

Section 2

Installation and System Checkout

NOTE

Read SECTION 3, OPERATION, before attempting checkout procedures which require tape motion.

GENERAL

All console systems are shipped with internal cabling already connected. Cable connections between consoles and the rack-mounted units -- master control panel, master record amplifier, and master bias oscillator are detailed in the illustrations of this section.

IMPORTANT

All tape transports, console or rack-mount, are shipped with a special lock that holds the capstan drive motor away from the rubber-tired capstan flywheel. Release the lock retaining ring, and disengage the lock arm. Always be sure to lock the capstan motor when preparing the equipment for shipping or the flywheel tire may be damaged beyond repair.

PLACEMENT OF UNITS

Although slave duplicators may be placed on both sides of the master reproduce console, placement of the slaves to the left of the master reproduce console simplifies performance measurements. With this positioning, tape can be threaded from any slave to the master for the alignment procedures described in section 2.

For rack installations, mount the two master reproduce amplifiers, the master tape transport, the master bias oscillator and the master control panel in descending order from top to bottom. To the left of the master rack, mount the slave number 1 tape transport and switching panel, then slave number two tape transport and switching panel. Any additional slave duplicator units can be mounted two to a rack in this same manner to the left of the preceding rack.

When rack mounting the equipment, the springs for the capstan drive system should be heavier than for console mounting; (see Tape Transport Section - page 4-5) also, adjustments must be made on the tape take up tension arm spring, brakes, and other mechanisms. Because the tape transport is operated in the vertical position, reels must be secured by hold down knobs Cat. No. 9093.

CABLE CONNECTIONS

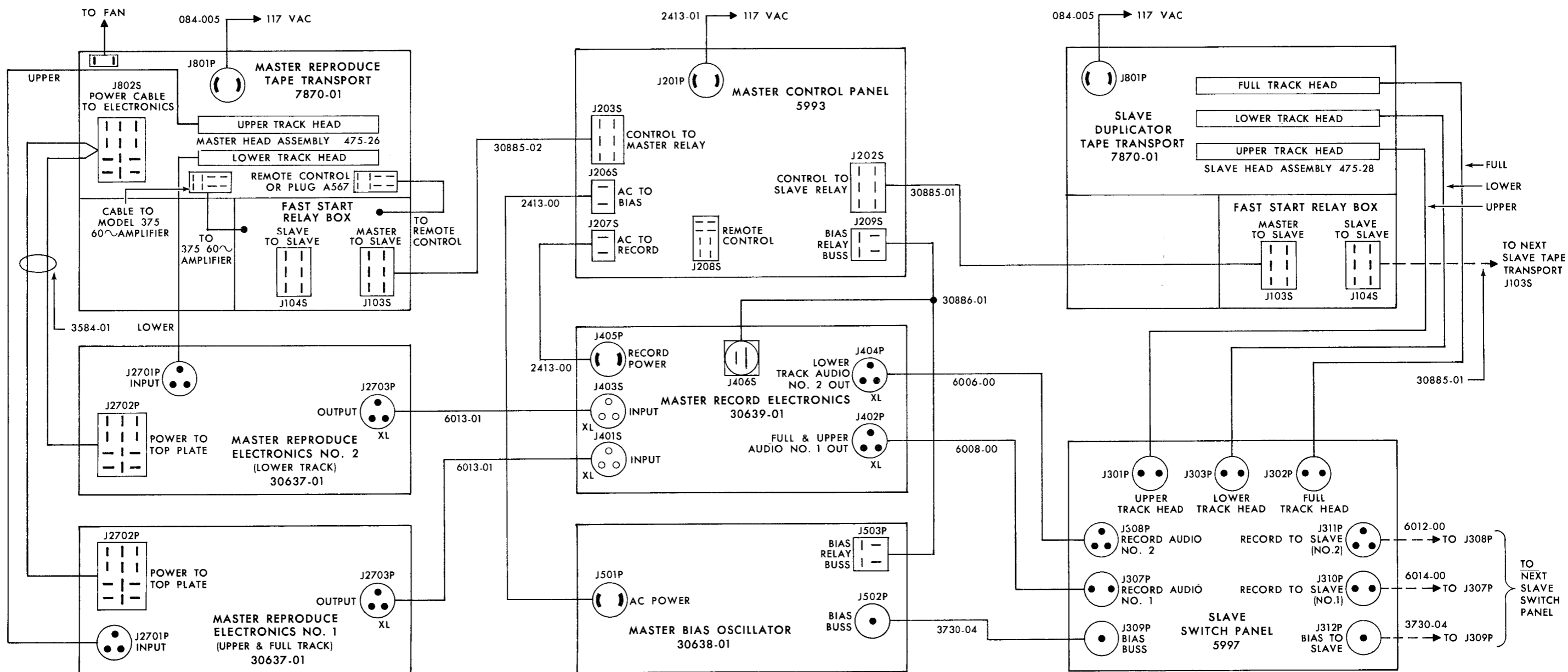
Make all cable connections as shown in Figure 2-1 of this section. In this equipment the head cables are marked individually. The master reproduce head assembly unit, the lower half track head cable is marked "LOWER". The upper half track head cable reads "UPPER". In the slave duplicators, the lower half-track head cable reads "LOWER", the full track head cable reads "FULL", and the upper half track head cable is marked "UPPER".

PERFORMANCE CHECKS

a. General

All adjustments are made at the factory immediately before shipment, and adjustment controls are locked. Certain adjust-

SYSTEM CABLING DIAGRAM
Figure 2-1



ments, however, are dependent upon the characteristics of the magnetic recording tape to be used on the slave tape transports. To insure proper operation, the capstan speed adjustment and overall system performance should be checked before placing the equipment into service. Overall system performance should also be checked weekly to maintain proper operation throughout the life of the equipment. If either of the aforementioned checks indicate unsatisfactory operation, the system can be realigned using the procedures in this section.

b. Minimum Test Equipment Required

- 1) An audio oscillator that covers the frequency range from at least 100 to 120,000 cps such as the Hewlett-Packard Model 200C or its equivalent.
- 2) An a-c vacuum tube voltmeter that is accurate to 350,000 cps such as the Hewlett-Packard Model 400C or its equivalent. (Two vtvm's are desirable but one is sufficient.
- 3) A distortion meter such as the Donner Model 2100 or its equivalent.
- 4) A tape reproducer such as the Ampex Model 352-2.
- 5) An Ampex Duplicator Standard Test Tape, Catalog No. 6878 (or 31300-01).
- 6) An Ampex 3-3/4 IPS Reproducer Standard Test Tape, Catalog No. 31331-01.
- 7) An Ampex 7-1/2 IPS Reproducer Standard Test Tape, Catalog No. 5563 (or 31321-01).

- 8) An Ampex 15 IPS Reproducer Standard Test Tape, Catalog No. 4494 (or 31311-01).
- 9) A pair of headphones or a speaker-amplifier.
- 10) A 7/16-inch hexagonal socket wrench.
- 11) A screwdriver with a 1/8-inch wide blade.
- 12) A screwdriver with a 1/4-inch wide blade.
- 13) An Ampex head demagnetizer #704.

c. Capstan Speed Check

Check the capstan speed on all tape transports after completing the installation. A strobosticker is provided for this purpose. Strobostickers for 60 cps bear the number 6, and for 50 cps the number 5.

- Step 1: Place the strobosticker gum side down on top of the capstan shaft setscrew and center it.
- Step 2: Place the POWER switch in the ON position.
- Step 3: Place the speed selector in the LOW position.
- Step 4: Place the MODE SELECTOR switch in the PLAY position.
- Step 5: Push the takeup tension arm toward its turntable. A microswitch coupled to the arm shaft will close. The closing of this switch is audible.

Step 6: Press the START button, causing the capstan to rotate (in FAST START the capstan will be rotating already).

Step 7: View the rotating shaft under a 60 cycle fluorescent light, such as a 2 watt neon lamp (50 cycle for 50 cycle machine). The capstan speed is correct when the bars of the strobosticker appear motionless. The capstan speed is too high when the strobosticker bars appear to move clockwise. The capstan speed is too low when the bars appear to rotate counterclockwise.

Speed adjustments can be made by the pressure spring locknut on the drive motor solenoid plunger. Adjust the locknut till the strobosticker bars appear motionless.

IMPORTANT

There are two settings of the adjustment nut at which the bars will appear motionless. To be certain the correct setting is chosen, tighten the locknut an additional 1/4 to 1/2 turn after stopping the apparent motion of the strobosticker bars. The bars should then appear to rotate in the direction opposite the capstan rotation. If this occurs, back off to the original setting and make no further adjustment. If tightening the locknut makes the strobosticker bars rotate clockwise, the original setting was incorrect. Continue to tighten the locknut and the strobosticker bars will stop once more. This will be the correct setting and can be checked by the above procedure.

d. Head Demagnetization

Residual magnetization in the heads may cause an increase of 5 to 10 db in noise level and, in the case of reproduce heads, will gradually erase the high frequencies on tapes played across them. Ampex Catalog No. 704 Head Demagnetizer is available as accessory equipment. Periodic noise level checks will determine frequency of demagnetizing. It is good practice to demagnetize heads after disconnecting and reconnecting head cables.

Step 1: Remove any tape from the recorder.

Step 2: Place a piece of electrical tape over the tips of the demagnetizer.

Step 3: Plug the Ampex Catalog No. 704 Head Demagnetizer into any 117v a-c source.

Step 4: Be sure that all power in the duplicator system is turned off.

Step 5: Open the head gate assembly.

Step 6: Run the tips of the demagnetizer up and down the length of the head stack several times.

Step 7: Remove the demagnetizer slowly, allowing the influence of its a-c field to die gradually.

Step 8: Repeat this procedure on all heads.

Step 9: Unplug the demagnetizer only when it is well away from the heads.

e. Overall System Check

The overall system can be checked using the following procedure. If performance does not meet specifications, the procedures following the "Overall System Check" should be used to locate and correct the trouble.

CABLE	CATALOG NO.	QUANTITY	FROM		TO	
			RECEPTACLE	CHASSIS	RECEPTACLE	CHASSIS
A-C	084-005	1 Per Transport	J801P	Tape Transport	A-C Source	
A-C	2413-01	1	J201P	Master Control Panel	A-C Source	
A-C Interconnecting	2413-00	1	A-C TO BIAS J206S	Master Control Panel	A-C POWER J501P	Master Bias Oscillator
A-C Interconnecting	2413-00	1	A-C TO RECORD J207S	Master Control Panel	RECORD POWER J405P	Master Record Electronics
Interconnecting	30885-02	1	CONTROL TO MASTER RELAY J203S	Master Control Panel	MASTER TO SLAVE J103S	Fast Start Relay Box (Master Transport)
Interconnecting	30885-01	1	CONTROL TO SLAVE RELAY J202S	Master Control Panel	MASTER TO SLAVE J103S	Fast Start Relay Box (Slave Transport)
Interconnecting	30886-01	1	BIAS RELAY BUSS J209S	Master Control Panel	RELAY BUSS (J406S) and BIAS RELAY BUSS (J503P)	Master Record Electronics and Master Bias Oscillator
Interconnecting	3584-01	1	POWER CABLE TO ELECTRONICS J802S	Power Panel Tape Transport	POWER TO TOP PLATE J2702P (to both reproduce electronics)	Master Reproduce Electronics
Interconnecting	30885-01	1 Per Slave Transport	SLAVE TO SLAVE J104S	Fast Start Relay Box (Slave Transport)	MASTER TO SLAVE J103S	Next Slave Tape Transport (Fast Start Relay Box)
Interconnecting	6013-01	1	OUTPUT J2703P	Master Reproduce Electronics	INPUT J403S	Master Record Electronics
Interconnecting	6013-01	1	OUTPUT J2703 P	Master Reproduce Electronics	INPUT J401S	Master Record Electronics

Figure 2-2

CABLE INTERCONNECTING DIAGRAM

CABLE	CATALOG NO.	QUANTITY	FROM		TO	
			RECEPTACLE	CHASSIS	RECEPTACLE	CHASSIS
Interconnecting	6006-00	1	LOWER TRACK AUDIO NO. 2 OUT J404P	Master Record Electronics	RECORD AUDIO No. 2 J308P	Slave Switch Panel
Interconnecting	6008-00	1	FULL AND UPPER AUDIO NO. 1 OUT J402P	Master Record Electronics	RECORD AUDIO No. 1 J307P	Slave Switch Panel
Interconnecting	3730-04	1	BIAS BUSS J502P	Master Bias Oscillator	BIAS BUSS J309P	Slave Switch Panel
Interconnecting	6012-00	1	RECORD TO SLAVE NO. 2 J311P	Slave Switch Panel	RECORD AUDIO NO. 2 J308P	Next Slave Switch Panel
Interconnecting	6014-00	1	RECORD TO SLAVE NO. 1 J310P	Slave Switch Panel	RECORD AUDIO NO. 1 J307P	Next Slave Switch Panel
Interconnecting	3730-04	1	BIAS TO SLAVE J312P	Slave Switch Panel	BIAS TO SLAVE J312P	Next Slave Switch Panel
Head Cable	UPPER 475-26 (Master)	1	Captive Upper Track Head	Tape Transport	INPUT J2701P	Master Reproduce Electronics No. 1
Head Cable	LOWER 475-26 (Master)	1	Captive Lower Track Head	Tape Transport	INPUT J2701P	Master Reproduce Electronics No. 2
Head Cable	FULL 475-28 (Slave)	1	Captive Full Track Head	Tape Transport	FULL TRACK HEAD J302P	Slave Head Switch Panel
Head Cable	LOWER 475-28 (Slave)	1	Captive Lower Track Head	Tape Transport	LOWER TRACK HEAD J303P	Slave Head Switch Panel
Head Cable	UPPER 475-28 (Slave)	1	Captive Upper Track Head	Tape Transport	UPPER TRACK HEAD J301P	Slave Head Switch Panel

CABLE INTERCONNECTING DIAGRAM

Step 1: Using the 3-3/4 ips tape (Catalog number 31331-01), calibrate the tape reproducer for a known output level (such as 0 dbm) and plot a frequency response curve.

Step 2: Place a standard tape of the speed of the master tape to be duplicated on the master transport. Set the tape speed switch in the proper position. Thread bulk degaussed tape on the slave or slaves to be checked. Set the slave transport(s) to the proper speed. Set the record amplifier speed switch to the speed combination being checked. Start the system so that duplicates of the standard tape will be made. Record level should be set so that the normal operating level of the standard tape in use, indicates \emptyset on the record level meter, for 15 ips copies. For 7-1/2 and 3-3/4 ips copies the level should be reduced 10 db to avoid possible tape saturation.

Step 3: Measure the output level and frequency response of the duplicate made in Step 2 and compare the results with the measured output level and frequency response of the Reproducer Standard Test Tape measured in Step 2. If the output level and frequency response of the copy is within ± 2 db of the Reproducer Standard Test Tape, the system can be considered to be operating properly. With care, the system can be adjusted to ± 1 db of the standard tape response.

NOTE

If the output level and frequency response of the copy is not within ± 2 db of the Reproduce Standard Test Tape, make the "Bias Current Adjustment",

the "Record Current Adjustment", the "Reproduce Alignment", and "Record Alignment"; in the order mentioned.

IMPORTANT

Since operation of duplicator system is dependent upon the accuracy of the Standard Test Tapes, it is of utmost importance that the Standard Test Tapes be properly cared for. Proper care consists of: (1) cleaning and demagnetizing heads and guides before use of the Standard Test Tapes; (2) do not rewind Standard Test Tape after use (it should be stored "tail out" and be rewound just before use); and (3) store the Standard Test Tapes at room temperature, avoid storage in or near magnetic fields.

f. Bias Current Adjustment

The individual bias controls for each head are mounted on the slave switch panels at the rear of each slave console. These controls are factory adjusted for optimum results with typical "Long Play" (1 mil base) tape. The controls should be checked and, if necessary, adjusted for optimum results with the user's normal tape. Differences in high frequency response (3 db) are compensated for by varying the individual head bias controls.

Step 1: Terminate the output of the upper and full track master reproduce amplifier in 600 ohms, and connect this output to an a-c vtvm, and set the audio oscillator to 2000 cps.

Step 2: Place the TAPE SPEED selector switches in the LOW position.

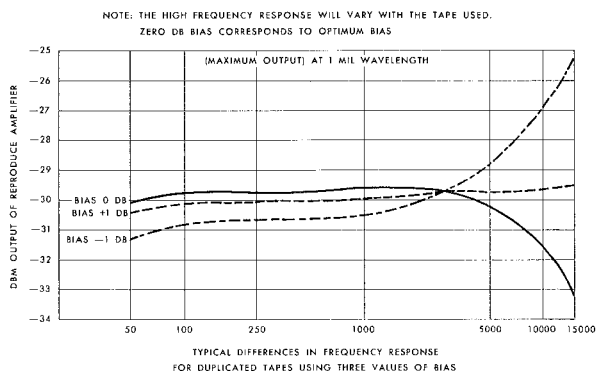


Figure 2-3

- Step 3:** Thread the tape to be used along the path shown in the illustration, "TAPE THREADING PATHS".
- Step 4:** Terminate the output of the full and upper track Master Reproduce Amp-
plifier in 600 ohms and connect this to a vtm.
- Step 5:** Press the START RECORD button, and adjust BIAS control on the front panel so that its meter reads zero v-u.
- Step 6:** Place the FULL TRACK record head switch in the ON position.
- Step 7:** Adjust the full track BIAS vernier for maximum output on the vtm.*
- Step 8:** Place the FULL TRACK head switch in the OFF position.
- Step 9:** Place the UPPER HALF TRACK head switch in the ON position.
- Step 10:** Adjust the upper half track BIAS vernier for maximum output.*

* The peak output level versus bias current curve may be so broad that consistent adjustments will be difficult to obtain. It is suggested that an a-c vtm such as a HP 400C be used to measure the bias current

at the record current jack while the 2 kc signal is being recorded. A consistent setting will be the bias current which is the medium value between the points where the output begins to drop. Typical values of bias currents (measured across 10 ohm resistor with an a-c vtm at slave head monitoring jacks of Slave Switch panel) are -db .78v 7.0 ma for half track heads and -db .78v 9.0 ma for full track type 475-28R head assemblies.

- Step 11:** Terminate the output of the lower track Master Reproduce Amplifier in 600 ohms and connect this output to a vtm.
- Step 12:** Place the UPPER HALF TRACK head switch in the OFF position.
- Step 13:** Place the LOWER TRACK head switch in the ON position.
- Step 14:** Adjust the lower track BIAS vernier for maximum output.*
- Step 15:** To determine the ultimate bias setting, duplicate copy of an Ampex Standard tape as noted in "e" "Overall System Check" and compare the response of the duplicate with that of the Reproducer Standard Test Tape, Cat. No. 5563 (or 31321-01) or 31331-01 (3-3/4 ips, 120 u sec). The response of the duplicate will vary approximately as shown in the graph and can be adjusted accordingly.

NOTE

If, after adjusting the bias current, the response of the system (disregarding level) is not within 2 db of the Reproducer Standard Test Tape, perform

*See footnote for Step 7.

the "Overall Response by Induction Loop". If the response of the system is within the desired tolerance of the test tape, perform the "Record Current Adjustment".

g. Reproduce Alignment with Standard Tape

Reproduce alignment consists of adjusting the azimuth of the reproduce heads, setting reproduce level and, if necessary, adjusting reproduce equalization. Each procedure must be carried out twice -- once for each reproduce head and reproduce amplifier.

Step 1: Remove the top cover on the master reproduce tape transport head assembly by removing the two socket head screws that hold it and pulling gently up and back. The two heads, from left to right, are the lower half track reproduce head and the upper half track reproduce head. The nut on the top left side of each head can be used for azimuth adjustment. NEVER ATTEMPT TO ADJUST ANY OTHER NUT OR SCREW ON THESE HEADS.

Step 2: Thread an Ampex alignment tape (Cat. No. 6878 or 31300-01) on the master.

Step 3: Terminate the output of the UPPER AND FULL TRACK master amplifier in a 600-ohm resistive load.

Step 4: Connect an a-c vtm and a pair of headphones or a speaker amplifier across this output.

Step 5: Place the master tape transport mode selector switch in the PLAY position.

Step 6: Place the master tape transport TAPE SPEED selector switch in the

LOW position.

Step 7: Place the master POWER toggle switch in the ON position.

Step 8: Press the START button on the tape transport.

Step 9: The first tone on the tape will be for head azimuth adjustment. Adjust the azimuth nut on the UPPER HALF TRACK head for maximum output as seen on the vtm.

Step 10: The next tone on the tape is recorded at normal operating level for adjusting reproduce level. Adjust the reproduce level control (PLAYBACK LEVEL) on the upper and full track master reproduce amplifier for a vtm reading of 1.23 volts rms (+4 dbm) on this tone.

Step 11: Next is a sequence of tones used for checking overall reproduce response. Check the response observed on the vtm as the tone sequence is played. If the response is satisfactory, rewind the standard tape, and repeat the entire procedure on the lower track head and master reproduce amplifier.

h. Record Alignment

Record channel alignment consists of adjusting the azimuth of all record heads, and setting the record level for each record head. The procedures outlined below must be repeated for each of the two record channels.

If the system contains more than one Slave Duplicator, each slave must be adjusted as described below:

Record head azimuth is adjusted while recording a signal on a slave and simultaneously playing it back on the Master Reproduce unit.

- Step 1: Remove the top cover of the Slave Duplicator head assembly. The heads, from left to right facing the machine are: full track, lower left track, upper half track. The azimuth adjustment is the nut on the top left side of each head can. Make this adjustment using a 1/4 inch Spintite socket wrench.
- Step 2: Place the TAPE SPEED switch in the LOW position on both Master and Slave Tape Transports.
- Step 3: Be certain all POWER switches on the master control panel are in the ON position.
- Step 4: Place the upper half track and lower half track head switches on the Slave Switch Panel in the OFF position.
- Step 5: Place the tape transport mode selector in the PLAY position.
- Step 6: Set an audio oscillator to 1000 cps at 1.23 volts rms, and feed this signal into the AUDIO NO. 1 input of the Master Record Amplifier.
- Step 7: Terminate the output of the upper and full track Master Reproduce Amplifier in 600 ohms, and connect this output to an a-c vtvm.
- Step 8: Set RECORD LEVEL for the FULL AND UPPER TRACK section of the Master Record Amplifier to zero on its v-u meter.
- Step 9: Advance the Audio Oscillator to 40,000 cps.
- Step 10: Press the START RECORD button.
- Step 11: Adjust the BIAS control on the front panel to obtain zero v-u on the bias meter.
- Step 12: Adjust the full track record head azimuth to a maximum reading on the vtvm.
- Step 13: Place the FULL TRACK head switch in the OFF position.
- Step 14: Place the UPPER TRACK head switch in the ON position.
- Step 15: Adjust the upper track record head for maximum output.
- Step 16: Place the UPPER TRACK head switch in the OFF position.
- Step 17: Set an audio oscillator to 1000 cps at 1.23 volts rms, and feed this signal into the AUDIO NO. 2 input of the Master Record Amplifier.
- Step 18: Terminate the output of the lower and full track Master Reproduce Amplifier in 600 ohms, and connect this output to an a-c vtvm.
- Step 19: Place the LOWER TRACK head switch in the ON position.
- Step 20: Terminate the output of the lower track Master Reproduce Amplifier in 600 ohms, and connect this output to an a-c vtvm.
- Step 21: Adjust lower track record head for maximum output.

NOTE

While recording, replace the head cover and tighten the screws, making certain that the azimuth adjustment does not change.

i. Record Level Setting

- Step 1: Terminate the output of the upper track Master Reproduce Amplifier

in 600 ohms and connect this output to a vtvm. (The Reproduce Amplifier gains should have been previously set for +4 dbm output at the 1kc reference level of a 6878 standard tape.)

Step 2: Set the audio oscillator to 500 cps and feed this signal into the audio No. 1 input of the Master Record Amplifier.

Step 3: Set the gain vernier for the upper and full track channel to maximum clockwise.

Step 4: Adjust the upper and full track channel gain attenuator so that the v-u meter reads between zero v-u and +2 v-u.

Step 5: Adjust the gain vernier so that v-u meter reads exactly zero v-u.

Step 6: Thread the tape to be used along the prescribed path.

Step 7: Place the full track record head switch in the ON position and the upper half track and lower half track head switches in the OFF position.

Step 8: Place the TAPE SPEED switches in the LOW position, and press the START RECORD button, making certain the bias meter still reads zero v-u.

Step 9: Adjust the full track record level vernier on the Slave Head Switch Panel for a reading of 1.23 volts rms (+4 dbm) on the vtvm.

Step 10: Place the full track head switch in the OFF position.

Step 11: Place the upper track head switch in the ON position.

Step 12: Adjust the upper track record level vernier for 1.23 volts rms (4 dbm) on the vtvm.

Step 13: Place the lower track head switch in the ON position.

Step 14: Place the upper and full track head switches in the OFF position.

Step 15: Feed the 500 cps signal from the audio oscillator to AUDIO NO. 2 input of the Master Record Amplifier.

Step 16: Terminate the output of the lower track master reproduce amplifier in 600 ohms and connect this output to a vtvm.

Step 17: Set the gain vernier for the lower track channel to maximum clockwise.

Step 18: Adjust the lower track channel gain attenuator so that the v-u meter reads between zero v-u and +2 v-u

Step 19: Adjust the gain vernier so that the v-u meter reads exactly zero v-u.

Step 20: Repeat steps 6 and 8 and adjust the lower track record level vernier on the Slave head switch panel for a reading of 1.23 volts rms (4 dbm) on the vtvm.

j. Record Current Adjustment

After bias current and/or reproduce equalization has been adjusted for optimum frequency response, the record current for each head should be adjusted.

Step 1: Duplicate the operating level section of the 15 ips, Standard Tape, with the duplicator gain controls set for normal record levels.

Step 2: Measure the output level and third harmonic distortion of the tone on the copy at the output of the calibrated tape reproducer. If the level of the respective tracks vary more than 1 db from each other or from the required level, the individual head current control for the track in question must be readjusted. Also, if the third harmonic distortion is greater than 1%, the record current must be readjusted. If a distortion level meter is not available, the Ampex 5563 (or 31321-01), 7-1/2 ips reference level, will correspond to 1% distortion level.

k. Overall Noise Measurements

Noise levels of duplicated tapes can be measured by three techniques:

1. Noise can be measured broadband, by connecting a vtvm across the output of a suitable reproducer. This is usually not satisfactory because it measures noise outside of the useful spectrum.
2. Selective filters may be placed between the reproducer and the vtvm. This affords precise measurements that can be easily repeated but involves costly equipment.
3. An ASA 40 phon A curve filter may be placed between the output of the reproducer and a vtvm. This filter is easily built and affords good results with low impedance output reproduce systems.

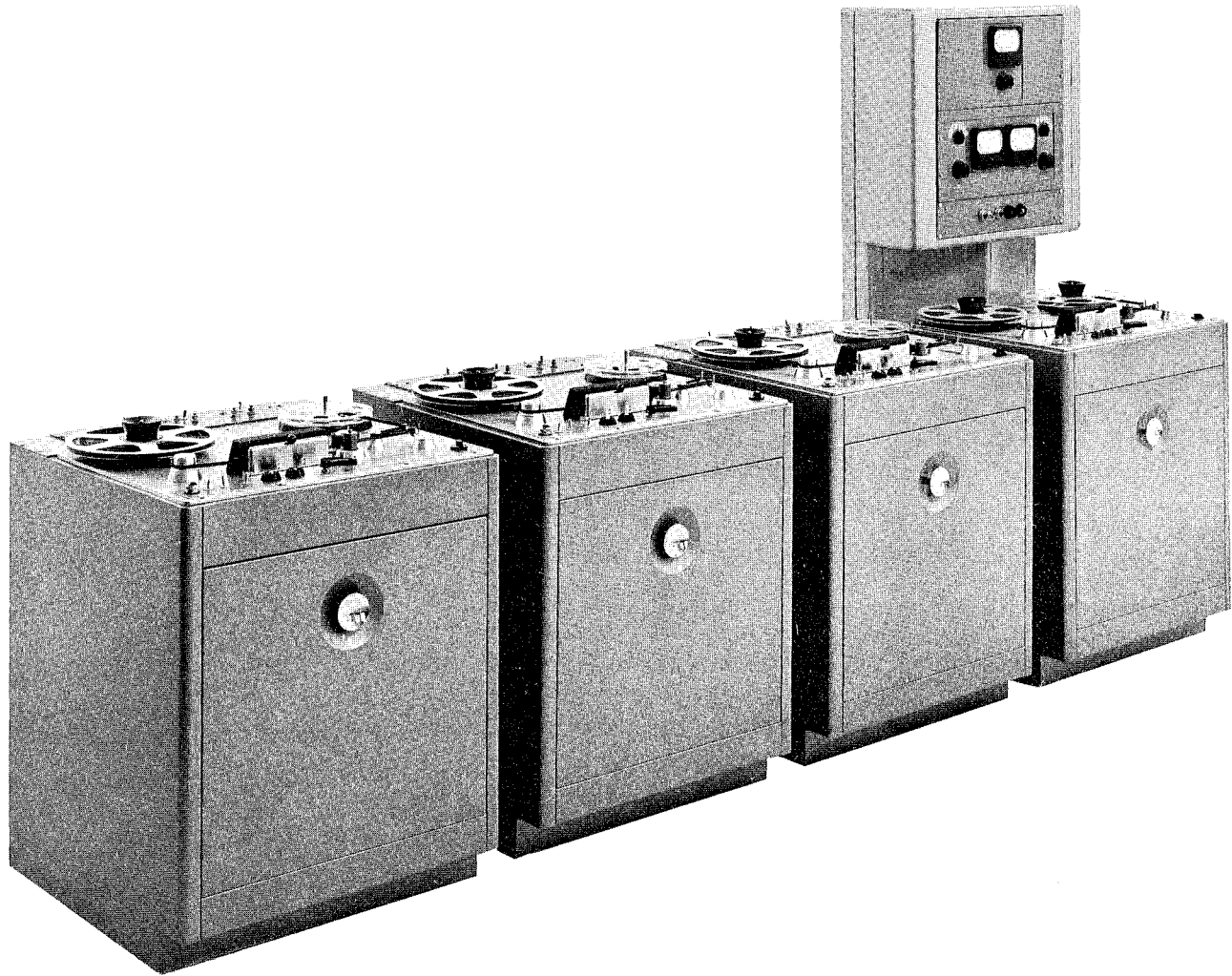


Figure 2-4

DUPLICATOR SYSTEM