



Maintenance and Operators Handbook for T20 Lathe

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CAUTION

IMPROPER OPERATION OR IMPROPER MAINTENANCE OF THIS LATHE MAY CAUSE SERIOUS BODILY INJURY.

DO NOT OPERATE LATHE UNTIL YOU HAVE RECEIVED OPERATING AND SAFETY INSTRUCTIONS FROM YOUR EMPLOYER.

FOLLOW ALL SAFETY PRACTICES PRESCRIBED BY YOUR EMPLOYER AND OUTLINED IN THE OPERATORS MANUAL.

ALWAYS AVOID UNSAFE CONDITIONS OF OPERATION SUCH AS EXCESSIVE FEEDS AND SPEEDS.

ALWAYS BE SURE ALL SAFETY DEVICES ARE IN GOOD OPERATING CONDITION (SEE MANUAL).

ALWAYS BE CERTAIN THAT SERVICE IS PERFORMED ONLY BY QUALIFIED PERSONNEL.

OPERATORS HANDBOOK

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(when furnished)

MACHINE SPECIFICATIONS

KESTREL		20"
SWING OVER BED		20"
SWING OVER CROSS-SLIDE		12"
CENTER DISTANCE		40", 60", 80", 120"
SPINDLE NOSE		D1-8"
SPINDLE NOSE - OPTIONAL		D1-11"
SPINDLE BORE		3.06"
SPINDLE BORE - OPTIONAL		4.06"
SPINDLE SPEEDS - 3 RANGES		40 - 2250
SPINDLE DRIVE - STANDARD		20 HP
SPINDLE DRIVE - OPTIONAL		25 HP
CROSS-SLIDE TRAVEL (X)		12"
LONGITUDINAL TRAVEL (Z)		36", 56", 76", 116"
RAPID TRAVERSE (X-AXIS) I.P.M.		200
RAPID TRAVERSE (Z-AXIS) I.P.M.		200
POSITIONING		.00025"
REPEATABILITY		.0002"
TAILSTOCK QUILL DIAMETER		2.94"
TAILSTOCK QUILL TAPER		MT5
TAILSTOCK QUILL STROKE		7"

STANDARD EQUIPMENT

TOOLPOST	QUICK CHANGE
TOOL HOLDERS (5 PC. SET)	1.25 SQ.
3-JAW UNIVERSAL CHUCK	12"
WORKLIGHT	✓
COOLANT	15 GALLON

OPTIONAL

PNEUMATIC CHUCK	12"
8-STATION DISK TURRET	✓
4-JAW INDEPENDENT CHUCK	16"

1. LIFTING AND INSTALLATION INSTRUCTIONS

1.1 Lifting the machine.

The machine should be lifted using a forklift truck as illustrated in Figure 1, page 3. Ensure that the forklift truck has sufficient capacity. Approximate machine weights are as follows:-

2040.....	4,800 lb
2060.....	5,100 lb
2080.....	5,400 lb.
20/120.....	6,000 lb

With reference to Figure 1, page 3, ensure that wooden blocks placed between the forks and the bed are sized to provide clearance in the areas indicated; under no circumstances are the forks to contact the sheet metal covers when lifting the machine.

1.2 Inspection

Check your delivery slip against the accessories that were ordered with the machine. If there is a shortage or error, report it to **ORIGINAL MACHINE TOOLS INC.** immediately, giving the serial number which is stamped in the recessed face on top of the bed at the tailstock end of the machine.

1.3 Cleaning

All unpainted parts of the machine have been coated with an anti-rust compound. This should be thoroughly removed after the machine is installed and before moving the carriage, cross slide or tailstock.

To remove anti-rust compound, wipe with a clean cloth.

All unpainted surfaces should be coated immediately with a film of light machine oil to prevent rust.

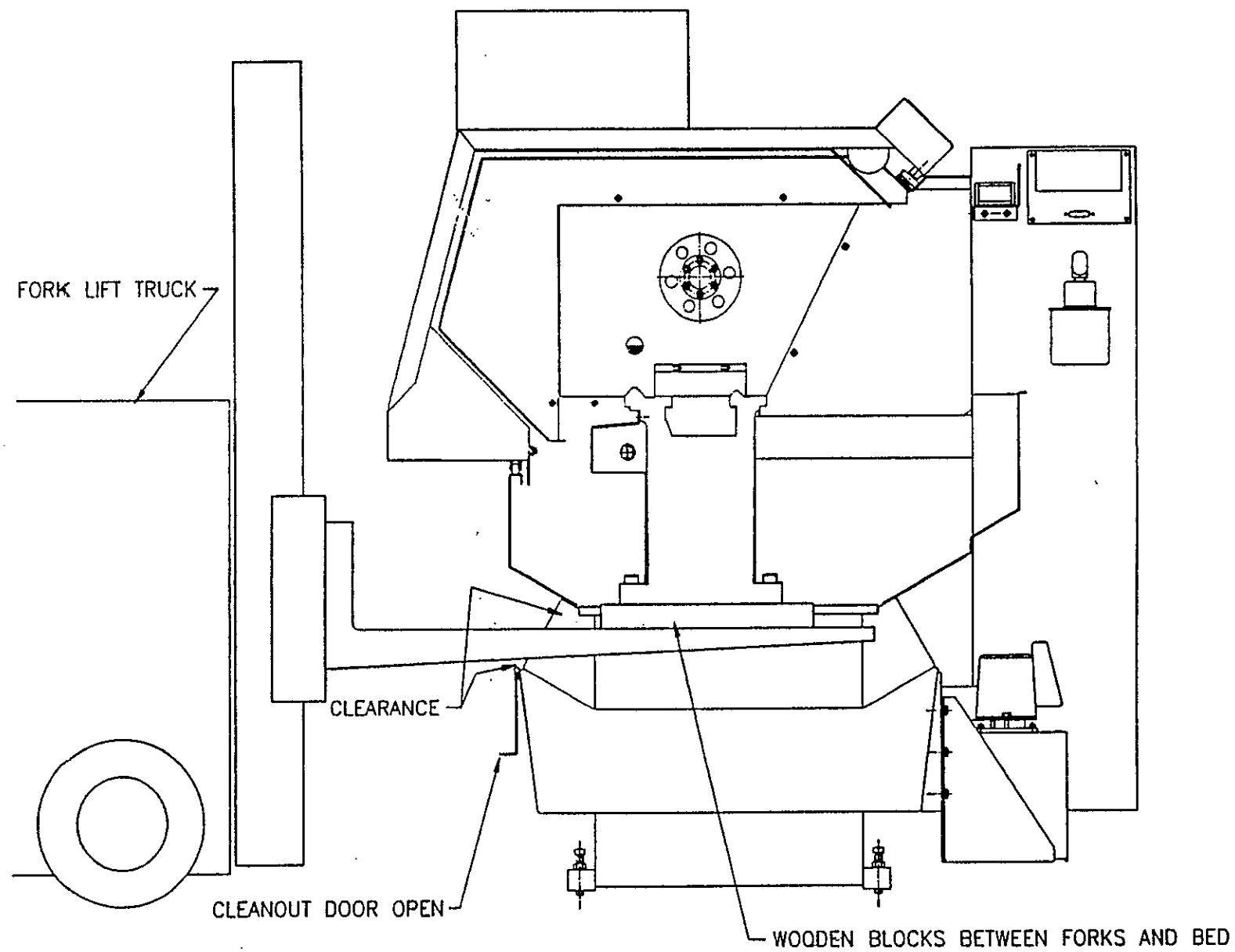


FIGURE 1 - LIFTING THE MACHINE

1.4 Installation

For proper operation, the machine should be set on a substantial floor capable of supporting a uniform pressure of 50 P.S.I. To secure the machine on its foundation, use anchor bolts or lag screws as shown on Floor Plan, Figure 2, page 5.

After the machine is in position, it must be levelled by use of the square head set screws provided, before tightening the lag screws. It will be necessary to use 4" square steel plates, about $\frac{3}{4}$ " thick, under the levelling screws to prevent the ends of the screws from sinking into the floor.

Use a precision level placed lengthwise and crosswise on the bed. To take a reading of the level for the crosswise levelling of the bed, use parallel bars placed on the flats of the bed.

After levelling within 0.0005 in/ft, the pedestals should be lagged to the floor and the levelling rechecked. Recheck the level of the machine at regular intervals.

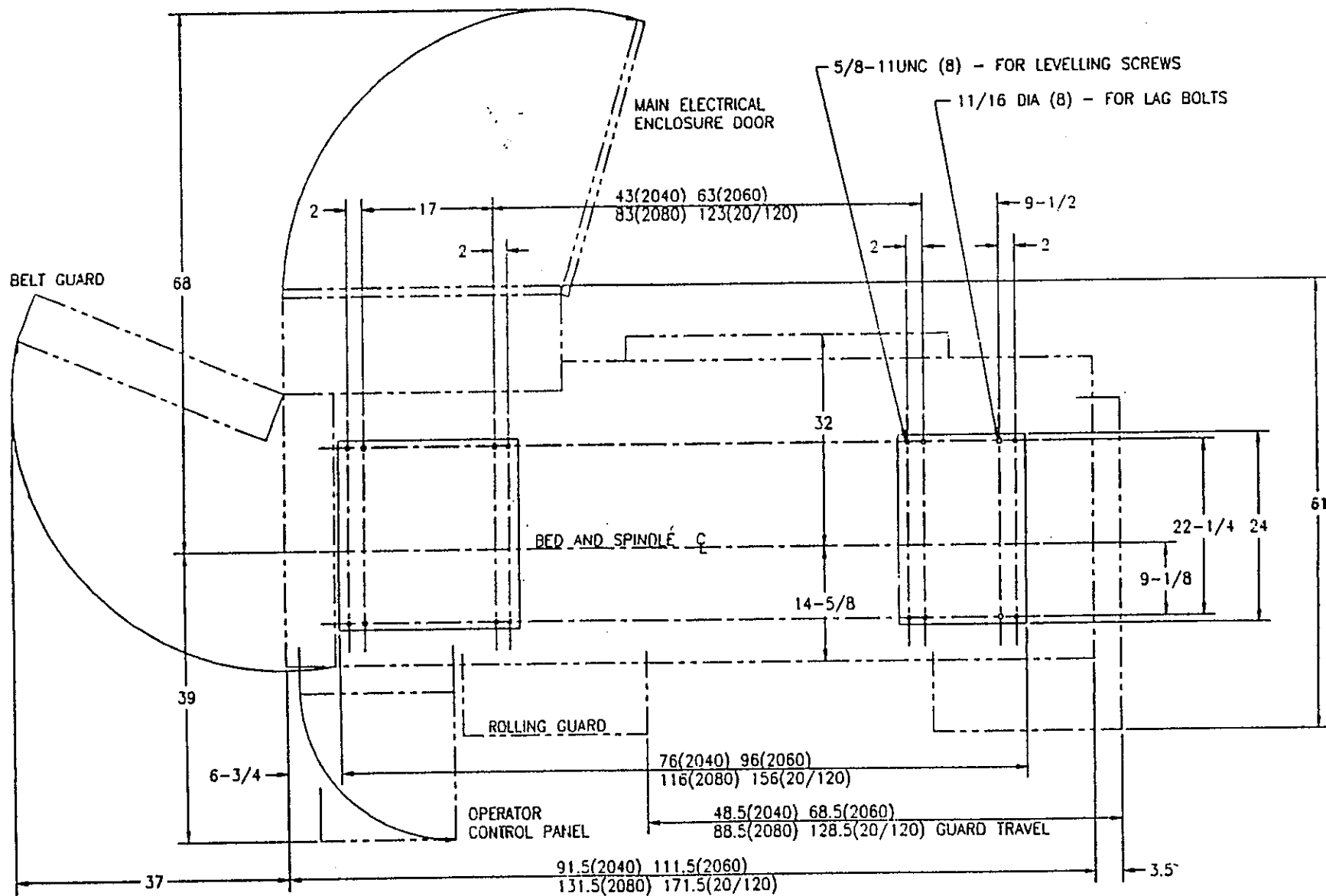


FIGURE 2 - FLOOR PLAN - 2040/2060/2080/20-120 CNC LATHE A-116234

2. LUBRICATION

2.1 Headstock

The headstock is lubricated by a self contained recirculating system, powered by an electric pump. In the event of pump failure, operation of the spindle will be disabled automatically.

Depending on operating conditions, usually every six months, the headstock should be drained and refilled to the level shown in the oil window adjacent to the spindle nose.

Light mineral oil with a viscosity of 100 SUS at 100° F, is recommended.

UNDER NO CIRCUMSTANCES IS AN OIL EXCEEDING THE RECOMMENDED VISCOSITY TO BE USED.

Access to the oil filler and drain plugs is obtained by opening the belt guard. For locations see Figure 3, page 8.

NOTE: Always turn the main disconnect switch to OFF before opening the belt guard.

2.2 Tailstock

The tailstock is lubricated by two oilers located on top of the tailstock housing and by applying lubricant directly to the bedway surfaces.

At least every eight hours, clean and lubricate way surfaces and top up the oiler.

A way lubricant (Sunoco "WAYLUBE 68" or equivalent) with a viscosity of 300 - 350 SUS at 100° F is recommended.

2.3 Ballscrews and Way surfaces

Ballscrew bearings are pre-lubricated with grease and sealed, so require no additional lubrication.

Ballnuts and way surfaces are automatically lubricated at timed intervals by a lubricator located on the side of the main electrical enclosure at the rear of the machine.

2. LUBRICATION Cont'd

2.3 Ballscrews and Way surfaces cont'd

A way lubricant (Sunoco "WAYLUBE 68" or equivalent) with a viscosity of 300 - 350 SUS at 100° F is recommended.

If the lubricant in the reservoir is not replenished, a level switch will automatically disable the automatic mode of the machine and display an alarm message. It is recommended that the lubricator be topped up every eight hours.

Discharge volume of the lubricator can be reduced if desired by adjusting as indicated in Figure 4 below.

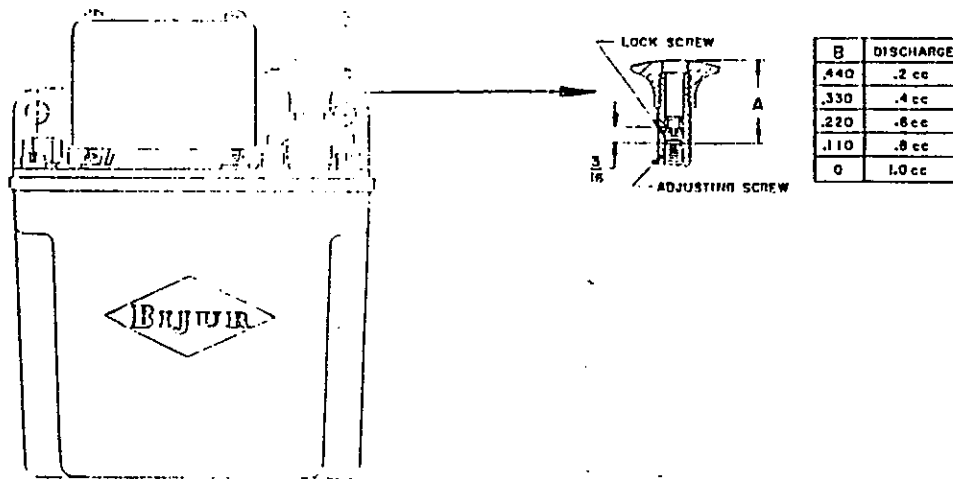


Figure 4

The lubricator is supplied set at maximum stroke, i.e. maximum discharge. For reduced delivery, remove lock screw, measure A, turn adjusting screw clockwise increasing A by B dimension.

The lubricator is fitted with an inlet filter located inside the reservoir. The filter should be inspected periodically and cleaned or replaced as required.

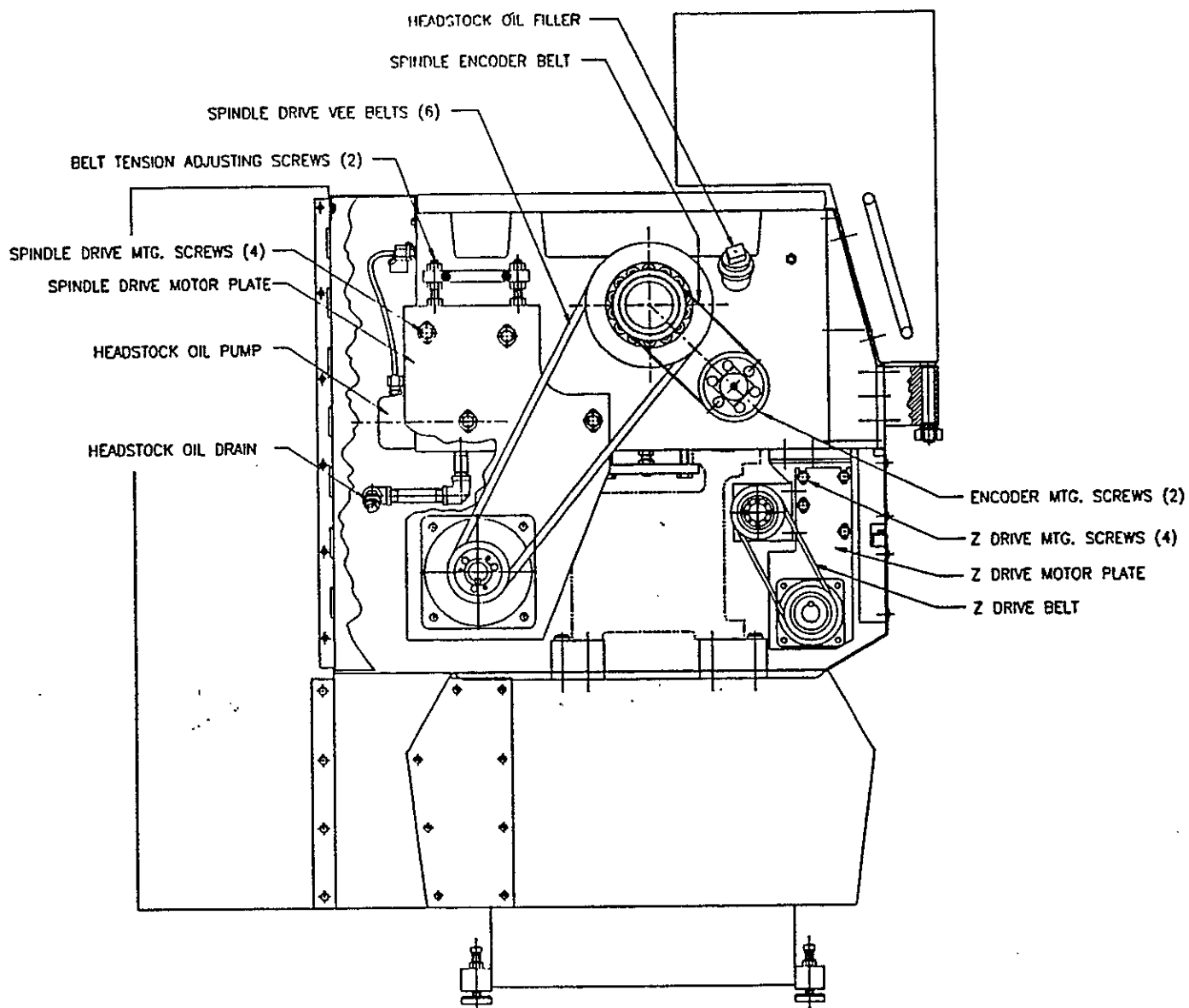


FIGURE 3 — HEADSTOCK LUBRICATION AND DRIVE BELTS

A-116235

3. MAINTENANCE

3.1 Vee belt replacement and tensioning

The spindle is driven by six (6) vee belts which should be tensioned to the lowest tension at which the belts will not slip under maximum loading.

With reference to Figure 3, page 8, slacken the four spindle drive mounting screws just enough to allow movement of the motor plate. Apply upward or downward pressure to slacken or tighten the belts and retighten the mounting screws. If belts are being replaced, the spindle encoder belt must first be removed. See para. 3.2.

Check the tension of new vee belts frequently during the first few days of operation and periodically thereafter.

If a vee belt slips under load, TIGHTEN it, bearing in mind that excessive tension shortens belt life.

3.2 Toothed belt replacement and tensioning

The Z drive ballscrew, X drive ballscrew and spindle encoder are all driven by toothed belts. Locations of the Z drive and spindle encoder belts are shown on Figure 3, page 8.

The X drive belt is located in the rear of the saddle assembly and is accessed by removing the belt guard #C-115905 (see page 30 in the parts section.)

Toothed belts should only be tensioned just enough to remove any slack; further tightening is of no benefit and only results in belt life reduction and unnecessary load on bearings.

The Z drive belt is tensioned thus:-

Slacken the four Z drive mounting screws, slide the motor plate to achieve the correct tension, then retighten the screws. Check the tension and re-adjust if necessary.

The encoder belt is tensioned similarly, except that there are only two mounting screws.

The X drive belt is tensioned by slackening the four motor mounting screws and sliding the motor plate to achieve the correct tension; the screws are then retightened. Ensure that the belt guard is replaced after adjusting the belts.

3. MAINTENANCE Cont'd

3.3 Cross Slide Ways

Wear in the cross slide ways may be taken up by carefully tightening (clockwise) the seven set screws located along the lower right hand side of the cross slide. Care must be taken to ensure that the screws are tightened gradually and evenly whilst maintaining free movement of the cross slide.

4. PARTS ORDERING PROCEDURE

1. Always quote the machine serial number.
This is found stamped in the recessed face on top of the bed at the tailstock end.
2. Refer to the appropriate assembly and individual part numbers taken directly from the illustrations.

5. LATHE SAFETY

Every effort has been made in the design and production of the lathe to comply with statutory safety requirements and to provide a fundamentally safe machine tool. In the further interests of safety, attention should be given to the following notes:

5.1 Machine use

Responsibility for the following points with respect to machining a component must inevitably rest with the user.

- (1) Ensure that the operator has had suitable training and possesses the required degree of skill and experience to undertake the work.
- (2) Provide suitable work holding and/or supporting equipment: chucks, steadies, revolving centers etc.
- (3) Ensure that suitable tooling is provided and correctly mounted.
- (4) Ensure that suitable feeds and speeds are selected.
(If in doubt select low).
- (5) Use guard provided at all times.

5.2 Lathe Safety Rules

- (1) Read and understand operation notes before attempting to use the machine.
- (2) Keep lathe work areas clean.
- (3) Keep area surrounding machine tidy.
- (4) **KNOW HOW TO STOP THE MACHINE BEFORE STARTING IT.**
- (5) **DO NOT** interchange chucks or other spindle mounted items between lathes without checking for correct locking.
- (6) We recommend only high speed chucks.
- (7) Before operating the lathe, note the maximum rated speed for chucks and face plates as supplied by the manufacturer.
- (8) Remove chuck key immediately after use.
- (9) Check load capacity of revolving centers.
- (10) Ensure guard is in position before starting machine.
- (11) **DO NOT** use cracked or chipped tools.
- (12) **STOP MACHINE IMMEDIATELY IF ANYTHING UNEXPECTED HAPPENS.**
- (13) **DO NOT** touch revolving chuck, spindle or workpiece.
- (14) **DO NOT** remove work from the machine without retracting tool to a safe position.
- (15) Use E-STOP button when leaving machine unattended.

5. LATHE SAFETY cont'd

5.3 Personal Safety Rules

- (1) Report any accident as soon as it happens.
- (2) Wear safety glasses.
- (3) Wear safety shoes.
- (4) Use barrier creams provided.
- (5) Wear your overalls buttoned up.
- (6) Roll sleeves up or button the cuffs.
- (7) Keep hair short or wear a cap.
- (8) Use the correct size wrench at all times.
- (9) Be careful of, and remove, all burrs and sharp edges.
- (10) When lifting a heavy workpiece, use the correct type of sling, ensuring that it is not worn or damaged and that its safe working load is not exceeded.
- (11) Stand clear when lifting workpieces or equipment by crane.
- (12) Obtain assistance when mounting heavy or awkwardly shaped workpieces.
- (13) DO NOT wear rings, watches, ties, etc.
- (14) DO NOT keep tools (scribers, etc.) in overall pockets.
- (15) DO NOT wash hands in coolant.
- (16) DO NOT remove chips with bare hands; use a rake or brush.
- (17) DO NOT manually lift heavy equipment.
- (18) DO NOT use files, scrapers, etc., on machine tools.
- (19) DO NOT lean on the machine.
- (20) DO NOT tamper with electrical equipment.

6. TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	CORRECTION
Vibration	Loose levelling screws	Set all screws so that they bear evenly on levelling plates.
	Torn or mismatched V-belts.	Replace V-belts with matched set.
	Work or chuck out of balance operating at high spindle speeds.	Balance chuck or reduce spindle speed.
Chatter	Tool bit improperly ground or not on center	Reground tool bit or adjust tool holder so that area of contact between tool bit and work is decreased. Avoid extreme negative rake.
	Tool overhang too great	Keep point of tool bit as close as possible to tool holder.
	Using improper cutting speed.	Reduce or increase spindle speed.
	Feed rate too high or too low.	Reduce or increase feed.
	Gib of cross slide loose.	Adjust gib.
	Spindle bearings worn or loose.	Adjust spindle bearings.
	Work improperly supported	Adjust tailstock center. Use steady rest or follow rest for long slender shafts. Minimize tailstock barrel extension.
	Vibration	See "Vibration" trouble above.

6. TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	CORRECTION
Work not turned straight	Headstock and tailstock not aligned.	Align tailstock center.
	Work improperly supported.	Use steady rest or follow rest. Reduce overhang from chuck.
	Bed not level.	Re-level bed using precision level.
Work out of round.	Work loose between centers.	Adjust tailstock center.
	Centers excessively worn. Work centers out of round.	Regrind centers. Lap work centers.
	Loose headstock spindle bearings.	Adjust headstock spindle bearings.
Cross slide movement does not coincide with control.	Gib setting too tight or too loose.	Adjust gibs.
	Work is too long and slender.	Use steady rest or follow rest for long slender shafts.

Power On

Push the control on button on the main control panel.

When the main CNC screen appears the **RESET** button will flash, push **RESET** to clear the message.

Manual Operation

In order to perform any axis movements the machine axis must be sent to home position.

Home sequence:

F1 HOME (Main Home)

After power off the control must be homed. To initiate a home sequence push **ESC** until the Main screen is reached, then push **F1 HOME**. A message requesting that **Cycle Start** button be pushed will appear on the screen and the **Cycle Start** button will start flashing. Pushing **Cycle Start** will start the home sequence and when it is finished the **Main** screen will return.

F10 HOME - HERE

Occasionally the machine may be shut down in a position where a full home sequence cannot be performed because of part or tool interference. The function of **F1 HOME - F10 HERE** will enable the machine to be homed at its current position without moving the slides. This function allows the operator to move the slides manually without doing a complete home sequence to clear the work or tool interference. The machine should not be run until a complete home is performed as all limits are based on the home position.

Jog:

F2 JOG

Upon pressing F2 JOG from the Main screen the following screen will appear:

Runtime: 0:00:00		Main-Jog		Active :04587																	
Current		Next																			
X	+00.0000	X	+00.0000																		
Z	+20.0000	Z	+20.0000																		
<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px; text-align: center;">↖ -Z-X</td> <td style="padding: 5px; text-align: center;">↑ -X</td> <td style="padding: 5px; text-align: center;">↗ +Z-X</td> <td style="padding: 5px; text-align: center;"> </td> </tr> <tr> <td style="padding: 5px; text-align: center;">← -Z</td> <td style="padding: 5px; text-align: center;"> </td> <td style="padding: 5px; text-align: center;">+Z →</td> <td style="padding: 5px; text-align: center;"> </td> </tr> <tr> <td style="padding: 5px; text-align: center;">↙ -Z+X</td> <td style="padding: 5px; text-align: center;">↓ +X</td> <td style="padding: 5px; text-align: center;">↘ +Z+X</td> <td style="padding: 5px; text-align: center;"> </td> </tr> <tr> <td style="padding: 5px; text-align: center;"> </td> <td style="padding: 5px; text-align: center;"> </td> <td style="padding: 5px; text-align: center;"> </td> <td style="padding: 5px; text-align: center;"> </td> </tr> </table>				↖ -Z-X	↑ -X	↗ +Z-X		← -Z		+Z →		↙ -Z+X	↓ +X	↘ +Z+X						<pre> Comp : Cancelled * Tool : 01(01) XLength : 00.0000 ZLength : 00.0000 Radius : 00.0469 WorkCord : 1 (G54) Interp : Linear (Feed) Feed : 000.0150 ipr <100%> : 000.0150 ipr Units : Abs/English Cycle : Cancelled Dwell : 0000.00 sec Spindle : 0000.0 rpm [3] <100%> : 0000.0 rpm(OFF) Coolant : Off </pre>	
↖ -Z-X	↑ -X	↗ +Z-X																			
← -Z		+Z →																			
↙ -Z+X	↓ +X	↘ +Z+X																			
F1 Slow	F2 Rapid	F3 ↔	F4 1	F5 .1	F6 .01	F7 .001	F8 .0001	F9 G54-Z	ESC Exit												

Note: The F9 key may be changed by parameter to store the Z axis (G50) offset.

The F keys across the bottom of the screen are used to select the type of jog.

F1 SLOW JOG

The **FEED OVERRIDE** switch on the main or remote panel is used to control the feed-rate.

F2 RAPID JOG**F3 CONTINUOUS JOG**

In this mode the axis will continue to move until the axis key is released.

F4 - F8 INCREMENTAL JOG

In this mode the axis will move the selected amount each time the axis key is pushed.

F9 G54 Z

This key sets a work offset (G54) for the Z axis at the current machine position. The **ESC** (escape) key exits the jog mode and returns to the Main screen

KEYBOARD

The keyboard diagram on the jog screen represents the numeric keyboard on the main panel and shows the axis direction for the corresponding key.

Handwheel:

F3 HDW

The Handwheel mode is used to move the axis around using the electronic handwheel on the remote panel. It is used to accurately position the axis while setting tool offsets floating zeroes and part alignment. Upon pushing the F3 HDW key from the Main menu the following screen is displayed:

Runtime: 8:00:00		Main-Hdw		Active :04587	
	Current		Next		
X	+00.0000		+00.0000		
Z	+20.0000		+20.0000		
Comp : Cancelled * Tool : 01(01) XLength: 00.0000 ZLength: 00.0000 Radius : 00.0469 WorkCord: 1 (G54) Interp : Linear (Feed) Feed : 000.0150 ipr (100%) : 000.0150 ipr Units : Abs/English Cycle : Cancelled Dwell : 0000.00 sec Spindle : 0000.0 rpm [3] (100%) : 0000.0 rpm(OFF) Coolant : Off					
F1	F2			F7	ESC
X	Z			XTool	Exit

Note: The increment value may be changed by parameter.

The F keys F1 and F2 at the bottom of the screen and the 4 jog keys on the remote panel are used to select which axis will be moved by the handwheel. The feedrate override switch will determine the value of the move for each increment on the handwheel.

PROCEDURE FOR SETTING TOOL LENGTH AND WORK OFFSETS

F7 XTOOL ZTOOL

The **F7 XTOOL** or **ZTOOL** is used to set tool length offsets into the tool table. In the handwheel mode a tool can be moved to a desired position. When **F7 XTOOL** is pressed the control will ask for the tool number. It then asks for the position of the tool (i.e. Z position for the Z axis or diameter for the X axis).

Procedure

1. Make sure all G50 offsets are zero. They are zeroed on power up or can be zeroed by using **F7 (PARMS) - F2 (COORD)** and editing the G50 offsets.
2. Make sure the G54 X offset is zero. It can be zeroed by using **F7(PARMS) F3 (COORD)** and editing the G54 offset. (This relates to the material length.)
3. Make sure tool #1, Z length , is zero. It can be zeroed by using **F7(PARMS)- F4 (TOOLS)** and editing the tool table.
4. Make sure all tool wear offsets are zero. They can be zeroed by using **F7 (PARMS) - F4 (WEAR)** and editing the wear offset table.
5. Make tool #1 active. Do an **MDI T0101 M6**.
6. Using the handwheel, touch the tip of the tool to the face of the material (or line up the center of the tool tip to the face of the part for diamond shaped turning tools). Then press **F8 (G54 - Z)**. This relates to the material length entered in programs for the graphics.
7. Using the handwheel, make a light turning cut on the diameter of the material. Press **F7 (XTOOL)** and enter "1" for the tool number. Then enter the measured diameter of the cut.

For drills, center the drill at the center of the material. Press **F7 (XTOOL)** and enter "1" for the tool number. Then enter "0" for the position.

The X offset for diamond shaped facing tools can be set like a drill or by lining up the center of the tool tip to a diameter on the part. Press **F7 (XTOOL)**, and then enter the tool number and position.

8. Make the next tool active. Do an **MDI T#### M6**.

9. Using the handwheel, touch the tip of the tool to the face of the material (or line up the center of the tool tip to the face of the part for diamond shaped turning tools). Then press **F7 (ZTOOL)** and enter the tool number, then enter "0" for the tool position.
10. Using the handwheel, make a small turning cut on the diameter of the material. Press **F7 (XTOOL)** and enter the tool number. Then enter the diameter of the cut for the position.

For drills, center the drill at the center of the material. Press **F7 (XTOOL)** and enter the tool number. Then enter "0" for the position.

The X offset for diamond shaped facing tools can be set like a drill or by lining up the center of the tool with a diameter on the part. Press **F7 (XTOOL)**, and then enter the tool number and position.

11. Go to step #8 for the next tool.
12. Enter the tool types and tool nose radii in the tool table by pressing **F7 (PARMS) - F3 (TOOLS)** and then editing the tool table. **F1 (TOOL>)** toggles the tool type.

Some sample tool types:

- 1- inside turning (from the chuck to the tailstock)
- 2- inside turning (from the tailstock to the chuck)
- 3- outside turning (from the tailstock to the chuck)
- 4- outside turning (from the chuck to the tailstock)
- 5- ???
- 6- inside threading
inside turning using diamond insert
boring tools using a diamond insert
- 7- drills
face grooving
facing tools
- 8- outside threading
outside turning using diamond insert
cut off tools
outside diameter grooving

note : The tool type relates to the imaginary tool tip and how the tool offsets are set.

Automatic operation

F4 RUN

Run is used to execute the active program. Upon pushing the RUN button the following screen appears.

Runtime: 0:00:00		Main-Run		Active :04587				
Current X +00.0000 Z +20.0000 Next X +00.0000 Z +20.0000								
Comp : Cancelled * Tool : 01(01) XLength: 00.0000 ZLength: 00.0000 Radius : 00.0469 WorkCord: 1 (G54) Interp : Linear (Feed) Feed : 000.0150 ipr (100%) : 000.0150 ipr Units : Abs/English Cycle : Cancelled Dwell : 0000.00 sec Spindle : 0000.0 rpm [3] (100%) : 0000.0 rpm(OFF) Coolant : Off								
F1 Start	F2 Old	F3 Block	F4 OStop	F5 BNDP	F6 Displ	F7 Menu	F8 Drv	ESC Esc

After the above screen appears, **F1 START** would be pushed to run the active program shown in the upper right hand box and the following screen would appear.

Runtime: 0:00:00		Main-Run _Start		Active :04587	
Current X +00.0000 Z +20.0000 Next X +00.0000 Z +20.0000					
Comp : Cancelled * Tool : 01(01) XLength: 00.0000 ZLength: 00.0000 Radius : 00.0469 WorkCord: 1 (G54) Interp : Linear (Feed) Feed : 000.0150 ipr (100%) : 000.0150 ipr Units : Abs/English Cycle : Cancelled Dwell : 0000.00 sec Spindle : 0000.0 rpm [3] (100%) : 0000.0 rpm(OFF) Coolant : Off					
F1 First	F2 Block	F3 Tool			ESC Abert

The **F1 FIRST** key is automatically selected when entering this screen. Therefore if it is desired to run the active program from the beginning, all that is necessary is to push the **CYCLE START** button. If **F2 BLOCK** is pushed, the control will request that the desired block or sequence number (to start the program from) be typed in, followed by **ENTER**. If the **CYCLE START** button is pressed the program will start running from the selected block number. If **F3 TOOL** is pressed, the control will request a tool number to start from.

*Note: If the block or tool number is not found in the active program, a message will say it was not located and **CYCLE START** will start the program from the beginning.*

Runtime: 0:00:00		Main-Run		Active :04587	
Current		Next			
X	+00.0000	X	+00.0000		
Z	+20.0000	Z	+20.0000		
				Comp : Cancelled * Tool : 01(01) XLength: 00.0000 ZLength: 00.0000 Radius : 00.0469 WorkCord: 1 (G54) Interp : Linear (Feed) Feed : 000.0150 ipr (100%) : 000.0150 ipr Units : Abs/English Cycle : Cancelled Dwell : 0000.00 sec Spindle : 0000.0 rpm [3] (100%) : 0000.0 rpm(OFF) Coolant : Off	
Block 13 G00 X123.4567					
		F3 Block	F4 OStop	F5 RSIdp	F6 Displ
			F8 Dry	F9 Halt	ESC Esc

This screen is the basic run screen after **CYCLE START** has been pressed. It has two new additions, a block number display and **F9 HALT**. The block number display shows the current line being executed as the program runs. The **HALT** key is similar to **FEEDHOLD** in that when pushed the machine will stop. However unlike **FEEDHOLD**, the **HALT** also exits the **RUN** mode and allows a new program to be started.

Once a program has been **HALTED** the **RESUME** feature of the control becomes active. The **F9 RESUM** key will now be displayed on the **RUN** screen instead of the **F9 HALT** key. A program may be **RESUMED** as long as one of the following functions has not been performed: **VERIFY**, **MDI**, **HOME**, **E-STOP** or modifying parameters. If not the axis may be moved away from the work by **JOG** or **HANDWHEEL** and the **RESUME** remains active.

Note: For further information on the resume function, refer to the programming manual section 5.5.1

MDI Mode

The MDI mode is for manual data input. All programmable functions may be entered from this mode. When the **F5 MDI** key is pressed from the Main menu the following screen will appear:

Runtime: 0:00:00		Main-MDI		Active :04587	
	Current		Next		
X	+00.0000		+00.0000		
Z	+20.0000		+20.0000		
				Comp : Cancelled Tool : 01(01) XLength: 00.0000 ZLength: 00.0000 Radius : 00.0469 WorkCord: 1 (G54) Interp : Linear (Feed) Feed : 000.0150 ipr (100%) : 000.0150 ipr Units : Abs/English Cycle : Cancelled Dwell : 0000.00 sec Spindle : 0000.0 rpm [31 (100%) : 0000.0 rpm(OFF) Coolant : Off	
<MDI> G00 X123.4567 Z123.4567 M03 S400					
F1 GCode	F2 MCode			F6 Displ	ESC Done

The line above the softkey template will display the entered MDI command. When the data is entered and the **ENTER** key is pressed, the control will prompt you to push **CYCLE START** to execute the command.

F1 GCODE

The **F1 GCODE** key will display a list of all usable G-Codes.

F2 MCODE

The **F2 MCODE** key will display a list of all usable M-Codes.

To change spindle ranges in MDI. Push **F5 MDI** from the main screen. Type **M41 ENTER**. At this time the control will prompt for **CYCLE START**. Push **CYCLE START**, the text line will be cleared and **CYCLE START** lamp will go out when the command is completed.

To start the spindle in a clockwise direction.
Type **M03 S400 ENTER. CYCLE START**

Note : A spindle range must be selected before a range is selected.

Spindle Horsepower

The Kestrel series lathes are equipped with a multi range variable speed spindle motor and drive. It is the machine programmers responsibility to program the correct speed / horsepower range for the cut required. This is accomplished by using a M-CODE (miscellaneous code) to select the correct range.

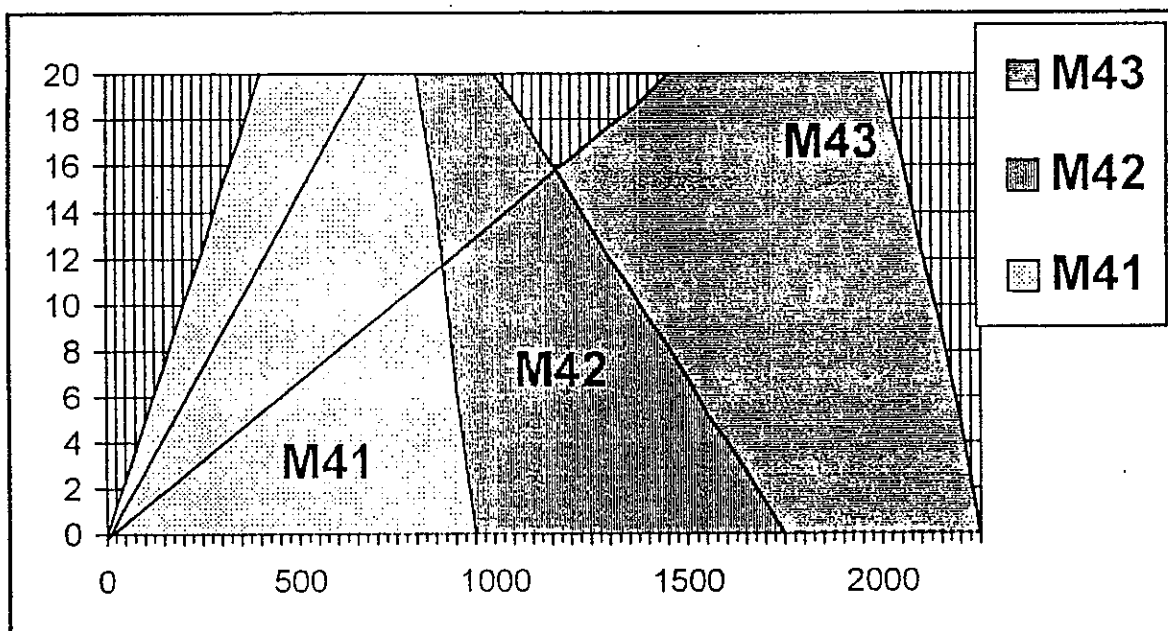
Spindle Ranges:

Kestrel 20"

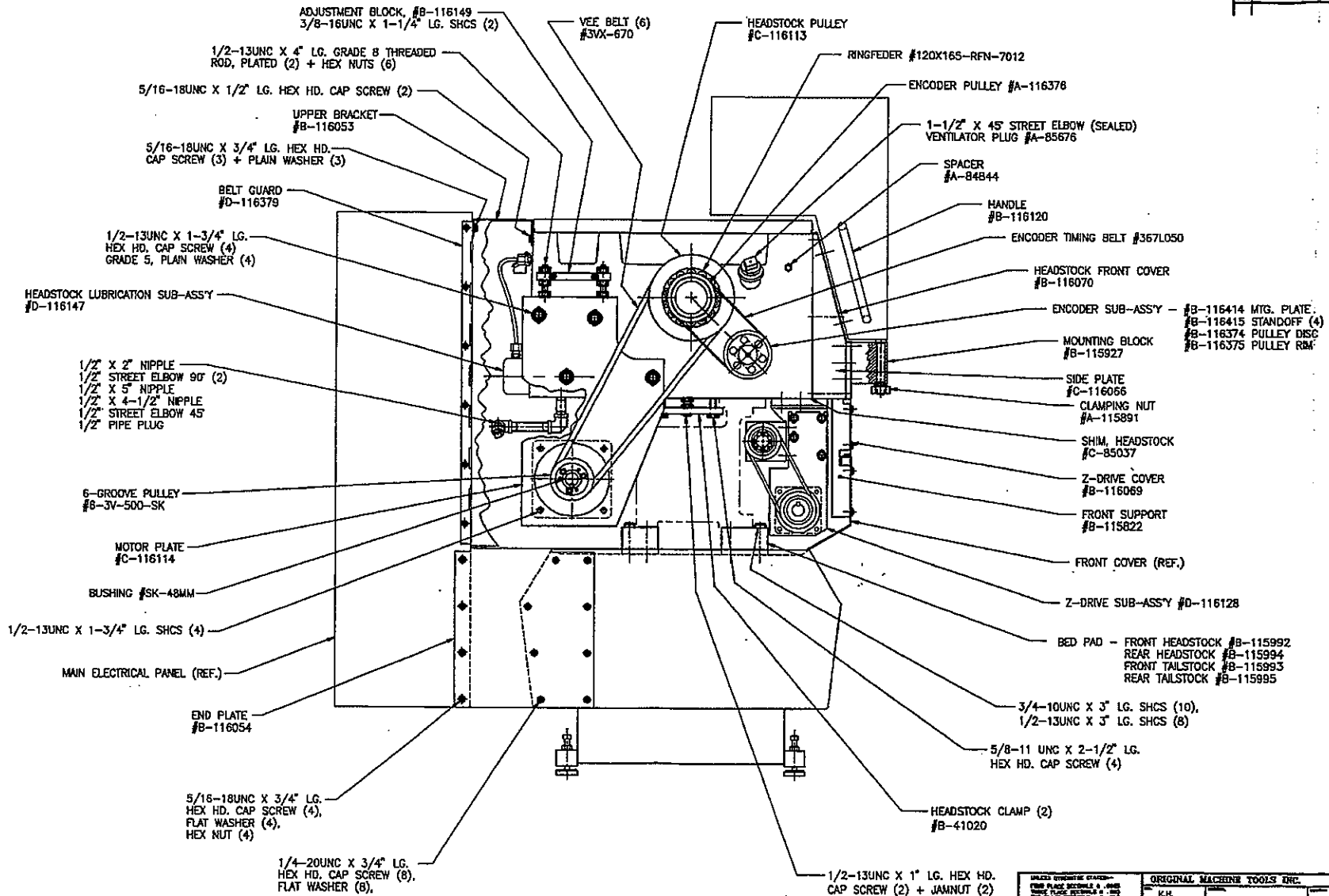
M41	LOW SPEED	HIGH TORQUE	40 -500 RPM
M42	MED SPEED	MED TORQUE	50 -1000 RPM
M43	HIGH SPEED	LOW TORQUE	100- 2250 RPM

It is very important to select the spindle range with sufficient horsepower to obtain the desired cut. Material depth of cut, spindle speed and tooling must be taken into account when making the range selection. The following chart shows the available horsepower in the three ranges. Available horsepower is the intersection point of spindle speed with the hatched area under the curve.

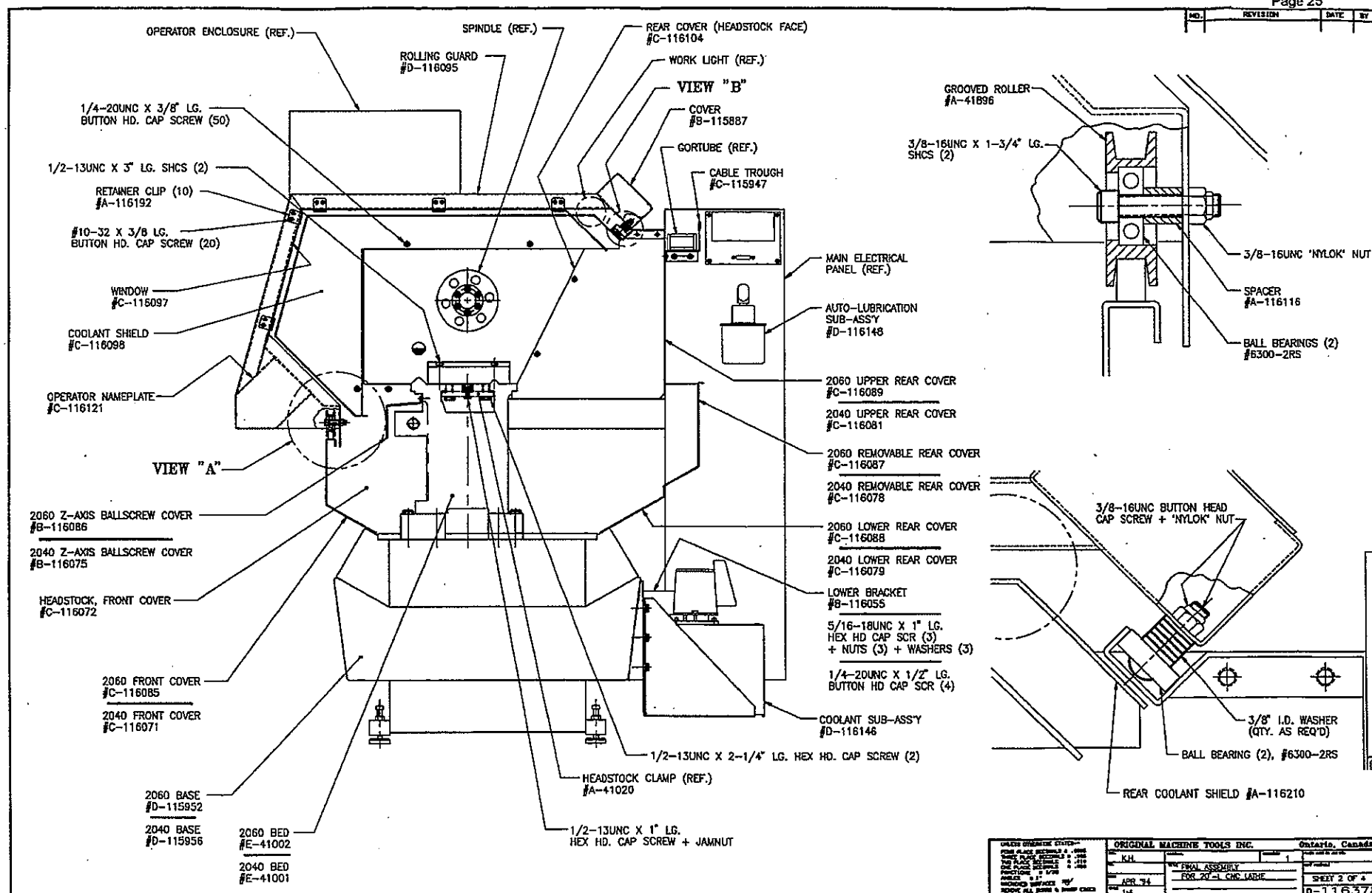
Spindle Horsepower Chart



NO.	REVISION	DATE	BY
-----	----------	------	----

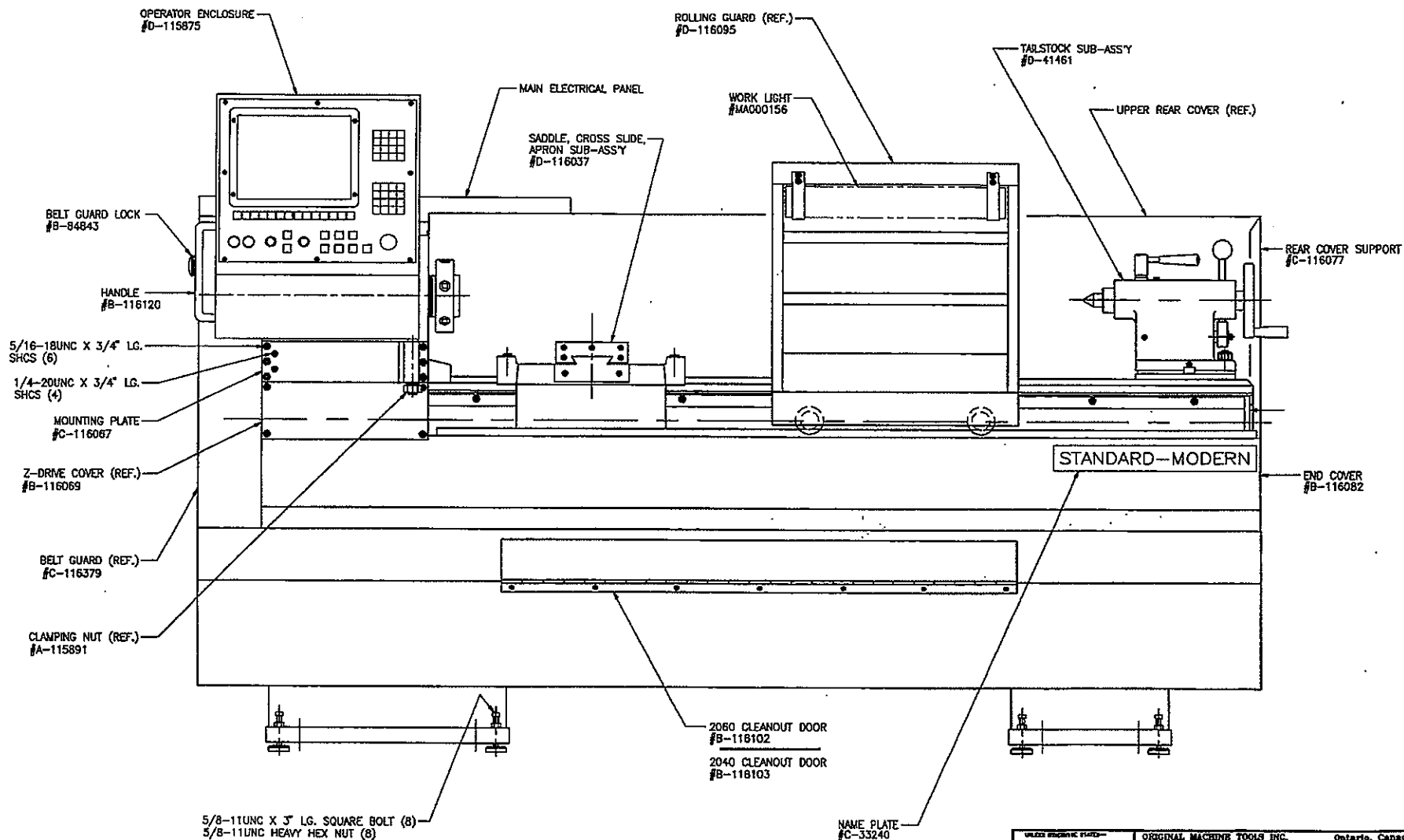


UNLESS OTHERWISE SPECIFIED: FRACTIONAL DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONAL DIMENSIONS: ±.005 DECIMAL DIMENSIONS: ±.001 HOLE DIMENSIONS: ±.001 FRACTIONAL DIMENSIONS: ±.001 HOLE DIMENSIONS: ±.001		ORIGINAL MACHINE TOOLS INC.		Ontario, Canada	
DATE: APR 24		SHEET 1 OF 4		D-116378	
BY: [Signature]		D-116378		D-116378	

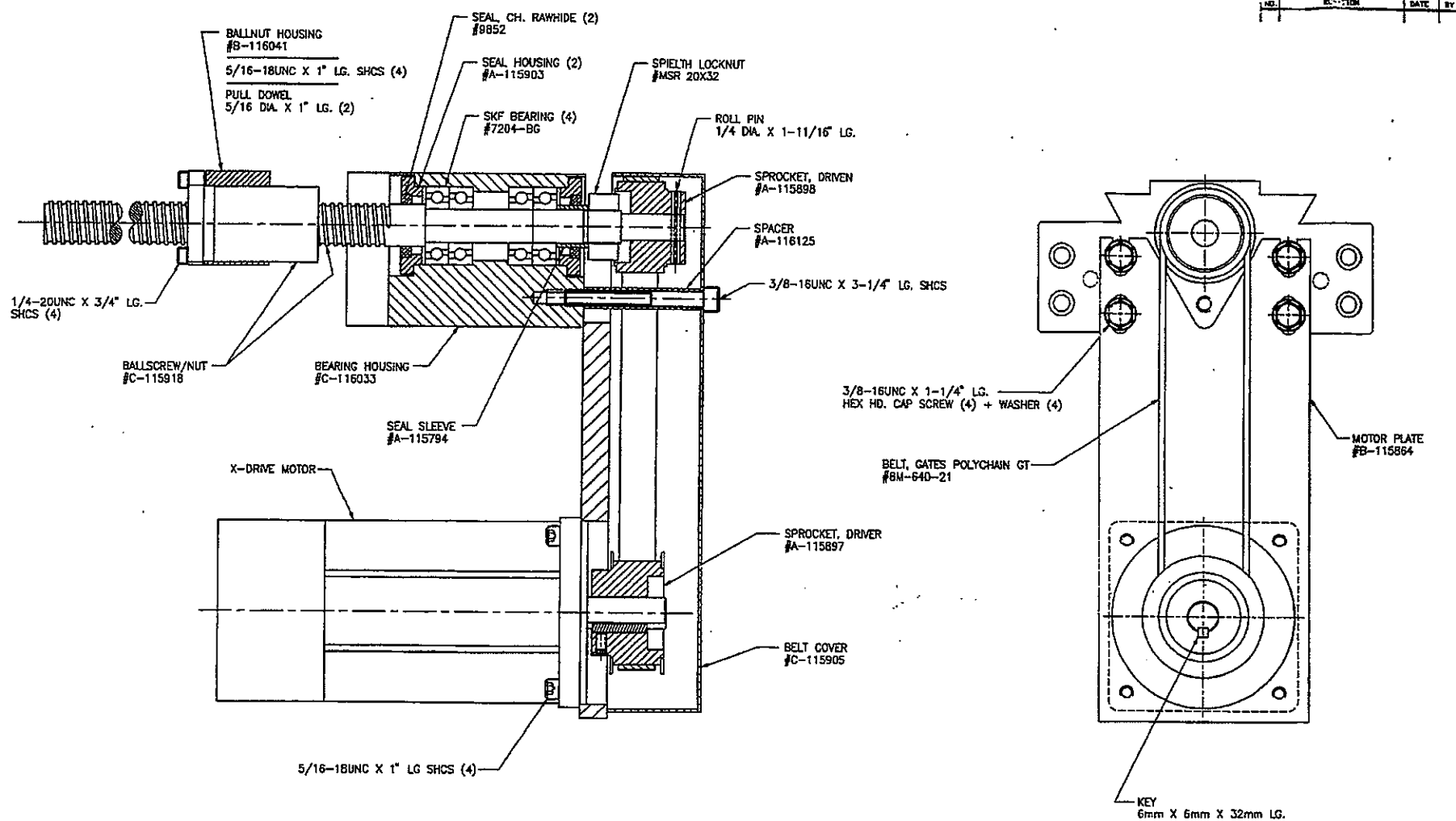


ORIGINAL MACHINE TOOLS INC.		Ontario, Canada	
DATE: APR 74	BY: JLS	FOR: FINAL ASSEMBLY	SHEET 2 OF 4
FOR: 20-1 CNC LATHE		0-116378	

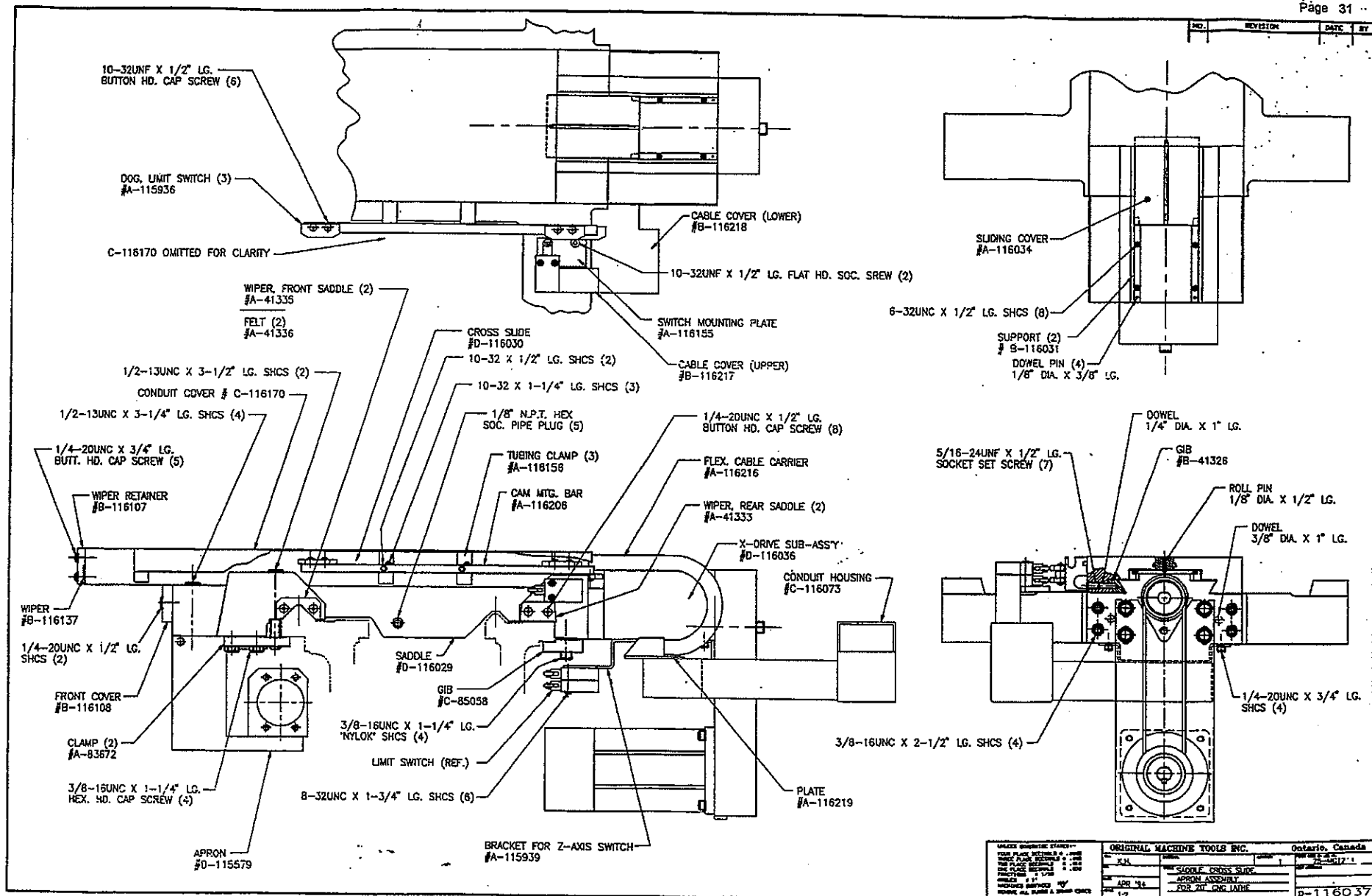
REV.	REVISION	DATE	BY
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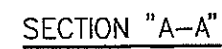


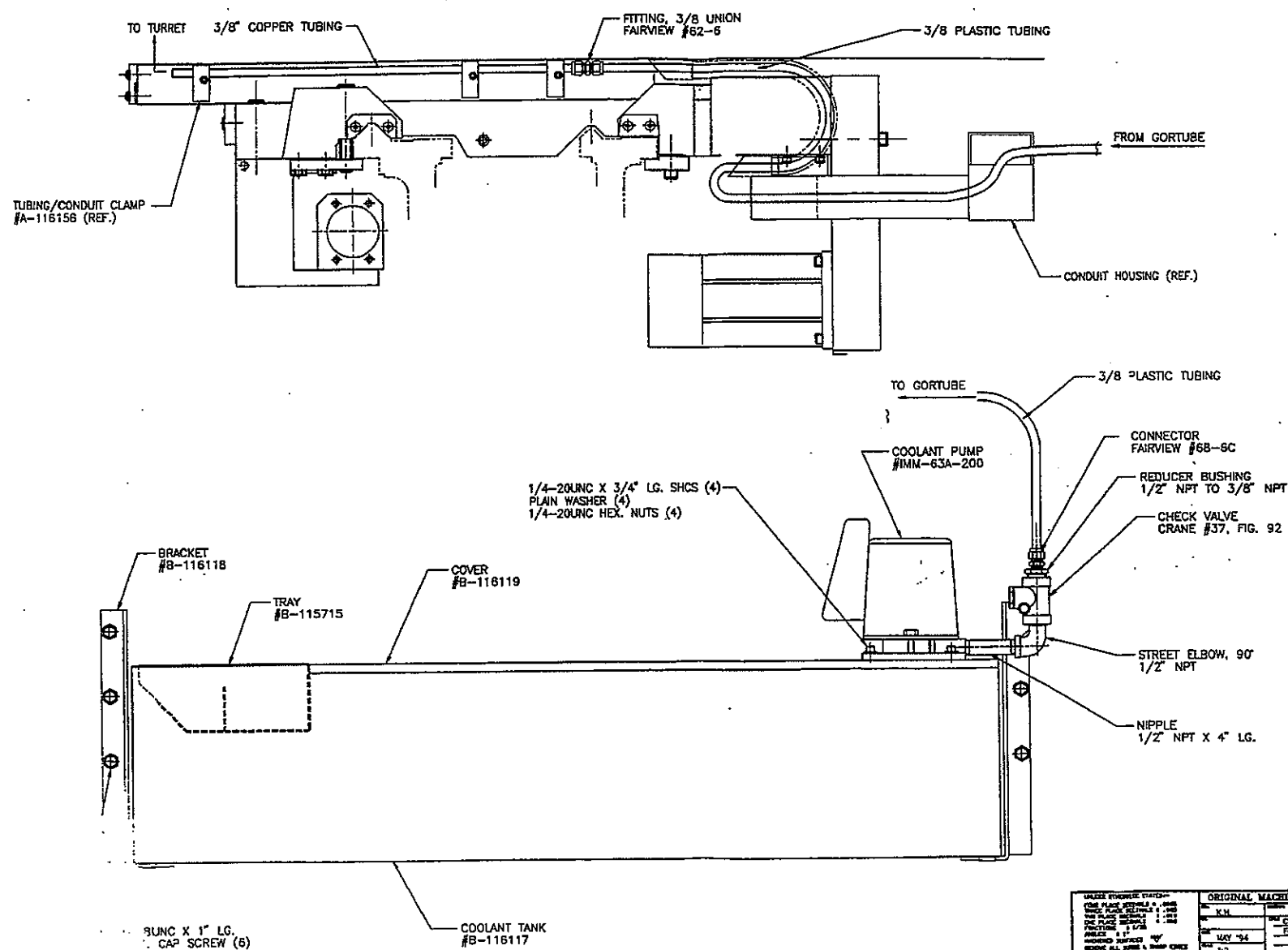
UNLESS OTHERWISE SPECIFIED—		ORIGINAL MACHINE TOOLS INC.		Ontario, Canada	
FINISH	AS FURNISHED	DATE	1	REV.	1
STAINLESS STEEL	304	BY		FOR	201-1 CNC LATHE
APPROVED		DATE	APR '84	SHEET	3 OF 4
REWORK		DATE		BY	8-116378



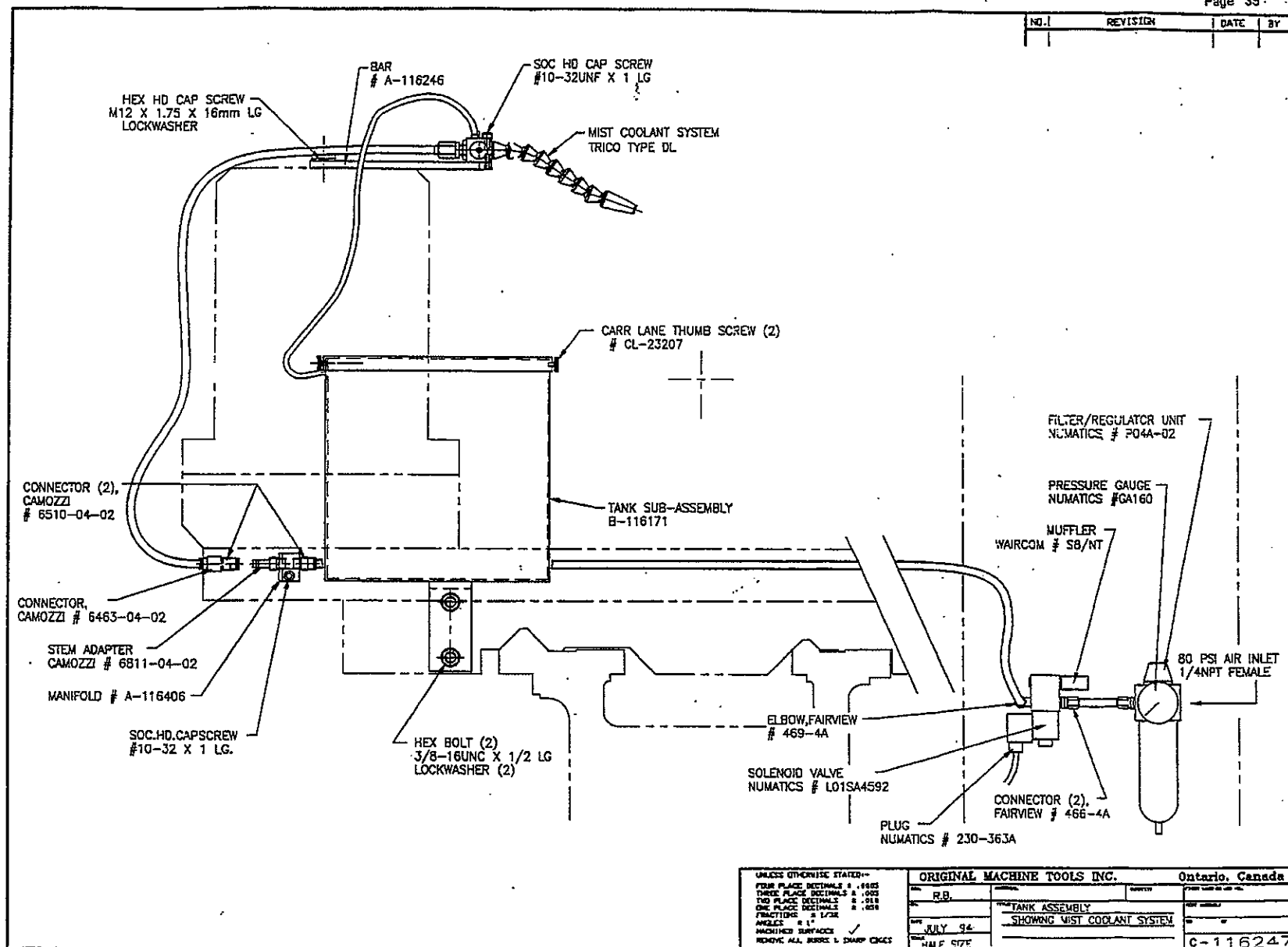
ORIGINAL MACHINE TOOLS INC.		Ontario, Canada	
DATE: APR 1984	BY: J.H.	REV: 1	111
PROJECT: X-DRIVE ASSY.	FOR 21" CHC LATE		
DESIGNED BY: J.H.	D-116036		



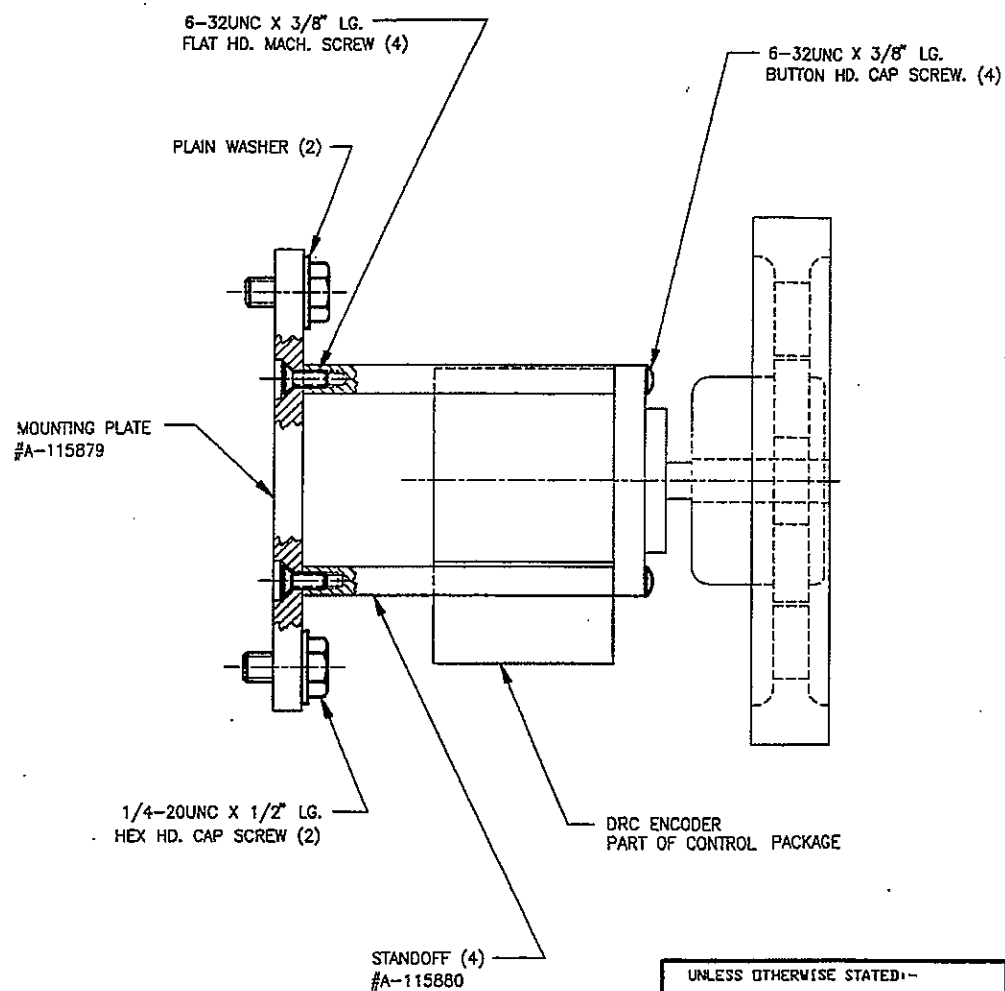
[illegible]



ORIGINAL MACHINE TOOLS INC.		Ontario, Canada	
DATE	1984	REV	1
BY	K.M.	FOR	COOLANT ASSEMBLY
DATE	MAY '84	FOR	20" CNC LATHE
REV	1	DATE	0-116146

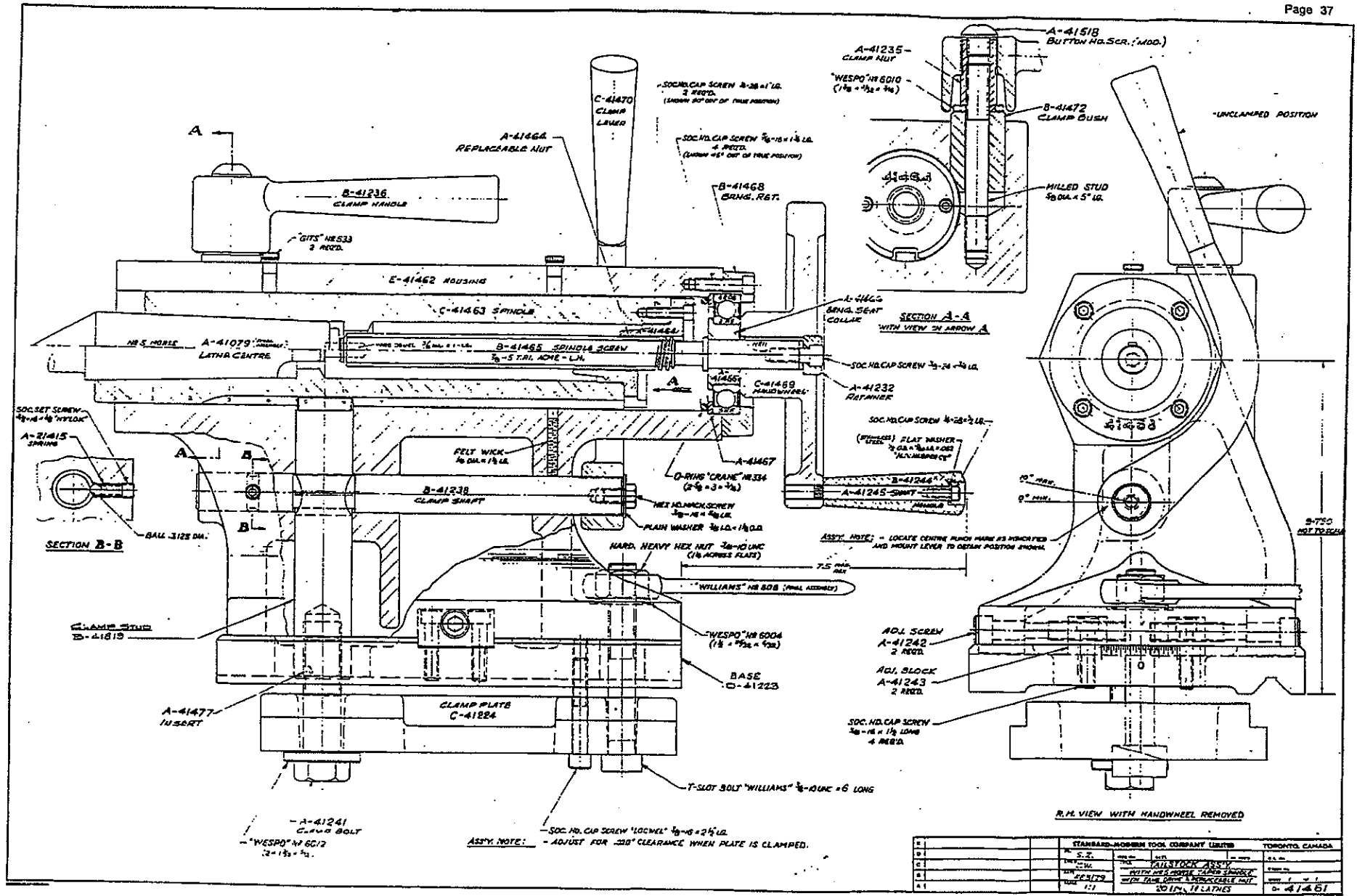


NO.	REVISION	DATE	BY



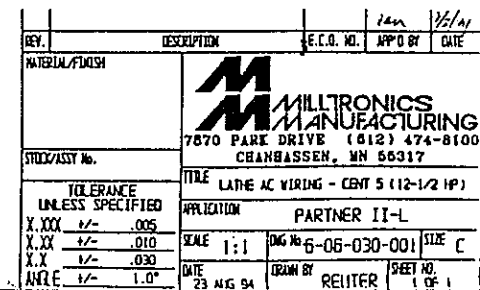
UNLESS OTHERWISE STATED:-
 FOUR PLACE DECIMALS $\pm .0005$
 THREE PLACE DECIMALS $\pm .005$
 TWO PLACE DECIMALS $\pm .010$
 ONE PLACE DECIMALS $\pm .050$
 FRACTIONS $\pm 1/32$
 ANGLES $\pm 1^\circ$
 MACHINED SURFACES $\sqrt{25}$
 REMOVE ALL BURRS & SHARP EDGES

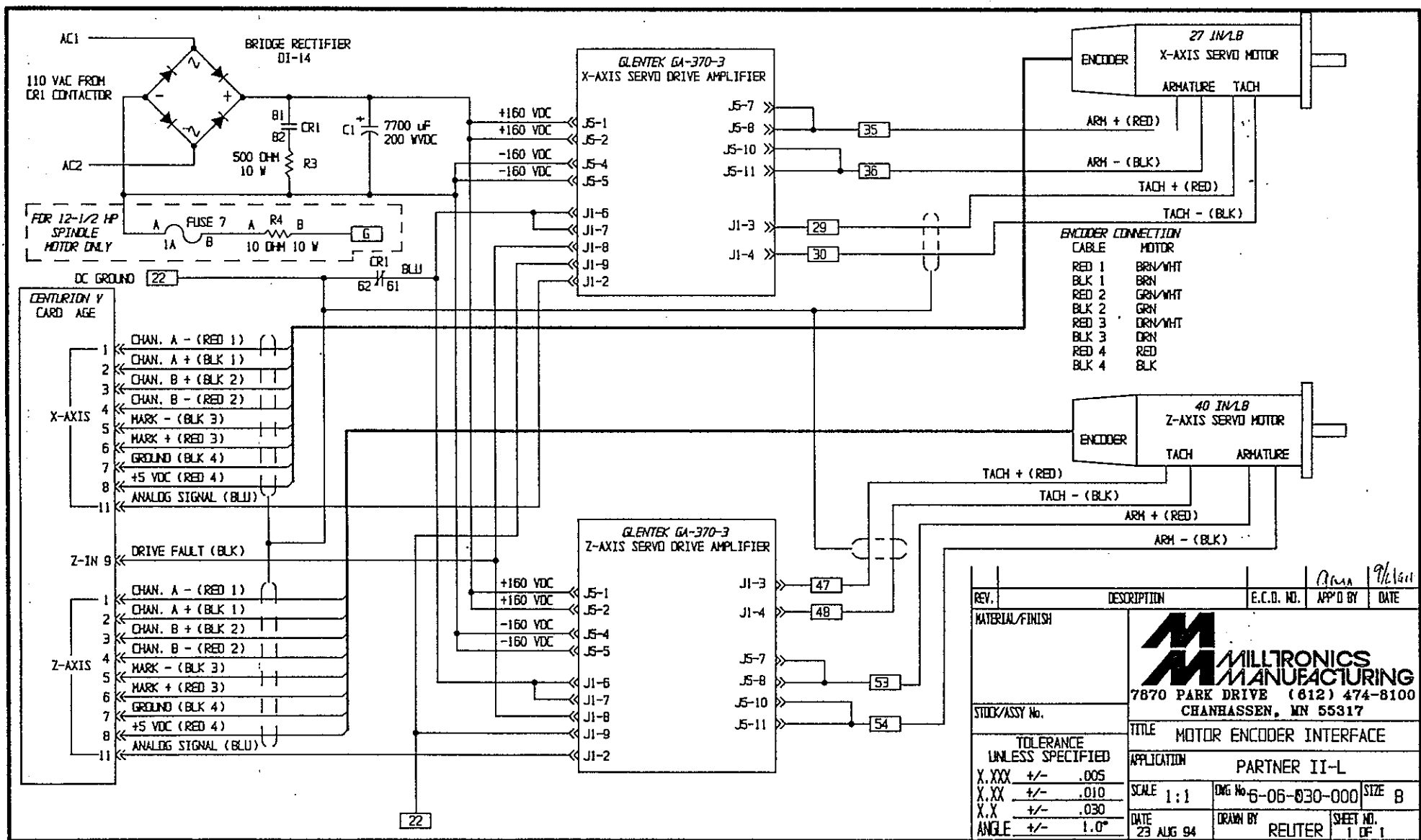
ORIGINAL MACHINE TOOLS INC.			Ontario, Canada
DRN.	K.H.	QUANTITY	1
CH.		TITLE	ASSEMBLY
DATE	APR '94		DRC ENCODER
SCALE	1:1		FOR 20" CNC LATHE
		FIRST USED ON JOB NO.	
		NEXT ASSEMBLY	D-116038
			B-116145

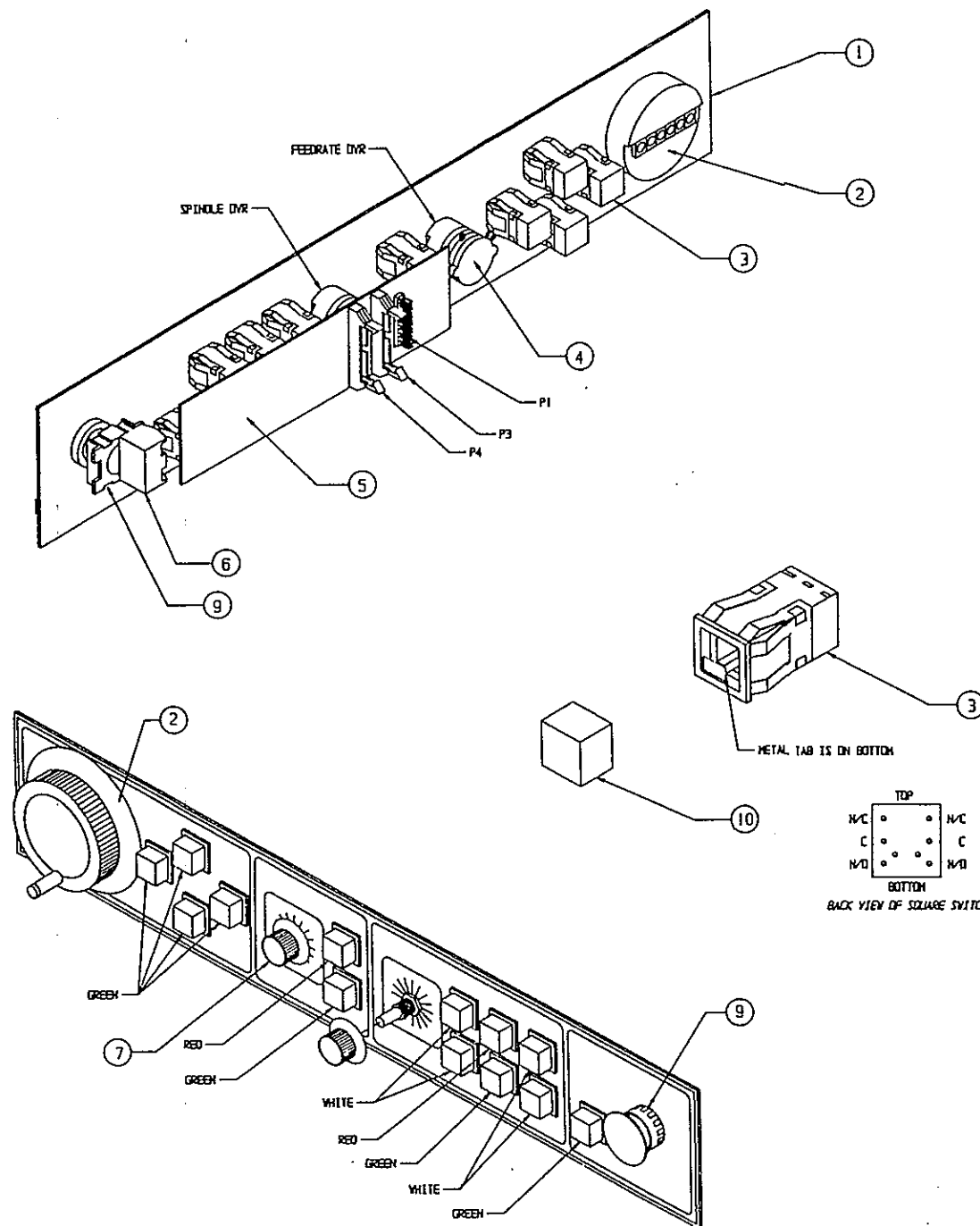


PARTNER T SERIES CNC LATHES
Electrical Drawings

1. Lathe AC Wiring (Centurion 5) 12½ HP Spindle
2. Lathe AC Wiring (Centurion 5) 7½ HP Spindle
3. Lathe DC Wiring (Centurion 5) 12½ HP Spindle
4. Lathe DC Wiring (Centurion 5) 7½ HP Spindle
5. Axis Drive Schematic
6. Centurion 5 Front Panel Wiring (1-2)
7. Lathe Remote Control Panel Interface
8. Centurion 5 Front Panel Assembly - Front
9. Centurion 5 Front Panel Assembly - Rear
10. Centurion 5 Card Cage Assembly (1-5)
11. CNC Lathe Remote Control Panel Assembly
12. Mag Panel Parts Layout - 12½ HP Spindle
13. Mag Panel Parts Layout - 7½ HP Spindle
14. Centurion 5 I/O Specifications for CNC Lathe







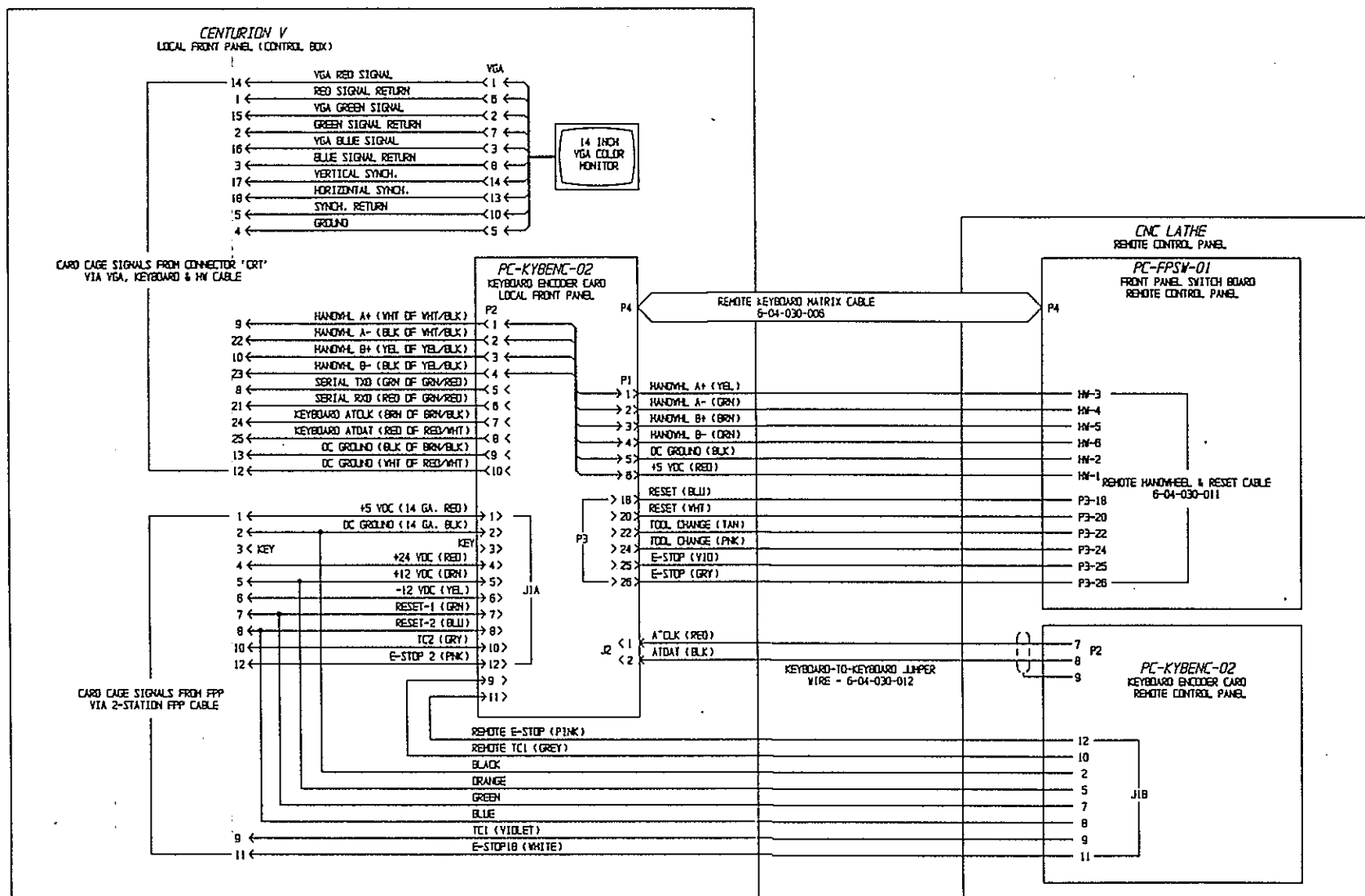
- PARTS LIST -

ITEM	STOCK No.	QTY.	DESCRIPTION
1	NONE	1	LATHE REMOTE CONTROL PANEL (SUPPLIED WITH THE LATHE)
2	ED-30	1	HANDWHEEL ENCODER, 100 COUNT SUTAK No. LGF-022-100
3	SV-87	13	SWITCH, MOMENTARY CONTACT, DPST HONEYWELL MICROSWITCH No. AML21CB3AC
4	NONE	1	ROTARY SWITCH ASSEMBLY (FEEDRATE & SPINDLE) DNG No. 6-04-004-020
5	ASSY 7300	1	FRONT PANEL SWITCH BOARD, MODIFIED, PC-FPSW-01 SEE 6-03-030-002 FOR MODS.
6	SV-38	1	SWITCH CONTACT BLOCK, N/C (RED) ALCO No. V-40
7	SV-35	2	ROTARY SWITCH KNOB, COMPOSITE BLACK ALCONOBS No. PCA-P708-1/4
9	SV-23	1	SWITCH ACTUATOR, RED HUSH-RIDON TOP ALCO No. 12050-2
10	SV-88	2	SQUARE KEYTOP, RED HONEYWELL MICROSWITCH No. AML51A10R
	SV-88	7	SQUARE KEYTOP, GREEN HONEYWELL MICROSWITCH No. AML51A10G
	SV-90	4	SQUARE KEYTOP, WHITE HONEYWELL MICROSWITCH No. AML51A10W

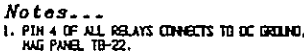
- ORDER OF ASSEMBLY -

1. THE HOLES FOR MOUNTING THE HANDWHEEL MUST BE ENLARGED. USE A No. 7 BIT TO DRILL OUT THESE HOLES. THEN MOUNT THE HANDWHEEL TO THE PANEL WITH THE HARDWARE PROVIDED WITH THE HANDWHEEL.
2. INSERT THE SQUARE FRONT PANEL SWITCHES. OBSERVE PROPER ORIENTATION OF THESE SWITCHES WHEN INSTALLING.
3. INSERT THE E-STOP SWITCH ACTUATOR AND LOOSELY SECURE IT TO THE PANEL WITH HARDWARE PROVIDED WITH THE ACTUATOR. TURN THE SWITCH SO THAT THE CONTACT BLOCK WILL FACE INWARDS AS SHOWN. TIGHTEN DOWN THE ACTUATOR AND THE CLIP ON THE CONTACT BLOCK.
4. INSTALL THE ROTARY SWITCHES ONTO THE PANEL AS A CABLE ASSEMBLY. THE SWITCHES ARE LABELED FOR CORRECT PLACEMENT. USE HARDWARE PROVIDED WITH THE ROTARY SWITCHES.
5. ATTACH THE MODIFIED FRONT PANEL SWITCH CARD INTO THE SQUARE SWITCHES. IF THE SWITCHES ARE NOT ORIENTED CORRECTLY, THE BOARD WILL NOT FIT.
6. CONNECT THE JDC SWITCHES WITH THE ADDITIONAL SOCKETS HANGING FROM PC-FPSW-01. SEE THE DRAWING SPECIFIED IN THE PARTS LIST FOR THESE SWITCH CONNECTIONS.
7. BE SURE THAT THE ROTARY SWITCH SHAFTS ARE TURNED COMPLETELY COUNTER-CLOCKWISE TO THE STOP. SLIDE THE KNOBS ONTO THE SHAFTS. TURN THE KNOB SO THAT THE MARK POINTS TO ZERO. (6 O'CLOCK POSITION), THEN TIGHTEN THE KNOBS WITH SETSCREWS PROVIDED.
8. PLACE SQUARE COLORED KEYTOPS ONTO FRONT PANEL SWITCHES. NOTE THE COLORS OF THE KEYTOPS.

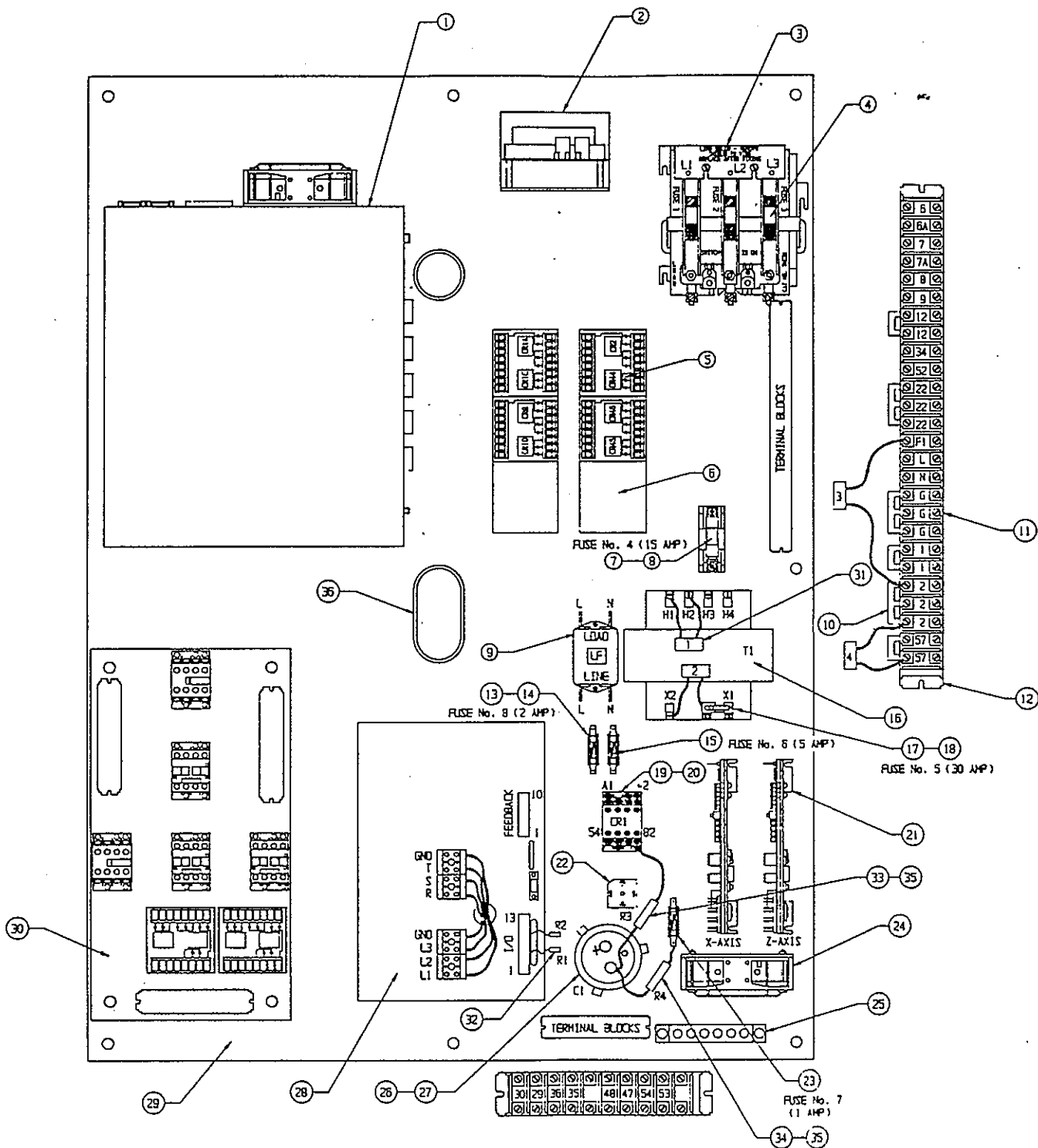
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MATERIAL/FINISH				
STOCK/ASSY No.				
TOLERANCE UNLESS SPECIFIED				
X.XXX	1/16	.005		
X.XX	1/32	.010		
X.X	1/64	.030		
INCH	1/8	1.0"		
MILLTRONICS MANUFACTURING		7870 PARK DRIVE (612) 474-8100 CHANHASSEN, MN 55317		
TITLE		LATHE REMOTE CONTROL PANEL ASSEMBLY		
APPLICATION		PARTNER II-L		
SCALE	2:1	DWG No	6-10-030-000	SIZE C
DATE	14 SEP 94	DRAWN BY	REUTER	SHEET NO. 1 OF 1



REV.	DESCRIPTION	E.C.O. NO.	APP'D BY	DATE
PATENT/FINISH				
STOCK/ASSY No.				
TOLERANCE UNLESS SPECIFIED				
X.XXX	±	.005		
X.XX	±	.010		
X.X	±	.030		
ANGLE	±	1.0°		
 MILLTRONICS MANUFACTURING 7870 PARK DRIVE (512) 474-8100 CBAHBASSEN, MN 55317				
TITLE FRONT PANEL INTERFACE				
APPLICATION PARTNER II-L				
SCALE 1:1	DATE 6-06-030-004	SIZE C		
DATE 20 SEP 94	DRAWN BY REUTER	SHEET NO. 2 OF 2		



B FIELD CHANGES		2102	16~	1/95
A MINOR CORRECTIONS		2021	A.A.N.	9/94
REV.	DESCRIPTION	E.C.D. NO.	APP'D BY	DATE
MATERIAL/FINISH		 MILLTRONICS MANUFACTURING 7870 PARK DRIVE (612) 474-8100 CHANHASSEN, MN 55317		
STOCK/ASSY NO.		TITLE DC LATHE WIRING - 7-1/2 HP APPLICATION PARTNER II-L SCALE 1:1 DATE 26 SEP 94 (Dwg No) 6-06-030-005 DRWN BY REUTER SHEET NO. 1 OF 1		
TOLERANCE UNLESS SPECIFIED X.XXX +/- .005 X.XX +/- .010 X.X +/- .030 ANGLE +/- 1.0°				

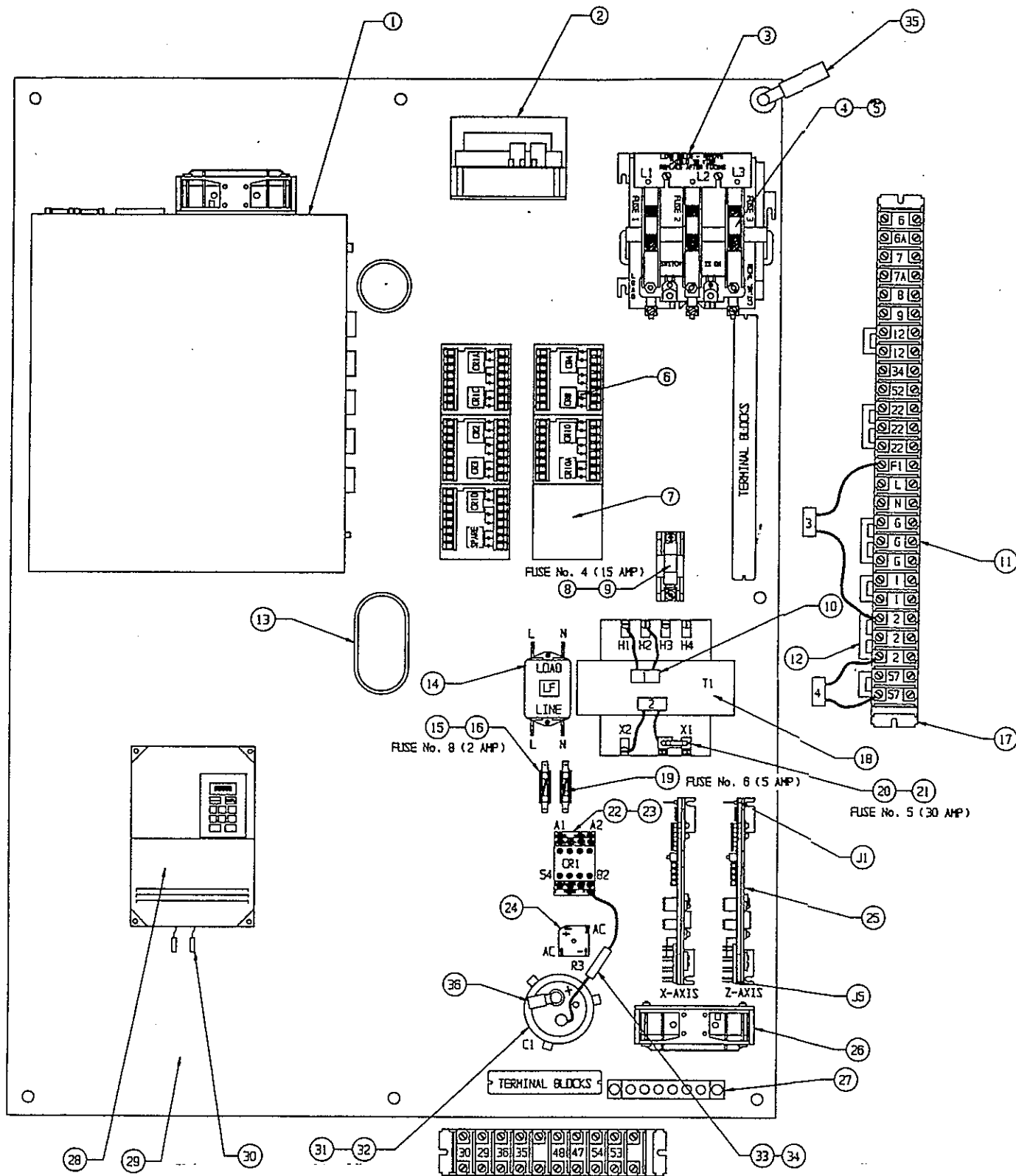


REV.	DESCRIPTION	E.C.D. NO.	APP'D BY	DATE
MATERIAL/FINISH	 MILLTRONICS MANUFACTURING 7870 PARK DRIVE (612) 474-8100 CHANHASSEN, MN 55317			
STOCK/ASSY No.				
TOLERANCE UNLESS SPECIFIED	TITLE MAG PANEL LAYOUT - 12-1/2 HP			
X.XXX +/- .005	APPLICATION PARTNER II-L			
X.XX +/- .010	SCALE 4:1			
X.X +/- .030	DWG No 6-03-030-000			
ANGLE +/- 1.0°	DATE 20 JUL 94			
	DRAWN BY REUTER			
	SHEET NO. 1 OF 1			

- PARTS LIST -

ITEM	STOCK No.	DESCRIPTION	QTY.
1	ASSY	CENTURION 5-T CNC CARD CAGE	1
2	ASSY 8177	POWER SUPPLY, 15/24 VDC 6-10-018-003	1
3	SW-	SWITCH, MAIN DISCONNECT GENERAL ELECTRIC No. TH32	1
4	FU-	FUSE, FRNR, 60 AMP	3
5	ASSY 9107	DOUBLE RELAY CARD, PC-REL-01 6-03-018-003	2
6	WC-64	SNAP-TRACK CARD CARRIER 6 IN. LENGTH	2
7	FU-37	FUSE, FRNR, 15 AMP	1
8	FU-45	FUSE BLOCK, SINGLE FRN-R	1
9	MI-10	EMI LINE FILTER, 10 AMP	1
10	TB-16	TERMINAL BLOCK JUMPER	2
11	TB-01	TERMINAL BLOCK, 2 POST	36
12	TB-02	TERMINAL BLOCK END PIECE	2
13	FU-28	FUSE, MOL GLASS, 2 AMP	1
14	FU-09	FUSE CLIP, SINGLE MOL	3
15	FU-01	FUSE, MOL GLASS, 5 AMP	1
16	TR-26	TRANSFORMER, 220/110 VAC 1.5 KVA G.E. No. 9T5883396	1
17	FU-51	FUSE, MOL GLASS, 30 AMP	1
18	FU-11	FUSE CLIP KIT, SINGLE MOL	1
19	RL-49	CONTACTOR RELAY, 5 HP TELEMECHANIQUE No. LC1018L0	1
20	RL-50	AUXILIARY CONTACTOR RELAY TELEMECHANIQUE No. LA10N13	1
21	AM-25	AXIS DRIVE AMPLIFIER BOARD WITH BRACKET GLENTEK No. GA370-3	2
22	DI-14	BRIDGE RECTIFIER MOA3502	1
23	FU-46	FUSE, MOL GLASS, 1 A	1
24	FA-01	FAN, 110 VAC	1
	FA-04	FAN GUARD WFG 473	1
	FA-03	FAN POWER CABLE, (NOT SHOWN)	1
	BR-09	FAN MOUNTING BRACKET 6-02-018-003	1
25	TB-	BUSSBAR, 5 POST	1
26	CA-51	CAPACITOR, ELECTROLYTIC 7700 uF - 200 WVDC	1
27	CA-30	CAPACITOR MOUNTING RING	1
28	PS-30	SPINDLE MOTOR CONTROL UNIT CUSTOM SERVO MOTORS No. PRE-50	1
29	PL-50	PARTNER II-L MAG PANEL 6-01-030-004	1
30	ASSY	12-1/2 HP SPINDLE MOTOR CONTACTOR PANEL 6-03-027-003	1
31	MI-09	NOISE SUPPRESSOR, 1/2 uF - 600 V 220 OHM 1/2 W 10%	4
32	RE-15	RESISTOR, 1K 1/4W	2
33	RE-90	RESISTOR, 500 OHM 10 W	1
34	RE-15	RESISTOR, 10 OHM 10 W	1
35	WC-60	SHRINK TUBE, 3/8 x 5 IN.	2
36	WX-85	HOLE LINER GROMMET	2

REV.	DESCRIPTION	E.C.D. NO.	APP'D BY	DATE
MATERIAL/FINISH		 MILLTRONICS MANUFACTURING 7870 PARK DRIVE (612) 474-8100 CHANHASSEN, MN 55317		
STOCK/ASSY No.		TITLE MAG PANEL LAYOUT - 12-1/2 HP		
TOLERANCE UNLESS SPECIFIED		APPLICATION PARTNER II-L		
X.XXX	+/- .005	SCALE 4:1	DWG No 6-03-030-000	SIZE C
X.XX	+/- .010	DATE 20 JUL 94	DRAWN BY REUTER	SHEET NO. 1 OF 1
X.X	+/- .030			
ANGLE	+/- 1.0°			



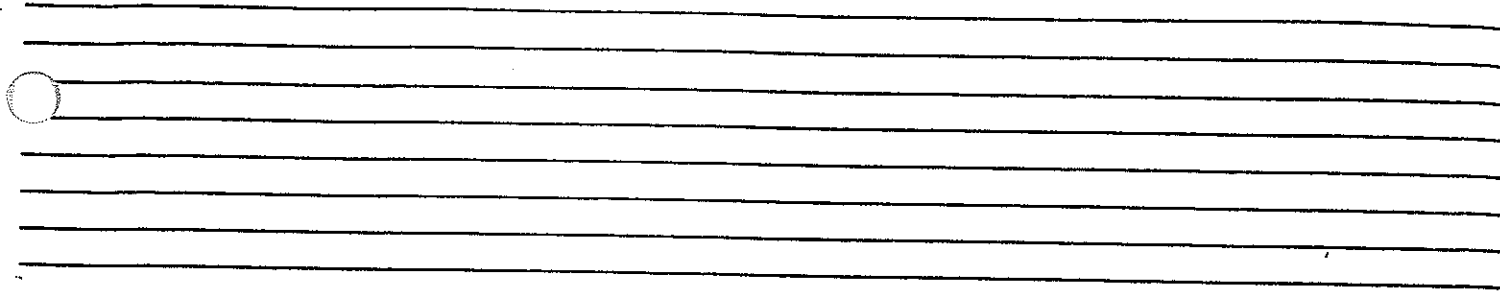
REV.	DESCRIPTION	E.C.O. NO.	APP'D BY	DATE
	MATERIAL/FINISH			
	SIZE/ASSY No.			
	TOLERANCE UNLESS SPECIFIED			
	X.XXX +/- .005			
	X.XX +/- .010			
	X.X +/- .030			
	ANGLE +/- 1.0°			
	TITLE			
	MAG PANEL LAYOUT - YASKAWA			
	APPLICATION			
	PARTNER II-L			
	SCALE 4:1			
	DATE 30 JUL 94			
	DWG No 6-03-030-001			
	SIZE C			
	DATE 30 JUL 94			
	DRAWN BY REUTER			
	SHEET NO. 1 OF 1			

MILLTRONICS MANUFACTURING
7870 PARK DRIVE (812) 474-8100
CHANHASSEN, MN 55317

- PARTS LIST -

ITEM	STOCK No.	DESCRIPTION	QTY.
1	ASSY 8080	CENTURION S-T CNC CARD CAGE	1
2	ASSY 8177	POWER SUPPLY, 15/24 VDC 6-10-018-003	1
3	SW-42	SWITCH, MAIN DISCONNECT GENERAL ELECTRIC No. THC32	1
4	FU-37	FUSE, FRNR, 30 AMP	3
5	FU-35	FUSE CLIP KIT, FRNR	1
6	ASSY 9107	DOUBLE RELAY CARD, PC-REL-01 6-03-018-003	5
7	WC-64	SNAP-TRACK CARD CARRIER 6 IN. LENGTH	2
8	FU-37	FUSE, FRNR, 15 AMP	1
9	FU-45	FUSE BLOCK, SINGLE FRN-R	1
10	MI-09	NOISE SUPPRESSOR, 1/2 uF - 600 V 220 OHM 1/2 W 10%	4
11	TB-01	TERMINAL BLOCK, 2 POST	36
12	TB-16	TERMINAL BLOCK JUMPER	2
13	WX-85	HOLE LINER GROMMET	2
14	MI-10	EMI LINE FILTER, 10 AMP	1
15	FU-28	FUSE, MOL GLASS, 2 AMP	1
16	FU-09	FUSE CLIP, SINGLE MOL	2
17	TB-02	TERMINAL BLOCK END PIECE	2
18	TR-26	TRANSFORMER, 220/110 VAC 1.5 KVA G.E. No. 9T5883396	1
19	FU-01	FUSE, MOL GLASS, 5 AMP	1
20	FU-51	FUSE, MOL GLASS, 30 AMP	1
21	FU-11	FUSE CLIP KIT, SINGLE MOL	1
22	RL-49	CONTACTOR RELAY, 5 HP TELEMECHANIQUE No. LC1D18L0	1
23	RL-50	AUXILIARY CONTACTOR RELAY TELEMECHANIQUE No. LA1DN13	1
24	DI-14	BRIDGE RECTIFIER MOA3502	1
25	AM-25	AXIS DRIVE AMPLIFIER BOARD WITH BRACKET GLENTEK No. GA370-3	2
26	FA-01 FA-04 FA-03 BR-09	FAN, 110 VAC FAN GUARD WFG 473 FAN POWER CABLE, (NOT SHOWN) FAN MOUNTING BRACKET 6-02-018-003	1
27	TB-	BUSSBAR, 5 POST	1
28	PS-17	YASKAWA/SAFTRONICS AC SPINDLE INVERTER MODEL PC3	1
29	PL-50	PARTNER II-L MAG PANEL 6-01-030-004	1
30	RE-20	RESISTOR, 4.7K, 1/4 WATT	2
31	CA-51	CAPACITOR, ELECTROLYTIC 7700 uF - 200 WVDC	1
32	CA-30	CAPACITOR MOUNTING RING	1
33	RE-90	RESISTOR, 500 OHM 10 W	1
34	WC-60	SHRINK TUBE, 3/8 x 5	1
J1	CD-24	DRIVE CONTROL SIGNALS (18 PIN)	2
J5	CD-73	DRIVE POWER (12 PIN)	2
35	WX-45	RING LUG, 1/4 10-12 GA.	1
36	WX-41	RING LUG, No. 10 10-12 GA.	24

REV.	DESCRIPTION	E.C.D. NO.	APP'D BY	DATE
				7/13/94
MATERIAL/FINISH		 MILLTRONICS MANUFACTURING 7870 PARK DRIVE (812) 474-8100 CHANHASSEN, MN 55317		
STOCK/ASSY No.		TITLE MAG PANEL LAYOUT - YASKAWA		
TOLERANCE UNLESS SPECIFIED		APPLICATION PARTNER II-L		
X.XXX	+/- .005	SCALE 4:1	DWG No 6-03-030-001	SIZE C
X.XX	+/- .010	DATE 30 JUL 94	DRAWN BY REUTER	SHEET NO. 1 OF 1
X.X	+/- .030			
ANGLE	+/- 1.0°			



Brushless Servo Amplifiers

MIL02

Custom Servo Motors Inc.
A Subsidiary of MTS Systems Corporation

2121 Bridge Street
New Ulm, MN 56073
Telephone: 507-354-1616
Fax: 507-354-1611

TABLE OF CONTENTS

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Introduction

The MIL02 option is available as a means to cause an automatic realignment of the resolver(10 degree shift) to allow for a reconfiguration of the motor windings from a DELTA to a WYE configuration. This capability allows for electrical shifting the WYE configuration windings are in series from phase to phase causing a higher KE and KT constant than the DELTA configuration, which is one winding phase to phase.

Along with the shift(SHFT) feature, three different TAC KE's are available for speed optimization.

The circuit board has user jumpers to allow for some re-configuration. The DC voltage proportional output proportional to current can be an absolute value instead of bi-polar. The amplifier can be configured to have internal ramping of the command signal input with a range of two to five seconds. The normal slow output can be configured as an at speed output if the ramp feature is used.

Specifications

Environmental Characteristics:

Operating Temperature:

0-45° C Max. Ambient (32°F to 113°F)

Relative Humidity:

0-95%, Non-condensing

Input/Output Interface:

Analog Signals

Velocity Command Input:

Differential Input 0 to $\pm 10\text{VDC}$ (15VDC Max.)

Auxiliary Input:

Differential Input 0 to $\pm 10\text{VDC}$ (15VDC Max.)

Velocity Output:

2.4 Volts = 1200, 2400, or 4200 RPM

Current Output:

± 10 Volts = $\pm$ Peak Current

24 Volt Logic:

- Enable
- Speed
- Shift

- Slow Output (Open Collector)
- Fault Output (Open Collector)

NOTE: +30 Volts open circuit; .15 Amps max when on

Fault Protection:

- Continuous Current
- Shorts (Stator)
- Amplifier Temperature
- Feedback Resolver Tracking
- Motor Thermal
- HI-BUS

Encoder Simulation:

- TTL Differential Output Plus Index
- Phase Quadrature
- Line Count: 1024

Adjustments:

- 0 - Peak Current Limit (CL)
- Response (RESP)
- Auxiliary (AUX)
- Signal (SIG)
- Balance (BAL)

Speed/Torque Regulation: $\pm 5\%$

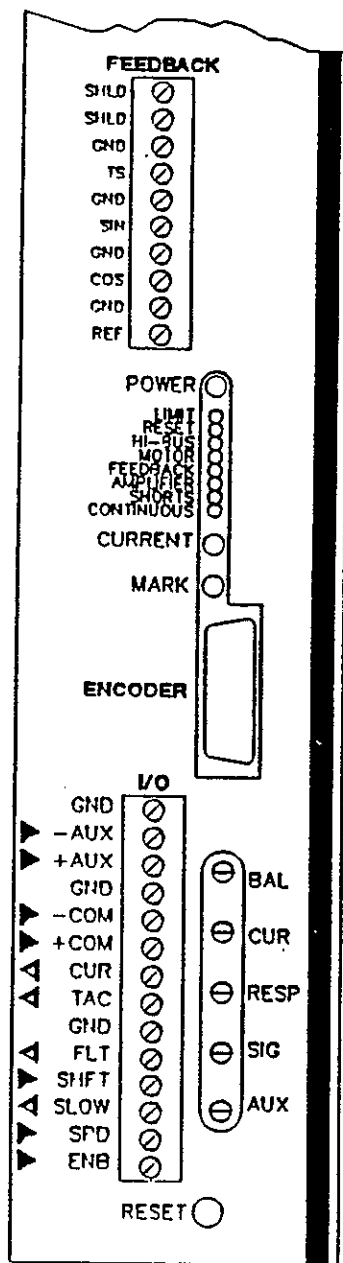
- Max Speed: 4200 RPM

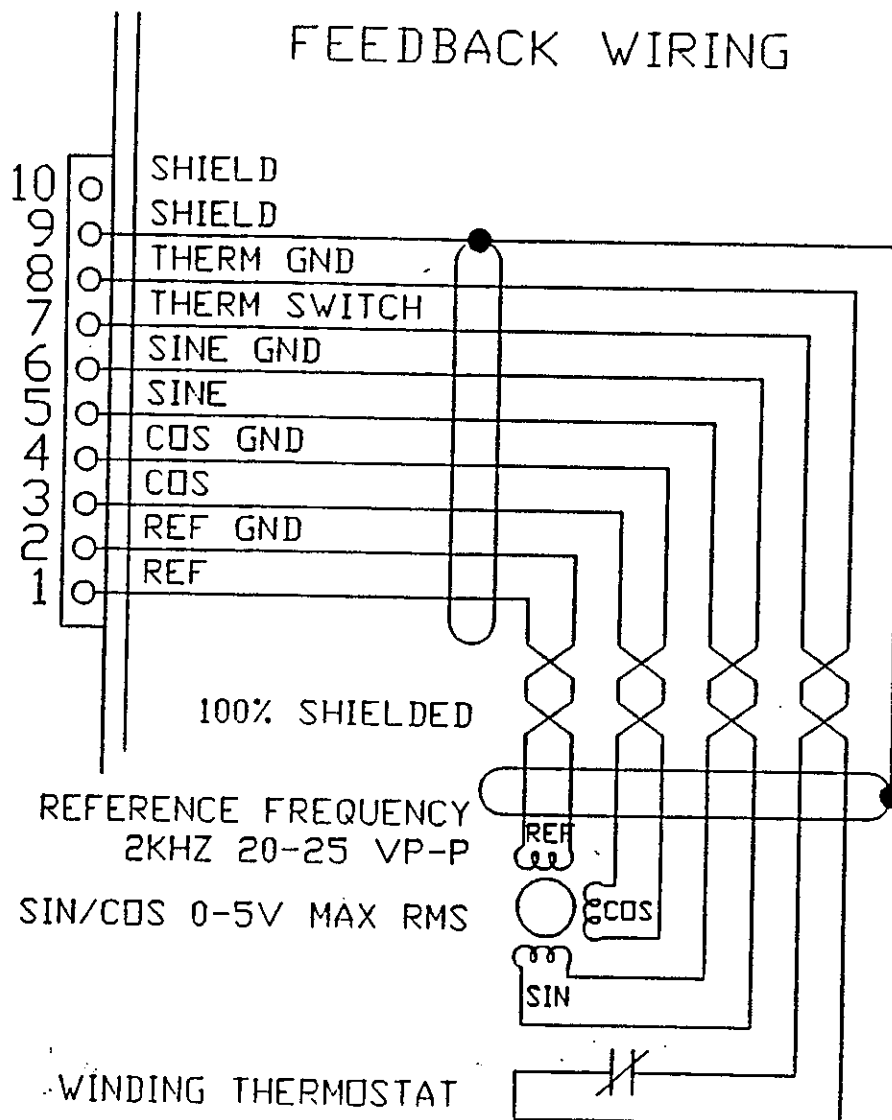
Encoder Signals:

- Resolution: 1024
- Accuracy:

<u>Resolver Cable Length</u>	<u>Max. Error</u>
15 foot	± 20 Minutes
25 foot	± 20 Minutes
50 foot	± 30 Minutes
100 foot	± 40 Minutes

Signal/Wiring Overview:





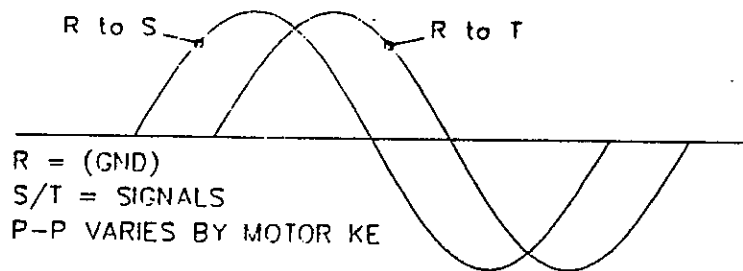
NOTE:

100% shielded cable is foil and braid. The pairs do not have to be twisted. The resolver wiring should not be run adjacent to any non-shielded high voltage wires, such as the motor wires(RST). If the wiring cannot be separated then the RST motor leads should also be 100% shielded. It is highly recommended that factory cable sets or wiring be provided.

Resolver Alignment

The motor phase relationship to resolver is established by knowing the relationship of the stator to the once per revolution mark output.

For identification purposes, the stator wiring must be identified; We'll use RST for this purpose. When the motor is back spun in a clockwise direction from the shaft end of the motor, the wave forms and RST relationships indicated match the amplifier.



With a DC voltage applied to R(+) and T(-) and sufficient current to cause the rotor to lock, the resolver can be rotated until the Mark LED on the amplifier is on.

If incorrect operation of the amplifier can not be achieved, then the SIN/COS signals should be reversed.

Thermostat

If the motor is equipped with a winding thermostat that is normally closed, it can be connected between terminals 7 and 8 of the feedback wiring connector. If an excess temperature thermal condition exists as indicated by an open thermostat, drive current is disabled.

Diagnostic Indicators

MARK(RED)

This is an output that comes on at the resolver zero position and can be used in conjunction with alignment procedures. The zero position is about .5 degrees.

CURRENT(BI-COLOR)

This is a bi-colored LED that produces either red or green as a function of load. The intensity increases with load. Red indicates positive torque and green indicates negative torque.

There are eight faults that will reduce amplifier current to zero.

1) CONTINUOUS

If a load condition exists that causes the amplifier to produce more than its continuous rating, this fault occurs.

2) STATOR SHORTS

If stator shorts or most major wiring errors of the stator occur, this fault occurs.

3) AMPLIFIER THERMAL

An 85°C thermostat is mounted to the amplifiers IGBT heat sink. If an excess temperature is sensed, this fault occurs.

4) FEEDBACK WIRING

For most resolver wiring errors, defective resolvers or tracking rate errors caused by the resolver, this fault occurs.

5) MOTOR THERMAL

If an excess thermal condition exists in the motor, this fault occurs.

6) HI-BUS

If excess AC voltage or a failure of the shunt circuit occurs, this fault occurs.

7) RESET

During the first second of power up or if the reset input is active, this LED will be on.

8) LIMIT

This LED is on if the motor is running above a speed where the SHFT Input should be switched.

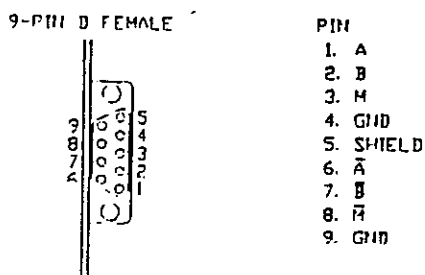
POWER(GREEN)

If logic +5 VDC is on then this LED is on.

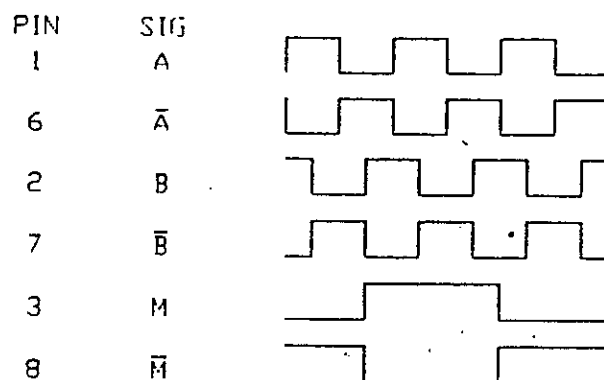
Simulated Encoder Signals

For external counting or position control, a 9-pin D type female connector that has TTL differential outputs is provided. This simulates quadrature encoder channel A and channel B signals. A differential mark signal is also available.

SIMULATED ENCODER CONNECTOR



The phase relationship of channels A, B and M are as follows for CW rotation:



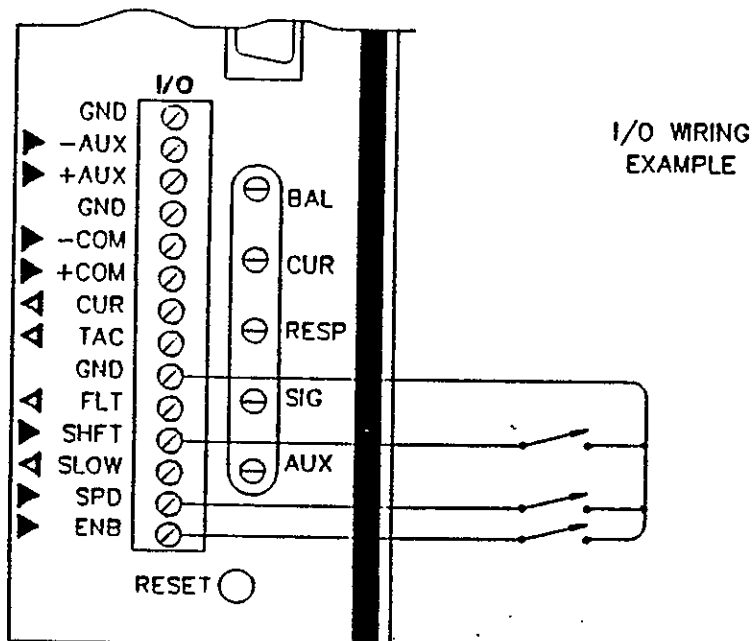
The marker pulse is about .5 degrees in width. The above illustration is for 1024 line condition.

The above signals are TTL differential outputs from a DS26LS31 differential driver. The logic 0 is typically between 0 and .5 volts and logic 1's are typically between 3.3 and 4 volts.

I/O Wiring and Descriptions

The amplifier has three inputs and two outputs. These inputs and outputs are designed to interface to a 24 volt logic system. The amplifier is shipped so that the operation of the inputs is as follows.

With no wires connected to ENB, SPD, or SHFT, the amplifier is not enabled and normal operation will not occur. The inputs are activated by connecting them with a switch closure to any of the provided GND terminals.



The actual decision as to open or closed switches occurs at a voltage level between 5-8 volts DC. Less than 5 volts is active; Greater than 8 volts is inactive.

The Enable(ENB) Input must be on(grounded) to allow the drive to be enabled.

The Shift(SHFT) Input determines the winding style of motor. If the Shift Input is off(not grounded) then the DELTA winding configuration is selected. A zero to 10 volt command signal will produce 4200 RPM and the Speed(SPD) Input is ignored. If the Shift Input is on then the WYE winding configuration of motor is selected. This is the most common form of a six pole configuration. When selected, there are two choices of speed based

on the Speed Input. With the Speed Input off(not grounded) a 10 volt command signal will produce 2400 RPM. With the Speed Input on(grounded) a 10 volt command signal will produce 1200 RPM.

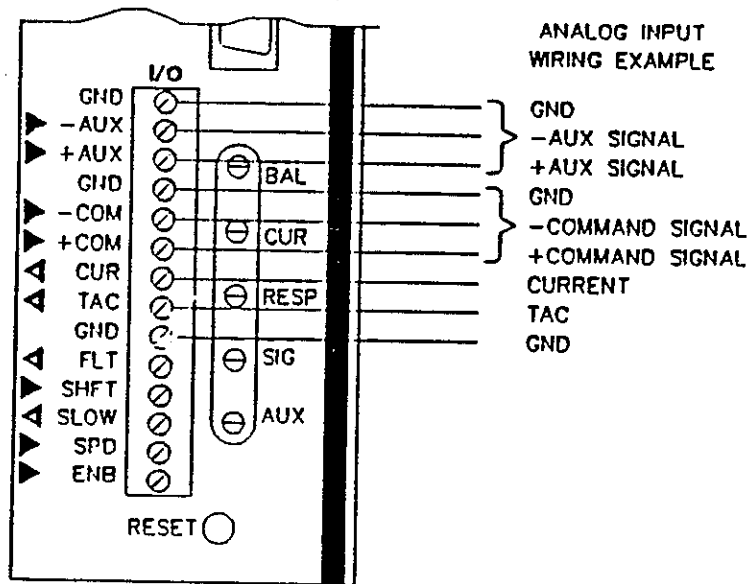
There are two outputs, Fault and Slow. These are open collector(NPN 2N2222) transistors with their emitters connected to GND. Each output can be connected to a +30 VDC maximum open circuit voltage source. Each transistor will sink .15 amps when it is on.

The Fault Output turns on if there is a fault and the slow output turns on if the motor is stopped or moving slowly as an indication that the Shift Input can be changed.

Analog Inputs, Outputs, and Adjustments

Inputs

There are two analog input channels; one for command and one for auxiliary. Both of these channels are differential inputs and both are summed with a TAC feedback differential amplifier that controls velocity.



Normal operation of the command signal is to apply a + voltage (pin #9) with respect to GND (pin #11) and get clockwise rotation of the shaft. ± 10 volts is then used to control velocity and the SIG pot is used for velocity adjustments. If the + COMMAND voltage is applied to the - COMMAND signal input, then an opposite shaft rotation occurs.

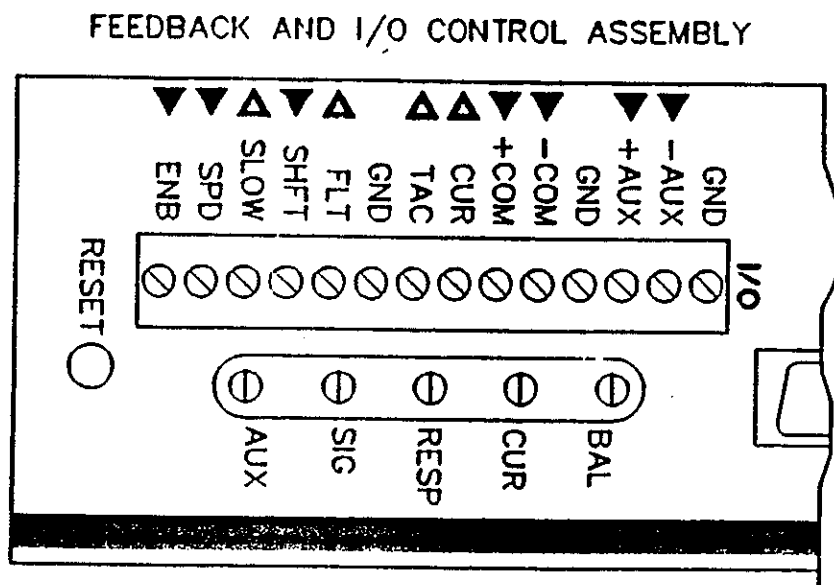
The operation of the AUXILIARY $\pm$ inputs is the same as the COMMAND inputs. The normal purpose of the AUXILIARY inputs is to provide a second summing voltage to compensate/modify normal COMMAND voltage. The AUX pot adjusts the auxiliary gain.

The current limit of the amplifier can be adjusted with the CUR pot from 0 (full CCW) to 100% (peak full CW). It is a good idea during start-up to adjust the CUR pot to its full CCW position and increase it slowly CW to assure normal operation.

During start-up the BAL adjustment can be used to reduce/stop any low speed CW/CCW drift caused by imbalance between the external command voltage and the amplifier.

Once connected to loads, the crispness of motion(step response) and stability can be optimized with the RESP pot. Full CW is maximum response.

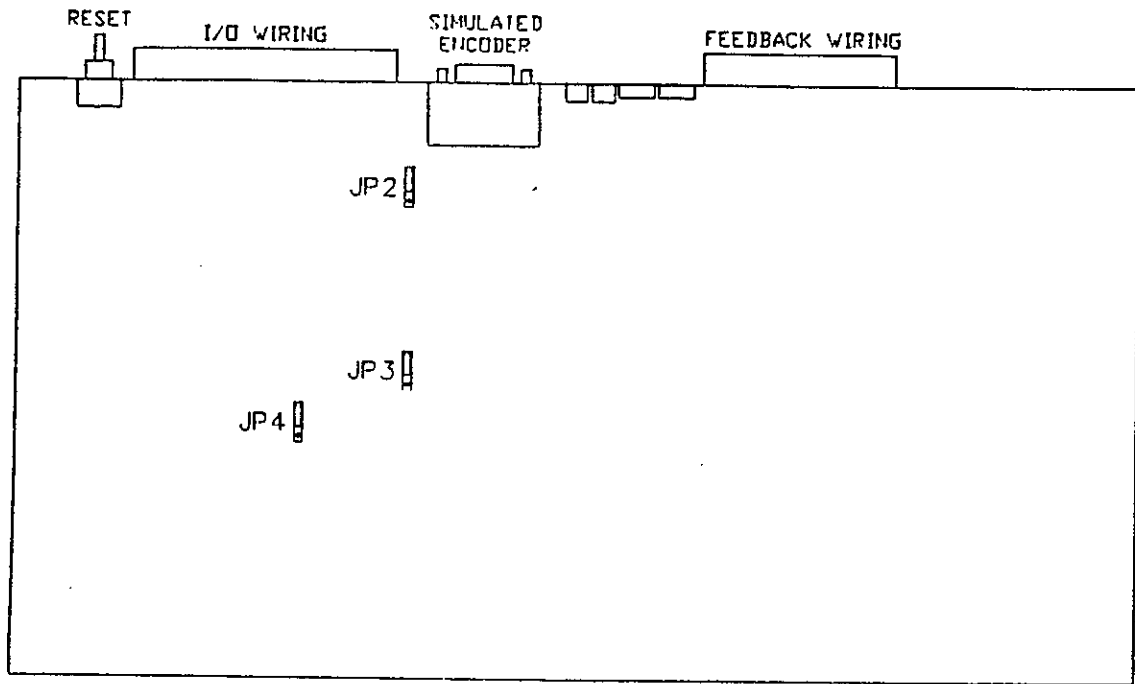
The location of these adjustments is directly below the I/O wiring.



Outputs

Two diagnostic outputs are the DC voltage proportional to velocity and the DC output proportional to current/torque. The nominal TAC gradient changes based on the selected speed range of 4200, 2400, or 1200 RPM, but is about ± 4.6 volts at full speed. The current gradient is 10 volts equal peak.

Jumper Selections



JP2 ☐ NO RAMPS (STANDARD)
☐ RAMPS

No ramps is standard. With the JP2 jumper in the ramps position, the ramps can be adjusted with RA1. Full CCW is the slowest (5 seconds) and full CW is the fastest (2 seconds).

JP3 ☐ BI-POLAR (STANDARD)
☐ ABSOLUTE

The position of this jumper determines the kind of DC voltage proportional to current that is a diagnostic signal at the (CUR) output of the I/O connector. With the shorting pin in the bi-polar position, the output CUR signal is plus for positive current and minus for negative current. The voltage range is plus and minus ten where ten equals the amplifiers peak current. With the jumper in absolute, the proportional voltage is always positive for either plus or minus motor current.

Start-Up

Once normal wiring is verified, power can be applied to the amplifier.

Assure the inputs are what are required. The Enable Input will disable the drive if it is not connected.

The CUR and RESP adjustments are turned down (CCW). CUR is 50% and RESP is minimal.

It is recommended that CUR be turned to its full CCW position. Once power is applied, CUR can be slowly increased in a CW direction to achieve shaft torque. Crispness can be increased by a CW adjustment of RESP.

For start-up verification of wiring with external position controls the following simple test can be used to verify the phase relationship.

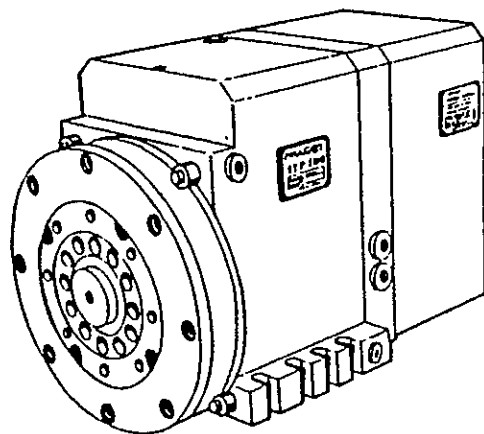
With the current limit turned full CCW or with the RST wiring disconnected, a CW rotation of the motor shaft will produce a negative command voltage at pin #9 (SIG) to pin #11 (GND) on the I/O (J1) connector. For a CCW rotation, a positive command must occur. The rotation is started from a null, or a close to zero shaft position. If the relationship is wrong, there are two choices:

- 1) interchange the A, A\ and B, B\ signals at the simulated encoder.
- 2) use the command - input for signal and pin #11 is still ground.

Either method works, but the first method still assures that positive command voltages cause CW rotation of the motor shaft as viewed from the shaft end of the motor.

BI-DIRECTIONAL TOOL TURRETS

INSTRUCTION MANUAL



- * BTP-125
- * BTP-100
- * BTP-80
- * BTP-63

PRAGATI

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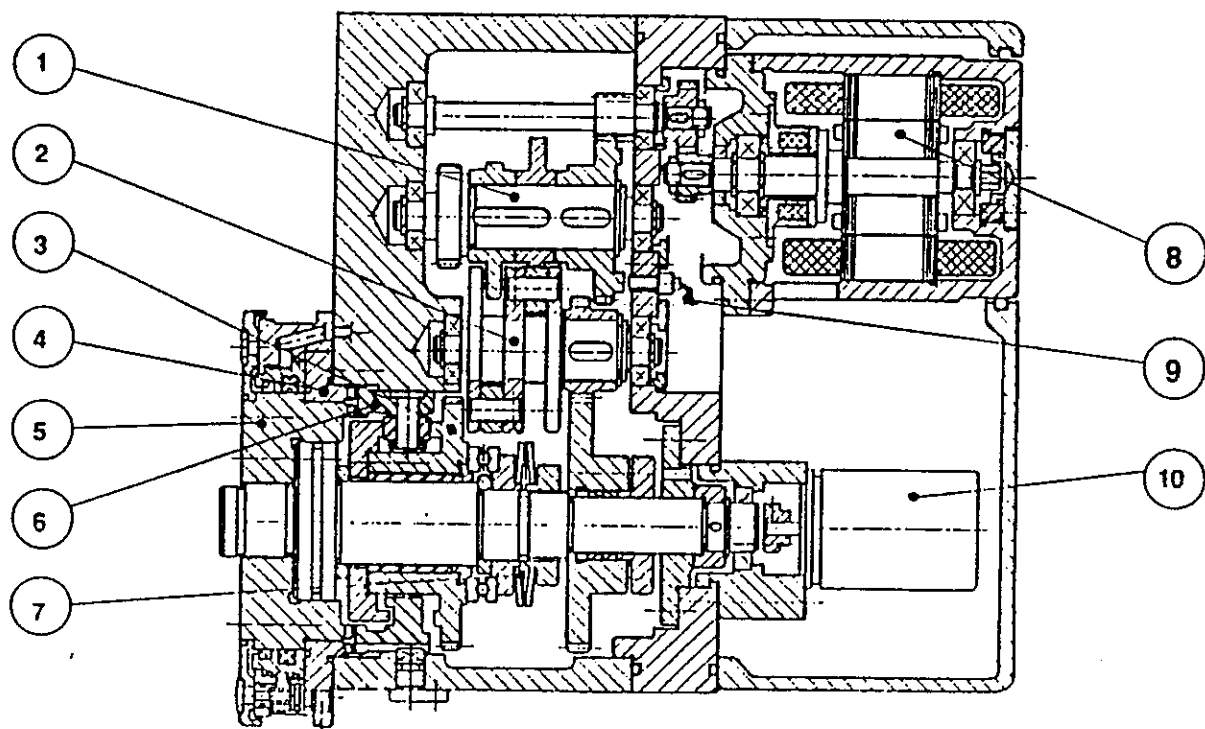
1. Principle of Working :

Three piece face gear coupling is the basic element used for indexing. Coupling design allows the tool disc to be indexed without lifting. It also ensures high repeat positioning accuracy as well as rigidity.

3 phase electric torque motor drives the cam shaft through a system of gears. 'Cam shaft' drives the 'follower shaft' in a non-uniform manner, similar to that of 'Geneva' mechanism. Cam shaft is also geared to the 'drum cam' which controls clamping and release of the coupling.

Initial 90° (approximate) movement of cam shaft does not transfer any rotary movement to follower shaft. However the drum cam rotates through 30°, which movement releases the clamping force and pulls the sliding coupling out of engagement. Further 180° (approx.) movement of cam shaft indexes the follower shaft through 90°, which in turn, indexes the turret by 30° or 45° depending on gear ratio. During this movement, drum cam profile keeps the sliding coupling in dis-engaged position. In the final 90° movement of the cam shaft, the follower shaft remains stationary. The drum cam pulls the sliding coupling into engagement and applies clamping force through disc spring. One revolution of cam shaft completes one indexing cycle of declamp-index-clamp.

Absolute position encoder gives feed-back of the turret position. Proximity switch inspects the clamped position of the turret.



1 Cam Shaft 2 Follower Shaft 3 Drum Cam 4 Fixed Coupling 5 Indexing Coupling 6 Sliding Coupling 7 Disc Spring
8 Torque Motor 9 Proximity Switch 10 Encoder

FIG 1.1

Diagram below gives relative positions of mechanical elements and electrical signals during one revolution of the cam shaft.

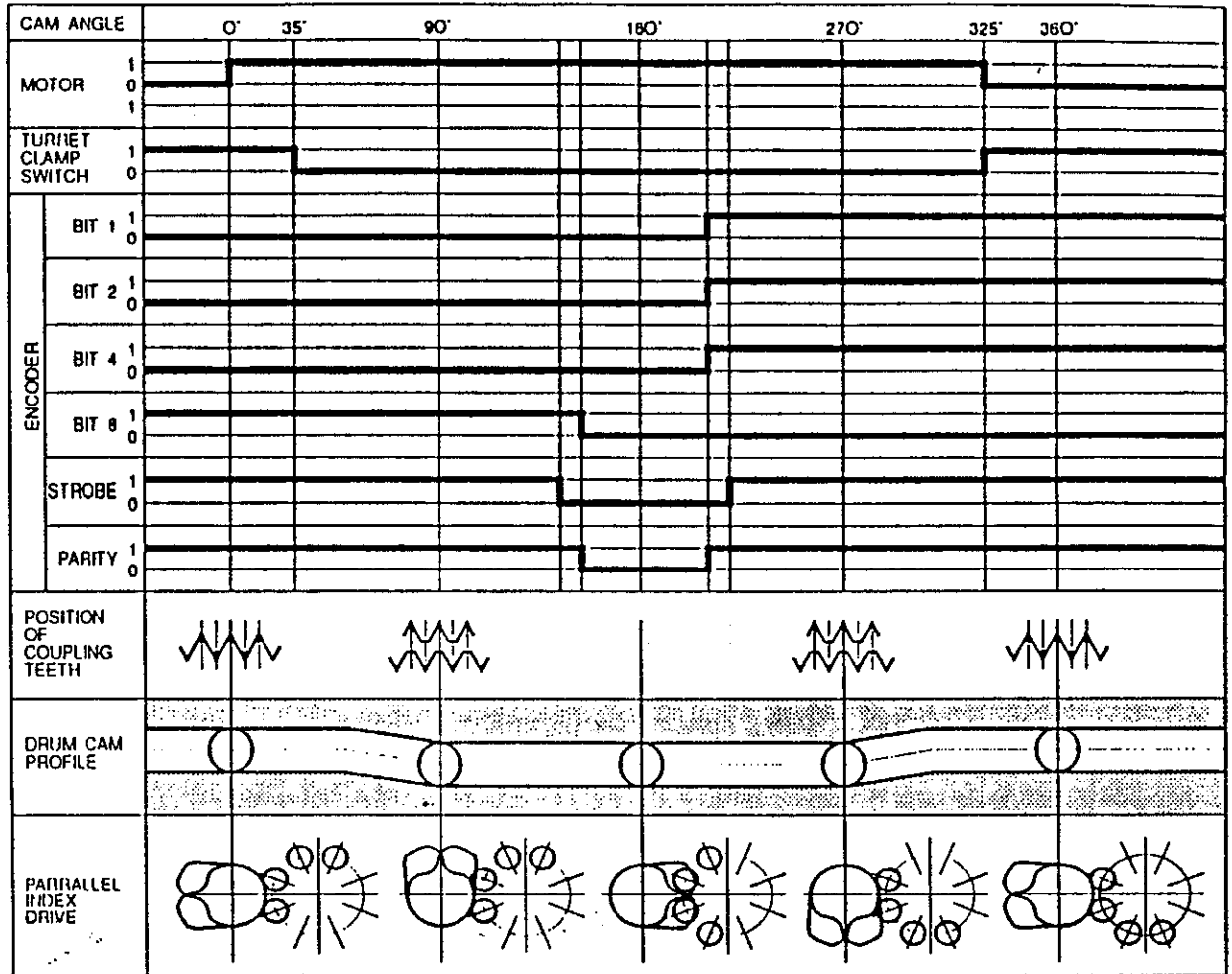


FIG 1.2

2. Fitment on the machine :

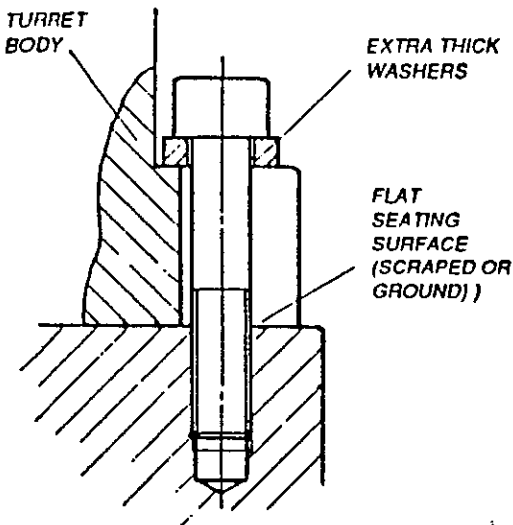


FIG 2.1

a difficult operation to be done on site, and is most likely to be less than perfect. On the other hand, it is perfectly possible to use the turret and tool disc without the use of dowels. The friction joint can easily take up normal cutting loads, including occasional over loads.

Pragati turrets, therefore, do not have a provision of dowelling the body to the base.

Seating surface of the machine should be flat to ensure proper contact with the turret base. Machine surface should be either scraped or surface-ground.

Turret should be aligned by dialing surface of the indexing flange. Clamping bolts should be tightened after aligning the seating surface, square to the lathe axis. Clamping bolts should use machine washers of extra thickness (min. 5 mm) to ensure proper clamping. Dowel Pins are not recommended for ensuring the alignment of turret. It is preferable to allow the turret to slip in the event of an accidental shock or overload. This slipping absorbs some of the energy of the shock and reduces the possible damage. Turret can again be brought back to alignment by dialing a reference surface on the tool disc.

There is one more reason for avoiding the dowel pin. Accidental collisions are not un-common in the field of CNC lathes. In the event of a collision, dowel-pins can get sheared or damaged. It is a difficult task to remove such dowel pins, and to fit new ones. New dowels may involve enlarging the damaged hole by drilling and reaming.

This is difficult to do at the customers place. This is

3. Fitment of Tool Disc on Turret Flange :

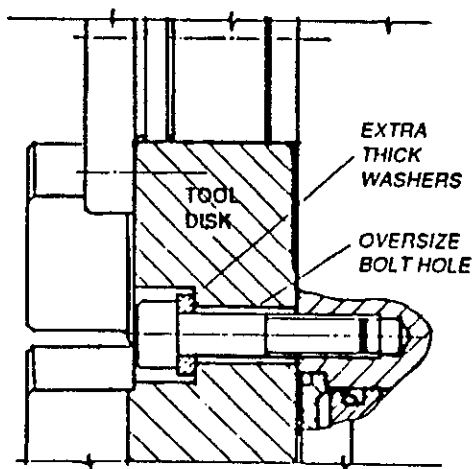


FIG 3.1

Tool disc is to be fitted on the indexing flange with the help of clamping bolts, and machine washers. Disc should be angularly adjusted within the clearance of the bolt holes, to get the correct centre height of the tool. It should then be firmly clamped by tightening the bolts. Dowel pins for ensuring the position are not recommended for the reasons explained earlier.

However, dowel pin can be used for the purpose of alignment, but it is recommended to remove the pin after clamping the tool disc in position. There is a provision of soft areas on the indexing flange to facilitate drilling and reaming for dowel pins.

Bolt holes in the tool disc should be of extra large size to allow for angular adjustment. Extra thick machine washers should be used to ensure proper clamping.

4. Operation of Coolant system :

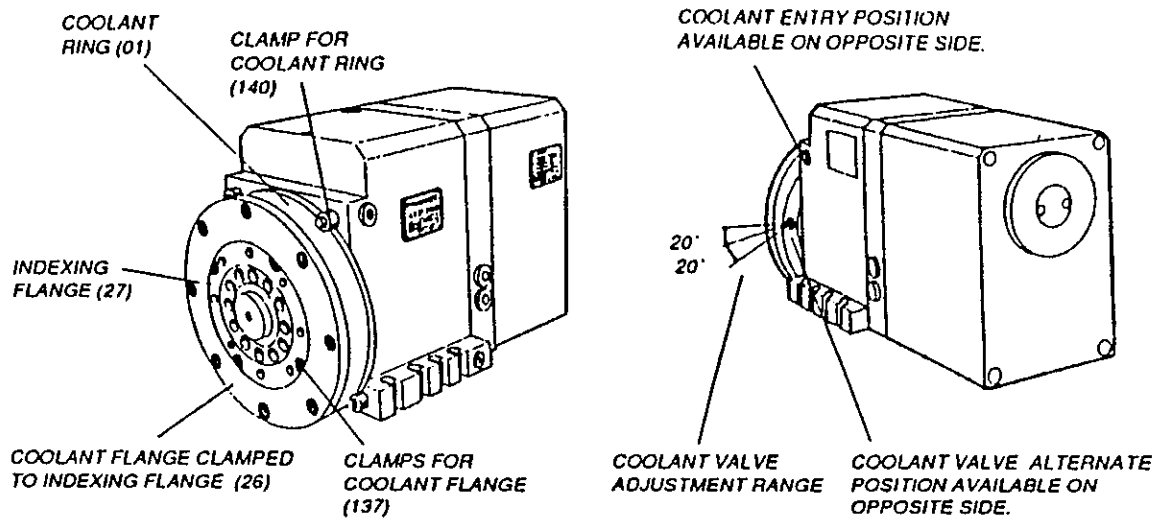


FIG 4.1

Turret has two alternative positions for the connection of coolant pipe. Coolant passes through the drilled hole in the body and enters the passage in the coolant ring (01&24). This ring has spring loaded coolant valve. Valve button (130) continuously presses against coolant flange (26) fitted on indexing flange. Coolant ring as well as coolant flange have provision for angular adjustment. Coolant flange should be adjusted to align the 'O' rings (37) with coolant passages on tool disc. Coolant ring should then be adjusted to align the coolant valve with the proper hole on the coolant flange. (ref. 4.1). There are 2 valve positions on the coolant ring. Only one of the positions is to be chosen as functional, and should be fitted with the spring loaded valve button (130). The other valve positions should be blocked by plug (136). This design ensures that the coolant is connected only to the working tool position. Coolant flow automatically stops during the indexing movement, as the coolant flange closes the opening of the valve button.

Coolant passage through the turret body, coolant ring and the valve has been designed to provide as little resistance to coolant flow as possible. However, the path is long and narrow, with a number of bends in the flow passage. Furthermore, coolant has to pass through drilled passages in the tool disc, before reaching the tool point. It might therefore be necessary to employ high pressure coolant pump, to ensure sufficient flow at tool point. Coolant passages in tool turret can withstand a maximum pressure of 6 bar.

4.1 Procedure for adjustment of coolant ring :

Coolant ring holds on to the indexing flange (27), because of the friction of wiper seals. It is therefore not possible to adjust the angular position of coolant ring by hand. Following procedure is to be followed for this adjustment.

- Loosen clamps (140). Move the coolant ring along with indexing flange by hand cranking (Ref. section 8, page 11) to required position. Tighten clamps (140).

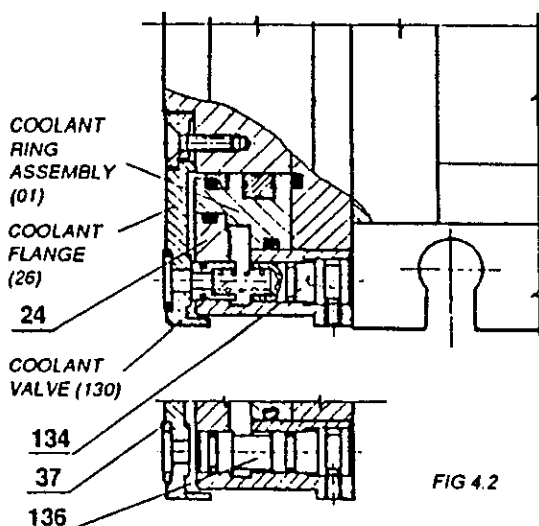


FIG 4.2

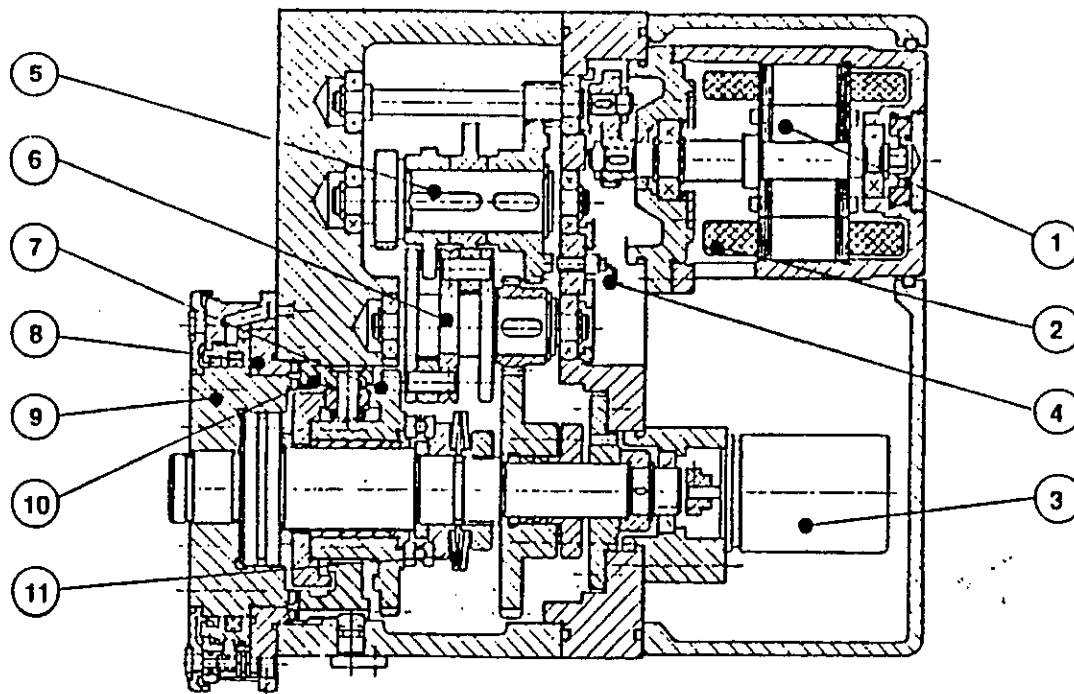
4.2 Replacement of Valve Button (fig. 4.2) :

Valve button rubs against the coolant flange during indexing, and is liable to wear. Provision has been made to replace the button, without removing the tool disc from the turret.

For replacement, loosen the clamp (140) and move the coolant ring to bring the valve in a suitable position to get access to the plug (134).

Remove the plug, the spring and the valve button. Replace with a new button, and place back the spring and the plug. Coolant ring should then be shifted back and clamped in original position.

5. Details of Electrical Connections



1.Torque Motor 2.Thermal Relay 3.Encoder 4.Turret Clamp Switch 5.Cam Shaft 6.Follower Shaft 7.Drum Cam 8.Fixed Coupling 9.Indexing Coupling 10.Sliding Coupling 11.Disc Spring

WIRING DETAILS FOR BI-DIRECTIONAL TOOL TURRET

NO	COMPONENT	CHARACTERISTICS	NUMBER	COLOR	DETAILS
1	TORQUE MOTOR	ALTERNATIVE VOLTAGES 415,380 AND 220 VAC 3 PHASE ALTERNATIVE FREQUENCIES 50 Hz AND 60 Hz MOTOR SHORT BTP-100 : 2.8 KVA CIRCUIT POWER BTP-80 : 1.5 KVA BTP-63 : 1.2 KVA	 3 ~ M M M E	RED RED RED GREEN	Phase Phase Phase Earthing
2	THERMAL RELAY	130° 2A 415 VAC NORMALLY CLOSED CONTACT	 T T	BLUE BLUE	
3	ABSOLUTE POSITION ENCODER	15-30 V DC RIPPLE 10% 350 mA (SUPPLY) 50 mA /CHANEL (LOAD) OUTPUT - PNP	 1 2 3 4 5 6 7 8	WHITE YELLOW GREEN VIOLET BLACK PINK BLUE BROWN	BIT 1 BIT 2 BIT 3 BIT 4 STORE PARITY 0° Volts 24 V DC
4	TURRET CLAMP SWITCH	10-30 V DC RIPPLE 10 % 200 mA (LOAD) OUTPUT - PNP - NO	 9 10 11	BLACK BLUE BROWN	OUTPUT 0° Volts 24 V DC

6. Electrical motor wiring details

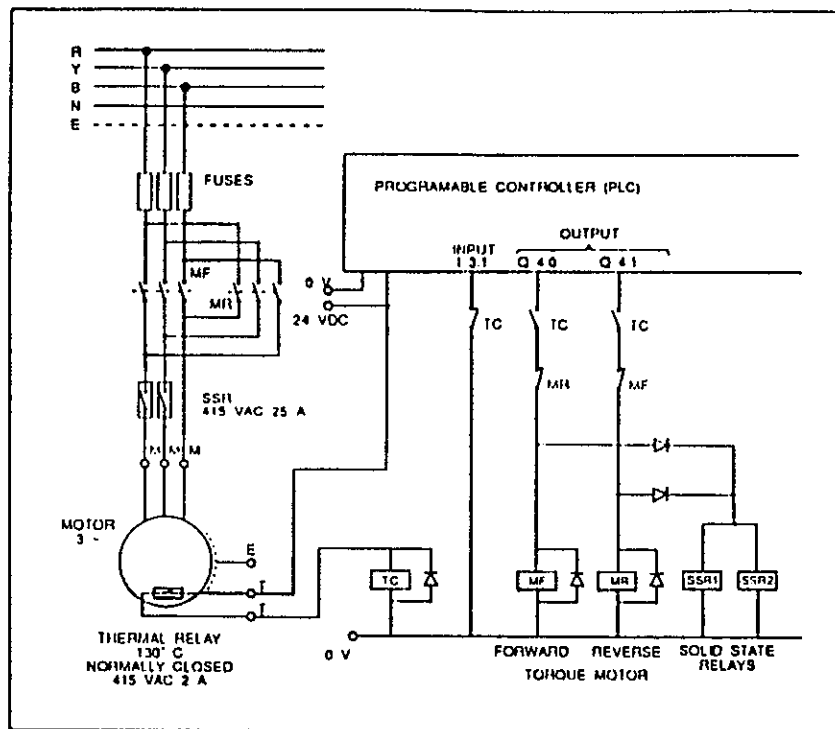


FIG 6.1 WIRING DIAGRAM FOR MOTOR

MOTOR CURRENT

MODEL	VOLTAGE AC			
	415/380	220	110	
BTP 125	2.6	4.2	9.4	
BTP 100	1.4	2.2	4.8	
BTP 80	1.4	1.8	3.6	
BTP 63	1.2	1.7	3.3	
BTP 50				

USE FUSE RATING ABOUT THREE TIMES MOTOR CURRENT. MINIMUM 6A FUSE TO BE USED.

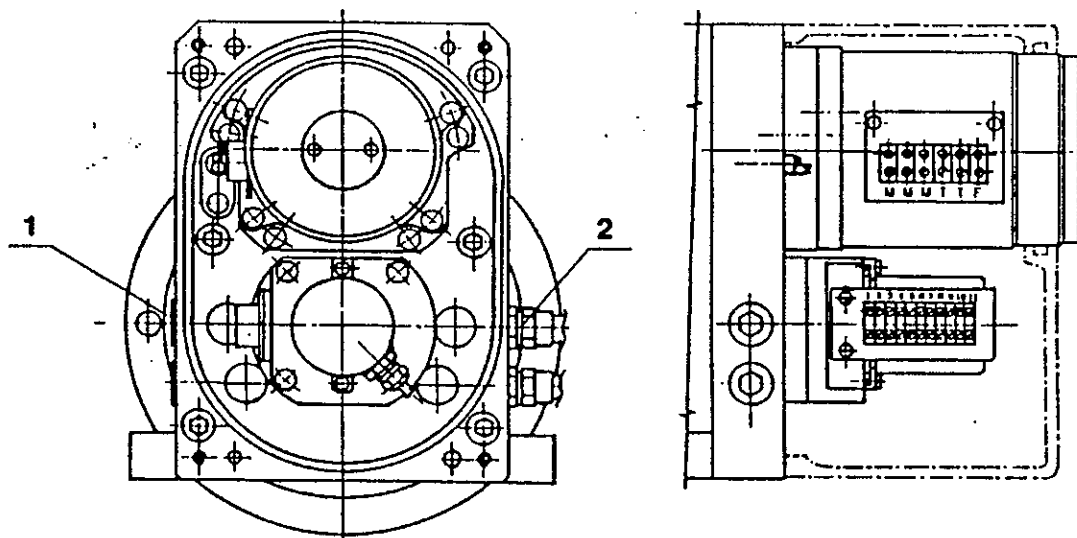


FIG 6.2 DETAILS OF ELECTRICAL TERMINALS

1. Unused electrical entry points to be properly plugged.
2. Electrical wiring should be brought in through water proof conduit connection. Wire braided hydraulic hoses can serve as conduits. They also give excellent protection against damage by hot chips.

7.0 Electrical Signals

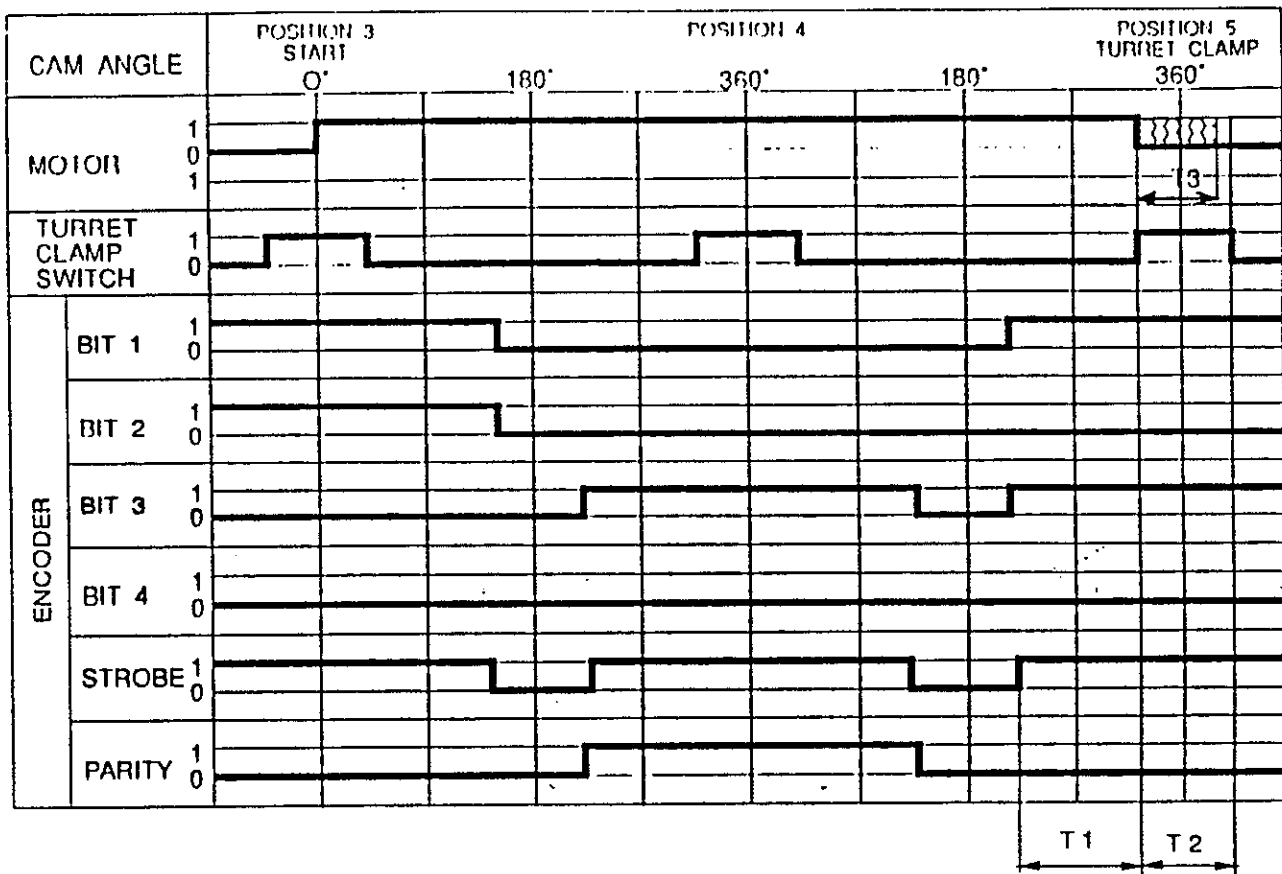


TABLE 1 ENCODER SIGNALS

	POSITION NUMBER											
	1	2	3	4	5	6	7	8	9	10	11	12
BIT 1	1	0	1	0	1	0	1	0	1	0	1	0
BIT 2	0	1	1	0	0	1	1	0	0	1	1	0
BIT 3	0	0	0	1	1	1	1	0	0	0	0	1
BIT 4	0	0	0	0	0	0	0	1	1	1	1	1
STROBE	1	1	1	1	1	1	1	1	1	1	1	1
PARITY	1	1	0	1	0	0	1	1	0	0	1	0

CCW → ← CW

TABLE 2

		T1	T2	T3
		ms	ms	max ms
BTP-100	FAST	110	60	50
	STD	135	75	60
BTP-80	FAST	100	55	45
	STD	110	60	50
BTP-63	STD	80	45	35

Following points should be noted while selecting control system for turret :

1. Direction of rotation of motor for shortest indexing time is to be decided by control system.
2. Indexing times of these turrets are short. It is necessary to select particularly fast PLC (programmable logic controller) for the control of turret operations.
3. Referring to the signal diagram, value of T3 is particularly critical. Motor must come to a physical halt within this time. Otherwise the turret will get de-clamped and the proximity switch signal will be lost. Following measures are suggested for stopping the motor in minimum possible time.
 - a. Control should be capable of detecting the proximity switch signal within 3 to 6 ms.
 - b. Solid state relays should be incorporated in the motor circuit to ensure fastest possible disconnection. Regular contactors can be used for motor direction selection, followed by solid state relays, at least in two phases.

8. Hand cranking :

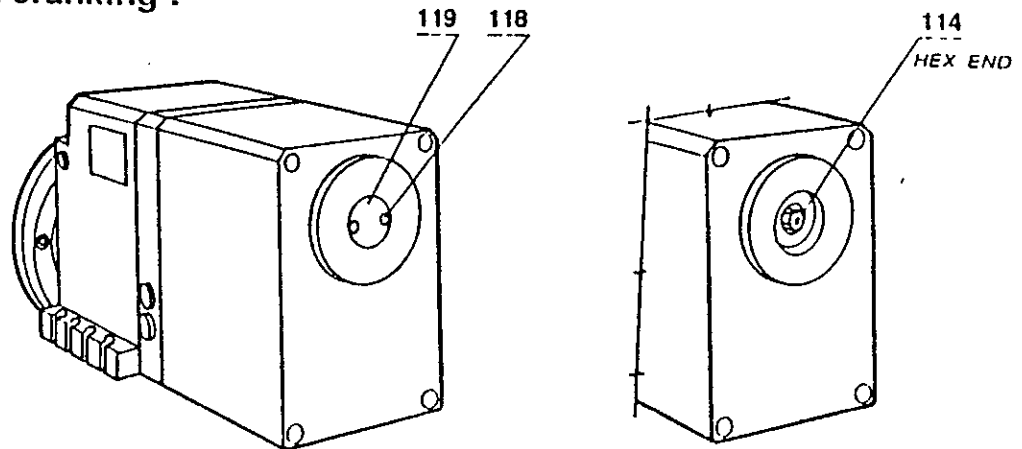


FIG 8.1

Turret can be indexed by cranking the rotor of electric motor by hand. Hand cranking is required for inspecting the setting of encoder and proximity switch. It is also necessary for inspecting the clamping function of disc springs.

Procedure for hand cranking is as follows :

1. Disconnect 3 phase power supply to the motor.
2. Remove end cover (119) of motor. Hexagon head of motor shaft is now approachable.
3. Use a suitable cranked spanner to crank the motor.
4. After cranking, do not forget to place cover (119), back in position.

9. Lubrication :

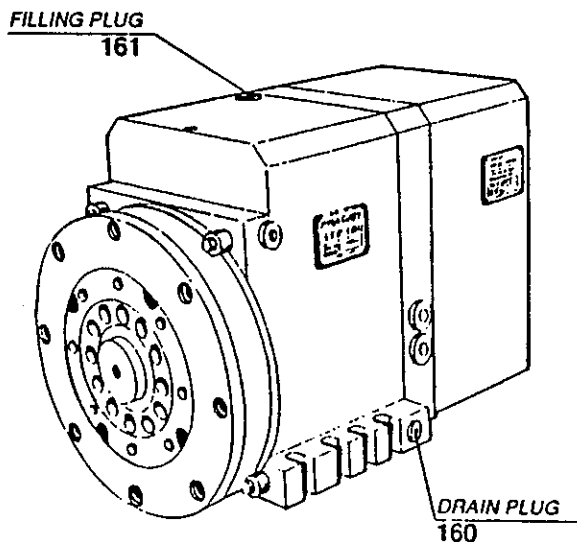


FIG 9.1

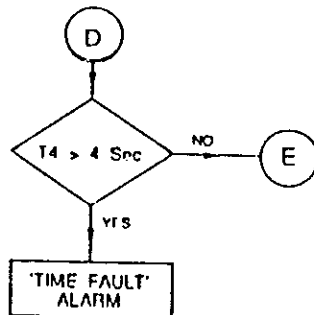
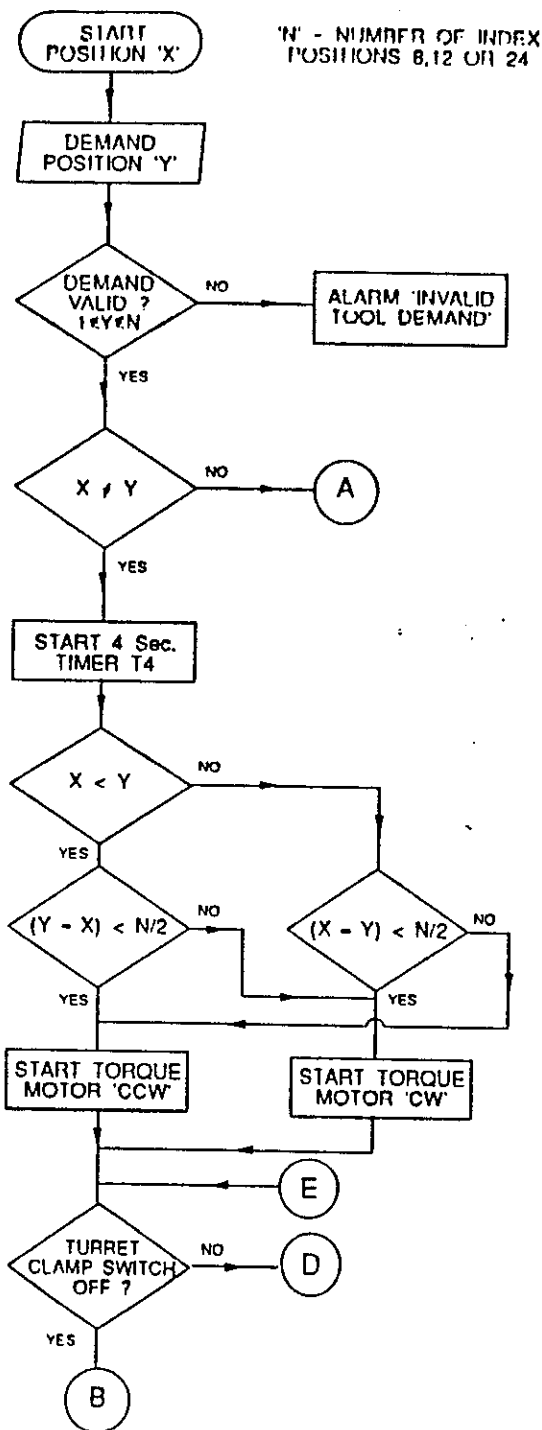
Turret is lubricated by medium viscosity gear box oil.

Oil can be filled after removing the filling plug (161) as shown in the figure (9.1). A drain plug (160) has been provided to drain out the oil, if so required.

Oil quantity required for different turret models is listed below:

MODEL	Oil Qty Lit.
BTP-125	1.75
BTP-100	1.25
BTP-80	1.00
BTP-63	0.75

10. Flowchart for turret control



Note : Monitor turret clamp switch signal on continuous basis. Generate FEED-HOLD if clamp signal missing.

11. Requirements of turret control :

11.1 Sequence of operation :

Suggested flow chart is given in the diagram on page 11. It might be necessary to modify the program depending on individual applications. However, following general points should be noted while selecting the control system and its program :

- Indexing times of these turrets are short. It is therefore necessary to select a particularly fast PLC (programmable logic controller) for the control of turret operation.
- Referring to the electrical signal diagram on page 8 ; time 'T3' is particularly critical. Motor must come to a physical halt within this time. Otherwise, the turret will get declamped, and the turret clamp switch signal will be lost.

For stopping the motor in minimum possible time, following measures are required:

- Control should be capable of detecting the turret clamp switch signal within a period 5 ms.
- Motor should be switched off by solid state relays, which give fastest possible operation, contactors take much longer time (30 to 40 ms). Suggested electrical circuit is on page 9.
- In case of doubt time delay between 'turret clamp signal' and 'motor switch off signal' should be monitored on a dual beam oscilloscope, with memory.

11.2 Safety Interlocks :

11.21. 'MOTOR OVERHEAT' SIGNAL

Thermal relay has been provided in the motor winding to give indication of motor overheating. In the event of overheating relay should trip the motor contactor, and also give 'Motor overheating' signal to the control circuit. Motor contactor should be tripped without depending on PLC software. Typical circuit diagram is given in page 9.

11.22. 'TIME FAULT' SIGNAL

Time required for indexing through 180° is between 1.3 seconds to 3.1 seconds depending on the model. This is the maximum time required for completing the indexing operation. If the 'cycle complete' signal is not received even after this time, this will be an indication of some fault in the indexing cycle. Control circuit should be programmed to give a 'Time Fault' signal, if the 'Cycle complete' signal is not received within a specified time (say 1 second more than the maximum expected time) after the 'Cycle Start' signal.

11.23. 'TURRET NOT LOCKED' SIGNAL.

Turret clamp switch should be continuously monitored. If the clamp signal is missing, a Feed Hold signal should be generated to stop the machine movements. Simultaneously, 'Turret not locked' alarm signal should also be generated.

11.24. 'POSITION FAULT' SIGNAL

At the end of indexing cycle, a check should be made to ensure that the turret has indexed to the demanded position. If the actual position and demanded position do not match, then 'Position fault' alarm signal should be generated.

11.25. 'INVALID DEMAND' SIGNAL

An eight position turret cannot react to a tool demand other than 1 to 8. If any other tool position (say 12) is demanded, the control should give out 'INVALID DEMAND' signal.

All these signals should stop the operation of the machine, and an indication should be available on the control panel regarding the nature of the fault.

11.3 Manual mode of turret control

Control panel should have a facility to change over the turret control to manual mode. Following facilities should be available in this mode :

11.31. 'Inching' the motor in either direction : During servicing, it is sometimes necessary to rotate the motor for checking the functioning of the turret mechanism. Push button switches should be provided to allow 'inching' of the motor in either direction.

11.32. Tool indexing cycle on manual demand : Control system should provide a facility to index the turret into desired position by manual data entry of 'tool demand'. This can be either by a 'thumb wheel' switch, or by push button data entry through CNC panel.

Indexing cycle through manual tool demand will be identical to the normal indexing cycle, except for the fact the cycle will start even if initial signal conditions are not satisfied.

Turret can stop in an unclamped position, if the power fails during the indexing cycle. It is then possible that valid encoder feedback is not available because the turret has stopped in an intermediate position. In such a case, in MDI mode, the control should choose a fixed direction of motor rotation (i.e. default direction) and then index the turret to demanded position.

12. Replacement or adjustment of rotory encoder (fig 12.1)

Rotary encoder is fitted on flange (19) with the help of clamps (20). Encoder can easily be removed by removing these clamps.

12.1 However, care should be taken while mounting the encoder back in its position. Angular position of the encoder is important. Procedure for setting the encoder in proper angular orientation is as follows :

- Index the turret to any working position by hand cranking the motor shaft. Proper clamped position is indicated by lighted LED on proximity switch (152).
- Check encoder output by monitoring LED indicators on the Turret Control System (or by checking PLC bits on CNC monitor). If 'Strobe' signal is not available, then adjust angular position of housing till you get 'Strobe' signal. This procedure sets encoder to its rough position.
- For accurate setting, slowly adjust the angular position of encoder housing, till the strobe signal LED changes over from signal 1 (light ON) to signal 0 (light OFF). Mark this position of the housing in relation to a reference line on the seating flange (19). Now slowly rotate the housing in opposite direction, till the strobe signal again changes from 1 to 0. Mark this new position on the housing.
- Strobe signal is now available in the angular position between the two marks. Angle between two marks will be 20° approximately.
- Rotate the housing backwards by half the distance (i.e., 10°), so that the reference line on the flange (19) is halfway between the two marks.
- Clamp the encoder in this position by tightening clamps (20).

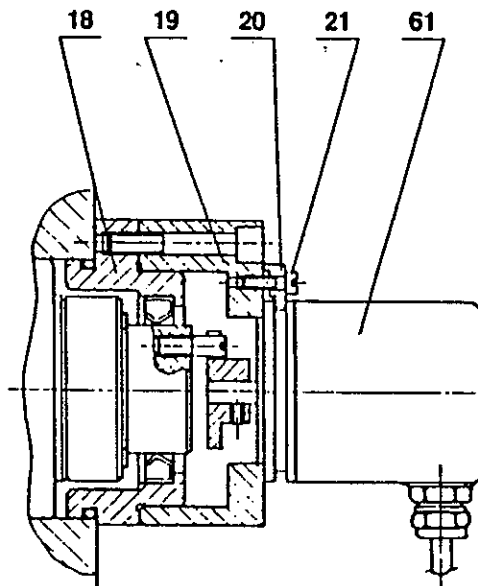


FIG 12.1

13. Proximity switch adjustment and replacement (fig. 13.1):

Proximity switch is operated by the projected 'switching area' on gear wheel (85); and indicates that the turret is in clamped position. Actuation of the switch is indicated by built in LED (light emitting diode).

Operation of the switch can be checked by hand-cranking the turret. (refer page 11), crank motor shaft to index the turret through 360°. Turret will pass through cycles of decamp-index-clamp; and your hand can feel the pressure during 'clamp' phases.

Proximity switch LED should light up during all these 'clamping' phases. Flickering of the light, or inconsistency of LED operation will be an indication of faulty proximity switch.

13.1 Replacement of the switch :

- Bring the turret in clamped position by hand cranking.
- Proximity switch is approachable after removing back cover (60). Switch is held in a clamp (153), and the clamp is bolted to the turret body by socked head screw (154).
- Remove screw (154), and take out proximity switch along with its clamp. Measure distance 'a' by vernier, and note it down. Loosen clamping screw (155), and remove switch from the clamp.
- Measure distance 'b' between the clamp seating surface, and the sensing surface on gear (85) by using a vernier or a depth gauge. Distance 'a' by which the proximity switch projects out from the clamp should be adjusted to give a gap of 0.8 to 1 mm.
- Place new switch in position. Crank turret by hand, and check the function of switch by watching the signals on the built in LED.

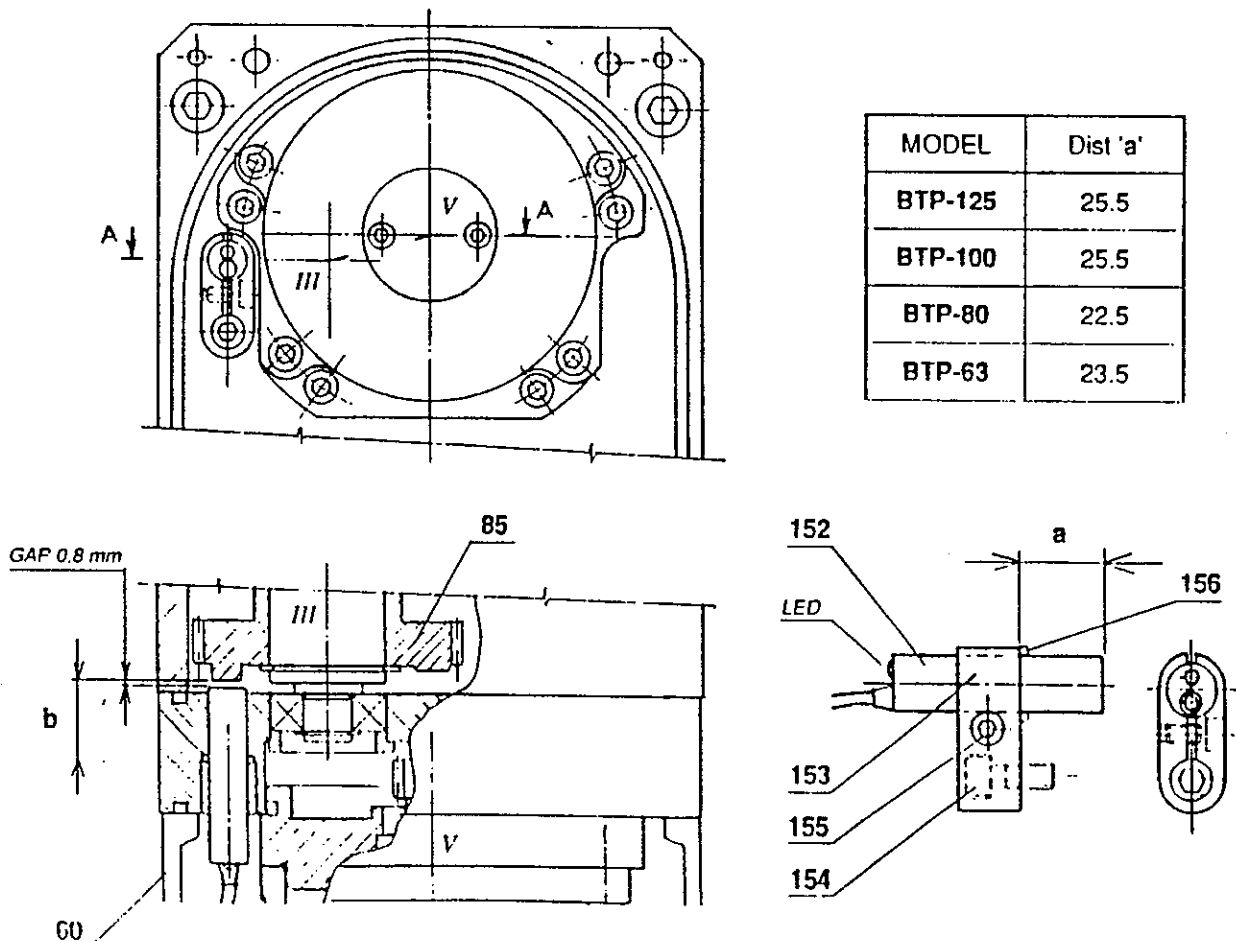


FIG 13.1

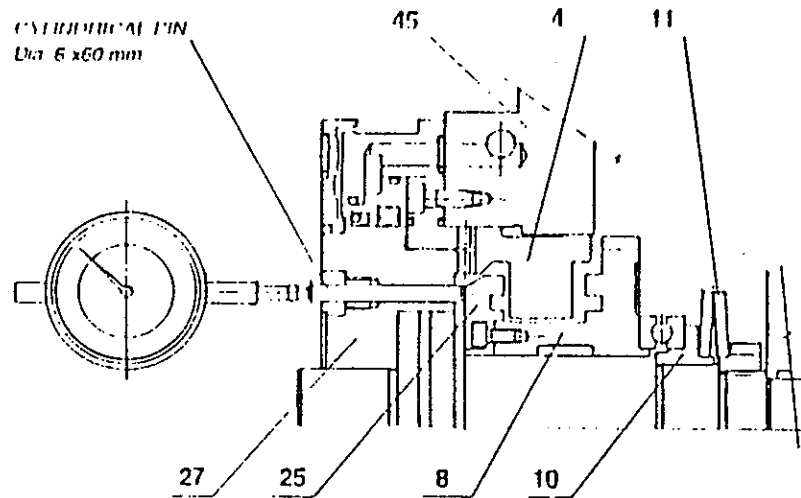


FIG 14.1
SPINDLE ASSEMBLY CORRESPONDING TO BTP-80 & BTP-63

14. Inspection of clamping action of disc spring (FIG. 14.1) :

At the end of indexing operation, cam gear (8) pushes sliding coupling (4) against coupling pair (4 to 27). As the coupling teeth mesh, sliding coupling cannot move further forward. So remaining axial movement is now taken over by drum cam (8 and 25), which moves towards the disc springs. At the end of clamping cycle, cam gear (8) compresses springs by pushing spring seat (10) away from the shaft shoulder. This action transfers the spring force from shaft shoulder to coupling teeth. Displacement of spring seat (10) is therefore an indication, that the clamping force has been applied on the coupling. This displacement is measured indirectly on the face of cam flange (25).

14.1.1 Land crank the turret to a suitable clamped position, where plug (28) is at a level above the spindle centre line. This will ensure that lubrication oil will not spill out when plug is removed.

Remove the plug and place a cylindrical pin (dia 6, length 60) as shown in figure. Position a dial indicator to measure axial movement of the pin.

Now slowly crank the turret by hand till you feel the release of clamping pressure. At this position, spring pressure has been taken over by shaft shoulder, and drum cam track does not carry the clamping load. Measure the displacement on dial indicator. It should be more than 0.1 mm.

Further cranking of turret will bring sliding coupling out of engagement. During this movement, drum cam (8,25) will move within its axial clearance, away from the springs. This movement will also be recorded on the dial indicator, but should be ignored as it does not correspond to the movement of spring seat (10)

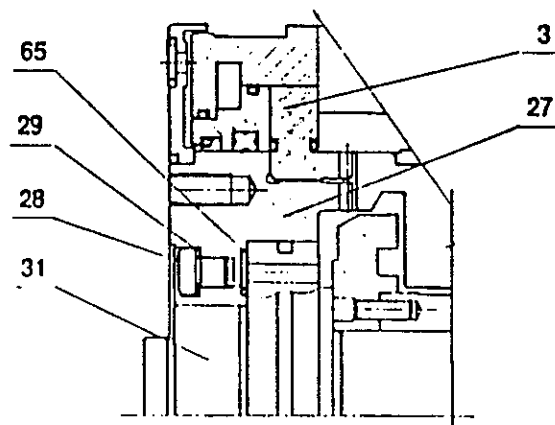


FIG 14.2
SPINDLE ASSEMBLY CORRESPONDING TO BTP 100 & BTP 125

Place back washer (29) and plug (28) after the test.

14.2. If dial indicator reading is less than 0.1 mm, it indicates wear of the cam track or cam follower roller. Inspect these components. If heavily worn out they should be replaced. In case the components are in good condition; then the spring seat lift should be increased by following the procedure given in section 17.15, page 24. Measure the existing lift and increase it suitably by grinding the end face of spring seat (10).

15. Assembly drawings

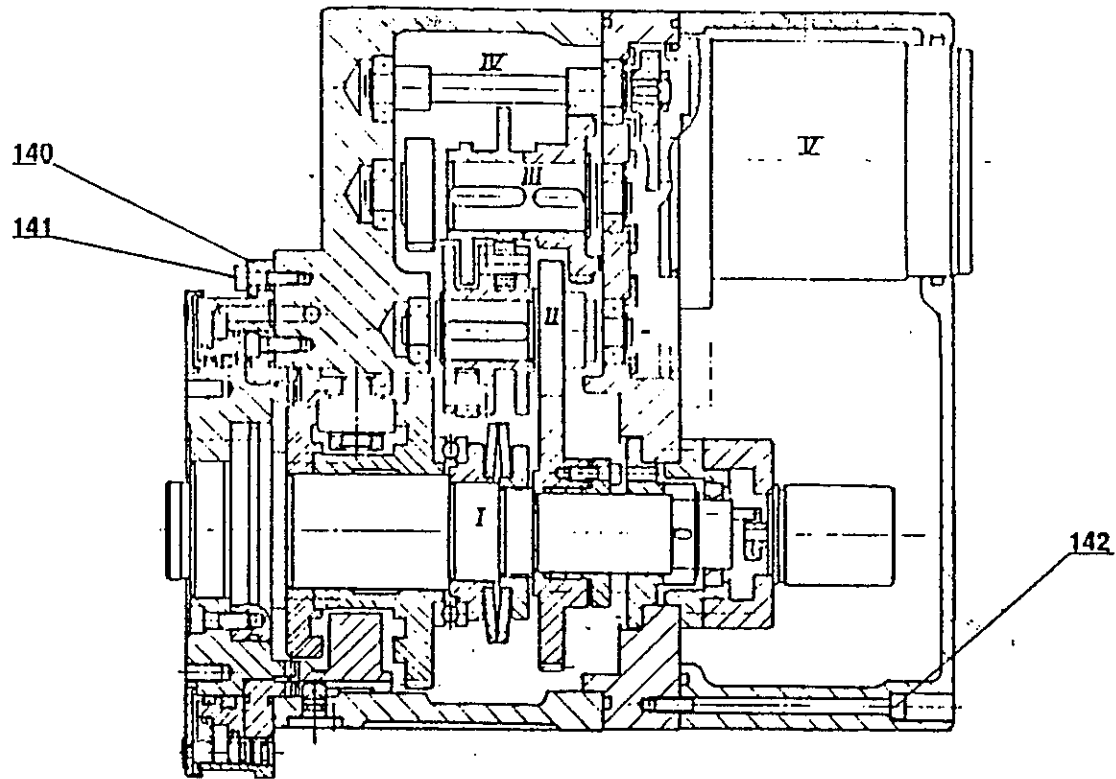


FIG 15.1 OVERALL ASSEMBLY
ALL AXES ARE SHOWN IN ONE PLANE FOR CLARITY

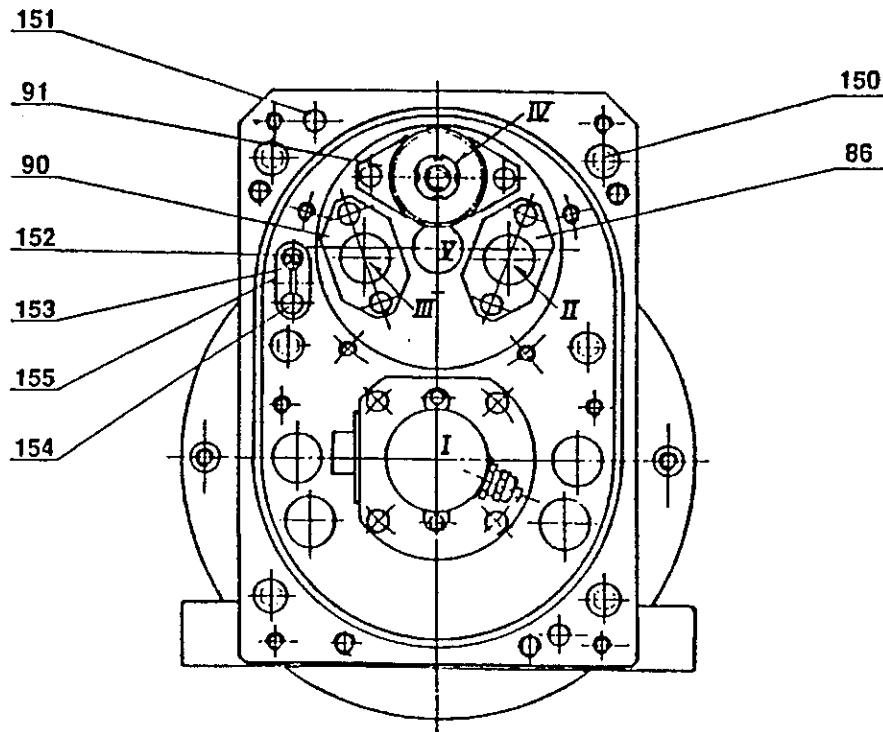


FIG 15.2 VIEW WITH BACK COVER AND MOTOR REMOVED.
ACTUAL ORIENTATION OF AXES IS VISIBLE IN THIS VIEW

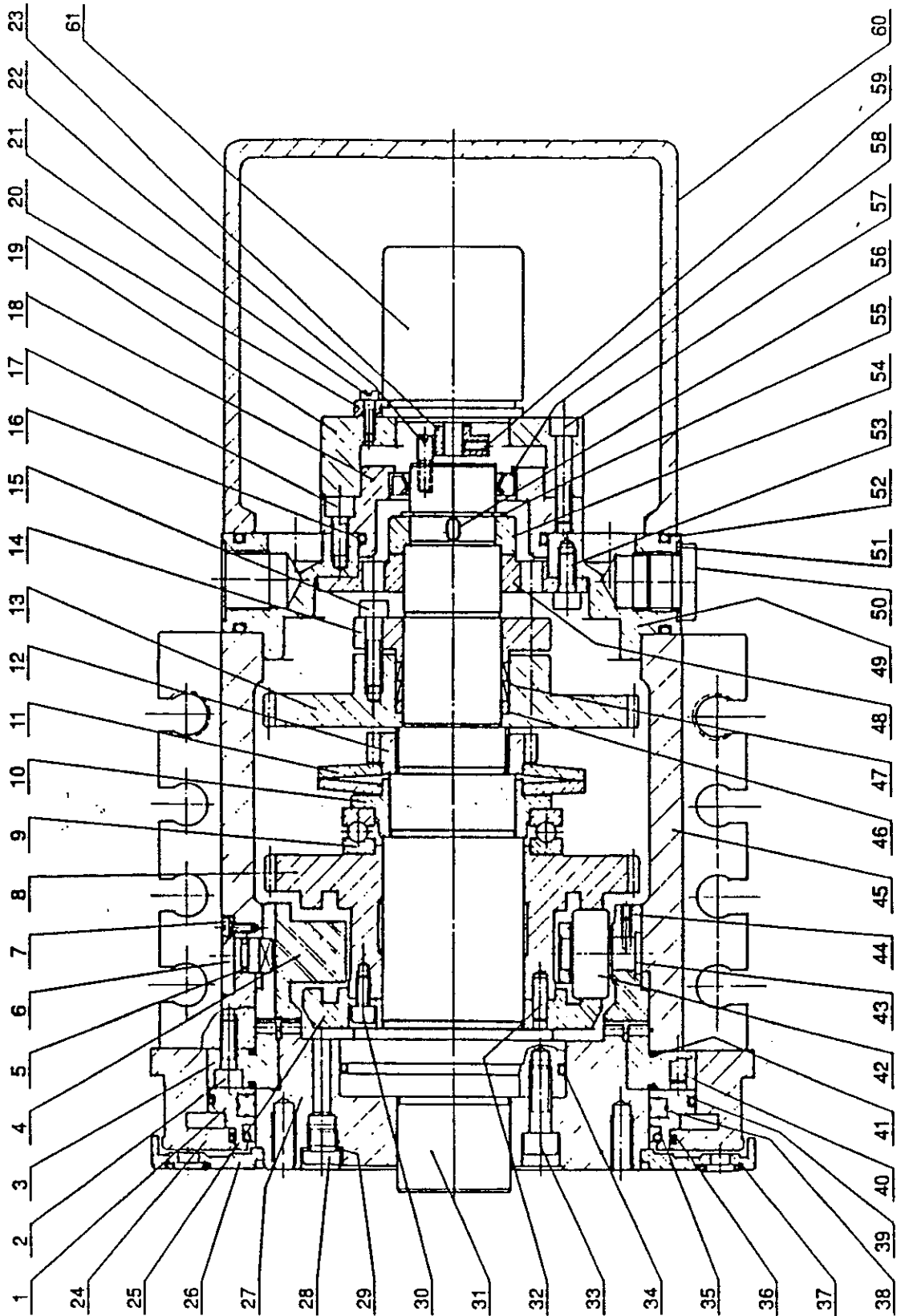


FIG 15.3 MAIN SPINDLE ASSEMBLY

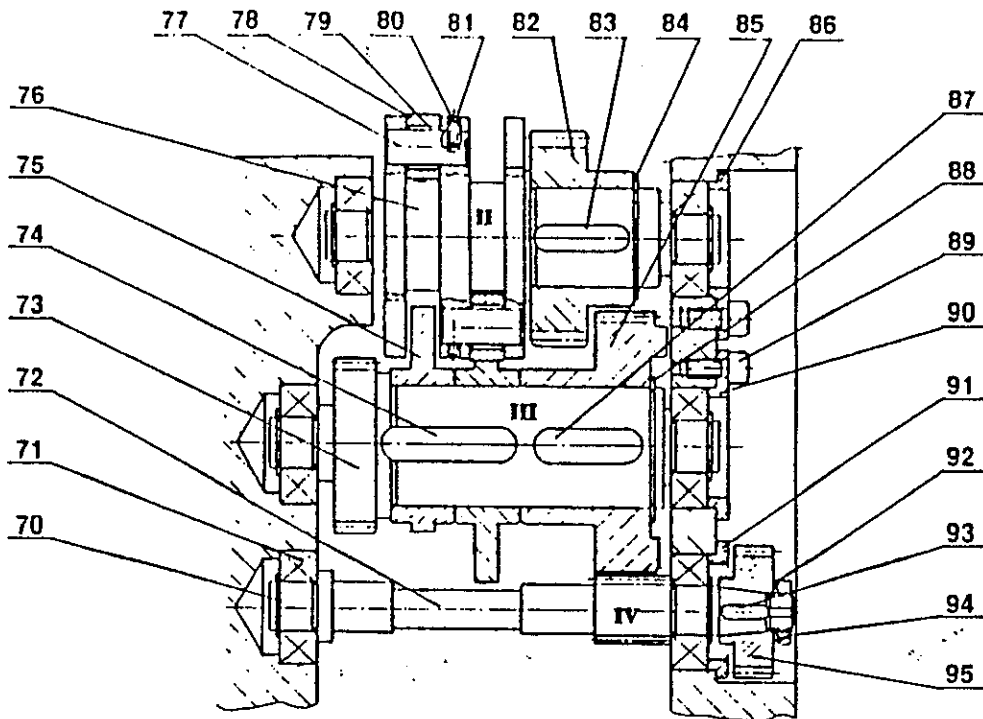


FIG 15.4A INDEXING DRIVE (BTP-80, BTP 63)

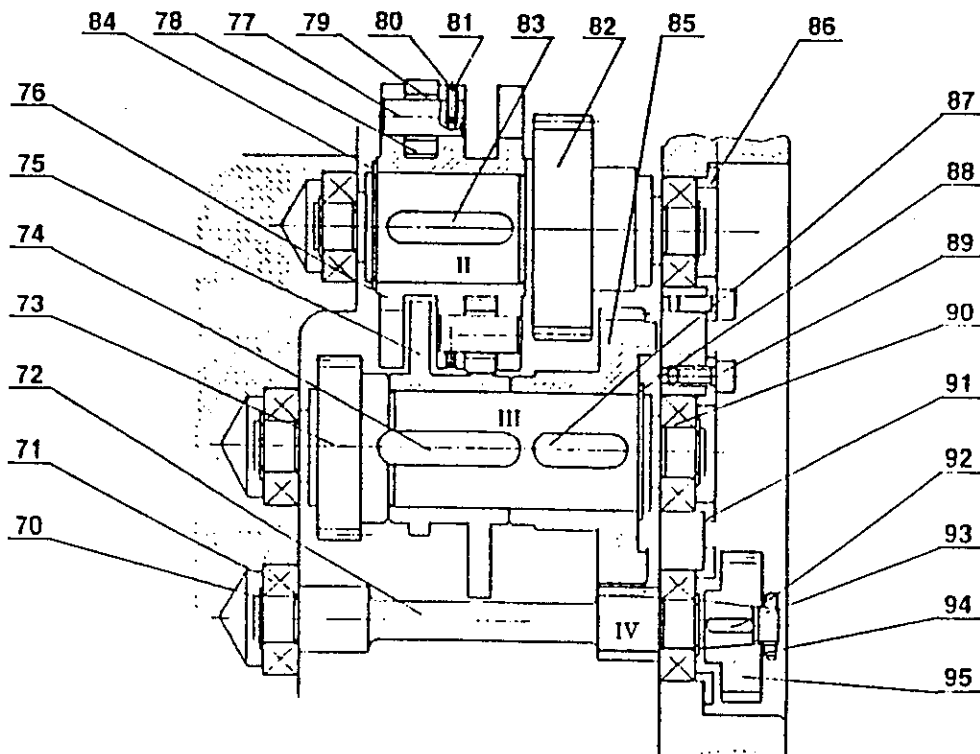


FIG 15.4B INDEXING DRIVE (BTP-125, BTP 100)

This diagram shows a cross-sectional view of a hydraulic cylinder assembly. The central component is a piston rod (112) with a piston (111) attached. The piston is sealed by a piston seal (110) and a wiper seal (109). The cylinder is filled with hydraulic fluid (113). The cylinder head (106) is secured by a head cap (105) and a head cap bolt (107). The head cap is sealed by a head cap seal (108). The head cap is also secured by a head cap nut (114) and a head cap washer (115). The head cap is also secured by a head cap gasket (116) and a head cap O-ring (117). The head cap is also secured by a head cap pin (118) and a head cap clip (119). The head cap is also secured by a head cap screw (120) and a head cap plug (121).

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15.1 Partlist

NO.	NAME	NO.	NAME	NO.	NAME
1	COOLANT RING (INNER)	45.	MAIN BODY	93	KEY
2	SOC HD. SCR.	46.	SPACER	94	LOCK NUT
3	FIXED COUPLING	47.	RING FEDER ELEMENT	95	GEAR
4	SLIDING COUPLING	48.	BEARING FLANGE	105	CIRCLIP
5	'O' RING	49.	END PLATE	106	CIRCLIP
6	ANTI ROTATION KEY	50.	PLUG	107.	OIL SEAL
7.	SOC HD. SCR.	51.	WASHER	108	'O' RING
8	CAM GEAR	52.	'O' RING	109	MOTOR FLANGE
9	THRUST BEARING	53	SOC. HD. SCR.	110	SOC. HD. SCR.
10.	SPRING SEAT	54.	BEARING RING	111	SOC. HD. SCR.
11.	DISC SPRING	55.	CIRCLIP	112	STATOR
12.	LOCK NUT	56	KEY	113	ROTOR
13.	INDEXING GEAR	57	SOC. HD. SCR.	114	PINION SHAFT
14	RING FEDER FLANGE	58.	OIL SEAL	115.	BEARING
15	SOC HD. SCR.	59	GRUB SCR.	116	CIRCLIP
16.	'O' RING	60.	BACK COVER	117	THREADED
17.	SOC HD SCR	61	ENCODER	118	SOC HD. SCR.
18.	FLANGE	62	PINION	119	COVER
19.	FLANGE	63	CIRCLIP	120.	'O' RING
20	CLAMP	64	NEEDLE BEARING	121	MOTOR BODY
21.	SOC. HD. SCR.	65.	'O' RING		
22.	PIN			130	COOLANT VALVE BUTTON
23.	FLANGE	70.	CIRCLIP	131	'O' RING
24.	COOLANT RING (OUTER)	71.	BEARING	132	SPRING
25.	CAM FLANGE	72.	PINION SHAFT	133	'O' RING
26.	COOLANT FLANGE	73.	CAM SHAFT	134	PLUG
27.	INDEXING FLANGE (COU- PLING)	74	KEY	135	GRUB SCR.
28.	PLUG	75.	INDEXING CAM	136	PLUG
29.	WASHER	76.	ROLLER HOUSING	137	CLAMP
30.	SOC. HD. SCR.	77.	PIN	138.	CSK SCREW
31.	SPINDLE	78.	TRACK ROLLER		
32.	CYL. PIN	79.	NEEDLE BEARING	140	CLAMP
33.	SOC. HD. SCR.	80.	BINDING RING	141.	SOC. HD. SCR.
34.	'O' RING	81.	GRUB SCR.	142.	SOC. HD. SCR.
35.	WIPER SEAL	82.	INDEXING PINION		
36.	'O' RING	83	KEY	150.	SOC. HD. SCR.
37.	'O' RING	84.	CIRCLIP	151.	CYL. PIN
38	QUAD RING	85.	GEAR	152	PROXIMITY SWITCH
39.	'O' RING	86.	BEARING COVER	153.	CLAMP
40.	CYL. PIN	87.	KEY	154.	SOC HD. SCR.
41.	'O' RING	88.	CIRCLIP	155.	SOC. HD. SCR.
42.	CAM FOLLOWER BEARING	89.	SOC. HD. SCR.	156.	'O' RING
43.	PIN	90.	BEARING COVER		
44.	GRUB SCR.	91.	BEARING COVER	160.	PLUG
		92.	LOCK WASHER	161.	PLUG

Note : Please specify the model and turret number, while ordering the spare parts.

16. Instructions for dismantling of the mechanical components :

Turret may have to be opened up in following circumstances :

Mechanical jam of the turret. If turret cannot be indexed even by hand cranking, it will be necessary to open up the turret for inspection.

Unusual knocking sound during indexing is also an indication of mechanical problem. Accidental collision with lathe chuck or other components. If the turret does not function properly immediately after an accident, internal component damage can be suspected.

16.1 Instructions for dismantling (fig 15.1,15.2,15.3,):

- Remove the turret from the lathe after draining lubrication oil
- Remove coolant flange (26) and coolant ring (24,1).
- Remove rear cover (60).
- Remove motor.
- Remove encoder (61) and mounting flange (19).
- Remove gear (95).
- Remove proximity switch (152), along with its clamp.
- Remove circlip (55)
- Remove screws (150). Use extraction screws and pull out the end plate (49).
- Remove gear (85) after removing circlip (88), fig 15.4
- Loosen clamping screws (15) of friction ring coupling and pull out the index gear (13).
- Shafts II, III & IV can now be pulled out. If necessary, use threaded holes at the shaft center for attaching a puller.
- Remove anti-rotation key (16).
- Release clamping bolts (2), use extraction screws and pull out the spindle assembly.

16.2 Dismantling of disc spring and drum-cam assembly (fig. 17.5).

- Considerable force is required to loosen the nut (12). To release the nut, clamp the index gear assembly (fig. 17.5) back in position. This will engage the pinion (162) onto the gear teeth of the nut (12). Now the nut can be released by turning the pinion with the help of a spanner.
- Drum cam assembly (fig.17.1) along with the sliding coupling (4) can now be removed.
- Remove screws (30) to separate two parts of drum cam, as well as the sliding coupling.

16.3 Inspection of mechanical components (fig. 15.4,15.3) :

- Check that the cam follower bearing (42) and (78) are in good condition. (8,25)
- Check that the working surfaces of indexing cam (75) and drum cam are in good condition.
- Check that wiper seals (35) and (39) are in good condition.

17. Instructions for assembly :

Assembly of turret requires careful attention to detail. Please follow step by step procedure given below :

17.1. Partial Assembly of Spindle

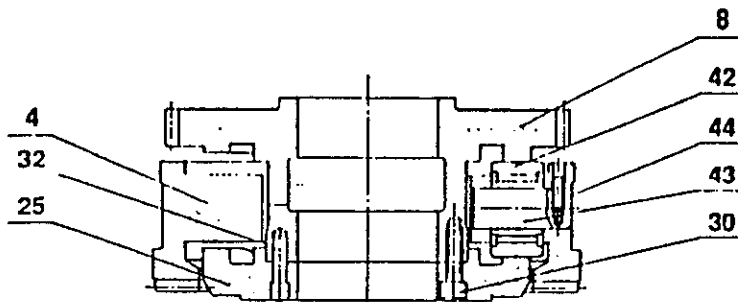


FIG 17.1

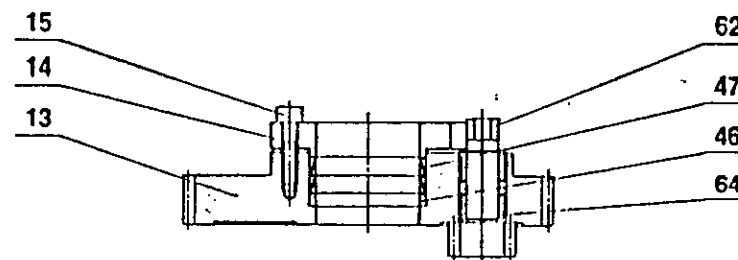


FIG 17.2

17.11. Drum Cam Sub-assembly (Fig 17.1) : Assemble all components as shown in figure 17.1. Screws (30) and (44) should be tightened firmly after coating them with anti vibration solution like Locktite. Check for free movement of sliding coupling rollers in drum cam groove.

17.12 Indexing Gear Sub-assembly (fig 17.2): Assemble all components as shown in fig 17.2. Tighten bolts (15) with a light force. In case of models BTP-80 and BTP-100, pinion assembly should also be in place.

17.13 Assemble spindle, indexing flange and fixed coupling (components 31, 34, 27, 3, 33); and keep this assembly in vertical position on a table (fig 17.3). It is convenient if the assembly could be clamped to the table with the help of a plate as shown in the drawing. If plate is not available you may use tool disc in place of the plate.

17.14 Place drum cam subassembly on the spindle, and place thrust bearing (9) and spring seat (10) in position.

17.15 Inspection of spring seat lift (fig 17.3): Hold sliding coupling (4) by one hand to prevent its rotation, and rotate drum cam gear (8) by hand (fig. 3). Sliding coupling will move up and down; engaging and dis-engaging with fixed and indexing couplings (3 and 27). At the end of downward stroke, spring seat should lift up by 0.25 mm to 0.35 mm. This lift should be inspected by using a dial indicator. If the lift is less, it should be adjusted by grinding the bottom face of spring seat (10). If lift is more, it can be reduced by removing material from the bearing seating surface of spring seat 10.

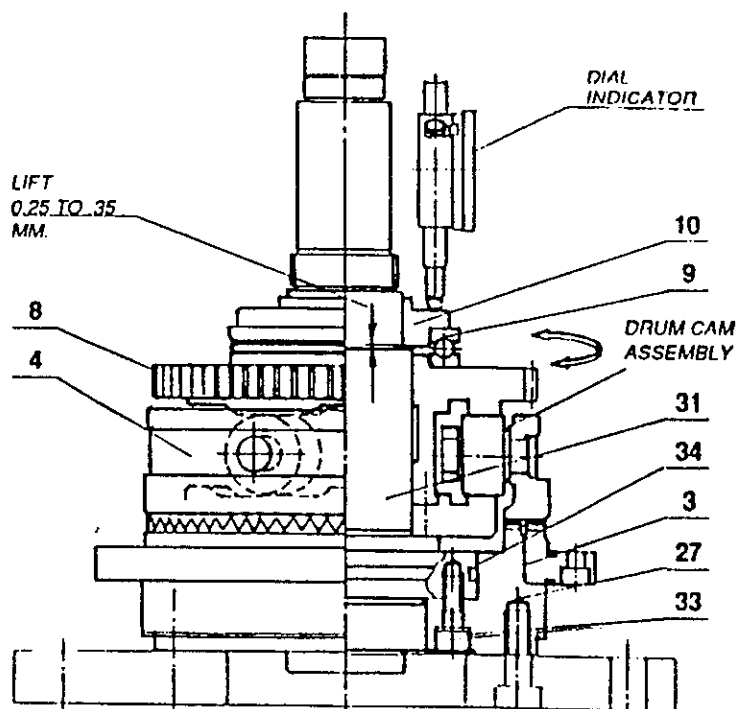


FIG 17.3
INSPECTION OF SPRING SEAT LIFT

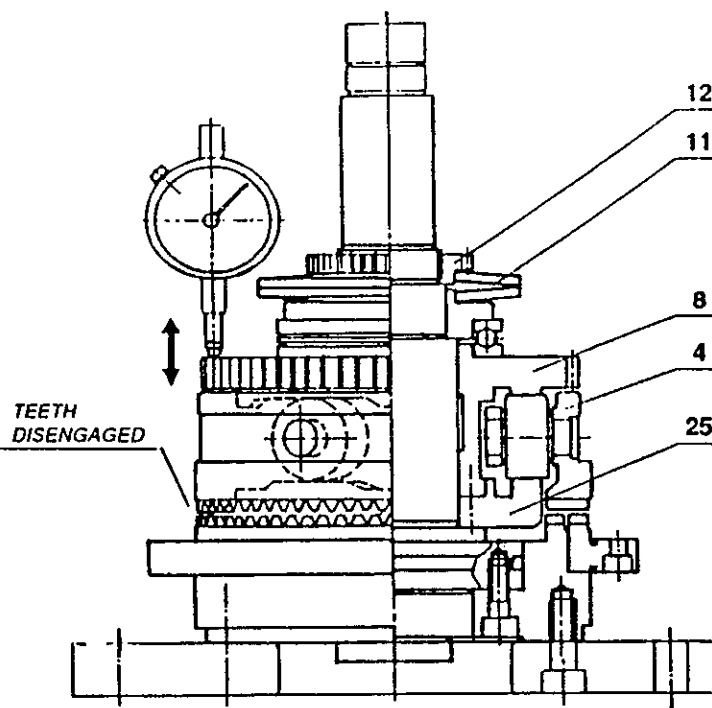


FIG 17.4 INSPECTION OF AXIAL CLEARANCE OF DRUM CAM ASSEMBLY

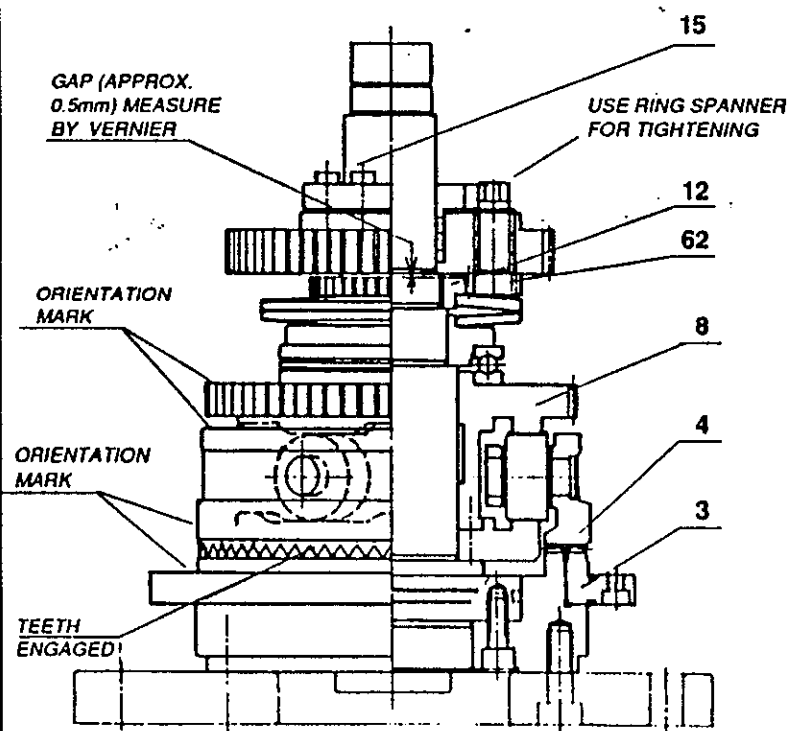


FIG 17.5 'LOADING' OF DISC SPRINGS

17.16 Inspection of axial clearance of drum cam assembly. (fig 17.4): Hold sliding coupling (4) by one hand and rotate cam gear (8) by the other hand, till the coupling teeth are dis-engaged as shown in fig. 4. Now place springs (11) and lock-nut (12) in position. Tighten locknut by hand, so that it will press the springs with a light pressure. Check axial clearance of drum cam by a dial indicator as shown in figure by lifting and lowering the cam gear by hand. Clearance should be within 0.1 to 0.2 mm. If clearance is low, it should be adjusted by surface grinding the bottom face of cam flange (25). If the clearance is more, it should be adjusted by replacing the flange (25) by a new flange of suitable extra thickness.

17.17 Remove disc springs (11) and screw in locknut (12) till it butts against shaft shoulder. Measure the gap between the nut face, and threaded shoulder (fig. 17.4). Mark a line on the nut face and spindle shaft to indicate the angular alignment.

17.18 Final sub assembly. (fig 17.5): Align orientation marks on fixed coupling (3) and sliding coupling (4). Also align orientation marks on cam gear (8) and sliding coupling (4).

Place disc springs (11) in position and tighten the lock nut (12) by hand. It is however not possible to tighten the nut by hand to its full travel up to shaft shoulder. For further tightening, insert indexing gear assembly (fig. 2) on the spindle. So that pinion teeth (62) engage with the teeth on lock nut (12). Tighten up screws (15) to lock gear on spindle. Now use a ring spanner to rotate pinion shaft, and to tighten the nut till it butts against shaft shoulder.

Remove indexing gear assembly. Inspect the gap, and check the alignment of making to ensure that the nut has been fully tightened. The sub assembly is now complete.

17.2 Partial Assembly of Indexing cam drive.

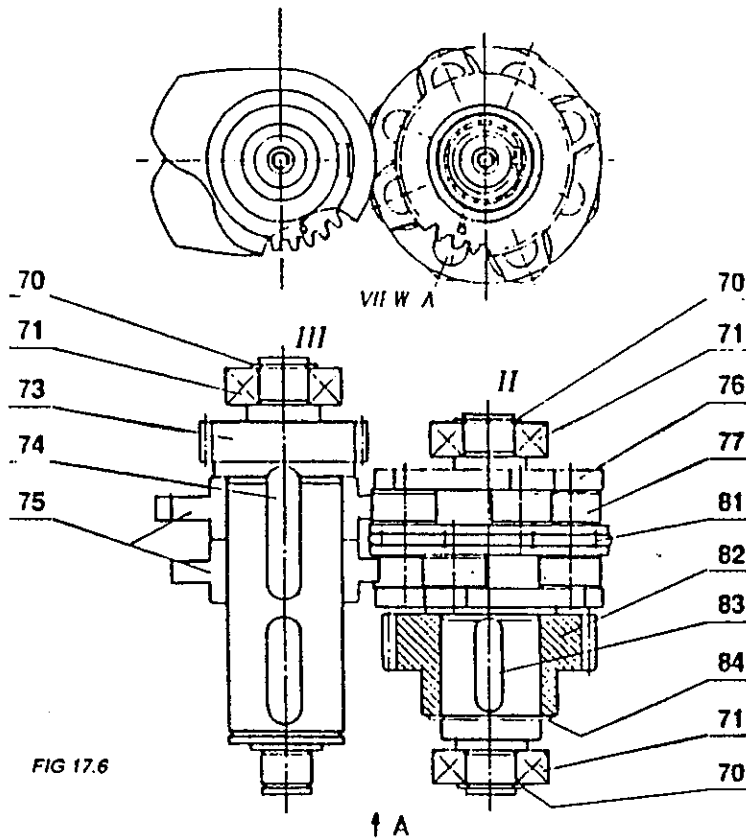


FIG 17.6

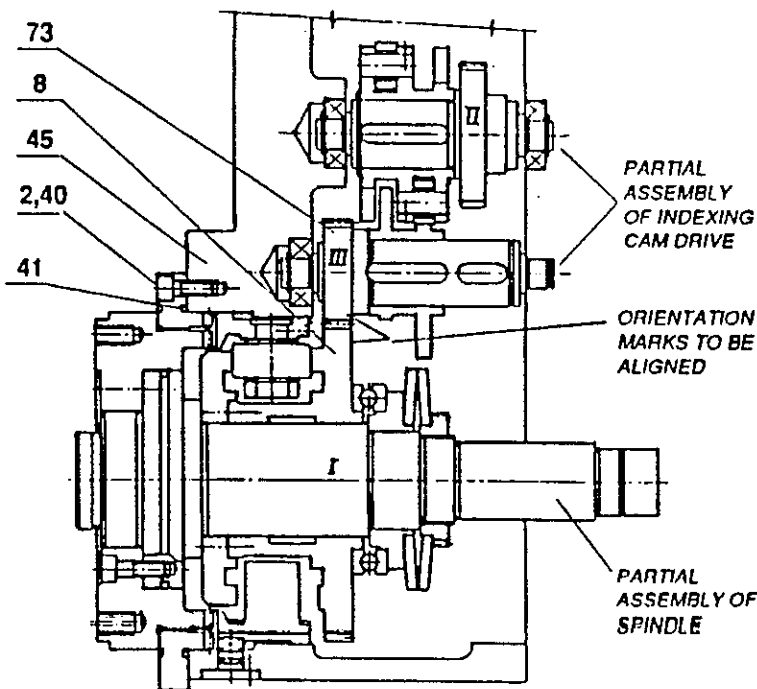


FIG 17.7

17.21 Assembly of Follower Shaft (Axis II): fig. 17.6.

Assemble all the components (70, 71, 76 to 84) as shown in the fig. 6, which shows details of BTP-63 and BTP 80 cam drive. Refer main assembly drawing (fig., page) for BTP-100 and BTP-125 details

17.22 Partial Assembly of Cam Shaft (Axis III):fig. 17.6.

Assemble the components (70, 71, 73, 74, 75) as shown in figure 6. Remaining components of the cam shaft are to be assembled at a later stage.

Indexing cam (75) may be in a single piece, or in two pieces depending on method of manufacture. If in two pieces, ensure that the assembly confirms to the side view shown in the figure.

17.3 Intermediate Assembly of Spindle and Indexing drive (Axis I, II and III) in main Body : fig 17.7.

Fit the partial spindle assembly into the main body (45) with the help of bolts (2) and cyl. pins (40). Also ensure that 'O' Ring (41) is in place.

Fit anti rotation key (6) in place.

Hold indexing drive subassemblies side by side in proper orientation as shown in Fig. 17.6. Circular parts of cam (75) should contact the rollers (78). Orientation marks on gears (73) and (83) should be positioned as shown in figure 17.6.

Fit these subassemblies in the main body (45), without losing their general orientation. Simultaneously it is necessary to ensure that the teeth of drive gear (73) and drum cam gear (8) mesh with orientation marks properly aligned. It might be necessary to use a torch light to check the alignment.

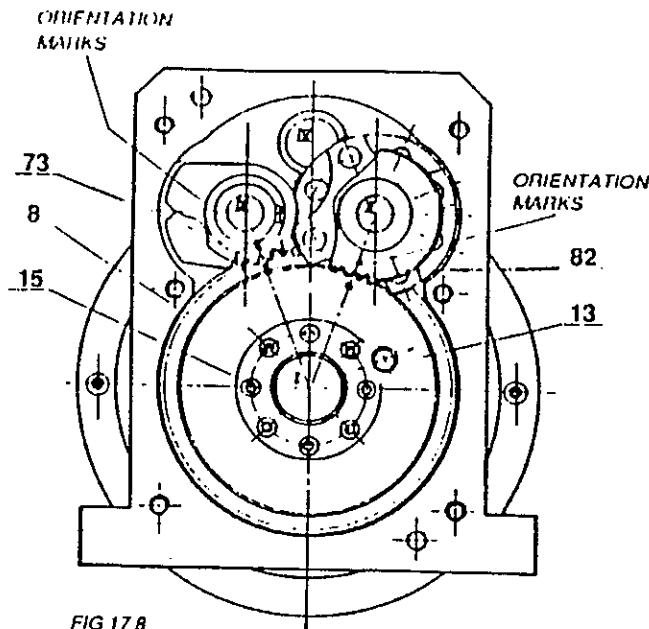


FIG 178

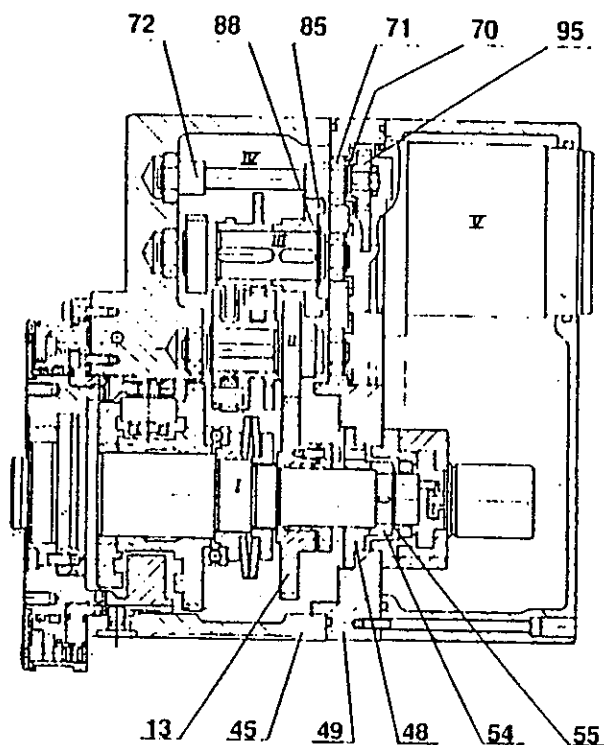


FIG 179

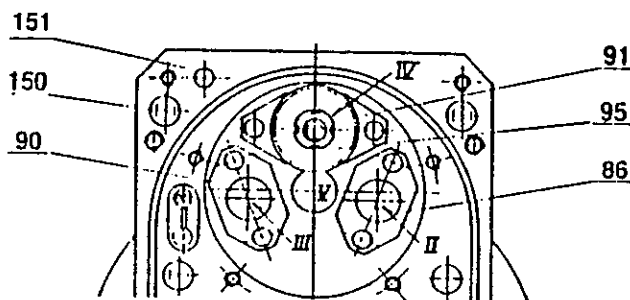


FIG 1710

17.4. Final Assembly :

- Slide the indexing gear (13) subassembly on the spindle; taking care that the orientation marks on the indexing gear (13) and indexing pinion (82) are in alignment. However do not tighten Ringfeder clamping screws (15) at this stage.
- Assemble gear (85) and circlip (88) on cam shaft (Axis III) Also fix bearing (71) and its circlip (70).
- Fit pinion shaft (72) and its bearing in position (i.e., Axis IV).
- Fit bearing flange (48) onto end plate (49).
- Fit back-plate (49) onto main body (45). Take care that bearings on axes II, III and IV are properly aligned and take proper entry into their seats, located in back plate. Clamp back plate to body with the help of bolts (150) and cylindrical pins (151).
- Now tighten bolts (15) to clamp indexing gear (13) onto the spindle. Bolts are approachable through holes in bearing flange (48). Bolts should be tightened in diagonal order, and in 3 or 4 stages.
- Fit thrust bearing ring (54) and circlip (55) on the spindle.
- Fit bearing covers (86,90 and 91), and fit gear (95) on pinion shaft (72).
- Fit motor in position, and check indexing movement by hand cranking the motor-shaft.
- Complete the assembly by fitting the remaining parts like encoder, proximity switch, end cover etc.
- Check for the clamping action of disc spring as per the procedure given on page 17.

19. List of spare parts :

No.	Part Name	Part No.	Assembly Reference	Quantity	Drg. No.	Page No.
GROUP 'A' SPARES						
1.	Electric motor	-	Final assembly	1	15.6	21
2.	Encoder	61	Spindle assembly	1	12.1	19
3.	Proximity switch	152	Final assembly	1	15.2	18
4.	Cam follower roller	42	Spindle assembly	3	15.3	19
5.	Track roller	78	Indexing drive	8	15.4	18
6.	Track roller pins	77	Indexing drive	8	15.4	18
GROUP 'B' SPARES						
1.	Oil seal	58	Spindle assembly	1	15.3	19
2.	Oil seal	107	Motor	1	15.6	21
3.	'O' Ring	5	Anti rotation key	1	15.3	19
4.	'O' Ring	16	Encoder flange	1	15.3	19
5.	'O' Ring	34	Spindle assembly	1	15.3	19
6.	'O' Ring	36	Coolant ring	1	15.3	19
7.	'O' Ring	37	Coolant flange	8 or 12	15.3	19
8.	'O' Ring	39	Coolant ring	1	15.3	19
9.	'O' Ring	65	Spindle assembly	1	14.2	17
9.	'O' Ring	108	Motor	1	15.6	21
10.	'O' Ring	120	Motor	1	15.6	21
11.	'O' Ring	133	Coolant valve	1	15.5	21
12.	'O' Ring	156	Proximity switch	1	13.2	16
GROUP 'C' SPARES						
1.	Wiper seal	35	Spindle assembly	1	15.3	19
2.	Quad ring	38	Spindle assembly	1	15.3	19
3.	'O' Ring	41	Spindle assembly	2	15.3	19
4.	'O' Ring	52	Spindle assembly	2	15.3	19
GROUP 'D' SPARES						
1.	Coolant valve button	130	Coolant valve	1	15.5	21
2.	'O' Ring	131	Coolant valve	1	15.5	21
3.	Spring	132	Coolant valve	1	15.5	21

NOTE :

Group 'A' : Relatively costly components. Only a small possibility of requiring replacement.

Group 'B' : Rubber seals. May require replacement if turret is totally dismantled for any reason.

Group 'C' : These components may have to be replaced during periodic inspection (about once in a year).

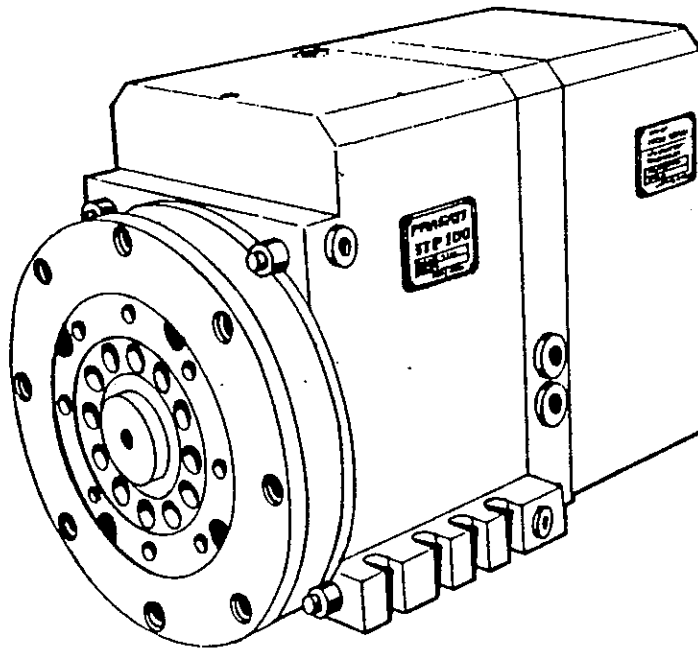
Group 'D' : Coolant valve. Relatively small value components . May require frequent changes.

19. Faults and corrective actions :

	FAULT		CAUSE		CORRECTIVE ACTION
1.	Turret remains unlocked at end of indexing cycle. Cycle complete signal not available even though the motor has stopped	a.	Turret motor not stopping in specified time.	a1.	Change SSR
		a1.	Faulty SSR (Solid State Relay)	a2.	Check whether motor power switches off within 5ms of prox. switch signal. This can be checked on dual beam oscilloscope with memory.
		a2.	Problem with turret control.		
		b.	Faulty Prox. switch.	b.	Replace switch
2.	Tool disc goes on rotating without stopping at selected position.	a.	Faulty encoder	a.	Crank the turret by hand. Observe encoder signals. If defective, replace encoder.
		b.	Faulty Prox. Switch	b.	Check whether proximity switch signal is present at proper time during hand cranking. If in doubt, replace proximity switch.
		c.	Fault in Control Circuit	c.	Check whether different Signals (like tool - demand, encoder feed - back., Prox. Switch etc. are available in proper sequence and at proper time.
3.	Excessive noise during indexing	a.	Slipping of ring-feeder joint (47)	a.	Loosen and reclamp the clamping bolts as per instructions on page.
4.	Rotational action not smooth	a.	Unbalance load on tool disc	a.	Reposition the tools to improve the balance
5.	Turret motor overheating signal	a.	Excessive frequency of indexing cycles	a.	Reduce the number of indexing cycles per minute.
		b.	Unbalanced Voltage supply	b.	Check voltage in all the three phases. Correct if necessary.

PRAGATI
BI-DIRECTIONAL
TOOL TURRETS

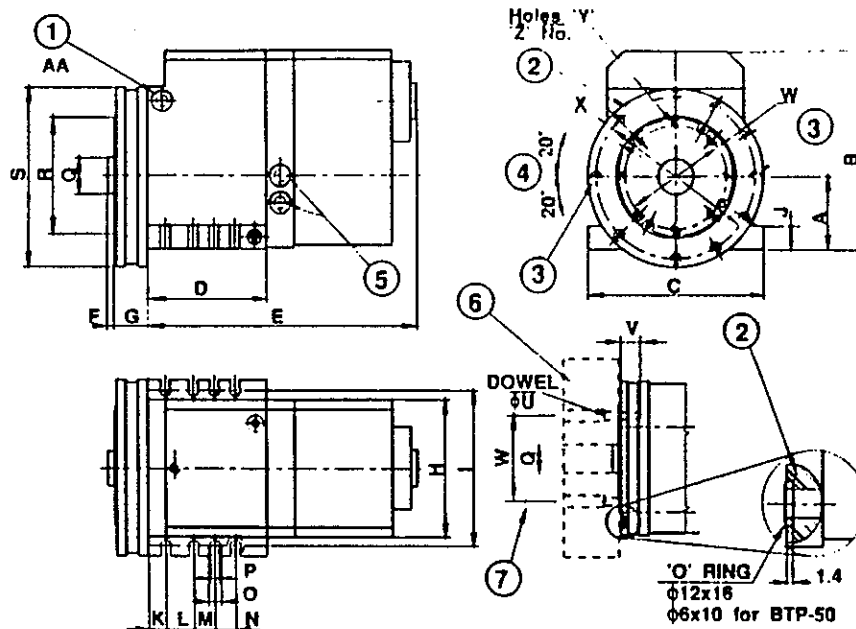
- * BTP-125
- * BTP-100
- * BTP-80
- * BTP-63
- * BTP-50



TECHNICAL INFORMATION

JULY 93

TECHNICAL SPECIFICATIONS



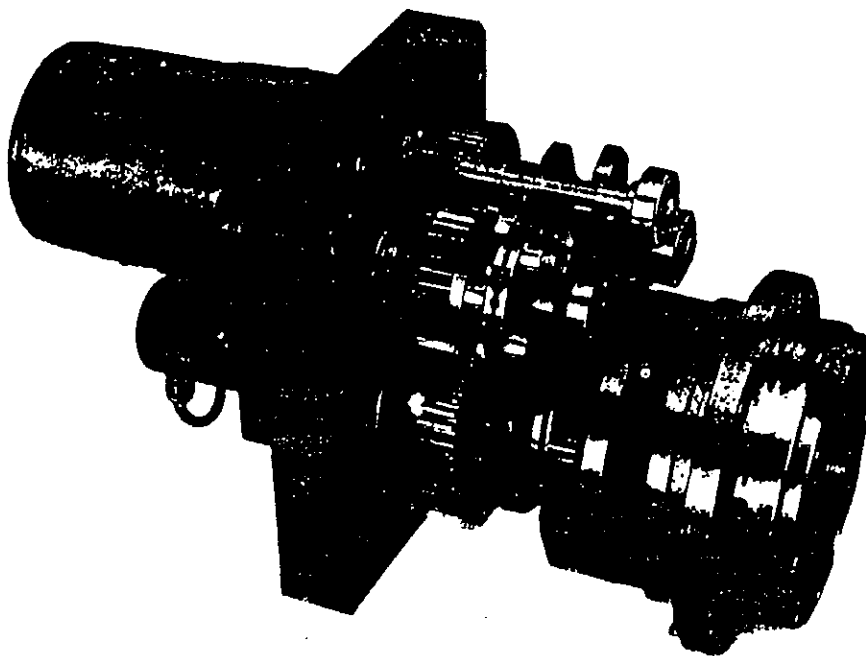
1. Coolant inlet from either side. BSP (AA) 2. Coolant plate can be clamped to indexing flange at a suitable angular position. Tool disc to be suitably designed to take the coolant entry with 'O' ring sealing from coolant plate. 3. Alternative positions of coolant outlet valve. 4. Adjustment range of coolant outlet valve. 5. Electrical connection from either side. 1/2" BSP 6. Tool disc. 7. Reference pin for tool disc if required. To be removed after alignment and clamping of tool disc.

	BTP 125	BTP 100	BTP 80	BTP 63	BTP 50
A	125	100	80	63	50
B	340	280	236	200	170
C	310	250	210	185	128
D	197	177	155	135	107
E	411	370	355	295	255
F	10	9	8	8	6
G	50	47	43	40	35
H	246	194	164	142	110
I	280	220	190	165	110
J	40	32	25	25	12
K	30	34	32	24	15
L	44	40	32	30	60
M	43	30	32	30	-
N	43	30	32	30	-
O	20	16	14	11	12
P	17	13	11	9	9
Q	63	50	40	30	25
R	204	162	134	103	85
S	310	250	215	175	140
U	16	12	10	8	6
V	25	25	20	20	15
W	182	145	120	90	70
X	280	226	190	150	120
Y	M12	M10	M8	M8	M6
Z	12	12	8	8	8
AA	3/8"	3/8"	1/4"	1/4"	1/4"

SPECIFICATIONS

			BTP-125	BTP-100	BTP-80	BTP-63	BTP-50
* Inertia of Transportable Masses		kg.m ²	4.0	2.0	0.8	0.6	0.3
* Total Indexing Time for 8 station Turret	45°	sec.	0.8	0.7	0.6	0.5	0.4
	90°	sec.	1.5	1.3	1.1	0.9	0.7
	180°	sec.	2.9	2.5	2.1	1.7	1.3
* Total Indexing Time for 12 station Turret	30°	sec.	0.8	0.7	0.6	0.5	0.4
	90°	sec.	2.2	1.9	1.6	1.3	1.0
	180°	sec.	4.3	3.7	3.1	2.5	1.9
* Indexing Frequency		1/min	12	15	15	15	15
* Repeat positioning accuracy		deg	±2"	±2"	±2"	±2"	±2"
* Indexing accuracy		deg	±6"	±6"	±6"	±6"	±6"
* Total weight (Without tool Disc)		kg	140	92	60	40	22
	LOADING CAPACITY Kg.cm						
	F1 x R		60,000	30,000	15,000	6,000	4,000
	F2 x R		100,000	35,000	15,000	7,000	3,500
	F3 x R		40,000	20,000	6,000	2,500	1,600

SPECIAL FEATURES



Three Piece, face gear coupling allows the tool disc to be indexed without lifting. It also ensures high repeat positioning accuracy and rigidity.

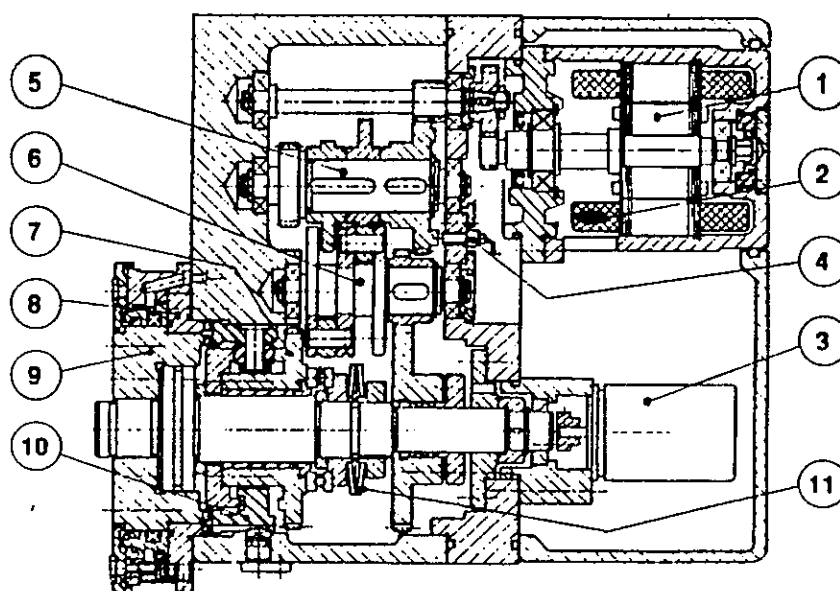
'Parallel Index' cam mechanism allows fast and smooth indexing of heavy tool discs. Computer generated cam-profiles ensure shock-free indexing action.

Totally enclosed, robust mechanism, with oil bath lubrication.

Electrical elements conveniently located in a separate area, free from oil and coolant.

Bi-directional working. Can index in either direction to allow shortest indexing time.

PRINCIPLE OF WORKING



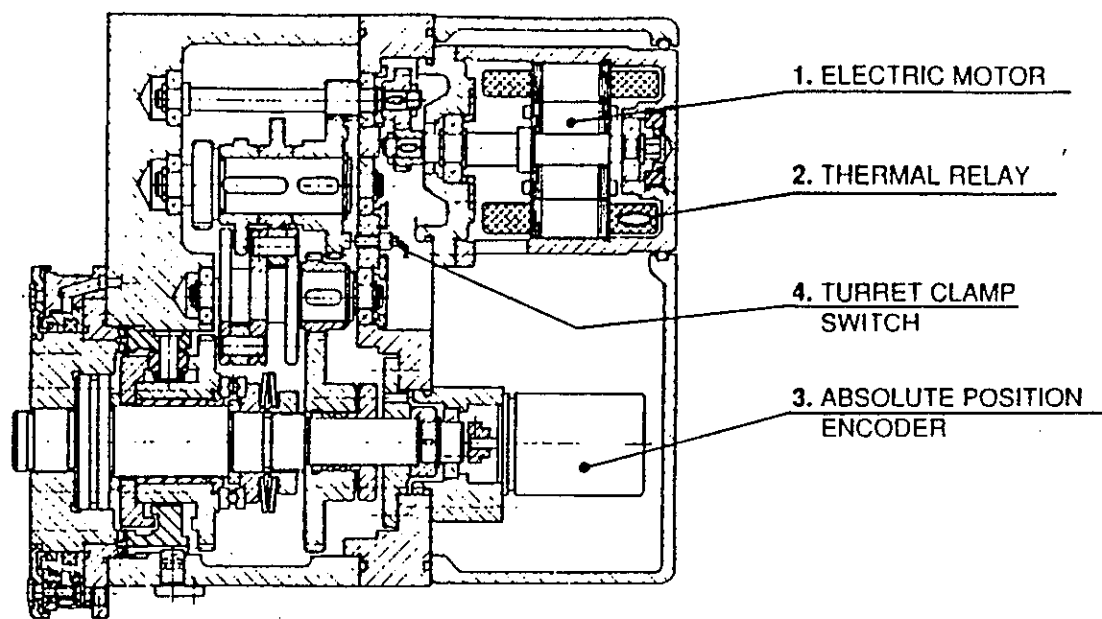
1. Torque Motor 2. Thermal Relay 3. Encoder 4. Turret Clamp Switch 5. Cam Shaft 6. Follower Shaft 7. Drum Cam 8. Fixed Coupling 9. Indexing Coupling 10. Sliding Coupling 11. Disc Spring.

Electric motor drives the cam shaft through a system of gears. Cam shaft indexes the follower shaft through a "parallel index" drive mechanism. Cam shaft is also geared to the "drum cam" which controls clamping and release of the 3 piece coupling.

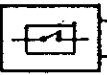
One revolution of cam shaft completes one indexing cycle of "declamping-indexing-clamping".

Absolute position encoder gives feed back of the turret position. Proximity switch inspects the clamped position of the turret.

WIRING DETAILS



WIRING DETAILS FOR BI-DIRECTIONAL TOOL TURRET

NO	COMPONENT	CHARACTERISTICS	NUMBER	COLOR	DETAILS
1	ELECTRIC MOTOR	ALTERNATIVE VOLTAGES 415, 380 AND 220 VAC 3 PHASE ALTERNATIVE FREQUENCIES 50 Hz. AND 60 Hz. SEE TABLE BELOW FOR MOTOR CURRENTS		RED RED RED GREEN	PHASE PHASE PHASE EARTH
2	THERMAL RELAY	130° 2A 415 VAC (NC) NORMALLY CLOSED CONTACT		BLUE BLUE	
3	ABSOLUTE POSITION ENCODER	15-30 V DC RIPPLE 10% 350 mA (SUPPLY) 50 mA /CHANNEL OUTPUT OUTPUT - PNP ODD PARITY		WHITE YELLOW GREEN VIOLET BLACK PINK BLUE BROWN	BIT 1 BIT 2 BIT 3 BIT 4 STROBE PARITY 0° VOLTS 24 V DC
4	TURRET CLAMP SWITCH	10-30 V DC RIPPLE 10% 200 mA OUTPUT (LOAD) OUTPUT - PNP - NO		BLACK BLUE BROWN	OUTPUT 0° VOLTS 24 V DC

MOTOR
CURRENT
(AMPERES)

VOLTAGE		BTP-125	BTP-100	BTP-80	BTP-63	BTP-50
3 PHASE 50/60 Hz.	415/ 380	4.0	2.6	1.9	1.6	1.0
	220	6.2	4.5	3.9	3.3	1.5
	110	9.4	6.8	5.9	5.0	2.3

ELECTRICAL SIGNALS

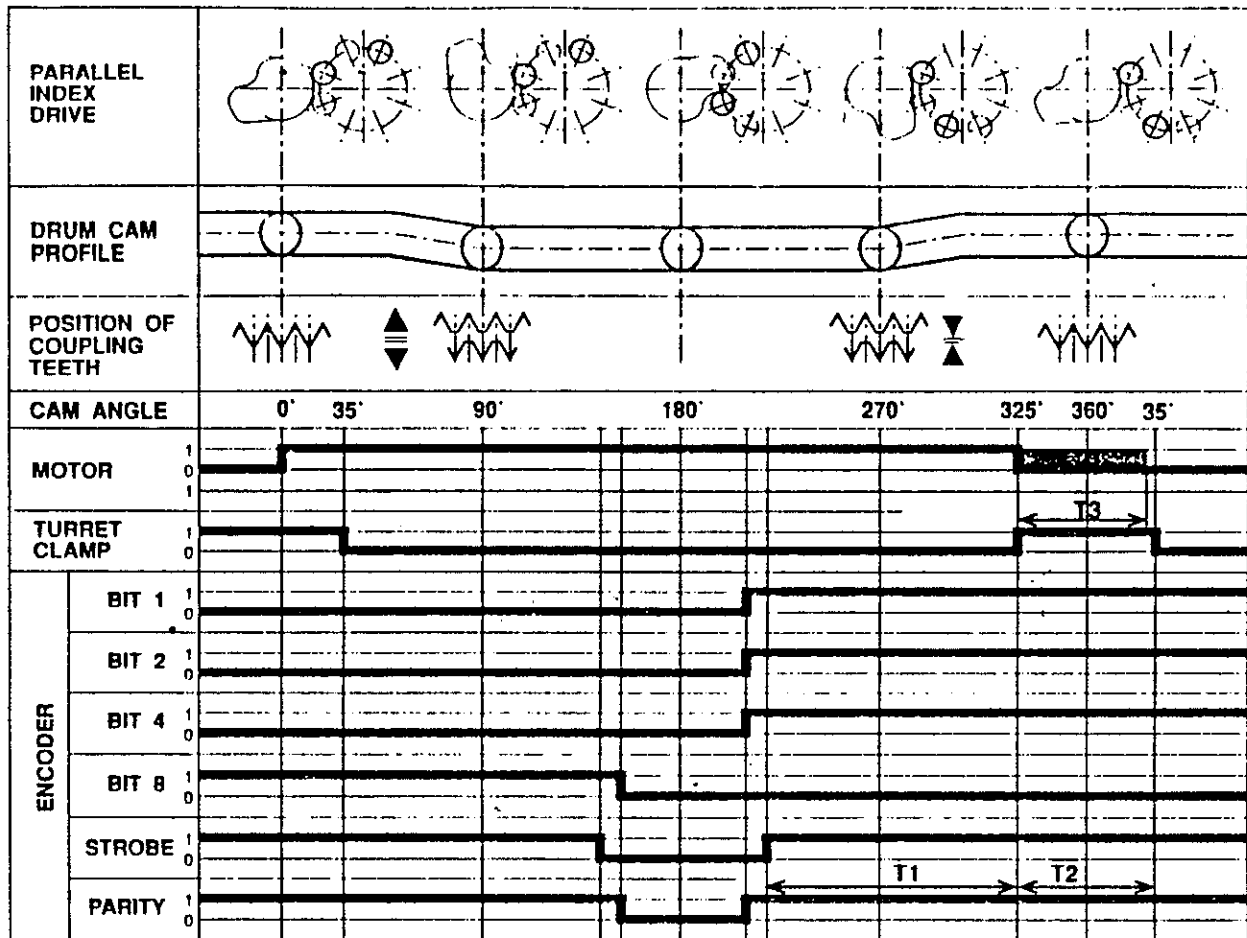


TABLE 1 : ENCODER SIGNALS

	POSITION NO											
	1	2	3	4	5	6	7	8	9	10	11	12
BIT 0	1	0	1	0	1	0	1	0	1	0	1	0
BIT 2	0	1	1	0	0	1	1	0	0	1	1	0
BIT 4	0	0	0	1	1	1	1	0	0	0	0	1
BIT 8	0	0	0	0	0	0	0	1	1	1	1	1
STROBE	1	1	1	1	1	1	1	1	1	1	1	1
PARITY	1	1	0	1	0	0	1	1	0	0	1	0

Viewed from shaft end CCW → ← CW

NOTE :

Referring to the signal diagram, value of T3 is particularly critical. Motor must come to a physical halt within this time. Otherwise the turret will get de-clamped and the proximity switch signal will be lost. Following measures are suggested for stopping the motor in minimum possible time.

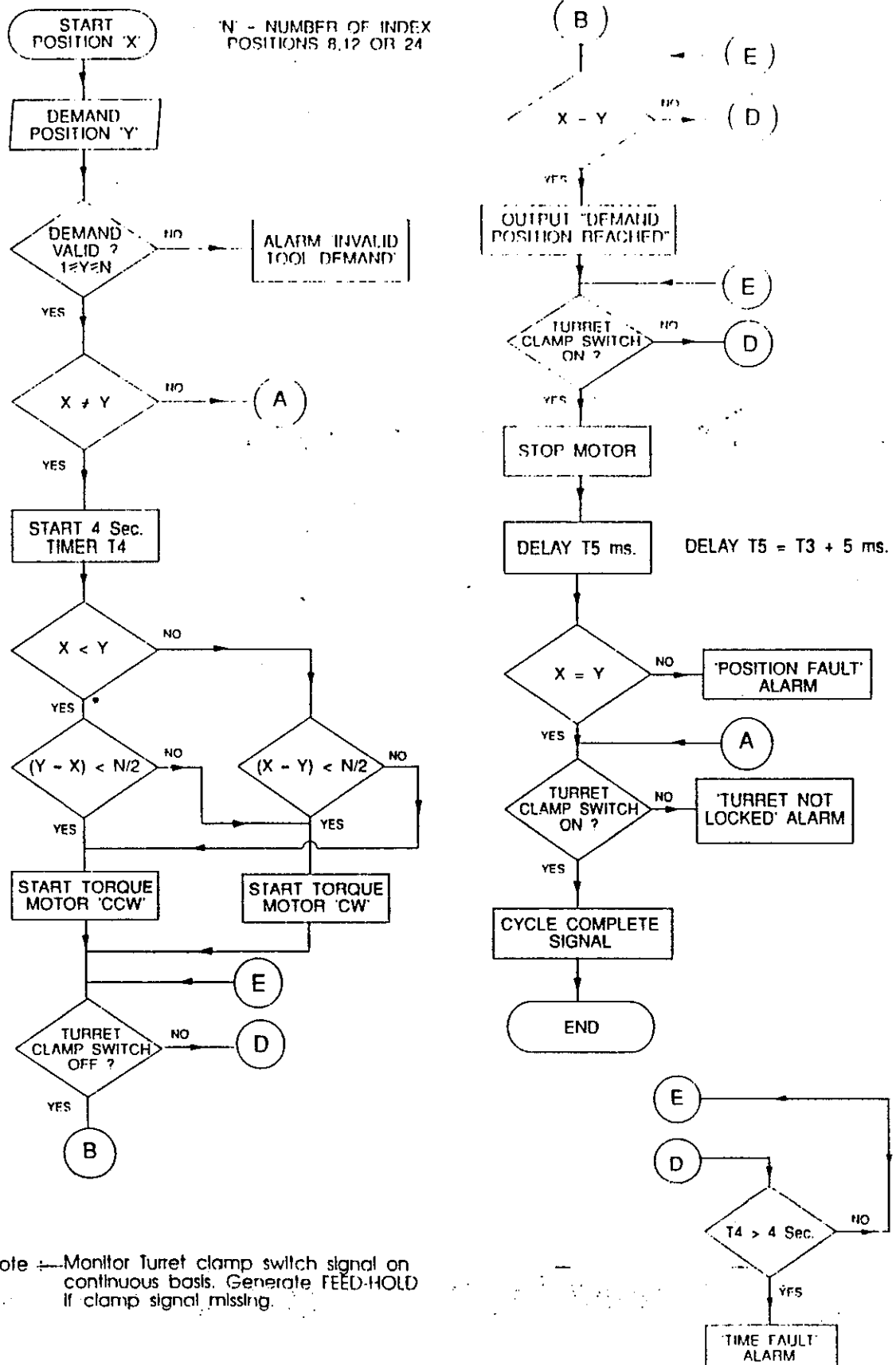
- Control should be capable of detecting the proximity switch signal within 5 ms.
- Solid state relays should be incorporated in the motor circuit to ensure fastest possible dis-connection. Regular contactors can be used for motor direction selection, followed by solid state relays, at least in two phases.

[illegible]

- Logical operation sequence of turret indexing is given in the 'Flow Chart' on next page.
- For fast switch-off of turret motor following things are recommended :
 1. Use SOLID STATE RELAYS for turret motor as shown in circuit diagram.
 2. Connect all feedback signals from turret (i.e. 6 encoder signals and turret clamp switch) on a single INPUT byte. Set bits in DEMAND byte as per the feed back expected from the turret at demand position. Compare the INPUT and DEMAND bytes. When they are equal switch-off the motor. Do the byte comparison in interrupt processing program area.
- Following safety interlocks should be available for quick diagnosis of turret faults :
 1. **Motor Overheat Signal** : Thermal relay has been provided in the motor winding to give indication of motor overheating. In the event of overheating, relay should trip the motor contactor and also give the 'Motor overheating' signal to the control circuit. Motor contactor should be tripped without depending on PLC software as shown above.
 2. Following ALARM signals should be generated as shown in the 'Flow Chart'.
 1. 'Invalid Tool Demand' Alarm
 2. 'Position Fault' Alarm
 3. 'Turret Not Locked' Alarm
 4. 'Time Fault' Alarm.

6

FLOW CHART FOR TURRET CONTROL



JP4 ☐ SLOW (STANDARD)
☒ AT SPEED

The position of this jumper determines the type of output at the I/O terminals (SLOW) output. In the slow position, the output turns on if the tac voltage is low, indicating slow speed and safe to alter contactor arrangements related to the delta/wye configuration. When the jumper is at the at speed position, then the operation of the slow output is altered so that it is on if the ramp generator output equals the ramp command inputs. This would mean that the motor is at the command speed.