

ELECTRICAL CHECKS, ADJUSTMENTS

are safe parameters. They may be used as a starting point for experimental L/L, L/V, and DEPTH GAIN settings more suitable to your own particular requirements.

5-7. TURNTABLE DRIVE SYSTEM ADJUSTMENTS

A. Speed Adjustment

If a major part is replaced in the turntable drive system, observe stroboscope pattern in mirror beneath turntable for each of the three turntable speed selections. The stroboscope drift should not exceed more than ± 3 marks per minute for any speed selection. (This corresponds with a timing error of 3 seconds per hour.) If the drift is excessive, adjust the appropriate "fine freq" potentiometer on the front of the OSCILLATOR card. Each of these potentiometers is marked according to its corresponding turntable speed (45, 33, or 16 rpm). Avoid readjustment of corresponding "coarse freq" potentiometer if possible.

B. Drive Signal Phase Alignment

The proper phase difference between the two turntable motor drive outputs of the power supply unit is given in Section IX in the test report of your Lathe. Checking and adjusting this difference ideally requires the use of a dual trace oscilloscope or a differential phase meter.

If a 'scope or meter is used, connect the A and B inputs of the instrument to the test points \emptyset , M, and COM on the main circuit board of the power supply unit. If the phasing is incorrect, extend the OSCILLATOR circuit card on the circuit board extender and adjust the appropriate "phase" control on the OSCILLATOR card needed for the correct phase difference. The appropriate "phase" control is the one in the oscillator channel having control of the speed in use (45, 33, or 16 rpm). Each channel is identified by markings on the card.

If neither a dual trace 'scope nor differential phase meter is available, remove the cover from the turntable drive motor and have someone feel the vibration of the motor plate while the "phase" control is being adjusted on the OSCILLATOR card. Set "phase" for least vibration, which will occur in the center of a gradual null.

C. Drive Adjustment

Connect an ac voltmeter to the \emptyset and COM test points in the power supply unit (main board). Extend the OSCILLATOR card and adjust the appropriate " \emptyset volts" potentiometer on the OSCILLATOR card as below. Then move the meter lead from the \emptyset test point to the M test point (on same board in power supply unit) and adjust the appropriate "M volts" potentiometer on the OSCILLATOR card as below.

<u>Turntable Speed</u>	<u>Rms Ac Voltage*</u>	<u>Measure</u>	<u>OSCILLATOR Card Adjustment</u>
45 rpm	100	\emptyset to COM	" \emptyset volts" (45) R P M
	100	M to COM	"M volts" (45) R P M

*Voltages here are approximate. See test report for actuals.

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Turntable Speed	Rms Ac Voltage*	Measure	OSCILLATOR	
			Card Adjustment	
33 rpm	80	Ø to COM	"Ø volts"	(33) RPM
	80	M to COM	"M volts"	(33) RPM
16 rpm	40	Ø to COM	"Ø volts"	(16) RPM
	40	M to COM	"M volts"	(16) RPM

*Voltages here are approximate. See Test report for actuals.

Final Check Out Report
continued --

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TURNTABLE DRIVE MOTOR

(1) Input (RMS A.C. Voltages)

(test points located on #4-60300 and #4-60400 circuit boards located in Power Supply Assembly)

<u>speed</u>	<u>main phase</u> #4-60300	<u>shifted phase</u> #4-60400
45	<u>.665</u> .660	<u>.466</u> .490
33	<u>.620</u> .700	<u>.430</u> .530
16	<u>.390</u> .430	<u>.277</u> .350

(2) Output (RMS A.C. Voltages/Degrees)

(see technical manual page 5-19, paragraph 5-7C)

<u>speed</u>	<u>main phase</u>	<u>shifted phase</u>	<u>phase shift</u> ^o
45	<u>95-100</u> 65Hz	<u>95</u>	<u>50.4</u> 1.12 x 45°
33	<u>80-80</u> 47Hz	<u>80</u>	<u>41.4</u> .98 x 45°
16	<u>40-40</u> 24Hz	<u>40</u>	<u>39.6</u> .88 x 45°



200 in 400 to 265
200 out 2 mil to 6 mil to 175 LPI

FINAL CHECK OUT REPORT

Customer: WORLD ELECTRONICS SUNSHINE STUDIOS

Model: LS 76 Serial Number: 653

D.C. VOLTAGES (See Technical Manual Page 5-6, paragraph 5-3)

<u>test point</u>	<u>voltage</u>	<u>test point</u>	<u>voltage</u>	<u>test point</u>	<u>voltage</u>
+18	<u>+17.36</u> 17.38	TT+	<u>+32.3</u> 34.08	S+	<u>+19.9</u> 21.12
-18	<u>-17.34</u> 17.29	TT-	<u>-31.9</u> 33.49	S-	<u>-20.0</u> 21.12
K15	<u>+15.11</u> 15.07	+24	<u>+24.0</u> 23.95	5	<u>+5.38</u> 5.83

D.C. VOLTAGES AT TEST POINT "TP" (See Technical Manual Page 5-15, Figure 5-3)

<u>speed</u>	<u>4 LPI finish</u>	<u>16 LPI lead-in</u>	<u>32 LPI band</u>	<u>150 LPI expand</u>	<u>400 LPI -100</u>
45	<u>13.41</u> 12.14/11.8X.	<u>2.81</u> 2.81	<u>1.42</u>	<u>1.517</u>	<u>.604</u> 2.243
33 3.332 PT	<u>9.91</u> 9.18	<u>2.13</u> 2.10	<u>1.14</u>	<u>1.122</u>	<u>.449</u> 1.643
16	<u>5.20</u>	<u>1.16</u>	<u>.539</u>	<u>.584</u>	<u>.237</u> .840

DEPTH OF CUT

2V 2 mil

4V 4 mil

6V 5.5 mil

3V 3 mil

5V 4.75 mil

7V 6 mil

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ELECTRICAL CHECKS, ADJUSTMENTS

**TABLE 5-1. FUNCTIONS OF CARD CAGE SUBASSEMBLIES
AND THEIR FRONT PANEL CONTROLS**

Circuit Card or Other Subassembly	Functions
BAND/EXPAND PITCH ADJUST *	<p>Means of presetting band and expand pitches of cuts.</p> <p>EXPAND and BAND PITCH screwdriver controls adjust respective pitches obtained with 45-, 33-1/3-, and 16-2/3-rpm turntable speeds. The respective expand pitch adjustments for the three speeds are located in the left-hand vertical column marked EXPAND. The respective band pitch adjustments for the three speeds are located in the right-hand vertical column marked BAND. Turning any adjustment clockwise gives a finer pitch. Turning any adjustment counterclockwise gives a coarser pitch. See paragraph 5-5 for adjustment instructions.</p>
OSCILLATOR	<p>Provides a highly stable bi-phase output for turntable motor drive. There are three separate oscillators and channels for the three turntable speeds. Via three relays on this card, the console TURNTABLE speed switch selects the correct oscillator channel as the source of the output. Output is amplified in power supply unit.</p>
GENERAL LOGIC	<p>Generally, any signal not associated with the pitch ("feed") or variable depth control system is created on this board. Signals such as Turntable, Lift, Drop, Audio, Vacuum, Tape, and inputs to lamp drivers are found here.</p>
FIXED PITCH	<p>Originates all functional signals related to fixed pitch -- i.e., lead in, band, logically programmed or manual expansion, finish, and fast in. (Does not originate signals for the variable-pitch servoed expansions caused by the audio program.)</p> <p>Two internal controls allow lead-in and finish pitches to be adjusted. See paragraph 5-5.</p>
DISPLAY PROCESSOR	<p>Converts base and expansion pitch control signals from variable pitch servo system into control inputs to console LINES/INCH readout. (Sums and linearizes audio-program-controlled expansions signals.)</p>

* Not a plug-in subassembly. Others are plug-in's.

ELECTRICAL CHECKS, ADJUSTMENTS

TABLE 5-1. FUNCTIONS OF CARD CAGE SUBASSEMBLIES
AND THEIR FRONT PANEL CONTROLS (Cont)

Circuit Card or Other Subassembly	Functions
SERVO AMPLIFIER	<p>All signals related to feedscrew drive are brought together here and are selectively fed to the input of the closed loop "feed" servo power amplifier on this same card. The voltage compensation network that scales the input voltage to the servo power amplifier according to turntable speed is also located on this card. This network is controlled by the console TURNTABLE speed switch.</p> <p>Card has five internal controls for servo system calibration, and the main servo system test point TP. See paragraphs 5-5 and 5-6.</p>
VARIABLE DEPTH	<p>Has electronic circuitry for the signal processing, storage, and control of audio-program-dependent depth of cut during recording. Also contains band pitch and lead-in/finish pitch circuitry related to depth of cut during these modes.</p> <p>DEPTH GAIN screwdriver control adjusts gain of the variable depth system.</p> <p>L/V screwdriver control adjusts the amount of pitch change obtained for a given increase in depth of cut.</p> <p>See variable depth system calibration procedure (paragraph 5-6) for instructions.</p> <p>*FIXED PITCH screwdriver control adjusts cutting depth obtained for <u>lead-in and finish-pitch cuts</u>. See paragraphs 5-5, 5-6.</p> <p>INCREASED BAND DEPTH toggle switch selects either the normal (base) band depth of cut (lower position of switch) or increased depth of cut (on position of switch) during banding. Band depth obtained for increased-depth (ON) position is same as determined by FIXED PITCH screwdriver control on this same panel.</p>
VARIABLE PITCH	<p>Contains circuitry for the signal amplification, storage, equalization, and delay required for audio-program-dependent expansions of pitch during recording.</p> <p>Front panel INPUT LEVEL test points allow the levels of stereo audio program signals received through P804 (LEFT) and P810 (RIGHT) on back of The Lathe to be measured with respect to GND.</p>

ELECTRICAL CHECKS, ADJUSTMENTS

**TABLE 5-1. FUNCTIONS OF CARD CAGE SUBASSEMBLIES
AND THEIR FRONT PANEL CONTROLS (Cont)**

Circuit Card or Other Subassembly	Functions
VARIABLE PITCH (Cont)	<p>Front panel LEFT and RIGHT screwdriver controls adjust the audio levels measured at LEFT and RIGHT test points. These signals are used to control the variable pitch ("feed") servo system.</p> <p>L/L screwdriver control adjusts amount of pitch change produced by a given lateral (audio) signal during recording. See variable pitch system calibration procedure (paragraph 5-6) for adjustment instructions.</p>

5-3. POWER SUPPLY CHECKS

When the power switch (figure 2-2) is first turned on at installation time, measure the following outputs at internal test points in the power supply unit to be sure of normal operating voltages in The Lathe. Also, occasionally repeat these measurements as a lathe maintenance task. Readings should be as listed below ± 5 percent or as listed on the test data sheet for your Lathe. If any reading is incorrect on receipt of The Lathe, check fuses; if necessary, contact the factory.

<u>Voltage</u>	<u>Test Point</u>	<u>Function of the Voltage</u>	<u>Internal Protection Provided</u>
+18	+18	+ Op Amp Supply (V+)	Foldback
-18	-18	- Op Amp Supply (V-)	Foldback
+15	K15	Relay supply	Foldback
+24	+24	Indicator lamps, head lift coil, latch coil, stylus heat	Foldback
+30	TT+	Turntable motor	Fuse TT+
-30	TT-	Turntable motor	Fuse TT-
+24	S+	Variable pitch ("feed") servo motor	Fuse S+
-24	S-	Variable pitch ("feed") servo motor	Fuse S-
+5	5	Logic Vcc	Fuse 5
Ground	GND	(General return circuit)	-----

NOTE

Other test points are provided in the power supply unit for the inputs and outputs of the turntable drive-motor bi-phase power amplifiers in this same unit.

ELECTRICAL CHECKS, ADJUSTMENTS

5-4. CHECKING PITCHES OF CUTS

A. Prerequisites for Checking

Lathe fully assembled.

Cutterhead suspension satisfactorily adjusted (Section III, paragraph 3-6).

Helium flow satisfactorily adjusted (Section III, paragraph 3-7).

Lathe power turned on. Power Supply output voltages normal (paragraph 5-3).

Feedscrew drive belt, vacuum, microscope arm, and turntable drive belt satisfactorily adjusted (Section IV, paragraphs 4-12 through 4-15).

Stylus heat satisfactorily adjusted per Section VI, paragraph 6-7.

Depth of cut adjusted as satisfactorily as possible per Section III, paragraph 3-8.

B. Checkout Procedure

Perform the following tests. If any result is unsatisfactory or other-than-standard pitches are desired, refer to the pitch system adjustment and calibration procedures in paragraphs 5-5 and 5-6. However, all of the following tests should be performed before disturbing any factory adjustment for any reason.

(1) Preliminary. Adjust console LINES/INCH control for 400 lines per inch (lpi) as indicated in console LINES/INCH readout. Remove all audio inputs from The Lathe at this time or accurately set them to 0v (ground).

(2) Groove Cutting Distance Checks. Verify correct pitches by checking groove cutting distances as follows. Put blank 12-inch disc on turntable.

CAUTION

Before making any new TURNTABLE speed selection, press "turntable" pushbutton to turn off turntable drive. (Light in "turntable" button will go out.)

(a) 45 rpm grooves. Use console TURNTABLE speed switch to select 45 rpm turntable speed. Press console "turntable" pushbutton to start turntable drive. Button should light and turntable start to rotate. Position carriage for cutting. Activate "feed" console pushbutton. Button should light. Set depth of cut for 2 mils (Section VI, paragraph 6-8).

- ① Cut at least 11 lines of grooves at 400 lpi per LINES/INCH readout. Then measure distance from line 1 through line 10. This dimension should be 0.025 ± 0.0005 inch (50 marks \pm 1 mark in the microscope when using 150X).

ELECTRICAL CHECKS, ADJUSTMENTS

- *2. Press "lead in" button on console. Drop cutter head and cut several grooves at lead-in pitch. The distance from groove to groove should be 1/16 inch (0.0625), corresponding with the standard lead-in pitch of 16 lpi.
- *3. Press "finish" button on console. Drop the cutter head and cut several finish-pitch grooves. The distance from groove to groove should be 1/4 inch (0.2500), corresponding with the standard finish pitch of 4 lpi.
4. Set BAND "time" switch to "off". Press and hold down console "band" pushbutton while cutting several band-pitch grooves. The groove to groove measurement should be 0.312 ± 0.001 inch, corresponding with the standard band pitch of 32 lpi. This measurement can be accurately made using the microscope. At 150X, it should be 62 ± 2 marks.
5. Set EXPANSION toggle switch to "pre/post" and EXPANSION "time" switch to "4" (seconds). Hold down "band" button, drop cutter head, and cut grooves. With toggle switch at "pre/post", cutting should begin at expansion pitch, changing to band pitch 4 seconds after activating "band" button. During the expansion sub-mode, LINES/-INCH readout should indicate 150. (If cutter head is dropped too late to cut at least two lines of expansion pitch grooves, repeat these operations with earlier cutterhead drop.) Measure expansion-pitch groove to groove distance. It should be 0.065 inch, or 13 marks using the microscope at 150X. This corresponds with 150 lpi.
6. Place manual "expand" toggle switch (on console) in upper position. Cut grooves. LINES/INCH readout should indicate 150 and groove to groove distances should be the same as in 5. above.

(b) 33 rpm grooves. Press console "turntable" pushbutton to turn off turntable drive. (Light in "turntable" button goes out.) Select 33 rpm TURNTABLE speed. Press "turntable" button again (re-light it) to turn on turntable drive at new speed. Leave "feed" activated.

1. Perform step (a)1 (base pitch) at 33 rpm without disturbing console LINES/INCH control knob. LINES/INCH readout should indicate 400 and the distance across the first 10 grooves should be as in (a)1.
2. Perform steps (a)3 (finish) and (a)4 (band) at 33 rpm. Groove to groove distances should be respectively the same as for 45 rpm in (a)3 and (a)4.
3. Other steps in (a) may be performed at 33 rpm if desired. Respective results should be the same as for 45 rpm.

(c) 16 rpm grooves. Press console "turntable" pushbutton to turn off turntable drive. (Light in "turntable" button goes out.) Select 16 rpm TURNTABLE speed. Press

ELECTRICAL CHECKS, ADJUSTMENTS

"turntable" button again (re-light it) to turn on turntable drive at new speed. Leave "feed" activated. Perform steps in (b) above for 16 rpm. Results should be the same as for respective steps in (a) at 45 rpm.

5-5. PITCH ADJUSTMENTS

If the pitch checks in paragraph 5-4 are not satisfactory, place another blank disc on the turntable and proceed with the steps charted in figure 5-2. Where necessary, make the appropriate adjustments indicated in the chart. Then repeat the charted steps to make further adjustments as necessary to remove the interactive effects of adjustments on each other.

NOTE

Measuring the analog voltages at the test point TP on the SERVO AMPLIFIER card in the card cage is desirable when making any adjustment in figure 5-2. Correct TP voltages for the various standard pitches are recorded in the test report of your Lathe. See Section IX. These voltages may be used to determine correct potentiometer settings and thus expedite the adjustments when several pitch controls have to be re-positioned. Trouble is indicated if the voltage obtained for a particular pitch on the disc appreciably differs from the value listed for that pitch and the related turntable speed in the test report.

Other pitches than specified in paragraph 5-4 and figure 5-2 may be set and used if desired. Ranges of the respective controls are as follows. Analog voltage differences at the SERVO AMPLIFIER test point TP are proportional to differences in lpi's.

<u>Pitch Control</u>	<u>Location</u>	<u>Range (Lpi)</u>
*"Finish Pitch"	FIXED PITCH card	3.5 to 12
*"Lead in Pitch"	(Same as above)	4 to 50
BAND 45, 33, or 16	BAND/EXPAND PITCH ADJUST panel in card cage	18 to 100
EXPAND 45, 33, or 16	(Same as above)	95 to 200
"Exp Lpi Adj" (manual expansion)	Back side of console panel	95 to 200
LINES/INCH (base pitch)	Front side of console panel	95 to 600

If a depth-of-cut adjustment is desired for lead in and finish, use the FIXED PITCH screwdriver control on the VARIABLE DEPTH front panel.

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setup may omit either automatic band or automatic finish if desired.

(a) Band. Select band cutting time ($1/2$ to 4 seconds and will be same for all bands) with The Lathe's BAND "time" control knob (5, figure 6-2). To omit automatic band, set BAND time at "off" (0 second). For any BAND "time" selection other than "off", splice 2 to 6 inches of paper leader between recorded selections on the magnetic tape. The transition from light to dark will be sensed by the optical pickup, in the tape machine, which then will signal a banding command to The Lathe. The cut will be made for the time selected with the BAND "time" control knob. It should not be necessary to use The Lathe's "band" pushbutton, but it will remain functional.

(b) Finish. To initiate finish automatically, splice-in two sections of paper leader 2 to 6 inches in length. Separate the two leader sections with 2 to 6 inches of the magnetic tape. Finish cutting time is not selected by means of an operator's control but by The Lathe's variable pitch servo system; hence, no counterpart of the BAND "time" switch needs to be set. In this finish set-up, The Lathe's "finish" pushbutton should not ordinarily need to be used, but remains functional and can serve for an earlier finish cut if ever desirable.

If automatic finish is not desired, simply do not splice-in finish-cut leader sections.

6-4. LATHE OPERATING PROCEDURE

Safety Pre-Requisites:

Cutter head lifted; manual lift lever up.

Feednut disengaged (lever up).

N.B. Feed nut interlock switch (3, figure 6-1) in upper position (interlock circuit switched on).

Preliminary steps:

- A. Turn on lathe system power.
- B. Preset the set-up controls (table 6-2).
- C. Ready the tape transfer (preview) machine (paragraph 6-3).
- D. Place disc and vacuum chuck on turntable. (Vacuum distribution cap must be properly positioned.)
- E. Position the carriage.

Operation:

- 1. Press "feed" button. Button lights green. Feedscrew rotates.
- 2. Press "turn-table" button. Button lights red. Turntable rotates. Vacuum pump starts.

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3. Lower the manual lift lever. (Head remains lifted.)
4. Engage feednut (lever down) when ready to cut.
5. Press "lead in". Button lights yellow. Use console "drop" button when ready to drop head if this function is not presently automated.

Beyond these skeletal requirements, there is no standard operating procedure for The Lathe. The setup in use and the necessary sequence and natures of the cuts will determine the other steps. When familiar with the controls described in tables 6-1 and 6-2, proceed as appropriate to the job at hand.

NOTE

Head cannot be dropped by electrical control until both feed and turntable are turned on and feednut is engaged. This interlock arrangement has been designed for stylus and disc protection. Please use controls as intended.

For special-case exception to the feednut engagement requirement, see 3, table 6-1.

6-5. PITCHES OF CUTS

The Lathe's variable pitch system and console controls provide the pitches listed on the next page. Each pitch except base is respectively preset to its standard number of lines per inch (lpi) when The Lathe is originally delivered from the factory. Other lpi's can be preset, if desired, within the ranges stated in the tabulation. The internal readjustments for this are explained in Section V. Base pitch is an operational selection made in conjunction with the digital LINES/INCH readout on The Lathe console.

Expansion is available as logically automated portions of the variable pitch servo program, not requiring initiation with an operator's control. When programmed expansion is used, an expansion cut is automatically made on completion of the lead-in cut. This prevents high-level energy from causing groove echo at the start of the selection being recorded. Similarly, the variable pitch system makes an automatic expansion cut on completion of each band cut -- the time when another selection begins. By appropriately presetting the "pre" - "pre/post" switch on the console, automatic expansion cuts at tail ends of the recorded selections can be entered into the program. The duration of each of these logically programmed cutting operations is preselected by means of a nine-position rotary EXPANSION "time" switch on The Lathe console. One of the nine positions, "off", is used to omit automated expansion from the program. Expansion is also available as a manual operation with manual timing by means of a toggle switch. The Lathe may be preset for the same or different numbers of lines per inch for the programmed and manual expansion modes.

Lead in is manually initiated and automatically discontinued at proper disc diameter. Band and finish may be manually initiated or automatically initiated on cue from tape in tape machine. Finish is automatically discontinued at proper disc diameter. Band, in "auto" band mode, is automatically discontinued at proper times. Lead-in and finish

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Pitch	Used for Selection	Presettable Lpi's		Remarks
		Factory Preset Lpi	Range of Pre- settable Lpi's*	
Base	(This pitch is provided by lathe when no other pitch is selected by the operator, variable pitch system, or automated set-up commands.)	None	95 to 600	Operator makes base pitch lpi selection at console with LINES/INCH control knob, 2 figure 6-2. Variable pitch system will automatically expand this pitch when necessary for program material being recorded.

*See Section V, paragraph 5-5 for adjustments.

On completion of finish cut, the concentric (locked) groove is automatically cut with feed-screw drive removed.

6-6. LINES/INCH DIGITAL READOUT AND SELECTION OF BASE PITCH

The numerical LINES/INCH readout on The Lathe console is provided as a built-in meter for setup adjustments and a groove-to-groove lpi monitor of base and expansion pitches during cutting. The readout accurately displays numbers of lines per inch (lpi) of pitches in use between 100 and 600. It cannot be used to verify coarse pitches such as lead in, band, or finish, which are typically 16, 32, and 4 lpi.

For pitch system changes of in-range lpi's, the readout is updated once per turntable revolution. At any time, the readout will also respond (within range) to manual controls. When lpi is constant, a standstill number is displayed.

Before beginning to cut a particular lacquer master, the desired maximum lpi of the base pitch should be entered into the readout with the LINES/INCH control knob. (See 2, figure 6-2 and table 6-2.) This selection will determine the finest cuts to be made. The selection can be anywhere from 100 to 600; a typical selection is 400.

Later, when beginning to cut modulated grooves, the numerals in the readout may display the pitch of the first automatic expansion cut in the pitch system program (e.g., 150 lpi). As that cut ends, cutting at base pitch will start, and the readout may be expected to change to a higher number. The display may or may not at that time return to the manually entered lpi, since certain audio program passages may need a coarser pitch to avoid groove echo or crosstalk. If so, the variable pitch servo system will comply for as long as necessary, and the readout will reflect the servo selection. The readout will also follow later servo selections of base pitch for later passages. These selections may vary from 95 lpi up to the manually selected lpi (e.g., 400). They will not exceed either limit, and the servo will maintain the base-pitch lpi as high as the audio program and manual pre-selection permit.

The servo system's control of the base pitch is governed by electronic preview samplings of the audio program material. When the servo selects a coarser pitch in response to an audio sample, the new pitch is an expansion. But, though all expansion cuts are made

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for similar reasons, expansion occurring in this way should not be confused with the lpi of either a logically programmed EXPANSION cut or manual "expand" cut related to console controls.

The servo system takes audio program preview samplings 25 times per turntable revolution and may alter the pitch once every $1/5$ revolution. The LINES/INCH readout displays the net results of changes in all of the most recent five $1/5$ revolutions. For example, if the servo decreases a base pitch of 400 lpi by 25 lpi in every $1/5$ of a revolution, the LINES/INCH display will change from 400 to 275 when the revolution is completed.

When the displayed numbers stand still at the lpi of the manually selected base pitch, you know that no audio program expansion has been required.

NOTE

For most efficient use of available space on disc, the pitch/depth control-input attenuators recommended in Section II, paragraph 2-5 and discussed in Section V, paragraph 5-6, should be used with The Lathe.

The "base pitch" toggle switch (2, figure 6-2 and table 6-2) causes the LINES/INCH readout to display the manually selected base-pitch lpi regardless of any pitch change made for audio program material. This switch has no effect on the servo. It merely allows the operator to recall his manual selection to the readout, where it remains on display until manually altered or the switch is released. Thus, any change of the manual selection desired while cutting modulated grooves should be made by viewing the readout with the switch in its lower position. (This same switch may be used in this same way for the 0-10v DEPTH meter and control, 3, figure 6-2.)

When the LINES/INCH control knob is being turned to alter a manual selection, there will be visual nulls in the display. This is because the display is stepped in 5- and 10-line increments and/or decrements as described in table 6-2. The variable pitch servo system will, however, be responding to the rotation of this control in lpi increments or decrements of 1 line.

6-7. CUTTER STYLUS HEATING CURRENT ADJUSTMENT

The optimum amount of cutter stylus heating current depends on the type of heating coil used. This, in turn, depends on the type of cutter head installed in The Lathe. An accurate way of determining the best heating current for your needs is to record while simultaneously playing back through The Lathe's tone arm. Read the heating current on the console STYLUS HEAT meter. Meanwhile, by listening to or electrically measuring the stereo playback signals from J805 and J812 on the back of The Lathe, you will find a setting of the console STYLUS HEAT control knob for which the noise no longer decreases with increased current. Leave knob at this setting.

6-8. DEPTH-OF-CUT ADJUSTMENTS

The Lathe's variable depth system is designed for either an advance ball (typ. Westrex) or floated (typ. Ortofon) type of cutter head. The different needs are met by the different cutterhead cabling connections used for the two types of heads. (See L. J. Scully Drawing

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4-10100 in Section IX.) The operator's DEPTH control voltage knob and DEPTH meter on The Lathe's console are part of this system and are used with either type of head. However, the setup adjustment criteria and the behavior of the meter during program controlled deepenings of cut are not the same. The recommended DEPTH adjustment procedure is therefore given in the following subparagraphs A and B for each type of head. Follow the applicable instructions. In either case, the DEPTH control should be set for desired minimum recording depth. Relative depth is measured on the disc in either case by using the microscope to measure groove width. A wider groove corresponds with a deeper cut. Subparagraph C, which identifies symptoms of need for a vertical slide adjustment, apply to either procedure in A or B.

The base depth of cut should be checked, and if necessary, the DEPTH adjustment should be re-performed whenever the cutter stylus is changed.

A. For Advance Ball Cutter Head

In this case, the DEPTH meter readings are indicative of a small dc offset bias voltage applied to the direct-coupled cutter drive amplifier. Due to polarity, increasing bias voltage retracts the stylus, thus causing a narrower (shallower) groove to be cut. To set console DEPTH control properly:

(1) Verify that previous correct adjustment of counterspring adjusting knob above cutter head has not been disturbed. (See Section III, paragraph 3-8, subparagraphs A and D(2)(a).)

(2) Turn lathe power on. Turn stylus heat on. Turn lathe console DEPTH control knob fully counterclockwise. This will remove the offset voltage from the cutter drive amplifier. DEPTH meter will now read zero.

(3) Put blank lacquer disc on turntable. Start turntable and cut test grooves. (It is usually best to drop and lift head with console controls at this time.) Adjust depth-of-cut control on the advance ball cutter head as required to obtain a groove 4 mils wide after completion of the lead-in cut. (Use microscope grid.)

(4) Turn DEPTH control clockwise as far as necessary to obtain a 10v (full scale) reading on DEPTH meter. Cut new test grooves. Observe that width of cut has decreased to 2 mils. If not 2 mils, adjust slide (25, figure 6-1) with vertical slide knob (26) until slide is vertically positioned as needed to obtain a groove that is 2 mils wide when DEPTH meter reads 10v. See subparagraph C for other symptoms of need for a vertical slide adjustment.

(5) DEPTH control may be left in 10v position, establishing depth obtained with 2-mil-wide groove as the minimum (or base) depth of cut to be used for recording. If greater deepness (wider groove) is desired for the minimum depth of cut, adjust DEPTH control for a correspondingly lower voltage reading. When the instructions in this procedure are followed, 1 volt decrease in meter reading = 1/4 mil increase in groove width. (Check with microscope.)

When signals in audio program need deeper-than-minimum cut, audio program difference signals will automatically cause The Lathe's variable depth system to decrease

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the bias voltage (meter reading), thereby deepening the cut. Program material that is in phase (sum) will not cause subtraction; meter in those times will display the voltage selected with the DEPTH knob, and stylus will cut at selected base depth. When system varies the meter reading, base DEPTH reading can be recalled, without interfering with servo, by moving the console "base pitch" toggle switch (2, figure 6-2) to its lower position. (LINES/INCH readout will recall manual selection of base pitch lpi at this same time.)

If DEPTH meter readings vs. groove widths are not compatible with these instructions, it may be necessary to perform the depth calibration procedure for internal card-cage depth controls per Section V, paragraph 5-6.

B. For Floated Cutter Head

For floated cutter heads, an electromagnetic coil in The Lathe's saddle assembly is used to apply an upward force to the tail of the head assembly, thus tilting the front of the head downward to deepen the cut. With this type of head, the voltage reading on the DEPTH meter on The Lathe console is indicative of the current passing through the coil. Increasing voltage readings mean wider (deeper) cuts. To set DEPTH control properly:

(1) Verify that previous correct adjustment of counterspring adjusting knob above cutter head has not been disturbed. See Section III, paragraph 3-8, subparagraphs A and D(3)(a).

(2) Turn lathe power on. Turn stylus heat on. Adjust DEPTH control knob on lathe console for 2 volt reading on console DEPTH meter.

(3) Put blank lacquer disc on turntable. Start turntable and cut test grooves. (It is usually best to drop and lift head with console controls at this time.) Use microscope grid to observe that groove is 2 mils wide after completion of the lead-in cut. If not 2 mils, adjust slide (25, figure 6-1) with vertical slide knob (26) until slide is vertically positioned as needed to obtain a groove that is 2 mils wide when DEPTH meter reads 2v. See subparagraph C below for other symptoms of need for a vertical slide adjustment.

(4) DEPTH control may be left in 2v position, establishing depth obtained with 2-mil-wide groove as the minimum (or base) depth of cut to be used for recording. If greater deepness (wider groove) is desired for the minimum depth of cut, adjust DEPTH control for a correspondingly higher voltage reading. When the instructions in this procedure are followed, 1 volt increase in meter reading = 1 mil increase in groove width. (Check with microscope.)

When signals in audio program need deeper-than-minimum cut, program difference signals will automatically cause The Lathe's variable depth electronics to increase the current (meter reading) through the deepening coil, thereby deepening the cut. Program material that is out of phase (sum) will not affect the coil current or meter reading; meter in those times will display the voltage selected with the DEPTH knob, and stylus will cut at selected base depth. As program varies the meter reading, base DEPTH reading can be recalled, without interfering with variable depth system, by moving console "base pitch" toggle switch (2, figure 6-2) to its lower position. (LINES/INCH readout will recall manual selection of base pitch lpi at this same time.)

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If DEPTH meter readings vs. groove widths are not compatible with these instructions, it may be necessary to perform the depth calibration procedure for internal card cage depth controls per Section V, paragraph 5-6.

C. Symptoms of Need for Vertical Slide Adjustment

Aside from inability to adjust depth of cut using DEPTH knob only, any one of the following symptoms may indicate a need for a vertical adjustment of the slide, 25, figure 6-1:

Cutter head appears to drag or hook with respect to stylus when cutting a disc.

Or:

Front face of pivot block (4, figure 3-3, Section III) not flush with front face of saddle yoke (6).

See Section III, paragraphs 3-6 and 3-8.

D. Lead-in, Finish, and Band Depths of Cut (Any Head)

If lead-in and finish depth of cut requires adjustment, use FIXED PITCH control located on front edge of VARIABLE DEPTH circuit board in The Lathe's electronics card cage. See Section V, paragraph 5-5 for further details. To select either base depth or increased depth of cut for banding, use switch marked INCREASED BAND DEPTH on VARIABLE DEPTH circuit board. The ON (upper) position of this switch will give a banding depth same as lead-in and finish depth. When increased depth of cut is not required in banding, keep this switch in its lower position.

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TABLE 6-2. FUNCTIONS OF ELECTRICAL CONTROLS AND INDICATORS

Figure No.	Index No.	Control Group	Control or Indicator	Function	Remarks
SET-UP CONTROLS					
6-1	37	Power Supply	Power on-off switch.	Turns primary ac power to The Lathe on or off.	Also turns ac on or off at convenience outlet strip on back of The Lathe. Turn switch knob clockwise to turn lathe power on.
6-2	Group 1	STYLUS HEAT	"on-off" toggle switch	Turns cutter stylus heating system on or off. <u>CAUTION</u> Do not drop head with heat switched on if chip pickup vacuum is not operative.	Heating system supplies heating current to dropped cutter head when switch is set to "on". Supplies no heating current when head is lifted or switch is set to "off".
			1 ampere current meter	Shows amount of heating current passing through cutterhead stylus heating coil.	Head must be dropped and STYLUS HEAT toggle switch set to "on"; otherwise meter reading is zero
			Control knob	Adjusts amount of heating current up to 0.9 ampere (typ adj between 0.5 and 0.7 ampere)	Read amount of current on meter, above. See paragraph 6-7 for recommended adjustment procedure.
	Group 2	LINES/- INCH	Digital readout	Three-digit numerical display of number of lines per inch in the base pitch manually selected for a particular cut. During cutting, the display will be modified when pitch is modified by automatic variable-pitch	Servo action occurs only during cutting and is appropriately determined by the servo and audio programs. See paragraph 6-6 for more detailed explanation of servo control and digital readout behavior.

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TABLE 6-2. FUNCTIONS OF ELECTRICAL CONTROLS
AND INDICATORS (Cont)

Figure No.	Index No.	Control Group	Control or Indicator	Function	Remarks
SET-UP CONTROLS (Cont)					
6-2 (Cont)	Group 2 (Cont)	LINES/- INCH (Cont)	Digital readout (Cont)	<p>servo control of lathe feedscrew drive.</p> <p>This readout will display any pitch in use if between 95 and 600 lpi.</p>	<p>Readouts are stepped in five-line lpi increments from 100 to 410 lpi; ten-line increments from 410 to 600 lpi.</p> <p>Numerals in readout are displayed by light-emitting diodes (LED's).</p>
			Control knob	Manual selection of base pitch lpi	<p>Read control knob selection in digital readout, above, before starting to cut.</p> <p>If desire to alter base pitch while cutting, use knob in conjunction with lower position of "base pitch" toggle switch, below.</p>
			<u>"base pitch" toggle switch</u>	<p>Lower position prevents LINES/INCH digital readout and DEPTH meter, 3, from following servo controlled lpi and depth-of-cut modifications that occur during cutting. Recalls manual selections to digital readout and meter</p> <p>Upper position allows readout and meter to follow the servo controlled lpi and depth-of-cut modifications that occur during cutting.</p>	Lower position of "base pitch" toggle switch is strictly an operator's convenience used when making an in-process change of base pitch or depth. For lower position, readout and meter will steadily display the knob-selected base pitch and base depth though variable pitch and variable depth systems will continue to operate the same as for the upper position.

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TABLE 6-2. FUNCTIONS OF ELECTRICAL CONTROLS
AND INDICATORS (Cont)

Figure No.	Index No.	Control Group	Control or Indicator	Function	Remarks
SET-UP CONTROLS (Cont)					
6-2 (Cont)	Group 3	DEPTH	0-10v voltmeter	Indicates depth-of-cut control voltage for cutter drive amplifier or cutter head (depending on type of head).	At set-up time, DEPTH meter indicates the manually selected base depth voltage set with DEPTH control knob. During cutting, The Lathe's variable depth circuits will automatically deepen the cut, varying the DEPTH meter reading, if and when dictated by contents of audio program. (Base depth reading then can be recalled with "base pitch" toggle switch, 2, if desired. See 2 above.)
			Control knob	Adjusts base depth-of-cut control voltage indicated by 0-10v voltmeter, above.	<p><u>If using advance ball cutter head:</u> program controlled deepening of cut will be indicated by lower voltage readings on meter.</p> <p><u>If using floated head:</u> program controlled deepening of cut will be indicated by higher voltage readings on meter.</p> <p>See A or B as appropriate, in paragraph 6-8 for recommended DEPTH control knob adjustment and expectable readings on DEPTH meter.</p>

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TABLE 6-2. FUNCTIONS OF ELECTRICAL CONTROLS
AND INDICATORS (Cont)

Figure No.	Index No.	Control Group	Control or Indicator	Function	Remarks
SET-UP CONTROLS (Cont)					
6-2 (Cont)	7 (Cont)	----	TURNTABLE rotary switch (Cont)		Positions marked 45 and 33-7 are used for 7-inch discs (preselect micro-switches marked 7 in microswitch cluster).
OPERATIONAL CONTROLS					
	8	(expansion pitch)	"expand" toggle switch	Upper position switches The Lathe to manual expansion mode. When The Lathe is preadjusted as delivered by L. J. Scully, this will preclude any logically programmed automatic expansion and will disable the expansion "time" switch, 4 above; will override The Lathe's entire variable pitch control system.	Lathe cuts at expansion pitch determined by preset internal EXPAND PITCH adjustment. (See Section V, paragraph 5-5.) While switch 8 is in use, LINES/INCH digital read-out will display the preset manual expansion pitch.
	9A	Push-button switches	"turn-table" (alternate-action switch; lights red)	Starts or stops turntable rotation. Turntable rotates at speed selected with TURN-TABLE switch, 7 above. Also starts or stops vacuum pump.	To verify correct turntable speed, observe appropriate stroboscope pattern in mirror under turntable. See 35 and 36, figure 6-1 and table 6-1.) "Turn-table" switch must be active (button lighted) before cutter head can be dropped by electrical control.
		<p>NOTE</p> <p>Each pushbutton switch is lighted when its respective function is activated; is unlighted at all other times.</p>			

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TABLE 6-2. FUNCTIONS OF ELECTRICAL CONTROLS
AND INDICATORS (Cont)

Figure No.	Index No.	Control Group	Control or Indicator	Function	Remarks
OPERATIONAL CONTROLS (Cont)					
6-2 (Cont)	9A (Cont)	Push- button switches (Cont)	"turn- table" (Cont)		Turntable and vacuum are automatically turned off after cutting concentric locked groove. (See "finish", 10D, below.)
	9B		"feed" (alternate- action switch; lights green)	<p>Turns feedscrew drive motor on or off.</p> <p>Feedscrew drives carriage only when this switch is active (button lighted) and feednut is engaged with lever (2, figure 6-1). (See table 6-1.)</p> <p>Pressing lighted "feed" button to stop feedscrew rotation normalizes lathe system in same way as described for end of finish cycle in 10D below. (Either waiting for programmed completion of finish cycle (10D) or pressing lighted "feed" button is proper way of normalizing.)</p>	<p>"feed must be active (button lighted) and feednut engaged for use of following other functions: lead-in pitch (9C); band pitch (9F); cutterhead drop (10A); finish pitch (10D), and manual expansion pitch (8).</p> <p>"feed" must also be active before cutter head can be dropped by electrical control.</p> <p>When lead-in, expansion, band, or finish is not demanded, feedscrew rotates at rate providing base pitch.</p>

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TABLE 6-2. FUNCTIONS OF ELECTRICAL CONTROLS
AND INDICATORS (Cont)

Figure No.	Index No.	Control Group	Control or Indicator	Function	Remarks
OPERATIONAL CONTROLS (Cont)					
6-2 (Cont)	9F (Cont)	Push-button switches (Cont)	"band" (Cont)	<p>above) is set at "off". Feedscrew rotation at band-pitch rate then will occur only while "band" pushbutton is being pressed; will stop immediately when "band" button is released.</p> <p>"band" button need not be used to start band pitch rotation when "auto"-"manual" BAND switch (see 5 above) is set at "auto" and magnetic tape is properly cued.</p>	<p>When BAND "time" switch is set at position other than "off", feedscrew rotation at band-pitch rate automatically continues to end of the preselected BAND time. ("auto" - "manual" BAND switch may be in either position for BAND "time" switch control of band time.)</p> <p>When band-pitch rotation is discontinued by BAND "time" switch or release of "band" button, feedscrew rotates at expansion-pitch rate for duration of preset EXPANSION time (if any), then is driven at base-pitch rate. (Behaves same as when lead-in pitch is automatically cancelled.)</p>
	10A		"drop" (lights red)	<p>Drops cutter head to disc. Turns on stylus heat at head. Briefly increases vacuum (suction) at vacuum pump. Extinguishes light in "lift" button, 10B.</p> <p>("feed" and "turntable" drive functions must be active. Manual lift lever, 23, figure 6-1, must be</p>	<p>Heating current begins to flow and vacuum (suction) increases as soon as head is down.</p> <p>Vacuum automatically decreases to preadjusted normal amount after a few seconds.</p>

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TABLE 6-2. FUNCTIONS OF ELECTRICAL CONTROLS
AND INDICATORS (Cont)

Figure No.	Index No.	Control Group	Control or Indicator	Function	Remarks
OPERATIONAL CONTROLS (Cont)					
6-2 (Cont)	10A (Cont)	Push- button switches (Cont)	"drop" (Cont)	<p>preset in lower position. Feednut must be engaged.)</p> <p>This button is normally used to drop cutter head only when MODE switch, 6 above, is used in "manual" position.</p> <p>"drop" button is lit-only when head is dropped by electrical control.</p> <p>Re-pressing "drop" button will not lift head but will briefly restore high vacuum (sometimes desirable).</p>	<p>When MODE switch is at "auto", appropriate CUTTER DROP micro-switch on back of carriage automatically drops cutter head at predetermined disc diameter. This microswitch also turns on stylus heat and intensifies suction of vacuum system.</p> <p>Cutter head also may be dropped by twisting manual drop knob (24, figure 6-1) at any time (power on or off) when manual lift lever (23, figure 6-1) is down.</p>
	10B		"lift" (lights green)	<p>Lifts cutter head from disc and discontinues stylus heat at any time pressed when cutter head is down and power is on.</p> <p>Extinguishes light in "drop" button, 10A. ("lift" button is lighted whenever head is lifted by any means, as long as power is on.)</p>	<p>Cutter head will be automatically lifted after cutting concentric (locked) groove or at any time when "feed" is deactivated. (See 10D below and 9B above.)</p> <p>Head also may be lifted (power on or off) by pressing manual drop knob (24, figure 6-1) or raising manual lift lever (23, figure 6-1). Raised position of</p>

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TABLE 6-2. FUNCTIONS OF ELECTRICAL CONTROLS
AND INDICATORS (Cont)

Figure No.	Index No.	Control Group	Control or Indicator	Function	Remarks
OPERATIONAL CONTROLS (Cont)					
6-2 (Cont)	10B (Cont)	Push- button switches (Cont)	"lift" (Cont)		lift lever protects head from accidental drop.
	10C		"fast in" (momentary switch; lights white)	When pressed when feednut is engaged, moves carriage from right to left for rapid pre-positioning. Releasing this button immediately stops carriage.	<u>Suggestion:</u> Move carriage closely to right of desired position using carriage handwheel (1, figure 6-1); then engage feednut and drive carriage precisely to desired position with "fast in" button.
	10D		"finish" (lights yellow)	Starts feedscrew rotation at finish-pitch rate. "finish" button need not be used to start finish-pitch rotation of feedscrew when "auto"- "manual" BAND switch (see 5 above) is used in "auto" position and magnetic tape is properly cued.	When "auto"- "manual" BAND switch is at "auto", properly cued tape in tape transfer machine automatically starts finish-pitch rotation of feedscrew. When "auto"- "manual" BAND switch is in either position, finish-pitch rotation of feedscrew is automatically discontinued (by appropriate FINISH microswitch beneath carriage) at predetermined disc diameter. At that time, light in "finish" and "feed" buttons will automatically go out with feed drive system reset to off condition. The concentric (locked) groove is automatically cut as soon as

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TABLE 6-2. FUNCTIONS OF ELECTRICAL CONTROLS
AND INDICATORS (Cont)

Figure No.	Index No.	Control Group	Control or Indicator	Function	Remarks
OPERATIONAL CONTROLS (Cont)					
6-2 (Cont)	10D (Cont)	Push-button switches (Cont)	"finish" (Cont)		feed is off. After an internally preset time of about 1-1/5 revolutions, cutter head is automatically lifted, turntable drive and vacuum are stopped, input signals are disabled at cutter amplifier, and tape transfer machine is stopped. (Light comes on in "lift" button; goes out in "drop", "turntable", "audio", and "tape" buttons.)