DOKORDER

model 7700

SERVICE MANUAL
SM. 1004–00
1977. 3

SECTION 1

TECHNICAL DESCRIPTION AND ADJUSTMENT PROCEDURES

Dokorder, Inc.
5430 ROSECRANS AVENUE, LAWNDALE, CALIF. 90260 U.S.A.
DENKI ONKYO CO., LTD.
26-11, 3-CHOME, NISHI-ROKUGO, OTA-KU, TOKYO, JAPAN

TABLE OF CONTENTS

Note

This Service Manual consists of three sections:

Section 1: Descriptions of circuitry, operating procedures, and methods of adjustments and maintenance, plus technical data.

Section 2: Exploded views, and parts list.

Section 3: Patterns, schematics and parts lists for printed circuit boards.

1. GENERAL DESCRIPTION

The Dokorder Model 7700 is a 4-track, 2-channel, 2-speed tape deck equipped with 3-motor, 3-head and solenoid operation facility. Designed for high dependability and electrical performance. Their features:

1-1 AMPLIFIER CIRCUITRY

1. The convenience features of the 7700's amplifier circuit such as the Monitor Switch, Mic AMP Circuit, Headphone AMP Circuit and Level Meter AMP Circuit built in.
2. 4-separate controls permit subtle input/output level adjustments.
3. 2-stepped Equalizer Switch is equipped to use for the several type of tapes. The relation between the tapes and the position of the switch is illustrated below.

Equalizer Switch	Type of Tape
Normal (button out)	Scotch #212 or equivalents
Special (button in)	Maxell #UD-35 or equivalents

1-2 TAPE TRANSPORT MECHANISM

1. The convenience features of the 7700's tape transport such as the all-electronic operation buttons, pause control, tape travel counter are positive, and the mechanisms themselves are rugged and dependable.
2. The tape transport offers an Auto Stop convenience, and when the tape reaches its end in any mode (fast forward, rewind, play or record), a solenoid releases the locked operating control(s) to place the deck in the stop mode.
3. High dependability is proven by using newly improved electronic solenoid control system that reduces the power consumption and heat up in the solenoid and its control transistors.
4. Especially high speed-accuracy and surprising wow/flutter characteristics are realized by using most advanced PLL (Phase-Locked Loop) Servo System in capstan motor drive.
5. Newly designed high-torque outer-rotor eddy-current motor is used for reel drive.

1-3 POWER SUPPLY CIRCUITRY

1. The primary winding of the power transformer is provided two taps 100 V and 54 V. The former is used for the reel motor drive in the fast winding mode, while the latter is used for the reel motor drive in the rec/play mode.
2. On the secondary side, the transformer also offers two windings for 5.6 V and 14 V x 2. The former is used for illuminating the pilot lamps, while the latter is rectified and then used to power the amplifiers, solenoid, PLL circuit and capstan motor.

2. SERVICE DATA

2-1 MECHANICAL

Record/Playback System	4 track 2 channel stereophonic
Tape Width	Standard 1/4 inch tape
Reel Size	7-inch or smaller
Motor	Three (one 2 speed PLL DC servomotor for capstan, two 6 pole induction outer-rotor type for reels)
Head	Three (1 erase, 1 record, 1 playback)
Tape Speed	±1.5% at 19 cm/sec (7-1/2 ips), ±1.5% at 9.5 cm/sec (3-3/4 ips)
Wow and Flutter	Playback (RMS) 0.13% at 19 cm/sec (7-1/2 ips), 0.20% at 9.5 cm/sec (3-3/4 ips)
Fast Winding Time	100 sec for 7-inch reel (1800-foot tape, 60 Hz)
Motor Torque	Hold-back tention (playback) 85 gr ±10 gr (255 ±30 g.cm) Take-up torque (playback) 150 gr (450 g.cm) FF/REW hold-back tention 30 gr (90 g.cm)
Brake Torque	600 ~ 800 gr (1.8 ~ 2.4 kg.cm)
Weight	35 lbs
Dimension	17-3/4" (H) X 16-7/8" (W) X 6-3/4" (D)

2-2 ELECTRICAL

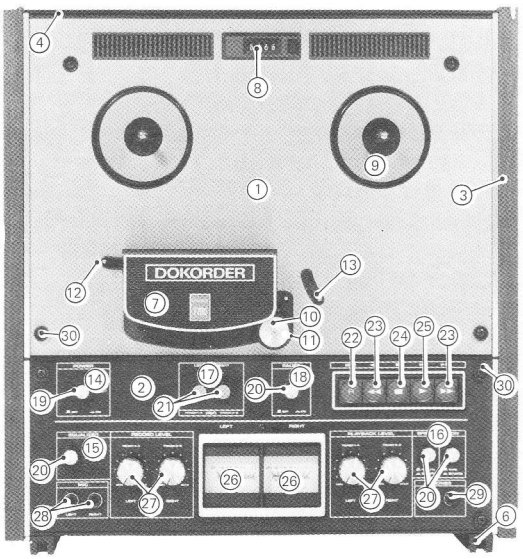
Equalization		NAB
Bias Frequency		130 KHz ±1 KHz
Frequency Response (Playback)		• 19 cm/sec (7-1/2 ips) 50 ~ 100 Hz $^{+3}_{-5}$ dB, 101 Hz ~ 15 KHz ±3 dB • 9.5 cm/sec (3-3/4 ips) 50 Hz ~ 7.5 KHz ±3 dB
Frequency Response (Overall)		• 19 cm/sec (7-1/2 ips) Normal 30 Hz ~ 20 KHz ±3 dB (30 ~ 100 Hz, 15 ~ 20 KHz ±5 dB) Special 30 Hz ~ 20 KHz ±3 dB (50 ~ 100 Hz, 15 ~ 20 KHz ±5 dB) • 9.5 cm/sec (3-3/4 ips) Normal 35 Hz ~ 12 KHz ±3 dB (35 ~ 100 Hz, 7.5 ~ 12 KHz ±5 dB) Special 35 Hz ~ 12 KHz ±3 dB (35 ~ 100 Hz, 7.5 ~ 12 KHz ±5 dB)
One-channel Recording		700 Hz ±1 dB, 15 KHz ±5 dB at 19 cm/sec (7-1/2 ips) 500 Hz ±1 dB, 7.5 KHz ±5 dB at 9.5 cm/sec (3-3/4 ips)
Signal to Noise Ratio		Better than 50 dB (Playback) at 0 dB output level Better than 46 dB (Overall) at 0 dB output level
Crosstalk		Better than 50 dB at 1 KHz
Channel Separation		Better than 40 dB at 1 KHz
Bias Leakage		Less than −25 dB
Erase Efficiency		Better than 65 dB at 1 KHz
Distortion (Overall)		Less than 3% at 1 KHz 0 dB output level
Meter Calibration		0 dB at 700 Hz 0 dB output level (P.B. VR-Max)
Input	Mic	−58 dB 10 KΩ (load impedance)
	Line	−20 dB 220 KΩ
	DIN	30 mV 80 KΩ
Output	Line	0 dB 47 KΩ
	DIN	260 mV 47 KΩ
	Headphone	2 mW 8 Ω
Circuit Complement		34 transistors, 29 diodes, 5 IC, 2 FET, 2 LED, 1 PUT
Power Consumption		75 W
Power Requirement		U.S.A. type 117 V (60 Hz) Universal type 100 V, 117 V, 125 V, 200 V, 220 V, 240 V (50/60 Hz)

Specs are subject to change without notice.

3. PARTS LOCATION

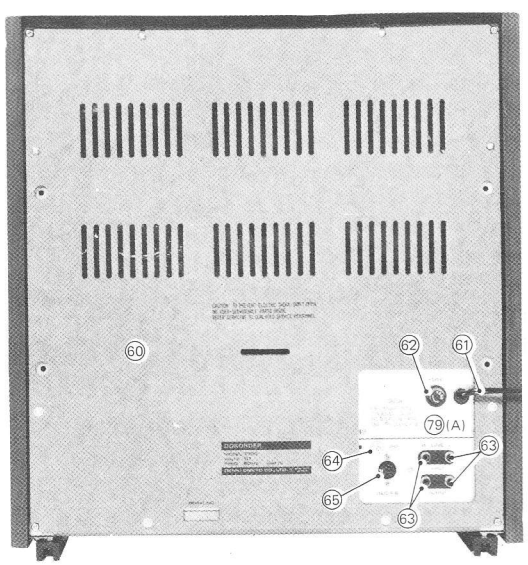
3-1 OUTER PARTS

Front View



1 Panel Ass'y, Deck (880-0017-00)
2 Panel Ass'y, Amp (880-0018-00)
3 Side Board (551-0018-02)
4 Top Board (551-0013-90)
5 Bottom Board (551-0010-00)
6 Foot Ass'y (880-0019-00)
7 Head Cover (880-0016-00)
8 Counter (143-3102-00)
9 Turn Table Ass'y (810-0011-00)
10 Dressing Washer, Pinch Roller (555-0050-02)
11 Pinch Roller (523-0029-00)
12 Tape Guide(L), Tension Arm (558-0020-00)
13 Tape Guide(R), Tension Arm (558-0021-00)
14 Switch, Push, Power (131-1018-80) or (131-1019-80)
15 Switch, Push, EQ. Select (131-1014-00)
16 Switch, Push, 2-station Speed & Monitor (131-1015-00)
17 Switch, Push, 2-station, Rec. (131-1017-00)
18 Switch, Push, Pause (131-1016-00)
19 Push Button, Metal, Power SW (556-0030-02)
20 Push Button, Metal, EQ, Speed, Monitor, Pause SW (556-0013-83)
21 Push Button, Red, Rec. SW (556-0009-00)
22 Operate Button, Rec. (556-0038-80)
23 Ope. Button, FF & REW (556-0037-80)
24 Ope. Button, Stop (556-0035-80)
25 Ope. Button, Play (556-0036-80)
26 Level Meter (141-1004-00)
27 Control Knob, Metal (556-0001-00)
28 Jack, Mic (135-5001-00)
29 Jack, Headphone (135-5002-00)
30 Cup Washer (532-0021-00)

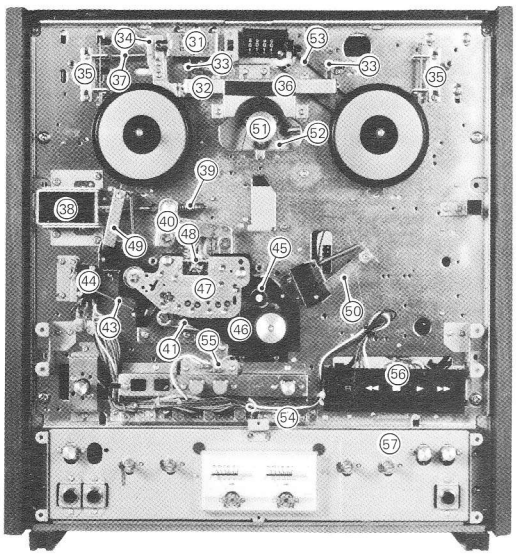
Back View



60 Back Board (551-0019-03) or (551-0020-00)
61 AC Cord with Plug (162-1001-00)
62 Holder, Fuse (135-7001-00)
Fuse, 1.5 A (138-1003-00)
63 Jack, 4-Pin (135-5008-00)
64 Terminal, GND (135-1001-00)
65 Socket, DIN (136-6003-00)

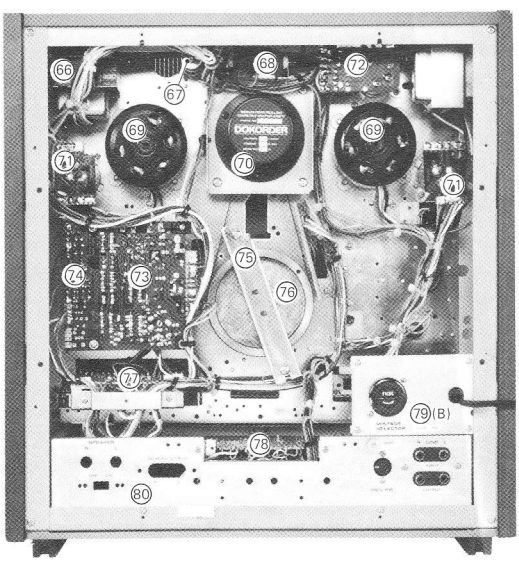
3-2 INNER PARTS

Front View



31 Solenoid, Brake, DC-24V 48 ohm (116-2002-00)
32 Linkage, Brake (525-0025-00)
33 Stopper, Brake Linkage (528-0008-00)
34 Linkage, Brake Solenoid (525-0027-00)
35 Bracket, Brake (533-0082-00)
36 Guide, Brake Linkage (528-0009-00)
37 Spring, Brake (541-0007-05)
38 Solenoid, Pinch Roller Pressure, DC-24V 15 ohm (116-2003-00)
39 Spring, Pressure (541-0010-01)
40 Arm, Pinch Roller Drive (525-0029-00)
41 Arm, Pinch Roller (525-0032-00)
42 Shaft, Pinch Roller (521-0025-05)
43 Arm, Auto Shut-Off (525-0024-04)
44 Switch, Micro, Auto Shut-Off (131-3001-00)
45 Bearing, Capstan (522-0010-02)
46 Dressing Plate, Tape Lifter (521-0029-00)
47 Head Base Ass'y (830-0011-00)
48 PC Board Ass'y (PCM-365A), Head Connect (831-0004-00)
49 Tension Arm Ass'y (Left) (840-0016-00)
50 Tension Arm Ass'y (Right) (840-0018-00)
51 Pulley, Motor, No.3 (523-0031-04)
52 Belt, Capstan Drive (524-0007-02)
53 Belt, Counter Drive (524-0006-00)
54 PC Board Ass'y (PCM-397B), Rec. & Pause (821-0020-00)
55 PC Board Ass'y (PCM-395A), LED (821-0019-00)
56 Switch Ass'y, Operate (820-0016-00)
57 Chassis(A), Amp. (512-0011-83)

Back View



66 Power Transformer (111-1021-00)
67 Resistor, Wirewound, 1200 ohm 20 W (302-1220-80)
Resistor, Wirewound, 600 ohm 15 W (302-6018-90)
68 Resistor, Wirewound, 200 ohm 10 W (302-2018-90)
Resistor, Wirewound, 150 ohm 10 W (302-1518-90)
69 Motor, Reel (113-1002-00)
70 Motor, Capstan (114-5001-00)
71 PC Board Ass'y (PCM-411B), Capstan Motor (861-0003-00)
72 PC Board Ass'y (PCM-361C), Capacitor, Reel Motor (161-1034-00)
73 PC Board Ass'y (PCM-417C), Control (851-0008-00)
74 PC Board Ass'y (PCM-413B), Bias OSC (851-0009-00)
75 Arm, Flywheel Support (533-0020-02)
76 Flywheel (523-0030-01)
77 PC Board Ass'y (PCM-416E), Operate SW (821-0021-00)
78 PC Board Ass'y (PCM-446A), Amp. (871-0012-00)
79 Chassis(A), Power Supply (533-0048-01)
Chassis (B), Power Supply (533-0049-00)
80 Chassis (B), Amp. (512-0012-00)

4. REMOVAL OF OUTER PARTS

4-1 FRONT PANEL

1. Referring to Fig. 4-1, withdraw head cover ① and remove head cover posts ② by turning them counterclockwise with pliers or box driver.
2. Holding pinch roller ⑥ still, turn counterclockwise screw ③ securing pinch roller dressing washer ④ and withdraw the screw together with the dressing washer. Then extract nylon washer ⑤ and the pinch roller from the pinch roller shaft.
   NOTE: When extracting the pinch roller, take care not to lose the nylon washer.
3. Remove four screws ⑦ and ⑧ securing the front panel by turning them counterclockwise; then remove the panel itself by moving it as the arrow in the illustration shows.
   NOTE: When mounting the front panel, reverse the steps described above. Take note that cup washer ⑨ should be fitted on the two screws securing the bottom part of the front panel. Also, note that conductive rubber washer ⑩ should be fitted on the screw securing the right side of the front panel. This is for grounding the front panel.

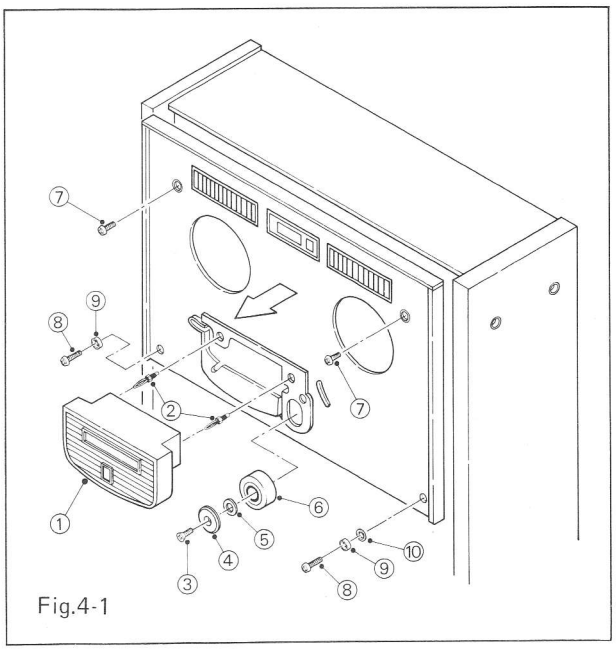


Fig.4-1

4-2 AMP PANEL

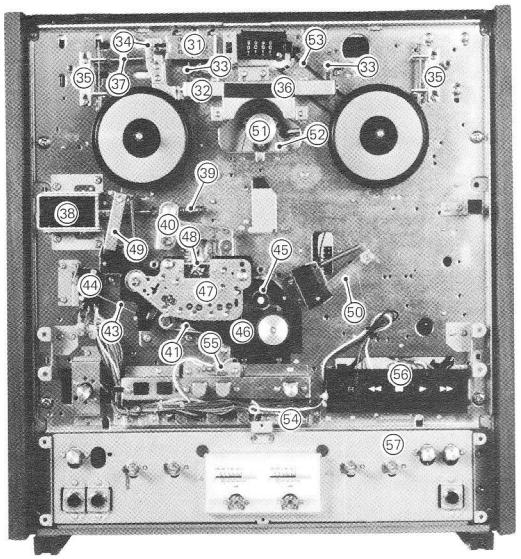
1. Withdraw control knobs—RECORD LEVEL CONTROLS and PLAYBACK LEVEL CONTROLS.
2. Remove the two screws (BS-3 X 6) above and (BS-3 X 18) below the level meters by turning them counterclockwise. Then, remove the four screws (BS-4 X 15) that secure the amp panel.
   NOTE: Take care not to lose the nylon washer when removing the two screws above and below the level meters.
3. When mounting the amp panel, reverse the steps described above.
   NOTE: Fit and tighten the screws only after checking to see that the record indicator LEDs are correctly fitted in the holes on the amp panel and that the level meters are also fitted correctly in the amp panel holes. Take note that the conductive rubber washer should be fitted on the screw that secures the upper right side of the amp panel (see 4-1, 3 above).

4-3 TOP AND BOTTOM BOARDS

1. Remove the six black-painted screws (RS-3 X 6) that secure the top board.
2. To remove the bottom board, remove the four screws (RS-3 X 14) securing the two FOOT ASS'YS by turning them counterclockwise. Then remove the FOOT ASS'YS themselves.
3. With the FOOT ASS'YS dismounted, remove the screw (RS-3 X 8) securing the bottom board at its center by turning it counterclockwise, then remove the bottom board itself.
4. When mounting the top and bottom boards, take care not to confuse the screws securing the top board with those securing the bottom board; they are different in size and finish.

3-2 INNER PARTS

Front View



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35 Bracket, Brake (533-0082-00)
36 Guide, Brake Linkage (528-0009-00)
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39 Spring, Pressure (541-0010-01)
40 Arm, Pinch Roller Drive (525-0029-00)
41 Arm, Pinch Roller (525-0032-00)
42 Shaft, Pinch Roller (521-0025-05)
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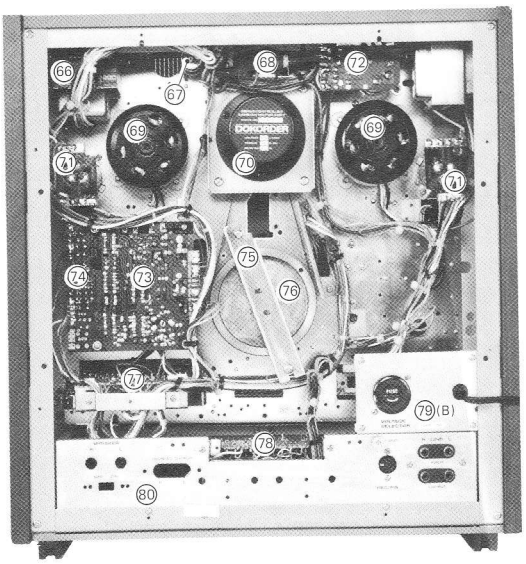
Back View



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5. ADJUSTMENT —MECHANICAL—

5-1 AUTO SHUT-OFF SWITCH

a. Specification
When the auto shut-off arm ① is pushed upward, the microswitch ② clicks (switches on) at the point of more than 8 mm (0.32 inch) outside of the tape travel position and clicks again (switches off) at the point of more than 14 mm (0.56 inch) outside of the tape travel position.

b. Adjustment
Adjust the mounting position of the microswitch ②.

c. Reference
Refer to Fig. 5-1 or section 2 on page M-12.

d. Special Tools and/or Instruments required
None

e. Preparation
Remove the head cover and front panel.

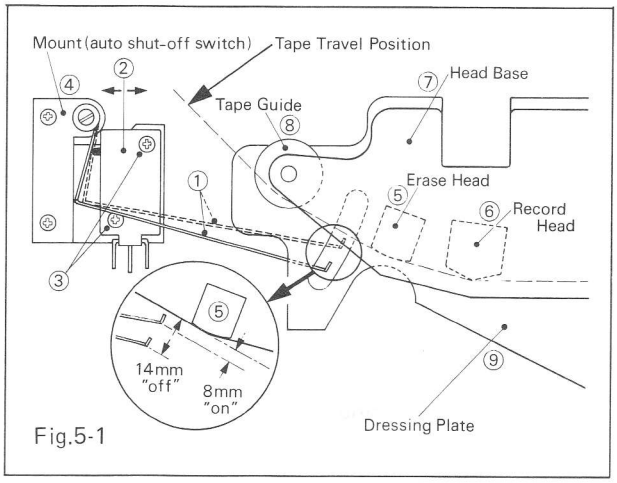


Fig.5-1

f. Procedure
(1) Check the on/off position of the microswitch by gently moving the auto shut-off arm by hand.
(2) If the on/off position does not meet the spec, adjust the position of the microswitch by loosening two mount screws ③.

g. Note
(1) Replace the dismounted parts and check again that the auto shut-off arm moves freely through the hole in the front panel and does not come into contact with head cover.
(2) Load the tape and set the deck in play mode and check if the tape travels normally. Then take up the tape completely by setting the deck in FF or REW mode, checking that the auto shut-off arm returns to shut off the tape travel automatically at the tape end.

5-2 PINCH ROLLER DRIVE MECHANISM

2-1 STROKE ADJUSTMENT OF THE PINCH ROLLER PRESSURE SOLENOID

a. Specification
Stroke of plunger 4 ~ 4.5 mm (0.16 ~ 0.18 inch).

b. Adjustment
Adjust the stroke adjusting nut ③.

c. Reference
Refer to Fig. 5-2 or section 2 on page M-20.

d. Special Tools and/or Instruments required
A open end wrench (4 mm).

e. Preparation
Remove the front panel (including pinch roller and head cover).
Fix the auto shut-off arm ON by a piece of sticking tape.

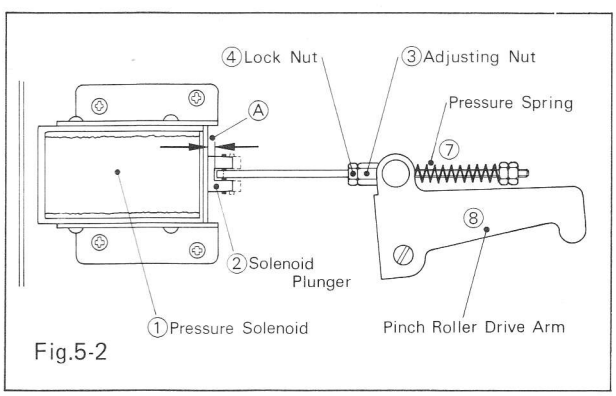


Fig.5-2

f. Procedure
(1) Push the play and stop buttons alternately several times, mark the position of the solenoid plunger ② as it pulls and returns.
(2) Adjust the nut ③ so that the operating stroke of the plunger (indicated as Ⓐ) is from 4 to 4.5 mm (0.16 ~ 0.18 inch).

g. Note
(1) Loosen the lock nut ④ first and then proceed with step f-(2).
(2) After the stroke has been adjusted, fix the nut ③ with the lock nut ④, then paint-lock it.

2-2 PINCH ROLLER PRESSURE

a. Specification
1.5 kg ±0.1 kg
b. Adjustment
Adjust the pressure adjusting nut ⑥.
c. Reference
Refer to Fig. 5-3 or section 2 on page M-20.
d. Special Tools and/or Instruments required
A open end wrench (4 mm) and spring balance (4 kg).
e. Preparation
Remove the front panel (including pinch roller and head cover).
Fix the auto shut-off arm ON by a piece of sticking tape.
f. Procedure
(1) Read the pressure indicated on the spring balance when the pinch roller loses contact with the capstan and the pinch roller stops revolving.
(2) Adjust the pressing force of the pinch roller by turning the nut ⑤ and ⑥, if necessary.
g. Note
(1) Use a precision spring balance with a scale of up to 4 kg graduated in steps of 50 g or less.
(2) Loosen lock nut first before attempting step f-(2).
(3) Fix the adjusting nut ⑥ with the lock nut ⑤ and then paint-lock it.

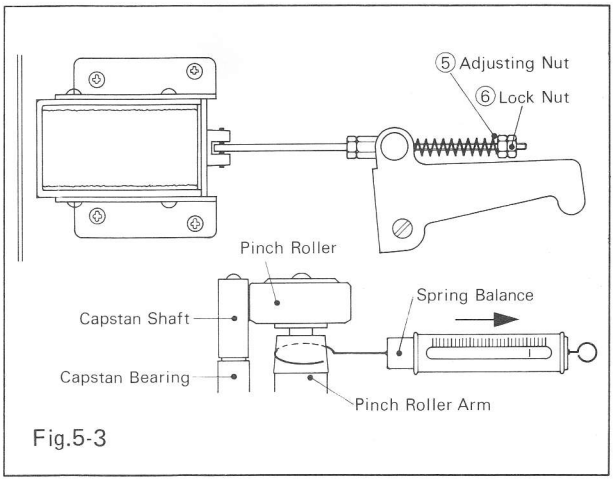


Fig.5-3

5-3 REEL MOTOR TORQUES

a. Specification
Hold-back Tension 85 gr ±10 gr (255 ±30 g. cm)
Take-up Torque 150 gr (450 g. cm)
b. Adjustment
Adjust the wirewound resistor R-2 (150 ohm) for the hold-back tension.
c. Reference
Refer to Fig. 5-4, 5-5 or section 2 on page M-22.
d. Special Tools and/or Instruments required
A spring balance (200 g) and 7-inch small-hub reel (6 cm in diameter).
e. Preparation
Remove the back and top boards.
Fix the auto shut-off arm ON by a piece of sticking tape.
f. Procedure
f-1. Hold-back tension (Playback)
(1) Mount the 7-inch reel on the left turntable with a piece of string attached to it, as shown in Fig. 5-5 (A).
(2) Set the deck in play mode and pull the spring balance gently in the direction indicated by the arrow in Fig. 5-5 (A) and read the indicated figures on the spring balance.
(3) Loosen lock screw ② securing the slide ring ① on the R-2 in Fig. 5-4 and adjust the position of the slide ring so that the spring balance indicates 85 g ±10 g (255 g. cm ±30).
f-2. Take-up torque (Playback)
(1) Mount the 7-inch reel on the right turntable with a piece of string attached to it, as shown in Fig. 5-5 (B).

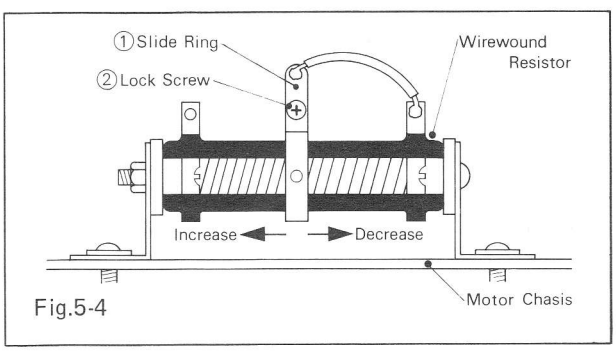


Fig.5-4

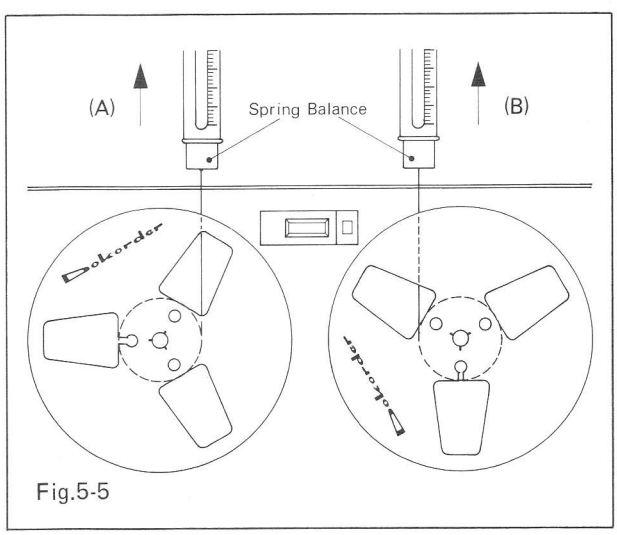


Fig.5-5

(2) Set the deck in play mode and pull the spring balance gently in the direction indicated by the arrow in Fig. 5-5 (B) and check that the take-up torque is nearly 150 g (450 g. cm).

g. Note

(1) The hold-back tension in both the FF and REW modes are determined by a fixed wire-wound resistor; therefore, there is no need to adjust, but do check that the hold-back tension is 90 g. cm.

(2) When the adjustment has been completed, paint-lock the lock screw ②.

5-4 BRAKE MECHANISM

4-1 BRAKE BAND

a. Specification

1 ~ 1.5 mm (0.04 ~ 0.06 inch) space between the brake drum ⑥ and the brake band ④.

b. Adjustment

Adjust the set position of the bracket ②.

c. Reference

Refer to Fig. 5-6 or section 2 on page M-16.

d. Special Tools and/or Instruments required

None

e. Preparation

Remove the front panel (including pinch roller and head cover).

Fix the auto shut-off arm ON by a piece of sticking tape.

f. Procedure

(1) Push the play and stop buttons alternately several times and check the movement of the brake band ④.

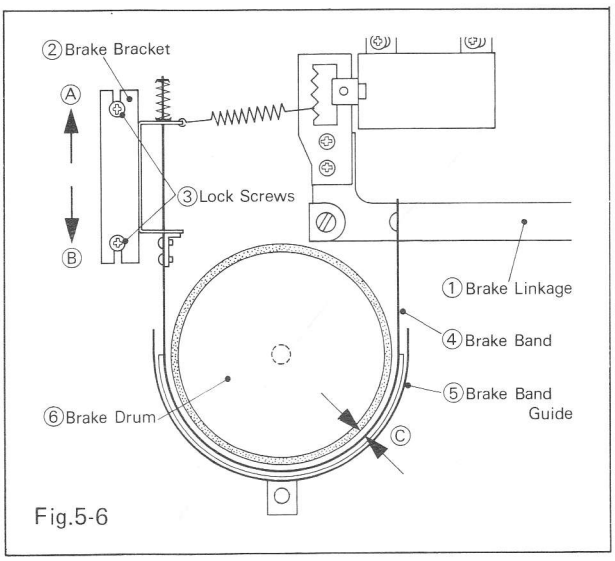


Fig.5-6

(2) Push the play button once again and loosen the two lock screws ③ securing the bracket ② so that the space between the brake band ④ and the brake drum ⑥ will be from 1 to 1.5 mm (0.04 ~ 0.06 inch). (Moving the bracket in the direction of arrow Ⓐ will increases the space Ⓒ)

(3) Keeping the tape deck in the stop mode, push the brake linkage ① downward by hand, check that the brake band ④ contacts the inside of the brake band guide ⑤ uniformly and that the space between the brake drum ⑥ and the brake band ④ is also uniform.

g. Note

When the adjustment has been completed, paint-lock the two lock screws ③.

4-2 STROKE OF BRAKE SOLENOID

a. Specification

Stroke of plunger 1 ~ 1.5 mm (0.04 ~ 0.06 inch).

b. Adjustment

Adjust the set position of the brake solenoid ①.

c. Reference

Refer to Fig. 5-7 or section 2 on page M-16.

d. Special Tools and/or Instruments required

None

e. Preparation

Remove the front panel (including pinch roller and head cover).

Fix the auto shut-off arm ON by a piece of sticking tape.

f. Procedure

(1) Push the play and stop buttons alternately and check the stroke of the brake solenoid plunger ② (indicated Ⓒ in Fig. 5-7).

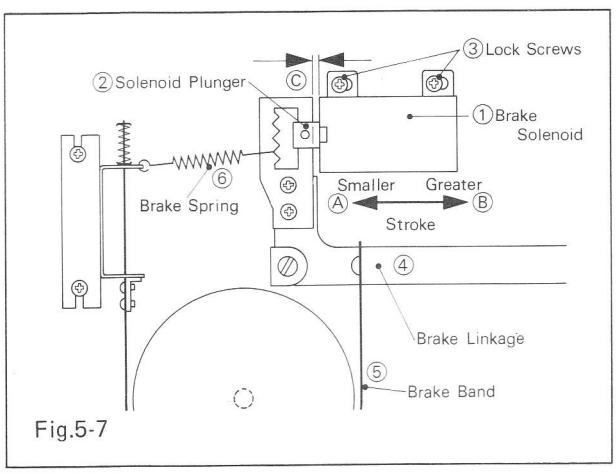


Fig.5-7

(2) Loosen two lock screws ③ and adjust the position of the solenoid ① so that the operating stroke of

the solenoid plunger ② will be from 1 to 1.5 mm (0.04 ~ 0.06 inch).

g. Note
After the stroke has been adjusted, paint-lock the two lock screws ③.

4-3 STROKE OF BRAKE LINKAGE STOPPER

a. Specification
1 mm (0.04 inch) space between the rubber damper ② and the brake linkage ①.

b. Adjustment
Adjust the set position of the brake linkage stoppers ④.

c. Reference
Refer to Fig. 5-8 or section 2 on page M-16.

d. Special Tools and/or Instruments required
A thickness gauge.

e. Preparation
Remove the front panel (including pinch roller and head cover).
Fix the auto shut-off arm ON by a piece of sticking tape.

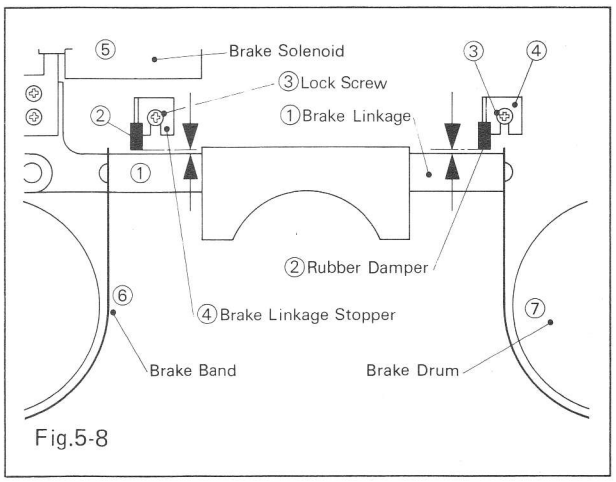


Fig.5-8

f. Procedure
(1) Push the play and stop buttons alternately and check that the brake linkage ① moves up and down properly.
(2) Push the play button once again, loosen the two lock screws ③ and adjust the position of the brake linkage guides so that the space between the rubber damper ② and the brake linkage ① may be 1 mm (0.04 inch).

g. Note
After the adjustment has been completed, paint-lock the two lock screws ③.

4-4 BRAKE TORQUE

a. Specification
600 ~ 800 g (1.8 ~ 2.4 kg. cm)

b. Adjustment
Adjust the brake linkage stoppers ④.

c. Reference
Refer to Fig. 5-5 on page 7.

d. Special Tools and/or Instruments required
A spring balance (1 kg) and 7-inch small-hub reel (6 cm in diameter).

e. Preparation
Remove the front panel (including pinch roller and head cover).
Fix the auto shut-off arm ON by a piece of sticking tape.

f. Procedure
(1) Mount the 7-inch reel on the left turntable with a piece of string to it, as shown in Fig. 5-5 (A).
(2) Push the stop button, hook a spring balance to the string attached above reel, pull the balance gently in the direction indicated by the arrow in Fig. 5-5 (A), and read the pressure indicated by the balance when the left turntable begins to turn.
(3) The reading (brake torque) on the spring balance should indicate pressure from 600 to 800 g as a brake torque (1.8 ~ 2.4 kg. cm).
(4) Repeat the steps (2) and (3) for the right turntable. If you discover a considerable difference between the brake torques for the left and right turntable, refer to adjustment chart.

When Torque is Greater than 800 grams	Refer to Fig. 5-8 in 4-3 "STROKE OF BRAKE LINKAGE STOPPER" and set the distance between the rubber damper ② and the brake linkage ① to less than 1 mm (0.04 inch).
Less than 600 grams	Refer to Fig. 5-8 in 4-3 "STROKE OF BRAKE LINKAGE STOPPER" and set the distance between the rubber damper ② and the brake linkage ① to more than 1 mm (0.04 inch).

5-5 TAPE SPEED

a. Specification
19 cm/sec (7-1/2 ips) ±1.5% (2955 ~ 3045 Hz by 3 KHz test tape).
9.5 cm/sec (3-3/4 ips) ±1.5% (2955 ~ 3045 Hz by 3 KHz test tape).

b. Adjustment
Adjust the semi-fixed resistor VR-901 on the C.P.M. control PC Board Ass'y.

c. Reference
Refer to Fig. 5-9.

d. Special Tools and/or Instruments required
Test tape DTT-5114 (19 cm/sec), DTT-3114 (9.5 cm/sec) or equivalents and frequency counter.

e. Preparation
Remove the back board.

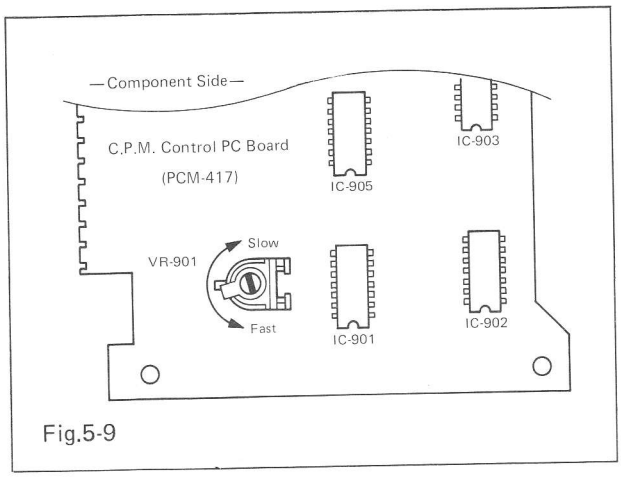


Fig.5-9

f. Procedure
(1) Set to the tape speed switch to the 19 cm/sec (7-1/2 ips) position, then connect the frequency counter to the line output jack.
(2) After the above connection are completed, load the test tape (DTT-5114) on the deck and push the play button to enter the playback mode.
(3) Adjust the semi-fixed resistor VR-901 on the C.P.M. control PC Board (PCM-417), so that the frequency counter reading may be 2955 to 3045 Hz.
(4) Change the tape speed switch to the 9.5 cm/sec (3-3/4 ips) position, then check that the line output signal frequency is 2955 to 3045 Hz.

g. Note
Before starting the adjustment, wipe clean the pinch roller, tape guide and all other parts that touch the tape, and also check if the pinch roller pressure and wow are within specifications.

5-6 WOW/FLUTTER

a. Specification
19 cm/sec (7-1/2 ips) 0.13% RMS
9.5 cm/sec (3-3/4 ips) 0.20% RMS

b. Adjustment
Adjust the motor torque, pinch pressure, alignment of tape path.

c. Reference
Refer to 5-1, 5-2, 5-3, 5-4 and 5-5 described above for mechanical adjustment.

d. Special Tools and/or Instruments required
Test tape DTT-5114 (19 cm/sec), DTT-3114 (9.5 cm/sec) or its equivalents, wow/flutter meter, frequency counter and tools described in the mechanical adjustment above.

e. Preparation
Remove the head cover and clean the heads, pinch roller, tape guide and all other parts that touch the tape.

f. Procedure
(1) Deterioration of wow/flutter may be avoided by attending to the following problems:
1. Parts along the tape path (the pinch roller, heads, tape guides, capstan shaft) may be stained with oxide particles, etc., scraped from tape surfaces.
2. Reel-motor torque, pinch roller pressure and tape path alignment may be needed.
3. Capstan drive assembly (the capstan belt, flywheel, motor pulley) may be fouled.
4. Rotational parts (such as the pinch roller metal, pinch roller shaft, capstan bearing, capstan shaft and motor shaft) may need lubrication.
5. Tape drive mechanism (such as the reel motors, capstan motor, guides, counter mechanism and solenoids) may need replacement.
6. Other causes might include cases where lead cables running along the tape drive mechanism are worn by friction, or where the disengaging action of the brake mechanism is faulty.

(2) Adjustments should be undertaken in the most efficient manner, as suggested below:

1. Use test tapes and measuring apparatus that are new (if possible) and well calibrated.
2. Check first that the tape transport mechanism is in order.
3. Carefully clean off accumulated tape particles.
   a) Inspect, clean and lubricate the pinch roller's metal parts, pinch roller shaft, capstan shaft, capstan bearing, etc.
   b) Clean the belts, flywheel, motor pulley, etc., and check for rubbing parts or marred surfaces.
4. Measure the wow; if it exceeds the specification, measure and adjust the reel motor torque.
5. In most cases, the measured wow/flutter should meet the specification by the time you reach the 3rd or 4th step above. If not, a faulty pinch roller, capstan or belt may be the cause, and replacement is called for.

   Usually replacement of a motor should not be considered; should the motor be suspect, first apply oil to its shaft and keep it running for two or three hours, and check it again. Inspecting the reel motor capacitor may also reveal the solution.

6. ADJUSTMENT —ELECTRICAL—

PRECAUTION

1. Before actually adjusting the parts, be sure to first clean the heads, pinch roller and other tape-scraping parts as well as the belts, idlers and other tape-drive torque transmission parts with alcohol. Lubricate, too, if necessary. Such procedures may bring back the performance to within tolerable specifications, eliminating any need for part replacements or torque re-adjustments.
   The position of the thrust stopper, if improperly set, may deteriorate the wow/flutter. So it is advisable to remove the belt and then turn the flywheel with your fingers to see if it turns smoothly.
2. For an efficient adjustment of record/playback level and frequency response, follow the order of preferences for the different adjusting procedures. For instance, if you adjust the record level before adjusting the playback level or without checking it, you'll have to re-adjust the record level same after you have adjusted the playback level.
3. When adjusting the overall response, it may sometimes become necessary to fine-adjust the previously-adjusted parts. In such a case, make sure that the fine-adjustments are still within tolerable ratings, before proceeding to the next step.
4. No two tapes, even if of the same brand and type, show identical recording responses, especially in the high-frequency range. Thus if you switch tapes during adjustments, you may have to re-adjust the parts you have already adjusted. If you are using a tape for the first time, it's often advisable to check its response beforehand, to know how different it is in response from the previous tape.

NOTES

The procedures in this section apply to the amplifier circuits of the Model 7700.
In adjusting the amplifier circuits following the instructions in this section, the tapes belowlisted should be used.

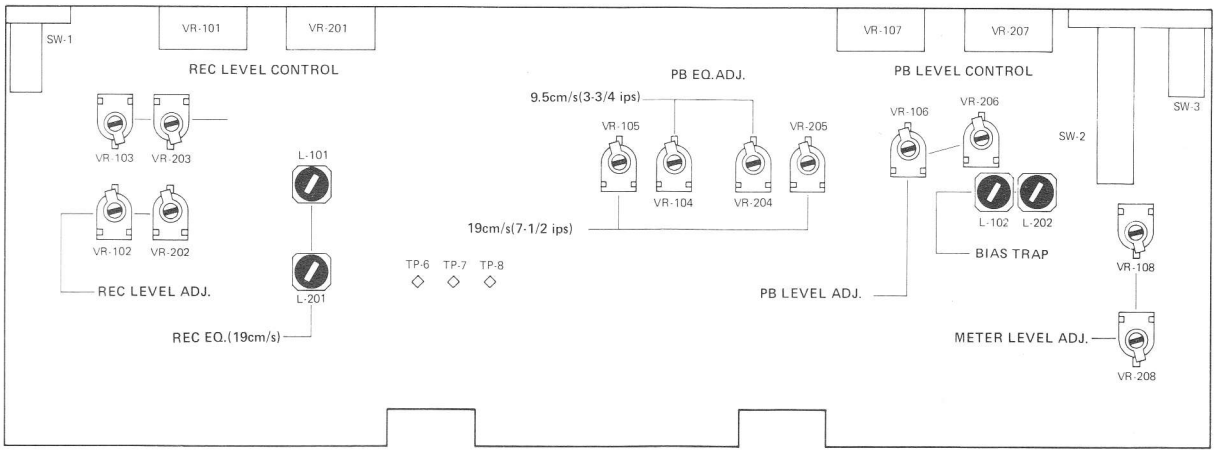
1. When adjusting the playback circuits:
   19 cm/sec (7-1/2 ips)
   DTT-5106 (700 Hz −10 dB) or equivalents (Adjustment of Playback Level & Frequency Response)
   DTT-5113 (15 KHz −10 dB) or equivalents (Adjustment of Head Azimuth & Playback Frequency Response)
   DTT-5102 (50 Hz −10 dB) or equivalents (Adjustment of Playback Frequency Response)
   9.5 cm/sec (3-3/4 ips)
   DTT-3106 (500 Hz −10 dB) or equivalents (Adjustment of Playback Frequency Response)
   DTT-3110 (7.5 KHz −10 dB) or equivalents (Adjustment of Playback Frequency Response)
   DTT-3102 (50 Hz −10 dB) or equivalents (Adjustment of Playback Frequency Response)
   (Or other types of alignment tape with the levels as are recorded on the above tapes.)
2. When adjusting the record circuits:
   Since with the Model 7700 the record bias and the record equalizer can be used independently of each other, there are several types of tape to be used, for adjustment such as those listed below. For adjustment of record frequency response, the Scotch #212 and Maxell UD-35.

ADJUSTMENT TAPE (Recording)

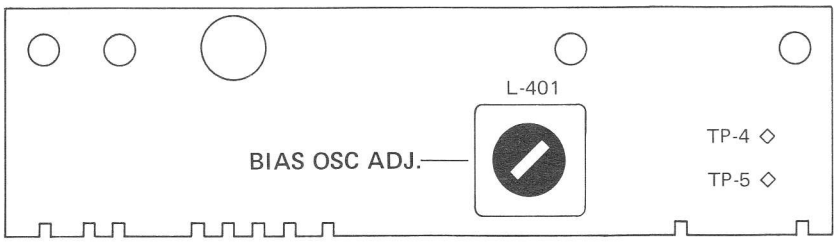
Tape Select Mode / Equalizer Switch	Adjustment Tape
NORMAL	Scotch 212 or equivalents
SPECIAL	Maxell UD-35 or equivalents

For the location of parts for adjustment on each of the amplifier circuit PC board (PCM-446), refer to the section "ADJUSTABLE PARTS LOCATION."

AMP P.C.B. (PCM-446A)



BIAS OSC P.C.B. (PCM-413B)



REC & PAUSE P.C.B. (PCM-397B)

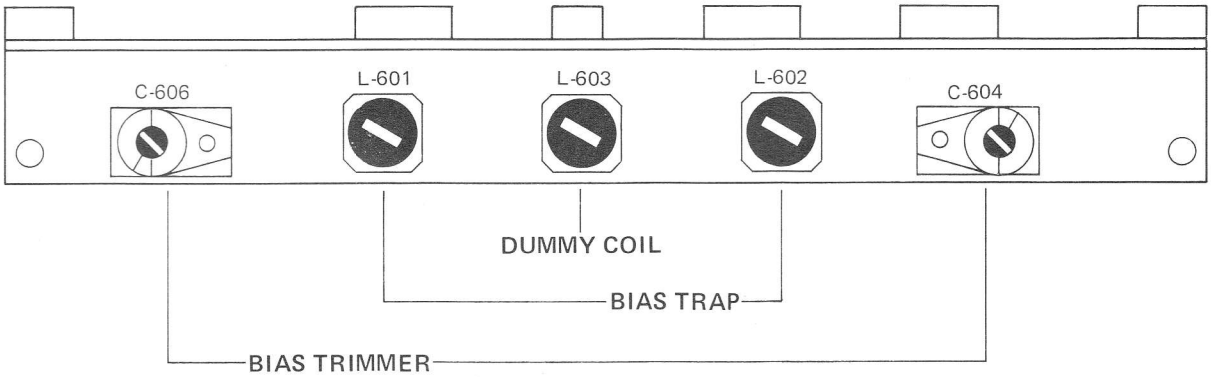


Fig.6-1

2-1 HEAD AZIMUTH (P.B. Head)

a. Specification
Max. output level under the signal in-phase condition.
b. Adjustment
Adjust the azimuth screw.
c. Reference
Refer to Fig. 6-2, Fig. 6-5 or section 2 on page M-20.
d. Test tape, special tools and instruments required
DTT-5113 (15 KHz −10 dB) or equivalents, VTVM and oscilloscope.
e. Test point
Connect the VTVM and oscilloscope to the line output jacks.

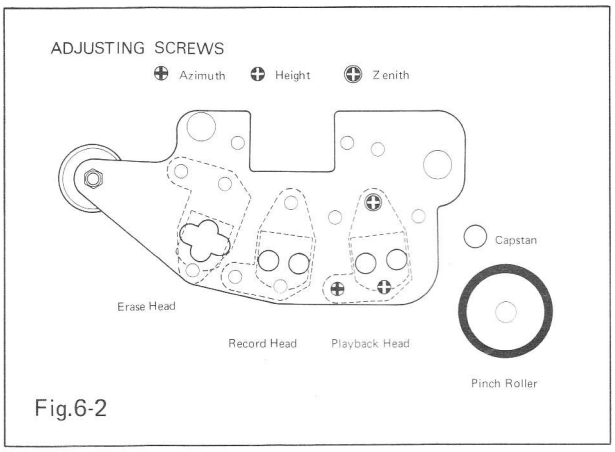


Fig.6-2

f. Mode of switch
(1) Tape speed SW-19 cm/s (button out), Monitor SW-TAPE (button out).
(2) Playback level controls-MAX, Record level controls-MIN.
g. Procedure
(1) After the above connections are completed, load the test tape (DTT-5113) on the deck and push the play button to enter the playback mode.
(2) Adjust the head azimuth by turning azimuth screw, so that the line output level becomes maximum and phase shift between both channels becomes minimum by observing the lissajous figure on the oscilloscope as shown Fig. 6-5 on page 20.
(3) When the azimuth adjustment is completed, paint-lock the azimuth screw.
h. Note
Since head azimuth is already adjusted before the deck leaves our Dokorder factory, normally azimuth adjustment is unnecessary; it is necessary only when heads are replaced.

2-2 PLAYBACK LEVEL

a. Specification
−10 dB ±0.5 dB of the line output jacks.
b. Adjustment
Adjust the semi-fixed resistors VR-106 (L-ch) and VR-206 (R-ch).
c. Reference
Refer to Fig. 6-1.
d. Test tape, special tools and instruments required
DTT-5106 (700 Hz −10 dB) or equivalents and VTVM.
e. Test point
Connect the VTVM to the line output jacks.
f. Mode of switch
(1) Tape speed SW-19 cm/s, Monitor SW-TAPE.
(2) P.B. level controls-MAX, Record level controls-MIN.
g. Procedure
(1) After the above connection is completed, load the test tape (DTT-5106) on the deck and push the play button to enter the playback mode.
(2) Adjust the semi-fixed resistors VR-106 and VR-206 on the AMP PC Board (PCM-446), so that the line output levels of the deck are −10 dB ±0.5 dB on the VTVM.

2-3 PLAYBACK FREQUENCY RESPONSE (19 cm/s & 9.5 cm/s)

a. Specification
   −10 dB ±1.0 dB (15 KHz, 19 cm/s), −10 dB $^{+3}_{-5}$ dB (50 Hz, 19 cm/s)
   −10 dB ±1.0 dB (7.5 KHz, 9.5 cm/s), −10 dB ±3 dB (50 Hz, 9.5 cm/s)
b. Adjustment
   (1) Adjust the semi-fixed resistors VR-105 and VR-205 (19 cm/s).
   (2) Adjust the semi-fixed resistors VR-104 and VR-204 (9.5 cm/s).
c. Reference
   Refer to Fig. 6-1.
d. Test tape, special tools and instruments required
   DTT-5106 (700 Hz −10 dB), DTT-5113 (15 KHz −10 dB), DTT-5102 (50 Hz −10 dB), DTT-3106 (500 Hz −10 dB), DTT-3110 (7.5 KHz −10 dB), DTT-3102 (50 Hz −10 dB) or equivalents, and VTVM.
e. Test point
   Connect the VTVM to the line output jacks.
f. Mode of switch
   (1) Tape speed SW-19 cm/s, Monitor SW-TAPE.
   (2) P.B. level controls-MAX, Record level controls-MIN.
g. Procedure
   (1) After the above connection is completed, load the test tape (DTT-5113) on the deck and push the play button to enter the playback mode.
   (2) Adjust the semi-fixed resistors VR-105 and VR-205 on the AMP PC Board (PCM-446), so that the line output levels may be −10 dB ±1.0 dB in reference to the level (700 Hz −10 dB).
   (3) When the step (2) is completed, play the test tape (DTT-5102) and check the output level is within the range of −10 dB +3 dB −5 dB in reference to the level (700 Hz −10 dB).
   (4) Change the tape speed switch to the 9.5 cm/s position, then play the test tape (DTT-3110) and adjust the semi-fixed resistors VR-104 and VR-204 on the AMP PC Board, so that the line output levels may be −10 dB ±1.0 dB in reference to the level (500 Hz −10 dB).
   (5) When the step (4) is completed, play the test tape (DTT-3102) and check the output level is within the range of −10 dB ±3 dB in reference to the level (500 Hz −10 dB).

2-4 SOURCE MONITOR LEVEL

a. Specification
   0 dB ±0.5 dB of the line output jacks.
b. Adjustment
   Adjust the semi-fixed resistors VR-103 and VR-203.
c. Reference
   Refer to Fig. 6-1.
d. Test tape, special tools and instruments required
   Signal generator and VTVM.
e. Test point
   Connect the VTVM to the line output jacks.
f. Mode of switch
   (1) Monitor SW-SOURCE (button in).
   (2) P.B. level controls-MAX, Record level controls-MAX.
g. Procedure
   (1) Connect the signal generator to the line input jacks, and apply a 700 Hz signal of −20 dB to the line inputs.
   (2) After the above connection is completed, adjust the semi-fixed resistors VR-103 and VR-203 on the AMP PC Board (PCM-446), so that the line output level may be 0 dB ±0.5 dB on the VTVM.

2-5 LEVEL METER CALIBRATION

a. Specification
0 dB of the level meter scale.
b. Adjustment
Adjust the semi-fixed resistors VR-108 and VR-208.
c. Reference
Refer to Fig. 6-1.
d. Test tape, special tools and instruments required
Signal generator and VTVM.
e. Test point
Connect the VTVM to the line output jacks.
f. Mode of switch
(1) Monitor SW-SOURCE.
(2) P.B. level controls-MAX, Record level controls-MAX.
g. Procedure
(1) Connect the signal generator to the line input jacks, and apply a 700 Hz signal of −20 dB to the line inputs.
(2) After the above connection is completed, adjust the semi-fixed resistors VR-108 and VR-208 on the AMP PC Board (PCM-446), so that, when the line output level is 0 dB ±0.5 dB, the level meter may indicate 0 dB.
h. Note
Since the level meter may give an incorrect reading when the tape deck is placed horizontally or in a slanted position, be sure to undertake the adjustment with the tape deck placed vertically.

2-6 BIAS FREQUENCY

a. Specification
130 KHz ±1 KHz
b. Adjustment
Adjust the oscillator coil L-401 (1139).
c. Reference
Refer to Fig. 6-1.
d. Test tape, special tools and instruments required
Frequency counter
e. Test point
Connect the frequency counter across the test points TP-4 and TP-5.
f. Mode of switch
(1) Record SW-ON (button in).
(2) P.B. level controls-MIN, Record level controls-MIN.
g. Procedure
(1) After the above connection is completed, load the blank tape on the deck and push the record button and play button simultaneously to enter the record mode, then push the pause button to stop tape travel.
(2) Adjust the bias oscillator coil L-401 on the Bias PC Board (PCM-413), so that the bias oscillator frequency may be 130 KHz ±1 KHz.
h. Note
Connect the ⊕ lead of the frequency counter to the test point TP-4, and its ⊖ lead to the test point TP-5.

2-7 BIAS TRAP (REC. Amp)

a. Specification
   Minimum.
b. Adjustment
   Adjust the bias trap coils L-601 (L-ch) and L-602 (R-ch).
c. Reference
   Refer to Fig. 6-1.
d. Test tape, special tools and instruments required
   Blank tape and VTVM.
e. Test point
   Connect the VTVM across the test points TP-7 & TP-6, and also across TP-8 & TP-6 on the AMP PC Board.
f. Mode of switch
   (1) Record SW-ON
   (2) P.B. level controls-MIN, Record level controls-MIN.
g. Procedure
   (1) After the above connection is completed, load the blank tape on the deck and push the record button and play button simultaneously to enter the record mode, then push the pause button to stop the tape travel.
   (2) Adjust the bias trap coils L-601 and L-602 on the REC switch PC Board (PCM-397), so that the bias leakage may be minimum by reading on the VTVM.

2-8 BIAS TRAP 2 (P.B. Amp)

a. Specification
   Less than −30 dB
b. Adjustment
   Adjust the bias trap coils L-102 and L-202.
c. Reference
   Refer to Fig. 6-1.
d. Test tape, special tools and instruments required
   Blank tape and VTVM.
e. Test point
   Connect the VTVM to the line output jacks.
f. Mode of switch
   (1) Monitor SW-TAPE, Record SW-ON.
   (2) P.B. level controls-MAX, Record level controls-MIN.
g. Procedure
   (1) After the above connection is completed, load the blank tape on the deck and push the record button and play button simultaneously to enter the record mode, then push the pause button to stop the tape travel.
   (2) Adjust the bias trap coils L-102 and L-202 on the AMP PC Board (PCM-446), so that the bias leakage may be less than −30 dB on the VTVM.
   (3) Change the record switch over to OFF position and check that the bias leakage is less than −30 dB.

2-9 BIAS SETTING & RECORDING LEVEL

a. Specification
   +0.3 dB (Over bias)
   0 dB (Recording level)
b. Adjustment
   (1) Adjust the bias trimmer capacitors C-604 (L-ch) and C-606 (R-ch).
   (2) Adjust the semi-fixed resistors VR-102 (L-ch) and VR-202 (R-ch).
c. Reference
   Refer to Fig. 6-1.

d. Test tape, special tools and instruments required
Blank tape (Scotch #212), oscilloscope, signal generator and VTVM.
e. Test point
Connect the VTVM and oscilloscope to the line output jacks.
f. Mode of switch
(1) Tape speed SW-19 cm/s, Monitor SW-TAPE, Equalizer SW-NORMAL (button out), Record SW-ON.
(2) P.B. level controls-MAX, Record level controls-MAX.
g. Procedure
(1) Connect the signal generator to the line input jacks, and apply a 700 Hz signal of −20 dB to the line inputs.
(2) After the above connections are completed, load the blank tape (Scotch #212) on the deck and push the record button and play button simultaneously to enter the record mode.
(3) Adjust the trimmer capacitors C-604 and C-606 on the REC switch PC Board (PCM-397), so that the bias may be overbiased at +0.3 dB.
(4) Then adjust the semi-fixed resistors for recording level adjustment VR-102 and VR-202 on the AMP PC Board (PCM-446), so that the line output level may be 0 dB.

2-10 HEAD AZIMUTH (REC. Head)

a. Specification
Max. and phase shift less than 45°.
b. Adjustment
Adjust the azimuth screw.
c. Reference
Refer to Fig. 6-3, Fig. 6-5 or section 2 on page M-20.
d. Test tape, special tools and instruments required
Blank tape (Scotch #212), oscilloscope, signal generator and VTVM.
e. Test point
Connect the VTVM and oscilloscope to the line output jacks.
f. Mode of switch
(1) Tape speed SW-19 cm/s, Monitor SW-TAPE, Equalizer SW-NORMAL, Record SW-ON.
(2) P.B. level controls-MAX, Record level controls-MAX.

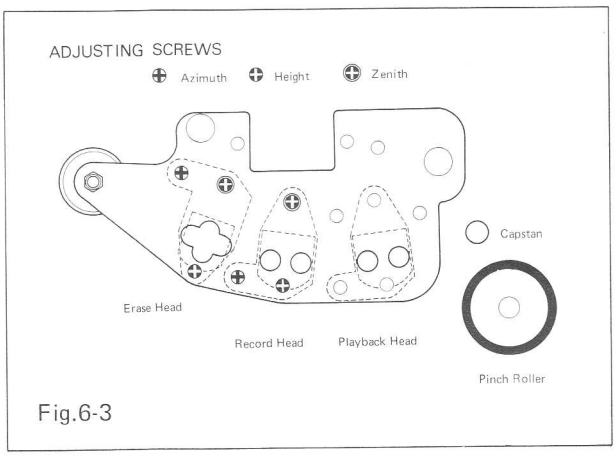


Fig.6-3

g. Procedure
(1) Connect the signal generator to the line input jacks, and apply a 20 KHz signal of −30 dB to the line inputs.
(2) After the above connections are completed, load the blank tape (Scotch #212) on the deck and push the record button and play button simultaneously to enter the record mode.
(3) Adjust the head azimuth by turning azimuth screw, so that the line output level becomes maximum and phase shift is less than 45° by observing the lissajous figure on the oscilloscope as shown Fig. 6-5 on page 20.
(4) When the azimuth adjustment is completed, paint-lock the azimuth screw.
h. Note
Since head azimuth is already adjusted before the deck leaves our Dokorder factory, normally azimuth adjustment is unnecessary; it is necessary only when heads are replaced.

2-11 OVERALL FREQUENCY RESPONSE (9.5 cm/s)

a. Specification
500 Hz 0 dB (−10 dB), 10 KHz ±2 dB, 35 Hz ±3 dB
b. Adjustment
Adjust the trimmer capacitors C-604 and C-606.
c. Reference
Refer to Fig. 6-1.
d. Test tape, special tools and instruments required
Blank tape (Scotch #212, Maxell #UD-35), signal generator and VTVM.
e. Test point
Connect the VTVM and oscilloscope to the line output jacks.
f. Mode of switch
(1) Tape speed SW-9.5 cm/s (button in), Monitor SW-TAPE, Equalizer SW-NORMAL, Record SW-ON.
(2) P.B. level controls-MAX, Record level controls-MAX.
g. Procedure
(1) Connect the signal generator to the line input jacks, and apply a 500 Hz signal of −30 dB to the line inputs.
(2) After above connections are completed, load the blank tape (Scotch #212) on the deck and push the record button and play button simultaneously to enter the record mode.
(3) Adjust the trimmer capacitors C-604 and C-606 on the REC switch PC Board (PCM-397) by sweeping the frequency, so that the line output level of the frequencies between 500 Hz and 10 KHz is in the range of −10 dB ±2 dB. And check that the line output level of the frequencies between 500 Hz and 35 Hz is in the range of −10 dB ±3 dB.
(4) Change the equalizer switch to SPECIAL (button in) position and load the blank tape (Maxell #UD-35) on the deck. Then enter the record mode to check frequency response for special tape.
(5) Check that the line output level of the frequencies between 500 Hz and 10 KHz is in the range of ±3 dB in reference to the level (500 Hz ~ 10 KHz −10 dB ±2 dB) and also that the line output level of the frequencies between 500 Hz and 35 Hz is in the range of ±3 dB in reference to the level (500 Hz ~ 35 Hz −10 dB ±3 dB).

2-12 OVERALL FREQUENCY RESPONSE (19 cm/s)

a. Specification
700 Hz 0 dB (−10 dB), 21 KHz ±2 dB, 30 Hz ±3 dB
b. Adjustment
Adjust the peaking coils L-101 and L-201.
c. Reference
Refer to Fig. 6-1.
d. Test tape, special tools and instruments required
Blank tape (Scotch #212, Maxell #UD-35), signal generator and VTVM.
e. Test point
Connect the VTVM and oscilloscope to the line output jacks.
f. Mode of switch
(1) Tape speed SW-19 cm/s, Monitor SW-TAPE, Equalizer SW-NORMAL, Record SW-ON.
(2) P.B. level controls-MAX, Record level controls-MAX.
g. Procedure
(1) Connect the signal generator to the line input jacks, and apply a 700 Hz signal of −30 dB to the line inputs.
(2) After the above connections are completed, load the blank tape (Scotch #212) on the deck and push the record button and play button simultaneously to enter the record mode.
(3) Adjust the peaking coils L-101 and L-201 on the AMP PC Board (PCM-446) by sweeping the frequency, so that the line output level of the frequencies between 700 Hz and 21 KHz is in the range of −10 dB ±2 dB. And check that the line output level of the frequencies between 700 Hz and 30 Hz is in the range of −10 dB ±3 dB.
(4) Change the equalizer switch to SPECIAL (button in) position and load the blank tape (Maxell #UD-35)

on the deck. Then enter the record mode to check frequency response for special tape.

(5) Check that the line output level of the frequencies between 700 Hz and 21 KHz is in the range of ±3 dB in reference to the level (700 Hz ~ 21 KHz −10 dB ±2 dB) and also that the line output level of the frequencies between 700 Hz and 30 Hz is in the range of ±3 dB in reference to the level (700 Hz ~ 30 Hz −10 dB ±3 dB).

2-13 DUMMY COIL

a. Specification
−10 dB ±3 dB (20 KHz)

b. Adjustment
Adjust the dummy coil L-603.

c. Reference
Refer to Fig. 6-1.

d. Test tape, special tools and instruments required
Blank tape (Scotch #212), oscilloscope, signal generator and VTVM.

e. Test point
Connect the VTVM and oscilloscope to the line output jacks.

f. Mode of switch
(1) Tape speed SW-19 cm/s, Monitor SW-TAPE, Equalizer SW-NORMAL, Record SW-ON.
(2) P.B. level controls-MAX, Record level controls-MAX.

g. Procedure
(1) Connect the signal generator to the line input jacks, and apply a 700 Hz signal of −30 dB to the line inputs.
(2) After the above connections are completed, load the blank tape (Scotch #212) on the deck and push the record and play buttons simultaneously to enter the record mode. By sweeping the frequency from 700 Hz to 20 KHz with the signal generator, check that the line output level is flat across the specified frequencies. Then set the frequency to 20 KHz.
(3) Set the left record switch OFF to record only in the right channel. Then record only in the left channel with the left record switch ON and the right record switch OFF. Adjust the dummy coil L-603 on the REC switch PC Board (PCM-397), so that the difference in line output levels between the left and right channel may be within −10 dB ±3 dB.

h. Note
Repeat step (3) several time until the difference in levels between the channels is within the specified range.

ADJUSTMENT PROCEDURES FOR AZIMUTH

Connect the test equipment as shown Fig.6-4. Adjust the Playback Head Azimuth Screw carefully so that the signals of Left and Right Channels are to be in phase. Then adjust Rec Head Azimuth Screw so that the phase shift is less than 45°. (Phase Shift Pattern as shown in Fig.6-5.)

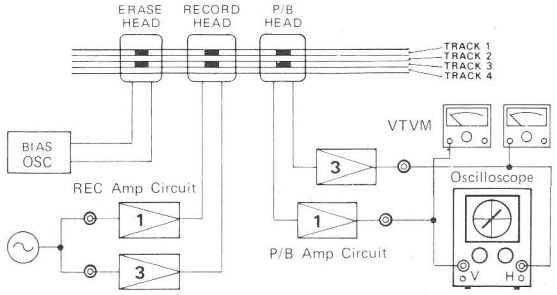


Fig.6-4 Connect the Test Equipment

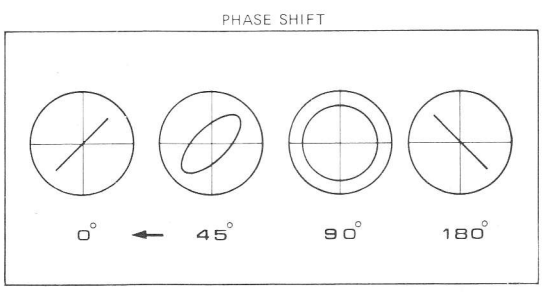


Fig.6-5 Lissajous Figure

7. MAINTENANCE

To maintain the deck's original performance, it is necessary to keep clean and well lubricated the rotating parts. Normally, motors, capstan, pinch roller, and other rotating parts require lubrication once every 1000 to 2000 hours. Therefore, once-a-year lubrication is all that is needed. However, dirt and dust accumulation, or extended use of the deck may result in a need for more frequent lubrication, even if oil was applied less than a year ago. So, be sure to check the rotating parts whenever you undertake repairs on the deck. Here's how to clean and lubricate each rotating part in the 7700.

7-1 CLEANING

a) Heads:
Clean the head surfaces by wiping them with a cotton or gauze swab stick moistened with cleaning liquid.
b) Pinch Roller:
Wipe the pinch roller gently where the tape scrapes, as well as its metal part, with alcohol-moistened lint cloth. Also wipe clean any residues on the pinch roller shaft. After cleaning, check very carefully that the rubber is not diformed or cracked.
c) Capstan:
Extract the shaft from the metal bearing and check it carefully for damage. Light scoring damage can be smoothened and cured with light emery paper and oil. Heavy damage, however, requires replacement of the shaft with flywheel. After checking and/or replacement, be sure to lubricate. Next, operate the deck in PLAYBACK moode for three to four hours, and then make sure the deck works well.
d) Belts & Pulleys:
Remove and clean the belts with an alcohol-moistened piece of cloth. Check for nicks and stretches. If defective, replace with new ones.
Dirt accumulates—much more than you can imagine—on the pulleys and flywheel where belts are in constant contact, so clean pulley and flywheel carefully. Dirt deteriorates the wow characteristic of the deck.

7-2 LUBRICATION

We suggest you lubricate parts only after running the deck for one hour or two, for by then the rotating parts will have warmed up enough to facilitate lubrication.
a) Motor:
Apply one or two drops of oil each to its motor bearing and motor shaft.
b) Pinch Roller:
Apply one drops of oil each to its bearing and shaft.
c) Capstan:
Apply one drop of oil to the capstan shaft, and one or two to the bearing hole.

NOTE: Should excessive oil flow from the bearing or oil orifice, be sure to wipe it perfectly clean. If left, it will eventually spread around, breaking down the mechanism. With a deck that is fresh from the factory, one drop or two of oil each to the bearings will suffice; you need not remove the pinch roller, capstan, etc.

7-3 DEMAGNETIZING

a) It is recommended to demagnetize the heads always before testing, adjusting or repairing the tape deck.
b) The heads tend to be magnetized with use over a period of time. If a recorded tape is played with a magnetized head, it may pick up noise. To avoid this, the heads should periodically cleaned (once every 50 hours of use minimum).
c) Follow the instructions below to use a head demagnetizer and demagnetize the heads.
   1. Remove the power cable from the AC outlet, and remove the head cover.
   2. Turn the head demagnetizer on, bring the tips of the demagnetizer close to the head surface (but do not actually touch the head surface), move them up and down over the head surface several times, and move the demagnetizer away from the head. Turn the demagnetizer power off when it is at least 12 inches away from the head. Repeat this process a few times to assure complete demagnetization.

8. TECHNICAL DESCRIPTION

8-1 SOLENOID DRIVE CIRCUIT

In Model 7700, a special voltage reduction circuit is used in the operating power supply for the pinch roller and brake solenoid which lowers the operating voltage required for normal operation of the solenoid to approximately one-half of the initial drive voltage. This circuit not only suppresses the heating of the solenoid coil effectively, but it also lowers the power consumption, ensuring the stability of the solenoid operation and a prolonged service life for the solenoid.

1-(A) Operation Principle

Before making reference to the actual circuit diagram, the principle of the voltage-reduction circuit will be explained below.

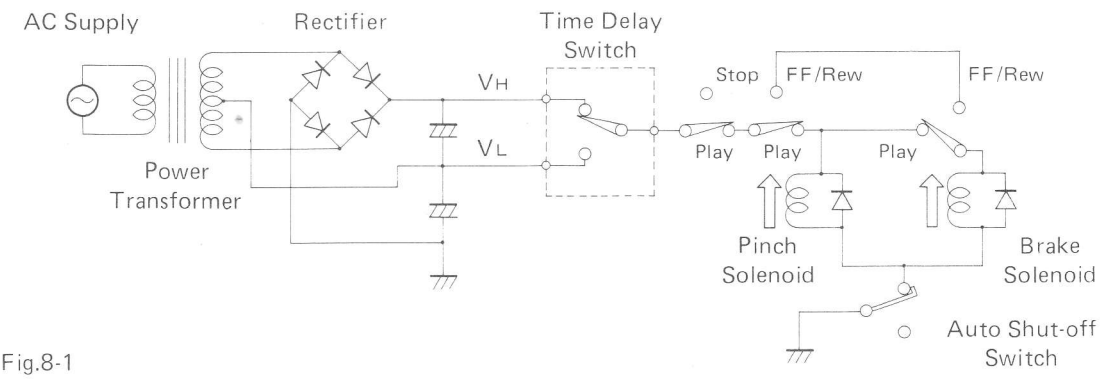
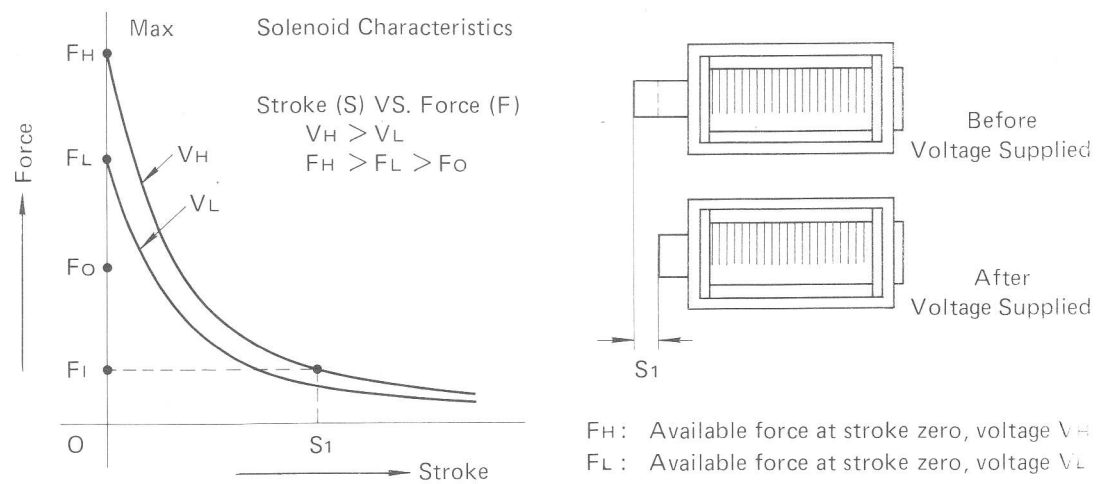


Fig.8-1

Fig. 8-1 shows a simplified circuit to illustrate the voltage-reduction operation. When all switches are in the PLAY mode, an initial drive voltage V_H (33 V) is supplied to the pinch roller solenoid and brake solenoid.

Then the pinch roller solenoid and brake solenoid draw, and pinch roller pressurizes the capstan and releasing the brake. Within 150 m sec. to 300 m sec., the Time Delay switch is automatically turned to the V_L (15 V) position so that the pinch roller solenoid and brake solenoid are both set to operate at a reduced voltage. This condition is then maintained throughout the PLAY mode.



FH : Available force at stroke zero, voltage VH
FL : Available force at stroke zero, voltage VL
FO : Required force at stroke zero.
FI : Available force at stroke S1, voltage VH

Fig.8-2

Fig. 8-2 illustrates how this reduced-voltage solenoid operation is possible.

When voltage V_H is supplied initially to the solenoid in Fig. 8-2, the plunger is drawn by force F_1 until it stops at Stroke Zero position. This motion drives a linked control mechanism to operate. The plunger movement produces force F_H, which is sufficiently larger than the force F_O required to drive the linked mechanism. Lowering the

operating voltage of the solenoid from V_H to V_L also lowers the drawing force of the solenoid from F_H to F_L. Yet, F_L is still larger than force F_0 so that the operation of the linked mechanism is retained.
When this circuit is switched to the STOP mode, the Time Delay switch is automatically turned to the V_H position, preparing for the next PLAY operation. The operation principle of this circuit also applies to the FF or REW mode in the same manner, so no explanations will be made.

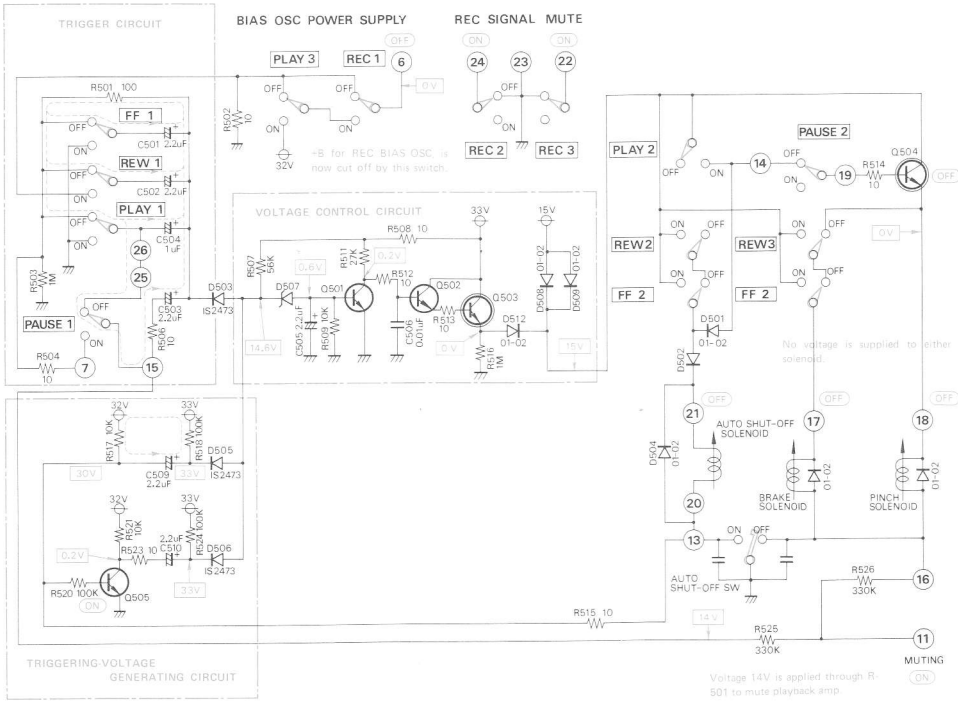
1-(B) Operation Modes

The actual circuit of Model 7700 is shown in Fig. 8-3, with the components but wirings not related to the solenoid drive circuits are omitted. Based on Fig. 8-3, the operation of the circuit in individual modes will be illustrated with figures and brief descriptions.

1. STOP mode
   Fig.8-3 on this page.
2. Switching from STOP to PLAY mode
   Fig.8-4 on page 24.
3. Switching from STOP to FF or REW mode
   Fig.8-5 on page 24.
4. Switching from STOP to REC mode
   Fig.8-6 on page 25.
5. Turning PAUSE switch ON/OFF in REC mode
   Fig.8-7 on page 25.
6. Turning AUTO SHUT-OFF switch ON in REC mode
   Fig.8-8 on page 26.

"STOP" mode

- Trigger Circuit
  C 501, C 502, C 503 and C 504 are all discharged through R 501.
- Voltage Control Circuit
  Voltage (14.6V) is applied to Zenner Diode to turn Q 501 on; Q 502 and Q 503 are then turned off.



NOTE: REC SW 1 ~ 3
FF SW 1 ~ 3
REW SW 1 ~ 3
PLAY SW 1 ~ 3
PAUSE SW 1 ~ 2

} Switches are separately ganged up to operate the deck in desired mode.

Fig.8-3

"STOP" to "PLAY" mode

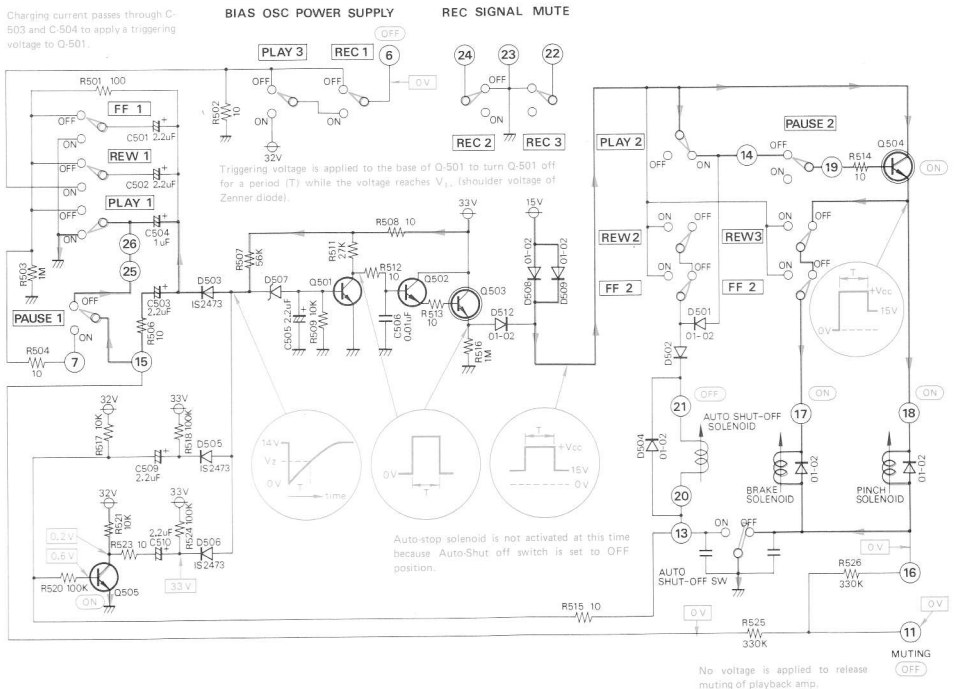


Fig. 8-4

"STOP" to "FF/REW" mode

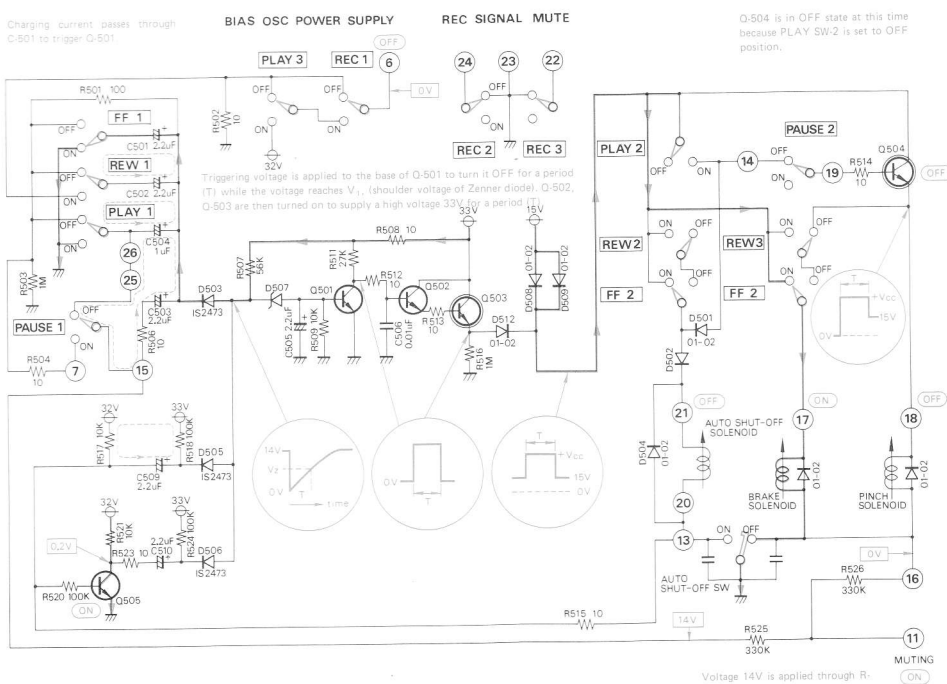


Fig. 8-5

"STOP" to "REC" mode

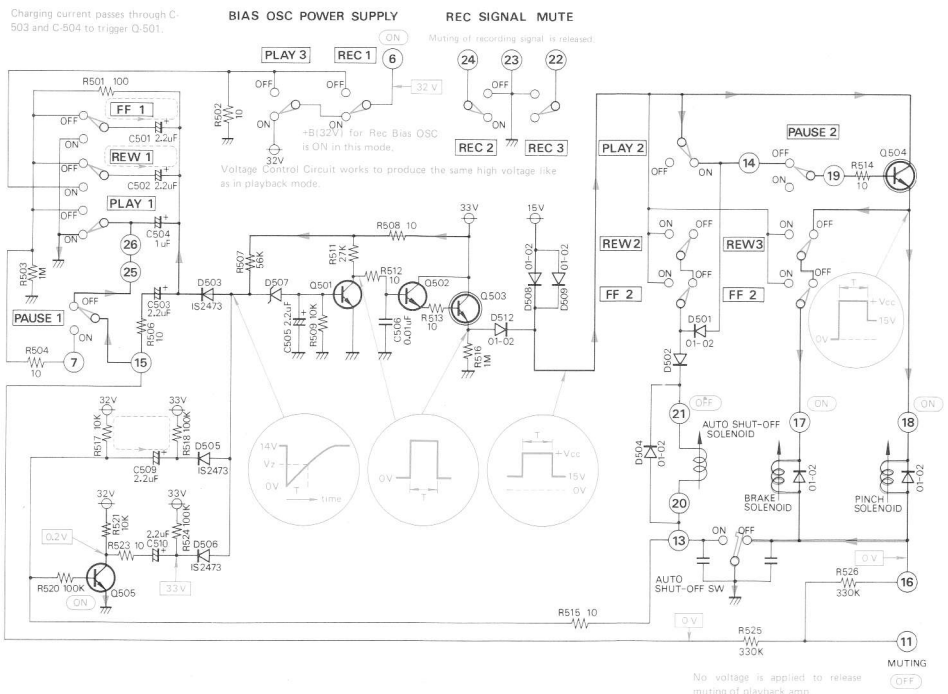


Fig. 8-6

"REC" to pause "ON/OFF" mode

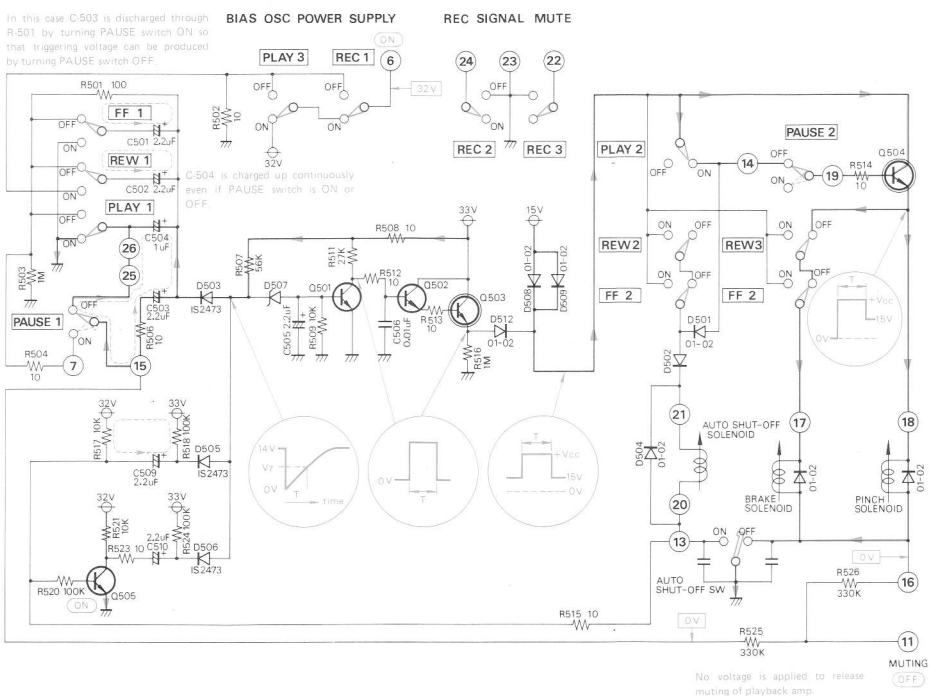


Fig. 8-7

"REC" to auto shut-off "ON" mode

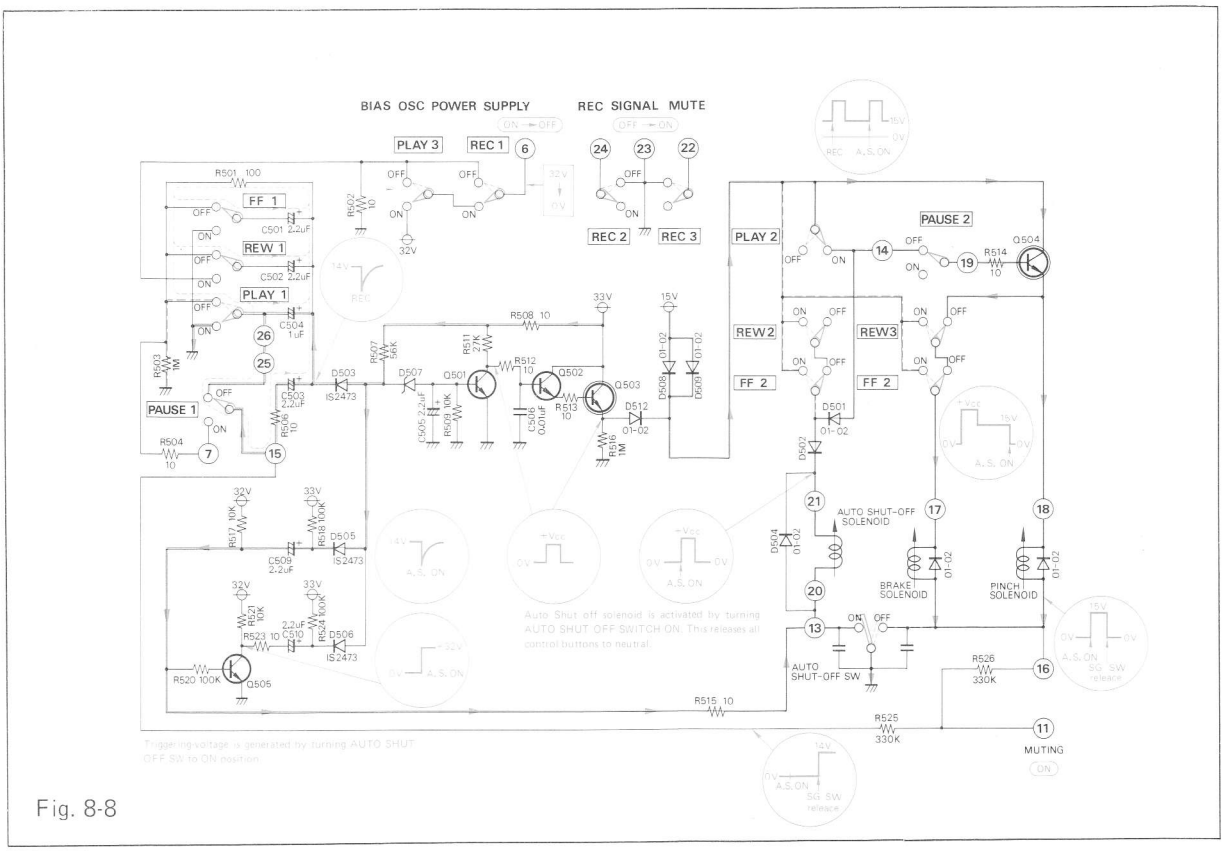


Fig. 8-8

8-2 CAPSTAN MOTOR DRIVE CIRCUIT

The capstan motor is the heart of open-reel tape decks. Dokorder products have for a long time used large-type, hysteresis synchronous AC motors that are superior to DC motors in terms of heat emission, stability against load conditions and long service life. But AC motors require somewhat large power consumption, and also have certain restrictions in the improvement of their wow-flutter characteristics because the number of poles is limited in them. Recent developments in the design and manufacture of DC motors, however, have introduced compact but high-performance DC motors. In addition, supported by the development of servo techniques to drive and control DC motors, low-cost, compact and low-power-consumption motors have become available that combine the advantages of the DC motor and servo control circuit. This combination ensures sufficiently stable motor speeds and prominent wow-flutter characteristics.

Dokorder has developed a unique servo circuit, and installed it and a DC motor together in the latest Model 7700. The servo control circuit not only enables a very high production yield for this tape deck.

2-(A) Schematic of C.P.M. (Capstan Motor) Control Circuit

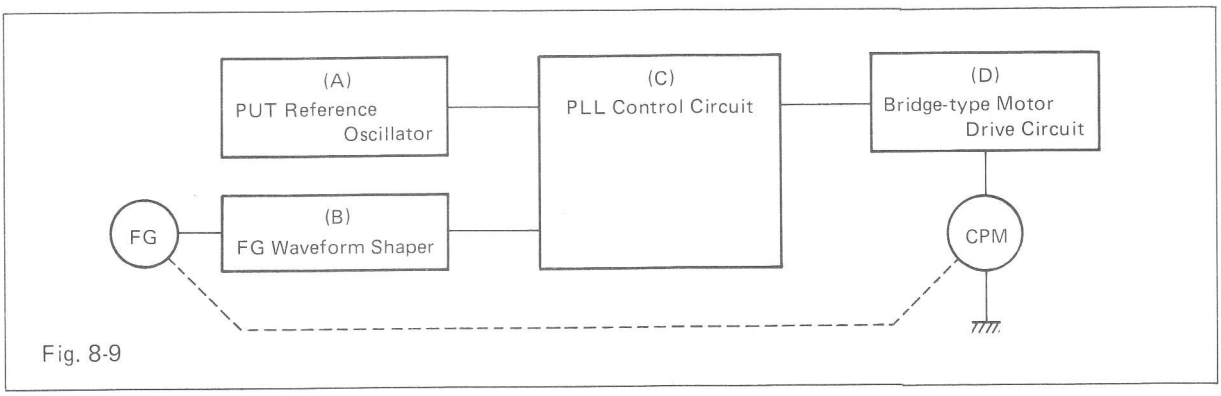


Fig. 8-9

As shown in Fig. 8-9, Block Diagram of the CPM Control Block, the CPM control circuit of Model 7700 is composed of (A) a Reference Oscillator Circuit using a PUT (Programmable Unijunction Transistor), (B) FG Waveform Shaper, (C) PLL Control Circuit, and (D) Bridge-type Motor Drive Circuit. These four packages are gate TTL modules.

Operation of Circuit Blocks

1. The PUT Reference Oscillator (A) is designed to oscillate at 512 Hz (19 cm/s) and 256 Hz (9.5 cm/s). This is in consideration of the shift-down of the 32 kHz quartz oscillator for other model.
2. The FG Waveform Shaper (B) shapes input signals into sharp pulses in order to control the TTL-RS flip-flop circuit.
3. The PLL Control Circuit (C) is composed of 3 flip-flops (frequency comparator, stop and speed acceleration). The Stop and Speed Acceleration flip-flops are controlled by time lagging T_1, T_2, or T_3 so that any asynchronous operation of the circuit will be pulled into a synchronous mode.
4. The Bridged Motor Drive Circuit (D) senses the motor voltage and current through a bridge circuit, and feeds them back in order to obtain sufficient stability of operation mainly against power voltage fluctuations. The power consumption in the transistor that drives the DC motor is reduced by supplying impulsive current to the motor.

2-(B) Operation Principle of Circuit Blocks in PPL Control Section

1 PLL Control Circuit

① Motor design

The torque required of the capstan motor is determined by the load applied to the tape deck. The motor's output torque and supply voltage are determined so that the motor torque required for the permitted over- or under-voltage condition (±10%) may be obtained in each operation mode when the FG output frequency (Fv) becomes approximately equal to the reference frequency (Fr).

② Loop response

Because of the inertial moment of the CPM itself and the load inertia of the belt, flywheel and capstan, the response of the control loop is faster during acceleration and slower during deceleration.

Since the motor has to be controlled for a constant speed, there exist many quasistable points at frequencies lower than the reference frequency Fr. Thus, a priority sequence logic must established to skip over the quasistable points and synchronize with the Fr when changing motor speeds to change the tape speed.

③ PLL block circuit

The FG output frequency must change from 0 to Fr. Due to the loop response discussed above, the following control is required:

(a)	$Fr \gg Fv$	Acceleration	
(b)	$Fr < Fv$	Deceleration	
(c)	$Fr > Fv$	↓ Fine acceleration	PLL Control
	$Fr \fallingdotseq Fv$	↓ Synchronization	

According to the control logic above, the PLL control block has the construction as shown below, in which

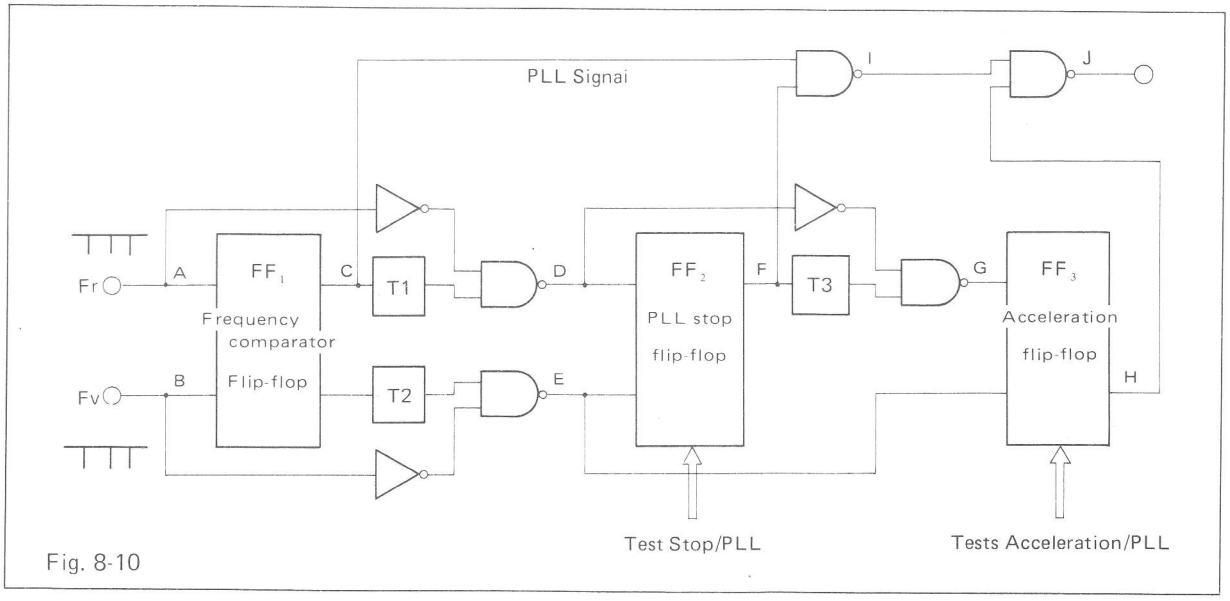


Fig. 8-10

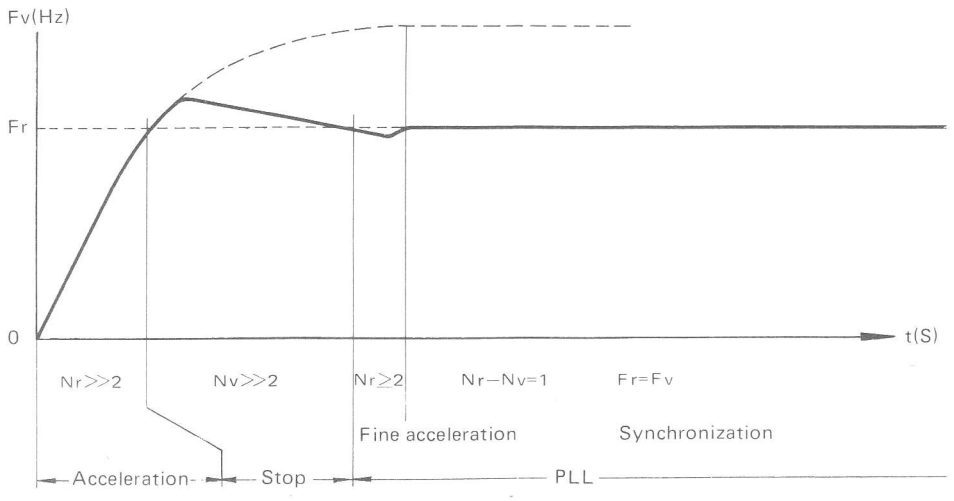
the reference signal is input to A and a variable signal Fv to B, and the FF_1 compares Fr and Fv to output a coarse PLL signal. T_1 and T_2 are time lags to test Fr > Fv and Fr < Fv, respectively. Flip-flop FF_2 determines whether to place the CPM in stop or apply PLL drive to it. Time lag T_3 tests Fr ≫ Fv, while flip-flop FF_3 determines whether to accelerate the CPM or apply PLL drive to it.

④ Priority sequence logic in PLL (time lags T_1, T_2 and T_3)

Setting the number of Fv pulses in an Fr cycle as Nv, and the number of Fr pulses in an Fv cycle as Nr, then

$Fr \geq 2$ $Nv = 0$ when $Fr \gg Fv$
$Nr \geq 2$ $Nr = 0$ when $Fr < Fv$
$Nr \geq 2$ when $Fr > Fv$
$Nr = Nv = 1$ when $Fr \fallingdotseq Fv$

1) When $Nr = Nv = 1$, T_1 and T_2 lock gate outputs D and E to H (High). When $Nr \geq 2$, T_1 and T_2 cause gate D to output an Nr–1 number of "L" pulses. But when $Nv \geq 2$, they cause gate E to output an Nv–1 number of "L" pulses. These gate outputs are used by flip-flop FF_2 to determine whether to stop the CPM or apply PLL drive to it.
2) When $Nv = 0$ and $Nr \geq 2$, gate N outputs an Nr–1 number of "L" pulses to set flip-flop FF_3 into acceleration mode.
Next, when Nv is $Nv \geq 2$, flip-flops FF_2 and FF_3 are reset so that Fv starts decreasing.
When $Nr \geq 2$, the FG frequency Fv varies very slowly according to the inertial moment, with the motor rotating at a frequency slightly lower than the synchronization frequency.
In order to avoid setting flip-flop FF_3 when $Nr \gg 2$ and accelerating the motor, flip-flop FF_3 is forced to reset by time constant T_3 for the period from when the PLL control is started to when $Nr = Nv = 1$ is established.



Rise Characteristic of Fv (from zero to forced synchronization)

Fig. 8-11

3) Speed-up from fine acceleration to synchronization:
The PLL mode itself is a sort of acceleration mode, and since Fv is a STOP signal and Fr is a TURN signal, the motor is accelerated more at Fv < Fr than at Fv = Fr. It causes the motor to be accelerated gradually at Fv < Fr, until Fv = Fr, i.e. Nv = Nr = 1, is reached. When this status is reached, the PLL output waveform covers from ⎍⎍ to ⎍⎍⎍. Unless the motor is subjected to a heavy torque variation which will place the PLL control out of the output range described above, the motor voltage is controlled within the range from 0 to +B (so long as the phase difference of Fv and Fr stays in the range from 0 to -2π). The system is ballanced allowing the motor to rotate in synchronization with the reference frequency Fr.

2 Reference Oscillator Circuit

For motor speed control, the reference frequency Fr must be sufficiently stable against the following factors:

1) Voltage fluctuation
2) Thermal variation

In general, quartz controlled oscillators, CR or LC oscillators and relaxation oscillators are popularly used to regulate speeds. The quartz oscillator can provide maximum stability but is expensive. For accurate control, the CR oscillator requires very precise and stable CR components, while the LC (tuned) oscillator is not suitable to control audio frequencies.
The thermally compensated PUT relaxation oscillator is a practical solution to these problems.

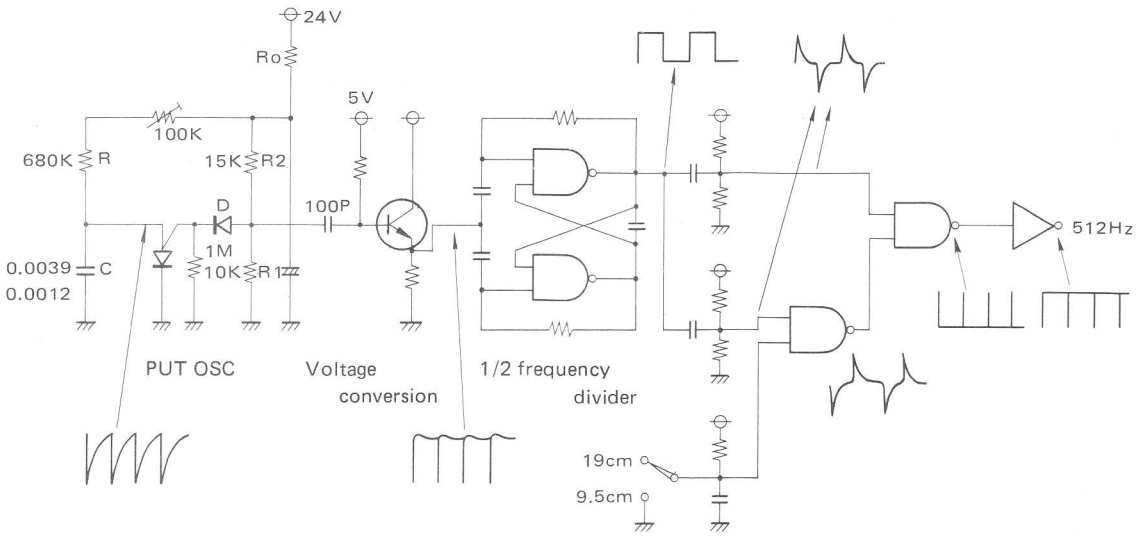


Fig. 8-12

In the above figure, the oscillating frequency is given by:

$$f_{osc} = \frac{1}{CR}\left(\ln\frac{1}{1-\eta}\right)^{-1} \qquad \eta = \frac{R_1}{R_1 + R_2} \quad \text{(stand-off ratio)}$$

Substituting for constants,

$$\eta = \frac{10}{15+10} = 0.4$$

$$f_{osc\ Max} = \frac{1}{6.8 \times 10^5 \times 5.1 \times 10^{-9}}\left(\ln\frac{1}{0.6}\right)^{-1} = 544\ \text{Hz}$$

$$f_{osc\ Min} = \frac{1}{7.8 \times 10^5 \times 5.1 \times 10^{-9}}\left(\ln\frac{1}{0.6}\right)^{-1} = 474\ \text{Hz}$$

Thus the 100 kΩ potentiometer can vary the oscillating frequency in the range from 474 Hz to 544 Hz.

3 Bridge-type Motor Drive Circuit

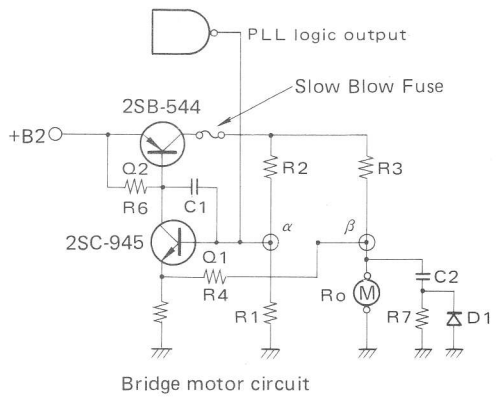
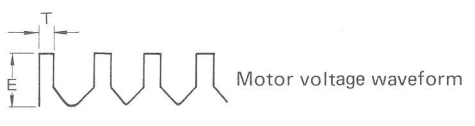


Fig. 8-13

Fig. 8-14



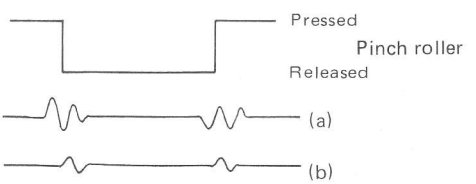


Fig. 8-17

R_3: DC motor current sensing resistor (in a negative feedback loop)

R_1, R_2: DC motor terminal voltage sensing resistor (in a positive feedback loop)

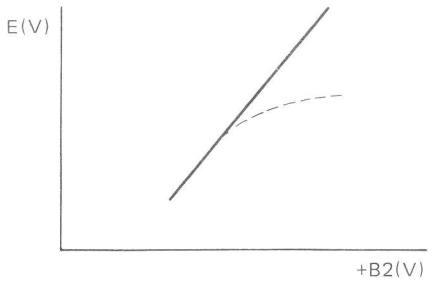


Fig. 8-15

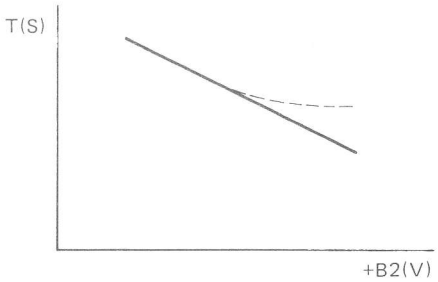
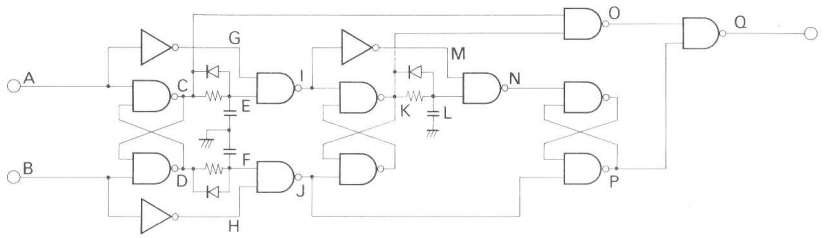


Fig. 8-16

In the motor drive circuit above, the PLL logic output operates transistors Q_1 and Q_2 to control the DC motor. At the same time, there is a bridge circuit composed of resistors R_1, R_2, R_3 and Ro (DC motor). Resistor R_3 is used to sense the motor current, while R_1 and R_2 are the motor voltage sensing resistors. The balance condition of the bridge, where R_1, R_3 = R_2, Ro, produces across α and β a counter electomotive force proportional to the motor speed. By supplying this electromotive force to the base-emitter of transistor Q_1, a feedback is provided to maintain the motor speed against load variations and power voltage fluctuations. If $+B_2$ increases, the voltage drop across Q_2 will increase to keep the motor voltage constant, while the pulse width will also be kept constant (Figs. 8-15 and 8-16).

The motor is also driven to the rated speed against variations in the load torque, so that sharp rising characteristics have been obtained when the pinch roller is pressed, as shown in Fig. 8-17.

2-(C) PLL CONTROL TIME CHART



1. At starting, the motor speed is always slower than the rated speed. Assuming that input A is the output from the PUT OSC, and that input B is derived from the frequency generator attached to the motor, then output A is always set to 512 Hz, while input B is low in frequency as shown in Time Chart-B.
   The "L" signal input to outputs A a high "H" signal at C . The next input, B , reverses the flip-flop causing output D to be turned to "H". The flip-flop is reversed again when another "L" signal appears at input A . Output C is then set to "H" again. In this state, output J is always kept at "H", so that the flip-flop which outputs P is always retained in that state (P = L) even though the input N may change from "H" to "L". Hence, output Q is always set to "H", supplying a high voltage and accelerating the motor.
2. The acceleration of the motor continues until an overshoot occurs (when the rated speed is exceeded). The FG frequency rises higher than 512 Hz, so that input B will also rise in frequency and more and more "L" signals are seen in output C (see Time Chart-B). At this stage, integrating circuit E will not operate, but only integrating circuit F will operate (because the TTL output of the integrator will turn to "H" only when two or more consecutive pulses are input).
   Under this condition, input H changes as shown in the chart, so that output J delivers some negative pulses. This turns output K from "H" to "L", changing input L accordingly. Thus, output N will deliver an "H" signal only, causing output P to be locked to "H". On the other hand, output K , which is set to "L", derives an "H" output from gate O . It changes output Q to "L", and the motor voltage is cut to zero. The motor stops or is braked.
3. By repeating these steps, the motor speed is synchronized to the rated speed, at which outputs C and D are reversed at the same intervals. It locks outputs I and P to "H", so that output C is directly transmitted to output Q.