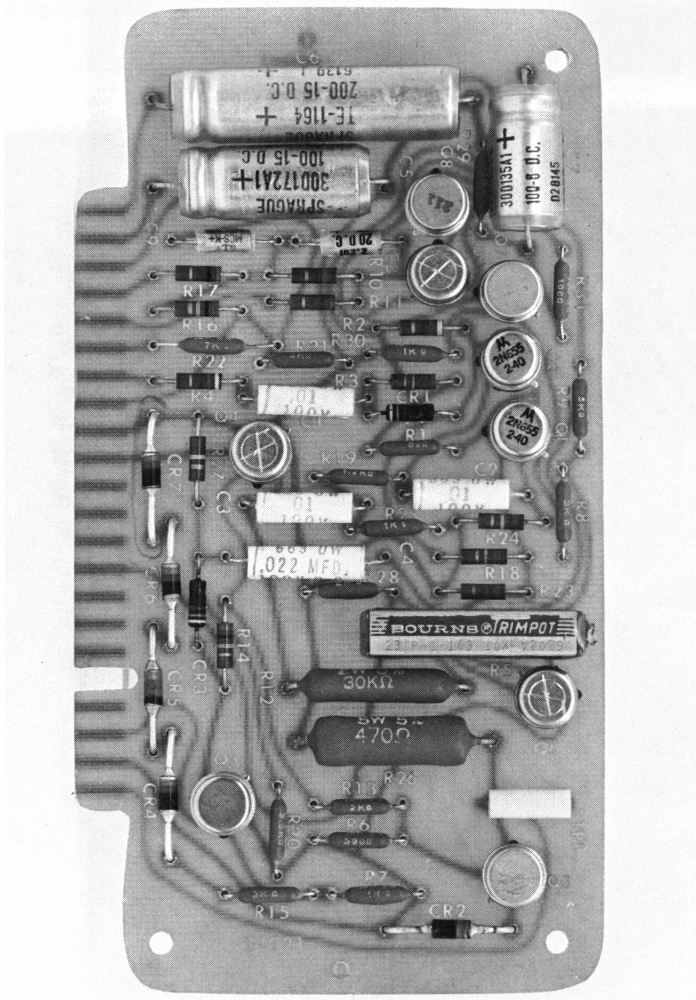




NOTES

1.— UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 5%.
ALL CAPACITOR VALUES ARE IN PICO FARADS, 10%, 600 VOLTS.
ALL TRANSISTORS ARE TYPE 2N404.
2.— USED WITH ASSY D-24015

AMPEX



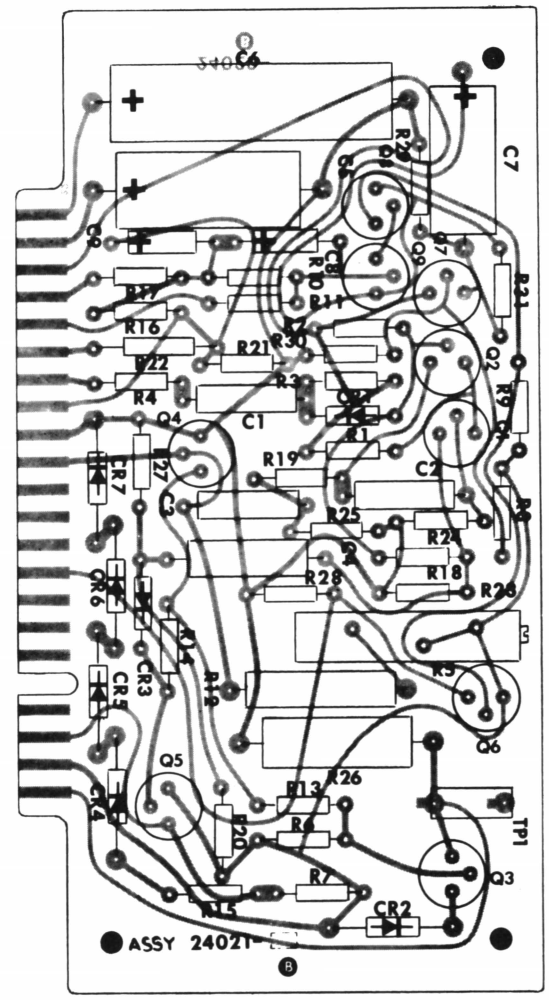


Figure 6-10. TIME BASE COMPARATOR CARD

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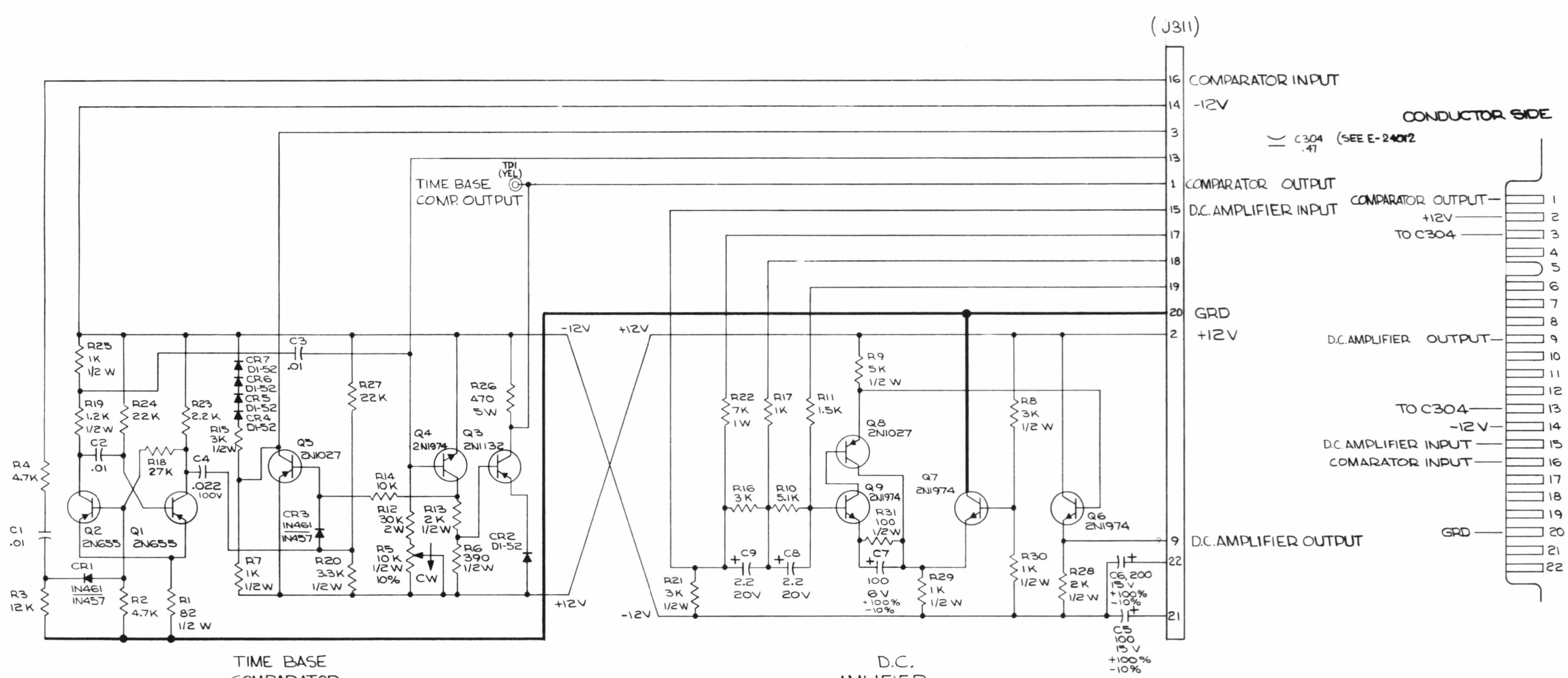
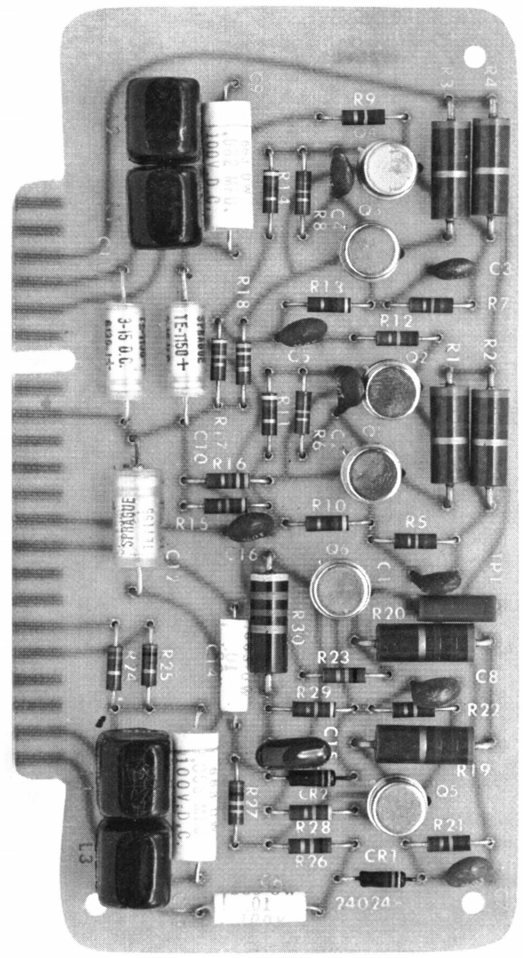


NOTES:

1. UNLESS OTHERWISE NOTED.
   RESISTANCE IS IN OHMS, 1/4 W, 5%
   CAPACITANCE IS IN MICROFARADS, 10%, 600 VOLTS.
2. USED WITH ASSEMBLY D-24021.

AMPEX

103349



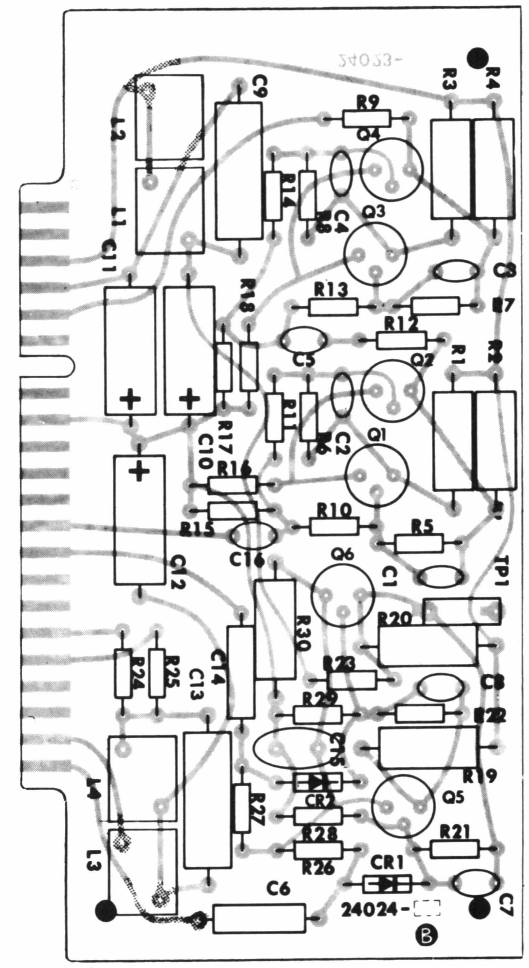


Figure 6-11. PHASE COMPARATOR CARD

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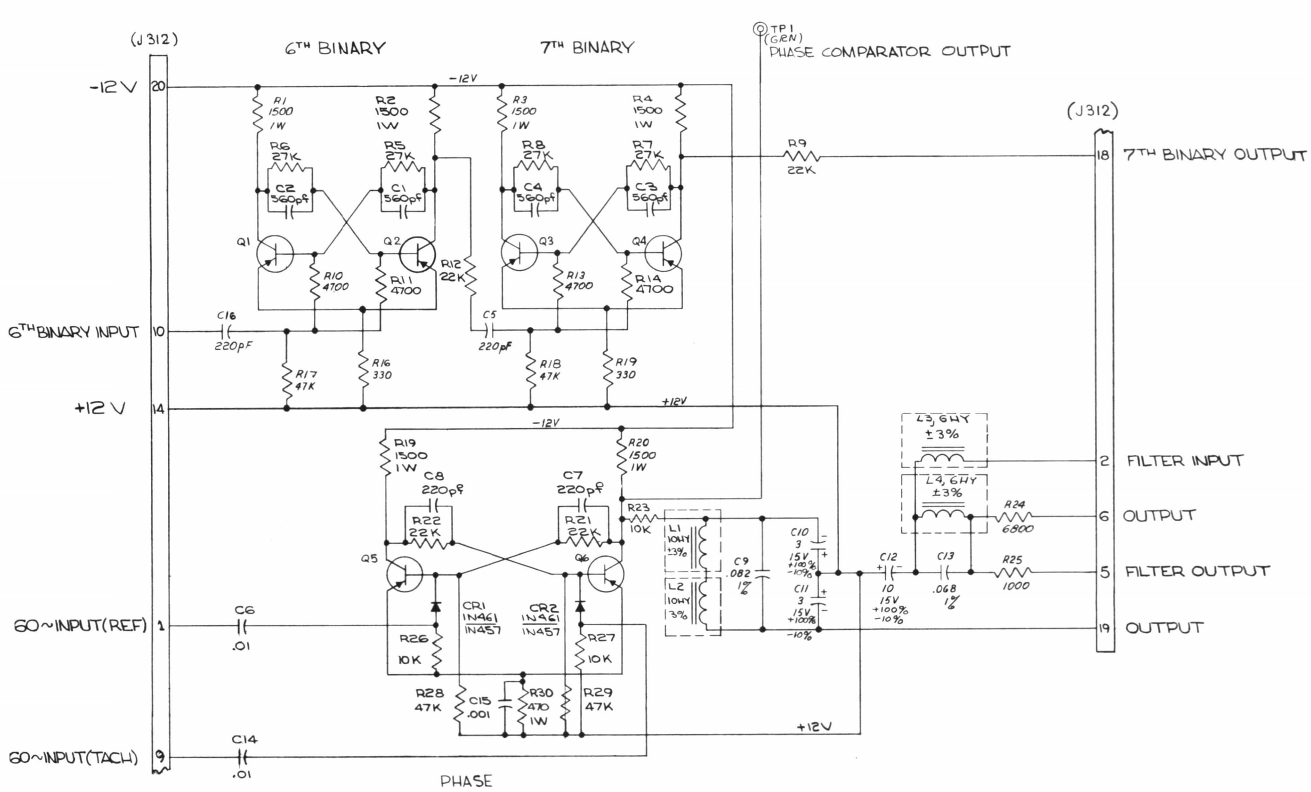
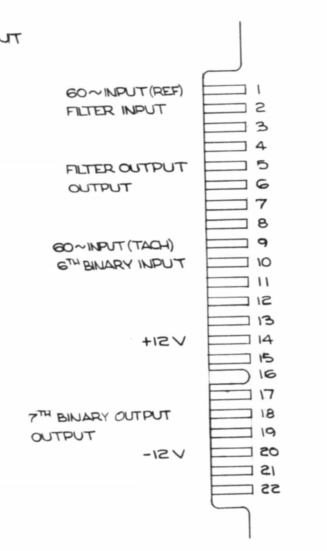
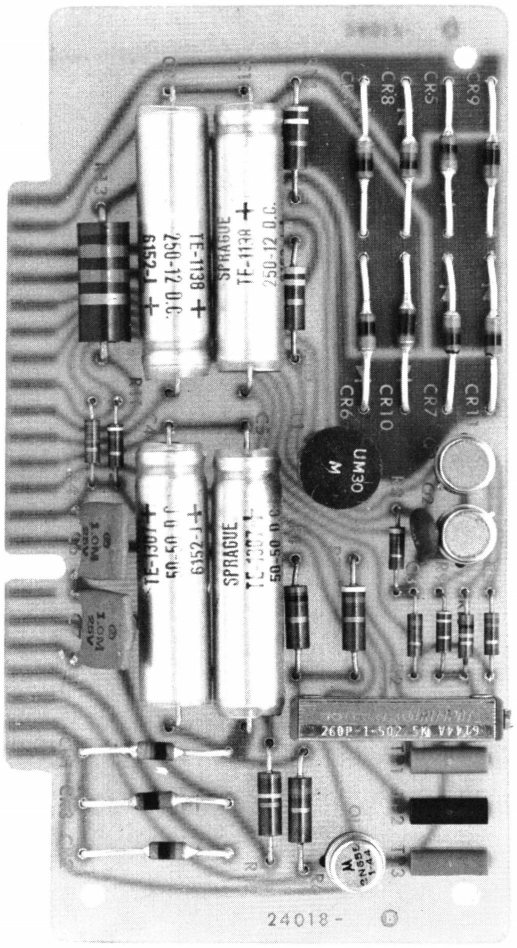




NOTES:
1.- UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 5%, ALL TRANSISTORS 2N404
ALL CAPACITOR VALUES ARE IN MICROFARADS, 10%, 500 VOLTS.
2.- USED WITH ASS'Y NO 24024



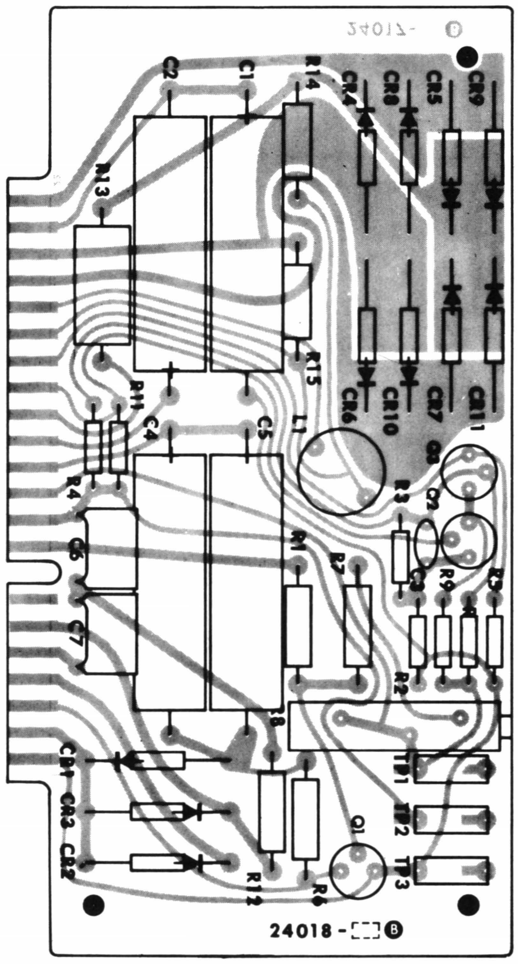


Figure 6-12. POWER SUPPLY CARD

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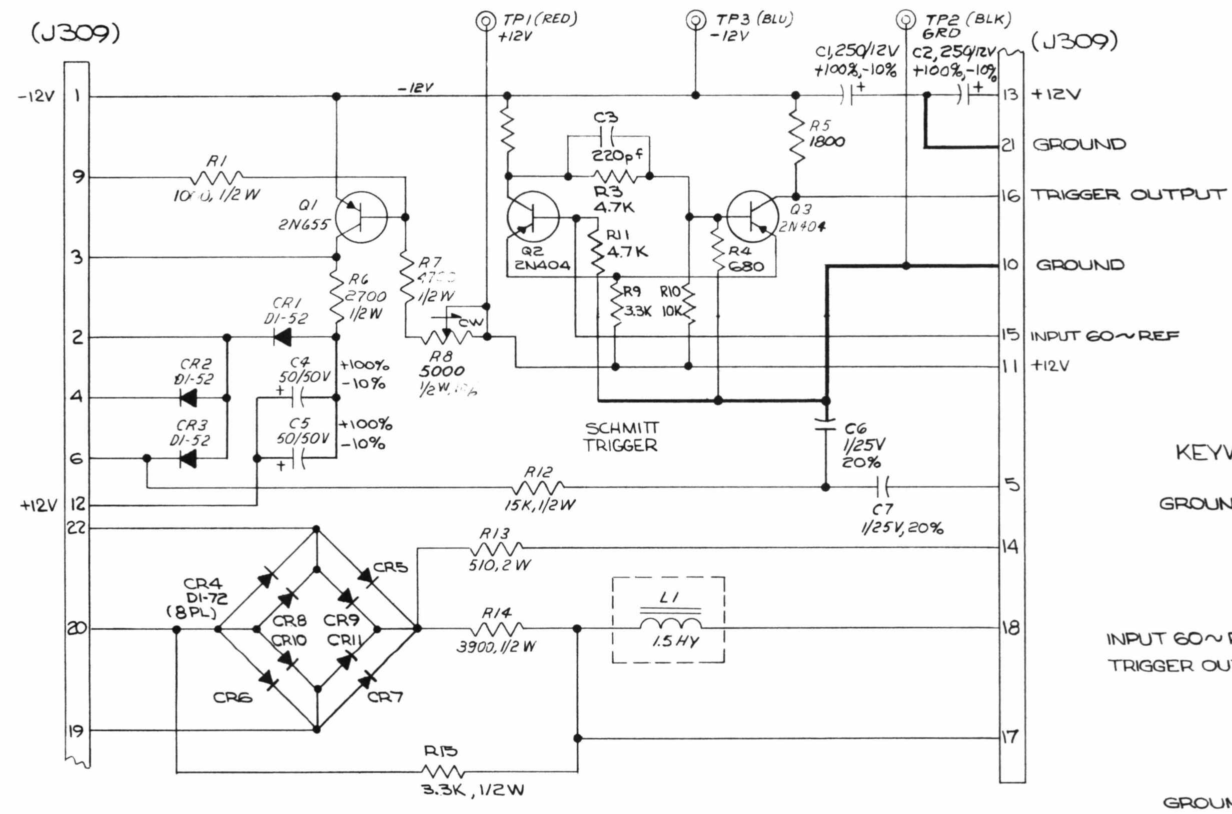

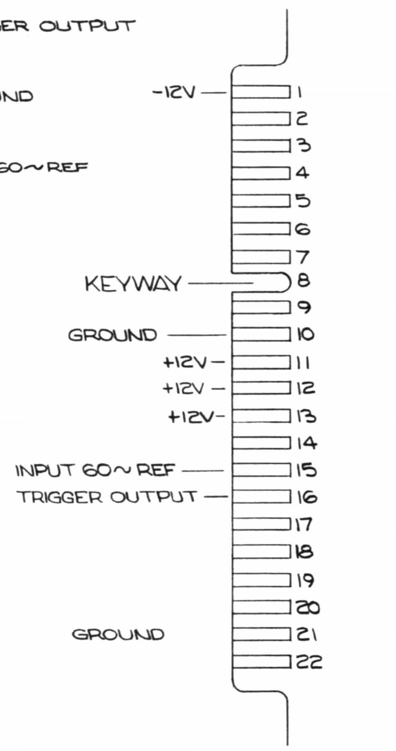

NOTES

1.- UNLESS OTHERWISE SPECIFIED
ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 5%
ALL CAPACITOR VALUES ARE IN MICROFARADS, 10%, 600 VOLTS.

2.- USED WITH ASS'Y NO 24018.

CHAPTER 7

RECORD/REPRODUCE ELECTRONICS

INFORMATION CONCERNING THE ES-100 RECORD AND REPRODUCE (SIGNAL) ELECTRONICS IS SUPPLIED AS A SECOND PART TO THIS MANUAL.

CHAPTER 8

SYSTEM PERFORMANCE TESTS

8-1. The system performance tests are groups of measurements which indicate the overall quality of instrument operation when compared with the specifications given for the instrument. Such tests provide reassurance that the recorder/reproducer is operating correctly, and also indicate need for adjustment or repair. The system performance tests in general require the use of the record/reproduce electronics and functions of the tape transport.

NOTE

Not all performance tests are presented in this preliminary manual. Additional tests will be provided in the final manual.

8-2. FLUTTER MEASUREMENT.

8-3. GENERAL. Flutter is a variation in the otherwise uniform speed of tape passing over the record/reproduce heads of a tape recorder/reproducer. It generally takes the form of a vibration having fairly well defined limits of frequency. Flutter is generated in all tape recorders and reproducers as a consequence of the movement of the tape. "WOW" is a term sometimes used to describe low frequency flutter. This term is not used in the instrumentation field. In properly designed instruments, the level of flutter is attenuated well below objectionable levels. In the FR-1300 transport, flutter is controlled principally by the holdback servo system which decouples tape passing over the heads from tape leaving the supply reel, and the highly stable drive servo system which pulls the tape at a uniform rate over the heads. Flutter is reduced in this instrument by use of the filtering idler assembly and the head idler assembly. Flutter is measured by using the record/reproduce electronics as a diagnostic tool. In general, if high amplitude flutter is detected, instrument bearings should be suspected. Tests for bearing malfunction are given in the corrective maintenance material dealing with each bearing.

8-4. TEST DESCRIPTION. Flutter is measured as a percentage of nominal tape speed, and is specified as a function of the frequency spectrum with which it occurs. Flutter is measured by recording a constant frequency signal on the tape, reproducing the recorded signal by means of an FM reproduce module and monitoring the reproduced signal for variations in frequency. Such variations are the electrical analog of flutter. Flutter is monitored by using an oscilloscope having a calibrated dc vertical amplifier. An adjustable band pass filter placed before the oscilloscope permits flutter measurement to be limited to selected portions of the spectrum. The test setup for measurement of flutter in FM record/reproduce instruments is shown in block form in figure 8-1. If the instrument is of the direct record/ reproduce configuration, it is recommended that an FM record module and an FM reproduce module be used as in figure 8-1 to measure flutter. An FM reproduce module can be used in conjunction with a direct record module if the test setup is changed to that shown in figure 8-2.

8-5. The FM record module generates a center frequency which is sufficiently accurate for flutter tests at all tape speeds. The frequency generated by the module circuitry is different for different tape speeds. In conducting the test, the module is held to center frequency by shorting its signal input terminals. The center frequencies for each tape speed are given in table 8-1.

TABLE 8-1. FM RECORD MODULE CENTER FREQUENCIES*

TAPE SPEED	CENTER FREQUENCY IN KILOCYCLES
In Inches per Second	
60	108.000
30	54.000
15	27.000
7-1/2	13.500
3-3/4	6.750
1-7/8	3.375

* FM Record Module AMPEX Part Numbers 69108-10 and 69110-10

8-6. ADJUSTMENT OF REPRODUCE MODULE FOR FLUTTER TEST. The FM reproduce module and the oscilloscope used for the flutter test must be adjusted together before the flutter test is conducted. The method of choice is shown in block form in figure 8-3. In this figure, the FM reproduce module is supplied with a known signal, and its output signal is used to set the scale of the oscilloscope. This method requires that the signal source be adjustable. The same results can be obtained in the absence of a signal generator by applying an adjustable direct current voltage to the input terminals of the FM record module. (See figure 8-4.) The frequency thus applied to the reproduce module is measured by a counter.

TABLE 8-2. LIST OF TEST EQUIPMENT FOR FLUTTER TEST

ITEM	IDENTIFICATION	REMARKS
1. FM Record Module	AMPEX 69107-10 or 69109-10	Single Speed Electrically Switched
2. FM Reproduce Module	AMPEX 69108-10 with FILTERS or 69110-10	Single Speed Electrically Switched
3. Variable Frequency Signal Source	Hewlett-Packard 200 CD	or equivalent
4. Counter	Hewlett Packard Model 523B	or equivalent
5. Variable Band Pass Filter	KRON-HITE Model 330-M	or equivalent
6. Oscilloscope	Hewlett-Packard Model 130B	or equivalent
7. Tape, Magnetic	AMPEX 743	AMPEX 741 may be used if 743 is not available.

The reproduce module is adjusted together with the oscilloscope for each tape speed before a flutter test is conducted at that tape speed. Test equipment used in this adjustment and in the flutter test is listed in table 8-2.

8-7. To prepare for adjustment of the FM reproduce module and oscilloscope at a selected tape speed of 60 ips, perform the following operations:

1. At the variable frequency source, turn down the amplitude control and turn on power to the unit.

2. Turn on power to the counter.

3. At the oscilloscope, turn down the intensity control and turn on power to the oscilloscope.

4. At the FR-1300, prepare the FM reproduce module for operation at a tape speed of 60 ips by inserting 60 ips filter in accordance with operating instructions. If electrically-switched electronics are installed, this step need not be performed.

5. Insert the module in Channel 6 or Channel 7 position in the module file if the instrument is provided with 14 channels. If a seven channel instrument is under test, insert the module in channel 4 position.

6. At the front of the FR-1300, turn the tape speed selector to the 60 ips position.

7. Turn on power to FR-1300.

8. Following the block diagram of figure 8-3, connect the counter to the variable frequency source.

9. Connect the output signal of the variable frequency source directly to TP3 on the front panel of the FM reproduce module.

10. At the frequency source, select 108,000 cycles per second.

11. Check the frequency with the counter, and adjust the source if necessary.

12. At the oscilloscope select DC vertical deflection. Set the sweep time to 0.1 milliseconds per centimeter, and set the trigger mode to internal sync. Oscilloscope sweep should be free-running.

8-8. To adjust the FM reproduce module and oscilloscope, perform the following operations:

1. At the oscilloscope, set the vertical deflection sensitivity to 50 millivolts per centimeter (0.05 volts/cm).

2. Ground the input probe and set the sweep to the bottom division on the graticule.

3. Connect the oscilloscope input probe to TP1 (OUTPUT MONITOR) on the front panel of the FM reproduce module.

4. Insure that the variable frequency source is operating at 108,000 cycles per second.

5. If the FM reproduce module output is not zero volts as measured on oscilloscope, turn the ZERO adjustment on the module front panel to bring the output signal level to zero.

6. At the variable frequency signal source, increase the input frequency by 10% of its value. Thus 108,000 kc x 10% = 10,800 cycles per second, and the new frequency is the sum: 118,800 cycles per second.

7. At the oscilloscope, the output level of the FM reproduce card should be 0.50 volts dc, or 10 centimeters in amplitude. If this value is not observed, turn the OUTPUT level adjustment on the FM reproduce module panel to bring the output level to this value.

8. Return the signal source frequency to 108,000 cycles per second. The output level observed at the oscilloscope should drop to zero volts.

8-9. The foregoing adjustment insures that a 1% frequency deviation at the input terminal to the FM reproduce module will cause a dc voltage of 0.050 volts to be generated at the module output terminals. It further insures that this level will cause deflection of the oscilloscope trace one centimeter in a vertical direction. The flutter test now follows in which the center frequency for the selected tape speed is recorded on the tape, then recovered from the tape and used to drive the FM reproduce module. In the absence of flutter, it is expected that such an undeviated carrier would produce an output signal from the module of zero volts. Mechanical disturbances, however, cause slight differences between the signal recorded on the tape and the signal recovered from the tape. These disturbances are flutter, and act on the FM reproduce module circuitry as would deviations in the frequency of the recorded signal.

8-10. **FLUTTER TEST SETUP.** To prepare for the flutter test after the calibration has been made, perform the following operations:

1. Clean the record/reproduce heads, guides, and pinch roller. Refer to chapter 9 for instructions.

2. At the speed selector on the side of an **FM** record module, select 60 ips. This step is not required if electrically-switched electronics are installed.

3. At the **FR-1300** insert the **FM** record module in the signal channel corresponding to the channel having the **FM** reproduce module.

4. On the front panel of the module, short the input connector by using a mating connector purposely shorted at its free end. This step insures that the record module output signal will be undeviated.

5. Following the block diagram of figure 8-1 connect the counter to TP3 (connected on the module to J6) and adjust the counter to measure the output frequency. Frequency should be 108,000 cycles per second. If the frequency is other than this, turn the **CARRIER-FREQ.** adjustment on the module front panel to bring the output frequency to the correct value.

6. Connect the input terminals of the variable band pass filter to connector J1 on the front of the **FM** reproduce module.

7. Connect the output terminals of the band pass filter to the oscilloscope input. Provide an adequate ground connection between the oscilloscope, filter, and the FR-1300.

8. Turn on power to the variable band pass filter.

9. At the filter, set the low frequency cutoff to 0.2 cycles per second.

10. Set the high frequency cutoff to 10 cycles per second.

11. Thread the FR-1300 with a full reel of high quality magnetic tape (**AMPEX** tape is recommended). Tape must be in good condition.

12. At the oscilloscope, set the sweep speed to 50 milliseconds per centimeter. Do not disturb other adjustments.

8-11. **THE FLUTTER TEST.** The flutter test described, measures the cumulative flutter as the band of frequencies examined is progressively widened. In this test, the low frequency cutoff is held constant and the cutoff frequency of the upper end of the band is raised by successive increments. At each increment, the level of flutter is recorded. To measure flutter, perform the following operations:

1. On the FR-1300, select the **RECORD** mode.

2. Observe and record the flutter level with the upper limit of the pass band at 10 cycles per second.

3. Raise the high frequency cutoff to each of the frequencies listed in table 8-3, and record the flutter level measured at each increase in the pass band.

TABLE 8-3. PASS BAND WIDTHS FOR CUMULATIVE FLUTTER TEST MEASUREMENTS

LOW FREQUENCY FILTER CUTOFF IN CYCLES PER SECOND	HIGH FREQUENCY FILTER CUTOFF IN CYCLES PER SECOND	FM REPRODUCE MODULE DESIGN -CUTOFF FREQUENCY FOR LISTED TAPE SPEEDS
0.2	10	
0.2	100	
0.2	312	
0.2	625	1-7/8 ips
0.2	1250	3-3/4 ips
0.2	2500	7-1/2 ips
0.2	5000	15 ips
0.2	10,000	30 ips
0.2	20,000	60 ips

8-12. To measure flutter at other tape speeds, follow the method described in the preceding paragraphs. Note that a completely new series of preliminary calibration adjustments must be made each time that a new tape speed is selected. The upper frequency limit for operation of the FM reproduce card varies with the tape speed selected as shown in table 8-3; thus unrealistic data will be recorded if the high frequency filter cutoff is adjusted above 625 cycles per second when the selected tape speed is 1-7/8 ips.

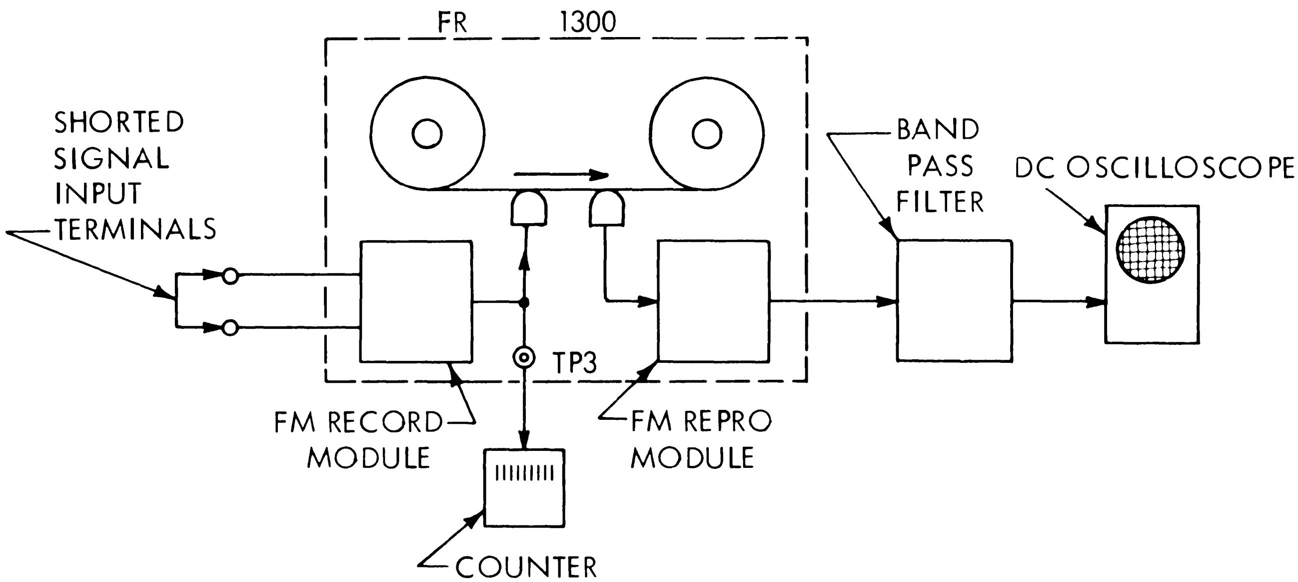

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Figure 8-1. FLUTTER TEST SETUP FOR INSTRUMENTS HAVING FM RECORD/REPRODUCE ELECTRONICS

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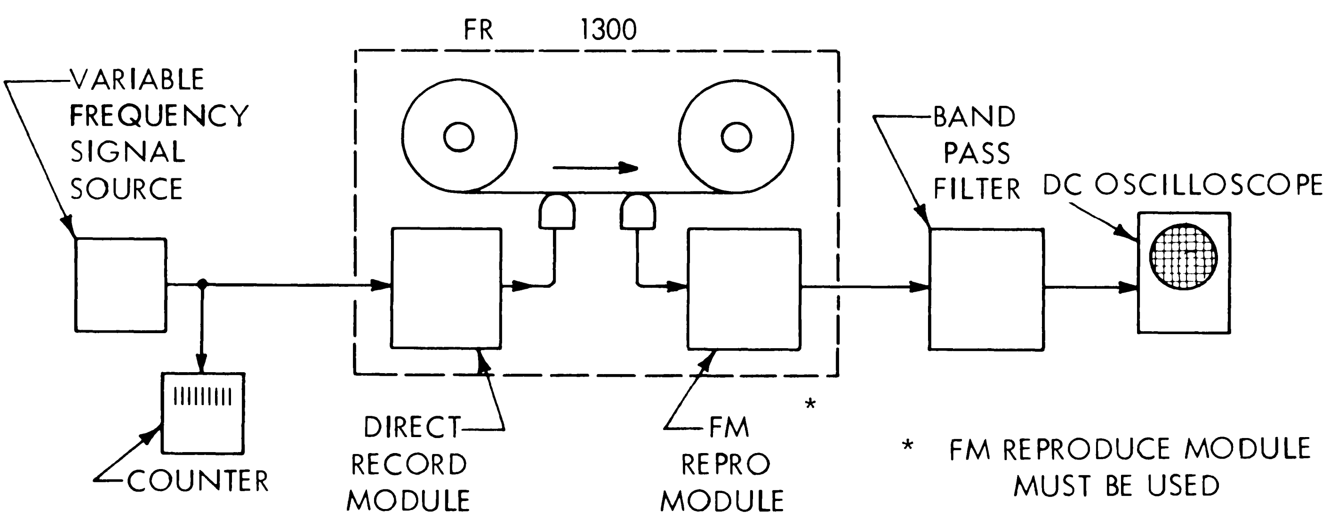


Figure 8-2. FLUTTER TEST SETUP FOR INSTRUMENTS HAVING DIRECT RECORD/REPRODUCE ELECTRONICS

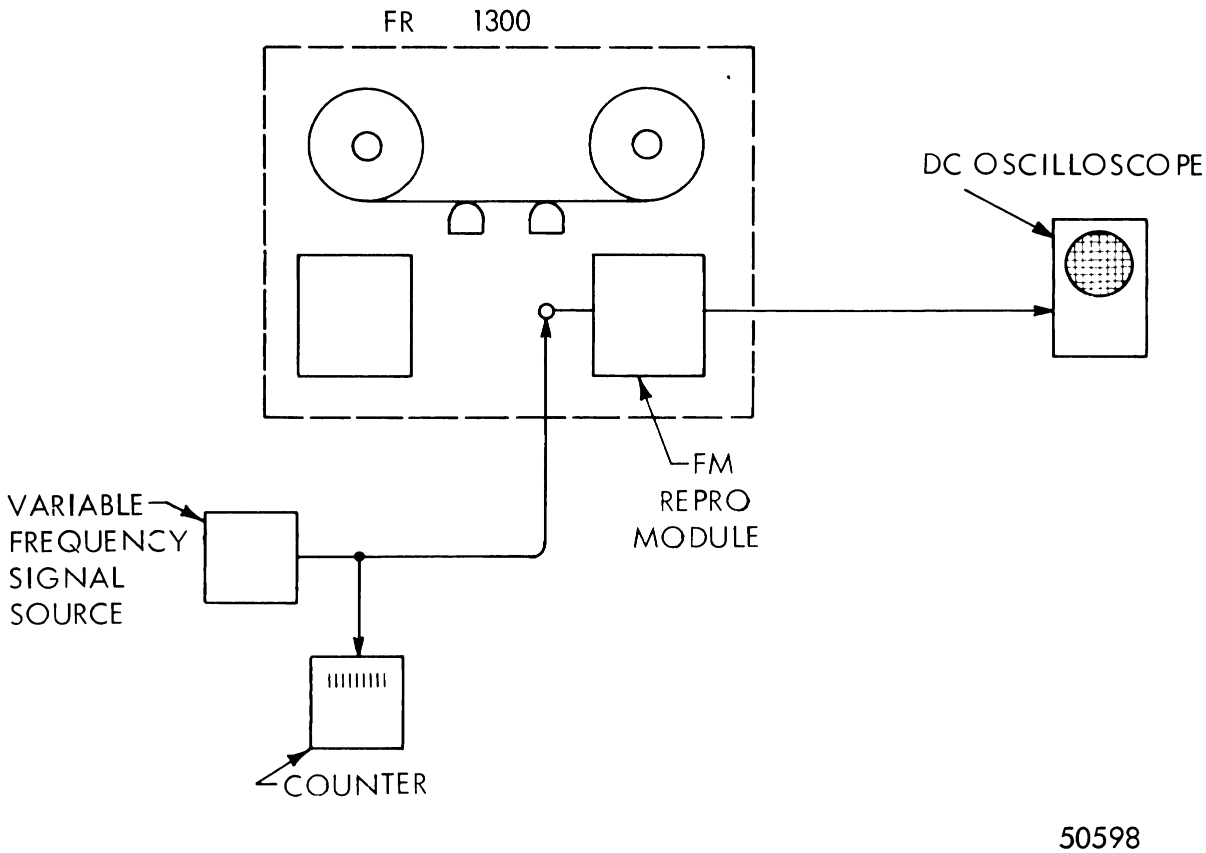


Figure 8-3. CALIBRATION SETUP FOR FLUTTER TEST

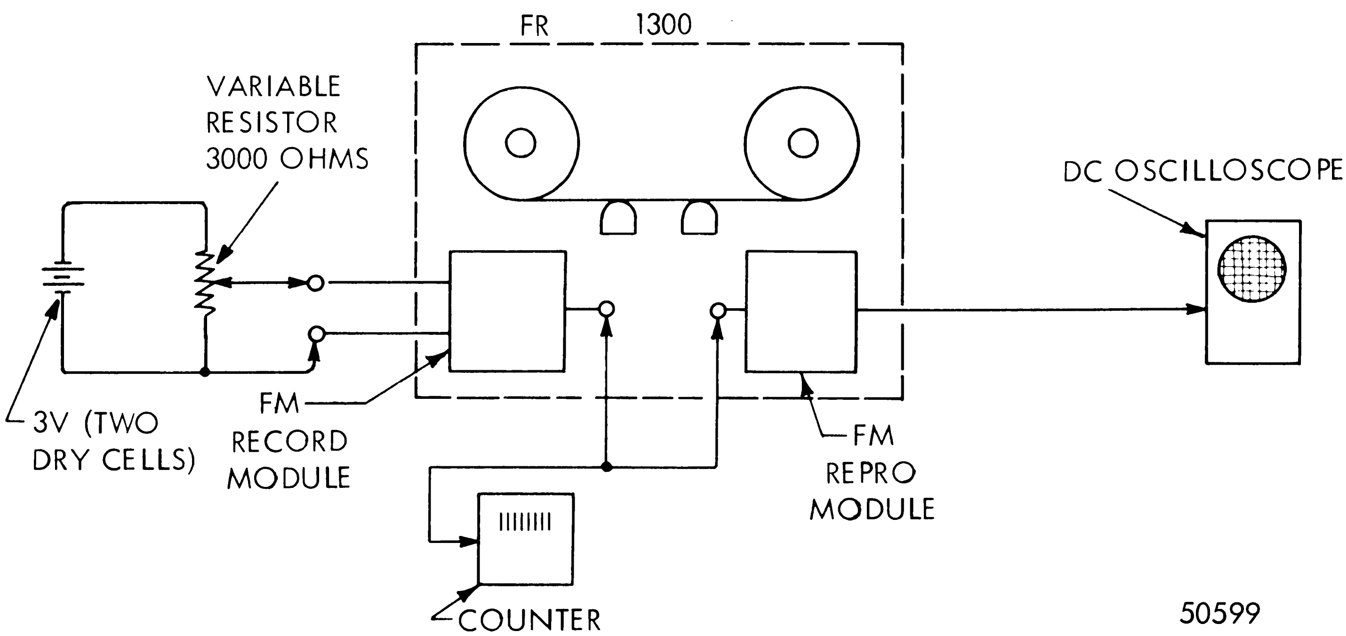


Figure 8-4. ALTERNATE CALIBRATION SETUP FOR FLUTTER TEST

CHAPTER 9

TRANSPORT MAINTENANCE

9-1. Transport maintenance is presented in two parts, preventive maintenance, and corrective maintenance.

9-2. TRANSPORT PREVENTIVE MAINTENANCE.

9-3. Long and satisfactory performance of the FR-1300 tape transport may best be assured by institution of a planned program of preventive maintenance. To be most effective, such a program should commence when the instrument is first placed in operation, and be conscientiously pursued according to a regular schedule. A recommended schedule, based on hours of operation, is provided in table 9-1 and amplified in the following paragraphs. The hours of operation shown in table 9-1 are for guidance only, and should be shortened if the instrument is operated under severe conditions.

TABLE 9-1. PREVENTIVE MAINTENANCE SCHEDULE

No.	Item	Required Maintenance	When	Remarks
1.	Record/Reproduce heads	Clean	every 8 hrs. of operation	refer to P/M procedure
2.	Record/Reproduce heads	Degauss	every 40 hrs. of operation	refer to P/M procedure
3.	Guides, Capstan, and Pinch Roller	Clean	every 8 hrs. of operation	refer to P/M procedure
4.	Filter and Fan	Clean	every 250 hrs.	refer to P/M procedure
5.	Tachometer Windows	Clean	every 500 hrs. of operation	refer to P/M procedure
6.	Holdback Servo Brake Cord	Inspect	every 500 hrs. of operation	refer to corrective maintenance procedure

9-4. RECORD/REPRODUCE HEAD PREVENTIVE MAINTENANCE.

9-5. HEAD CLEANING. The record/reproduce heads should be cleaned of oxide accumulations at least once in each eight hours of instrument operation. To clean the heads, remove head cover and carefully wipe the heads free of oxide using absorbent disposable tissue moistened with AMPEX Head Cleaning Solution, catalog number 087-007. General purpose cotton tipped swabs may be used to clean spaces between heads.

CAUTION

USE ONLY THE RECOMMENDED CLEANING SOLUTION. OTHER AGENTS MAY DAMAGE HEAD LAMINATION ADHESIVE.

9-6. HEAD DEGAUSSING. The record/reproduce heads gradually acquire a certain amount of magnetism while they are in use. This magnetism is cumulative to a degree, and when present, results in a degradation of high frequency response in both the recorded signal and in the reproduced signal. Certain precautions in this regard, if observed, will materially improve the response. They are:

1. Do not connect or disconnect signal input or head connections while the instrument is in the record mode.
2. Do not test continuity of heads with an ohm meter.
3. Do not allow magnetized objects to touch any part of the head group.

9-7. The record/reproduce heads should be degaussed at least once in each eight hours of instrument operation. Degaussing may be accomplished without removing the head group, by using a small hand-held degausser. Alternatively, the head group may be removed from the instrument and be degaussed on an open-type bulk tape degausser.

9-8. To degauss the heads using a hand-held degausser such as the AMPEX Model 704, perform the following operations:

1. Turn off all power to FR-1300.
2. With the degausser at a distance from the head group, apply power (117 V ac 60 cps) to the degausser.

3. Bring the degausser into position near the head group.

4. Starting with the uppermost head, bring the tips of the degausser pole-pieces against the head in such manner that the tips straddle the head gap.

5. Rub the tips up and down the entire length of the head two or three times, with the tips straddling the head gap.

6. Slowly move the degausser from the head, allowing the ac field to diminish gradually.

7. Follow steps 4 through 6 for the remainder at the heads. Turn off the degausser.

NOTE

Do not turn the degausser power on or off while degausser is held near the heads.

9-9. To degauss the heads using an open type bulk tape degausser, perform the following operations:

1. At the transport, remove head cover.

2. Release head group by unscrewing three capscrews shown in figure 9-22.

CAUTION

SUPPORT THE HEADS

3. Grasp head bail and while supporting head group with other hand, gently pull the head group free of the instrument.

4. Turn on power to bulk degausser.

5. Bring head group slowly into the ac field of the degausser with the head-gaps generally turned toward the magnetic field.

6. Move the head group in a circular manner close to the magnetic field, insuring that all heads are equally exposed to the field.

7. After 5 or 6 passes, slowly remove the head group from the ac field.

8. With the head group well away from the degausser, turn off degausser power.

CAUTION

TREAT THE HEAD GROUP WITH CARE, DO NOT STRIKE HEADS. WHEN REPLACING THE HEAD GROUP, BE SURE THAT LOCATING DOWELS ON TRANSPORT FRAME ARE ENGAGED WITH MATING HOLES IN HEAD BASE AND THAT THE HEAD BASE IS SEATED FIRMLY AGAINST THE TRANSPORT FRAME BEFORE CAPSCREWS ARE TIGHTENED. DO NOT OVER-TIGHTEN THESE SCREWS. FAILURE TO OBSERVE THESE PRECAUTIONS MAY CAUSE PERMANENT DAMAGE TO HEAD BASE WHICH WILL IMPAIR ITS OPERATION.

9. Replace head group on transport using steps 1 through 3 as a guide.

9-10. TAPE GUIDES, CAPSTAN, AND PINCH ROLLER PREVENTIVE MAINTENANCE.

9-11. Preventive maintenance of the tape guides, capstan, and pinch roller is limited to cleaning these parts of oxide accumulation. Such cleaning should be accomplished at least once in each eight hours of instrument operation. To clean these parts, wipe them with an absorbent disposable wiper moistened in AMPEX Head Cleaning Solution, catalog number 087-007. General purpose cotton tipped swabs may be used if care is exercised to use only sufficient cleaner to dampen swab.

9-12. FILTER AND FAN PREVENTIVE MAINTENANCE. See figure 9-1.

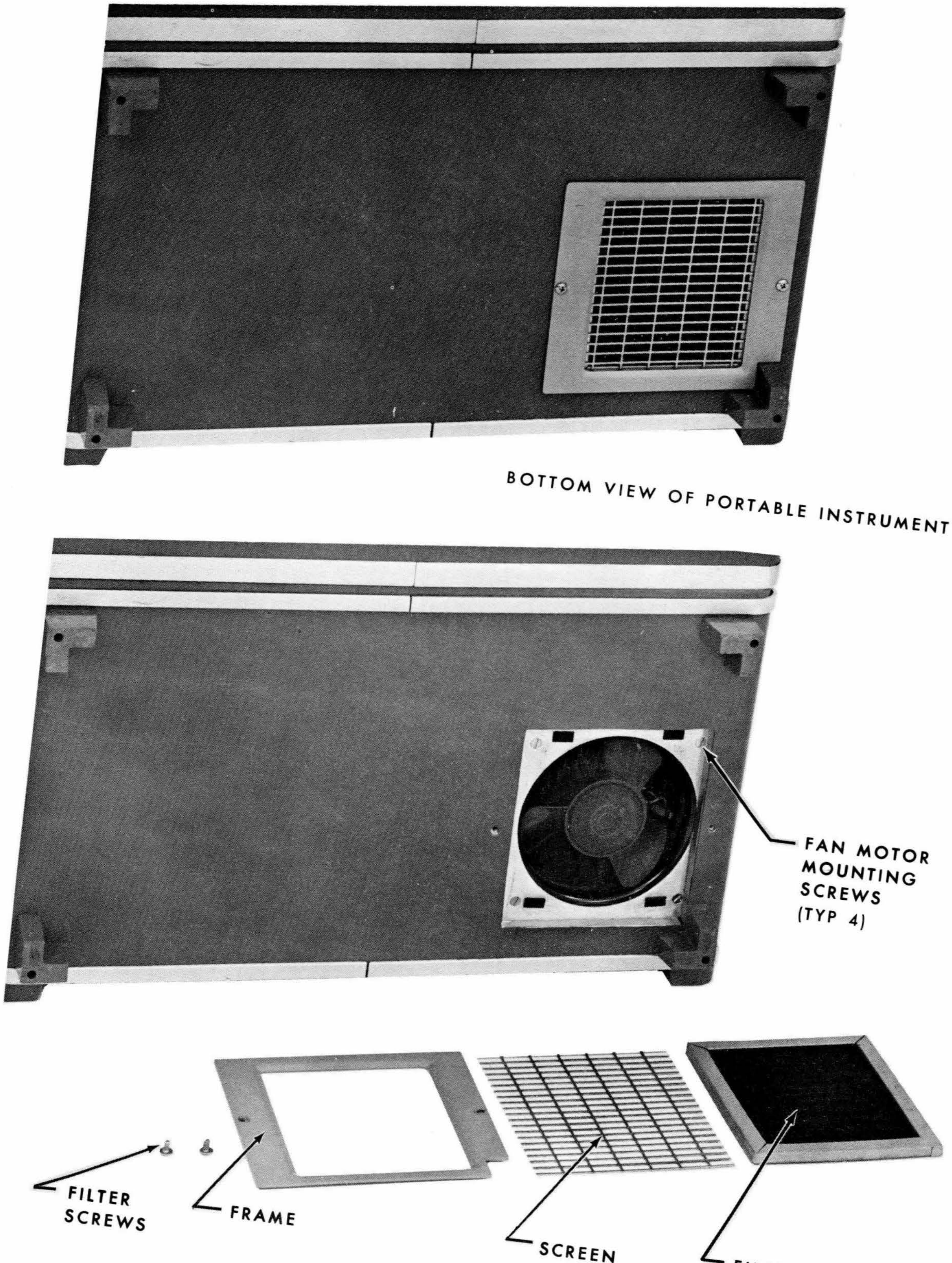
9-13. Preventive maintenance of the filter and fan is accomplished by cleaning both items of accumulated dust. The cleaning procedure is the same for portable and rack -mounted instruments, however, the procedure required to remove the filter differs.

9-14. FILTER REMOVAL IN PORTABLE INSTRUMENTS. To remove the filter from the portable instrument, perform the following operations:

1. Disconnect power to instrument.
2. With the help of an assistant, carefully lift the instrument onto its back, thus exposing the filter on the underside of the case.
3. Remove two screws shown in figure 9-1.
4. Remove filter grille.
5. Lift out filter.

9-15. FILTER REMOVAL IN RACK MOUNTED INSTRUMENT. In rack mounted instruments, the fan and filter are located inside those trays having electronics power supplies. To remove filter, perform the following operations:

1. Disconnect power to instrument.
2. At front of cabinet, release captive screws at either side of tray.
3. Pull out tray carefully and lock in the extended position.
4. On top of tray, loosen six screws which hold access cover.
5. Lift off access cover, thus exposing filter and fan.
6. Lift out filter.



FILTER REMOVED

Figure 9-1. FILTER REMOVAL

8346-15

9-16. FAN CLEANING PROCEDURE. The fan of either the portable or rack-mounted instrument may be cleaned by wiping dust from the blades using a water-dampened cloth or absorbent disposable tissue. If dust accumulation is heavy, a soft paint brush and vacuum cleaner may be employed prior to wiping.

9-17. FILTER CLEANING PROCEDURE. The filter may be cleaned by the following procedure:

1. Remove dust from filter with a vacuum cleaner.
2. Wash filter in warm household detergent.
3. Rinse filter in clear water.
4. Dry filter at room temperature.

NOTE

Do not spray filter with oil.

9-18. TACHOMETER ASSEMBLY PREVENTIVE MAINTENANCE.

9-19. Preventive maintenance of the tachometer assembly consists of removing dust accumulation from the tachometer windows. Cleaning should be accomplished once in every 500 hours of instrument operation in accordance with the following procedure:

1. Remove power from instrument.
2. Remove rear panel of portable instrument following instructions given in paragraph 9-134.
3. Using a clean toothbrush, or a brush of equivalent stiffness, remove dust accumulations from tachometer windows. A vacuum cleaner may be employed in this step.

CAUTION

DO NOT USE AIR PRESSURE OR SOLVENTS TO CLEAN WINDOWS.

9-20 TRANSPORT CORRECTIVE MAINTENANCE.

9-21. In this sub-chapter, procedures are given for isolating, identifying, and correcting the causes of malfunctions which may exist within the tape transport. Each of the transport assemblies is considered separately in terms of its effect on operation of the instrument should it be out of adjustment. Tests are described for each assembly, followed by corrective adjustments and instructions for removal and replacement of certain items. The transport mechanical system is treated separately from the electrical control circuit and the drive servo system. Removal and replacement procedures applicable to several operations are provided at the end of the sub-section.

9-22. MECHANICAL SYSTEMS CORRECTIVE MAINTENANCE.

9-23. In the corrective maintenance instructions which follow, the mechanical systems and assemblies are treated in the same order in which they are described in chapter 4. This order is as follows:

- Tape Guide Assemblies
- Tape Lifter Assembly
- Threading Lever Assembly
- Reel Drive Assembly
- Stopping Brake Assembly
- Hold-back Servo System
- Pinch Roller Assembly
- Capstan Motor

9-24. INPUT AND OUTPUT TAPE GUIDE CORRECTIVE MAINTENANCE. The input and output tape guide assemblies, shown in figures 9-2 and 9-3, are nonrotating, and therefore subject to wear only on the surface in contact with the tape. After prolonged use of the FR-1300, the flanges of the guide may become worn by the edges of the tape to an extent that tape guiding difficulties result. If this condition exists, the guide may be turned to expose a new surface to the tape. Flattening of the guide is not in itself a problem, however, if a used guide is removed, it should be turned to expose an unused surface to the tape when it is reinstalled. The heights of the tape guides are fixed within close limits and must remain within these limits for proper tape guidance. Adjustment of the guide height is required when guides are changed, or if the guide assembly is replaced with a new or different assembly. Height should be checked if the assembly has sustained physical damage. The input guide assembly may be removed from the transport to facilitate guide height adjustment.

9-25. GUIDE ADJUSTMENT, REMOVAL, AND REPLACEMENT. Either guide may be loosened and turned to present a new surface to the tape, or removed from the instrument, using a hex key. To loosen or remove a guide, insert a hex key into the cap screw located in the end of the guide. Turn the key to loosen the guide. If a guide is to be turned, turn the guide 1/2 turn and tighten cap screw. If the guide is to be removed, insure against loss of shims located beneath guide. Reverse the removal procedure to replace a guide or to install a new guide. If guides are changed, the guide height must be adjusted, followed by adjustment of the tape support rod or bracket. Refer to paragraph 9-28.

9-26. INPUT GUIDE ASSEMBLY REMOVAL AND REPLACEMENT. To remove or replace the input guide, perform the following operations:

1. Remove threading lever assembly. (Refer to paragraph 9-60 for procedure.)
2. Remove servo arm spring from pin on guide pedestal. (See figure 9-4.)
3. Remove 3 mounting screws from pedestal, and lift input guide assembly clear of the transport.
4. To replace the assembly, follow steps 1 through 3 in reverse order.

9-27. OUTPUT GUIDE ASSEMBLY REMOVAL AND REPLACEMENT. The output guide assembly is held in place on the transport by a single screw which passes through the transport frame and is threaded into the guide standoff. This screw is accessible from the rear of the transport. To remove the output guide assembly, perform the following operations:

1. Turn off power to the instrument.
2. Remove overlay plate. For procedure, refer to paragraph 9-132.

3. Remove rear panels from portable. For procedure refer to paragraph 9-134.

4. With a long phillips-type screwdriver, loosen the mounting screw. Screw is located below and to the inboard side of the capstan motor. It is recommended that the assembly not be allowed to turn.

5. To replace the output guide assembly, follow steps 1 through 4 in reverse order.

9-28. TAPE GUIDE HEIGHT MEASUREMENT AND ADJUSTMENT. The input and output tape guide heights are set within close limits during manufacture of the instrument. These heights, measured from ground reference bosses on the front of the transport casting, must be maintained for proper tape guidance; the procedure for measuring the height is not given since equipment employed will vary. To prepare for guide height measurement, remove the overlay plate in accordance with instructions given in paragraph 9-132.

9-29. The height of both guides is the same, and is measured from ground reference bosses on the transport frame to the inner tape guide flange marked REFERENCE in figures 9-2 and 9-3. Correct measurements for both guides are as shown in table 9-2. The input tape guide assembly may be removed from the transport for height measurement. For procedure to remove the assembly, refer to paragraph 9-26.

TABLE 9-2. TAPE GUIDE HEIGHT

Tape Width	Height of Inner Flange Above Reference Plane in Inches
One Inch	1.406 ± .001
One-half Inch	1.656 ± .001

9-30. INPUT TAPE GUIDE HEIGHT ADJUSTMENT. The input tape guide height is varied by adding or removing shims below the guide. To add or remove shims, follow the procedure given in paragraph 9-25 for guide removal and replacement. When guide height is changed, the tape support rod (figure 9-2) must be adjusted. The rod, used to facilitate tape threading, should be adjusted so that it is 1/32 ± 1/64 inch below the tape. Adjustment is made by loosening the tape support setscrew located on the guide pedestal; adjusting the height, then tightening the setscrew.

9-31. OUTPUT TAPE GUIDE HEIGHT ADJUSTMENT. The output tape guide height is varied by adding or removing shims below the guide. To add or remove shims, follow the procedure given in paragraph 9-27 for guide removal and replacement. When guide height is changed, the tape support bracket must be readjusted. This bracket, like the tape support rod, is used to facilitate tape threading. The bracket is locked to the standoff by means of a locking screw on the bracket. The outer edge of the bracket should be adjusted so that it is 1/32 ± 1/64 inch below the tape. In making this adjustment, insure that the bracket is properly oriented on the standoff so that it will line up with the slot in the overlay plate.

9-32. SERVO ARM GUIDE ASSEMBLY CORRECTIVE MAINTENANCE. The servo arm guide is flanged, and rotates about its own axis when driven by contact with moving tape. The assembly, shown in figure 9-4, located at the lower end of the holdback servo arm, is held in place by a stud in the arm. The guide rotates on two flanged ball bearings set into the ends of the guide. The bearings and guide are in turn installed on a post which is secured to the servo arm. Maintenance of the assembly is low, and should be limited to replacement of bearings and possibly the guide. Following such changes, the guide height above the transport reference bosses must be measured and adjustment made if necessary. Guide height is adjusted by adding, or removing shims between the base of the post and the servo arm.

9-33. Worn bearings in the servo arm guide may cause an audible noise when the instrument is operated at 60 ips. Some noise in fast modes is normal. If bearings are suspected, but no audible noise is evident, rest the blade of a screwdriver on the exposed screw at the end of the guide and place the ear against the screwdriver handle. This simple test conducted with the instrument operating at 60 ips will readily pin-point faulty bearings. If noise is detected by either means, both bearings should be replaced.

9-34. SERVO ARM GUIDE REMOVAL. To remove the servo arm guide, in order to replace bearings, or the guide, remove the screw from the exposed end of the guide, and slide the guide, with bearings, off the post. Replace the guide in the same manner.

9-35. SERVO ARM BEARING REMOVAL. With the guide removed from the post, remove the bearings from the ends of the guide by pulling outward on the flanges. Note that the guide flanges are formed by flanges on the outer race of each bearing. Press new bearings into place in the ends of each guide using finger pressure on the outer race. Bearings may be installed in a new guide using the same procedure. The guide with bearings is then placed on the post and secured in place by the holding screw. If a new front bearing or new guide has been installed, the guide height must be measured, and adjustment made if necessary. To prepare for measurement, remove the overlay plate following the procedure given in paragraph 9-132.

9-36. SERVO ARM GUIDE HEIGHT MEASUREMENT. The servo arm guide height is measured from the inner flange, marked reference A in figure 9-4, to the ground reference bosses on the transport frame. Correct measurements are given in table 9-3. Guide height is adjusted to the correct measurement by adding or removing shims between the post and the servo arm.

CAUTION

WHEN MAKING MEASUREMENTS, BE CAREFUL NOT TO COMPRESS PRELOADING SPRING.

TABLE 9-3. SERVO ARM GUIDE HEIGHT

Tape Width	Height of Inner Flange Above Reference Plane in Inches
One inch	1.406 ± .001
One-half Inch	1.656 ± .001

9-37. SERVO ARM GUIDE ASSEMBLY, REMOVAL AND REPLACEMENT. Adjustment of the servo arm guide height requires removal of the guide assembly from the arm in order to add or remove shims. To remove the servo arm guide assembly from the arm, hold the servo arm and turn the post counterclockwise with a wrench applied to the flats at the base of the post. Remove the assembly from the arm. Reassemble following the opposite procedure. Note that the retaining stud is secured into the arm with a "liquid stake" adhesive, and should not be loosened.

9-38. FILTERING IDLER ASSEMBLY CORRECTIVE MAINTENANCE. The filtering idler assembly shown in figure 4-1, 4-2, 9-5, and 9-6, provides damping of low frequency vibration in the moving tape. Such vibration, if not damped, would cause flutter in the 15 to 100 cps range of the recorded and reproduced signal. Maintenance of the filtering idler assembly may include replacement of worn bearings, replacement of the shaft, or replenishment of the oil film on which the flywheel turns. Measurements required, following such replacements, are for end play and idler pulley perpendicularity. Adjustment of end play is made from the rear of the transport frame (figure 9-5) by turning the threaded rear bearing assembly in or out. Perpendicularity is adjusted from the front of the instrument by means of two set-screws on the idler support (figure 4-2). Normally, bearings or shaft may be replaced without disturbing perpendicularity provided set-screw adjustment is not changed. Set-screw heads are filled with beeswax to discourage inadvertent adjustment.

9-39. TESTS. Faulty bearings in the filtering idler assembly may be detected during flutter tests if flutter level does not meet the specifications over the range of 200-400 cps. Such a general test is valid only if a flutter-meter is used which has a sharp cut-off characteristic for frequencies above 400 cps. The presence of the oil film between flywheel and idler shaft may be tested by rotating the flywheel while holding the idler. The flywheel should turn smoothly with uniform resistance. Variations in resistance or obvious looseness of the flywheel indicate a need for film replenishment. Bearings may be tested by rotating the flywheel by hand, and allowing it to coast to rest. If the flywheel slows abruptly, bearing failure may be suspected. Another test, conducted with the instrument operating at 60 ips consists of listening for bearing noise by using a screwdriver. The screwdriver blade is rested on the front bearing holder, and the ear placed against the screwdriver handle. The presence of noise indicates a faulty bearing. The rear bearing may be tested in the same manner. Poor tape tracking may be traced to non-perpendicularity of the idler shaft in relation to the frame reference plane.

9-40. REMOVAL AND REPLACEMENT OF FILTERING IDLER. Maintenance of the filtering idler assembly requires removal of the idler shaft and flywheel from the transport. This operation must be performed under conditions of greatest cleanliness since the bearings and shaft ends will be exposed. To remove the filtering idler from the transport, perform the following operations:

1. Turn off power to the instrument.
2. Remove overlay plate. Refer to paragraph 9-132 for removal procedure.
3. Remove record/reproduce head group. Refer to paragraph 9-130 for removal procedure.
4. Remove one screw from end of tape switch, loosen the second screw and swing switch clear.

CAUTION

IN REMOVING IDLER SUPPORT, BE CAREFUL NOT TO KNOCK BEARING HOUSING OUT OF THE SUPPORT.

5. Support the idler shaft and idler support, and with other hand remove 4 capscrews which hold the idler support.
6. Carefully remove the idler support. Handle with care to avoid loss of bearing and bearing housing.
7. Raise the holdback servo arm and carefully remove the filtering idler.
8. The filtering idler is replaced by carrying out steps 1 through 7 as a guide. If a new idler shaft is installed, back out rear bearing assembly one-half turn for added clearance, then measure and adjust for correct end play in accordance with paragraph 9-45.

CAUTION

IN REPLACING FILTERING IDLER, BE CAREFUL NOT TO DAMAGE BEARINGS.

9-41. **REMOVAL AND REPLACEMENT OF IDLER FLYWHEEL.** The flywheel is removed from the idler shaft in order to replenish the oil film on which the flywheel rides, or to replace the idler shaft. Care should be taken during the procedure not to damage the conical ends of the shaft. To remove the flywheel from the idler shaft, perform the following operations:

1. With hex key, loosen setscrews holding rear collar.
2. Remove collar.
3. Slide flywheel off rear end of idler shaft.
4. If shaft is to be replaced, remove front collar. Note that the idler pulley is an integral part of the idler shaft.

9-42. To replace the flywheel on the same shaft after lubrication, use steps 1 through 3 of paragraph 9-41 as a guide. If a new shaft is used, place the front collar on the shaft and lock collar lightly in the approximate operating position, then lubricate both shaft and flywheel bearing. Replace the flywheel on the shaft in accordance with the following procedure:

1. Slide the flywheel onto the shaft sufficiently far enough that the shoulder on the shaft is exposed.
2. Place rear collar on shaft.
3. Insure rear collar is resting on shaft shoulder, then lock the collar to the shaft.
4. Adjust the front collar to provide .005 to .010 inch end play of the flywheel. Flywheel should turn freely on oil film.

9-43. **LUBRICATION OF FLYWHEEL BEARING.** With the flywheel removed from the idler shaft, perform the following operations to lubricate the flywheel bearing:

1. Wipe old lubricant from flywheel bearing and from bearing surface of shaft using disposable wiping tissue. The conical ends of the shaft may be wiped clean during this step.

2. With a clean wooden stick, apply special silicone oil lubricant. DOW-CORNING 200 (30, 000 centistoke viscosity) to the bearing surface of the shaft, and to the flywheel bearing. Insure that the annular groove within the flywheel bearing receives oil.

CAUTION

DO NOT USE OTHER THAN APPROVED LUBRICANT.

9-44. REMOVAL AND REPLACEMENT OF BEARINGS. Bearings used in the filtering idler assembly are each composed of four balls in an enclosed outer race. A central opening in one side of the enclosure admits the conical end of the idler shaft which serves as an inner race. Therefore, if faulty bearings are suspected, one or both bearings may be replaced and further tests as described in paragraph 9-39 conducted to insure correction of the condition. If both bearings have been replaced and faulty operation continues, the idler shaft should also be replaced. The front bearing may be replaced without disturbing the bearing housing, and thereby avoiding the necessity for end play or perpendicularity adjustments. End play must be measured and adjustment made if the rear bearing housing is disturbed, or if a new idler shaft is installed. In carrying out the steps to remove and replace bearings, be careful not to introduce dust into bearings.

CAUTION

DO NOT LOOSEN SETSCREWS IN IDLER SUPPORT. THESE SETSCREWS MAINTAIN THE PERPENDICULARITY OF THE IDLER SHAFT.

To remove the rear bearing, carefully press the bearing out of the adjustable bearing holder by means of a plastic rod or wooden stick inserted from the rear of the holder. In portable instruments this operation may be performed from the front of the transport by using a length of heavy wire having the end bent in a U-shape. The wire is inserted through one of the openings in the spider and the end worked into the rear of the holder to apply light pressure to the bearing.

9-45. **FILTERING IDLER END PLAY MEASUREMENT AND ADJUSTMENT.** End play must be adjusted when a new idler shaft is installed or when the adjustable bearing holder has been disturbed. End play is measured between the outer edge of the idler pulley and the rim of the front bearing holder. This measurement point is called "clearance" in figure 9-5. Clearance should be .010 ± .005 inch. Turn the adjustable bearing holder of the rear bearing assembly to provide this clearance.

9-46. **FILTERING IDLER PERPENDICULARITY MEASUREMENT AND ADJUSTMENT.** For proper tape tracking, the cylindrical surface of the idler pulley must be perpendicular to the plane formed by the reference bosses on the transport frame. Perpendicularity must exist within .001 inch per inch. Adjustment is made using the two setscrews which retain the front bearing holder. A recommended procedure for adjusting the perpendicularity is given in the following paragraph.

9-47. To adjust the perpendicularity of the idler pulley, perform the following operations:

1. Remove power from the instrument.
2. Remove record/reproduce head group.
3. Remove the four screws holding the control cluster, and move the cluster aside, allowing it to be supported by the harness.
4. Remove the standoff nearest the input tape guide pedestal. Note that operations 2 through 4 expose three reference bosses spaced evenly about the periphery of the flywheel.
5. Provide a single arbitrary reference point on the flywheel periphery by marking on the flywheel with a pencil.
6. Measure the height of the reference mark from each of the reference bosses. If the idler pulley is within limit of perpendicularity, the three measurements should agree within .003 inch.
7. If the measurements do not fall within .003 inch, adjust the two setscrews in the idler support using a heated hex key to displace the wax. Measure the perpendicularity after each adjustment.

8. At the conclusion of adjustment, replace the standoff, control cluster and record reproduce heads. Fill the hex socket in each setscrew with beeswax.

9-48. HEAD IDLER ASSEMBLY CORRECTIVE MAINTENANCE. The head idler, shown in figures 4-1, 9-7, and 9-8, provides damping of high frequency vibrations in moving tape. Vibrations damped by the head idler are in the region above 300 cps. Maintenance of the head idler is limited to replacement of bearings and idler roller. End play must be adjusted if either the bearings or the idler roller is replaced. The perpendicularity of the cylindrical surface of the idler roller to the mounting plane of the head base is fixed within extremely close limits at manufacture but is not affected by replacement of idler roller or bearings provided the perpendicularity adjustments are not disturbed. Maintenance operations are performed on the head idler with the head group removed from the transport. It is recommended that all maintenance be performed under best possible conditions of cleanliness.

9-49. TESTS. Faulty bearings in the head idler assembly may be suspected if during flutter tests, the flutter level does not meet the specifications in the frequency range below 300 cps. The idler assembly may be singled out for closer examination, if during such flutter tests at 60 ips tape speed, the flutter level is markedly reduced (more than 10 - 15%) by stopping idler rotation with the finger. Faulty bearings are indicated by such test results. Faulty bearings may also cause audible noise during instrument operation in search mode. Bearing noise may be detected with a screwdriver, by resting the screwdriver tip on the head idler support and listening with the ear against the screwdriver handle. Poor tape tracking may be traced to non-perpendicularity of the idler roller surfaces to the head base mounting plane.

9-50. REMOVAL OF HEAD IDLER ROLLER AND IDLER BEARINGS. The head idler is provided with ball bearings similar in construction to those used in the filtering idler. As in the filtering idler, cone points on either end of the roller shaft act as the bearing inner race. The rear bearing assembly is contained within the head base, and is accessible from the bottom of the base. End play of the idler is adjusted at the rear bearing assembly. The front bearing assembly is located in the end of the head idler support. The bearing is held in a bearing housing which is retained and positioned in the support by means of two setscrews and ball-and-spring spaced at 120° intervals about the support. The perpendicularity of the idler roller is fixed by adjustment of these setscrews. Perpendicularity of the cylindrical surfaces of the roller and the head base reference plane is accurately fixed during manufacture of the head assembly and great care must be taken when removing and replacing bearings to avoid disturbing the bearing housing.

CAUTION

IN PERFORMING BEARING REMOVAL OPERATIONS, DO NOT LOOSEN HEAD IDLER SUPPORT, OR CHANGE ADJUSTMENT OF THE PERPENDICULARITY SETSCREWS. BE CAREFUL NOT TO DISTURB THE POSITION OF THE BEARING HOUSING WHEN REMOVING THE BEARING.

9-51. To remove the head idler roller and idler bearings, perform the following operations:

1. Turn off power to the instrument.
2. Remove the record/reproduce head group from the transport following the procedure given in paragraph 9-130.
3. At the back of the head base, use a heated hex key to remove the cone-point setscrew which retains the idler rear bearing. Remove the spring and bearing by turning the head group over while holding the hand under the rear bearing assembly to catch the parts.
4. Remove screw holding dust shield clamp.
5. Press idler roller toward rear of head base to free roller front bearing surface from front bearing.
6. Lower front end of roller and remove roller from the assembly.

CAUTION

DO NOT PERMIT THE FRONT BEARING HOUSING TO ROTATE SINCE PERPENDICULARITY MAY BE AFFECTED.

7. Remove front bearing by pressing on the back of the bearing with a plastic or wooden stick inserted into the bearing holder from the front of the head idler support.

9-52. REPLACEMENT OF HEAD IDLER ROLLER AND IDLER BEARINGS. To replace the roller and bearings in the assembly, perform the following operations:

1. Place the spring in the rear bearing assembly.
2. Hold spring in place with the cone-point setscrew. Do not tighten setscrew.
3. Place front bearing in front bearing holder.
4. At the front of the head base, insert the rear bearing into the bearing assembly to the point where it is supported by the spring.
5. Place dust shield clamp over dust shield in proper relation for assembly.
6. Slide dust shield and clamp over the after shaft of the idler roller.
7. Holding the idler roller, insert the conical point of the after shaft into the rear bearing.
8. Press the rear bearing inward against the spring until sufficient clearance is gained to enable the point of the front shaft to be placed into the front bearing.
9. Insure that the idler roller shaft tips are inserted into bearings, then gently tighten the cone point setscrew to permit bearings to support the roller. Do not over-tighten.

CAUTION

DO NOT OVER-TIGHTEN BEARINGS. END PLAY MUST EXIST OR BEARINGS WILL BE RUINED.

10. Loosely fasten dust shield clamp.
11. Carefully center the dust shield about the rear roller shaft, insuring that the shield does not touch the shaft.

12. Tighten the clamp, then recheck to insure that dust shield does not contact the shaft.

13. Adjust the roller end play in accordance with the procedure given in paragraph 9-53.

9-53. HEAD IDLER END PLAY ADJUSTMENT. End play adjustment is required following replacement of the idler roller and bearings in order to insure proper bearing loading. Adjustment is performed by means of the cone-point setscrew, and measurement made between the front bearing holder rim and outer edge of roller when the roller is pressed rearward against the spring. To adjust the end play, turn the cone-point setscrew into the head base to the point where the roller will move against the spring a distance of 1/32 ± 1/64 inch.

9-54. HEAD IDLER PERPENDICULARITY. The perpendicularity of the roller surface of the head idler to the mounting plane of the head base is set during manufacture to an accuracy of .0005 inch/inch. The adjustment, consisting of two setscrews in the idler support, are sealed with beeswax following adjustment. Non-perpendicularity of the roller to reference plane will cause faulty tape tracking. Should this condition be suspected, carefully remove the head group from the instrument and place it on a surface plate. Using a square and guage, measure the perpendicularity of the roller to the surface plate. If non -perpendicularity is confirmed, it is recommended that the head group be returned to the AMPEX Corporation for adjustment.

9-55. TAPE LIFTER ASSEMBLY CORRECTIVE MAINTENANCE. The tape lifter, shown in figures 9-9 and 9-17, should seldom require attention, except after long use of the instrument or in the event of damage to the assembly. The lifter fingers are non-rotating and therefore subject to slight wear on the surface contacted by the tape. The procedure is given for rotating the fingers should the need arise. Removal and replacement of the assembly is not given since these operations, if required, are straightforward and may be performed using the exploded view, figure 9-9 , as a guide. Adjustment of the tape lifter assembly consists of adjusting the height to which the tape is raised above the head idler when the lifter solenoid is energized. In preparation for such maintenance, remove the overlay plate in accordance with instructions given in paragraph 9-132.

9-56. TAPE LIFTER FINGER ADJUSTMENT, REMOVAL, AND REPLACEMENT. The tape lifter fingers are each held in place on the bellcranks by a setscrew. To turn the lifter finger to present a new surface to the tape, loosen the setscrew using a hex key. Turn the finger one-half turn, and tighten the setscrew. The finger may be removed when the setscrew has been loosened, by pulling straight out on the finger. If a used finger is removed, or becomes loose, it should be turned to expose an unused surface to the tape when it is re-installed.

9-57. TAPE LIFTER ASSEMBLY TEST, AND ADJUSTMENT. The tape lifter assembly is tested to insure that the lifter fingers raise the tape clear of the head idler. To test the clearance, perform the following operations:

1. With tape threaded, and power applied to the instrument, place the FR-1300 in the STOP mode.
2. At the head idler, measure the clearance between the idler roller and the surface of the tape. Clearance should be $1/32 \pm 1/64$ inch. Should the clearance require adjustment, refer to the following paragraph.

9-58. To adjust the lifter clearance, perform the following operations:

1. Turn off electrical power to the instrument.
2. Remove overlay plate. Procedure is given in paragraph 9-132.
3. Install reels, and thread tape on instrument.
4. Apply power and place instrument in STOP mode.
5. With screwdriver, loosen the solenoid mounting screws.
6. Slide the solenoid up, or down, to provide correct clearance between head idler and tape.
7. Lock the solenoid in place.
8. Remove power from the instrument.

9. Remove remove reels and tape.

10. Replace overlay plate.

9-59. THREADING LEVER ASSEMBLY CORRECTIVE MAINTENANCE. See figure 4-4. Maintenance of the threading lever assembly is limited primarily to adjustment of the release mechanism. The threading lever and slider must be removed to gain access to the input guide pedestal mounting screws, and to gain access to the holdback servo arm bearing. The slider is lubricated at assembly and should not normally require additional lubrication. If however, lubricant is needed, use Lubriplate #107 (grease).

9-60. REMOVAL OF THREADING LEVER AND SLIDER. To remove the threading lever and slider, remove three E-rings from the pins on which the slider rides. Remove fiber washers, then lift off the lever and slider.

9-61. ADJUSTMENT OF THREADING LEVER RELEASE MECHANISM. The threading lever is locked in the raised operation by a detent, which is tripped by the pivot arm when the brakes are applied. The pivot arm is operated by an adjustable collar on the takeup brake rod. When the mechanism is operating properly, the lever is released immediately before the brakes are released. To adjust the release, lift the threading lever into tape threading position, then move and lock the collar on the brake rod at the point where the lever drops when the brake solenoid plunger is depressed by hand to the point where brake spring tension is felt.

9-62. REEL DRIVE ASSEMBLY CORRECTIVE MAINTENANCE. Maintenance of the reel drive assembly consists principally of adjustment of the drive belt tension, and adjustment of the tightness of the reel hold-down knob assembly. Turntable bearing failure is not predictable, but if it occurs, it may cause an audible noise during instrument operation, and a feeling of "roughness" when the turntable is rotated by hand with brakes off. Procedures for removal and replacement of the turntable bearings and the torque motors are given following the adjustment procedures.

9-63. DRIVE BELT TENSION ADJUSTMENT. See figure 9-10. The tension of each drive belt is adjusted by repositioning the motor in relation to the turntable. Motors are repositioned by loosening the four screws which hold them to the frame. Belt tension is measured by firmly resting a straight edge on the belt so that the pulley and turntable are bridged, then at the midpoint of the belt span, pressing the felt inward with 1 lb. load. The amount of deflection of the belt away from the straight edge is indicative of belt tension. Adjust the belt deflection to the values given in table 9-4.

TABLE 9-4. BELT TENSION

Belt Identity	Deflection in Inches
Supply	3/8 ± 1/32
Takeup	1/8 ± 1/16

9-64. HOLD-DOWN KNOB TIGHTNESS ADJUSTMENT. See figure 9-11. The reel hold-down knob occassionally becomes loose after long use. To tighten the knob, perform the following operations:

1. Remove cover from front of knob by loosening setscrews at either end. This operation exposes a large pivot screw.
2. Loosen retaining setscrew in side of knob assembly using hex key.
3. Tighten large pivot screw until knob locking cam turns smoothly without looseness.
4. Tighten retaining setscrew.
5. Replace cover.

9-65. REMOVAL OF TURNTABLE BEARINGS. See figures 4-5, 9-11, and 9-12. Turntable bearings of either assembly may be removed from the portable instrument without removing the transport. This is accomplished by removing in succession the hold-down knob, spacer, dust cover, and shims, then removing the bearing housing by working through the spokes of the turntable. The bearings may be removed from the rack-mounted instrument, or a portable from which the transport has been removed, by dismounting the entire turntable then removing the bearing housing. Preliminary operations for either approach include removal of the overlay plate and the drive belt, and disconnection of brake cord(s).

9-66. REMOVAL OF TURNTABLE BEARINGS FROM PORTABLE INSTRUMENT. To remove the turntable bearings of the portable FR-1300 without removing the transport from the case, perform the following operations:

1. Turn off power to instrument.
2. Remove overlay plate following procedure given in paragraph 9-132.
3. Loosen screws holding torque motor, relieve belt tension, then remove belt from torque motor pulley.
4. Disconnect one end of brake cord. If supply turntable bearing is being replaced, also disconnect one end of holdback servo brake cord.
5. At hold-down knob, remove cover, loosen setscrew and back out large pivot screw below cover. This step removes cam and handles. Refer to paragraph 9-64 and figure 9-11.
6. Remove three flat-head screws which fasten the reel hold-down base to turntable.
7. Remove hold-down base, dust cover, and shims from face of turntable.
8. Working through spokes of turntable, remove screws which hold the bearing housing.
9. Remove the turntable and bearing housing from the transport. (Orientation of housing in transport frame need not be marked.)
10. At rear of bearing housing, remove self-locking nut from end of turntable shaft, and remove turntable from bearings using hand pressure only.
11. Press bearings out the ends of the housing using hand pressure exerted through a plastic rod or wooden stick.

9-67. New bearings may be installed by pressing them into each end of housing by hand. Do not force bearings into housing. Replacement of the assembly into the transport is accomplished using the removal steps as a guide. When the turntable is secured into the bearings by means of the locking nut, care should be taken to provide .005 to .010 inch end play.

CAUTION

DO NOT OVER-TIGHTEN NUT OR BEARINGS WILL BE DAMAGED.

Adjust belt tension in accordance with instructions in paragraph 9-63.

9-68. REMOVAL OF TURNTABLE BEARINGS FROM RACK-MOUNTED INSTRUMENT. Turntable bearings may be removed from the rack-mounted instrument, and from portable instruments from which the transport has been removed, by the following operations:

1. Peform steps 1 through 4 of the preceding paragraph in which bearing removal in the portable instrument is described.

2. At rear of transport, remove self-locking nut from end of turntable shaft.

3. Remove turntable from front of transport.

4. Remove bearings from bearing housing using hand pressure exerted on the outer race through a plastic rod or wooden stick.

5. New bearings may be installed by the procedure given in the preceding paragraph.

9-69. TURNTABLE HEIGHT ADJUSTMENT. The turntable height is measured from the reference surfaces on the front of the transport frame to the top of the dust cover disk located behind the cork spacer. This measurement should be 1.237 ± .003 inch for both turntables. Adjustment is made by adding or removing shims (figure 4-5) between the turntable and the dust cover. This adjustment requires removal of the hold-down knob, spacer, and dust cover, and is described in steps 5 through 7 of the paragraph relating to the removal of turntable bearings in the portable instrument.

9-70. TORQUE MOTOR REMOVAL. The torque motors may be removed from either the portable or rack-mounted instrument by the following procedure:

1. Turn off power to the instrument.
2. Remove overlay plate in accordance with instructions in paragraph 9-132.
3. On portable instruments, remove the rear panel in accordance with instructions in paragraph 9-134.
4. Remove cable clamp from motor electrical harness.
5. On rear of control chassis, below takeup torque motor, remove P305 if the supply motor is to be removed, and P304 if the takeup torque motor is to be removed. (See figure 9-10.)
6. On front of transport, remove pulley.
7. Remove 4 screws holding motor. Support motor while removing screws.
8. Remove pulley.
9. Remove motor.
10. Reinstallation of the motor is accomplished by performing removal steps in inverse order. On completion of reinstallation, adjust pulley height and belt tension.

9-71. PULLEY HEIGHT ADJUSTMENT. Pulley height is measured from the ground reference bosses on the front of the transport frame to the inner side of the pulley. This measurement, shown in figure 9-10, should be 1/16 inch for both torque motors. Correct clearance is obtained by sliding the pulley in or out on the torque motor shaft to the correct point, then locking the pulley in place.

9-72. STOPPING BRAKE ASSEMBLY CORRECTIVE MAINTENANCE. The stopping brake assembly, shown in figures 4-6 and 9-13, consists of a supply brake assembly, a takeup brake assembly, and a brake solenoid common to both assemblies. The supply brake only is described in the corrective maintenance measures since adjustment of the takeup brake is identical. Corrective maintenance of the stopping brake assembly is primarily limited to adjustment of the brake cords. Faulty braking is indicated by tape loops thrown when tape motion is stopped, as in transferring the instrument from a tape handling mode (DRIVE, RECORD, FWD or REW) to the STOP mode. Such loops, if occurring, are caused by insufficient braking of the trailing reel, or excessive braking of the leading reel. Faulty braking action is normally corrected by adjustment of the brake cords. If, however, oil or other contaminant has come into contact with the brake cord, or turntable groove, the cord should be replaced. If a replacement brake cord is not available, the contaminant may be washed from the cord by soaking the cord in an industrial solvent such as naptha, or carbon tetrachloride. The cord must be scrubbed to remove contaminant, then dried before reinstallation.

WARNING

OBSERVE PRECAUTIONS APPLICABLE TO THE SOLVENT USED. FIRE HAZARD, VENTILATION, AND EFFECTS ON SKIN MUST BE CONSIDERED.

9-73. STOPPING BRAKE ADJUSTMENT. Adjustment of the stopping brake is performed in two parts; adjustment of the linkage when the brake is applied; and adjustment of the linkage when the brake is released. Clearance is measured for both parts of the adjustment, between the brake arm and the stop pin. See figure 4-6. To adjust the stopping brakes, perform the operations described in the following paragraphs.

9-74. To adjust the brake linkage with the brake applied, perform the following operations:

1. Turn off power to instrument.
2. Remove the overlay plate in accordance with instructions in paragraph 9-132.
3. Measure clearance between the brake arm and the stop pin. Clearance should be 1/16 ± 1/64 inch. If clearance is incorrect, perform the next step. If clearance is correct, perform second part of adjustment. Refer to paragraph 9-75.
4. Adjust the linkage for correct clearance by loosening and moving the brake cord anchor. When correct clearance is reached, lock the anchor in place. Perform second part of adjustment.

9-75. To adjust the brake linkage with the brake released, perform the following operations:

1. Hold brake solenoid plunger in bottomed position during measurement and adjustment.
2. Measure clearance between the brake arm and the stop pin. Clearance should be 5/32 ± 1/32 inch. If clearance is correct, adjustment is completed. If clearance is incorrect, proceed to the next step.
3. At the bellcrank, adjust the clearance to correct value by loosening the collar holding the brake rod and sliding the brake rod within the collar. When correct adjustment is reached, lock the collar. If takeup brake is adjusted, the tape lifter detent may require adjustment. This operation is described in paragraph 9-55.

9-76. BRAKE CORD REMOVAL. See figure 4-6. To remove the brake cord, perform the following operations:

1. Turn off power to the instrument.
2. At the brake anchor, compress the high-torque brake spring while holding T-shaped brake cord anchor connector.
3. Remove spring retainer from anchor connector, and remove spring. This step frees one end of brake cord.
4. At the brake arm, remove low-torque brake spring from spring anchor pin.
5. At the bellcrank, loosen collar and slide the brake rod clear of collar. Remove collar.
6. At the brake arm, remove grip-ring from pivot pin.
7. Remove brake arm and brake cord from transport.
8. On back of brake arm, remove grip-ring on retaining pin.
9. Carefully remove pin from brake arm, noting the order of assembly of the spacer, brake arm connector, and spring. This step frees cord from brake arm.

9-77. BRAKE CORD REPLACEMENT. To replace a brake cord, perform the following operations:

1. Secure the brake arm connector of the cord to the brake arm using steps 8 and 9 of paragraph 9-76 as a guide.

2. Reinstall the brake arm on transport, and replace brake rod and collar.

3. If the cord is being installed on the supply turntable, wrap the brake cord clockwise into the wide groove located toward the rear of the turntable. Bring the start of the second turn in front of the first turn already laid in the groove.

4. If the cord is being installed on the takeup turntable, wrap the brake cord counterclockwise into the wide groove, then follow additional instructions in step 3.

5. Secure anchor connector of brake cord to the brake anchor using steps 2 and 3, paragraph 9-76 as a guide.

6. Following installation of brake cord, perform brake adjustment. (Refer to paragraph 9-73.)

NOTE

New brake cord may cause erratic operation during first minutes of use.

9-78. BRAKE SOLENOID REMOVAL. To remove the brake solenoid, perform the following operations:

1. Turn off power to instrument.

2. At bellcrank, remove return spring.

3. Loosen brake rod collars, remove brake rods and collars.

4. Remove grip-ring on bellcrank pivot pin.

5. Hold solenoid, and remove two screws which secure the solenoid to transport frame.

6. Lift solenoid to remove bellcrank from pivot pin, then move solenoid aside to expose terminal board TB403.

7. Remove solenoid connections from terminal board.

8. Remove solenoid from transport.

9. With pin punch, drive out rolled pin at end of solenoid plunger, thus freeing bellcrank.

10. Remove mounting block from side of solenoid.

11. Replace the solenoid with a new solenoid using the steps of removal as a guide. When assembling the mounting block to the solenoid, use LOCTITE, Grade "C" (AMPEX part number 018-030) or an equivalent liquid-stake on screw threads.

CAUTION

TO AVOID DAMAGE TO SOLENOID WINDINGS, USE SCREWS OF CORRECT LENGTH TO SECURE MOUNTING BLOCK TO SOLENOID.

When the solenoid has been replaced, adjust the assembly in accordance with instructions in paragraph 9-73.

9-79. HOLDBACK SERVO SYSTEM CORRECTIVE MAINTENANCE. See figure 4-8, 9-13 and 9-14. Maintenance of the holdback servo system is generally limited to adjustment of the servo system brake and linkage, and to occasional replacement of the brake cord. A need for brake adjustment is indicated if during instrument operation in the drive mode, the distance between the servo arm and the stop pin (figure 9-14) becomes less than 5/16 ± 1/32 inch. Brake adjustment is also indicated if during instrument operation in the drive mode, the brake link slot is not centered about the limit pin. This latter inspection is made with the overlay plate removed and no tape on the instrument. (The servo arm must be manually lifted from end-of-tape switch.) Brake cord life is largely determined by the type of service required of the instrument. Constant operation at 60 ips tape speed will result in shorter cord life than operation of slower speeds. If the instrument is operated at high speeds, the brake cord should be inspected for wear once in 500 hours of operation. At lower speeds the inspection can be made at longer intervals. Wear of the brake cord is indicated by fraying of the nylon sleeve of the cord. If wear exists, the cord should be replaced. Blackening of the cord does not degrade servo operation. Gross tape mistracking at the capstan when the drive mode is entered may be traced to a loss of holdback tension. Such mistracking, most noticeable at 60 ips, is evidenced by expulsion of tape to one side of the pinch roller. The cause may be mechanical or electrical. In the following paragraphs, replacement of the brake cord is discussed first, followed by a procedure to adjust the linkage. Adjustment of tape tension is described last.

9-80. SERVO BRAKE CORD REMOVAL AND REPLACEMENT. A new brake cord should be installed when the cord in use becomes frayed. After replacement of the cord, the linkage must be adjusted and tape tension regulated. The brake cord and the brake link to which the cord is riveted are removed and replaced as a unit. To remove the brake cord perform the following operations:

1. Turn off power to the instrument.
2. Remove overlay plate in accordance with procedure in paragraph 9-131.
3. Remove grip-ring from pin on adjustable anchor and free brake cord-end.
4. Remove grip-ring from limit pin.
5. Remove grip-ring from rocker arm pin, and remove fiber washer.
6. Remove brake link and attached cord from the transport.

9-81. To replace the brake cord, wipe out the turntable groove with wiping tissue, moistened with a solvent such as carbon tetrachloride, and install brake cord using steps 3 through 6 of paragraph 9-80 as a guide. If a new cord is installed, perform the linkage adjustment and measure tape tension.

WARNING

OBSERVE PRECAUTIONS APPLICABLE TO THE SOLVENT USED. FIRE HAZARD, VENTILATION AND EFFECTS ON SKIN MUST BE CONSIDERED.

9-82. **LINKAGE AND ADJUSTMENT.** The holdback servo system will function properly only if the linkage is properly adjusted and the tape tension is correct. The linkage should be adjusted when a new brake cord is installed, and at other times if necessary. To adjust the linkage, perform the following operations:

1. At the holdback servo solenoid, loosen the lock-nut at the right end of the tape tension spring.

2. Rotate the solenoid plunger to screw the spade bolt into the tape tension spring to a point where the spring is stretched when the plunger is bottomed.

3. Loosen the capscrew of the limit pin assembly.

4. With thumb and forefinger of left hand, squeeze pins A and B (figure 9-14) together, then move both pins to the left, tightening the brake cord. This action brings the linkage and servo arm into operating position. Check again to insure that the solenoid plunger is not bottomed since solenoid bottoming will interfer with adjustment.

5. Measure the distance between the lower end of the servo arm and the stop pin. This distance should be 5/16 ± 1/32 inch. Correct the clearance by rotating the adjustment disc located under the brake anchor. Lock the disc following adjustment.

6. Pull the brake link to the left to tighten the brake cord.

7. Adjust the limit pin assembly to center the limit pin to the brake link slot.

8. Lock the limit pin assembly in place.

NOTE

All linkage pivot points must be loose for correct operation. The brake link must not rest against either grip-ring on the limit pin assembly when the holdback servo system is activated.

9-83. TAPE TENSION ADJUSTMENT. See figure 9-16. Tape tension should be measured and adjusted to the correct value following adjustment of the brake linkage. Tension values are given in table 9-5 for different tape widths.

TABLE 9-5. TAPE TENSION	
One inch	13 ± 1 oz.
One-half inch	9 ± 1 oz.

9-84. To measure tape tension, perform the following operations:

1. Place an almost empty reel of tape on the supply hub.
2. Thread the instrument in normal manner, but only as far as the filtering idler pulley.
3. Attach a 0-16 oz. spring scale to the tape end with masking tape or other tape which, when removed, does not leave adhesive on the tape.
4. Apply power to the instrument.
5. Put sufficient tension on the tape to lift the servo arm off the end-of-tape switch.
6. At the control cluster, select the DRIVE mode.
7. Pull tape off the supply reel at a slow and even rate so that the filtering idler turns at a constant speed, and note the tape tension indicated by the scale. See figure 9-16. Tape tension should be within the limits given in table 9-5. If it is not, adjust tension by the procedure in paragraph 9-85.

NOTE

If the scale used cannot be corrected for attitude, measurements must be corrected for weight of scale mechanism.

9-85. To adjust tape tension, perform the following operations:

1. Remove overlay plate in accordance with instructions in paragraph 9-131.

2. At the holdback servo solenoid, loosen one of the adjustment locknuts on the tape tension spring.

3. Rotate either the solenoid plunger or the spring to adjust tape tension. Repeat the measurement procedure described in paragraph 9-84.

4. When adjustment is completed, tighten locknuts and replace overlay plate.

9-86. HOLDBACK SERVO SOLENOID REMOVAL. See figures 4-8, 9-14, and 9-15. The holdback servo solenoid can be removed from the transport without first removing the transport from portable instruments. To remove the holdback servo solenoid from either the portable or rack-mounted instrument, perform the following operations:

1. Turn off power to instrument.

2. Remove overlay plate. Refer to paragraph 9-132 for procedure.

3. At top of rocker arm, remove grip-ring from one end of the pin joining the rocker arm to the tape tension spring.

4. Remove pin, thus freeing one end of tension spring.

5. In portable instruments, remove brake solenoid to expose terminal board TB403 located under the solenoid.

6. In rack-mounted instruments, remove screws holding TB403 from rear of transport, and swing out terminal board.

7. Remove 2 screws which hold the servo solenoid to the frame.

8. Lift servo solenoid aside and remove harness connections from TB405 located on back of solenoid.

9. At TB403, disconnect connections associated with the servo solenoid.

10. Remove the servo solenoid.

11. To remove solenoid from tape tension spring, drive out rolled pin using a pin punch and light hammer.

9-87. HOLDBACK SERVO SOLENOID, REPLACEMENT. Replace the solenoid with a new solenoid using the steps of removal as a guide. When assembling the mounting block to the solenoid, use LOCTITE, Grade "C" (AMPEX part number 018-030) or an equivalent liquid-stake on screw threads.

CAUTION

TO AVOID DAMAGE TO SOLENOID WINDINGS, USE SCREWS OF CORRECT LENGTH TO SECURE MOUNTING BLOCK TO SOLENOID.

When the solenoid has been replaced, adjust the servo linkage in accordance with instructions in paragraphs 9-82 and 9-83.

9-88. PINCH ROLLER ASSEMBLY CORRECTIVE MAINTENANCE. See figures 9-17, 9-18, and 9-19. Corrective maintenance of the pinch roller assembly consists primarily of adjustment of pinch roller pressure. After long service, pinch roller bearings may require replacement. Some indications of incorrect pinch roller pressure are: random flutter, flutter in the 40 cps region when tape speed is 60 ips, poor tape tracking, or a delayed click when the instrument is transferred from the STOP mode to the DRIVE mode. In normal operation of the FR-1300, a small tape loop will be thrown on the output side of the capstan during starts at 60 ips and 30 ips. If this loop does not occur, pinch roller pressure may be too low. The pinch roller pressure can be measured without removing the overlay plate, however, the plate must be removed for adjustment of the pressure. In time, the pinch roller bearings may become worn. Faulty bearings may cause an audible noise at a tape speed of 60 ips. Noise of lower intensity may be detected while the instrument is operating at 60 ips, by resting a screwdriver tip on the bellcrank and placing the ear against the screwdriver handle. Faulty bearings are also indicated if the disengaged roller slows abruptly when spun by hand.

9-89. PINCH ROLLER PRESSURE MEASUREMENT. See figure 9-20. To measure pinch roller tension, perform the following operations:

1. Attach a 0-5 lb. (80 oz.) scale to one end of a four-foot length of 1 mil mylar base tape.

2. Turn on power to the instrument.

3. Select 1-7/8 ips tape speed (refer to operating instructions).

4. Thread tape between capstan and pinch roller.

5. Defeat the end-of-tape switch by lifting the servo arm and placing a rubber grommet over the stop pin. Grommet should be of sufficient size to just hold the servo arm off the end-of-tape switch.

6. With the oxide side of the tape toward the roller, select DRIVE mode. Apply tension to tape to insure that the tape is centered on the pinch roller and that pinch roller does not contact the capstan except through the tape.

7. With the tape held just against the record/reproduce head closest to the capstan, determine the tension required to cause tape slippage on the capstan. This tension should be 32-40 oz. If the tension is incorrect, refer to the next paragraph for adjustment procedure.

9-90. PINCH ROLLER PRESSURE ADJUSTMENT. To adjust the pinch roller pressure, perform the following operations:

1. Remove power to instrument.

2. Clean the capstan of oxide accumulations. (Refer to preventive maintenance procedure for cleaning procedure.)

3. Remove overlay plate in accordance with instructions in paragraph 9-132.

4. At the spade bolt linkage, (figure 9-18), loosen the locknut, then screw the chamfered nut toward the plunger of the pinch roller solenoid.

5. Defeat the end-of-tape switch by lifting the servo arm and placing a rubber grommet over the stop pin. Grommet should be of sufficient size to just hold the servo arm off the end-of-tape switch.

6. Apply power to instrument.

7. Press the DRIVE button to apply power to the pinch roller solenoid.

8. Insure that the solenoid is bottomed.

9. Adjust the self-locking nut at the lower end of the spade bolt to give approximately the correct pressure. This step requires accomplishment of steps 3 through 7 of paragraph 9-89.

10. Adjust the chamfered nut to provide a clearance of 1/16 to 1/32 inch between the end of the chamfered nut and the spring collar. See figure 9-18.

11. Lock the chamfered nut in place with the locknut.

12. Again check pinch roller pressure and readjust the self-locking nut as required.

13. Insure that clearance exists (step 9).

9-91. **REMOVAL OF PINCH ROLLER AND BELLCRANK.** The pinch roller and bellcrank may be removed from the transport without removing the overlay plate. Removal of these components is required in order to replace pinch roller bearings. To remove the pinch roller and bellcrank, perform the following operations:

1. Turn off power to instrument.

2. Free connecting link by removing grip-ring from pin at end of link.

3. Remove E-ring from exposed end of bellcrank shaft.

4. Remove bellcrank, pinch roller and connecting link from transport.

9-92. **REMOVAL OF PINCH ROLLER BEARINGS.** See figure 9-19. To remove the pinch roller bearings, perform the following operations:

1. Loosen setscrew on front bracket of bellcrank.

2. Shaft will normally slide out either end of the bellcrank. This step removes the pinch roller from the bellcrank.

3. Press each bearing out of pinch roller using a plastic or wooden stick inserted through one end of the roller to apply pressure against the outer race of the bearing.

9-93. REPLACEMENT OF PINCH ROLLER BEARINGS. To replace the pinch roller bearings with new bearings, press the new bearings into the ends of the roller using hand pressure on the outer race, then reassemble the roller and bellcrank. No perpendicularity adjustment is required following replacement of either the bearings or the pinch roller.

9-94. REMOVAL OF PINCH ROLLER SOLENOID. See figure 9-18. To remove the pinch roller from the solenoid, perform the following operations:

1. Turn off power to instrument.
2. Remove overlay plate. Refer to paragraph 9-132 for procedure.
3. On portable instruments, remove rear panels. Refer to paragraph 9-134 for procedure.
4. At pinch roller solenoid, remove self-locking nut, spring, and both spring collars from the lower end of the spade bolt.
5. At rear of transport frame, remove solenoid connections from TB402 located on the frame below the solenoid.
6. Remove two screws holding solenoid to frame.
7. Lift solenoid clear of transport.
8. Remove mounting block from side of solenoid.
9. With pin punch, drive out rolled pin from end of solenoid plunger, thus freeing spade bolt.

9-95. REPLACEMENT OF SOLENOID. Replace the solenoid with a new solenoid using the steps of removal as a guide. When assembling the mounting block to the solenoid, use LOCTITE, Grade "C" (AMPEX part number 018-030) or an equivalent liquid stake on screw threads.

CAUTION

TO AVOID DAMAGE TO SOLENOID WINDINGS, USE SCREWS OF CORRECT LENGTH TO SECURE MOUNTING BLOCK TO SOLENOID.

When the solenoid has been replaced, adjust the assembly in accordance with instructions in paragraphs 9-89 and 9-90.

9-96. REMOVAL OF TAPE LIFTER ASSEMBLY. See figure 9-9. To remove the tape lifter assembly from the transport, perform the following operations:

1. Turn off power to the instrument.
2. Remove overlay plate. Refer to paragraph 9-132 for procedure.
3. Remove record/reproduce heads. Refer to paragraph 9-130 for procedure.
4. Remove solenoid electrical leads from TB401 located adjacent to the solenoid.
5. Remove end of lifter spring from anchor pin at top of linkage.
6. Remove end of plunger spring from anchor pin.
7. Remove grip-ring from exposed ends of bellcrank pivots.
8. Remove screws holding solenoid to transport frame.
9. Lift bellcrank assembly from transport.

9-97. REPLACEMENT OF TAPE LIFTER ASSEMBLY. Replace the tape lifter assembly using the steps of removal as a guide. When the assembly is reinstalled, adjust the lifters in accordance with instructions in paragraph 9-55.

9-98. REMOVAL AND REPLACEMENT OF BELLCRANKS AND SOLENOID. To remove and replace bellcranks of the tape lifter assembly, remove grip-ring from pin holding links, and remove bellcrank. Replacement is straightforward, and can be accomplished using steps of removal and figure 9-9 as guides. The solenoid plunger is disconnected from the linkage by removing the plunger spring from the end of the clevis pin, then removing the clevis pin.

CAUTION

TO AVOID DAMAGE TO SOLENOID WINDINGS, USE SCREWS OF CORRECT LENGTH WHEN REPLACING SOLENOID BRACKET.

9-99. REMOVAL OF CAPSTAN MOTOR. See figure 4-9. To remove the capstan motor from the transport, perform the following operations:

1. Turn off power to transport.
2. Remove overlay plate. Refer to paragraph 9-132 for procedure.
3. Remove both rear panels. (Portable only.) Refer to paragraph 9-134 for procedure.
4. Remove record/reproduce heads from transport. Refer to paragraph 9-130 for procedure.
5. On top of capstan motor, remove all electrical connections to top of TB501.
6. At front of transport, remove 4 capscrews which hold motor to transport. Support motor carefully during this operation.
7. Carefully remove capstan motor and tachometer assembly from the the transport.

9-100. REPLACEMENT OF CAPSTAN MOTOR. Replace the capstan motor using the steps of removal as a guide. When motor is placed in transport shift motor toward left edge of transport frame (as viewed from front of instrument) then tighten capscrews which hold the motor. This step eliminates the need for readjustment of pinch roller pressure.

CAUTION

HANDLE CAPSTAN MOTOR AND FLYWHEEL WITH CARE. BOTH ARE PRECISION-BUILT ITEMS WHICH CAN BE DAMAGED BY CARELESS HANDLING. WINDOWS IN FLYWHEEL SKIRT MUST NOT BE DAMAGED.

9-101. <u>ELECTRICAL CONTROL CIRCUIT CORRECTIVE MAINTENANCE.</u>

9-102. Corrective maintenance of the electrical control circuit may include replacement of lamps, relays, switches, and fuses. Fuse replacement information is given for all fuses used in the instrument.

9-103. CONTROL PUSHBUTTON LAMP REMOVAL. To remove a pushbutton lamp at the control cluster, perform the following operations:

1. Remove control cover.
2. Remove button by pulling outward on the button.
3. Using a one-inch length of plastic tubing (AMPEX part number 600-049) press tubing over glass envelope of the lamp.
4. Rotate tubing counterclockwise to unscrew lamp from its socket.

9-104. CONTROL PUSHBUTTON LAMP REPLACEMENT. To replace a lamp in the control cluster, perform the following operations:

1. Place end of plastic tubing over the glass envelope at a new lamp.
2. Insert lamp into socket and tighten.
3. Remove plastic tubing and replace button and control cover.

9-105. CONTROL PUSHBUTTON LAMP REMOVAL AND REPLACEMENT IN REMOTE CONTROL UNIT. Lamps are removed and replaced in the remote control unit in the same manner as in the FR-1300. The procedure for such operations is described in paragraphs 103 and 104. If buttons are difficult to pull off, remove the cover of the remote unit by the following procedure:

1. Disconnect remote control cable from control unit.
2. At the rear of the unit, remove two screws located below upper edge.
3. On the underside of the unit, remove two screws located on front edge next to rubber feet.
4. Lift off cover.

9-106. RELAY REMOVAL AND REPLACEMENT. See figure 5-1. Relays of the electrical control circuit are located on the right side of the control chassis as viewed from the rear of the instrument. To remove relay, turn off power to the instrument then lift up on the relay to remove it from the socket. Replace a relay by plugging it in the socket.

9-107. REMOVAL OF CONTROL PUSHBUTTON SWITCH. To remove a control pushbutton switch, perform the following operations:

1. Turn off power to the instrument.
2. Remove overlay plate. Refer to paragraph 9-132 for procedure.
3. Remove pushbutton and lamp. Refer to paragraph 9-103 for procedure.
4. Remove large nut and lockwasher from front of switch. This step frees the switch from the switch plate.
5. Press switch clear of switch plate, then pull switch to side of switch plate.

9-108. REPLACEMENT OF CONTROL PUSHBUTTON SWITCH. Replace a control pushbutton switch using the steps of removal as a guide. Before tightening nut, place pushbutton on switch and align it with other buttons of the cluster.

9-109. REMOVAL AND REPLACEMENT OF CONTROL PUSHBUTTON SWITCH IN REMOTE CONTROL UNIT. To remove a pushbutton switch in the remote control unit, remove the cover (refer to steps in paragraph 9-105 for procedure) then follow the procedure for removal and replacement of switches in the recorder/reproducer. Refer to paragraph 9-107. If during replacement of a switch, the switch bracket is removed, it should be loosely held in place by its four mounting screws until the cover has been replaced to permit centering the buttons in the holes of the cover.

9-110. FUSE IDENTIFICATION. See figures 2-1 and 2-11. All fuses of the portable and rack-mounted instruments are contained in fuse holders located on the power panel. Fusing is identical for both instruments, and is given in table 9-6 together with the identity of the circuits protected. A spare fuse holder is provided on each panel for possible future use. A single fuse (F1) is located on the rear panel of those card trays having power supplies.

TABLE 9-6. FUSE IDENTIFICATION

Fuse	Amperage	Ampex Part Number	Identity of Protected Circuits
F1	5 Amp	070-007	Master fuse for all circuits.
F2	1-1/2 Amp	070-016	Protects electrical control circuit and electrical switching circuits of electrically switched electronics (if installed)
F3	1 Amp	070-003	Protects drive servo motor and brake circuit.
F4	2 Amp	070-016	Protects electronics power supply.
Card Tray (Rack Mount) Fuse			
F1	3 Amp	070-001	Protects fan and electronics power supply if they are installed in the tray.

9-111. FUSE REMOVAL AND REPLACEMENT. Fuses are removed from fuse holders by turning the cap 1/3 turn counterclockwise. Spring pressure will push cap and attached fuse out of holder. Fuse can then be inspected for condition. If a fuse is found to be blown as shown by a broken fuse-link within the glass capsule, this is evidence of an existing short circuit within the protected circuit. It is recommended that the protected circuit be inspected and the cause of overload corrected before installing a new fuse. To install a new fuse, place end of fuse in retainer on cap and insert fuse into fuse holder, then press on cap and turn the cap 1/3 turn clockwise to seat fuse.

CAUTION

USE CORRECT VALUE OF FUSE.

9-112. DRIVE SERVO SYSTEM CORRECTIVE MAINTENANCE.

9-113. Corrective maintenance of the drive servo system is treated in two parts. In the first part, the correction of minor malfunctions by use of system adjustments is described. The second part deals with correction of malfunctions which cannot be corrected with adjustments.

9-114. CORRECTION OF MINOR MALFUNCTIONS. See figures 6-10 and 6-12. Three adjustments are provided in the drive servo system: variable resistors R5 and R8 on the circuit cards, and the phase adjustment R304 on the front panel of the control chassis. Variable resistor R8 located on the power supply card provides a means to adjust power supply ripple. Variable resistor R5 on the time base comparator card controls the period of the second stage one-shot multivibrator.

9-115. Power supply ripple should be measured following any repairs to the power supply. Measurement of ripple is made by connecting an oscilloscope between the black test point (TP2) on the power supply card (card 24018) and the blue test point (TP3) on the same card. Ripple voltage should be approximately 50 millivolts (.050 volts). If ripple is greater or less than this value, adjust R8 to reduce ripple to the proper value.

9-116. The period of the waveform from the second stage of the time base comparator is adjusted by means of resistor R5. Resistor R5 is located on the edge of the time base comparator card (24021). The period of the waveform may be adjusted satisfactorily by the following procedure:

1. Remove the capstan cover and place the servo reference switch in the INTERNAL REFERENCE POSITION.

2. Turn the tape speed selector (IPS) to the 60 ips position.

3. Turn on power to the instrument.

4. Turn the PHASE adjustment (R304) on the front of the transport so that it is mechanically in the center of its range of rotation. Ignore the phase meter indication.

5. At the rear of the instrument, adjust the setting of resistor R5 until the needle of the phase meter (M301) is centered on its scale and provides a steady indication. Oscillation of the needle, even though centered on the scale, indicates that further adjustment is needed.

9-117. If an instrument not provided with a frequency standard must be operated from a power source having poor frequency stability, an emergency procedure may be employed to operate the instrument. This procedure inactivates the phase control subsystem of the drive servo system, thus allowing the tape speed to be controlled only by the frequency control subsystem. Such operation requires that the time base comparator be adjusted under operating conditions each time that a different tape speed is selected. To perform such an adjustment, thread the instrument with tape, and proceed as follows:

1. Using an oscilloscope, apply the input probe to the yellow test point (TP1) on the time base comparator card (24021). Ground the oscilloscope to the control chassis.

2. Remove the capstan cover and check that the servo reference switch in the INTERNAL REFERENCE POSITION.

3. Remove the shorting plug (P314A) from the 60 cycle FREQUENCY REFERENCE socket (J314).

4. Turn the tape speed selector (IPS) to the tape speed desired.

5. Turn on power to the instrument.

6. Press the DRIVE button.

7. At the time base comparator card, adjust resistor R5 until the period of the output waveform is 4. 17 milliseconds.

8. To return the instrument to normal operation replace P314A and adjust the drive servo in accordance with the procedure in paragraph 9-115.

9-118. TACHOMETER ASSEMBLY CORRECTIVE MAINTENANCE. See figure 4-9.

9-119. Corrective maintenance of the tachometer assembly is limited primarily to replacement of the tachometer lamp, and possible replacement or cleaning of the photo -voltaic detector (V501) after long use of the instrument. Removal and replacement of the lamp is accomplished from the rear of both the portable and the rack-mounted instruments. Removal and replacement of the photo-voltaic detector in portable instruments may best be accomplished by first removing the capstan motor from the instrument in order to gain access to the tachometer assembly. Refer to paragraph 9-99 for capstan motor removal procedure.

9-120. REMOVAL AND REPLACEMENT OF THE TACHOMETER LAMP. See figure 4-9. To remove and replace the tachometer lamp, perform the following operations:

1. Turn off power to the instrument.

2. Remove rear panels from portable instrument. Refer to paragraph 9-134 for procedure.

3. At the front of the tachometer housing, loosen nylon screw on left side of the housing (as seen from the rear of the instrument).

4. Lift left end of the rear contact spring.

5. Press out lamp using a small stick inserted through hole in rear of housing.

6. Replace lamp and tighten nylon screw.

9-121. REMOVAL OF TACHOMETER ASSEMBLY. See figure 4-9. To remove the tachometer assembly from the instrument, perform the following operations:

1. Turn off power to the instrument.
2. Remove rear panels from portable instrument following instructions in paragraph 9-134.
3. In portable instrument, remove capstan motor from the transport following instructions in paragraph 9-99.

CAUTION

BEFORE PERFORMING NEXT STEP, MARK THE LEADS OF THE PHOTO-VOLTAIC DETECTOR WITH THE NUMBER OF THE TERMINALS TO WHICH THEY ARE CONNECTED.

4. At TB501, remove lamp and detector connections from bottom of board.
5. Remove four screws which hold mounting plate to top of capstan motor.
6. Slide mounting plate and tachometer housing away from flywheel, until housing clears the flywheel skirt.
7. Lift the housing and remove 2 screws which hold the housing to the edge of the mounting plate.
8. Remove tachometer assembly.

9-122. REPLACEMENT OF TACHOMETER ASSEMBLY. Replace the tachometer assembly using removal instructions as a guide. Be careful to connect the photo-voltaic detector leads to the terminals in the same order in which they were removed. If a new detector is installed, the lead having the red dot identification is connected to terminal 4 of TB501. See figure 9-21.

9-123. REMOVAL OF DETECTOR FROM TACHOMETER HOUSING. Removal of the photo-voltaic detector from the tachometer housing requires that the tachometer housing requires that the tachometer housing first be removed from the mounting plate. This operation is described in paragraph 9-121. The detector is removed from the housing by removing two nylon screws from the front of the housing, then removing the several parts of the lamp contact group, the lamp, then the detector. The exploded assembly drawing, figure 4-9, may be used as a guide for disassembly.

9-124. REPLACEMENT OF DETECTOR. See figure 9-21. Perform the following operations to install a new detector in tachometer housing:

1. Identify the detector lead having a red dot on its surface.

2. Install sleeving on new detector. Sleeving of replaced unit may be used.

3. Attach terminals to lead-ends, taking care to preserve the identity of the lead marked with a red dot.

4. Identify the black side of the detector. The opposite side is silver in color. As a check, note that the lead having the red dot is connected to the black side of the detector.

5. Orient the black side of the detector toward the lamp, and insert the unit in the hole in the tachometer housing.

6. Replace the parts of the lamp contact group following the exploded view, figure 4-9 as a guide.

9-125. CORRECTION OF MAJOR MALFUNCTIONS. The correction of major malfunctions in the drive servo system generally requires the services of a technician familiar with the system, and familiar with the use of common laboratory instruments in localizing and correcting circuit failures. If major malfunctions develop in the drive servo system, it is recommended that the AMPEX Instrumentation Service Engineer be contacted. (Refer to listings in Appendix.) A general guide for localization of circuit faults and suggestions for repair of printed circuit cards are given in the following paragraphs.

9-126. If a malfunction is suspected in the drive servo system, perform the following preliminary operations to eliminate general causes of apparent failure:

1. Check fuses at the power panel. Refer to paragraph 9-101.

2. Measure the voltage and frequency of ac power supplied to the instrument. These measurements should be within the limits stated in the instrument specifications. (Refer to chapter 1.)

3. Press cards down into mating receptacles to insure good contact.

4. At the power supply card (24018), shown in figure 6-12, measure the + and -12 volt supply to insure voltages are correct.

5. At the power supply card (24018), measure power supply ripple in accordance with instructions in paragraph 9-114. Perform adjustment if necessary.

6. If instrument is operating, determine whether or not malfunction is present at all tape speeds.

7. Remove capstan cover and place servo reference switch in the TAPE REFERENCE POSITION. This action isolates the frequency control subsystem by disconnecting the output signal of the phase control subsystem. Test again for presence of malfunction at different tape speeds. Return switch to INTERNAL REFERENCE POSITION.

8. If duplicate cards are available, substitute one card at a time to localize the cause of malfunction.

9. If a malfunction is found to exist in a card, place the card in a card-extender and place the extender into the card receptacle on the control chassis.

9-127. Isolation of a faulty component may best be accomplished with the oscilloscope, using a signal tracing technique. In using the technique, waveforms are observed at key points, in the circuit under examination, and compared with waveforms which should exist at those points for proper circuit operation. As a general rule, signal tracing is commenced at the output terminals of a related group of circuits suspected to contain a faulty component, and progresses toward the input terminals, to the point in the circuit where correct waveforms are encountered. Efforts are then concentrated on discovering the components which impede the passage of the signal to the inoperative circuits. Voltage measurements may be of assistance in pinpointing faulty components. A knowledge of circuit function is essential to effective use of the technique described. For a detailed description of the drive servo system and its waveform, refer to chapter 6. Drive servo card components and circuits are shown in figures 6-8 through 6-12, and the composite schematic diagram in chapter 10.

9-128. In making repairs to a printed circuit card, it is essential that soldering be performed with an iron having a narrow tip, and that the level of heat used be only sufficient to melt solder. Too much heat will cause the printed conductors to separate from the circuit card. Resin-core solder of 60/40 alloy, having a .032 inch diameter is recommended.

CAUTION

DO NOT USE ACID, OR ACID-CORE SOLDER IN REPAIRING ELECTRONIC OR ELECTRICAL CIRCUITS.

A component may be removed from a card by cutting its leads near the card, then unsoldering and removing the remaining lead-ends from the printed circuit-side of the card. In removing a component, excess solder often builds up at the point where the component is soldered to the circuit conductor. This solder may be absorbed by a section of copper braid sandwiched between the circuit conductor and the soldering iron. When repairs are completed to a printed circuit card, inspect the card carefully for evidence of accidental shorting together of circuit paths.

9-129. GENERAL PROCEDURES.

9-130. REMOVAL OF RECORD/REPRODUCE HEAD GROUP. To remove the record /reproduce head group from the instrument, perform the following operations:

1. Turn off power to the instrument.
2. Remove head cover.
3. Release head group by unscrewing three cap screws shown in figure 9-22. Support head group.
4. Grasp head bail, and while supporting head group with other hand, gently pull the head group free of the instrument.

9-131. REPLACEMENT OF RECORD/REPRODUCE HEAD GROUP. To replace the head group, perform the following operations:

1. Replace cap screws and lockwashers in holes in head base.

2. Press head group into position on transport, and hold it in position.

3. Tighten the three cap screws. Do not over-tighten.

CAUTION

TREAT THE HEAD GROUP WITH CARE, DO NOT STRIKE HEADS. WHEN REPLACING THE HEAD GROUP, BE SURE THAT LOCATING DOWELS ON TRANSPORT FRAME ARE ENGAGED WITH MATING HOLES IN HEAD BASE AND THAT THE HEAD BASE IS SEATED FIRMLY AGAINST THE TRANSPORT FRAME BEFORE CAP SCREWS ARE TIGHTENED. DO NOT OVERTIGHTEN THESE SCREWS. FAILURE TO OBSERVE THESE PRECAUTIONS MAY CAUSE PERMANENT DAMAGE TO HEAD BASE WHICH WILL IMPAIR ITS OPERATION.

9-132. REMOVAL OF OVERLAY PLATE. See figure 9-23. To remove the overlay plate from the instrument, perform the following operations:

1. Turn off power to the instrument.

2. Remove tape reels, control cover, head cover, and capstan cover from the instrument.

3. Remove eight screws from front of plate.

4. Lift plate off over control cluster and hubs. Guide overlay plate carefully past heads.

NOTE

Instrument can be operated with overlay plate removed, however, signal performance specifications will not be met.

9-133. REPLACEMENT OF OVERLAY PLATE. Replace the overlay plate and covers using steps of removal as a guide.

9-134. REMOVAL OF REAR PANELS. To remove both rear panels, perform the following operations:

1. Remove power from instrument.
2. Remove 2 screws from access plate on lower panel, then remove access plate. This step exposes mated power connectors P3 and J3.
3. Separate power connectors P3 and J3.
4. Remove remaining four screws around edge of lower panel while supporting panel.
5. Release, and fold upper panel over lower panel.
6. Pull top of lower panel out far enough to grasp folded panels by their edges.
7. Carefully remove panels with attached power supply.

9-135. REPLACEMENT OF REAR PANELS. Replace the rear panels using the steps of removal in paragraph 9-134 as a guide.

9-136. REMOVAL OF FAN ASSEMBLY FROM PORTABLE INSTRUMENT. To remove the fan assembly from the portable instrument, perform the following operations:

1. Turn off power to the instrument.
2. Remove rear panels. Refer to paragraph 9-134 for procedure.

3. Disconnect connector P303 from J303 located on the rear of the front panel of the control chassis. (See figure 5-2.)

4. Place instrument on its side on a padded surface to expose the fan assembly and the filter.

5. Remove the filter. Refer to paragraph 9-14 for procedure. Removal of the filter exposes four flat-head screws which hold the fan assembly.

6. Remove the four flat-head screws while supporting the assembly, then remove fan assembly.

9-137. REPLACEMENT OF FAN ASSEMBLY. Replace the fan assembly using removal instructions as a guide.

9-138. TRANSPORT REMOVAL FROM PORTABLE CASE. See figures 9-24 and 9-25. The transport can be removed from the front of the portable case. This operation is necessary for making repairs to the card file, and may be desirable for maintenance of the transport. When the transport is removed from the case, it is rested on the control chassis. The control chassis will safely support the transport weight. Removal of the transport is accomplished in two parts. In the first part, the transport is moved out of the case, but is still attached by cables. The second stage operations free the transport and control from the case. To remove the transport from the case, perform the following operations:

1. Turn off power to instrument.

2. Remove overlay plate. Refer to paragraph 9-132 for procedure.

3. Remove rear panels. Refer to paragraph 9-134 for procedure.

4. Remove record/reproduce head group. Refer to paragraph 9-132 for procedure.

5. With a 7/64 hex key, remove 2 capscrews from dust cover catch, then remove catch.

6. At TB404, located next to control cluster, remove 2 connections to free harness from transport.

7. Remove three signal ground connections held under a screw to the right of the terminal board.

8. From rear of case, remove connectors P302, P303, P306, P307, and P308. These connectors are located on the rear of the control chassis front panel, below the take-up torque motor. See figure 5-2.

9. Identify, then remove four harness connections to TB301 at rear of control chassis.

10. Remove 3 capscrews which support transport frame in case.

11. Lift transport out of case and rest it on the control chassis. Be careful of cables which are still connected to case. Maintenance may be performed with transport partially removed. To entirely separate the transport and case, perform the following operations:

12. At front of transport, remove screws holding record head connectors J401 and J402. (These are the connectors closest to the control cluster.)

13. Position the connectors, one at a time, over the enlarged opening in the transport casting, and push the connectors through the transport frame.

CAUTION

IDENTIFY CONNECTORS P309 AND P310 WITH MATING RECEPTACLES BEFORE SEPARATING THEM.

14. Remove connectors P309 and P310 from end of preamplifier box. See figure 5-2.

9-139. REPLACEMENT OF TRANSPORT INTO PORTABLE CASE. Replace the transport in the case using the steps of removal as a guide.

9-140. REMOVAL OF CONTROL CHASSIS FROM TRANSPORT. To facilitate corrective maintenance of items on the control chassis, the chassis may be removed from the transport. In the portable instrument, this operation may be performed by removing the chassis from the rear of the case. As an alternative, the chassis may be removed from the transport after both have been removed from the case. The last method raises a problem of supporting the transport frame. Removal of the control chassis from rack mounted instruments involves the same procedure as for the portable instrument except for fan motor removal. To remove the control chassis from the transport of the portable or rack-mounted instrument, perform the following operations:

1. Turn off power to the instrument.

2. Remove overlay plate from instrument. Refer to paragraph 9-132 for procedure.

3. Remove the rear panels of portable instrument. Refer to paragraph 9-134 for procedure.

4. Remove the fan motor from portable instrument. Refer to paragraph 9-136 for procedure.

5. In rack-mounted instruments, remove connector P302 from J302, located on the rear of the control chassis front panel. (See figure 5-1.)

6. In rack-mounted instruments, remove seven screws holding power panel to the side panels and control chassis, then remove power panel.

7. At front of transport, remove two cabled conductors from end-of-tape switch terminal board TB404, located adjacent to the control cluster.

8. Remove 3 cable clamps on cable to control cluster.

9. Remove 4 screws holding control cluster.

10. At rear of instrument, disconnect the following connectors from the front panel of the control chassis: P301, P302, P303, P304, P305, P306, P307, and P308.

NOTE

To remove P301, it may be necessary to first move the large capacitor C401 aside.

11. On the portable instrument, remove cable from TB301 on rear of control chassis.

12. At TB501 located on top of capstan motor, disconnect control cable connections 1 through 8 by loosening screws and lifting connections clear.

13. Insure that all removed cable ends are clear of transport, then perform the following steps.(Support the control chassis of rack-mounted instrument.)

14. Separate the control chassis from the transport by removing four capscrews from angle brackets located above control chassis.

15. In rack-mounted instruments, carefully lower the chassis clear of the transport. In portable instruments, slide the chassis out the rear of the case.

9-141. REPLACEMENT OF CONTROL CHASSIS. Replace the control chassis using the steps of removal as a guide. Check that speed and phase screws line up with holes in overlay plate. If necessary, loosen capscrews holding control chassis and reposition the chassis slightly.

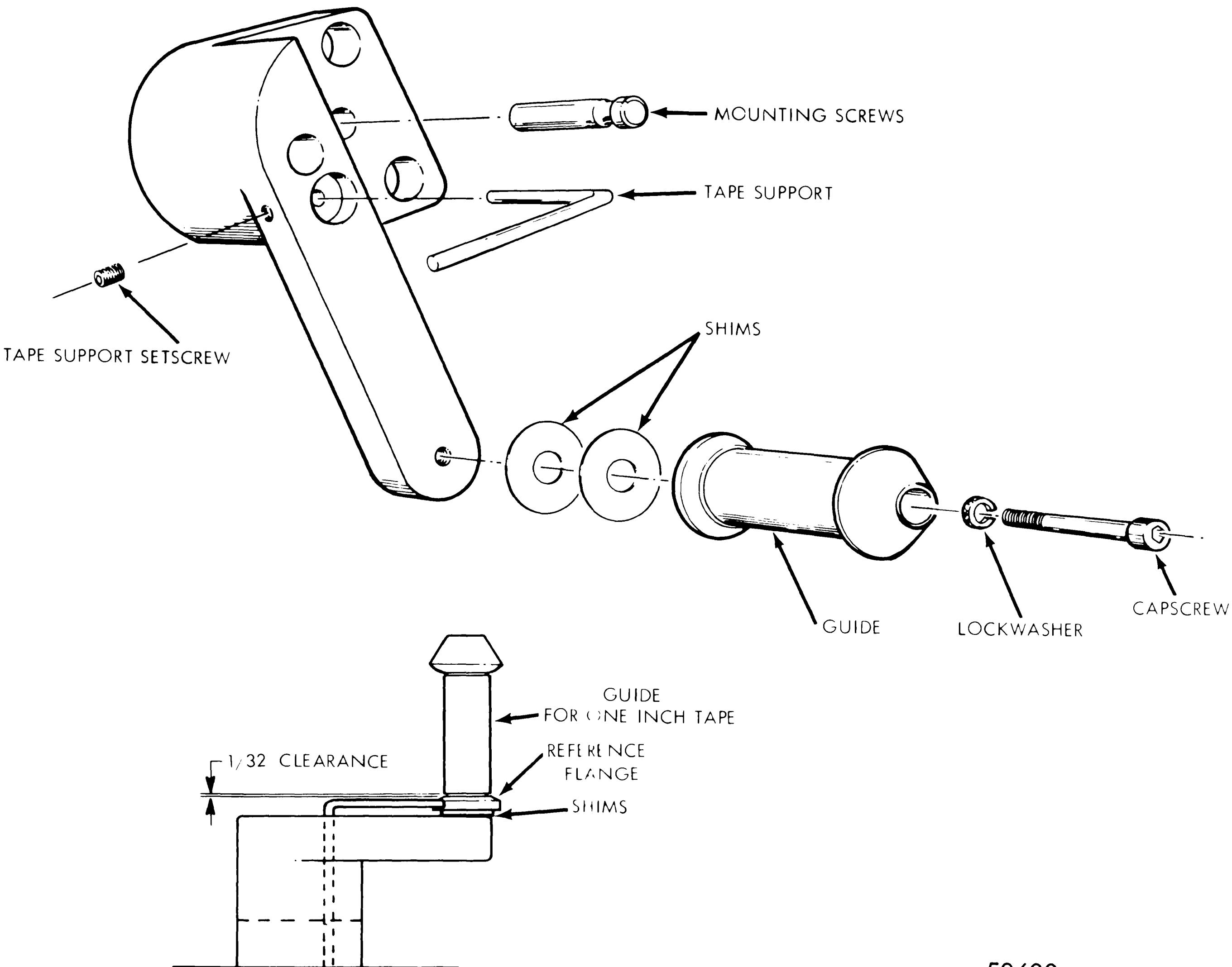


Figure 9-2. INPUT TAPE GUIDE ASSEMBLY

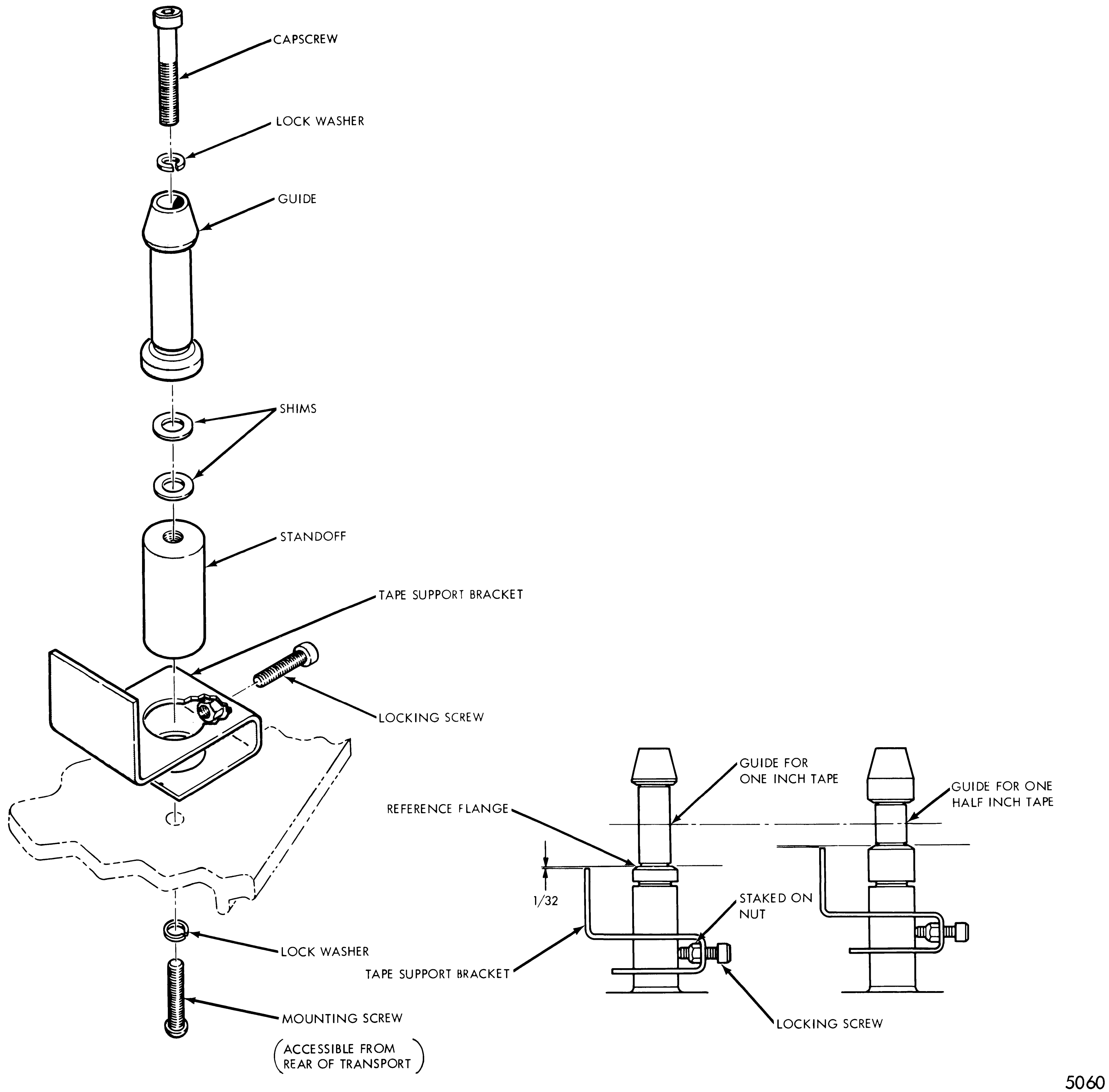


Figure 9-3. OUTPUT TAPE GUIDE ASSEMBLY

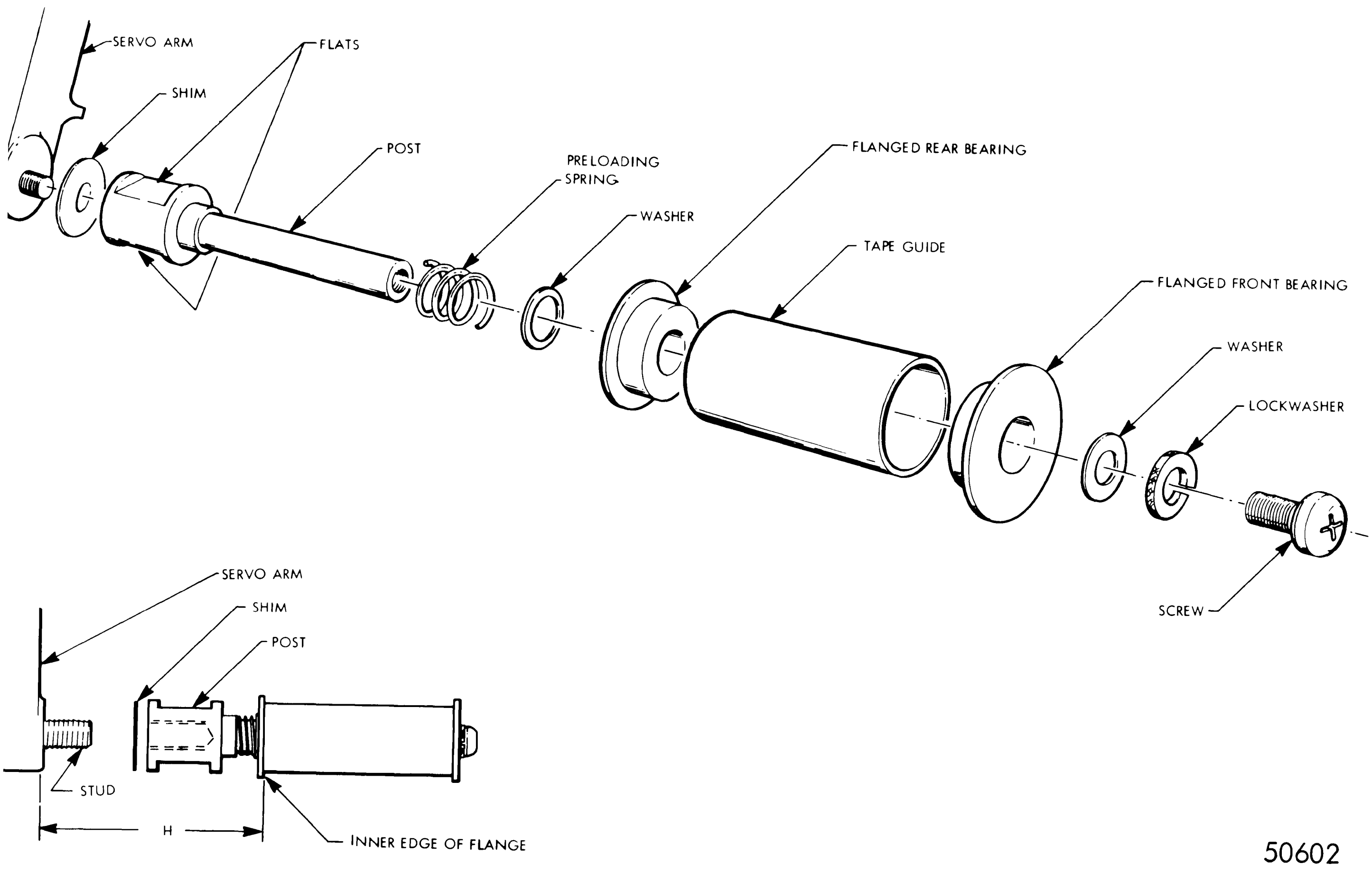


Figure 9-4. SERVO ARM TAPE GUIDE ASSEMBLY

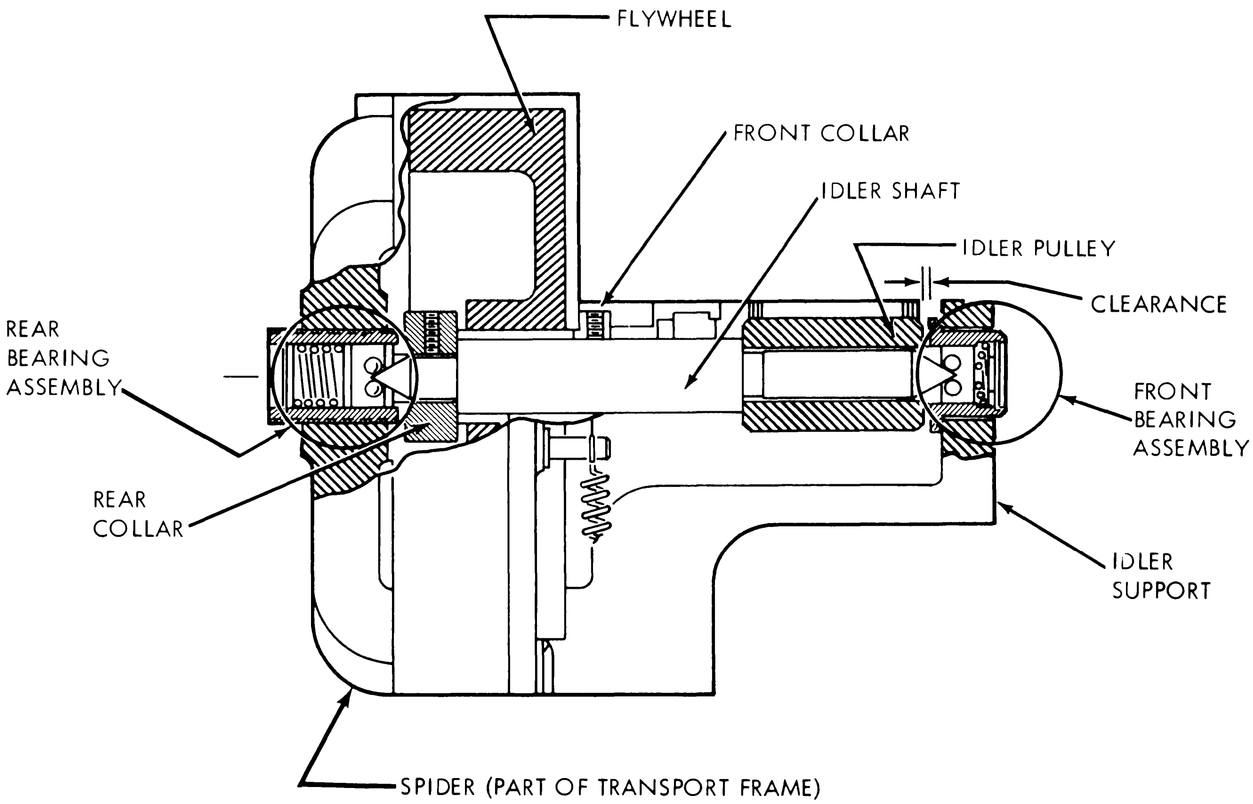
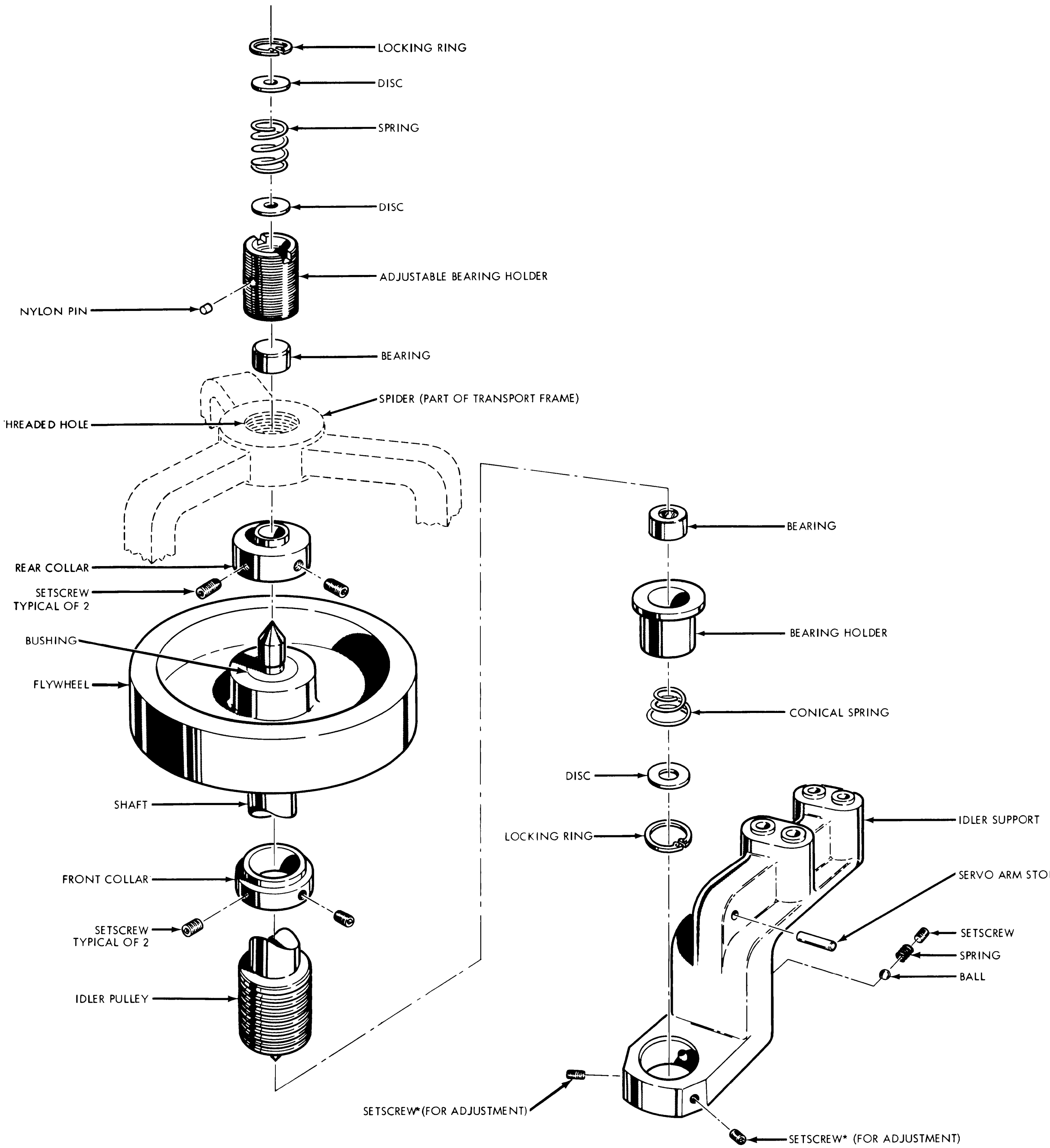


Figure 9-5. FILTERING IDLER ASSEMBLY CUTAWAY VIEW



NOTE: FLYWHEEL TURNS FREELY ON SHAFT

* DO NOT ADJUST

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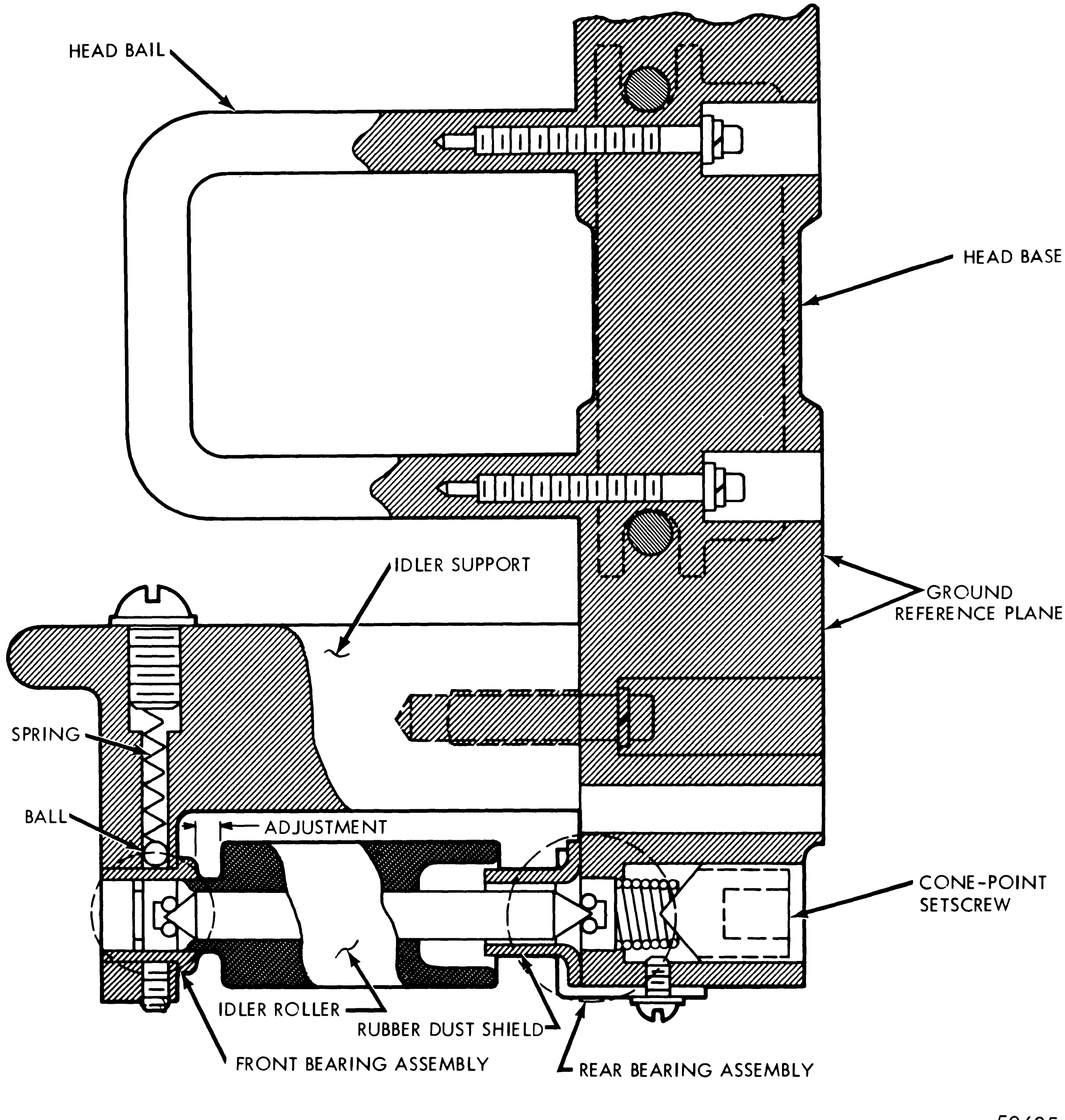
Figure 9-6. FILTERING IDLER ASSEMBLY EXPLODED VIEW



B. HEAD IDLER CUTAWAY VIEW

Figure 9-7. HEAD IDLER ASSEMBLY

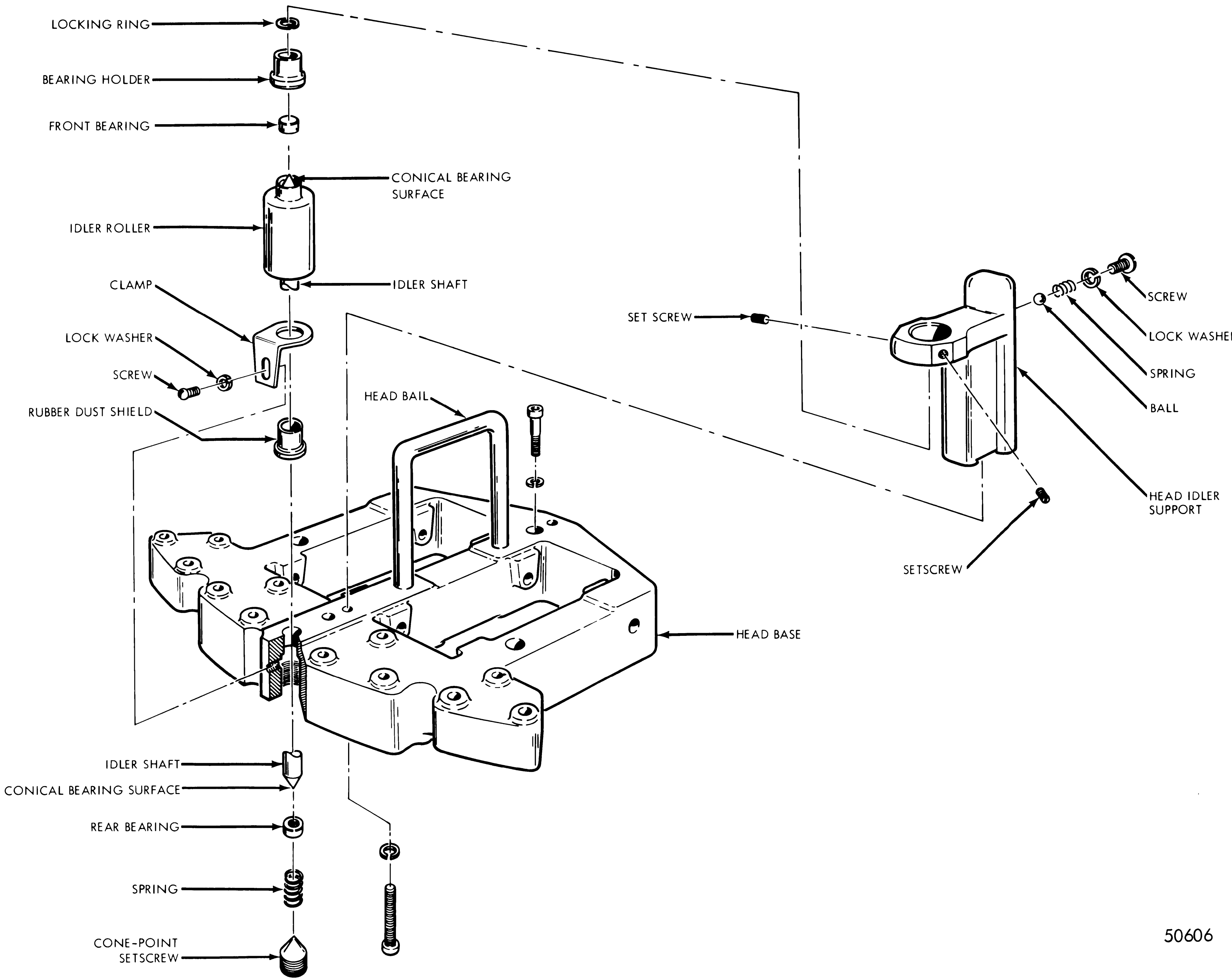


Figure 9-8. HEAD IDLER EXPLODED VIEW

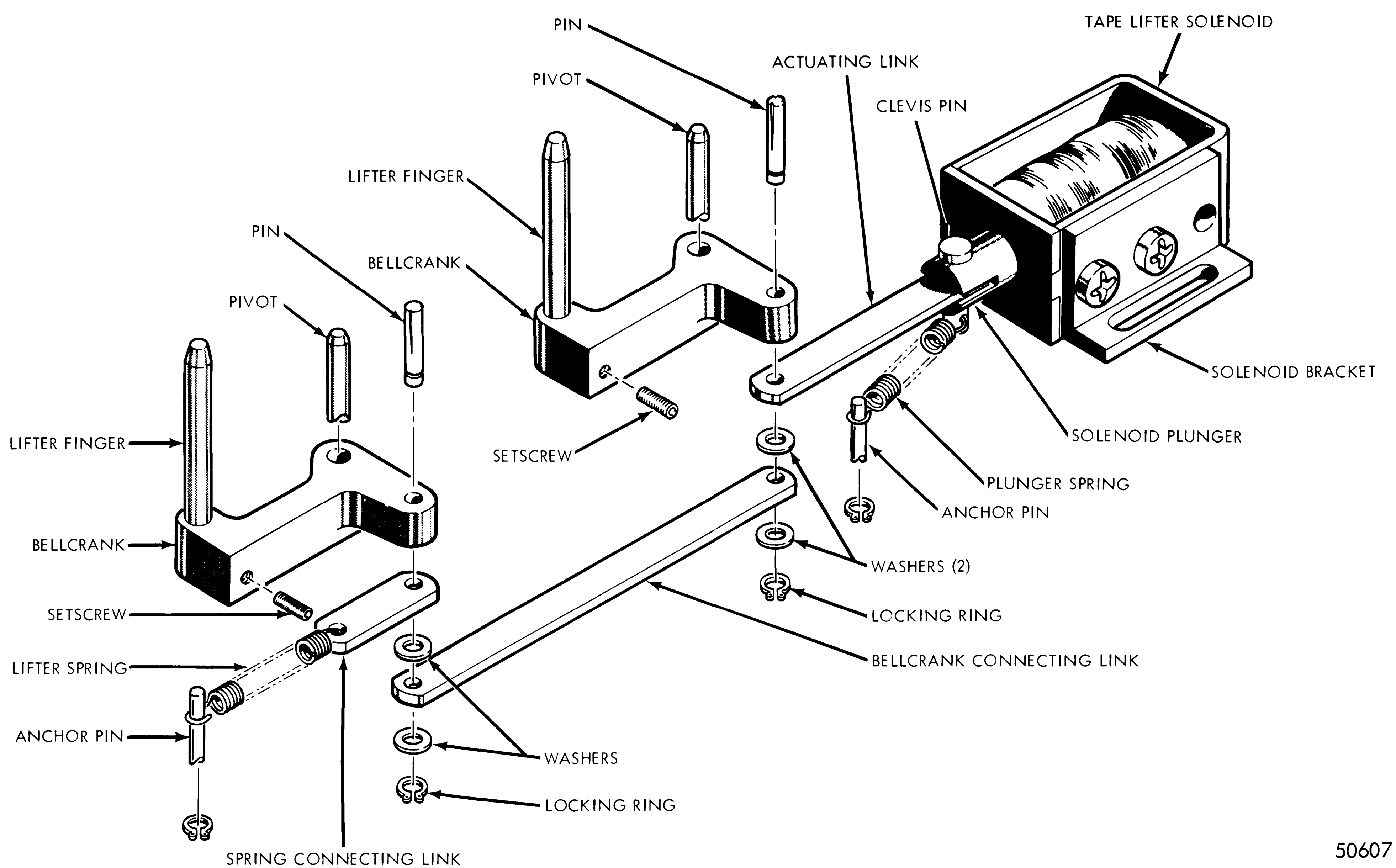


Figure 9-9. TAPE LIFTER ASSEMBLY EXPLODED VIEW

ILLUSTRATION TO APPEAR
IN FINAL MANUAL

50608

Figure 9-10. TORQUE MOTOR ASSEMBLY

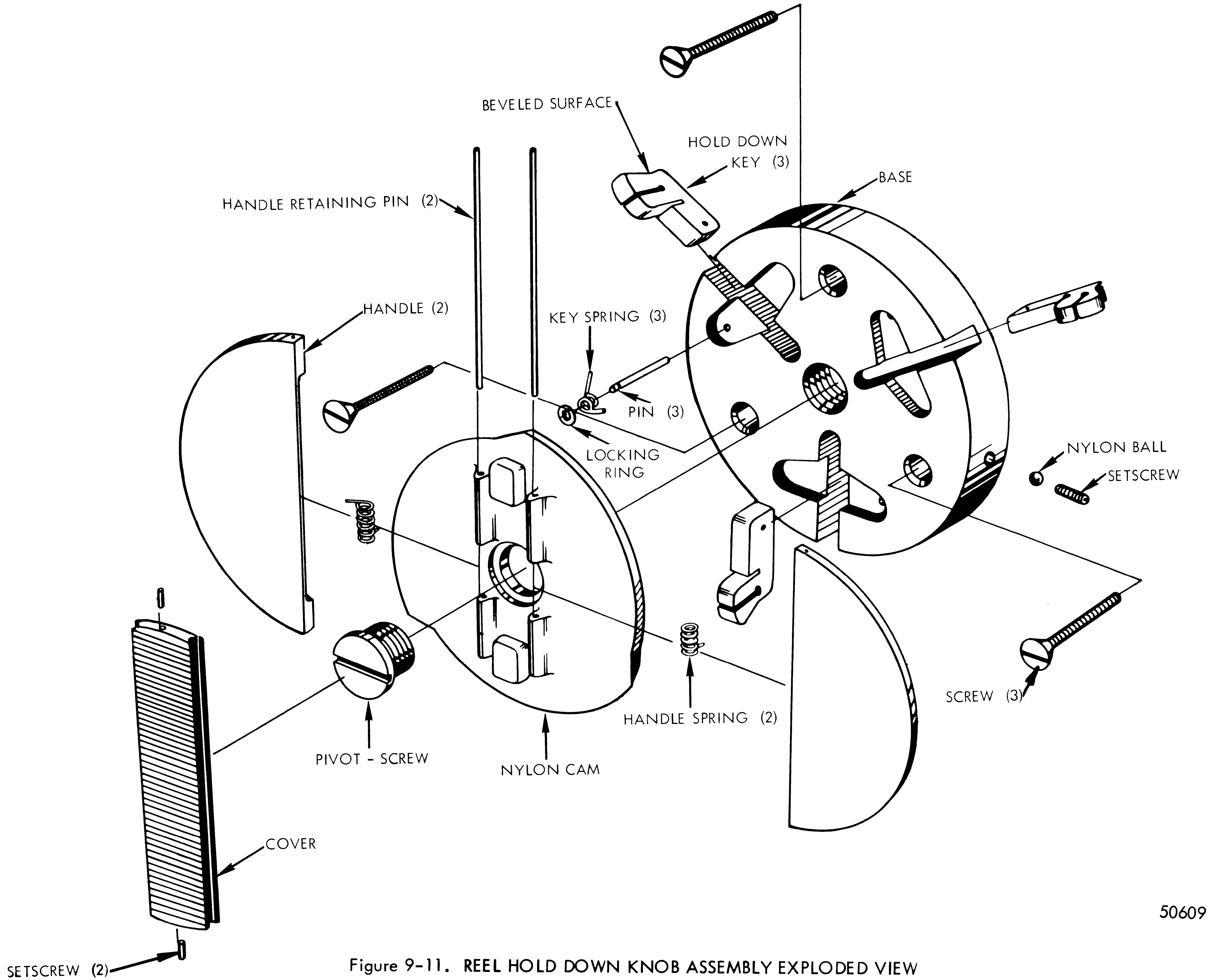


Figure 9-11. **REEL HOLD DOWN KNOB ASSEMBLY EXPLODED VIEW**

ILLUSTRATION TO APPEAR
IN FINAL MANUAL

50610

Figure 9-12. TURNTABLE AND TURNTABLE BEARING ASSEMBLY

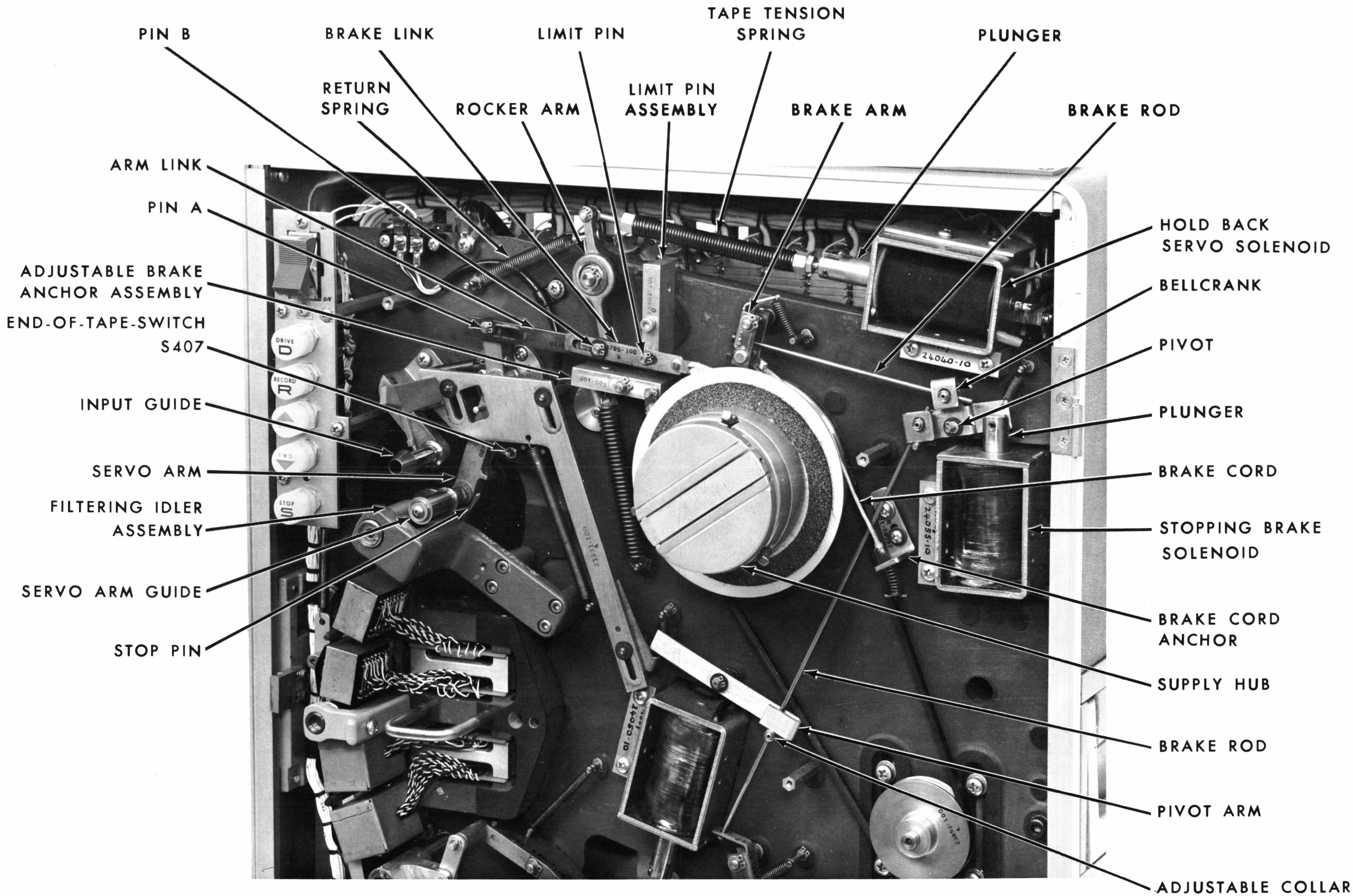
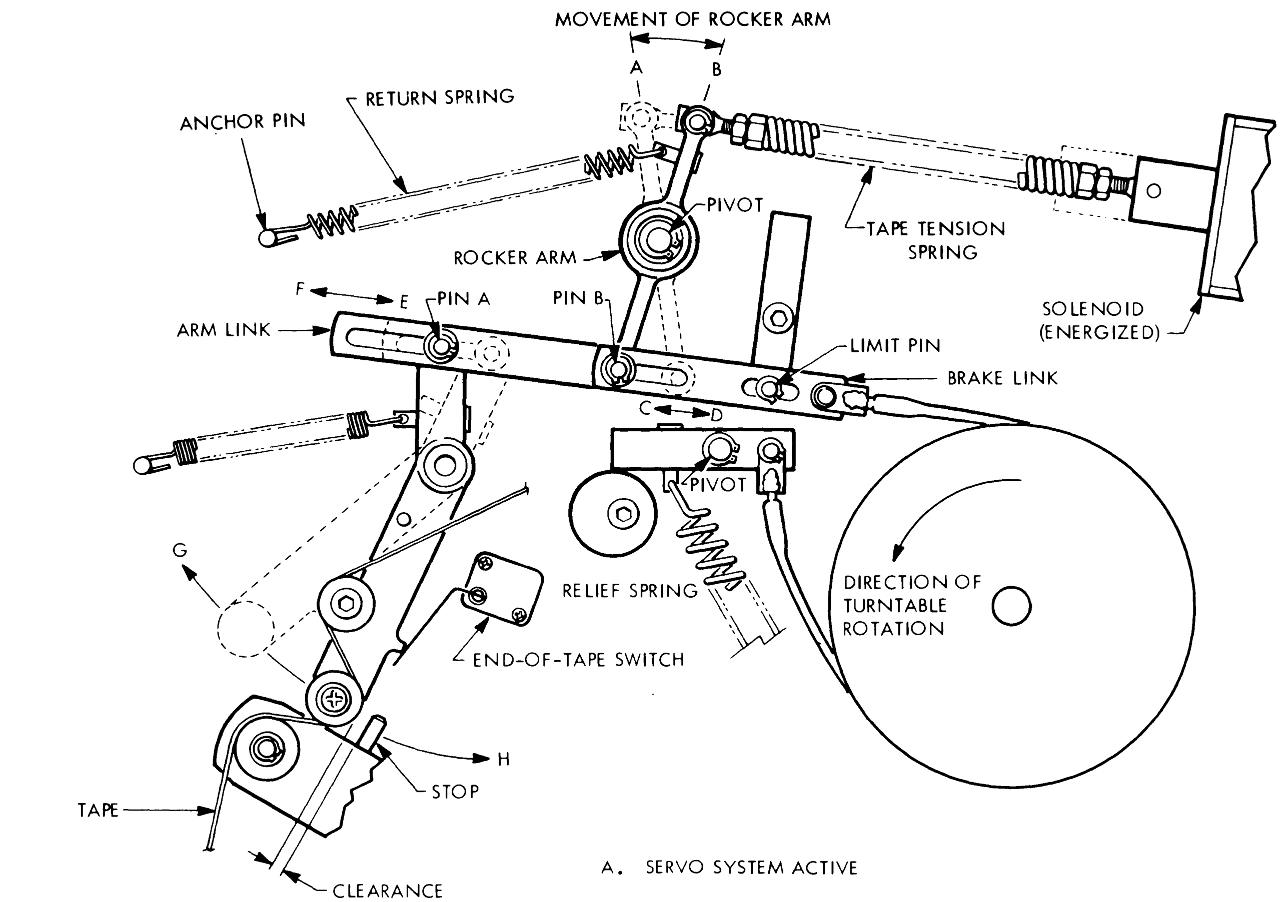
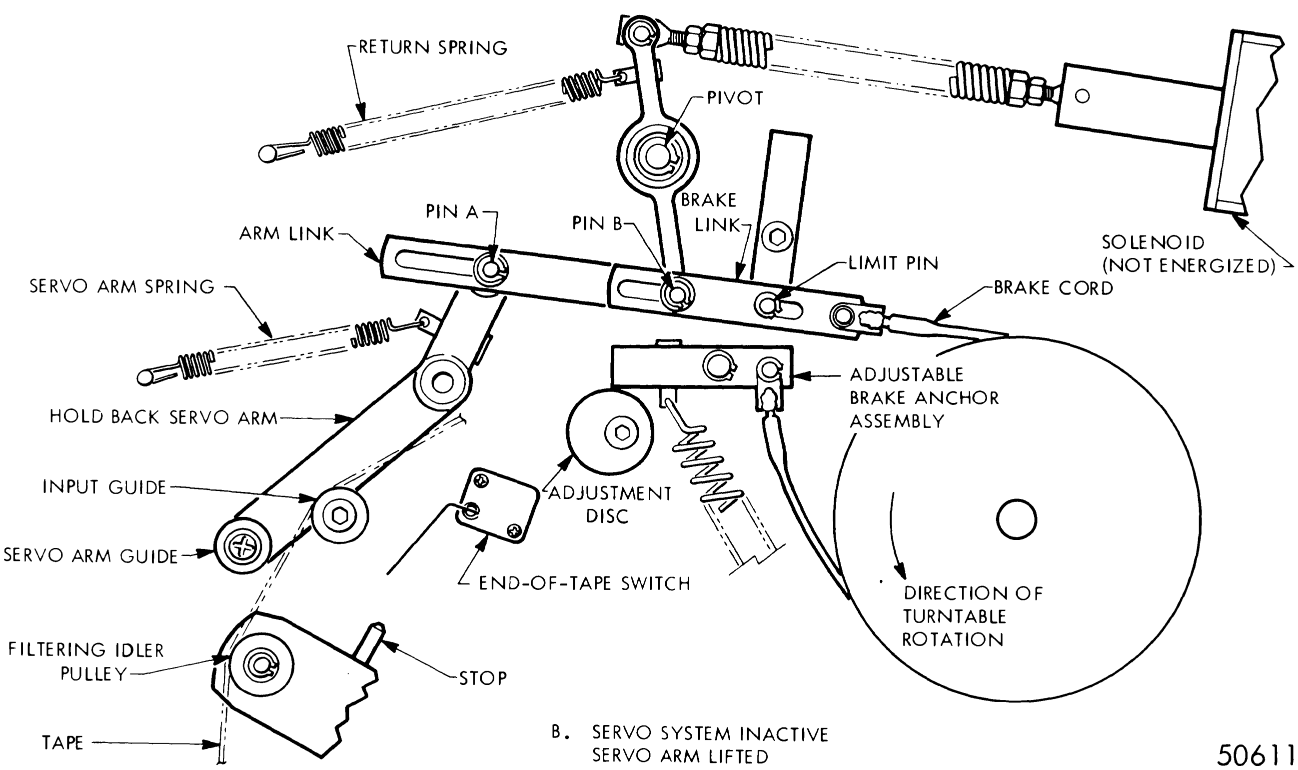


Figure 9-13. BRAKE AND HOLD BACK SERVO ASSEMBLIES



A. SERVO SYSTEM ACTIVE



B. SERVO SYSTEM INACTIVE
SERVO ARM LIFTED

50611

Figure 9-14. HOLDBACK SERVO SYSTEM ACTION

ILLUSTRATION TO APPEAR
IN FINAL MANUAL

50612

Figure 9-15. HOLDBACK SERVO SYSTEM DETAIL

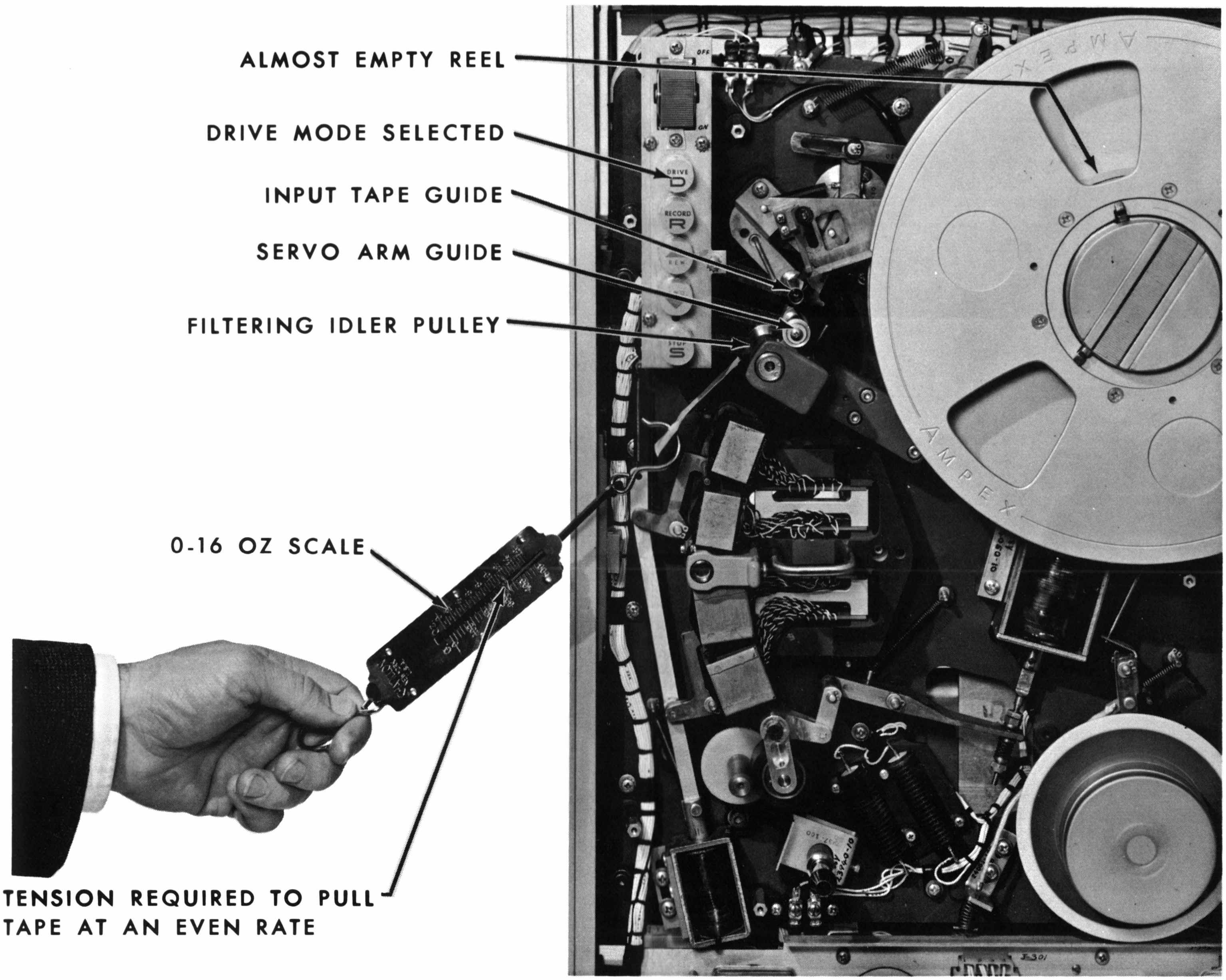


Figure 9-16. TAPE TENSION MEASUREMENT

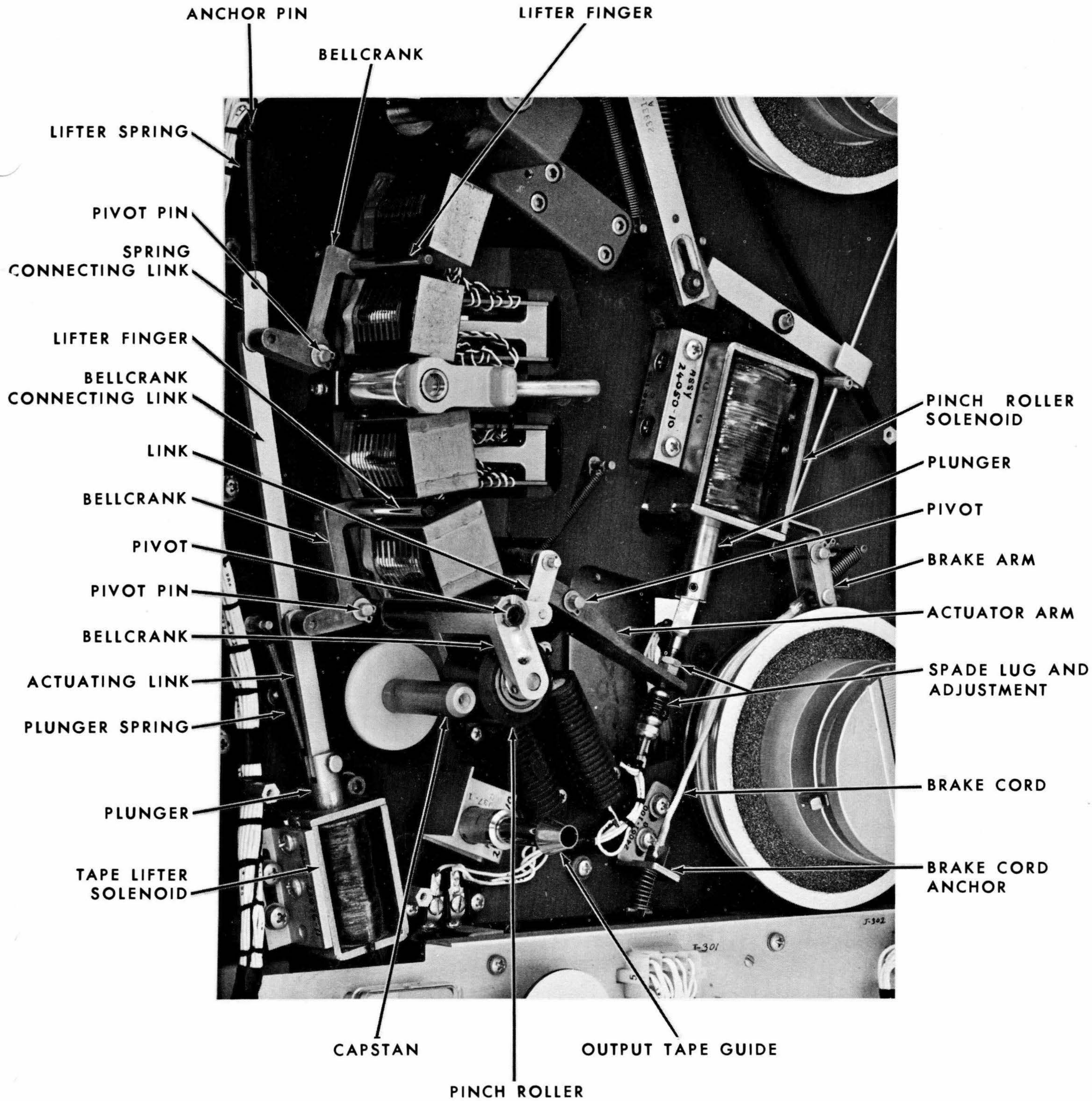


Figure 9-17. LOCATION OF PINCH ROLLER AND OTHER ASSEMBLIES

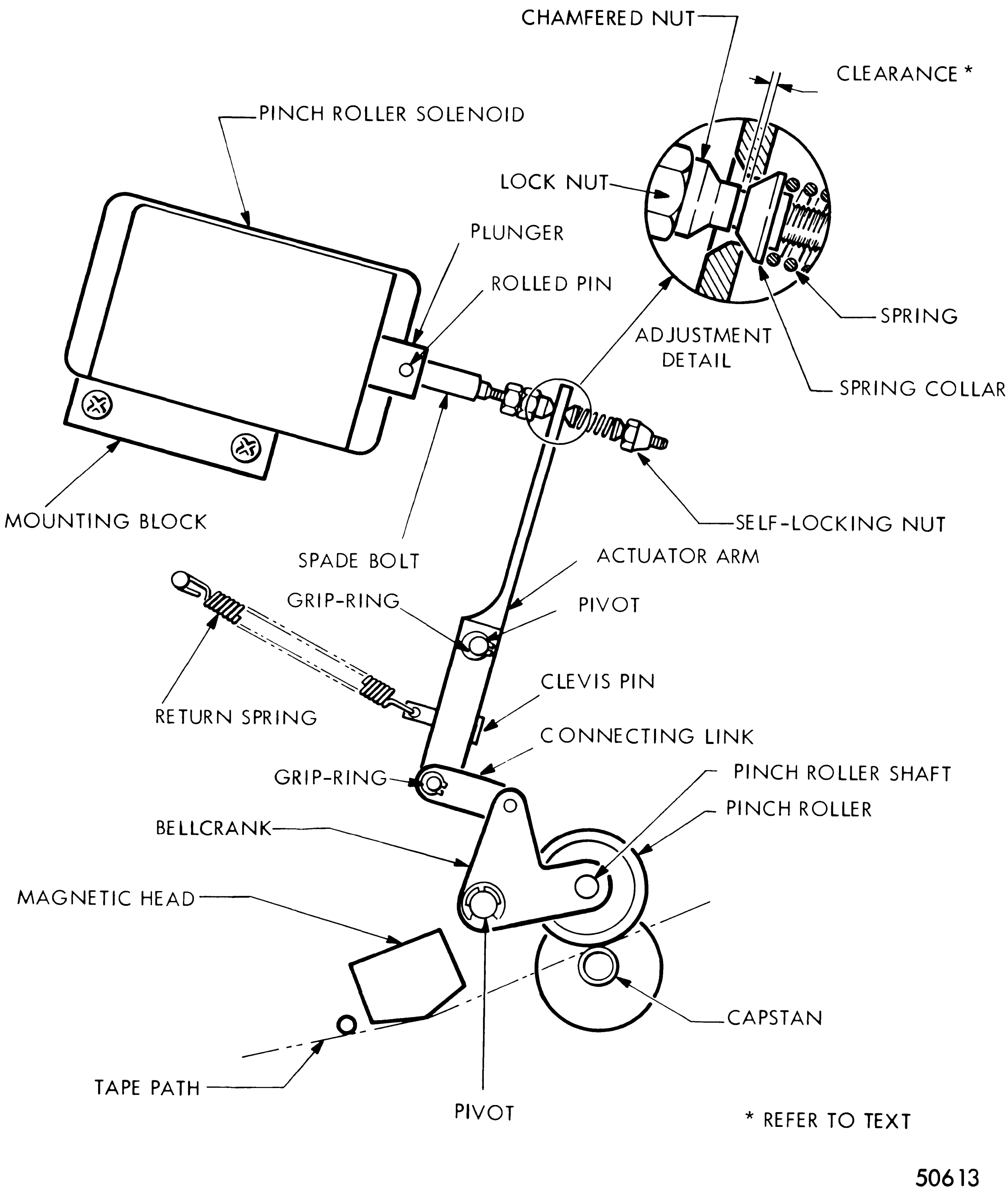


Figure 9-18. THE PINCH ROLLER ASSEMBLY

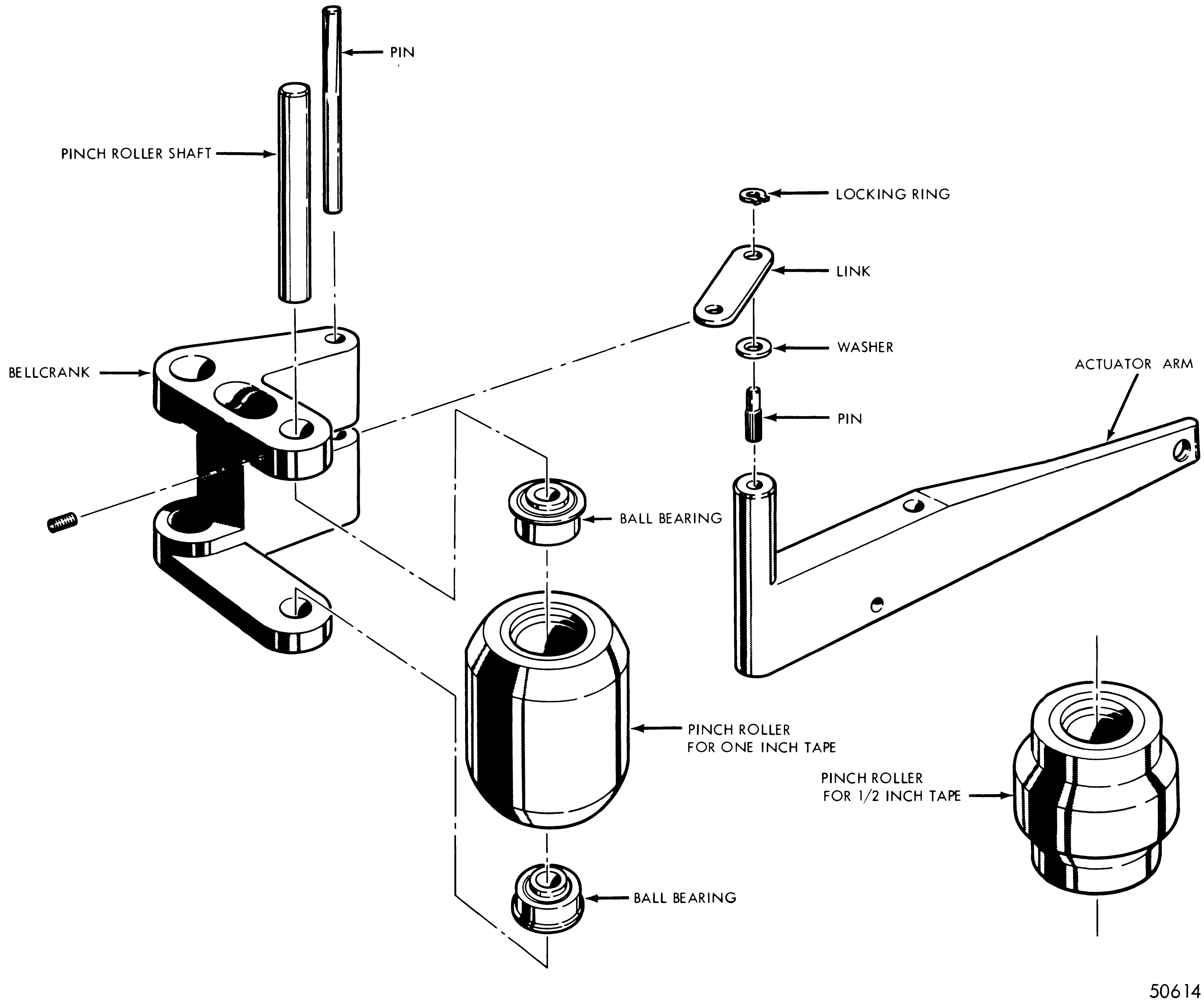


Figure 9-19. PINCH ROLLER BEARING ASSEMBLY EXPLODED VIEW

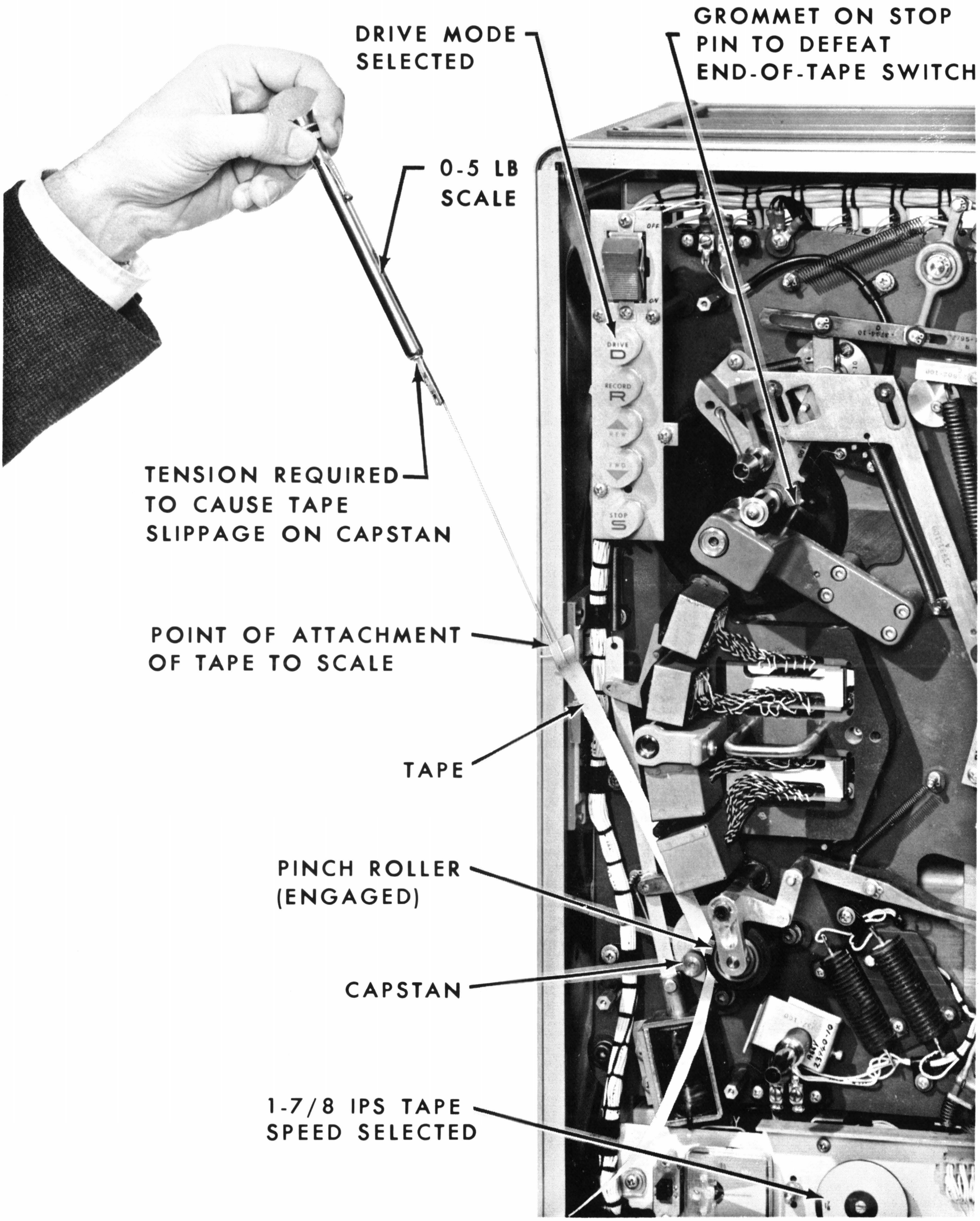


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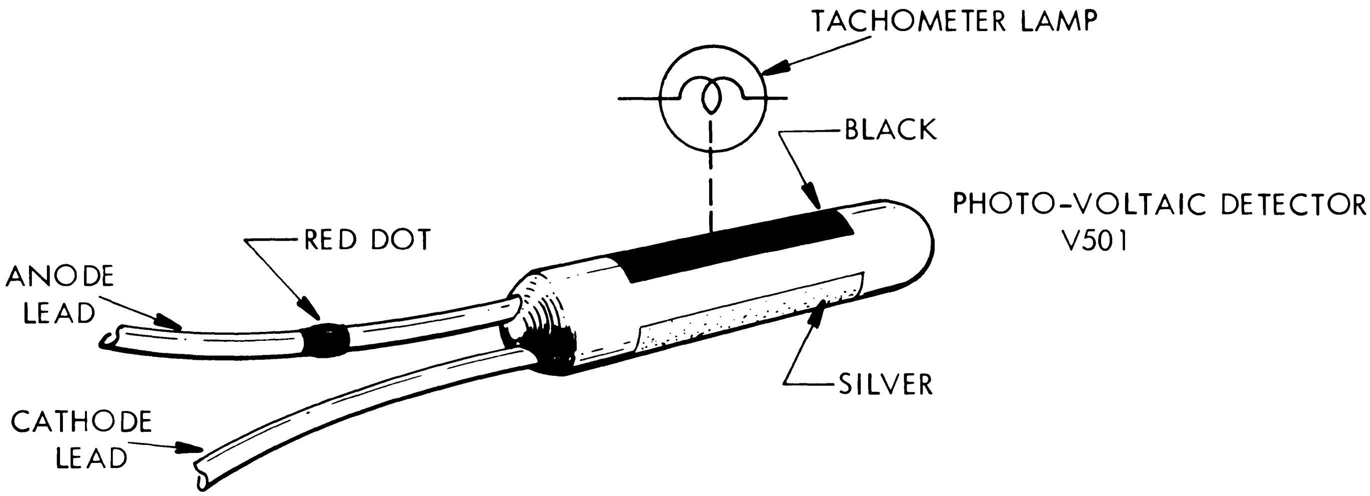
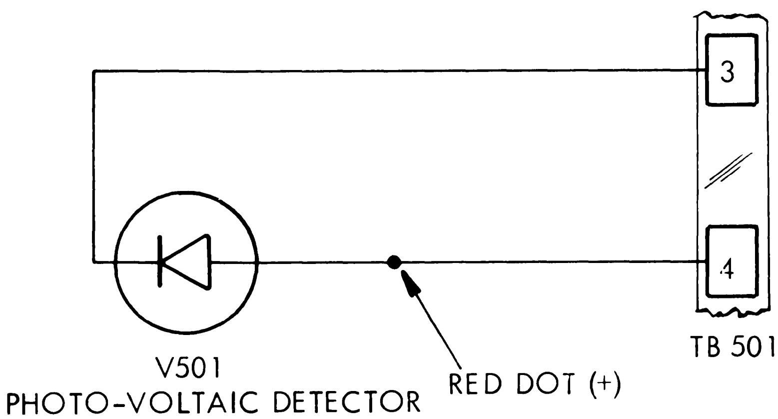
Figure 9-20. PINCH ROLLER PRESSURE MEASUREMENT



A. PHOTO-VOLTAIC DETECTOR FEATURES AND ORIENTATION TO LAMP



B. PHOTO DIODE CONNECTIONS

50615

Figure 9-21. PHOTO DIODE CONNECTIONS

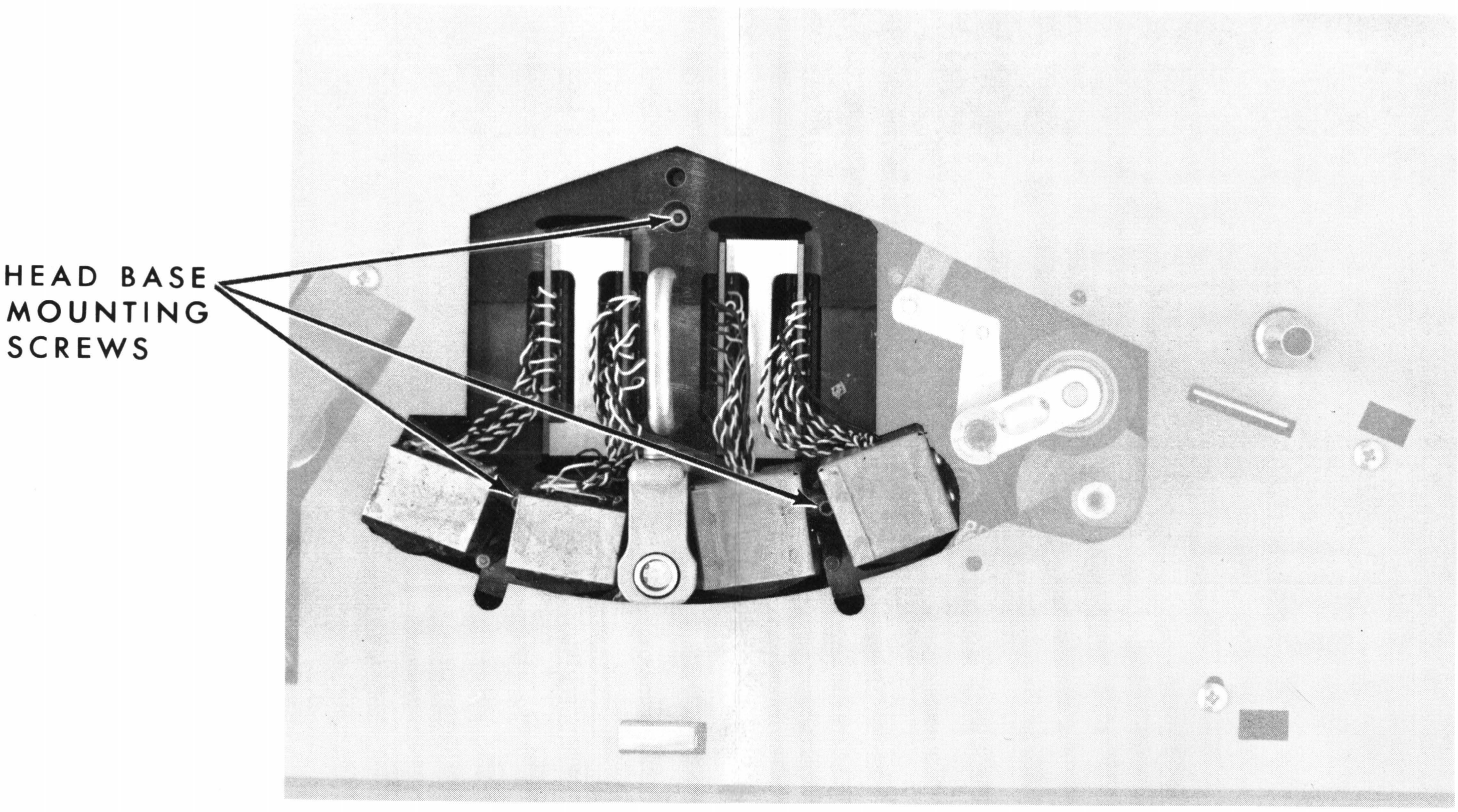
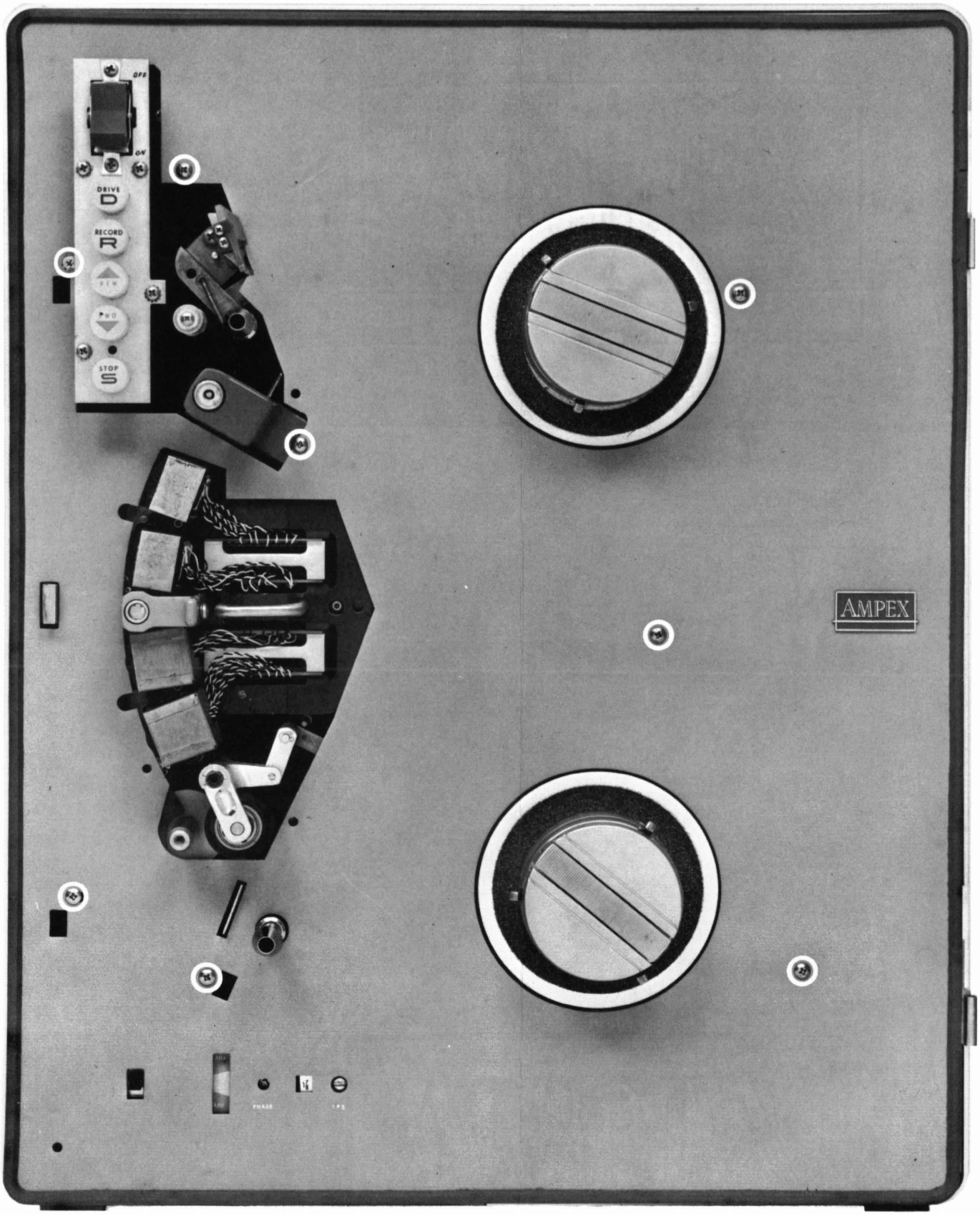


Figure 9-22. HEAD BASE MOUNTING SCREW LOCATION



8346-5

Figure 9-23. LOCATION OF OVERLAY PLATE RETAINING SCREWS

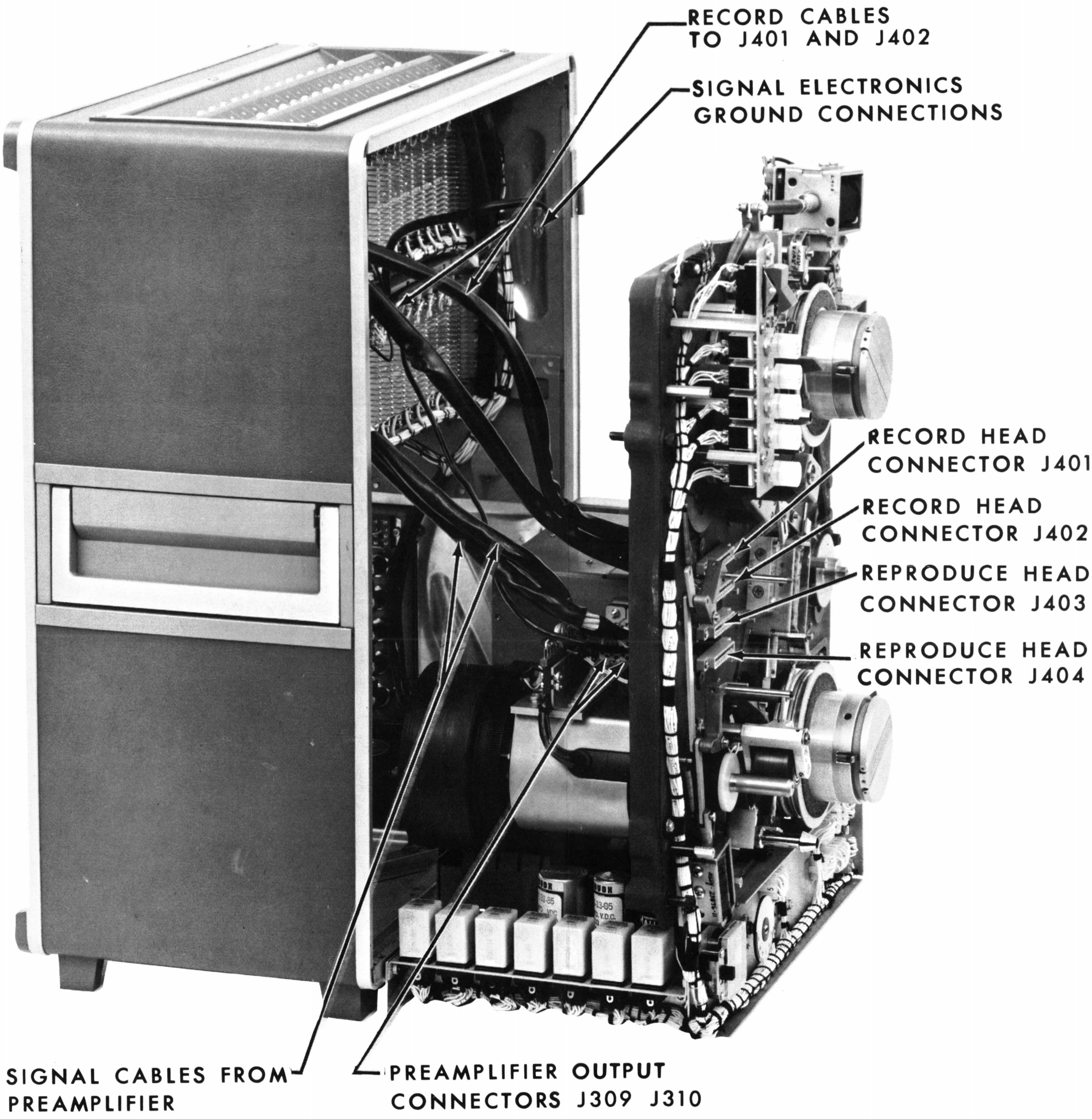


Figure 9-24. TRANSPORT PARTIALLY REMOVED FROM CASE

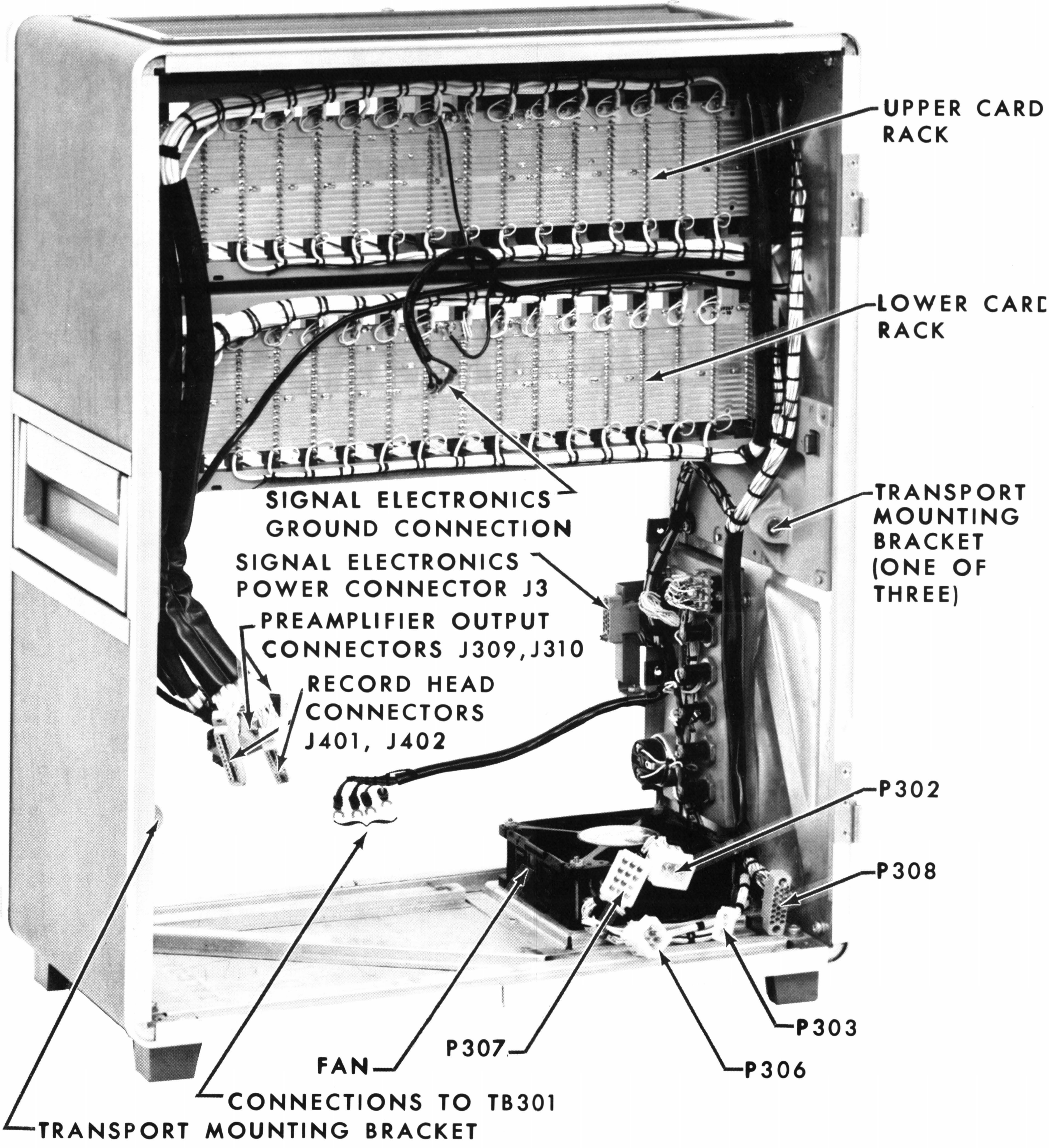


Figure 9-25. VIEW OF TRANSPORT CASE WITH TRANSPORT REMOVED

8346-30

LIST OF SCHEMATICS AND CABLING DIAGRAMS

TABLE 1-1. CONFIGURATIONS OF THE PORTABLE FR-1300

Configurations Note 3	Card Arrangement	Signal Electronics: Single Speed	Signal Electronics: Electrically Switched	Number of Tape Tracks: Record	Number of Tape Tracks: Reproduce	Card File and Preamplifier Identification: Upper Card File Part No. 69102-	Lower Card File Part No. 69102-	Preamplifier Assembly Part No. 69244-
A	Record cards in lower file Reproduce cards in upper file	X	—	1-14	1-14	-2	-1	-1
B	Record cards in lower file Upper file space vacant	X	—	1-14	Record only	Blank Panel Note 2	-1	Not installed
C	Lower file space vacant Repro. cards in upper file	X	—	Reproduce only	1-14	-2	Blank Panel Note 2	-1
D	Record and Reproduce cards Alternated (key given on file)	X	—	1-7	1-7	-3	Blank Panel Note 2	-2
E	Record Cards in lower file Reproduce cards in upper file	—	X	1-7	1-7	-5	-4	-2
F	Record cards in both upper and lower files	—	X	1-14	Record only	-6	-6	Not installed
G	Record cards in lower file Upper file vacant	—	X	1-7	Record only	Blank Panel Note 2	-4	Not installed
H	Reproduce cards in both upper and lower files	—	X	Reproduce only	1-14	-5	-5	-1
J	Repro. cards in upper file Lower file vacant	—	X	Reproduce only	1-7	-5	Blank Panel Note 2	-2

NOTES

1. Power supply provided for all configurations is AMPEX Part No. 69121-1.
2. Blank panel AMPEX Part No. 24175-10.
3. See figures 10-1 through 10-10.

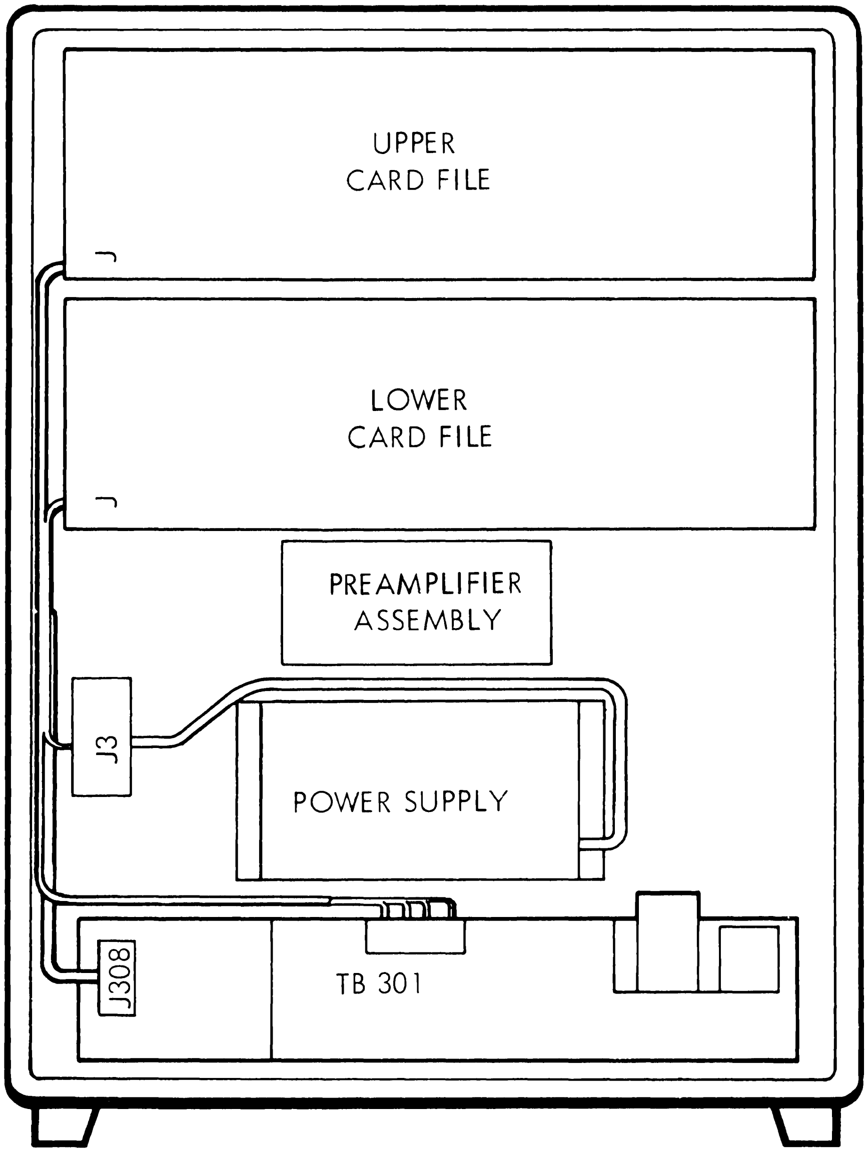


Figure 10-1. GENERAL ARRANGEMENT OF SIGNAL ELECTRONICS IN PORTABLE INSTRUMENT

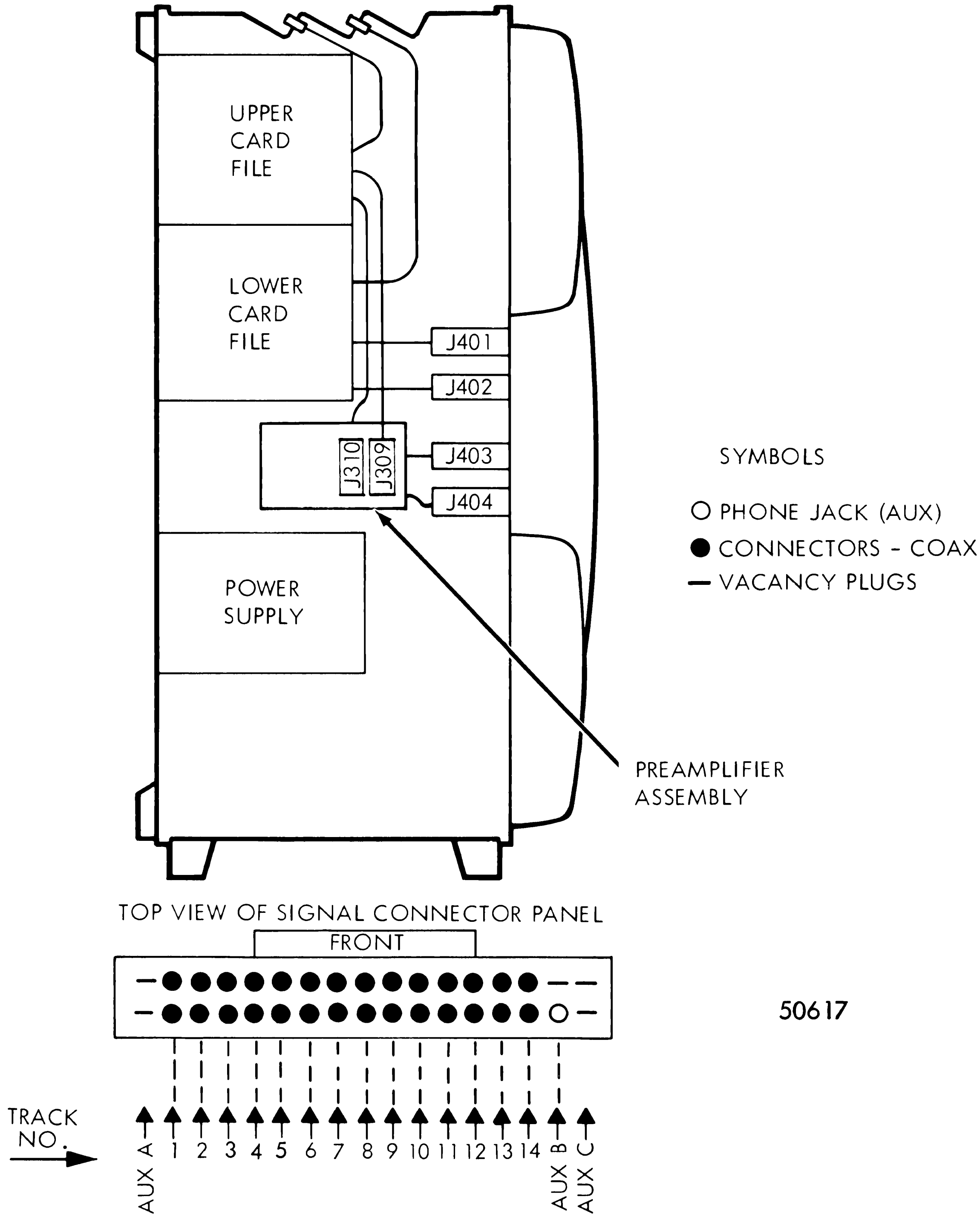


Figure 10-2. PORTABLE CONFIGURATION A

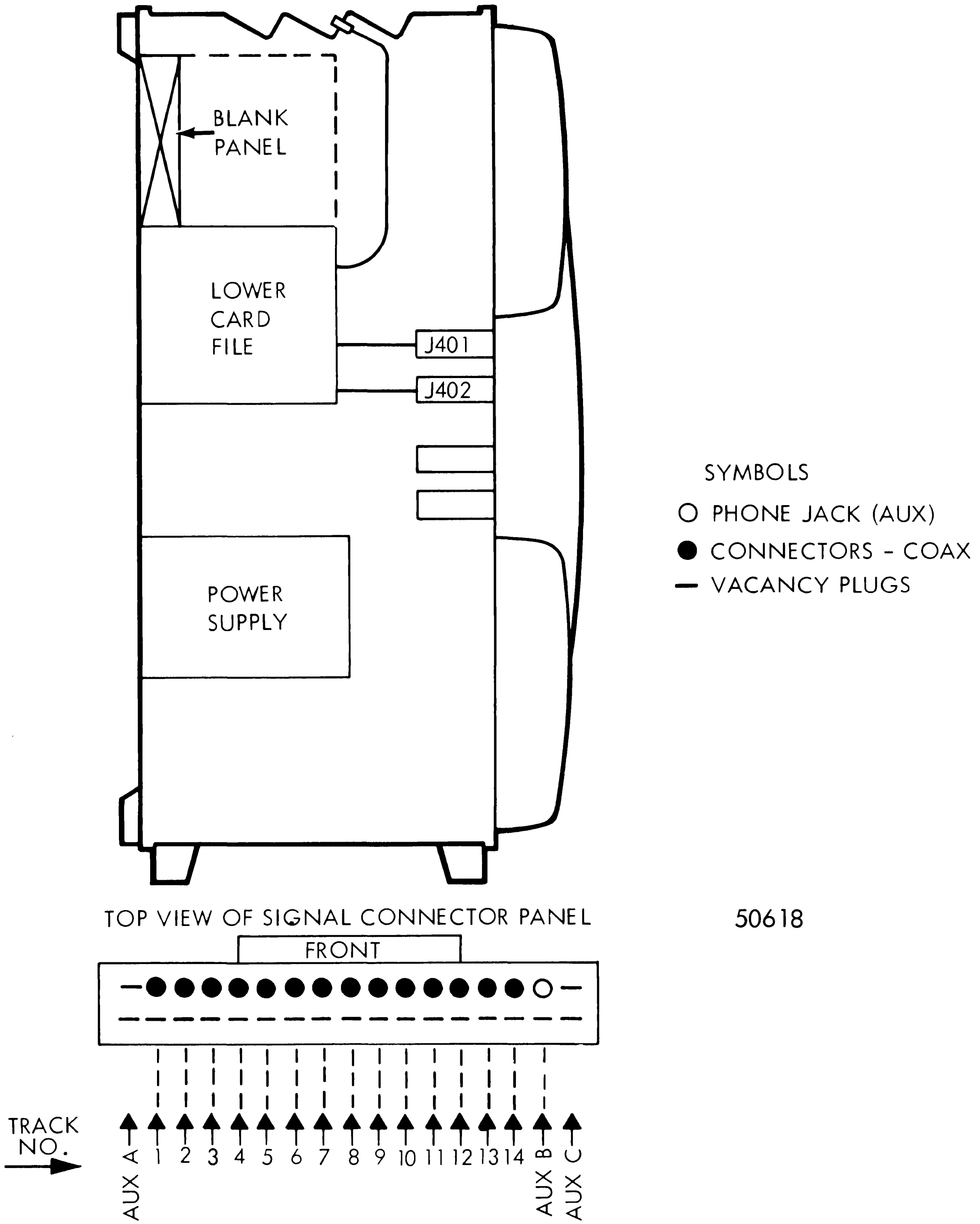


Figure 10-3. PORTABLE CONFIGURATION B

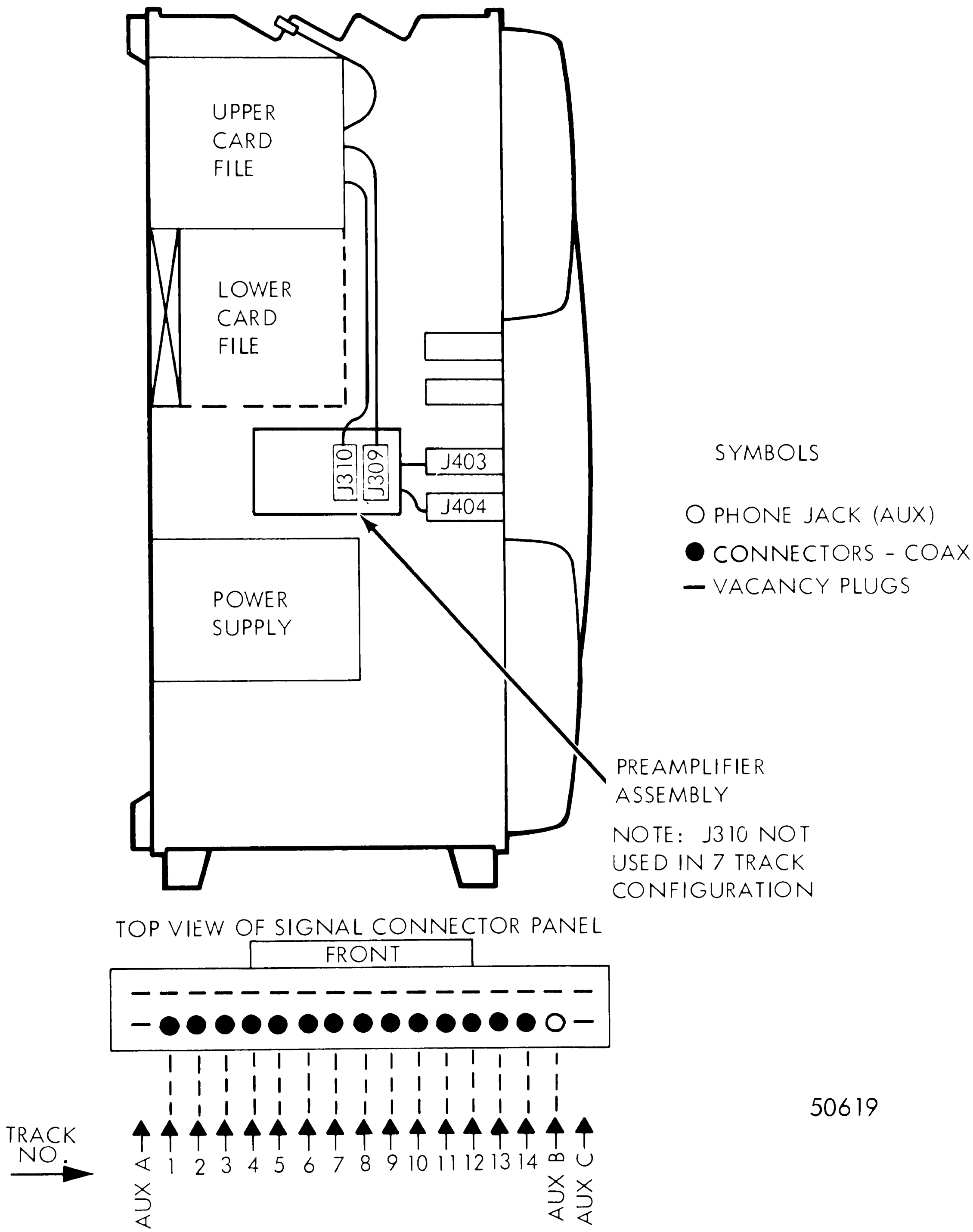


Figure 10-4. PORTABLE CONFIGURATION C

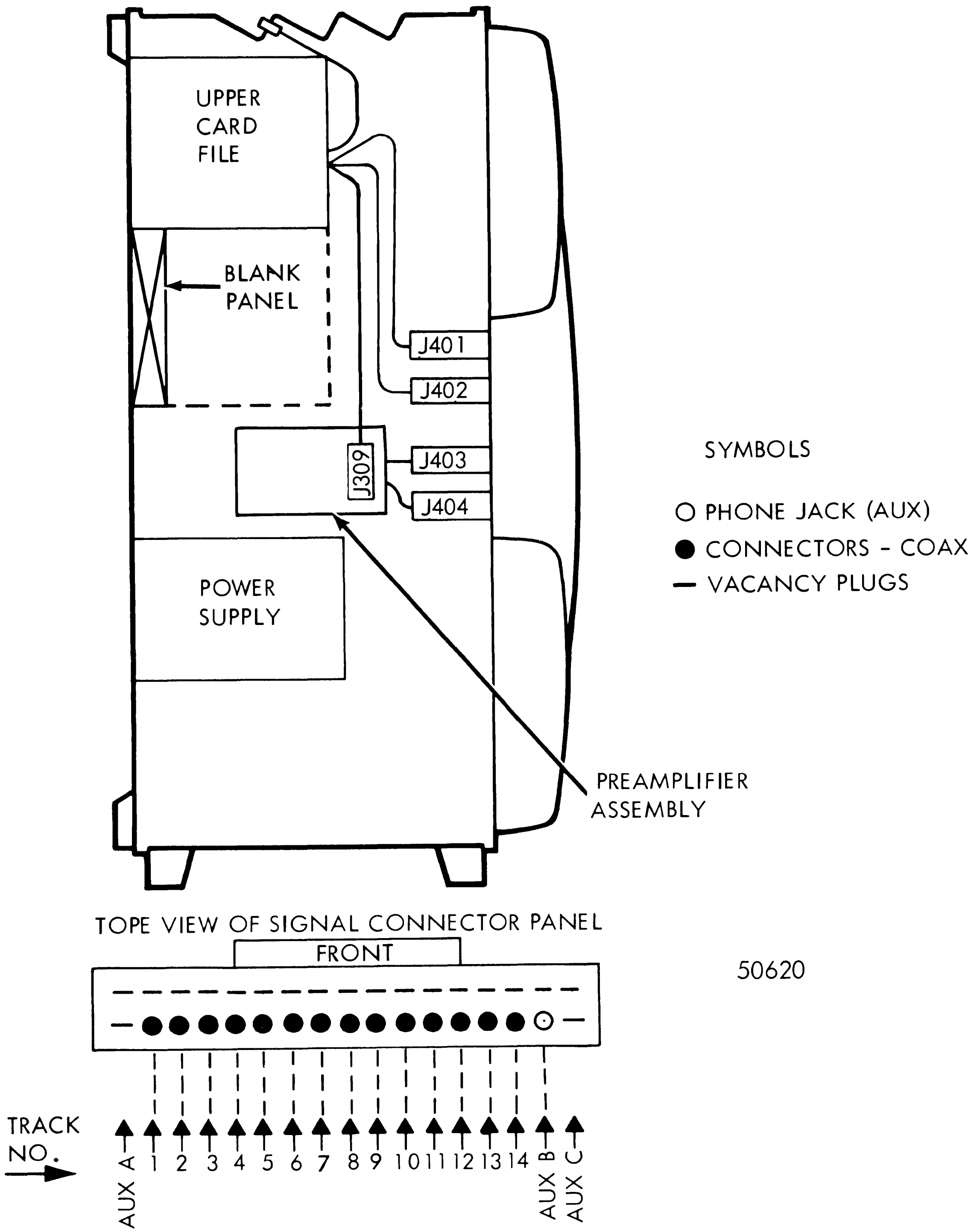


Figure 10-5. PORTABLE CONFIGURATION D

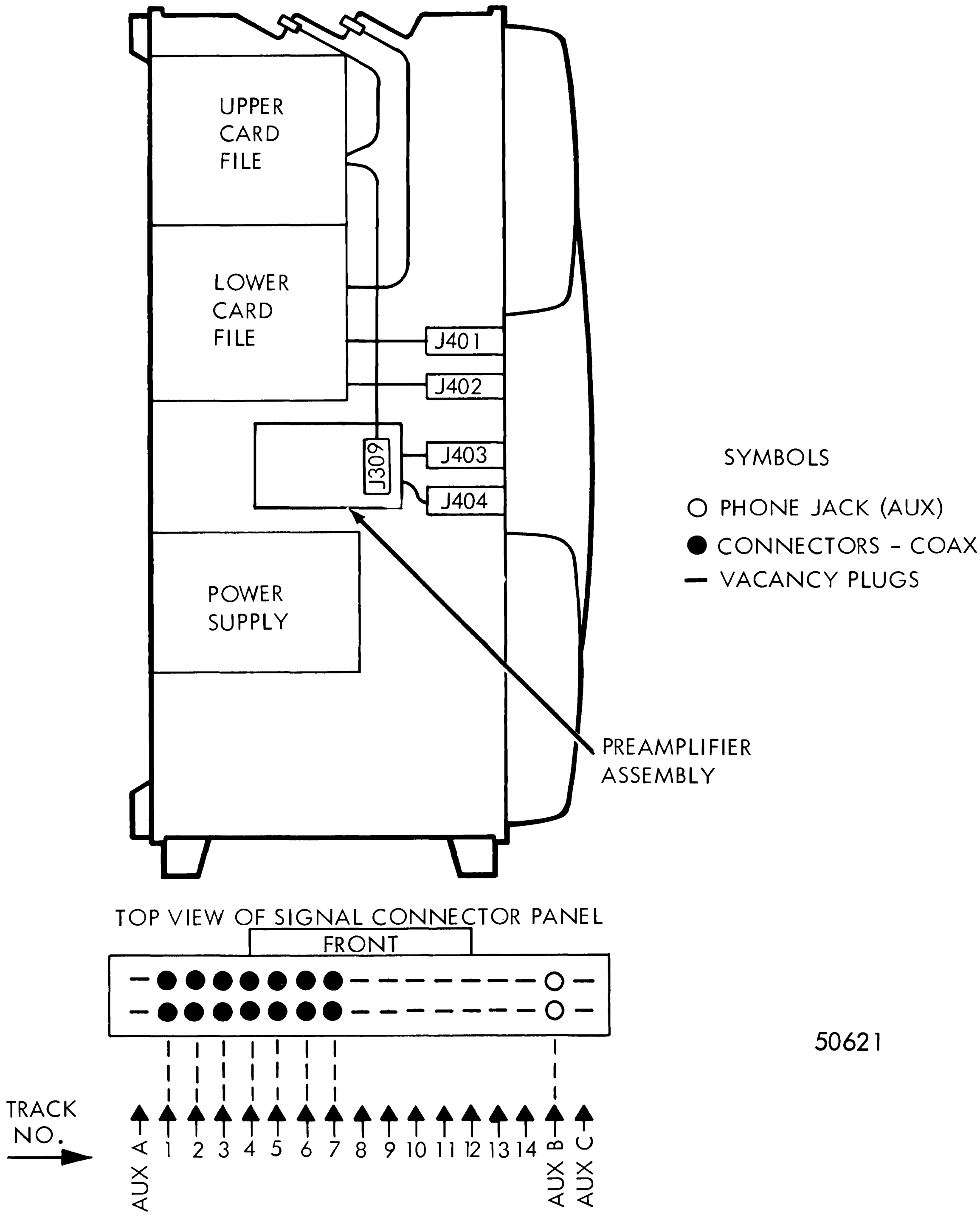


Figure 10-6. PORTABLE CONFIGURATION E

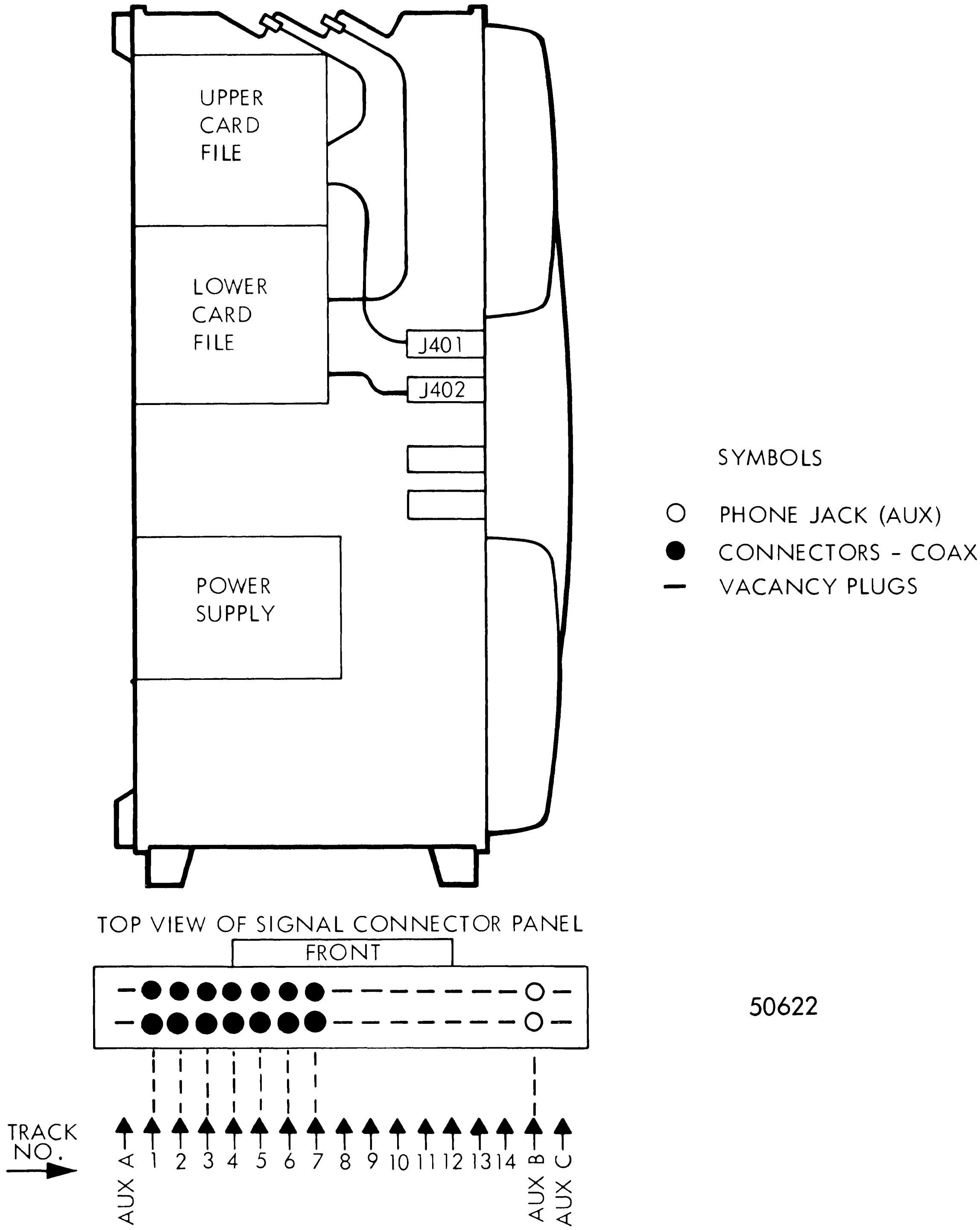


Figure 10-7. PORTABLE CONFIGURATION F

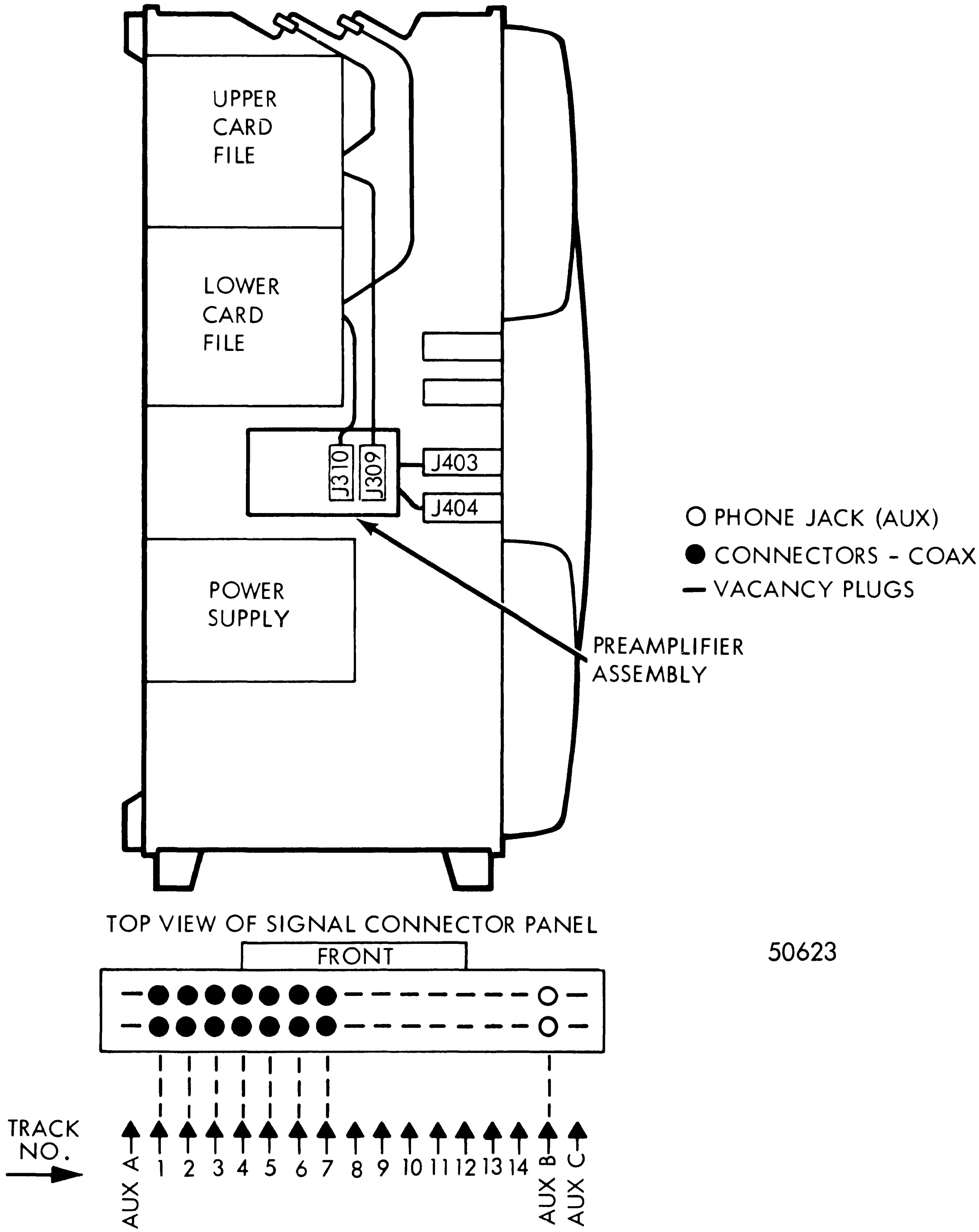


Figure 10-8. PORTABLE CONFIGURATION G

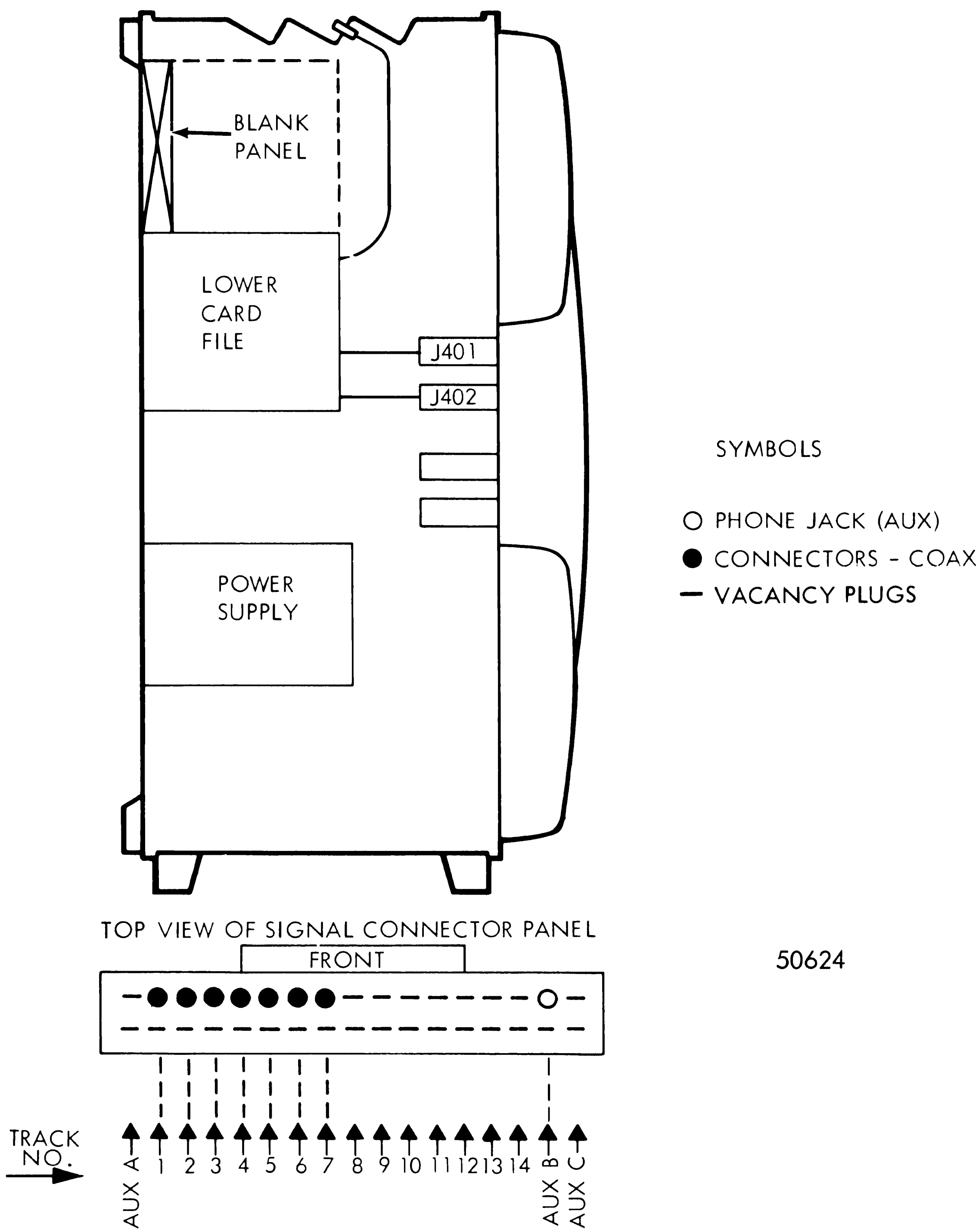


Figure 10-9. PORTABLE CONFIGURATION H

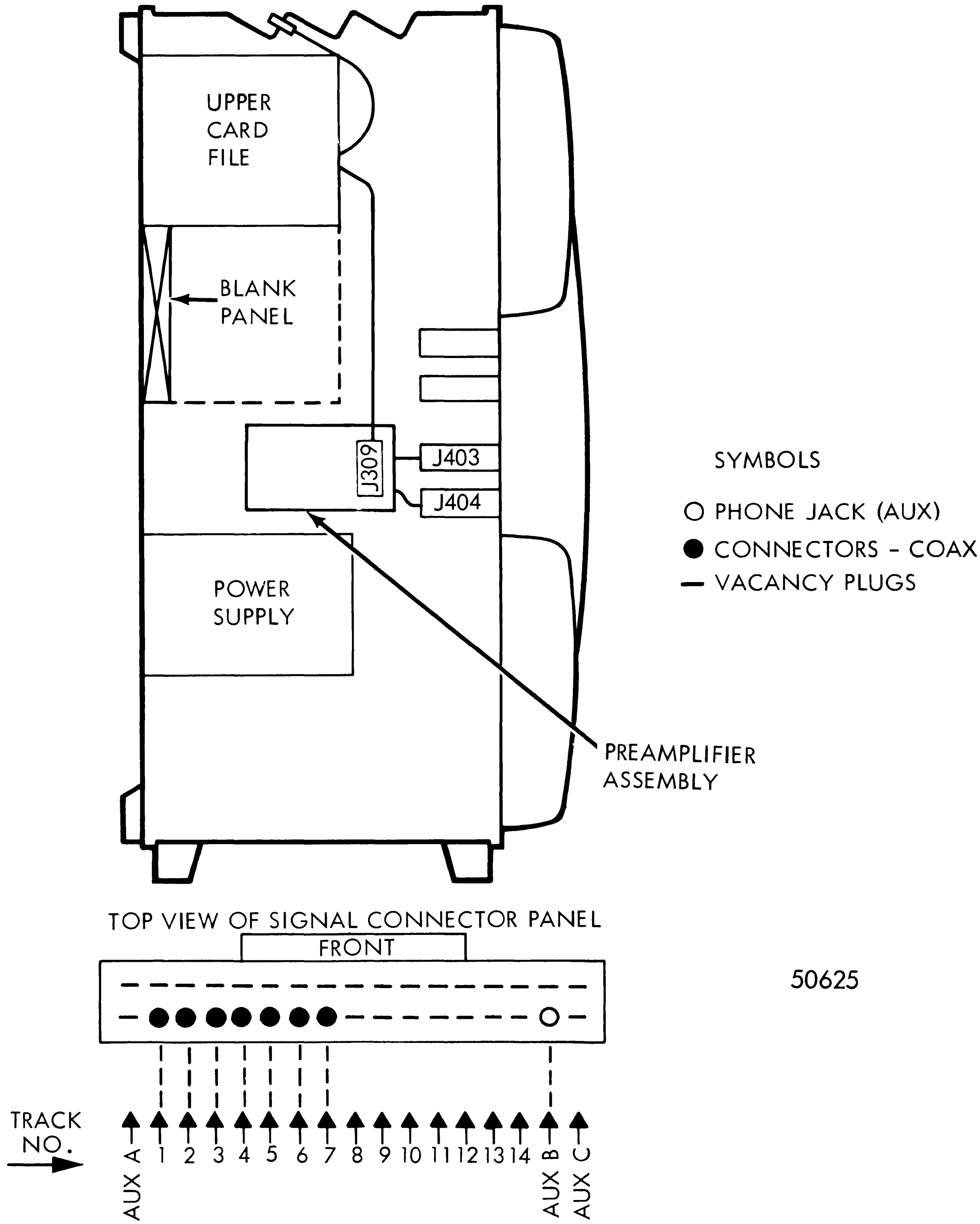
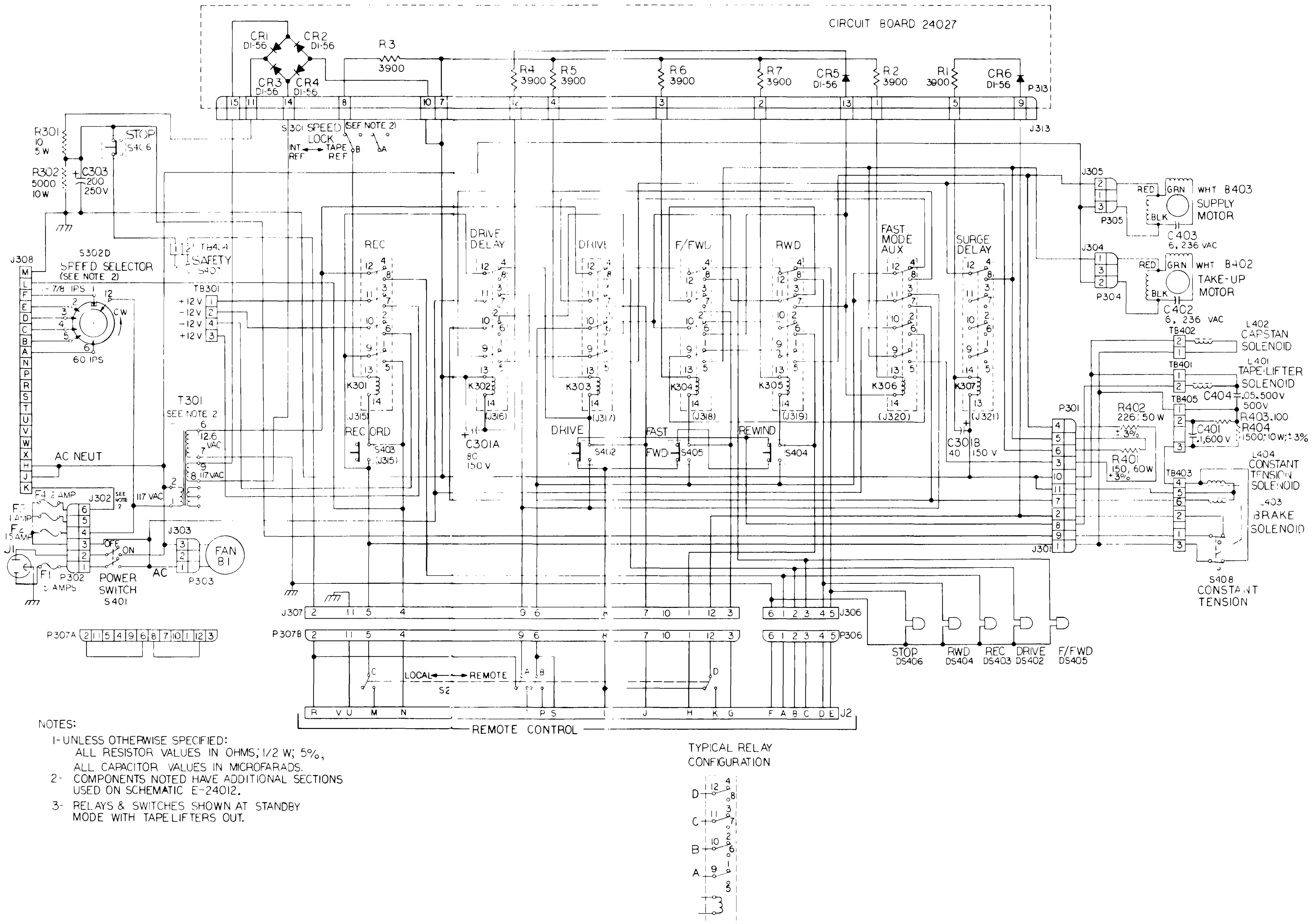


Figure 10-10. PORTABLE CONFIGURATION J



NOTES:

1- UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES IN OHMS, 1/2 W, 5%,
   ALL CAPACITOR VALUES IN MICROFARADS.
2- COMPONENTS NOTED HAVE ADDITIONAL SECTIONS USED ON SCHEMATIC E-24012.
3- RELAYS & SWITCHES SHOWN AT STANDBY MODE WITH TAPE LIFTERS OUT.

50626

Figure 10-11. ELECTRICAL CONTROL SYSTEM SCHEMATIC

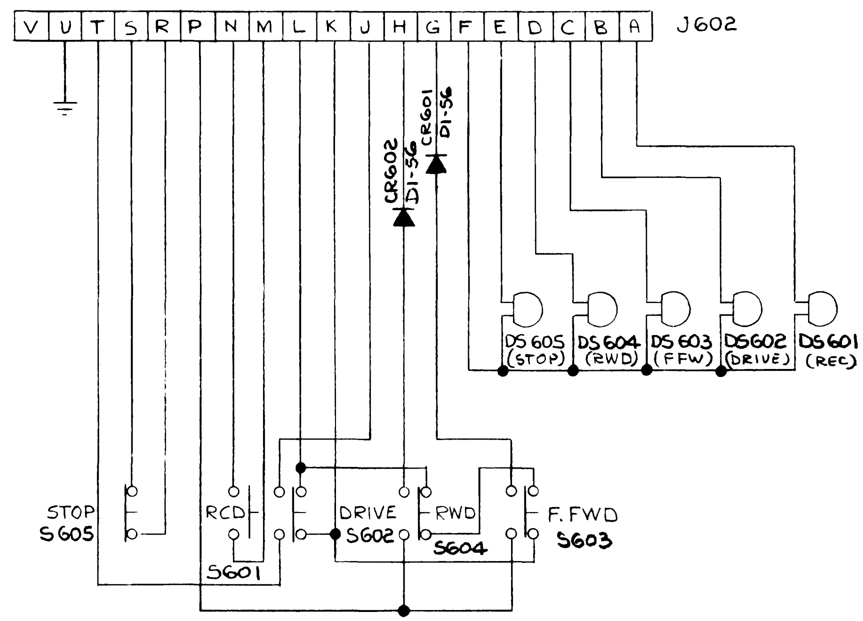
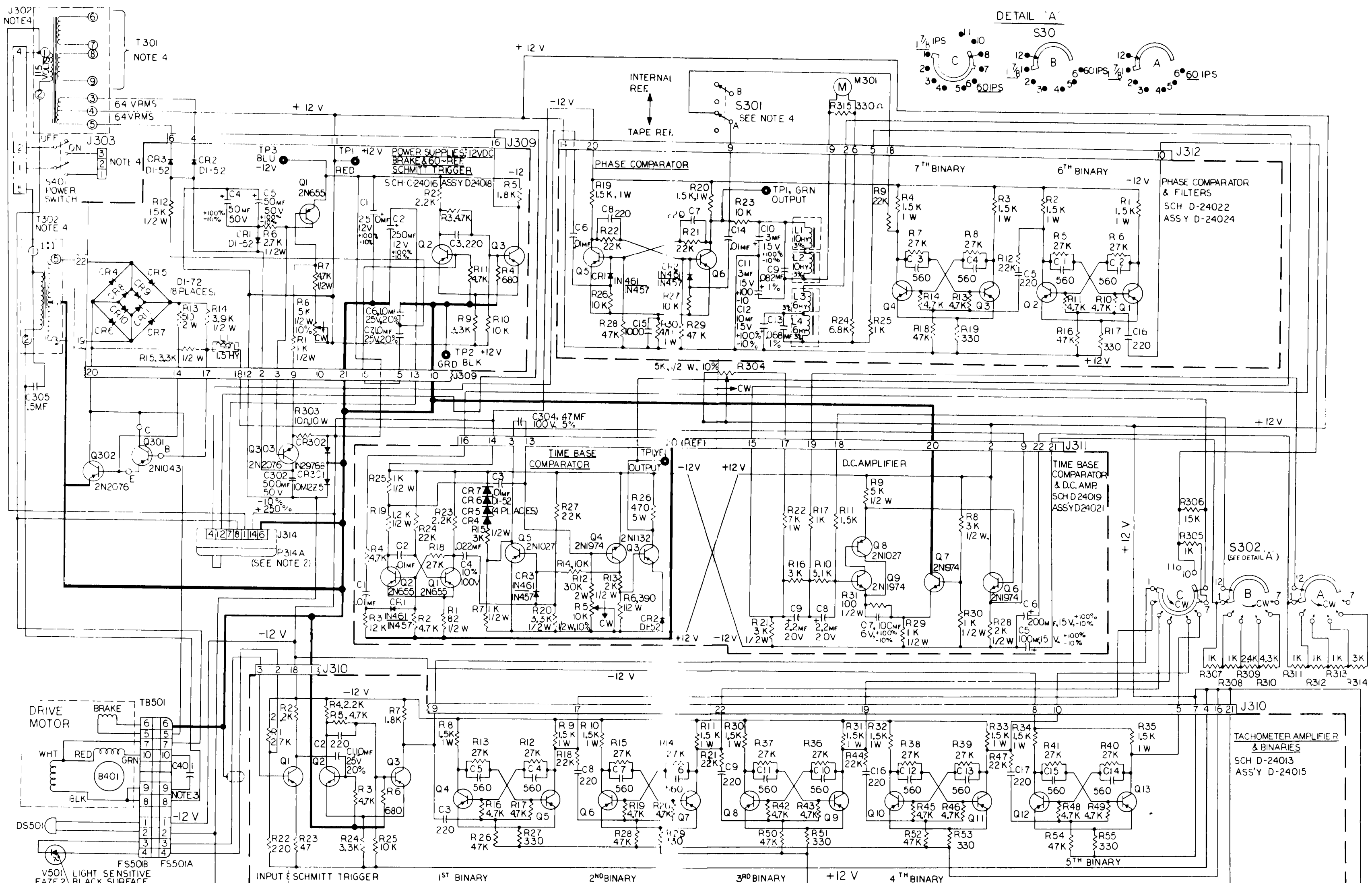


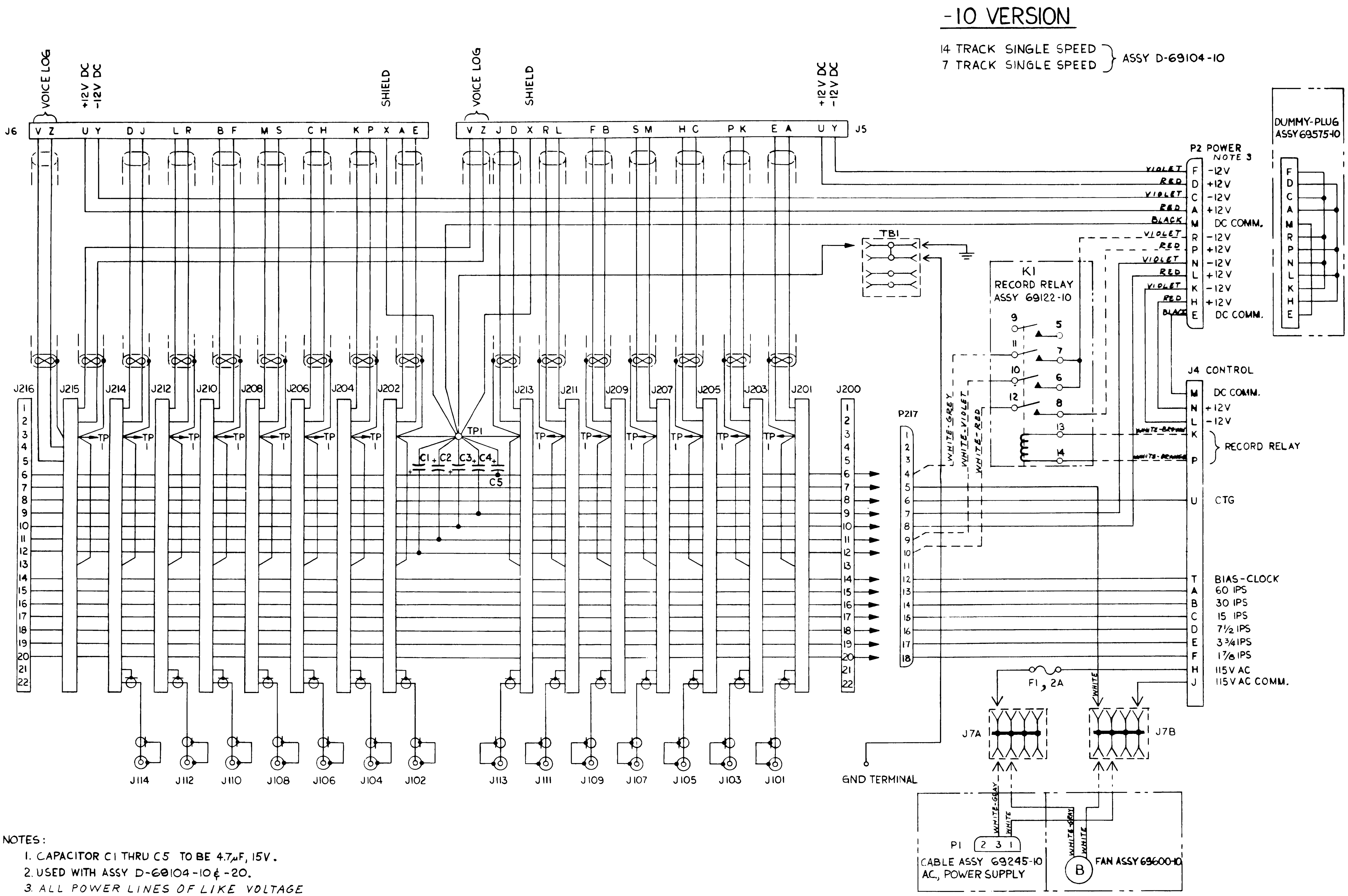
Figure 10-12. REMOTE CONTROL SYSTEM SCHEMATIC



NOTES:
1. RESISTANCE IS IN OHMS ± 5%, 1/4 W. CAPACITANCE IS IN PICOFARADS, ± 10%, 600 VOLTS. ALL TRANSISTORS ARE 2N404, UNLESS OTHERWISE NOTED.
2. P314A FOR LINE LOCK ONLY.
3. C401 IS 9.0 MF, ±10 %, 236 VAC FOR 60~; 10MF, ±10 %, 236 VAC FOR 50~.
4. COMPONENTS NOTED HAVE ADDITIONAL SECTIONS USED ON SCHEMATIC E-23823.

50628

Figure 10-13. DRIVE SERVO SYSTEM SCHEMATIC

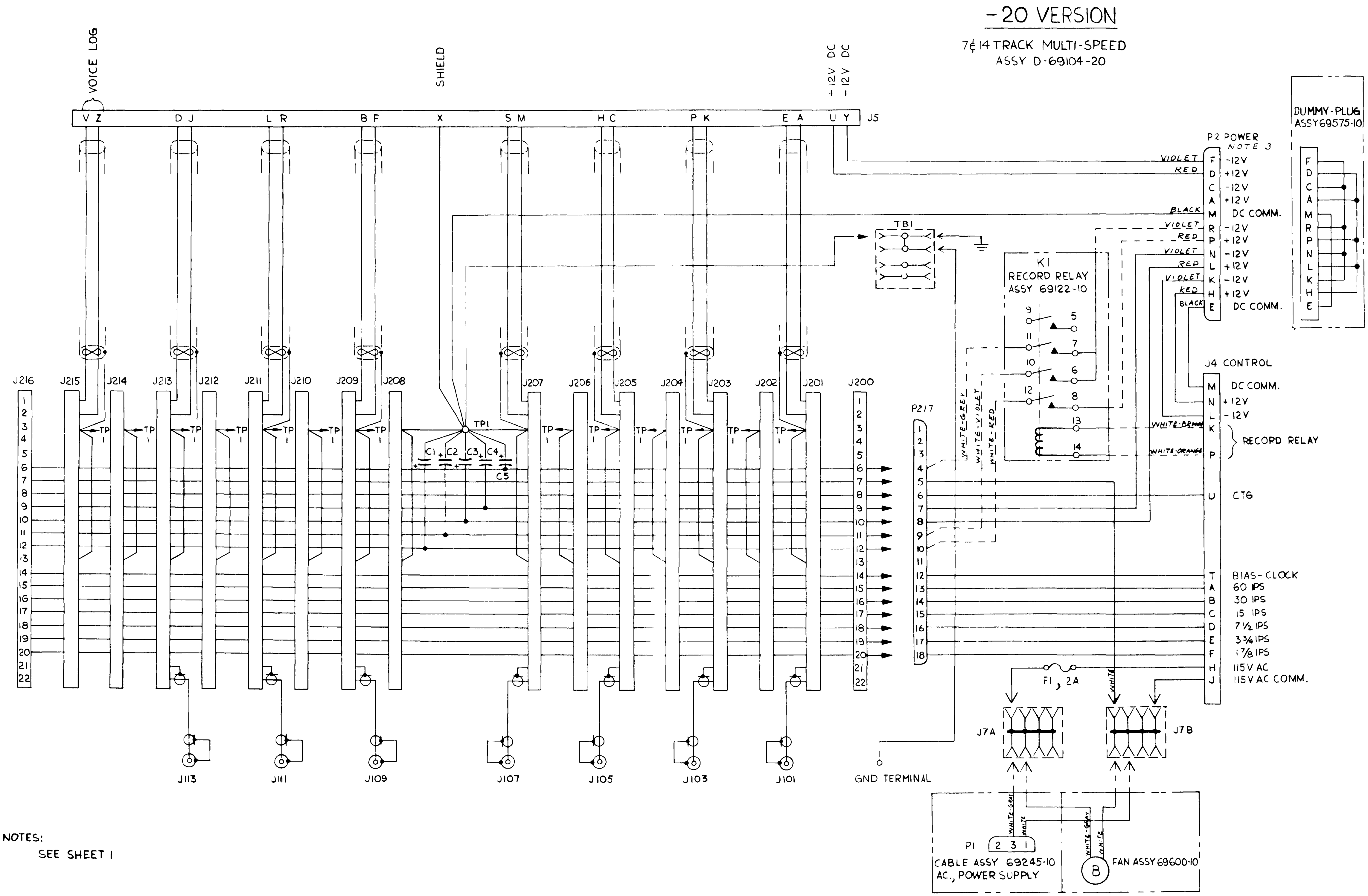


NOTES:

1. CAPACITOR C1 THRU C5 TO BE 4.7μF, 15V.
2. USED WITH ASSY D-69104-10 & -20.
3. ALL POWER LINES OF LIKE VOLTAGE & POLARITY ARE BUSSED TOGETHER IN THE 69121 POWER SUPPLY.

Figure 10-14. ELECTRONICS TRAY SCHEMATIC, 7 AND 14 TRACK SINGLE SPEED ELECTRONICS (Sheet 1 of 2)

50629/1

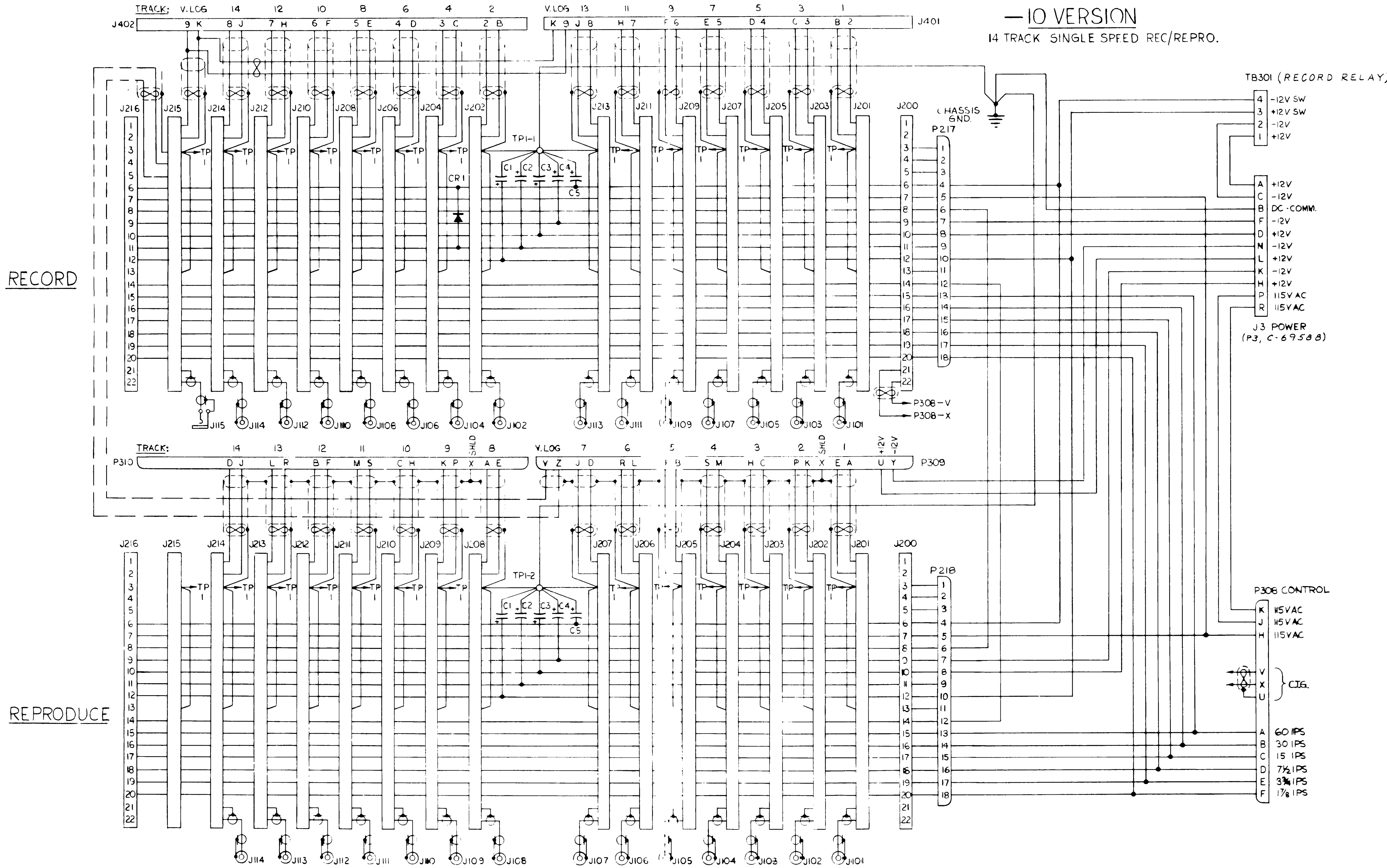


NOTES:
SEE SHEET 1

Figure 10-14. ELECTRONICS TRAY SCHEMATIC,
7 AND 14 TRACK SINGLE SPEED ELECTRONICS
(Sheet 2 of 2)

50629/2

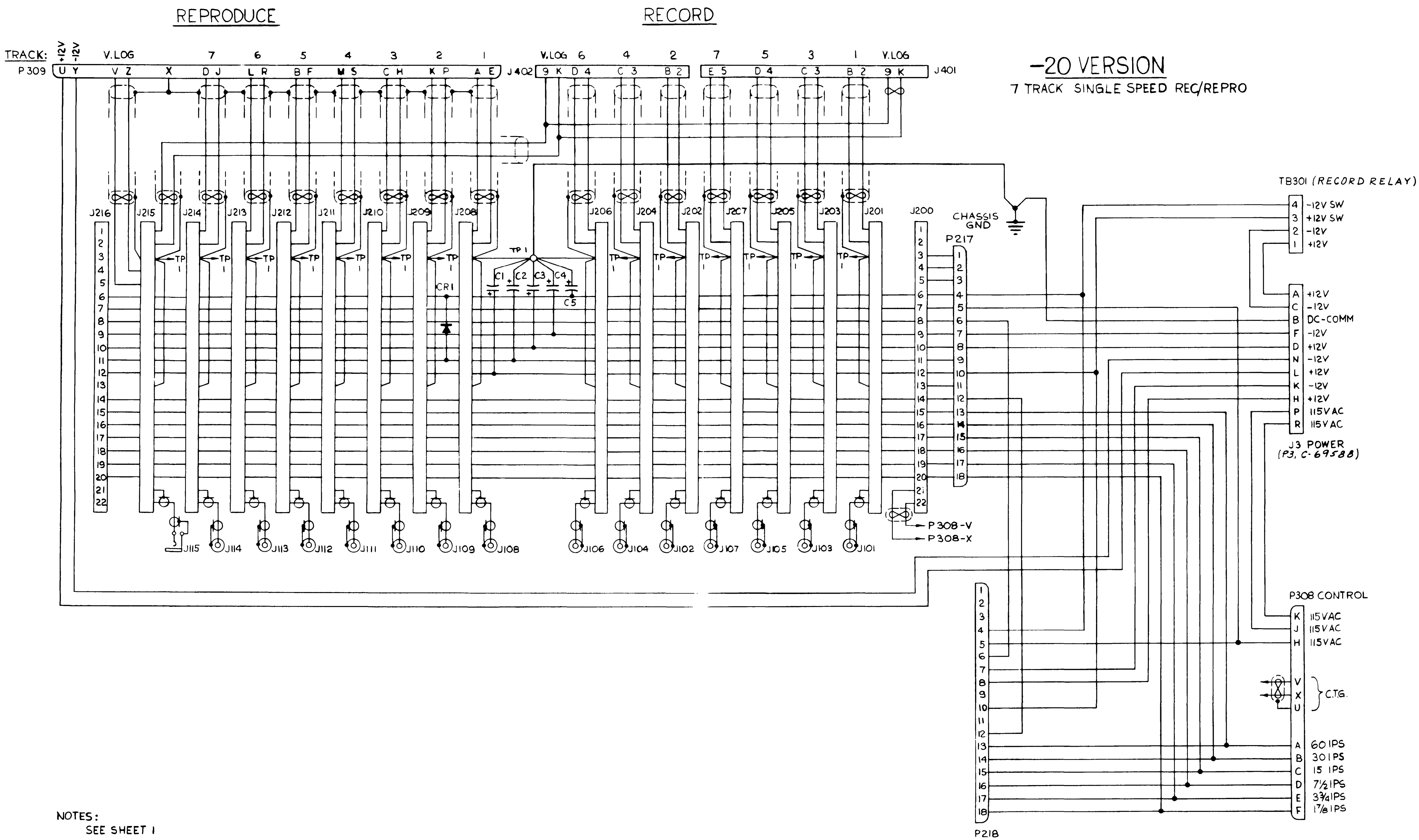
103458



NOTES:
1. CAPACITOR C1 THRU C5 TO BE 4.7μF, 15V.
2. DIODE CR1 TO BE TYPE DI-52 OR EQUIVALENT.
3. USED WITH ASSY D-69592 & D-69593

Figure 10-15. CARD FILE SCHEMATIC, 14 TRACK SINGLE SPEED ELECTRONICS (Sheet 1 of 5)

50630/1



NOTES:
SEE SHEET 1

Figure 10-15. CARD FILE SCHEMATIC, 7 TRACK SINGLE SPEED ELECTRONICS
(Sheet 2 of 5)

50630/2

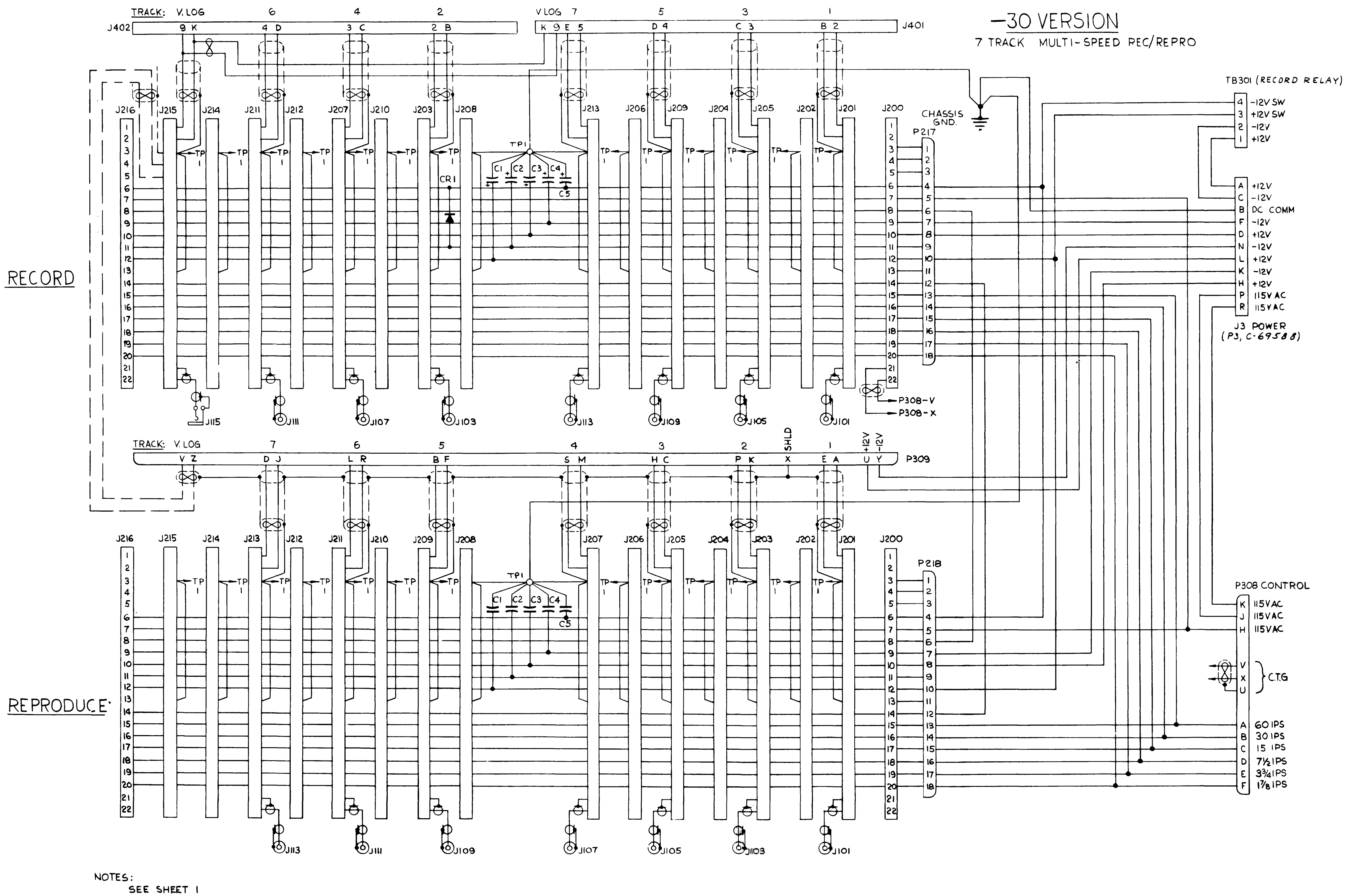


Figure 10-15. CARD FILE SCHEMATIC, 7 TRACK SIX SPEED ELECTRONICS (Sheet 3 of 5)

50630/3

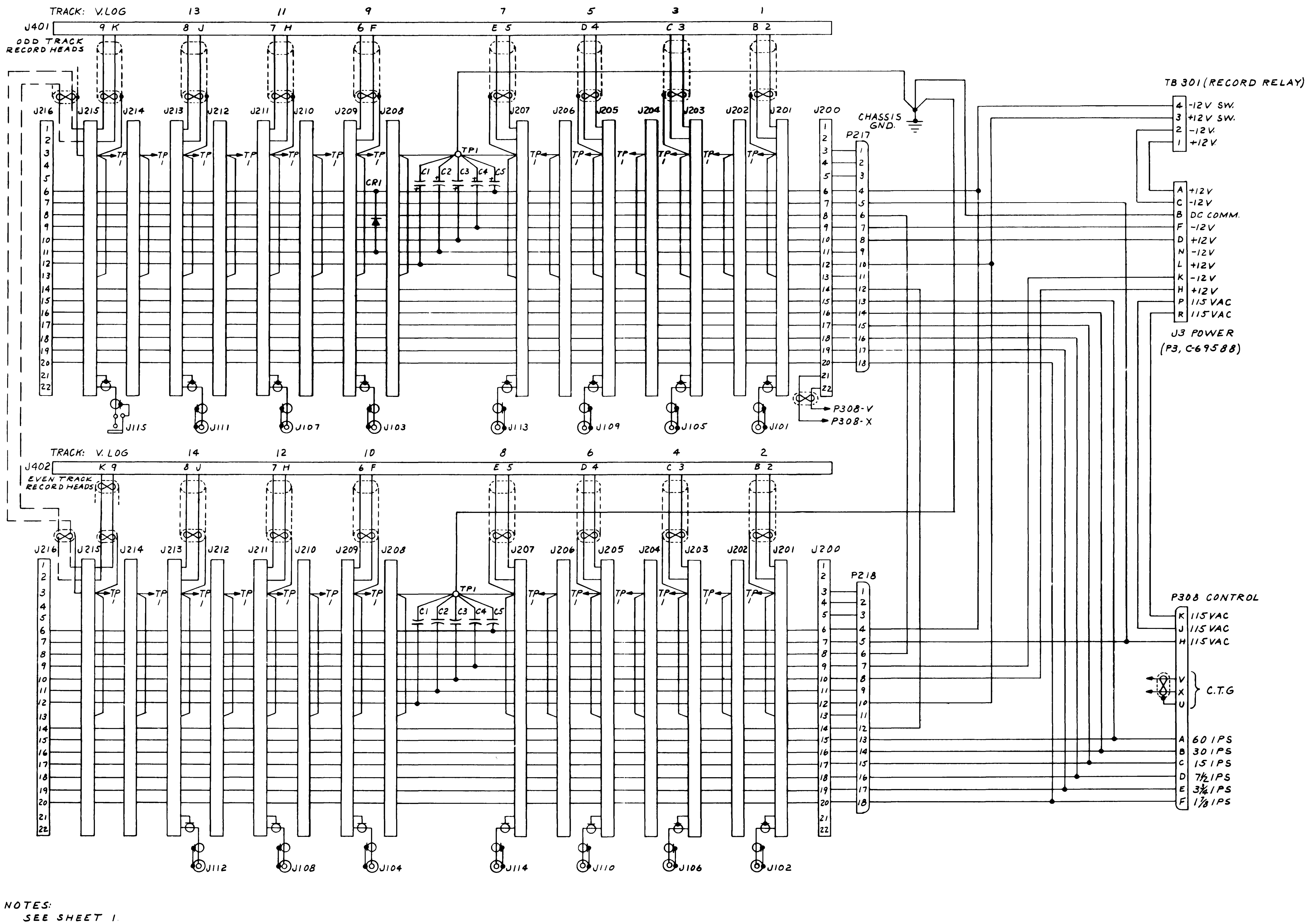
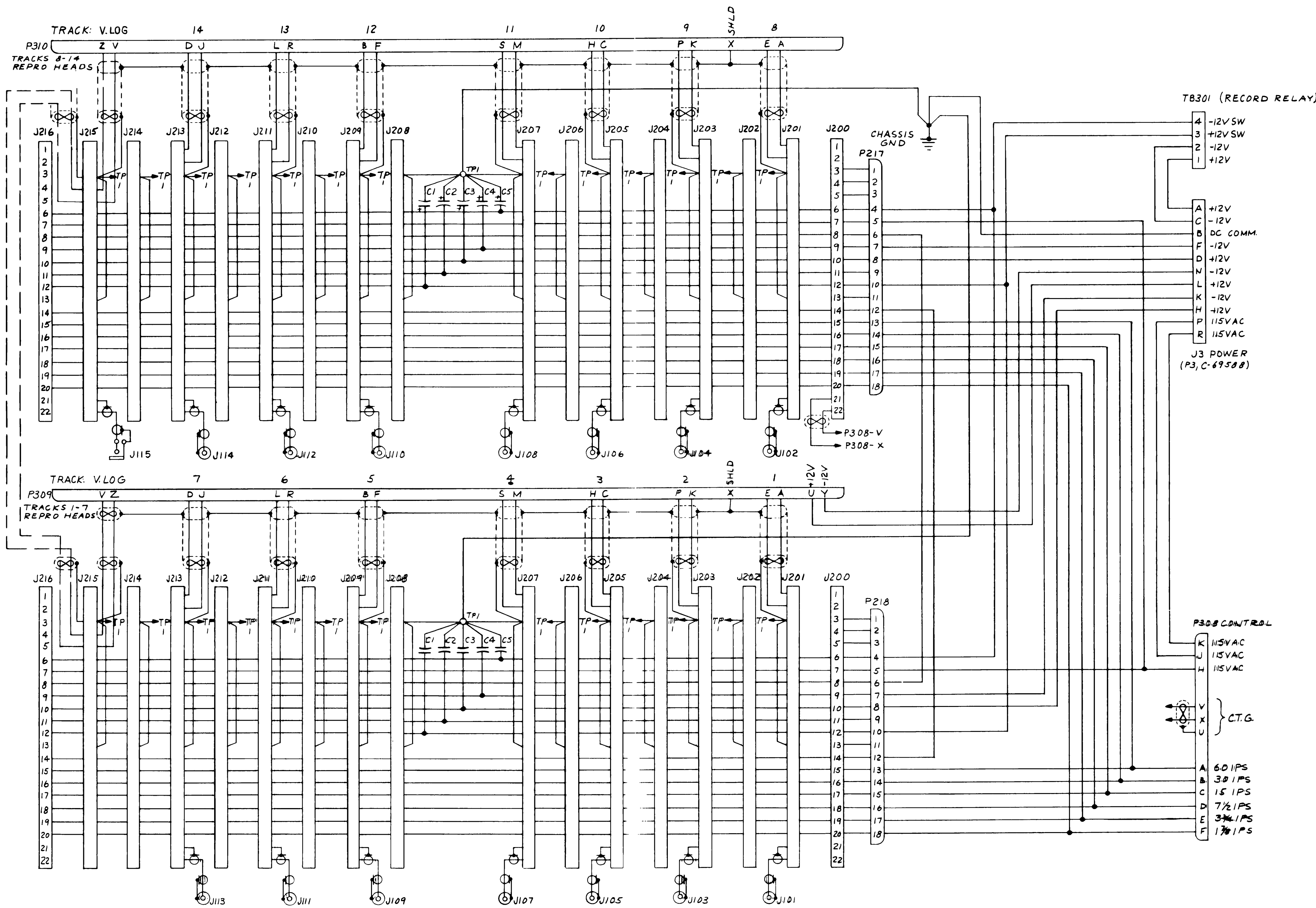


Figure 10-15. CARD FILE SCHEMATIC, 14 TRACK SIX SPEED RECORD ELECTRONICS (Sheet 4 of 5)

50630/4



NOTES:
SEE SHEET 1.

Figure 10-15. CARD FILE SCHEMATIC, 14 TRACK SIX SPEED REPRODUCE ELECTRONICS (Sheet 5 of 5)

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APPENDIX

AMPEX SERVICE

AMPEX REPRESENTATIVES. The AMPEX Corporation has engineering service engineers in principal cities throughout the world. The services of these representatives are available to the users of AMPEX products. Services include assistance in initial installation and maintenance of installed equipment. AMPEX representatives are listed in the following table:

AMPEX SALES AND SERVICE REPRESENTATIVES

UNITED STATES

MIDWEST	NORTHEAST
2-N-575 York Road, Suite 1-A Elmhurst, Illinois TErrace 3-8500 TWX 312-833-6509	600 East Palisade Avenue, Suite 22 Englewood Cliffs, New Jersey 567-7800 TWX 201-567-0593
333 West First Street, Suite 338 Dayton 2, Ohio BAldwin 8-5117 TWX 513-944-0024	947 Old York Road Abington, Pennsylvania TUrner 7-7650 TWX 215-884-2822
4010 West 65th Street Minneapolis 24, Minnesota WAlnut 7-5638 TWX 612-292-4141	235 Bear Hill Road Waltham 54, Massachusetts TWinbrook 9-2040 TWX 617-894-0636
NORTHWEST	SOUTH CENTRAL
Standford Professional Center 750 Welch Road, Room 206 Palo Alto, California DAvenport 6-2797 TWX 415-492-9400	2626 West Mockingbird Lane Suite 232 Dallas 35, Texas FLeetwood 7-0481 TWX 214-899-9001
5220 Rainier Avenue South Seattle 18, Washington PArkway 3-3170 TWX 206-998-0914	2829 E. Second Ave., Room 209 Denver, Colorado 322-3296 TWX 303-292-3561

SOUTHWEST

8467 Beverly Boulevard
Los Angeles 48, California
OLive 3-1610
TWX 213-655-6535

SOUTHEAST

3376 Peachtree Road N.W.
Atlanta 5, Georgia
231-3480
TWX 404-231-1637

10 Coleman Arcade Building
P.O. Box 215
Melbourne, Florida
PArkway 3-3553
TWX 305-723-1557

Holiday Office Center
3322 S. Memorial Parkway
Suite 65
Huntsville, Alabama
881-4271
TWX 205-881-0776

MID-ATLANTIC

Universal Building, Suite 218
Connecticut and Florida Avenue N.W.
Washington 9, D.C.
DEcatur 2-0300
TWX 202-965-0366

NOTE

The addresses of AMPEX representatives in countries other than the United States will be provided in the final manual.

PARTS LIST

The parts list presented in this appendix is comprehensive for **FR**-1300 catalog items other than those designated ES-100 electronics. Parts lists for ES-100 items are presented in the second part of the manual.

AMPEX PARTS

AMPEX parts are available through the local AMPEX representative, or directly from the AMPEX Corporation. To order after-hours, or emergency shipments of replacement parts for the FR-1300, telephone EMerson 5-0661, Redwood City, California, area code 415. Orders placed by this telephone service will be filled within hours after receipt. Shipment will normally be by air. Users who wish to stock spare parts for the FR-1300 may obtain information on recommended stock levels from the AMPEX representative.

NOTE

When contacting the AMPEX representative for service or parts, please describe the instrument model, catalog number and serial number, whether portable or rack-mount, and the electronics configuration (example: single speed FM seven track record and seven track reproduce).

PARTS LIST FOR: ACCESSORY KIT CATALOG NO. 24090-10

REF NO	AMPEX PART NO	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
1.	084-010		Cord Set, 3 Conductor, 8 Ft. Length	1
2.	087-007		Cleaning Agent, Head Assy. (4 oz. can)	1
3.	600-049		Tubing, Insulating, Clear #5 (3" length) (for removing pushbutton lamps)	1
4.	69630-10		Tip Plug, Electronic Test - Red	1
5.	69630-20		Tip Plug, Electronic Test - Black	1
6.	69630-30		Tip Plug, Electronic Test - Green	1
7.	24090-10		Tuning Tool	1

PARTS LIST FOR		SERVO EXTENSION CARDS CATALOG NOS. 24189-10, -20, -30, -40	
REF NO	AMPEX PART NO.	MIL OR GOVT. NO. DESCRIPTION	NO/ ASSY.
1.	24189-10	Servo Extension Card for Power Supply Card (24018)	1
2.	24189-20	Servo Extension Card for Tachometer Amplifier Card (24015)	1
3.	24189-30	Servo Extension Card for Time Base Comparator Card (24021)	1
4.	24189-40	Servo Extension Card for Phase Comparator Card (24024)	1

PARTS LIST FOR			REMOTE CONTROL ASSEMBLY CATALOG NO. 24110-10	
REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
1.	23871-10		Cable, Remote Control	1
2.	502-008	MS 35338	Washer, #4 Spring Lock; SST	4
3.	501-015	MS 15795-306	Washer, #6 Flat; SST	4
4.	502-009	MS 35338-79	Washer, #6 Spring Lock; SST	8
5.	496-002		Nut, Keps; 6-32 NC-2B, STL CAD PL	4
6.	492-014		Nut, Plain Hex; 4-40 NC-2B; SST	4
7.	471-113	MS 35216-15	Screw, 4-40 NC - 2A x 7/16 lg. Phil. Pan Hd. STLS STL	4
8.	471-121	MS 35216-27	Screw, 6-32 NC - 2A x 1/2 Lg. Phil. Pan Hd. SST	4
9.	471-119	MS 35216-25	Screw, 6-32 NC - 2A x 3/8 Lg. Phil Pan Hd. SST	4
10.	497-009		Nut, Push-on Tinnerman	2
11.	250-013		Bumper, Rubbercraft #6313	4
12.	92424-40		Emblem, Trademark	1
13.	11751-16		Plate, Identification	1
14.	24098-10		Plate, Washer	2
15.	24097-10		Frame	1
16.	23903-50		Pushbutton (STOP)(plastic button)	1
17.	23903-40		Pushbutton (RECORD) (plastic button)	1
18.	23903-30		Pushbutton (DRIVE) (plastic button)	1
19.	23903-20		Pushbutton (REWIND) (plastic button)	1
20.	23903-10		Pushbutton (FORWARD) (plastic button)	1
21.	24095-10		COVER ASS'Y.	1
22.	23950-10		HARNESS ASS'Y.	1

PARTS LIST FOR: HARNESS ASSEMBLY, CASE, REMOTE CONTROL CATALOG NO. 24115-10

REF. NO.	AMPEX PART NO.	MIL OR GOVT NO.	DESCRIPTION	NO/ ASSY.
1.	302-074		Clamp, Cable, nylon, black, 1/4 I.D.	1
2.	496-004		Nut, Keps, 4-40 NF-2B, Stl. Cad Plate.	4
3.	496-002		Nut, Keps, 6-32 NF-2B, Stl. Cad Plate.	2
4.	471-118		Screw, 6-32 NF-2A, 5/16 Lg. S. Stl.	2
5.	471-112		Screw, 4-40 NF-2A, 3/8 Lg. S. Stl.	4
6.	169-996		Connector, Cap, 6 pin, white.	1
7.	169-135		Connector, Cap, 12 pin, white.	1
8.	24122		Switch, remote - local.	1
9.	146-217		Connector, Receptacle, female, 19 pin.	1
10.	169-035		Connector Pin, 22-20 awg wire.	17

PARTS LIST FOR: HARNESS ASSEMBLY, RACK MOUNT, REMOTE CONTROL CATALOG NO. 24114-10

REF. NO.	AMPEX PART NO.	MIL OR GOVT NO.	DESCRIPTION	NO/ ASSY.
1.	302-074		Clamp, Cable, nylon, black, 1/4 I. D.	1
2.	496-004		Nut, Keps, 4-40 NF-2B, stl. cad plate.	4
3.	496-002		Nut, Keps, 6-32 NF-2B, stl. cad plate.	2
4.	471-118		Screw, 6-32 NF-2A, 3/16 lg., s. stl.	2
5.	471-112		Screw, 4-40 NF-2A, 3/8 lg., s. stl.	4
6.	169-996		Connector, cap, 6 pin, white.	1
7.	169-135		Connector, cap, 12 pin, white.	1
8.	24122		Switch, remote-local.	1
9.	146-217		Connector, receptacle, remale, 19 pin.	1
10.	169-035		Connector pin, 22-20 awg. wire.	17

PARTS LIST FOR		OSCILLATOR, 60 CYCLE CATALOG NO. 23882-10	
REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO. DESCRIPTION	NO/ ASSY.
1.	23882-10	Oscillator, 60 Cycle (servo frequency reference) Refer to Note. NOTE The frequency standard is sealed at manufacture. If a malfunction develops within the unit, it should be returned to AMPEX for servicing.	1

PARTS LIST FOR		RACK-MOUNT ADAPTER CATALOG NO. 23825-10	
REF. NO.	**AMPEX PART NO.**	**MIL OR GOVT. NO.**	**DESCRIPTION**	**NO/ ASSY.**

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
1.	502-010	MS 35338-80	Washer, #8 Spring Lock; SST	11
2.	471-346	MS 35192-41	Screw; 8-32 NC - 2A x 7/16 Lg. Phil. Flat Hd. STL CAD PLATE	2
3.	471-336	MS 35192-25	Screw; 6-32 NC - 2A x 3/8 Lg. Phil. Flat Hd. STL CAD PLATE	2
4.	471-078	MS 35208-40	Screw; 8-32 NC - 2A x 3/8 Lg. Phil. Pan Hd. STL CAD PLATE	11
5.	302-046		Clamp and Keeper, 1" White Nylon; Dakota 2C1-100/2C1-100A	2
6.	302-043		Clamp and Keeper, 3/8" White Nylon; Dakota 2C1-37/2C1-37A	2
7.	24080-10		Frame, Adapter	1
8.	23857-20		Panel, Side	1
9.	23857-10		Panel, Side	1
10.	23862-10		CHASSIS ASS'Y, POWER INPUT	1
11.	501-009		Washer, Flat, #6, STL CAD PLATE	1
12.	302-075		Clamp, Cable; Nylon (black)	1
13.	496-004		Nut, Keps; 4-40 NF - 2B STL CAD PLATE	2
14.	496-002		Nut, Keps; 6-32 NC - 2B STL CAD PLATE	2
15.	471-388		Screw, 6-32 NC - 2A x 7/16 Lg. Phil. Pan Hd. MACH SST	3
16.	471-111		Screw, 4-40 NF - 2A x 5/16 Lg. Phil. Pan Hd. MACH SST	2
17.	147-148		Connector, Receptacle, Male	1
18.	085-005		Fuse, Extractor Post (fuse holder)	5
19.	24113-10		HARNESS ASS'Y., Power Input Panel, Rack-Mount	1
20.	23859-10		Shield	1
21.	23858-10		Panel, Rear	1

PARTS LIST FOR: FINAL CASE ASSEMBLY CATALOG NO. 24100-11

NOTE

The case is, to a large extent, composed of formed and extruded parts welded together to provide a sturdy enclosure. Because of this type of construction, many of the parts are not replaceable, but rather, the entire weldment must be replaced. This aspect of construction is reflected in the parts list in which only the replaceable items are given.

REF NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
1.	475-031		Screw, Sem Pan Hd. Slotted, Ext. Tooth #6-32 x 1/4 Lg. STL NICKEL PLATE	2
2.	475-016		Screw, Sem Pan Hd. Slotted, Int. Tooth #6-32 x 3/8 Lg. STL NICKEL PLATE	2
3.	471-331		Screw, Machine, 82° Flat Phil. Hd. #4-40 x 5/8 Lg. STL. CAD PLATE	4
4.	471-964		Screw, Machine, Truss Hd. Phillips Dr. #6-32 x 3/4 Lg. STLS. STL.	6
5.	471-845		Screw, Machine, Truss Hd. Phillips Dr. #4-40 x 1/4 Lg. STLS. STL.	5
6.	471-327		Screw, Machine, 82° Flat Phillips Dr. #4-40 x 5/16 Lg. STL. CAD PLATE	2
7.	471-326		Screw, Machine, 82° Flat Phillips Dr. #4-40 x 1/4 Lg. STL. CAD PLATE	6
8.	471-129		Screw, Machine, Pan Hd. Phillips Dr. #8-32 x 7/16 Lg. STLS. STL.	6
9.	470-020		Screw, Cap, Hex-Sckt. Drive #6-32 x 1/2 Lg. STL. CAD PLATE	2
10.	470-008		Screw, Cap Hex-Sckt. Drive #6-32 x 1/4 Lg. STL. CAD PLATE	4
11.	496-006		Nut, Keps #8-32 STL. CAD PLATE	5
12.	498-071		Nut and Washer Preassembled #6-32 STL. CAD PLATE	4
13.	470-019		Screw, Cap Hex-Sckt. Drive #6-32 x 7/16 Lg. STL. CAD PLATE	4
14.	310-108		Fastener	6
15.	310-107		Fastener	4
16.	302-075		Clamp, Cable, 5/16 NY Grip	2
17.	502-009		Washer, Lock #6 STLS. STL.	2
18.	506-016		Washer, #6 Weckesser D-167 STL. CAD PLATE	2
19.	501-021		Washer, Flat #6 STL. CAD PLATE	6
20.	496-005		Nut, Keps #6-32 STL. CAD PLATE	4
21.	496-004		Nut, Keps #4-40 STL. CAD PLATE	7
22.	23824-10		Panel - Access	1
23.	24156-20		Hinge - Male	1
24.	24156-10		Hinge - Male	1
25.	24146-10		Catch - Cover Latch	1
26.	23992-10		Bracket - Door Stop	1
27.	23960-10		Frame - Connector (Signal Connector Panel)	1
28.	11751-16		Plate - Identification	1
29.	24003-10		Filter	1
30.	24002-10		Frame - Filter	1
31.	24001-10		Grill - Filter	1
32.	23993-10		BACK PANEL ASSEMBLY	1
33.	23991-10		Panel, Back	1
34.	23989-10		Bracket, Channel Back Panel	1
35.	23988-10		Hinge, Back Panel	1
36.	24009-10		DOOR - ACCESS	1
37.	251-017		Plug Button NYLON	2
38.	430-174		Retaining Ring, Camloc Fastener Corp #5S3-2 or Equiv. SST	2
39.	310-103		Stud Assy., Camloc Fastener Corp #12S1-36-1BB or Equiv. SST	2 A/R
40.	23949-10		PANEL - INPUT ASSEMBLY	1
41.	23918-10		Harness Assy., Panel - Input	1
42.	496-004		Nut, Keps #4-40 STL. CAD PLATE	2
43.	496-002		Nut, Keps #6-32 STL. CAD PLATE	2
44.	471-118		Screw, Machine Pan Hd. Phillips Dr. #6-32 x 5/16 Lg. STLS. STL.	2
45.	471-111		Screw, Machine Pan Hd. Phillips Dr. #4-40 x 5/16 Lg. STLS. STL.	2
46.	147-148		Connector, Receptacle, Male	1
47.	085-005		Fuse, Extractor Post	5
48.	23959-11		Panel - Input	1
49.	23948-10		Cover, Panel	1

PARTS LIST FOR: FINAL CASE ASSEMBLY (Continued) Sheet 2 of 2

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
50.	24099-10		CASE - SUBASSEMBLY	1
51.	24069-10		Spring	2
52.	24010-10		Case, Upper	1
53.	24005-10		Foot, Case	4
54.	24004-10		Leg, Case	4
55.	23987-10		Frame, Case Lower	1
56.	23986-10		Frame, Case Upper	1
57.	23985-10		Case, Lower	1
58.	23972-10		Handle	2
59.	23971-11		Receptacle, Handle	1
60.	23970-10		Receptacle, Handle	1
61.	23958-10		Trim, Handle Receptacle	2
62.	23924-10		Pad	4
63.	460-128		Rivet: 1/8 Dia. x 9/16 Lg. 100° Flat Hd. ALUM.	1
64.	232-046		Royalite: Sheet, .031 Thk. #20 - 9003 - RL, SLATE S #2	A/R
65.	503-035		Washer, Flat, FIBER	A/R
66.	502-011		Washer, Lock, Spring #10 STLS. STL.	8
67.	502-009		Washer, Lock, Spring #6 STLS. STL.	2
68.	501-011		Washer, Flat #10 STL. CAD PLATE	8
69.	501-009		Washer, Flat #6 STL. CAD PLATE	2
70.	477-032		Screw, Set Hex Sckt. Dr. Cup Pt. #4-40 x 5/16 Lg. STL. CAD PLATE	4
71.	471-093		Screw, Mach. Pan Hd. Phillips Drive #10-32 x 1" Lg. STL. CAD PLATE	4
72.	471-091		Screw, Mach. Pan Hd. Phillips Drive #10-32 x 3/4 Lg. STL. CAD PLATE	4
73.	471-071		Screw, Mach. Pan Hd. Phillips Drive #6-32 x 1/2 Lg. STL. CAD PLATE	2
74.	470-030		Screw, Cap. Hex Sckt. Drive #8-32 x 5/8 Lg. STL. CAD PLATE	8
75.	460-121		Rivet, 1/8 Dia. x 11/16 Lg. 100° Ft. Hd. ALUM.	15
76.	402-020		Pin, Dowel .187 Dia. x 2" Lg.	4
77.	23788-11		FAN ASSEMBLY	1
78.	503-055		Washer, Non-metallic, 3/16 I.D. x 1/2 O.D.	4
79.	494-020		Nut, Self-locking, Nylon Insert: 4-40 NC-3B BRASS CAD PLATE	4
80.	611-544		Wire, Insulated #22 AWG MIL-W-16878 Type B, WHITE	A/R
81.	169-035		Connector Contact	2
82.	169-136		Cap NYLON	1
83.	23863-10		Fan	1
84.	69588-10		Cable Harness, Power Supply, FR-1300 (J1 to P3)	
85.	69589-10		HARNESS ASSY., POWER AND CONTROL (P303, P217, GND, TB801, J3, J309)	1
86.	492-008		Nut, Hex, #4, STL. CAD PLATE	1
87.	502-013		Washer, Loc, #4 Ext. Tooth STL. CAD PLATE	1
88.	471-062		Screw, #4 x 3/8 Lg. Pan Hd. Phillips Dr., STL. CAD PLATE	1
89.	302-074		Clamp Cable #1/4, Color: BLACK	1
90.	169-160		Connector, Flag Type, Crip Style	26
91.	171-117		Connector, Solderless, Spadetongue #6	4
92.	171-006		Solderless, Ring Tongue #8	3
93.	169-076		Contact, Female, #20, Crimp Type, Insertable	2
94.	169-117		Contact, Female, #16, Crimp Type, Insertable	11
95.	169-086		Contact, Male, #24, Crimp Type, Insertable	2
96.	169-077		Contact, Male, #16, Crimp Type, Insertable	10
97.	168-050		Edge, 18 Pin, Female	2
98.	144-147		MRAC 14-S-G, Winchester or equivalent	1
99.	145-195		Connector, MRAC 20P-G, Winchester or equivalent	1
100.	24008-10		Bracket, Connector	1

PARTS LIST FOR: DUST COVER ASSEMBLY CATALOG NO. 24085-10				
REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
1.	24073-11		Cover, Dust	1
2.	24083-10		Frame, Dust Cover	1
3.	24157-10		Hinge, Female	2
4.	24079-10		Seal, Window	1
5.	23224-40		Filler Extrusion	1
6.	24084-10		Pane, Window	1
7.	24086-10		Seal, Dust	1
8.	24145-10		Handle, Dust Cover	1
9.	24144-10		Latch, Dust Cover	1
10.	24147-10		Spring, Latch	1
11.	24148-10		Pin, Cover Latch	1

PARTS LIST FOR: DUMMY CARD FILE CATALOG NO. 24175-11				
REF. NO	AMPEX PART NO.	MIL OR GOVT NO.	DESCRIPTION	NO/ ASSY.
1.	24178-10		Plug button	17
2.	474-088		Stud, self-clinching pem; 6-32 NC-2A x 3/8 lg. s. st. FHS 632-6	4
3.	24177-10		Bracket	2
4.	24176-10		Frame	1

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
1.	23875-10		TAPE TRANSPORT, 1" Tape, 60 cycle	1
2.	23875-20		TAPE TRANSPORT, 1/2" Tape, 60 cycle	1
3.	23875-40		TAPE TRANSPORT, 1" Tape, 50 cycle	1
4.	23875-50		TAPE TRANSPORT, 1/2" Tape, 50 cycle	1
			NOTE	
			Parts listed for the transport are identical for all four transport configurations unless otherwise noted.	
			MISCELLANEOUS ITEMS ASSOCIATED WITH TRANSPORT FRAME	
5.	470-103	MS 35457-24	Screw; 10-24 NC - 2A x 5/8 Lg. Soc. Cap, STL CAD PLATE	4
6.	470-188		Screw; 1/4 - 28 NF - 2A x 1-3/4 Lg. Soc. Cap, STL CAD PLATE	3
7.	471-061	MS 35208-13	Screw, 4-40 NF - 2A x 5/16 Lg. Phil. Pan Hd. STL CAD PLATE	4
8.	471-068	MS 35208-24	Screw; 6-32 NC - 2A x 5/16 Lg. Phil. Pan Hd. STL CAD PLATE	8
9.	471-069	MS 35208-25	Screw; 6-32 NC - 2A x 3/8 Lg. Phil. Pan Hd. STL CAD PLATE	11
10.	471-071	MS 35208-27	Screw; 6-32 NC - 2A x 1/2 Lg. Phil. Pan Hd. STL CAD PLATE	6
11.	471-080	MS 35208-41	Screw; 8-32 NC - 2A x 1/2 Lg. Phil. Pan Hd. STL CAD PLATE	6
12.	471-471	MS 35208-18	Screw; 4-40 NC - 2A x 3/4 Lg. Phil. Pan Hd. STL CAD PLATE	2
13.	471-606		Screw; 6-32 NC - 2A x 1/4 Lg. Phil. Truss Hd. SST	8
14.	472-042		Screw; 8-32 NC - 2A x 1-3/4 Lg. Slotted Pan Hd. STL CAD PLATE	2
15.	471-078	MS 35208-40	Screw; 8-32 NC - 2A x 3/8 Lg. Phil. Pan Hd. STL CAD PLATE	4
16.	501-009	MS 15795-206	Washer, #6 flat; STL CAD PLATE	15
17.	501-010	MS 15795-207	Washer, #8 flat; STL CAD PLATE	8
18.	501-011	MS 15795-208	Washer, #10 flat; STL CAD PLATE	4
19.	502-008	MS 35338-78	Washer, #4 Spring Lock SST	6
20.	502-009	MS 35338-79	Washer, #6 Spring Lock SST	6
21.	502-010	MS 35338-80	Washer, #8 Spring Lock SST	10
22.	502-011	MS 35338-81	Washer, #10 Spring Lock SST	4
23.	502-019	MS 35335-58	Washer, #6 Flat Ext. Tooth SST	19
24.	502-020	MS 35335-59	Washer, #8 Flat Ext. Tooth SST	2
25.	501-012	AN 960 416	Washer, 1/4 Flat STL CAD PLATE	3
26.	503-047		Washer, Nylon $\frac{1/4}{9/32}$ I. D. 5/8 O. D. .063 thk.	3
27.	302-075		Clamp, Cable; 5/16	3
28.	302-080		Clamp, Cable; 3/16	2
29.	302-118		Clamp, Cable; 3/32	3
30.	302-120		Clamp, Cable; 1/8	5
31.	23812-10		Bracket, Control Chassis	2
32.	24092-10		Plate, Identification	1
33.	11751-16		Plate, Identification	1
34.	24117-10		Head Cover	1
35.	24070-11		Cover, Pushbutton (Control Cover)	1
36.	24071-10		Cover, Capstan	
37.	23848-10		TRANSPORT FRAME ASSEMBLY	1
38.	23792-10		Pin, Spring Anchor	10
39.	23851-10		Pin	2
40.	23889-10		Pin, Pivot	5
41.	23927-10		Standoff, Tape Slider	3
42.	23904-10		Frame, Transport	1
43.	24046-10		Pin	6
44.	402-023		Pin, Dowel; .1875 Dia. x 5/8 Lg. SST	2
45.	430-171		Ring, Grip; 1/8 Truarc 5555-12-MD	15
46.	430-119		Ring, Grip; 3/16 Truarc 5555-18S-ZD	5
47.	430-172		Ring, Grip; 1/4 Truarc 5555-25-MD	2
48.	495-007		Insert, Stainless STL Helicoil	3
49.	23920-10		OVERLAY PLATE ASSEMBLY	1
50.	23921-10		Shield	1
51.	497-009		Nut, Speednut; Push-on, Rect. for 1/8 Stud, 37/64 Lg. 5/16 Wide SPRING STL	2
52.	92424-6		Emblem, Trademark	1
53.	23957-10		Seal, Overlay Plate	1
54.	23956-10		Plate, Overlay	1

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
55.			INPUT TAPE GUIDE ASSEMBLY	1
56.	23894-10		For One-Inch Tape	
57.	23894-20		For One-half Inch Tape	
58.	23942-10		Guide, Tape 1"	1
59.	23942-20		Guide, Tape 1/2"	1
60.	24067-10		Bracket	1
61.	24068-10		Support	1
62.	405-038		Pin, Grooved 1/8 Dia x 1/2 Lg.	1
63.	470-127		Screw, 6-32 NC - 3A x 1-1/4 Lg. Socket Cap SST	1
64.	477-184		Set Screw, 6-32 NC - 3A x 3/16 Lg. Flat Pt. NYLOCK STL CAD PLATE	1
65.	501-047		Washer, Shim; .149 I.D. x 3/8 O.D. .002 Thk. BRASS (as required)	
66.	501-065		Washer, Shim; .149 I.D. x .375 O.D. .005 Thk. BRASS (as required)	
67.	502-009	MS 35338-79	Washer, #6 Spring Lock SST	1
68.			OUTPUT TAPE GUIDE ASSEMBLY	1
69.	23940-10		For One-Inch Tape	
70.	23940-20		For One-half Inch Tape	
71.	23936-10		Standoff, Tape Guide	1
72.	23937-10		Support, Tape	1
73.	23942-10		Guide, Tape 1"	1
74.	23942-20		Guide, Tape 1/2"	1
75.	470-127		Screw; 6-32 NC - 3A x 1-1/4 Lg. Socket Cap, SST	1
76.	470-012		Screw; 4-40 NC - 3A x 1/2 Lg. Hex Socket, Cap, STL CAD PLATE	1
77.	501-047		Washer, Shim; .149 I.D. x 3/8 O.D. .002 Thk. BRASS (as required)	
78.	501-065		Washer, Shim; .149 I.D. x .375 O.D. .005 Thk. BRASS (as required)	
79.	502-009	MS 35338-79	Washer, #6 Spring Lock SST	1
80.			SERVO ARM GUIDE	1
81.	23925-11		For One-Inch Tape	
82.	23925-21		For One-half Inch Tape	
83.	1200036-10		Spool, Tape Guide 1"	1
84.	1200036-20		Spool, Tape Guide 1/2"	1
85.	23923-10		Shaft, Tape Guide 1"	1
86.	23923-20		Shaft, Tape Guide 1/2"	1
87.	24135-11		Spring	1
88.	164876-020		Bearing, Flanged	2
89.	471-845		Screw, 4-40 NC - 2A x 1/4 Phil. Truss Hd. SST	1
90.	501-126		Washer, .120 I.D. x .437 O.D. .025/.040 Thk. SST	1
91.	501-128		Washer, .192 I.D. x .375 O.D. .010 Thk. BRASS CAD PLATE	1
92.	502-002		Washer, #4 Spring Lock	1
93.	23842-12		FILTERING IDLER ASSEMBLY	1
94.	477-060	MS 51025-18	Setscrew; 6-32 NC - 3A x 3/16 Lg. Hex Soc. Fl. Pt. STL CAD PLATE	4
95.	23839-10		Collar	1
96.	23838-10		Collar	1
97.	23780-11		Pulley Sub-Assy. (replaceable as a sub-assy. only)	1
98.	23834-11		Flywheel Reel Idler	1
99.	477-185		Setscrew; 1/4 - 20 NC - 2A x 1/4 Fl. Pt. STL CAD PLATE	1
100.	477-184		Setscrew; 6-32 NC - 2A x 3/16 Fl. Pt. NYLON Insert	2
101.	430-173		Ring, Retaining; Int. Truarc N 5000 43-MD	1
102.	420-002		Ball; .187 Dia. SST	1
103.	164891-030		Bearing, Ball	1
104.	24138-10		Spring	1
105.	23843-10		Disk	1
106.	23837-10		Housing, Bearing Support	1
107.	23830-10		Bracket	1
108.	23821-11		Spring, Conical	1
109.	430-173		Ring, Retaining; Truarc N 5000-43-MD	1
110.	352-030		Spring, Compression Wallace-Barnes #C420-045-0500	1
111.	164891-030		Bearing, Ball	1
112.	23843-10		Disk	2
113.	23841-10		Bushing, Bearing	1
114.	470-104	MS 35457-20	Screw; 8-32 NC - 3A x 1-1/4 Lg. Hex Soc. Cap STL CAD PLATE (Support Mounting)	4
115.	502-010	MS 35338-80	Washer; #8 Spring Lock SST (Support Mounting)	4

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
116.			HEAD IDLER ASSEMBLY	1
			NOTE Mechanical parts only listed for head group. Refer to ES-100 electronics description for part number of head group.	
117.	23900-10		Base Plate	1
118.	23854-10		Support	1
119.	23866-10		Housing	1
120.	23869-11		Idler Assembly	1
121.	23806-10		Sleeve	1
122.	23805-10		Clamp	1
123.	24155-10		Handle	1
124.	120215010		Rod	4
125.	120467-010		Spacer-Connector	4
126.	24137-10		Spring	1
127.	24136-10		Spring	1
128.	164873-03		Ball Bearing	2
129.	420-016		Ball, 1/8 Dia.	1
130.	430-022		Ring Retaining Internal	1
131.	471-059		Pan Head Screw; 4-40 x 3/16 STL CAD PLATE	1
132.	471-127		Pan Head Screw; 8-32 x 5/16 SST	1
133.	470-011		Hex Socket Head Cap Screw; 4-40 x 7/16 STL CAD PLATE	12
134.	470-021		Hex Socket Head Cap Screw; 6-32 x 5/8 STL CAD PLATE	1
135.	470-136		Hex Socket Head Cap Screw; 4-40 x 7/8 STL CAD PLATE	2
136.	470-022		Hex Socket Head Cap Screw; 6-32 x 3/4 STL CAD PLATE	3
137.	477-184		Set Screw 6-32 x 3/16 (Hex Sckt.) NYLOCK Fl. Point STL CAD PLATE	2
138.	477-183		Set Screw 3/8-24 x 1/2 (Hex Sckt.) NYLOCK Cone Point STL CAD PLATE	1
139.	502-002		Spring L'W #4 STL CAD PLATE	15
140.	502-003		Spring L'W #6 STL CAD PLATE	4
141.	502-004		Spring L'W #8 STL CAD PLATE	1
142.	501-008		Fl. Washer #4 STL CAD PLATE	3
143.	23876-12		TAPE LIFTER ASSEMBLY	1
144.	69532-10		Solenoid	1
145.	23790-10		Link, Tape Lift Solenoid	1
146.	23847-10		Link, Pinch Roller	1
147.	23860-10		Bellcrank	2
148.	23861-10		Link, Tape Lift-off	1
149.	23870-10		Finger, Tape Lift	2
150.	24139-10		Spring	1
151.	23879-10		Bracket, Solenoid	1
152.	400-007		Pin, Clevis; Pan Hd. STL CAD PLATE .125 Dia.	1
153.	403-043		Pin, Driv-Lok; .125 Dia. x 3/4 Lg. STL CAD PLATE Type C	2
154.	471-076		Screw, Mach. Pan Hd. Phillips Dr. STL CAD PLATE, #8-32NC x 1/4 Lg.	2
155.	477-063		Screw, Set; 6-32 NC - 3A x 3/8 Lg. Flat Pt. STL CAD PLATE	2
156.	430-171		Ring, Grip; 1/8 TRUARC 5555-12-MD	2
157.	503-009		Washer, Flat; 1/8 I.D. x 3/8 O.D. x 1/32 Thk. LAMICOID	4
158.	430-119		Ring, Grip 3/16 TRUARC 5555 - 18S 2D STL CAD PLATE	2
159.	24139-10		Spring, Tape Lifter	1
160.	471-080	MS 35208-42	Screw, 8-32 NC - 2A x 1/2 Lg. Phil. Pan Hd. STL CAD PLATE	2
161.	501-010	MS 15795-207	Washer #8 Flat, STL CAD PLATE	2
162.	502-010	MS 35338-80	Washer #8 Spring Lock SST	2
163.			THREADING LEVER ASSEMBLY	1
164.	23930-10		Tape Threading Lever	1
165.	23931-10		Threading Lever Slider	1
166.	23929-10		Detent Arm	1
167.	23928-10		Pivot Arm	1
168.	23927-10		Standoff	3
169.	24129-10		Spring, Tape Slider	1
170.	24130-10		Spring, Slider Detent	1
171.	24124-10		Spacer, (Pivot Arm)	1
172.	430-171		Grip Ring, 1/8 TRUARC 5555-MD STL CAD PLATE	1
173.	430-152		Ring, Retaining; 1/8 Ext. "E" SST TRUARC 5133-12W	9
174.	503-009		Washer, 1/8 I.D. x 3/8 O.D. x 1/32 Thk. LAMICOID	6
175.	471-064	MS 35208-16	Screw, 4-40 NC - 2A x 1/2 Lg. Phil. Pan Hd. STL CAD PLATE	2
176.	502-030	MS 35333-70	Washer, #4 Int. Tooth, Flat, SST	2

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
177.			REEL HOLD-DOWN KNOB ASSEMBLY	2
178.	60950-14		For One-Inch Tape	
179.	60950-15		For One-half Inch Tape	
180.	60852-01		Cover	1
181.	420-010		Ball, Nylon 1/8 Dia.	1
182.	471-743		Screw #10-32 x 1-3/4 STL CAD PLATE, Fl. H.d Phillips (one-inch only)	3
183.	477-031		Screw Set #4-40 x 1/4 Lg. Cup Pt. Hex Sock. STL CAD PLATE	2
184.	477-040		Screw Set #3-32 x 3/16 Cup Pt. Hex Sock. STL CAD PLATE	1
185.	15213-01		Spacer, 1/2" Tape ℄ Tape Constant (one-half inch only)	1
186.	402-012		Pin, Dowell, .1250 Dia. 1" Lg. STLS STL (one-half inch only)	1
187.	402-018		Pin, Dowell, .1250 Dia. 1-1/4 Lg. STLS STL (one-inch only)	1
188.	18233-15		Spacer, 1" Tape, Lower Edge and ℄ Tape Constant (one-inch only)	1
189.	18147-01		Bushing Hold-Down Knob	1
190.	471-733		Screw, 10-32 NF - 2B x 1-1/2" Phil. Fl. Hd. STL CAD PLATE (one-half inch only)	3
191.	60853-01		Spring, Reel Hold-Down Knob	3
192.	60854-01		Key, Reel Hold-Down Knob	3
193.	60856-01		Base, Reel Hold-Down Knob	1
194.	403-011		Pin, DRIVELOCK .095 x 3/8 Lg. Type C 1/4 Groove	3
195.	430-039		Ring, Retaining, TRUARC 5105-9-S-PD, or Equivalent	3
196.	60851-01		Handle, Reel Hold-Down Knob	2
197.	60855-01		Stud, Handle Retaining	1
198.	60857-01		Cam, Reel Hold-Down Knob	1
199.	61007-01		Pin, Handle Retaining	2
200.	60894-01		Spring, Handle Retaining	2
			ADDITIONAL ITEMS ASSOCIATED WITH REEL HOLD-DOWN ASSEMBLY	
201.	23916-10		Shield, Brake (Dust Cover)	1
202.	23917-10		Reel Shim, 0.01" Stock (as required)	
203.	23917-20		Reel Shim, .003" Stock (as required)	
204.	18119-10		Pad, Turntable (Resilient Pad)	1
205.	23914-10		TURNTABLE ASSEMBLY	2
206.	23911-10		Housing, Bearing	1
207.	23915-11		Turntable	1
208.	164875-020		Bearing, Ball	2
209.	430-033		Ring, Retaining; 1-1/8 Int. Flat TRUARC 5000-112-S-ZD or Equivalent	2
210.	501-106		Washer, Flat, 1/4 STL CAD PLATE	1
211.	506-011		Washer, Bowed	1
212.	493-027		Nut, Self Locking, Hex, Nylon Insert, STL CAD PLATE 1/4-28NF-3	1
213.	471-082	MS 35208-44	Screw, 8-32 NC - 2A x 3/4 Lg. Phil Pan Hd. STL CAD PLATE (housing mounting)	3
214.	502-010	MS 35338-80	Washer, #8 Spring Lock SST (Housing mounting)	3
215.			TORQUE MOTOR ASSEMBLY	2
			60 CPS Operation	
216.	23773-10		Supply Reel Torque Motor Assembly	
217.	23773-20		Take-up Reel Torque Motor Assembly	
			50 CPS Operation	
218.	23773-30		Supply Reel Torque Motor Assembly	
219.	23773-40		Take-Up Reel Torque Motor Assembly	
220.	1200050-20		Capacitor, Motor 7 MFD (for use with -30 and -40 motors)	1
221.	24124-10		Spacer	4
222.	502-019		Washer, Lock, Ext. Tooth #6	4
223.	501-009		Washer, Flat #6	4
224.	471-070		Screw, Pan Hd. Phillips #6-32 x 7/16	4
225.	169-035		* Connector, Pin	2
226.	169-136		Cap, NYLON	1
227.	1200050-10		Capacitor, Motor 6 MFD (for use with -10 and -20 motors)	1
228.	23772-10		Motor, Torque	1

* Connections made to pin connector differ between supply and take-up torque motors. See table below.

		Pin Connector Termination	
Wire No.	Color	-10 and -30	-20 and -40
0	Black	3	1
2	Red	2	2
5	Green	2	1
9	White	3	2

REF NO	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
			ADDITIONAL ITEMS ASSOCIATED WITH TORQUE MOTORS	
229.	23901-20		Drive Belt, Supply Reel	1
230.	23901-10		Drive Belt, Take-up Reel	1
231.	23852-10		Pulley, Reel Drive	2
232.	477-047	MS 51018-49	Setscrew; 10-32 NF - 3A x 1/4 Lg. Hex Soc. Cup Pt. STL CAD PLATE	2
233.	471-091	MS 35209-57	Screw; 10-24 NC - 2A x 5/8 Lg. Phil Pan Hd. STL CAD PLATE (Mounting Screws)	8
234.	501-011	MS 15795-208	Washer, #10 Flat, STL CAD PLATE	8
235.	502-011	MS 35338-81	Washer, #10 Spring Lock SST	8
245.			STOPPING BRAKE ASSEMBLY	
246.	24055-10		Brake Solenoid and Bellcrank	1
247.	23820		Block, Solenoid Mounting	1
248.	23898		Bellcrank	1
249.	69536-10		Solenoid	1
250.	406-029		Pin, ROLLPIN 1/8 Dia. x 1/2 Lg. SST ESNA 79-028-125-500	1
251.	471-399		Screw, 8-32 NC - 2A x 5/8Lg. Phil Fl. Hd. SST	2
252.			BRAKE CORD, ARM AND ANCHOR	
253.	24125-10		For Supply Reel	1
254.	24125-20		For Take-up Reel	1
255.	24054-10		Arm, Brake	1
256.	24061-10		Bracket, Brake Anchor	1
257.	24063-10		Retainer, Spring	1
258.	24089-10		Cord Assembly, Brake	1
259.	24124-10		Spacer, Brake Band	1
260.	24140-10		Spring, Brake (high torque)	1
261.	24142-10		Spring, Brake Cord Support	1
262.	400-007		Pin, Clevis; .125 Dia. Pan Hd.	1
263.	430-171		Ring, Grip, 1/8 TRUARC 5555-12-MD	
			ADDITIONAL ITEMS ASSOCIATED WITH STOPPING BRAKES	
264.	24126-10		Spring, Brake (low torque)	2
265.	23897-10		Rod (Supply Reel Brake Rod)	1
266.	23897-20		Rod (Take-up Reel Brake Rod)	1
267.	23896-10		Collar, Brake Adjusting (on rods)	3
268.	477-060	MS 51025-18	Setscrew, 6-32 NC - 3A x 3/16 lg. Hex Soc. Flat Pt. STL CAD PLATE (for collars)	3
269.	430-171		Ring, Grip 1/8 TRUARC 5555-12 MD STL CAD PLATE (brake bellcrank)	1
270.	503-009		Washer, 1/8 I.D. x 3/8 O.D. x 1/32 Thk. LAMICOID (brake bellcrank)	1
271.	471-084	MS 35208-46	Screw, 8-32 NC - 2A x 1" Lg. Phil. Pan Hd. STL CAD PLATE (Brake Solenoid Mounting)	2
272.	502-010	MS 35338-80	Washer, #8 Spring Lock, SST (Brake Solenoid Mounting)	2
273.	430-119		Ring, Grip, 3/16 TRUARC 5555-18S 2D STL CAD PLATE	2
274.	23872-10		Collar, Pivot (Brake Arm Pivot)	2
275.	471-070	MS 35208-26	Screw, 6-32 NC - 2A x 7/16 Lg. Phil Pan Hd. STL CAD PLATE (Anchor Mounting)	4
276.	501-009	MS 15795-206	Washer, #6 Flat STL CAD PLATE (Anchor Mounting)	4
277.	502-009	MS 35338-79	Washer, #6 Spring Lock SST (Anchor Mounting)	4

PARTS LIST FOR:			TAPE TRANSPORT (continued) CATALOG NO. 23875-10,-20,-40,-50 Sheet 6 of 14	
REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
278.			HOLDBACK SERVO SYSTEM	
279.			HOLDBACK SERVO SOLENOID	1
280.	180-042		Terminal Strip, Barrier KULKA; 599-3/4 ST-3M (TB405) *	1
281.	172-003		Solder, Lug #6 Shakeproof; 2104-06	1
282.	043-549		Resistor, Wire Wound Dale, RH-10, 10W, 1500 Ω 3% (R404) *	1
283.	041-003		Resistor, Carbon 100 Ω MIL-R-11 RC20GF101J (R403) *	1
284.	030-032		Capacitor, 1 mfd 500V Sprague 5HK-P1 (C401) *	1
285.	030-031		Capacitor, .05 mfd 500V Sprague 5HK-S50 (C404) *	1
286.	23778-10		Bracket	1
287.	23776-10		Solenoid and Switch (L403 and S408) *	1
288.	492-009	MS 35649-62	Nut, #6-32 NC-2B STL CAD PLATE	2
289.	502-015	MS 35335-31	Washer, Ext. To. Lock #8 STL CAD PLATE	2
290.	502-014	MS 35335-30	Washer, Ext. To. Lock #6 STL CAD PLATE	2
291.	502-007	MS 35338-77	Washer, Spring Lock #2 SST Passivated	2
292.	492-007	MS 35649-22	Nut #2-56 NC - 2B STL CAD PLATE	2
293.	471-076	MS 35208-38	Screw, #8-32 NC - 2A x 1/4 Lg. Pan Hd. Phil. STL CAD PLATE	2
294.	471-071	MS 35208-27	Screw, #6-32 NC - 2A x 1/2 Lg. Pan Hd. Phil. STL CAD PLATE	2
295.	23820-1		Block, Solenoid Mounting	1
295-A	471-058	MS 35225-7	Screw #2-56 NC -2A x 3/8 Lg. Pan Hd. Slot STL CAD PLATE	2
			* Refer to electrical control system parts list.	
			TAPE TENSION SPRING	1
296.	24042-10		Plug	2
297.	24043-10		Spring, Preset (Tape Tension Spring)	1
298.	406-029		Pin, ROLLPIN, 1/8 Dia. x 1/2 Lg. SST ESNA 79-028-125-500	1
299.	402-019		Pin, Dowel; 1/8 Dia. x 7/8 Lg. SST	1
300.	430-171		Ring, Grip; 1/8 TRUARC 5555-12-MD	2
301.	471-399		Screw, 8-32 NC - 2A x 5/8 Lg. Phil. Flat Hd. SST	2
302.	480-010		Spadebolt; 8-32 NC - 2A x 1 Lg.	2
303.	492-010		Nut; 8-32 NC - 2B STL CAD PLATE	2
			ROCKER ARM	1
304.	23796-10		Rocker - Arm	1
305.	164872-020		Bearing, Ball; Flanged Radial Type .2500 I.D. x .6257 O.D.	2
306.	430-172		Ring, Grip 1/4 TRUARC 5555-25 MD STL CAD PLATE (Arm Retainer)	1
307.	400-007		Pin, Clevis .124 Dia. x .641 Lg. Pan Hd. STL CAD PLATE	1
308.	24133-10		Spring, Constant Tension Sol. Return (Return Spring)	1
			LIMIT PIN ASSEMBLY	1
309.	23802-10		Anchor, Brake (block)	1
310.	470-104	MS 35457-20	Screw, 8-32 NC - 3A x 1-1/4 Lg. Hex Soc. Cap STL CAD PLATE	1
311.	502-010	MS 35338-80	Washer, #8 Spring Lock SST	1
			ADJUSTABLE BRAKE ANCHOR	1
312.	23802-20		Anchor, Brake (block)	1
313.	430-172		Ring, Grip 1/4 TRUARC 5555-25 MD STL CAD PLATE	1
314.	400-007		Pin, Clevis; .124 Dia. x .641 Lg. Pan Hd. STL CAD PLATE	1
315.	24132-10		Spring, Constant Tension Relief	1
316.	23808-10		Washer, Eccentric (Adjustment Disc)	1
317.	470-029	MS 35457-15	Screw, 8-32 NC - 3A x 1/2 lg. Hex Soc. Cap STL CAD PLATE	1
318.	502-010	MS 35338-80	Washer, #8 Spring Lock SST	1
319.	430-171		Ring, Grip; 1/8 TRUARC 5555-12 MD STL CAD PLATE	2

PARTS LIST FOR: TAPE TRANSPORT (continued) CATALOG NOS. 23875-10, -20, -40, -50 Sheet 7 of 14

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
320.			SERVO ARM (Servo Arm Guide listed separately)	1
321.	23811-10		Housing, Bearing	1
322.	164872-020		Bearing, Ball, Flanged	2
323.	506-020		Washer, Bowed; 17/64 I. D. x 13/32 O. D. .005 Thk. 5/16 Bend R. Spring STL	1
324.	501-077		Washer, Shim (as required)	
325.	430-170		Ring, Retaining TRUARC 5133-25 or Equivalent EXT "E"	1
326.	471-391	MS 35200-29	Screw, 6-32 x 3/4 Phil. Fl. Hd. SST	1
327.	400-007		Pin, Clevis .124 Dia. x .641 Lg. Pan Hd. STL CAD PLATE	1
328.	24131-10		Spring, Constant Tension Arm (Servo Arm Spring)	1
329.	471-070	MS 35208-26	Screw, 6-32 NC - 2A x 7/16 Lg. Phil. Pan Hd. STL CAD PLATE (Housing Mounting)	3
330.	502-009	MS 35338-79	Washer #6, Spring Lock, SST (Housing Mounting)	3
331.			LINKAGE AND BRAKE CORD	
332.	24041-10		Brake Cord Assembly (Servo brake cord and brake link)	1
333.	23794-10		Arm Link	1
334.	503-009		Washer, 1/8 I. D. x 3/8 O. D. x 1/32 Thk., LAMICOID	6
335.	430-171		Ring, Grip; 1/8 TRUARC 5555-12 MD STL CAD PLATE	4
336.			PINCH ROLLER ASSEMBLY	1
337.			SOLENOID AND SPADEBOLT	
338.	69536-10		Solenoid	1
339.	23820-10		Block, Solenoid Mounting	1
340.	23932-10		Spadebolt	1
341.	23933-10		Nut, Adjusting (Chamfered Nut)	1
342.	406-029		Pin, ROLLPIN, 1/8 Dia. x 1/2 Lg. SST ESNA 79-028-125-500	1
343.	471-399		Screw; 8-32 NC - 2A x 5/8 Lg. Phil. Fl. Hd. SST	2
344.	492-009		Nut, Hex; 6-32 NC - 2B STL CAD PLATE	1
345.			PINCH ROLLER	
346.	23845-10		Pinch Roller (one inch)	1
347.	23845-20		Pinch Roller (one-half inch)	1
348.	23833-10		Arm (actuator arm)	1
349.	23846-10		Bellcrank	1
350.	23847-10		Link	1
351.	23851-10		Pin	1
352.	164872-020		Bearing, Ball; flanged radial	2
353.	405-036		Pin, Grooved; .125 Dia. x 3/4 Lg. TYPE 4	1
354.	403-014		Pin, DRIV-LOK; .125 Dia. x 1 Lg. TYPE B	1
355.	430-171		Ring, Grip; 1/8 TRUARC 5555-12 MD	1
356.	477-166		Setscrew; 6-32 x 3/16 lg. Flat Pt. Hex. Soc. NYLOK	1
357.	503-009		Washer, Lamacoid, .125 I. D. x 3/8 O. D. x 1/32 Thk.	1
			ADDITIONAL ITEMS ASSOCIATED WITH PINCH ROLLER ASSEMBLY	
358.	24128-10		Spring, Return - Pinch Roller	1
359.	400-007		Pin, Clevis; .124 Dia. x .641 Lg. Pan Hd. STL CAD PLATE	1
360.	430-119		Ring, Grip 3/16 TRUARC 5555-18S ZD STL CAD PLATE (Actuator Arm retaining)	1
361.	430-175		Ring, Retaining, EXT "E" TRUARC 5133-31 MD (on Pivot)	1
362.	23849-10		Pivot, Pinch Roller	1
363.	502-011	MS 35338-81	Washer, #10 Spring Lock SST (on Pivot)	1
364.	23934-10		Spring Collar (on Spadebolt at ends of spring)	2
365.	24141-10		Spring, Pinch Roller (on Spadebolt)	1
366.	493-006		Nut, 6-32 NC - 3B Hex, self-locking (on Spadebolt)	1
367.	471-084	MS 35208-46	Screw, 8-32 NC - 2A x 1" Lg. Phil. Pan Hd. STL CAD PLATE (Solenoid Mounting)	2
368.	502-010	MS 35338-80	Washer, #8 Spring Lock SST (Solenoid Mounting)	2
369.	470-090		Screw, 10-32 NF - 3A x 5/8 Lg. Hex Soc. Cap SST (Pivot retaining)	1
370.	502-011	MS 35338-81	Washer, #10 Spring Lock SST (Pivot retaining)	1

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION			NO/ ASSY.
			ELECTRICAL CONTROL SYSTEM			
475.			Harness			
476.	24028-11		TRANSPORT HARNESS ASSEMBLY includes:			1
477.	169-135		Cap, NYLON, 12 pin		(P301 housing only)	1
478.	169-035		Connector pin, AWG 22-20 Wire		(P301 pins only)	11
479.	24029-10		CONTROL CHASSIS HARNESS ASSEMBLY includes:			1
480.	169-148		Plug, Chassis 12 pin		(J301 housing only)	1
481.	169-035		Connector Pin, AWG 22-20 Wire		(J301 pins only)	14
482.	169-999		Plug, Chassis, 6 pin		(J302 housing only)	1
483.	169-019		Connector Pin, AWG 20-15 Wire		(J302 pins only)	7
484.	169-987		Plug, Chassis, 3 pin		(J303 housing only)	1
485.	169-035		Connector Pin, AWG 22-20 Wire		(J303 pins only)	2
486.	169-149		Polarizing Key, Plug		(J303 inserted in position 2)	1
487.	169-987		Plug, Chassis, 3 pin		(J304 housing only)	1
488.	169-035		Connector Pin, AWG 22-20 Wire		(J304 pins only)	3
489.	169-149		Polarizing Key, plug		(J304 inserted in position 3)	1
490.	169-987		Plug, Chassis, 3 pin		(J305 housing only)	1
491.	169-035		Connector Pin, AWG 22-20 Wire		(J305 pins only)	3
492.	169-149		Polarizing Key, plug		(J305 inserted in position 1)	1
493.	169-999		Plug, Chassis, 6 pin		(J306 housing only)	1
494.	169-035		Connector Pin, AWG 22-20 Wire		(J306 pins only)	6
495.	169-148		Plug, Chassis, 12 pin		(J307 housing only)	1
496.	169-035		Connector Pin, AWG 22-20 Wire		(J307 pins only)	12
497.	169-076		Winchester Connector Pin, AWG 20 Wire		(J308 pins)	2
498.	169-144		Winchester Connector Pin, AWG 22 Wire		(J308 pins)	9
			CONNECTORS			
499.	150-113		Socket, Relay		(J315 through J321)	7
500.	23919-10		Dummy Plug Ass'y.		(P307A used if remote harness is not installed)	1
501.	144-148		Connector (20 pin)		(J308)	1
502.	168-042		Connector, P.W. Board 15 Contact, Key F		(J313 connector for rectifier and resistor board)	1
			TERMINAL BOARDS			
503.	180-139		Terminal Strip, 4 Term.		(TB301 electronics power)	1
504.	180-138		Terminal Strip, Barrier Type, 2 terminals		(TB401 and TB404 on front of transport frame and TB402 on rear of transport frame)	2 1
505.	180-082		Terminal Strip, Barrier Type, 6 terminals		(TB403 behind brake solenoid)	1
506.	180-042		Terminal Strip, Barrier		(TB405 on holdback servo solenoid)	1
			SWITCHES			
507.	24122-10		Switch, special	S2	(local-remote if remote harness is installed)	1
508.	120-139		Switch, Slide (dpdt)	S301	(Servo reference SW)	1
509.	24120-20		Switch, Rotary	S302D	(one deck of tape speed selector switch S302)	1
510.	120-140		Toggle Switch (DPST)	S401	(power switch)	1
511.	23782-10		Switch Ass'y.	S407	(end-of-tape switch)	1
512.	23776-10		Solenoid L403 and switch S408	S408	(on holdback servo solenoid)	1
513.	120-133		Pushbutton switch 1 lb. actuation	S402	(drive SW)	1
514.	2903-30		Lens with Inscription		(button marked DRIVE)	1
515.	120-134		Pushbutton switch, 5 lb. actuation	S403	(record SW)	1
516.	2903-40		Lens with inscription		(button marked RECORD)	1
517.	120-133		Pushbutton Switch, 1 lb. actuation	S404	(rewind SW)	1
518.	2903-20		Lens with inscription		(button marked REW)	1
519.	120-133		Pushbutton Switch, 1 lb. actuation	S405	(forward SW)	1
520.	2903-10		Lens with inscription		(button marked FWD)	1
521.	120-133		Pushbutton Switch, 1 lb. actuation	S406	(stop SW)	1
522.	2903-50		Lens with insciption		(button marked STOP)	1

REF NO	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
			CONTROL CHASSIS	
409.			Fabricated metal parts and fasteners	
410.	23878-10		Front Panel	1
411.	23784-10		Base Assembly consisting of the following items:	
412.	23818-10		Bracket	1
413.	23831-10		Panel	1
414.	23827-10		Support	1
415.	23826-11		Support	1
416.	23816-10		Barrier	1
417.	23804-10		Base	1
			Fittings consisting of the following items:	
418.	503-012		Washer, Shoulder, #6 FIBER	2
419.	502-023		Lockwasher, Int. #2	2
420.	502-015		Lockwasher, Ext. #8	1
421.	502-014		Lockwasher, Ext. #6	13
422.	502-013		Lockwasher, Ext. #4	14
423.	502-001		Lockwasher, Split #2	6
424.	501-009		Flatwasher, #6 STL CAD PLATE	4
425.	492-066		Nut, Small Pat. #2-56, STL CAD PLATE	6
426.	492-010		Nut, #8-32 STL CAD PLATE	1
427.	492-009		Nut, #6-32 STL CAD PLATE	9
428.	492-008		Nut, #4-40 STL CAD PLATE	14
429.	492-007		Nut, #2-56 STL CAD PLATE	2
430.	475-063		Screw, P.H. Sems PH. #8-32 x 1/2	1
431.	474-082		Tie Point, 3/4 Dia.	2
432.	471-471		Screw, P.H. Mach. PH. #4-40 x 3/4	2
433.	471-071		Screw, P.H. Mach. PH. #6-32 x 1/2	5
434.	471-069		Screw, P.H. Mach. PH. #6-32 x 3/8	8
435.	471-064		Screw, P.H. Mach. PH. #4-40 x 1/2	10
436.	471-062		Screw, P.H. Mach. PH. #4-40 x 3/8	2
437.	471-055		Screw, P.H. Mach. SL. #2-56 x 5/16	6
438.	471-054		Screw, P.H. Mach. SL. #2-56 x 1/4	2
439.	280-009		Spacer 1/2 Lg.	2
440.	280-005		Spacer 19/64 Lg.	4
441.	260-045		Grommet, NYLON, 5/8 I.D.	1
442.	260-038		Grommet, NYLON, .347 I.D.	1
443.	260-017		Grommet, RUBBER, 3/8 I.D.	1
444.	260-014		Grommet, RUBBER, 1/4 I.D.	1
445.	260-010		Grommet, RUBBER, 1/8 I.D.	2
			MISCELLANEOUS ITEMS ASSOCIATED WITH THE CONTROL CHASSIS	
446.	501-009		Flatwasher, #6 STL CAD PLATE	5
447.	600-037		Tubing, Plastic, Clear #20 (.034 I.D.) (as required)	
448.	502-016		Lockwasher, Ext. STL CAD PLATE #10	4
449.	502-015		Lockwasher, Ext. STL CAD PLATE #8	10
450.	502-014		Lockwasher, Ext. STL CAD PLATE #6	9
451.	492-009		Nut, #6-32 NC - 2B, STL CAD PLATE	9
452.	471-087		Screw, P.H. Mach. PH. #10-32 NC - 2A x 3/8, STL CAD PLATE	4
453.	471-084		Screw, P.H. Mach. PH. #8-32 NC - 2A x 1", STL CAD PLATE	6
454.	471-078		Screw, P.H. Mach. PH. #8-32 NC - 2A x 3/8, STL CAD PLATE	4
455.	471-068		Screw, P.H. Mach. PH. #6-32 NC - 2A x 5/16, STL CAD PLATE	9
456.	302-116		Clamp, NYLON, (Black) 1/16	1
457.	302-115		Clamp, STL CAD PLATE 1/2	1
458.	302-080		Clamp, NYLON, (Black) 3/16	2
459.	302-075		Clamp, NYLON, (Black) 5/16	1
460.	302-074		Clamp, NYLON, (Black) 1/4	1
461.	302-038		Clamp, STL CAD PLATE	2
462.	496-005		Nut, Keps, External Tooth	4
463.	471-071		Screw, Mach. Pan Hd. Phillips	4
464.	926-106		Felt Pad	2
465.	471-068		Screw, Pan Phil. STL CAD PLATE 6-32 NC - 2A, 5/16	2
466.	502-014		Washer, Lock, Ext. Tooth, STL CAD PLATE #6	2
467.	492-009		Nut, Hex, STL CAD PLATE, 6-32 NC - 2B	2
468.	23809-10		Nut, Special (for meter M301)	4
469.	173-105		Terminal, Feed-thru, TEFLON	2
470.	173-029		Terminal, Lug, Single Ended	3
471.	23887		Bracket, Terminal Strip	1
472.	23874-10		Plate, Switch Mounting	1
473.	014-201		Heat Radiator (for transistors Q302, Q303)	2
474.	24161		Dial (tape speed selector dial)	1

PARTS LIST FOR:	TAPE TRANSPORT (continued)	CATALOG NOS. 23875-10, -20, -40, -50	Sheet 8 of 14

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION	NO/ ASSY.
371.	23770-11		CAPSTAN MOTOR ASSEMBLY	1
			MOTOR AND MAGNETIC SHIELD	
372.	23771-11		Motor, Capstan	1
373.	24031-10		Flywheel, Tachometer	1
374.	23783-10		Shield (Magnetic Shield)	1
375.	501-143		Washer, Flat; .145/.149 I.D., 1/2 O.D. .061 Thk.	1
376.	470-018		Screw, Cap; 6-32 NC - 3A x 3/8 Lg. STL CAD PLATE	1
			NOTE DO NOT REMOVE FLYWHEEL FROM MOTOR SHAFT.	
377.	23775-11		TACHOMETER LAMP AND PHOTO-CELL ASSEMBLY	1
378.	013-263		Diode, Silicon, Photo-Voltaic	1
379.	502-008	MS 35338-78	Washer, #4 Split Lock SST	4
380.	502-014	MS 35335-58	Washer, #6 Ext. Tooth STL CAD PLATE	2
381.	492-019		Nut, 4-40 NC - 2B BRASS CAD PLATE	4
382.	471-965		Screw, #2-56 x 3/4 Lg. Flt. Hd. STL CAD PLATE	2
383.	471-833		Screw, #4-40 x 3/8 Lg. NYLON	2
384.	471-067	MS 35208-23	Screw, #6-32 NC - 2A x 1/4 STL CAD PLATE	2
385.	471-435		Screw, 4-40 NC - 2A Phil. Fill. Hd. BRASS CAD PLATE	4
386.	180-135		Terminal Strip, Barrier KULKA #410-3/4 ST-10	1
387.	060-019		Lamp, Miniature Flanged	1
388.	24188-10		Bracket, Terminal	1
389.	24187-10		Insulator	1
390.	24186-10		Spring, Lamp Contact	1
391.	24185-10		Contact, Lamp	1
392.	24184-10		Housing, Tachometer	1
393.	24183-11		Plate, Tachometer Mounting	1
394.	24107-10		Insulator	1
395.	502-011	MS 35338-81	Washer, #10 Spring Lock SST (Sub-assembly Mounting)	4
396.	471-089	MS 35209-55	Screw, #10-32 NF - 3A x 1/2 Lg. Phil. STL (Sub-assembly Mounting)	4
			ADDITIONAL ITEMS ASSOCIATED WITH CAPSTAN MOTOR	
397.	23946-10		Clamp, Capacitor	1
398.	23945-10		Plate, Capacitor Mounting	1
399.	472-042		Screw, 8-32 NC - 2A x 1-3/4 Lg. Slotted Pan Hd. STL CAD PLATE	2
400.	502-020	MS 35335-59	Washer, #8 Flat Ext. Tooth SST	2
401.	23906-10		Capacitor Assembly for 60 Cycle Operation consists of the following items:	
402.	036-064		Capacitor, 9 MICROFARAD 236 V AC	1
403.	18881-2		Fanning Strip	1
404.	24118-2		Marker Strip	1
405.			Capacitor Assembly for 50 Cycle Operation consists of the following items:	
406.	036-066		Capacitor, 10 MICROFARAD, 236 V AC	1
407.	18881-2		Fanning Strip	1
408.	24118-2		Marker Strip	1

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION		NO/ ASSY.
			LAMPS		
523.	060-075		14 V Chicago Minature Lamp Works CM8-697	(DS402 through DS406)	5
			RELAYS		
524.	020-133		Relay, 4 PDT, 3 AMP	(K301 through K307)	7
525.			SOLENOIDS (refer to specific mechanical assemblies for complete breakdown)		
				(L401) Tape Lifter Solenoid	1
				(L402) Pinch Roller Solenoid	1
				(L403) Stopping Brake Solenoid	1
				(L404) Holdback Servo Solenoid	1
526.			MOTORS (refer to specific mechanical assemblies for complete breakdown)		
				Supply Torque Motor	1
				Take-up Torque Motor	1
				Fan Motor	1
			CAPACITORS		
527.	031-300		Capacitor, Electrolytic 40-80 MFD. 150 V	(C301 A, B)	1
528.	031-298		Capacitor, Electrolytic 200 MFD. 250 V	(C303)	1
529.	030-032		Capacitor, .1 mfd 500 V	(C401) on holdback solenoid	1
530.	030-031		Capacitor, .05 mfd 500 V 5000 Ω, 10 W 3%	(C404) on holdback solenoid	1
			RESISTORS		
531.	043-557		Resistor, Fixed, Wire Wound, 10Ω, 5W 3%	(R301 located back of front panel)	1
532.	043-559		Resistor, Fixed, Wire Wound	(R302 5000 Ω 10W (rectifier))	1
533.	043-522		Resistor, Fixed, Wire Wound, 150Ω, 50W 3%	(R401 drive take-up resistor on transport frame)	1
534.	047-090		Resistor, Fixed, Wire Wound, 226Ω, 50W 3%	(R402 fast wind holdback resistor on transport frame)	1
535.	041-003	MIL-R-11: RC20GF101J	Resistor Carbon 100Ω	(R403 on TB405)	1
536.	043-549		Resistor, Wire Wound, 10W, 1500Ω 3%	(R404 on TB405)	1
			FUSES		
537.	070-007			F1 5 AMP	1
538.	070-016			F2 1-1/2 AMP	1
539.	070-003			F3 1 AMP	1
540.	070-016			F4 2 AMP	1
541.	070-001			F1 3 AMP (electronics tray of rack-mount)	1
			TRANSFORMERS		
542.	24119-10		Transformer (power)	T301 (on servo chassis)	1
543.	24027-10		RECTIFIER AND RESISTOR CARD		1
544.	460-055		Rivet, Alu. Semi Tubular		1
545.	23817-10		Clip, .038 Thk.		1
546.	013-154		Diode, DI-56	CRI thru CR6	6
547.	041-303		Resistor, Fixed, Carbon 3900Ω, 1/2W, 5%	R1 thru R7	7
547.	24026-10		Printed Wiring Board		1
			DRIVE SERVO SYSTEM		
			CONNECTORS		
548.	146-272		Connector, Miniature, 14 Pin	J314	1
549.	24116-10		Dummy Plug, Assembly	P314A (shorting plug used in place of 60 cps ref.)	1
550.	168-041		Connector, P.W. Board, 22 Contact, Key J	J309 (receives card 24018)	1
551.	168-040		Connector, P.W. Board, 22 Contact, Key N	J310 (receives card 24015)	1
552.	168-038		Connector, P.W. Board, 22 Contact, Key E	J311 (receives card 24021)	1
553.	168-039		Connector, P.W. Board, 22 Contact, Key T	J312 (receives card 24024)	1
			TERMINAL BOARDS		
554.	18881-8		Fanning Strip, 8 Pin	FS501A (fanning strip mating with TB501)	1
555.	24118-10		Marker Strip, Terminal		1
			SWITCHES		
556.	120-139		Switch, Slide (DPDT)	S301 (servo reference switch)	1
557.	24120-20		Switch, Rotary	S302 (tape speed selector)	1

PARTS LIST FOR:	TAPE TRANSPORT (continued)		CATALOG NOS. 23875-10, -20, -40, -50	Sheet 12 of 14

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION		NO/ ASSY.
			MOTOR (refer to mechanical assemblies for detailed breakdown)		
558.				Capstan Motor Assembly	1
			TRANSFORMERS		
559.				T301 (T301 is shared with electrical control system - refer to electrical control system for listing)	
560.	24121-10		Transformer (Servo)	T302	1
			METER		
561.	23881-10		Meter Assembly	M301 (phase meter)	1
			CAPACITORS		
562.	031-299		Capacitor, Electrolytic, 500 MFD, 50V	C302 (500 MFD, 50V)	1
563.			0.5 MFD	(C305 across T302 primary)	1
564.			Capstan Motor Capacitor - refer to mechanical ass'y. for listing	(C401)	1
565.	035-430		Capacitor, Polystyrene, .47 MFD, 10%, 100V	C304 (.47 100V - associated with 24021	1
			RESISTORS		
566.	043-377		Resistor, Fixed, Wire Wound, 10Ω, 10W, 3%	R303 10Ω, 10W	1
567.	044-100		Resistor, Variable, 5000Ω, 1/2W, 10%	R304 5K 1/2W, 10% adjustable	1
568.	041-410		Resistor, Fixed Carbon, 1000Ω, 1/4W, 5%	R305, R307, R308, R311, R312, R313	6
569.	041-409		Resistor, Fixed Carbon, 15K, 1/4W, 5%	R306	1
570.	041-570		Resistor, Fixed Carbon, 2400Ω, 1/4W, 5%	R309 2.4K on S302	1
571.	041-584		Resistor, Fixed Carbon, 4300Ω, 1/4W, 5%	R310 4.3K on S302	
572.	041-550		Resistor, Fixed Carbon, 3000Ω, 1/4W, 5%	R314 3K on S302	
573.	041-427		Resistor, Fixed Carbon, 330Ω, 1/4W, 5%	R315 330Ω across meter M301	1
			DIODES		
574.	013-265		Diode ZENER (IN2976B)	CR301, CR302	1
			TRANSISTORS		
575.	014-204		Transistor (2N1043)	Q301	1
576.	014-203		Transistor (2N2076)	Q302, Q303	2
			DRIVE SERVO CIRCUIT CARDS		
577.	24018-11		Power Supply Card Assembly consisting of the following parts:		1
578.	041-278		Resistor, Fixed, Carbon, 2700Ω, 1/2W, 5%	R6	1
579.	041-245		1000Ω, 1/2W, 5%	R1	1
580.	041-412		4700Ω, 1/4W, 5%	R3, R11	2
581.	041-408		10K , 1/4W, 5%	R10	1
582.	041-407		3300Ω, 1/4W, 5%	R9	1
583.	041-434		1800Ω, 1/4W, 5%	R5	1
584.	041-429		680 Ω, 1/4W, 5%	R4	1
585.	041-414		Resistor, Fixed, Carbon, 2200Ω, 1/4W, 5%	R2	1
586.	044-250		Resistor, Variable, 5000Ω, 1/2W, 10%	R8	1
587.	030-094		Capacitor, CER., 1μF	C6, C7	2
588.	031-187		Capacitor, Elect., 50μF, 50V	C4, C5	2
589.	030-198		Capacitor, CER., pF, 10%	C3	1
590.	031-220		Capacitor, Elect., 250μF, 12V	C1, C2	2
591	013-157		Diode, D1-52	CR1, CR2, CR3	3
592.	540-064		Inductor, 1.5 Hy 100Ω DC	L1	1
593.	014-036		Transistor, 2N404	Q2, Q3	2
594.	014-028		Transistor, 2N655	Q1	1
595.	280-030		Transistor Mtg. Pads		3
596.	148-030		Test Point, BLU.	TP3	1
597.	148-052		Test Point, BLK.	TP2	1
598.	148-027		Test Point, Red	TP1	1
599.	24017-11		Printed Wiring Board		1
600.	013-279		Diode D1-72	CR4 thru CR11	8
601.	041-313		Resistor, Fixed, Carbon, 510Ω, 2W, 5%	R13	1
602.	041-331		Resistor, Fixed, Carbon, 3300Ω, 1/2W, 5%	R15	1
603.	041-303		Resistor, Fixed, Carbon, 3900Ω, 1/2W, 5%	R14	1
604.	041-254		Resistor, Fixed, Carbon, 15K , 1/2W, 5%	R12	1
605.	041-013		Resistor, Fixed, Carbon, 4700Ω, 1/2W, 5%	R7	1

PARTS LIST FOR: TAPE TRANSPORT (continued) CATALOG NOS. 23875-10, -20, -40, -50 Sheet 13 of 14

REF. NO.	AMPEX PART NO.	MIL OR GOVT. NO.	DESCRIPTION		NO/ ASSY.
606.	24015-10		Tachometer Amplifier Card Assembly consisting of the following parts:		1
607.	041-427		Resistor, F.C., 330 Ω, 1/4W, 5%	R27, R29, R51, R53, R55	5
608.	041-411		47K , 1/4W, 5%	R26, R28, R50, R52, R54	5
609.	041-408		10K , 1/4W, 5%	R25	1
610.	041-407		3300Ω, 1/4W, 5%	R24	1
611.	041-425		47 Ω, 1/4W, 5%	R23	1
612.	041-396		220 Ω, 1/4W, 5%	R22	1
613.	041-406		22K , 1/4W, 5%	R18, R21, R44, R47	4
614.	041-103		1500Ω, 1 W, 5%	R8 thru R11, R30 thru R35	10
615.	041-434		1800Ω, 1/4W, 5%	R7	1
616.	041-429		680 Ω, 1/4W, 5%	R6	1
617.	041-412		4700Ω, 1/4W, 5%	R3, R5, R16, R17, R19, R20, R42, R43, R45, R46, R48, R49	12
618.	041-414		2200Ω, 1/4W, 5%	R2, R4	2
619.	041-483		Resistor, F.C., 27K , 1/4W, 5%	R1, R12-R15, R36-R41	11
620.	030-197		Capacitor, CER, 560Pf , 600V, 10%	C4 thru C7, C10 thru C15	10
621.	030-198		Capacitor, CER, 220Pf , 600V, 10%	C2, C3, C8, C9, C16, C17	6
622.	030-094		Capacitor, CER, IMF, 25V,	C1	1
623.	014-036		Transistor, 2N404	Q1 thru Q13	13
624.	280-030		Transistor, Mtg. Pad		13
625.	615-002		Wire, Bare, #22 AWG, Solid, Copper Tinned	(as required)	
626.	24014-10		Printed Wiring Board		1
627.	24021-20		Time Base Comparator Card Assembly consisting of the following parts:		1
628.	037-989		Capacitor, Tantalum, 2.2MF, 20V, 10%	C8, C9	2
629.	031-166		Capacitor, Elect., 100MF, 6V	C7	1
630.	041-406		Resistor, F.C., 22K , 1/4W, 5%	R24, R27	2
631.	041-414		2200Ω, 1/4W, 5%	R23	1
632.	041-483		27K , 1/4W, 5%	R18	1
633.	041-410		1000Ω, 1/4W, 5%	R17	1
634.	041-550		3000Ω, 1/4W, 5%	R16	1
635.	041-408		10K , 1/4W, 5%	R14	1
636.	041-430		1500Ω, 1/4W, 5%	R11	1
637.	041-561		5100Ω, 1/4W, 5%	R10	1
638.	041-482		12K , 1/4W, 5%	R3	1
639.	041,412		4100Ω, 1/4W, 5%	R2, R4	2
640.	044-249		Resistor, VAR, 10K, 1/2W, 10%	R5	1
641.	043-533		Resistor, F.WW, 100 Ω, 1/2W, 5%	R31.	1
642.	043-539		3300Ω, 1/2W, 5%	R20	1
643.	043-536		1200Ω, 1/2W, 5%	R19	1
644.	043-537		2000Ω, 1/2W, 5%	R13, R28	2
645.	043-540		5000Ω, 1/2W, 5%	R9	1
646.	043-538		3000Ω, 1/2W, 5%	R8, R15, R21	3
647.	043-535		1000Ω, 1/2W, 5%	R7, R25, R29, R30	4
648.	043-534		390 Ω, 1/2W, 5%	R6	1
649.	043-532		82 Ω, 1/2W, 5%	R1	1
650.	043-541		7000Ω, 1 W, 5%	R22	1
651.	043-542		30K , 2 W, 5%	R12	1
652.	043-543		Resistor, F.WW, 470 Ω, 5 W, 5%	R26	
653.	031-247		Capacitor, Elect., 200 MF, 15V	C6	1
654.	031-271		Capacitor, Elect., 100 MF, 15V	C5	1
655.	035-357		Capacitor, Mylar, .022 MF, 100V, 10%	C4	1
656.	035-219		Capacitor, Mylar, .01 MF, 100V, 10%	C1, C2, C3	3
657.	013-157		Diode, D1-52	CR2, CR4, thru CR7	5
658.	013-190		Diode, IN457	CR1, CR3	2
659.	014-188		Transistor, 2N1027	Q5, Q8	2
660.	014-141		Transistor, 2N1974	Q4, Q6, Q7, Q9	4
661.	014-193		Transistor, 2N1132	Q3	1
662.	014-028		Transistor, 2N655	Q1, Q2	2
663.	280-030		Transistor, Mounting Pads		9
664.	148-031		Test Point, Yellow	TP1	1
665.	24020-20		Printed Wiring Board		1

PARTS LIST FOR: TAPE TRANSPORT (continued) CATALOG NOS. 23875-10, -20, -40, -50 Sheet 14 of 14

REF. NO.	AMPEX PART NO.	DESCRIPTION		NO/ ASSY.
666.	24024-10	Phase Comparator Card Assembly consisting of the following parts:		1
667.	041-412	Resistor, F.C., 4700 Ω, 1/4W, 5%	R10, R11, R13, R14	4
668.	041-406	Resistor, F.C., 22K , 1/4W, 5%	R9, R12, R21, R22	4
669.	041-483	Resistor, F.C., 27K , 1/4W, 5%	R5 thru R8	4
670.	034-377	Capacitor, Mica, .001 MF, 500V, 10%	C15	1
671.	035-418	MYLAR, .068 MF, 100V 1%	C13	1
672.	031-141	Elect., 10 MF, 15V, 5%	C12	1
673.	031-288	Elect., 3 MF, 15V, 5%	C10, C11	2
674.	035-419	MYLAR, .082 MF, 100V, 1%	C9	1
675.	035-219	MYLAR, .01 MF, 100V, 10%	C6, C14	2
676.	030-198	CER., 220PF, 600V, 10%	C5, C7, C8, C16	4
677.	030-197	Capacitor, CER., 560PF, 600V, 10%	C1 thru C4	4
678.	540-063	Inductor, 10H	L1, L2	2
679.	540-062	Inductor, 6H	L3, L4	2
680.	013-190	Diode, IN457	CR1, CR2	2
681.	014-036	Transistor, 2N404	Q1 thru Q6	6
682.	280-030	Transistor Mounting Pad		6
683.	148-029	Test Point, GREEN	TP1	1
684.	24023-10	Printed Wiring Board		1
685.	041-100	Resistor, F.C., 470 Ω, 1W, 5%	R30	1
686.	041-103	1500Ω, 1W, 5%	R1 thru R4, R19, R20	6
687.	041-410	1000Ω, 1/4W, 5%	R25	1
688.	041-413	6800Ω, 1/4W, 5%	R24	1
689.	041-408	10K , 1/4W, 5%	R23, R26, R27	3
690.	041-427	330 Ω, 1/4W, 5%	R16, R18	2
691.	041-411	Resistor, F.C., 47K , 1/4W, 5%	R15, R17, R28, R29	4