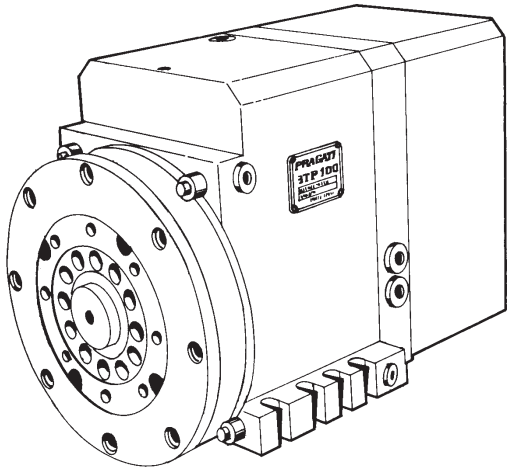
BI–DIRECTIONAL

TOOL TURRETS

INSTRUCTION MANUAL



❖ BTP-63 ❖ BTP-80 ❖ BTP-100 ❖ BTP-125

PRAGATI

JUNE 2003

INDEX

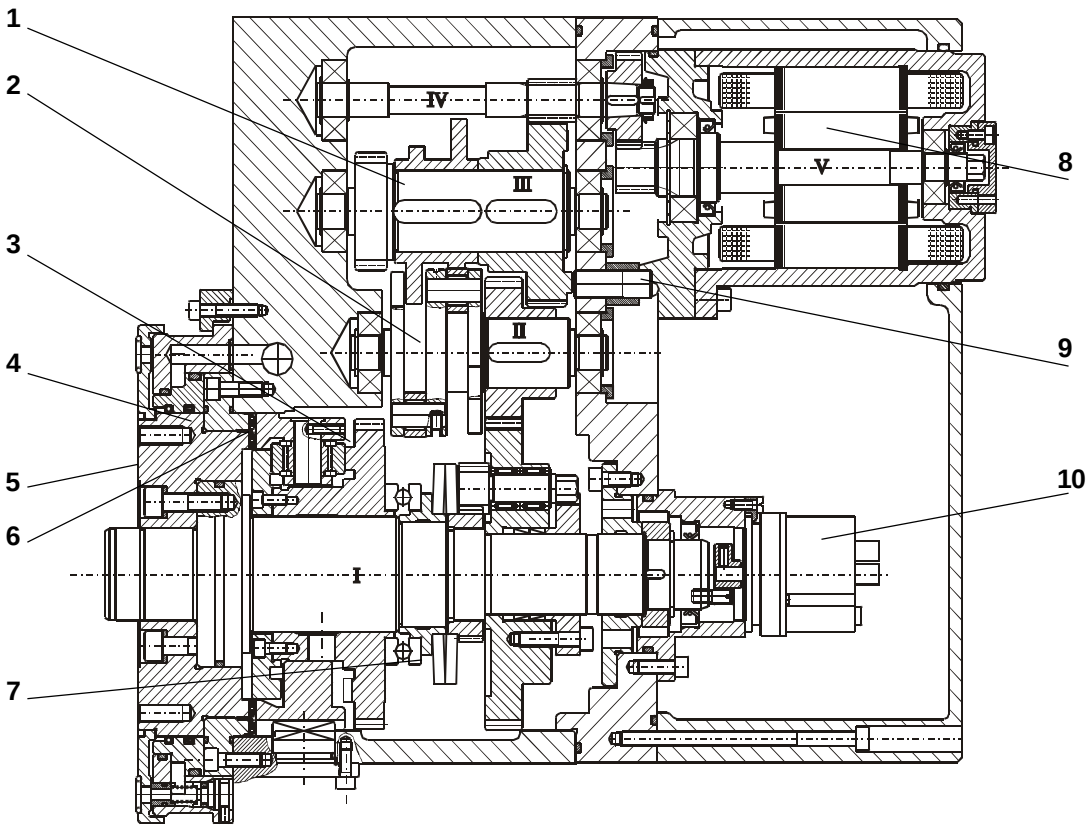
1. Principle of Working :

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.

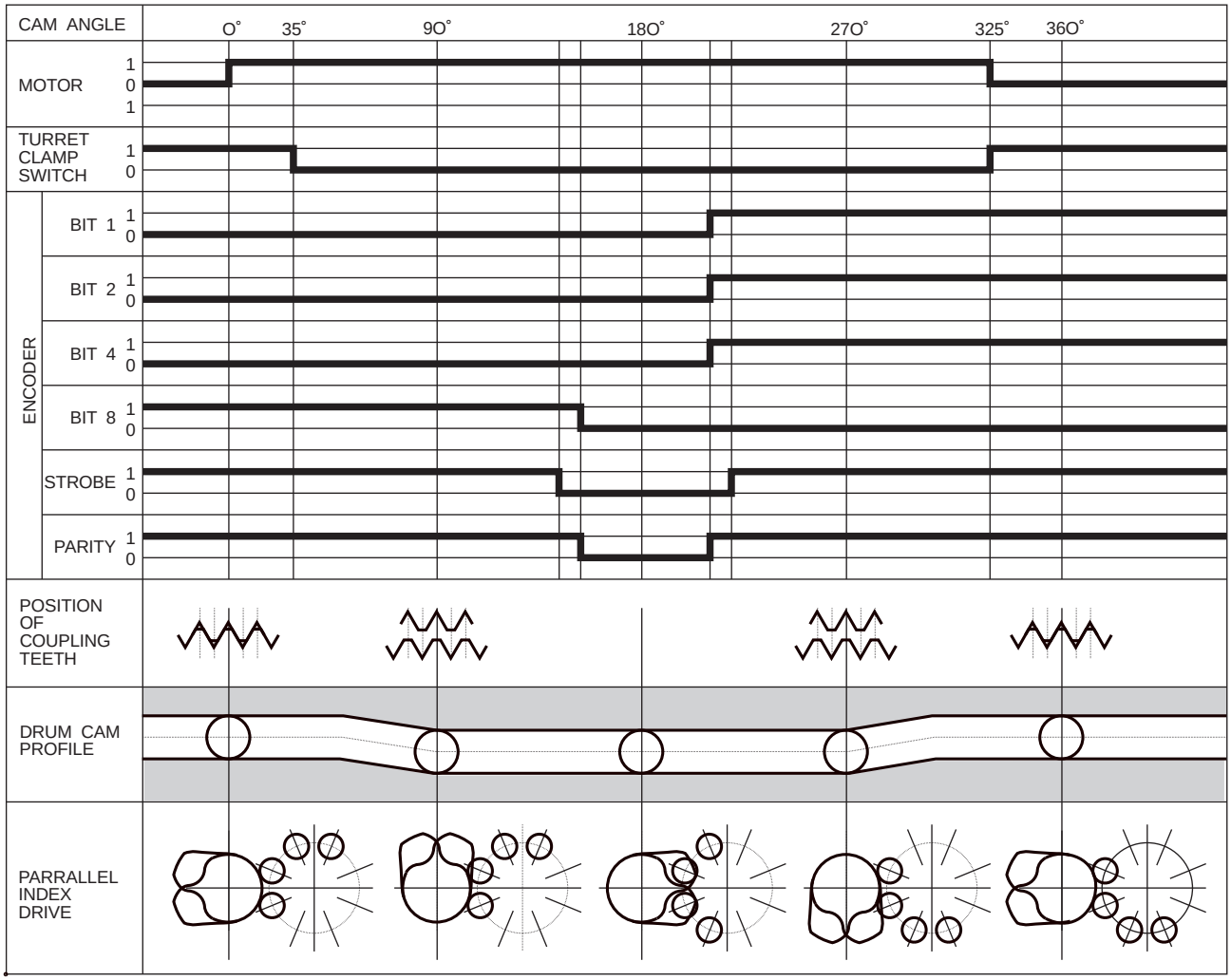


FIG 1.2

2. Fitment on the machine :

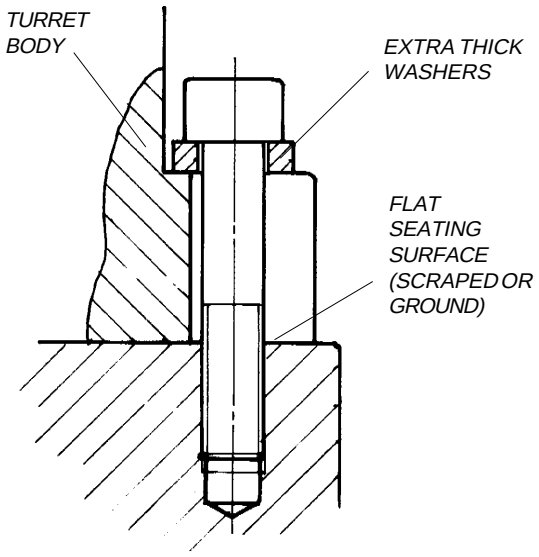


FIG 2.1

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 customer's place. This is 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.

3. Fitment of Tool Disc on Turret Flange :

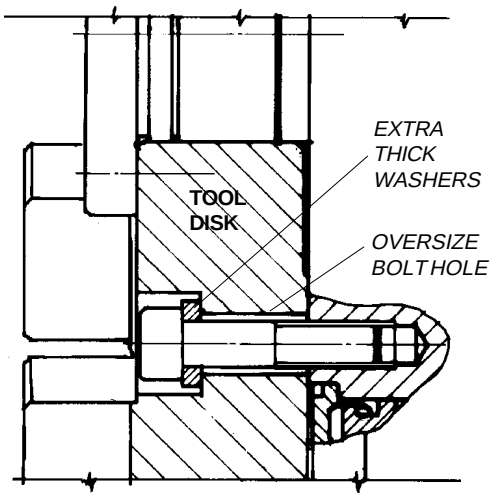


FIG 3.1

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 :

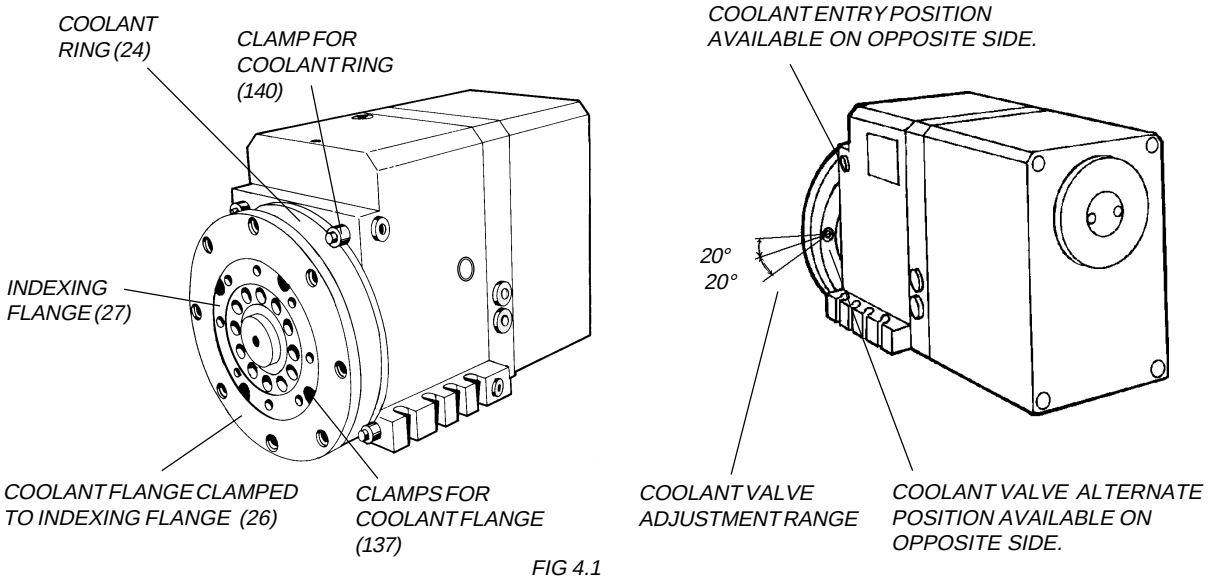


FIG 4.1

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).

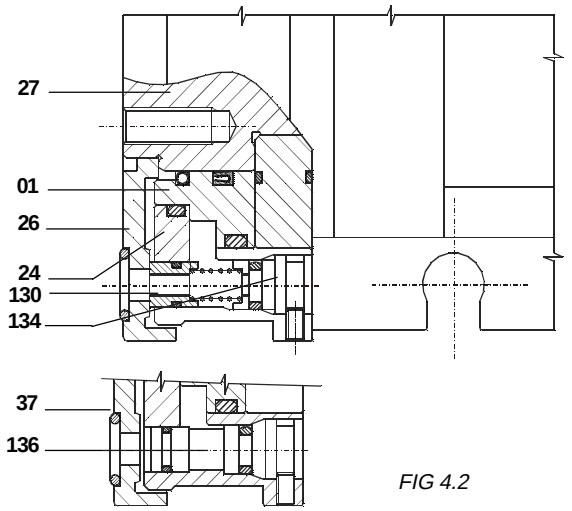
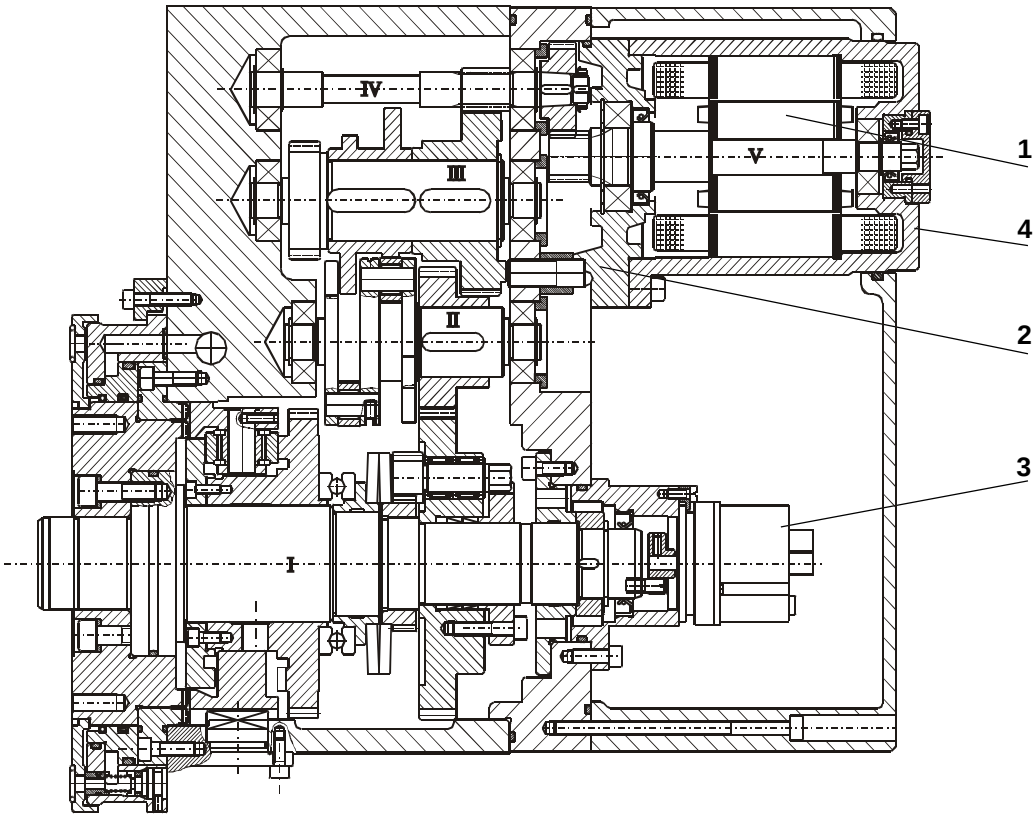


FIG 4.2

4.2 Replacement of Valve Button (fig. 4.2) :

Valve button(130) 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.** Proximity Switch **3.** Absolute Encoder **4.**Thermal Relay*

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 CIRCUIT POWER **BTP-100 : 1.9 KVA** **BTP-80 : 1.6 KVA** **BTP-63 : 1.2 KVA** **BTP-125 : 2.3 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 BIT4 STROBE PARITY '0' Volts 24 V DC
4	PROXIMITY SWITCH (TURRET CLAMP SIGNAL)	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

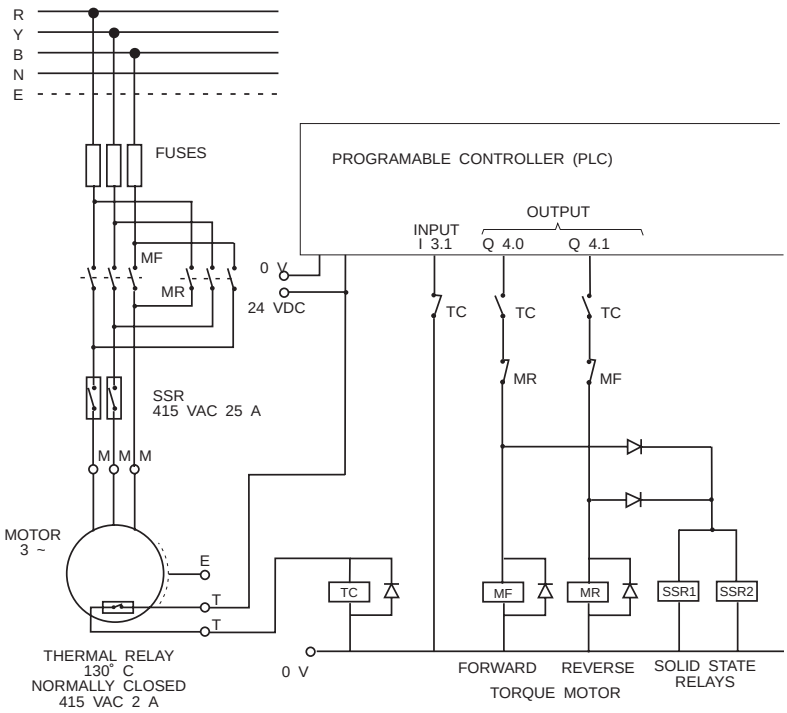


FIG 6.1 WIRING DIAGRAM FOR MOTOR

MOTOR CURRENT (Amps)

MODEL	*VOLTAGE AC*		
	415/ 380	220	110
BTP-125	3.2	6.3	8.0
BTP-100	2.6	4.5	7.4
BTP-80	2.3	3.9	6.3
BTP-63	1.6	3.0	5.0
BTP-50	1.3	2.6	3.3

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

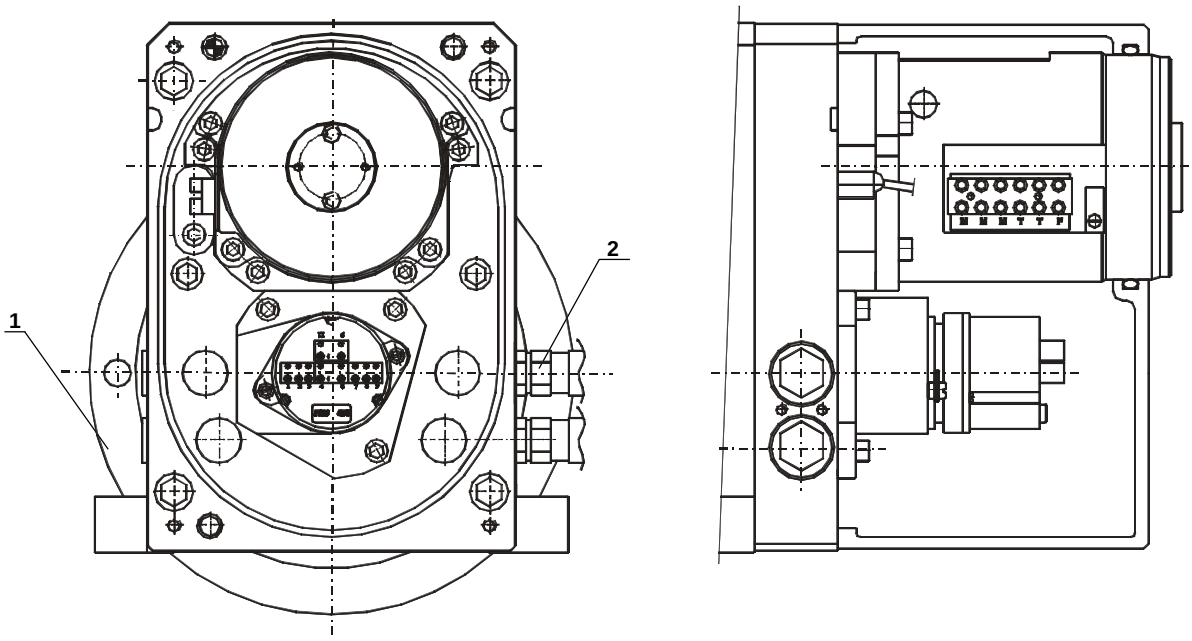


FIG 6.2 DETAILS OF ELECTRICAL TERMINALS

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. Electrical Signals

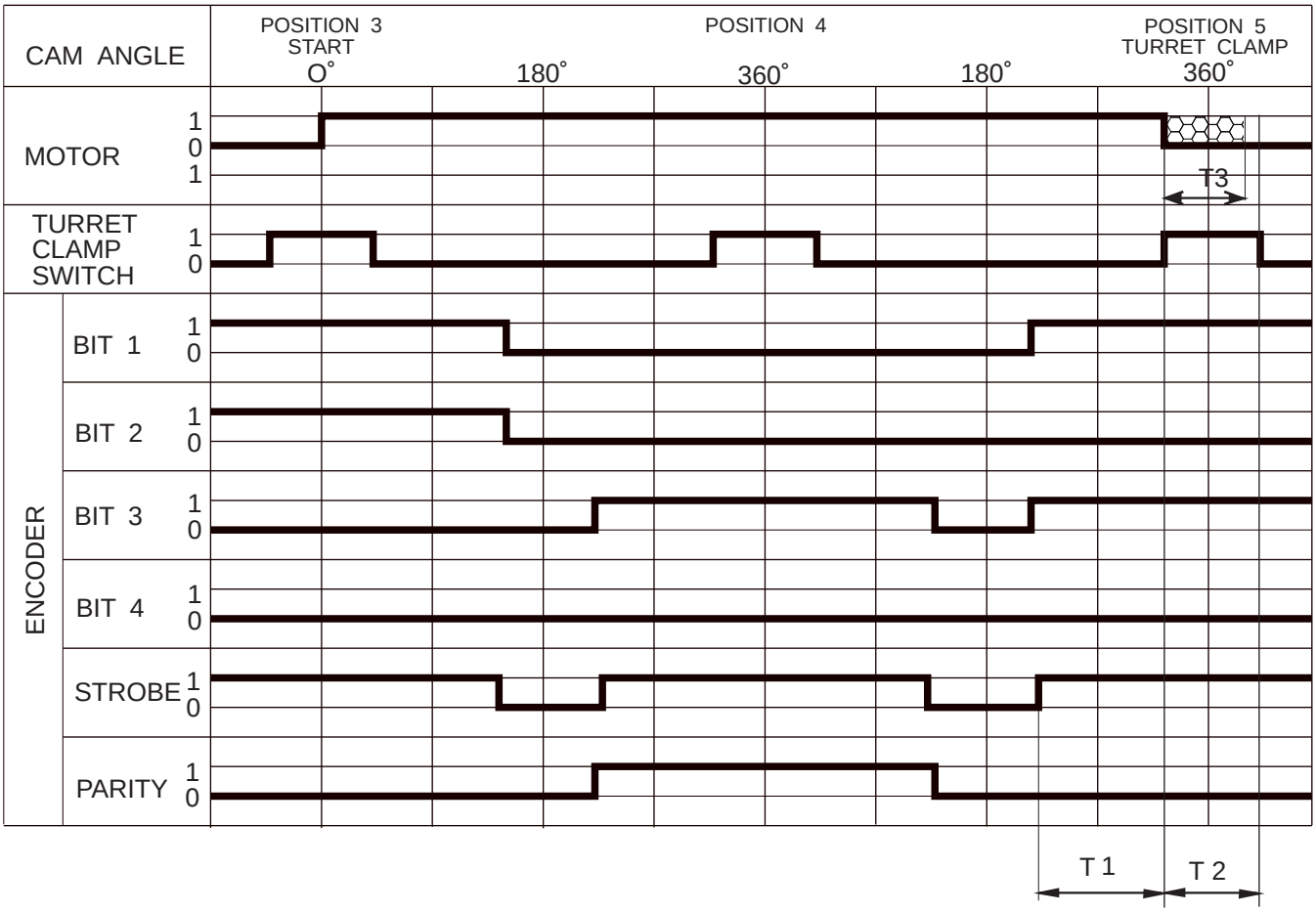


TABLE 1 *ENCODER SIGNALS*

	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 ms	**T2 ms**
BTP-125	175	135
BTP-100	150	115
BTP-80	125	95
BTP-63	100	75
BTP-50	75	60

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 :

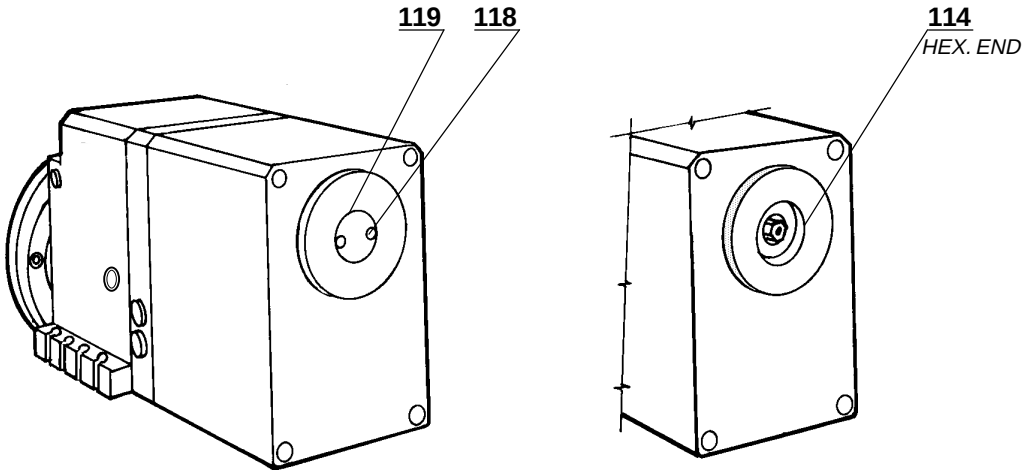


FIG 8.1

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 :

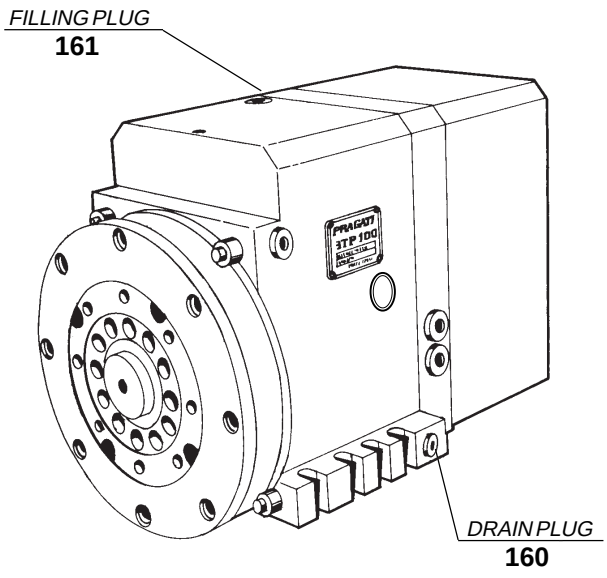


FIG 9.1

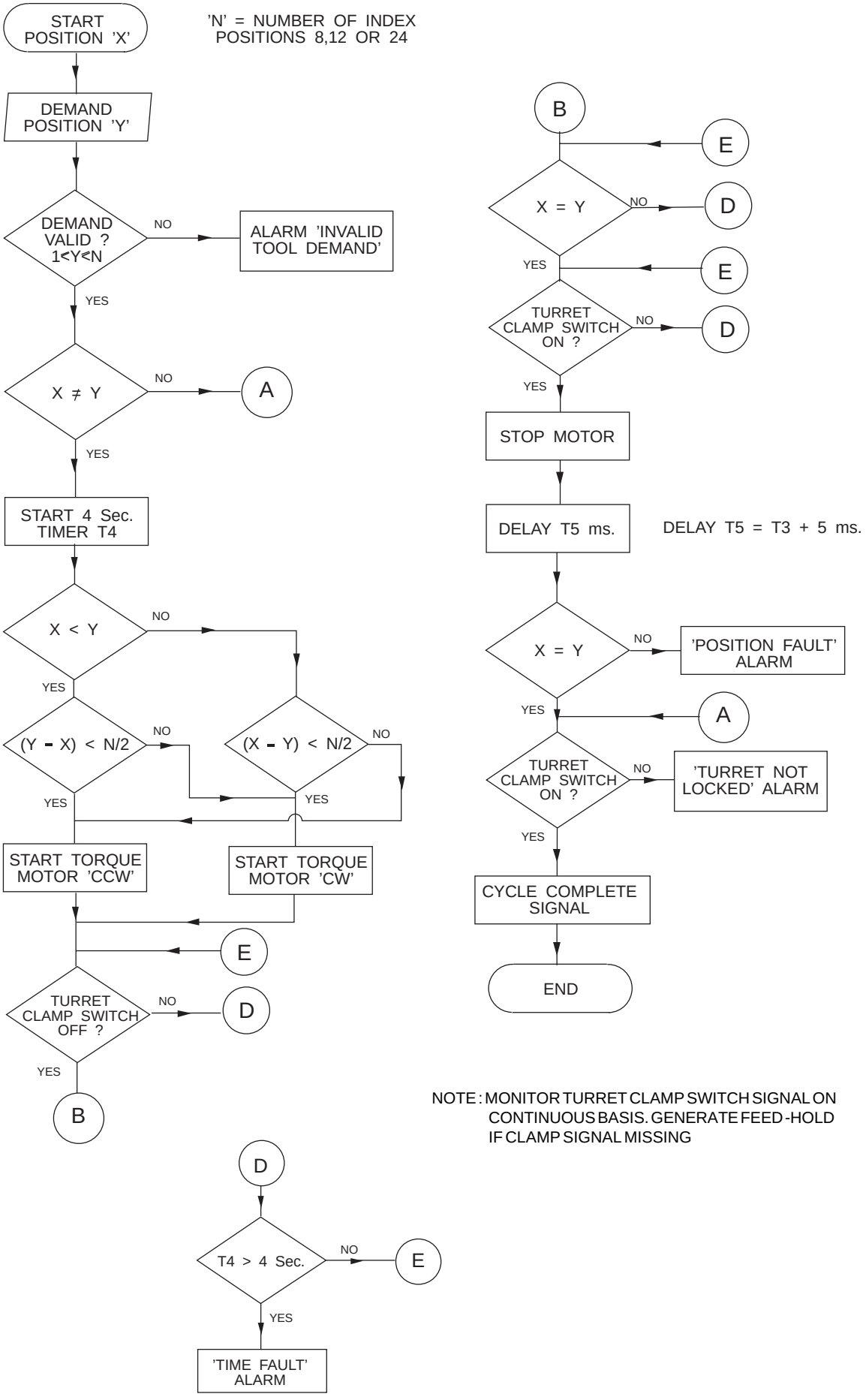
Turret is lubricated by medium viscosity gear box oil.

Oil can be filled after removing the filling plug (161) as shown in the fig (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 12. 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 10 ; 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 rotary encoder

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

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).

* Align the slot of the drive dog(23) with pin(22) on main spindle(31) and mount the encoder on the flange(19).

* Now rotate the encoder such that marks on encoder matches the marks on flange.

* Clamp the encoder in this position by tightening clamps (20).

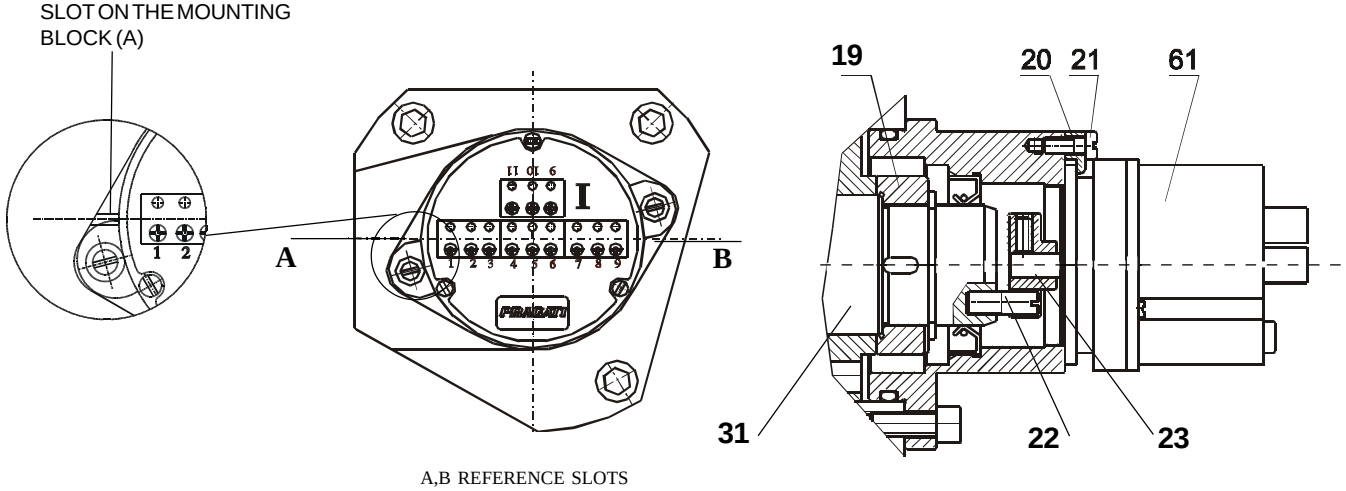


FIG 12.1

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

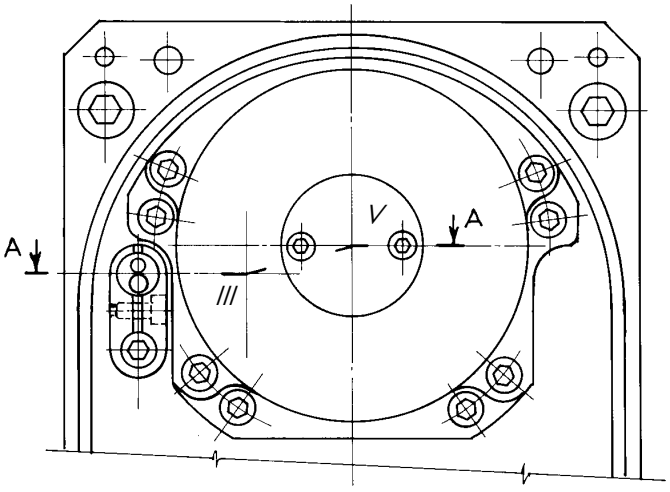
Proximity switch is operated by the projected 'switching area' on gear wheel (85); and indicates that the turret is in clamped position. Actuation of the switch is indicated by built in LED (light emitting diode).

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 declamp-index-clamp; and your hand can feel the pressure during 'clamp' phases.

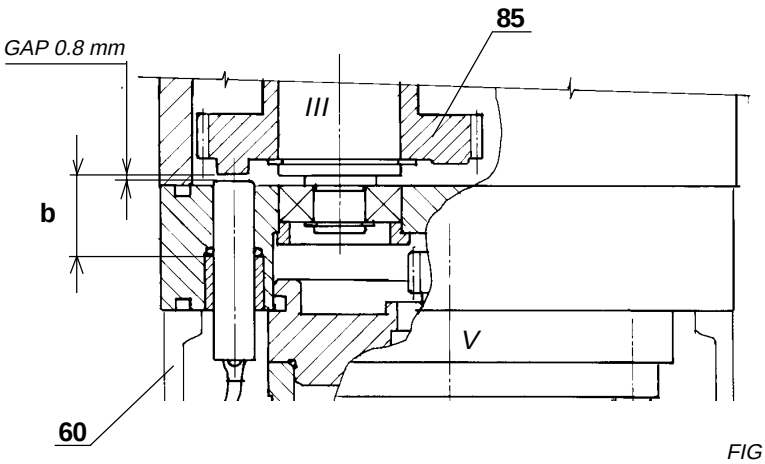
Proximity switch LED should light up during all these 'clamping' phases. Flickering of the light, or inconsistency of LED operation will be an indication of faulty proximity switch.

14. Replacement of proximity 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 socket 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.



MODEL	Dist 'a'
BTP-125	25.5
BTP-100	25.5
BTP-80	22.5
BTP-63	23.5



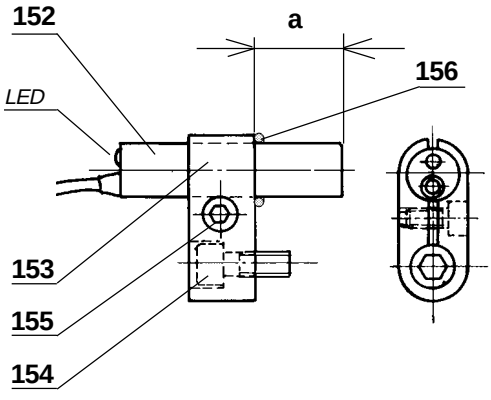


FIG 14.1

15. Assembly Drawings

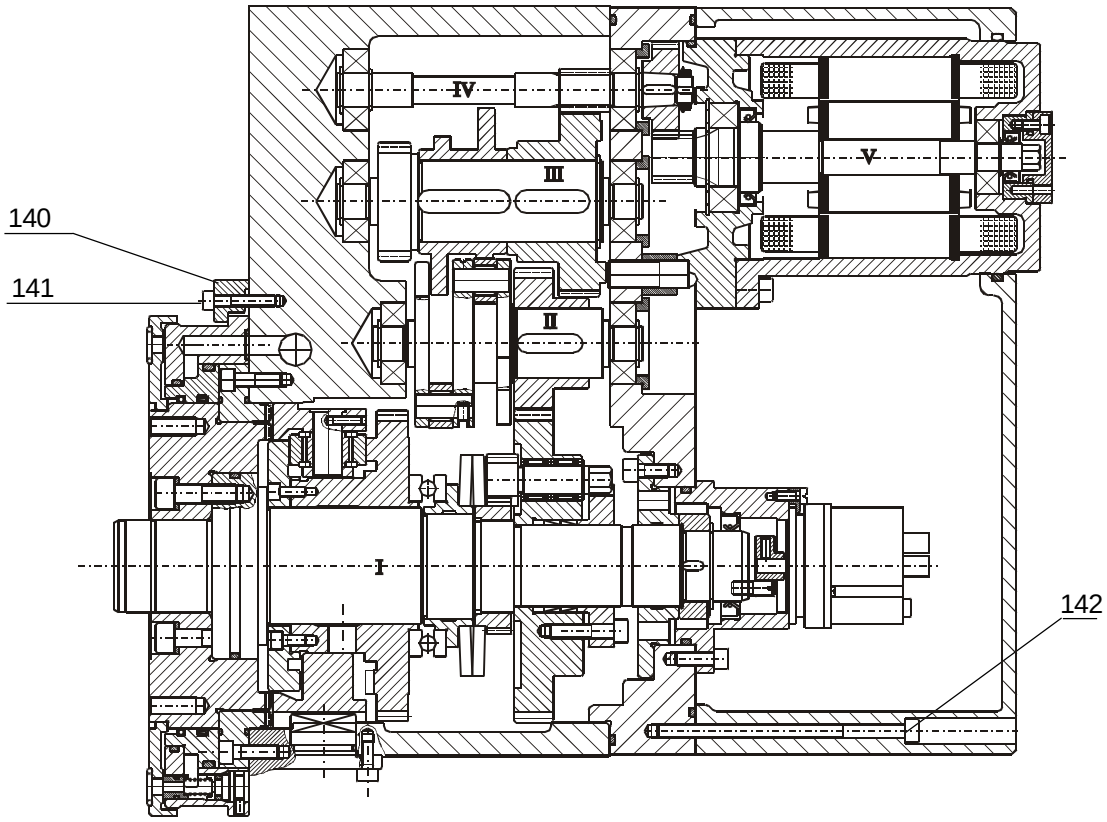


FIG 15.1 OVERALL ASSEMBLY
ALL AXES ARE SHOWN IN ONE PLANE FOR CLARITY

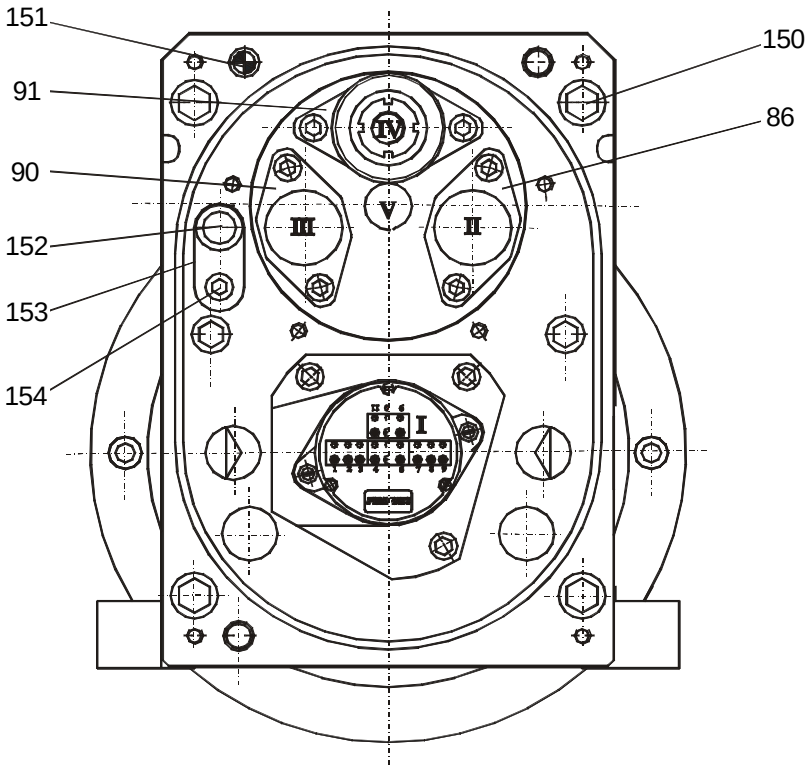


FIG 15.2 VIEW WITH BACK COVER AND MOTOR REMOVED.
ACTUAL ORIENTATION OF AXES IS VISIBLE IN THIS VIEW

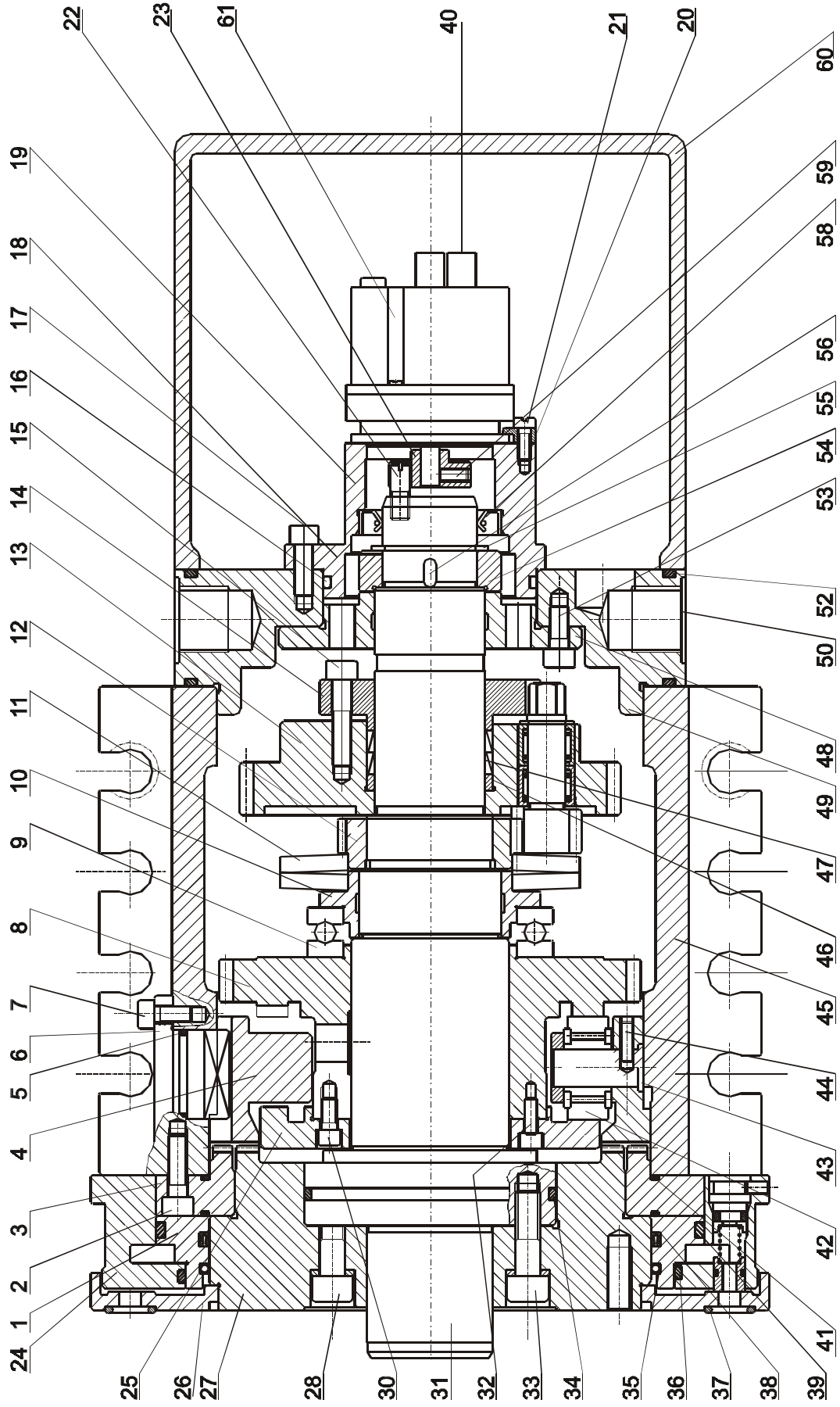


FIG 15.3 MAIN SPINDLE ASSEMBLY

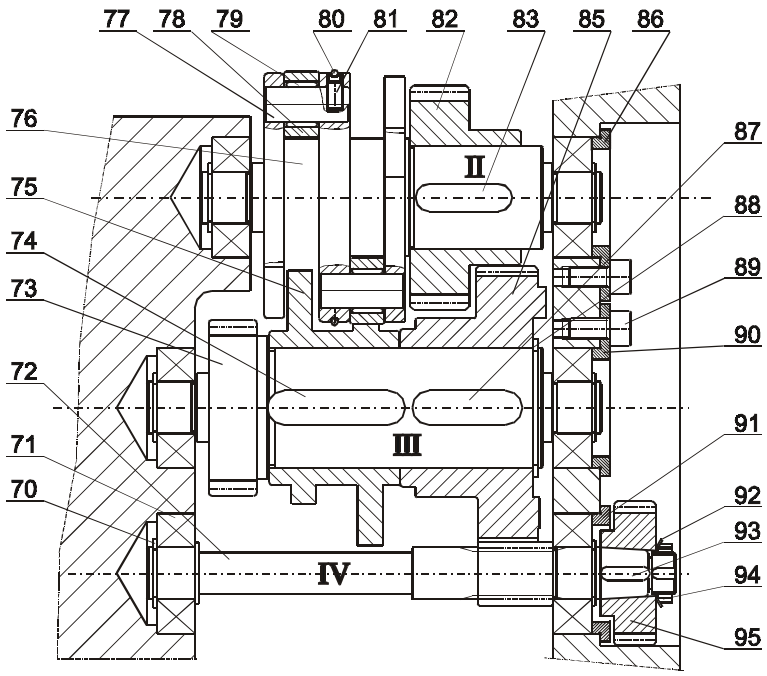


FIG 15.4A INDEXING DRIVE (BTP-80, BTP-63)

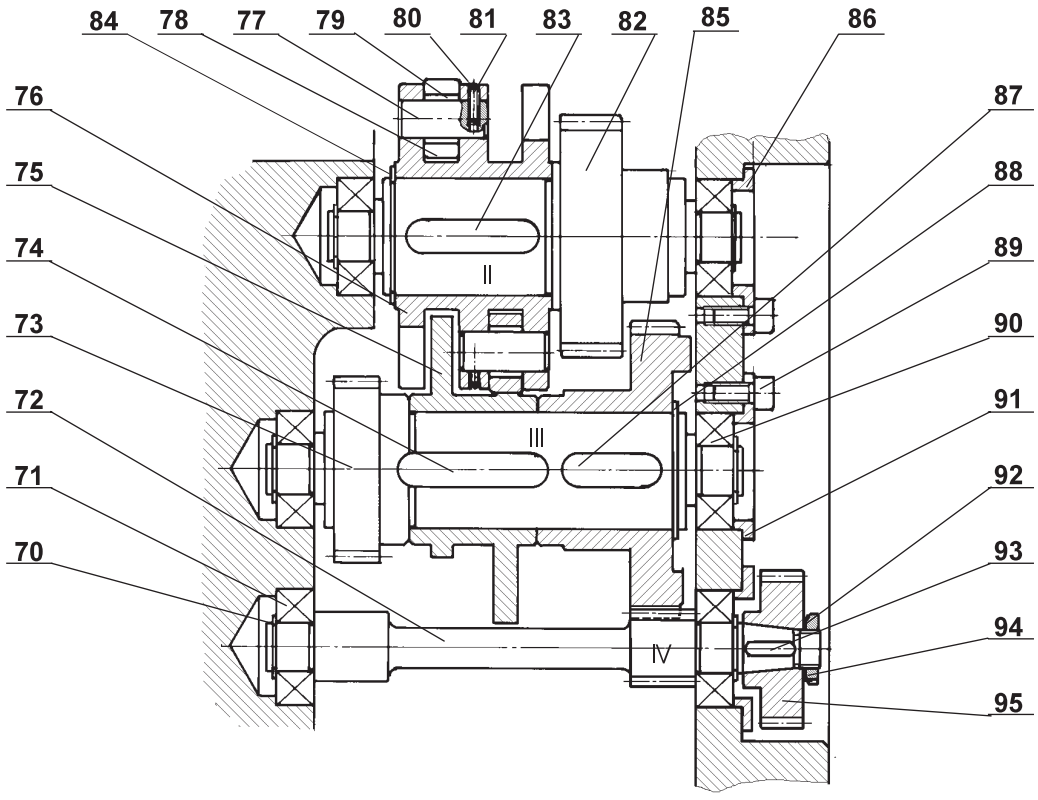


FIG 15.4B INDEXING DRIVE (BTP-125, BTP-100)

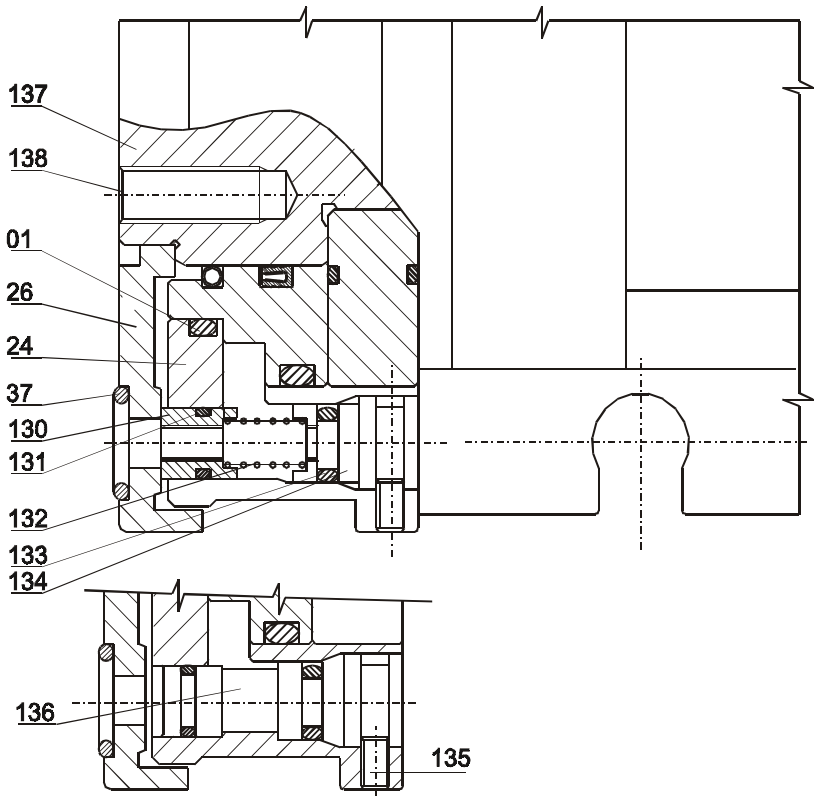


FIG 15.5 COOLANT VALVE ASSEMBLY

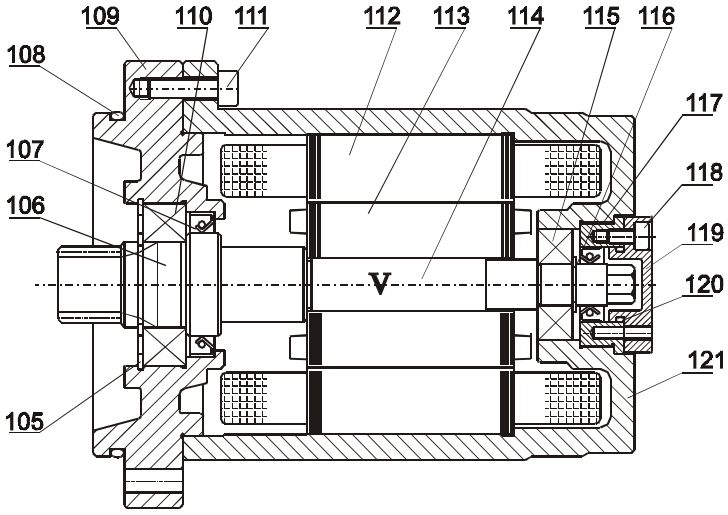


FIG 15.6 MOTOR ASSEMBLY

15.1 Partlist

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

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. This can be caused due to 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(153).
* 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 centre 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 pinon with the help of a spanner.
* In models BTP-50,BTP-63,BTP-80,the nut can be losened using a 'C'-spaner
* Drum cam assembly (fig 17.1) along with the sliding coupling (4) can now be removed.
* Remove screws (30) to seperate 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 (72) 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 :

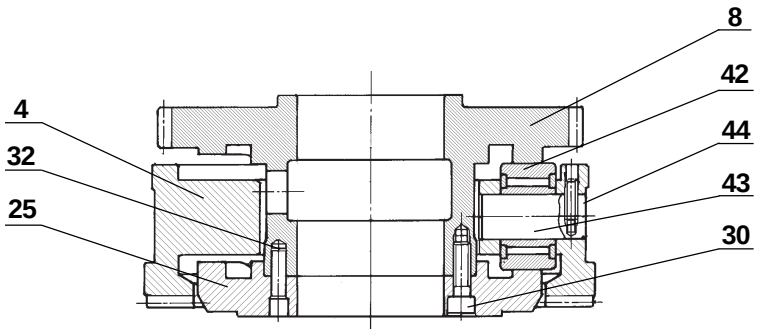


FIG.17.1

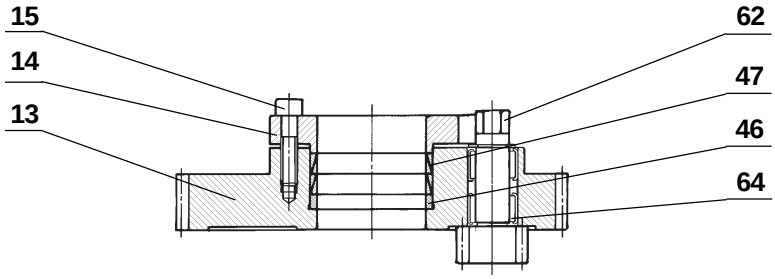


FIG.17.2

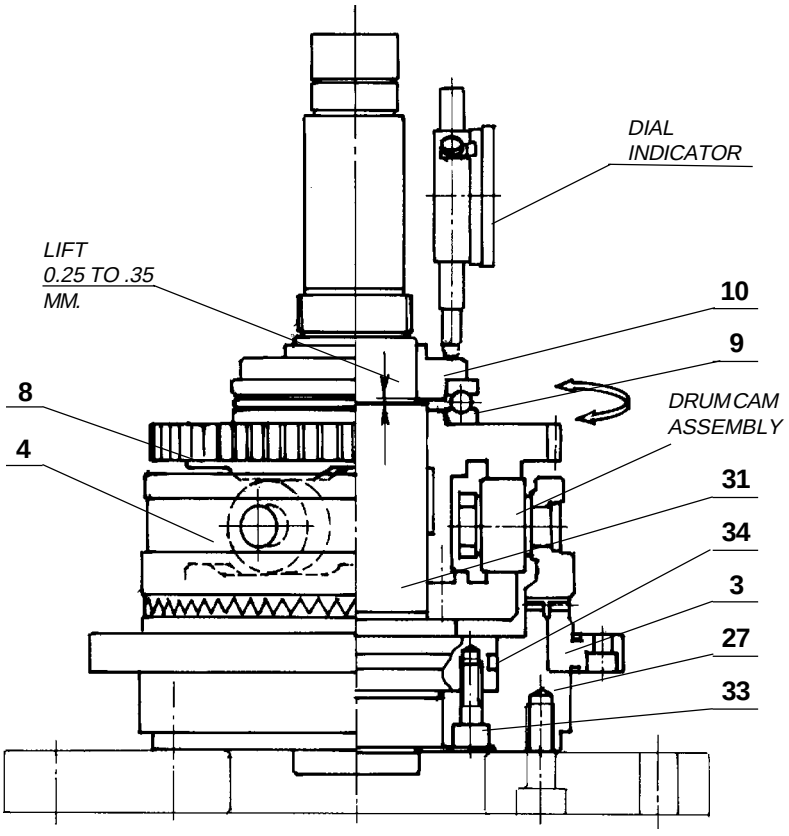


FIG.17.3
INSPECTION OF SPRING SEAT LIFT

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

17.1. Partial Assembly of Spindle

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 Loctite. 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.

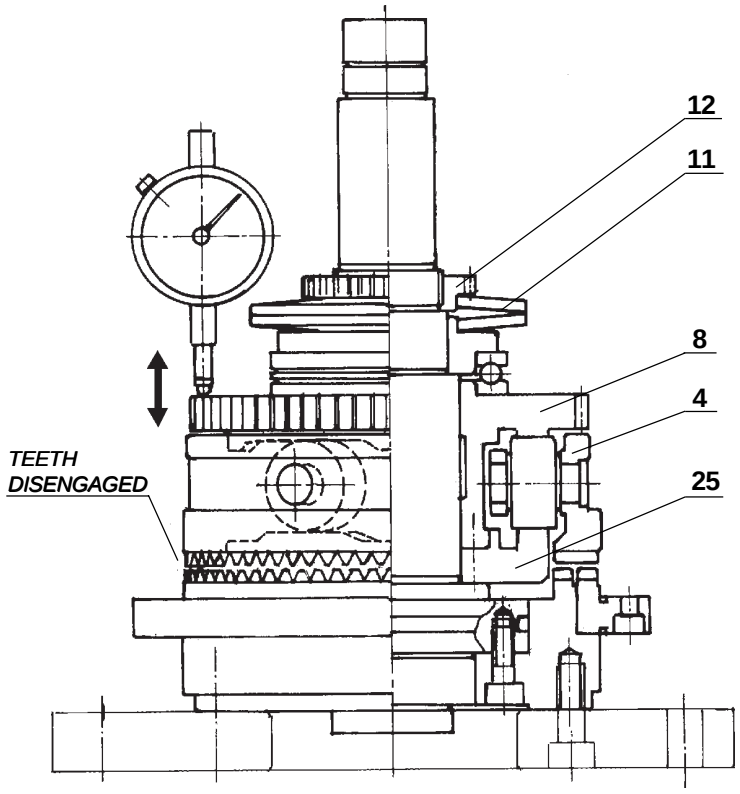


FIG 17.4 INSPECTIONOF AXIAL CLEARANCE OF DRUM CAM ASSEMBLY

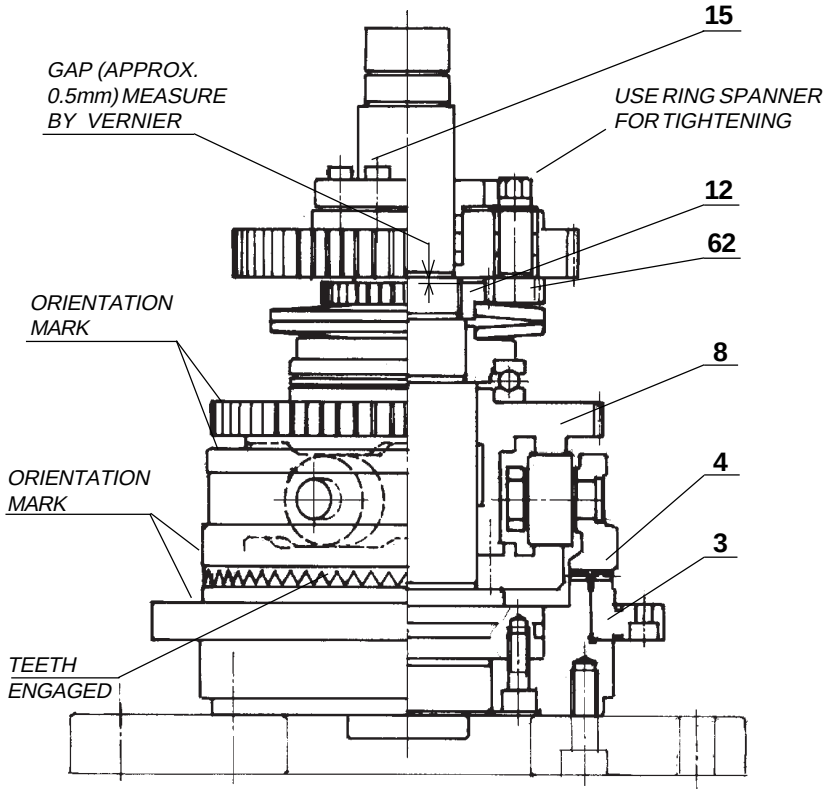


FIG 17.5 'LOADING' OF DISC SPRINGS.

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.

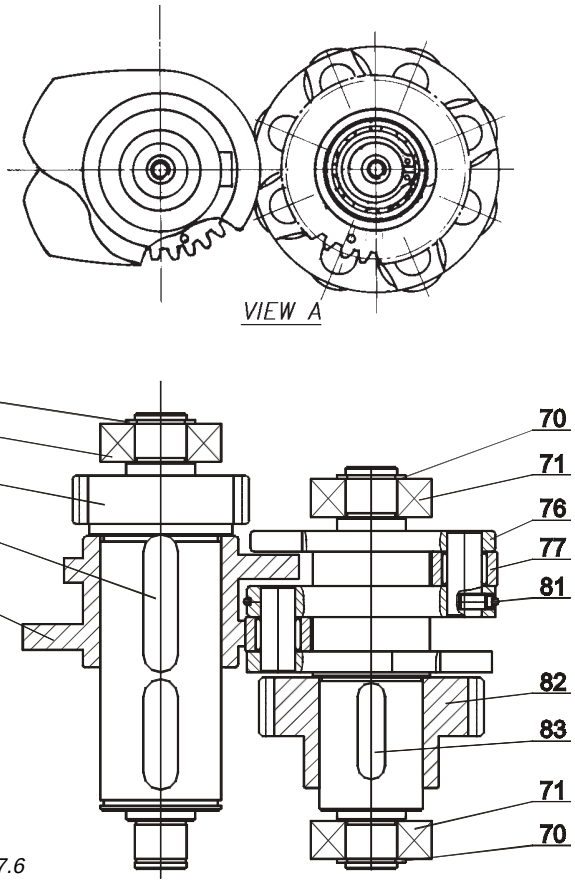


FIG 17.6

17.2 Partial Assembly of indexing cam drive.

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

Assemble all the components (70, 71, 76 to 84) as shown in 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 fig 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.

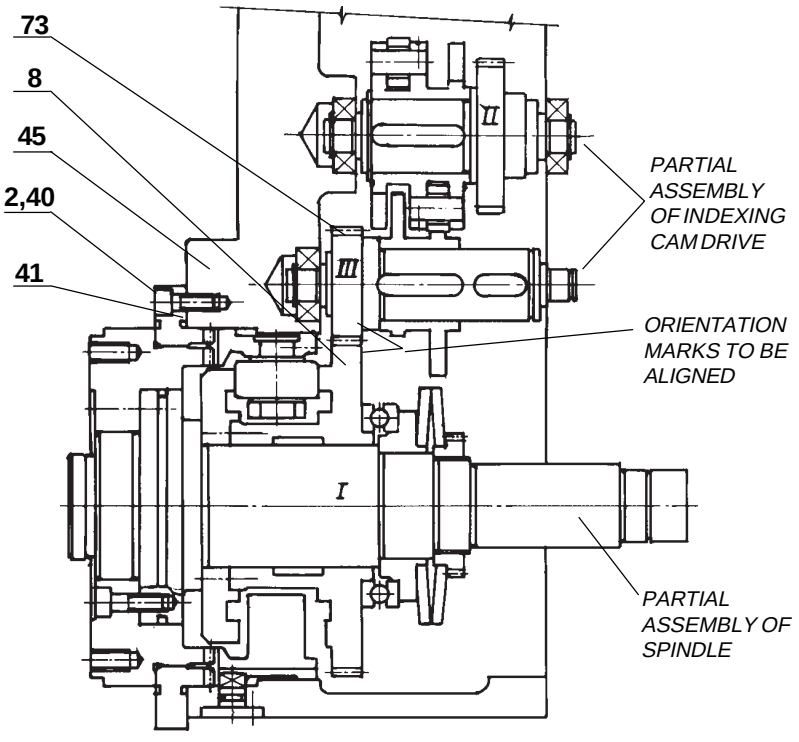


FIG 17.7

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 loosing 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.

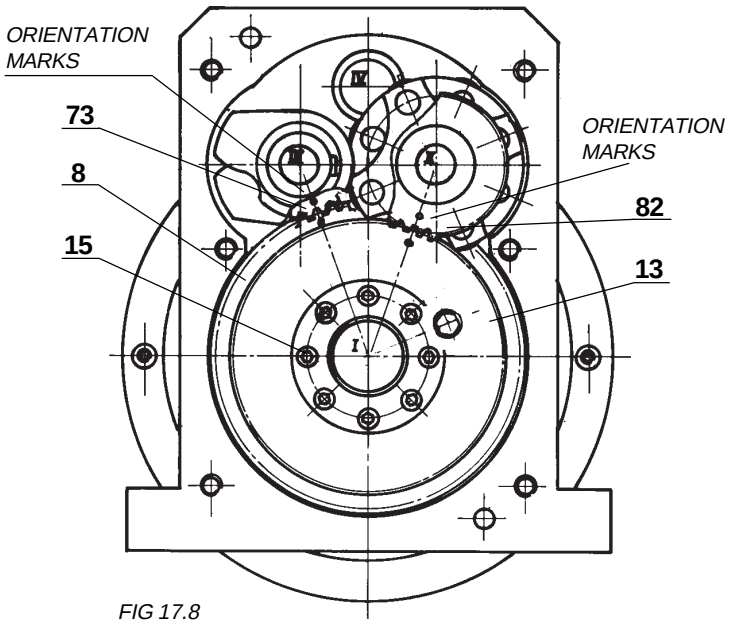


FIG 17.8

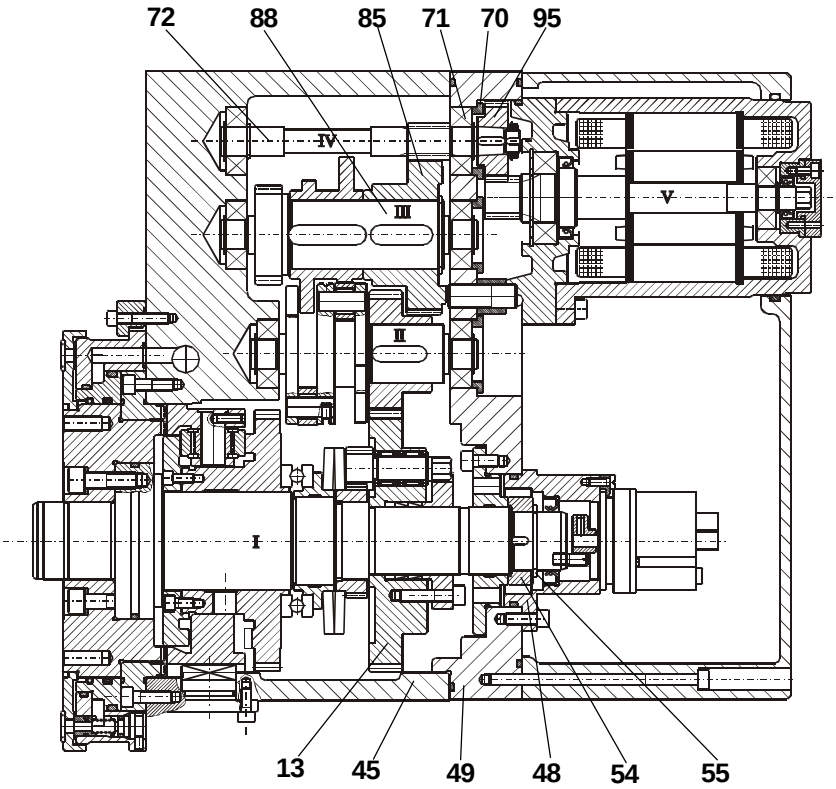


FIG 17.9

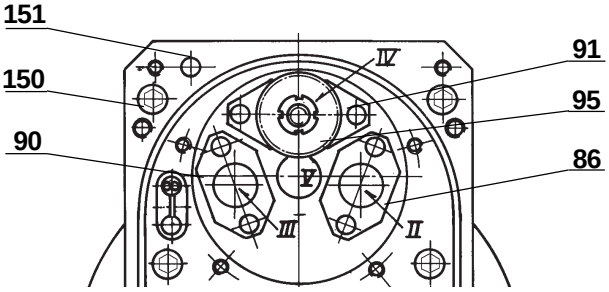


FIG 17.10

17.4. Final Assembly :

* Slide the indexing gear (13) sub-assembly 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.

18. Adjustment of Ringfeder Clamps

In rare cases, it is possible that accident can occur while the turret is indexing spurious signals in control circuit can unintentionally start the indexing cycle, causing the turret to index in the middle of a machining operation. In some controls, a "block search" operation can cause the turret to index to a tool position expected after the axis are repositioned after block search. If such a 'block search' is made without indexing the turret to a expected tool no at the end of block search, then the turret tooling can hit a rotating chuck, or work piece, causing an accident.
In such accidents, the friction joint of Ringfeder slips; and protects the internal mechanism from damage. In such cases, it is necessary to put back the indexing mechanism into proper orientation by adjustment of ringfeder clamps.
Such a condition is usually associated with the change in angular position of tool disc in the clamped position or excessive noise in one direction during indexing.

18.1 Procedure for adjustment of ringfeder clamps.

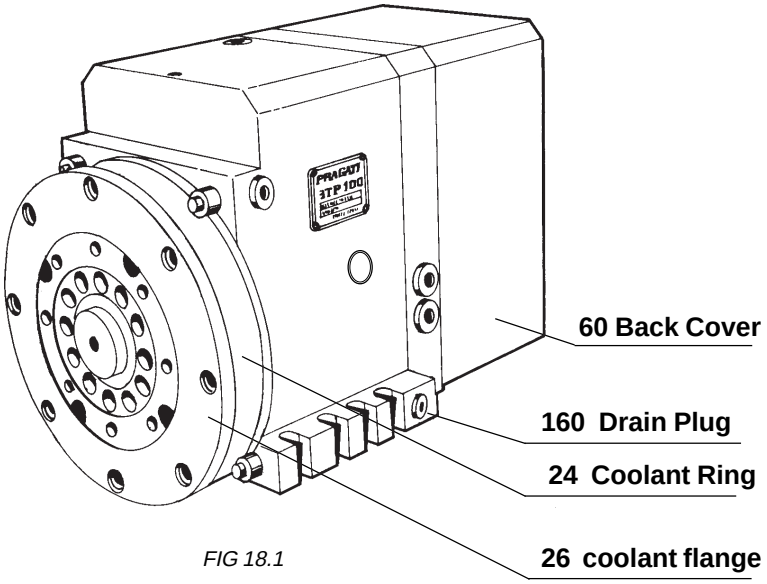


FIG 18.1

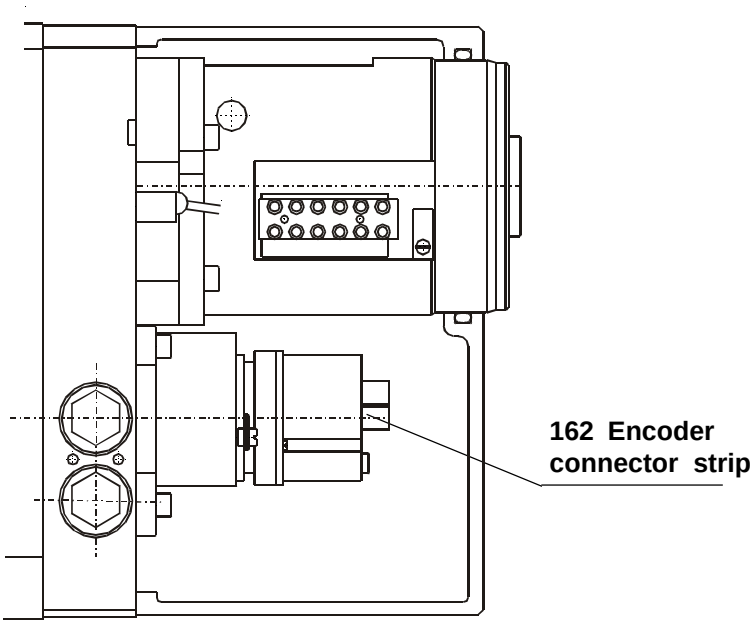


FIG 18.2

* Disconnect power supply to the turret.
* Drain Lube oil, using drain plug (160).
* Remove back cover (60).
* Bring the turret in a clamped position by hand cranking, (refer page 11). Note down the tool position. Also make a reference mark by a marker pen on coolant flange (26) as well as on coolant ring (outer) (24). Even if turret clamping is not possible at this stage follow the next steps.
* Take out the encoder (61). Do not disconnect wiring.
* Remove flange (19) .
* In the clamped position of the turret, bolts (15) are in line with the holes drilled in flange (48). In case of a 12 station turret bolts (15) may not be in line with the holes. Then crank the turret through one or two stations to get the alignment. In case turret clamping is not possible then rotate the motor shaft in whichever direction possible; in some intermediate position bolts (15) will be in line with the holes in flange (48). Use suitable allen key (6 mm size for BTP-125, 5 mm size for BTP-100, 80, 63) and loosen all the bolts.

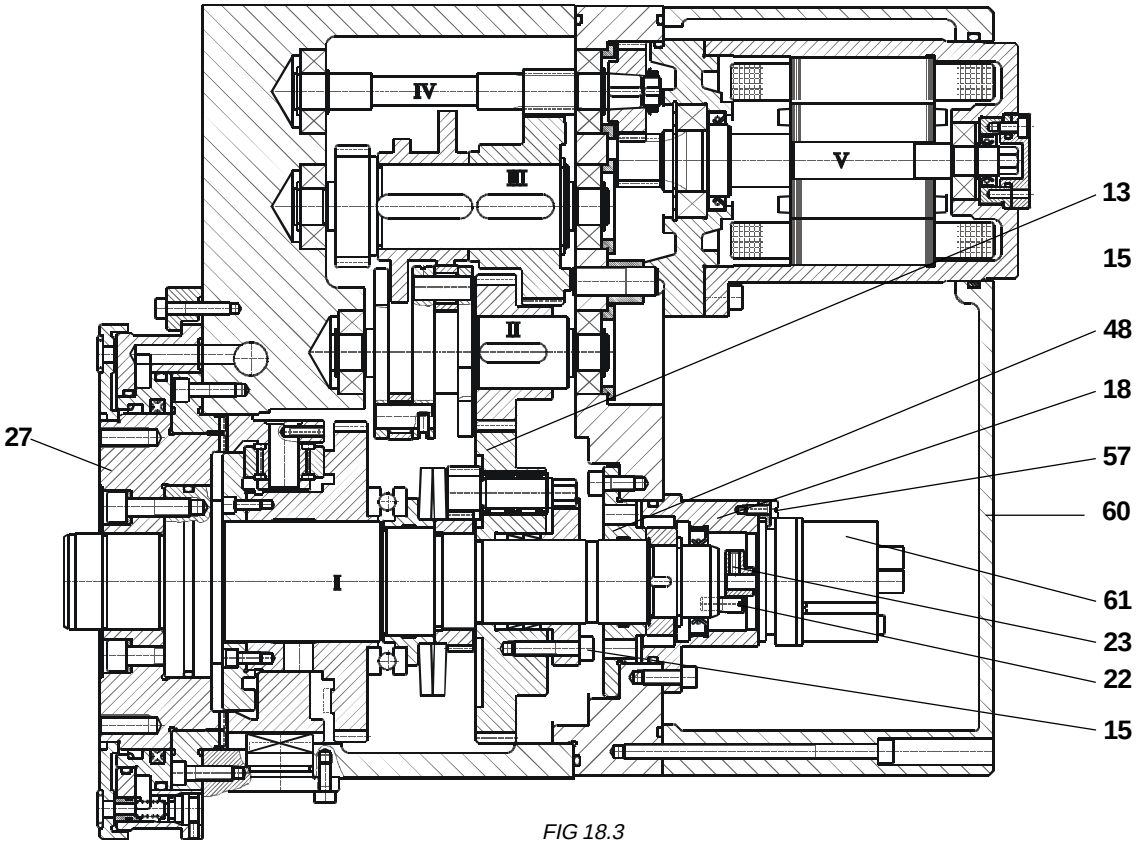


FIG 18.3

* Crank the motor by hand and bring the turret in de-clamped position. Declamped position can be sensed by the reduction in pressure during hand cranking. If in doubt connect 24V DC supply to the turret. 'OFF' condition of LED on proximity switch also indicates de-clamped position. Rotate motor shaft further two revolutions in same direction. Slightly tap the bolt heads (15) using allen key to release the Ringfeder clamp. (Insert allen key in bolt head socket and tap it with hammer).
* In this position, it is possible to turn the indexing flange (27) by hand. If necessary, force the angular movement of the flange to loosen the grip of ringfeder clamps. Bring the Indexing flange (along with tool disc, if it is not removed) in proper angular position. Reference mark made on the coolant flanges (26) and (24) can serve as a rough guide.
  CAUTION : * If you make a mistake of one tooth, the tool disc position will change by 5°. The tool disc will then sit in an angular position, making it impossible to align the tools.
  * If you do not take care, you may position the indexing flange (and tool disc) at some other tool position. In such a case, tool position number, and encoder feedback will not match.
* Crank the motor and bring the turret in clamped position, as indicated by proximity switch LED.
* Now tighten the bolts (15) to clamp indexing gear (13) on the spindle. Bolts should be tightened in gradual manner, in 3 to 4 stages. Tighten opposite bolts in sequence (1,5,2,6,3,7,4,8).
* Crank the motor by hand in both directions, and check for the correct indexing movement.
* Fit flange (18).
* Now the encoder can be fitted back in position.First roughly position the slot in drive dog (23) in the same angular orientation as the pin (22) on the spindle.Then gently fit the encoder in position ensuring that slot fits properly on the pin. Clamp the encoder in position,such that the orientation marks on encoder and flange match.
* Supply 24V DC power to encoder, and check that the encoder feed back position matches with the actual position of tool disc.
* Follow the procedure given on page (14) to adjust the encoder in proper position.
* Fit back the cover (60).
* Put the lubricating oil (Page 11).
* Run the turret with power to check for proper functioning.

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 totaliy 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.

19.1 LIST OF 'O'RINGS & OIL SEALS USED IN VARIOUS BTP MODELS

FOR BTP-63

No.	Assembly Reference	Part No	Id X Wire dia	Quantity
1	Spindle Assembly	41	110 X 2.0	1
2	Spindle Assembly	41	115 X 2.0	1
3	Spindle Assembly	34	62 X 2.0	1
4	Coolant Ring	39	129 X 2.0	1
5	Coolant Flange	37	12 X 2.0	1
6	Encoder Flange	16	50 X 3.0	1
7	Spindle Assembly	52	165 X 3.0	2
8	Coolant valve	131	7 X 1.5	2
9	Coolant valve	133	8 X 1.5	2
10	Motor	108	83 X 2.5	1
11	Motor	120	18 X 2.0	1
12	Anti Rotation key	5	8 X 1.5	1
13	Spindle Assembly	58	25 X 42 X 7	1
14	Oil Seal - Motor	10	25 x 37 x 7	1
15	Motor	107	12 X 24 X 7	1

FOR BTP-80

No.	Assembly Reference	Part No	Id X Wire dia	Quantity
1	Spindle Assembly	41	140 X 2.0	2
2	Spindle Assembly	34	74 X 3.0	1
3	Coolant Ring	36	155 X 2.5	1
4	Coolant Flange	37	12 X 2.0	8
5	Encoder Flange	16	63 X 3.0	1
6	Spindle Assembly	52	193 X 3.0	2
7	Coolant valve	131	7 X 1.5	2
8	Coolant valve	133	8 X 1.5	2
9	Anti Rotation key	5	24 X 2.0	1
10	Motor	108	95 X 2.5	1
11	Motor	120	18 X 2.0	1
12	Spindle Assembly	58	30 X 45 X 8	1
13	Motor	107	30 x 42 x 7	1

18.1 LIST OF 'O'RINGS & OIL SEALS USED IN VARIOUS BTP MODELS

FOR BTP-100

No.	Assembly Reference	Part No	Id X Wire dia	Quantity
1	Spindle Assembly	41	170 X 2.5	2
2	Spindle Assembly	34	105 X 3.5	1
3	Coolant Ring	36	190 X 3.0	1
4	Coolant Flange	37	12 X 2.0	8
5	Encoder Flange	16	66 X 3.0	1
6	Spindle Assembly	52	225 X 3.5	2
7	Coolant valve	131	7 X 1.5	2
8	Coolant valve	133	8 X 1.5	2
9	Anti Rotation key	5	24 X 2.0	1
10	Motor	108	115 X 2.5	1
11	Motor	120	18 X 2	1
12	Spindle Assembly	58	35 X 52 X 10	1
13	Motor	107	30 X 45 X 7	1

FOR BTP-125

No.	Assembly Reference	Part No	Id X Wire dia	Quantity
1	Spindle Assembly	41	210 X 3.0	2
2	Spindle Assembly	34	120 X 3.5	1
3	Coolant Ring	36	230 X 3.0	1
4	Coolant Ring	39	256 X 3.0	1
5	Coolant Flange	37	12 X 2.0	8
6	Encoder Flange	16	99 X 3.0	1
7	Spindle Assembly	52	287 X 3.0	2
8	Coolant valve	131	9 X 1.5	2
9	Coolant valve	133	9 X 2.0	2
10	Anti Rotation key	5	24 X 2.0	1
11	Motor	108	135 X 3.0	1
12	Motor	120	25 X 2.0	1
13	Spindle Assembly	58	60 X 80 X 10	1
14	Motor	107	30 X 47 X 7	1

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 MOTER HAS STOPPED.	A A1 A2 B	TURRET MOTOR NOT STOPPING IN SPECIFIED TIME FAULTY SSR(SOLID STATE RELAY) PROBLEM WITH TURRET CONTROL FAULTY PROX.SWITCH	A1 A2 B	CHANGE SSR CHECK WHETHER MOTOR POWER SWITCHES OFF WITHIN 5MS OF PROX.SWITCH SIGNAL.THIS CAN BE CHECKED ON DUEL BEAM OSCILLOSCOPE WITH MEMORY. REPLACE SWITCH
2	TOOL DISC GOES ON ROTATING WITHOUT STOPPING AT SELECTED POSITION.	A B C	FAULTY ENCODER FAULTY PROX.SWITCH FAULT IN CONTROL CIRCUIT	A B C	CRANK THE TURRET BY HAND.OBSERVE ENCODER SIGNALS.IF DEFECTIVE,REPLACE ENCODER. CHECK WHETHER PROXIMITY SWITCH SIGNAL IS PRESENT AT PROPER TIME DURING HAND CRACKING.IF IN OUBT,REPLACE PROXIMITY SWITCH CHECK WHETHER DIFFERENT SIGNALS(LIKE TOOL DEMAND,ENCODER FEED-BACK,PROX.SWITCH ETC.ARE AVAILABLE IN PROPER SEQUENCE & AT PROPER TIME.
3	EXCESSIVE NOISE DURING INDEXING	A	SLIPPING OF RING-FEEDER JOINT	A	LOOSEN AND RECLAMP THE CLAMPING BOLTS AS PER INSTRUCTIONS ON PAGE 26
4	ROTATIONAL ACTION NOT SMOOTH	A	UNBALANCE LOAD ON TOOL DISC	A	REPOSISTION THE TOOLS TO IMPROVE THE BALANCE
5	TURRET MOTOR OVERHEATING SIGNAL	A B	EXCESSIVE FREQUENCY OF INDEXING CYCLES UNBALANCED POWER SUPPLY	A B	REDUCE THE NUMBER OF INDEXING CYCLES PER MINUTE (Max.10/min) CHECK VOLTAGE IN ALL THE THREE PHASES,CORRECT IF NECESSARY.

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