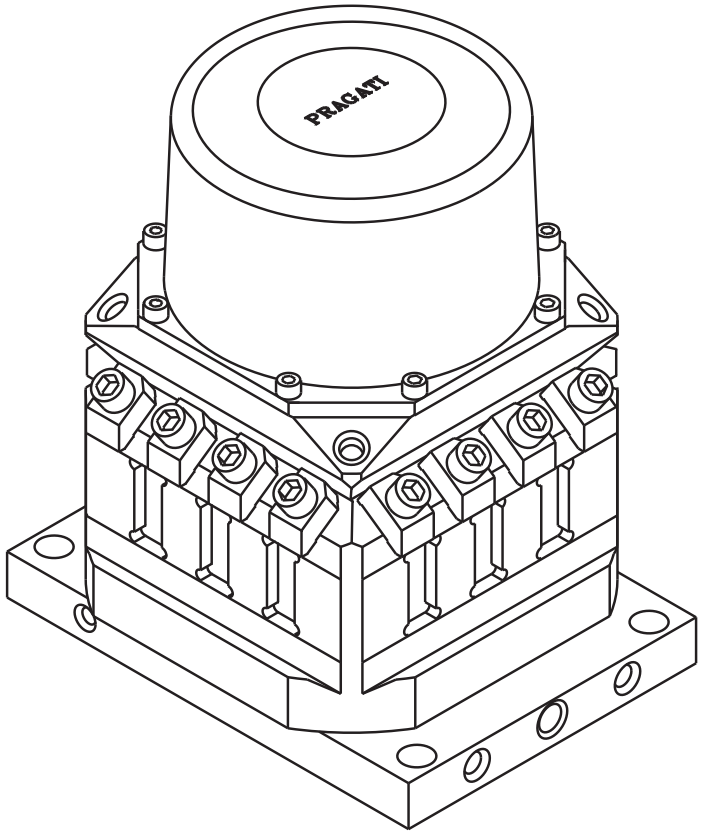
VERTICAL

TOOL TURRETS



VTP-250 VTP-200 VTP-160

INSTRUCTION MANUAL

PRAGATI

March 2009

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1. Principle of Working

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

3 Phase torque motor drives the internal gear (4) as well as roller housing (7) through a set of gears. Initial 40° rotation of roller housing declamps the turret and disengages the sliding coupling (11). but no motion is transfererred to the body. Further rotation of motor drives the sliding coupling and body. Turret angular movement is monitered by encoder (8). Turret logic controller energises the solenoid (9) just before reaching the demanded position. Plunger (10) engages into the slot of solenoid ring (3) as soon as the correct index position is reached. Plunger engagement is sensed by the proximity switch. This signal is used to reverse the motor. Turret remains stationery, but internal gear (4) rotates in reverse direction along with roller housing (7). Turret gets clamped in 40° of reverse rotation; and is sensed by 'clamp' signal from the encoder. Then the motor is switched off and solenoid de-energised.

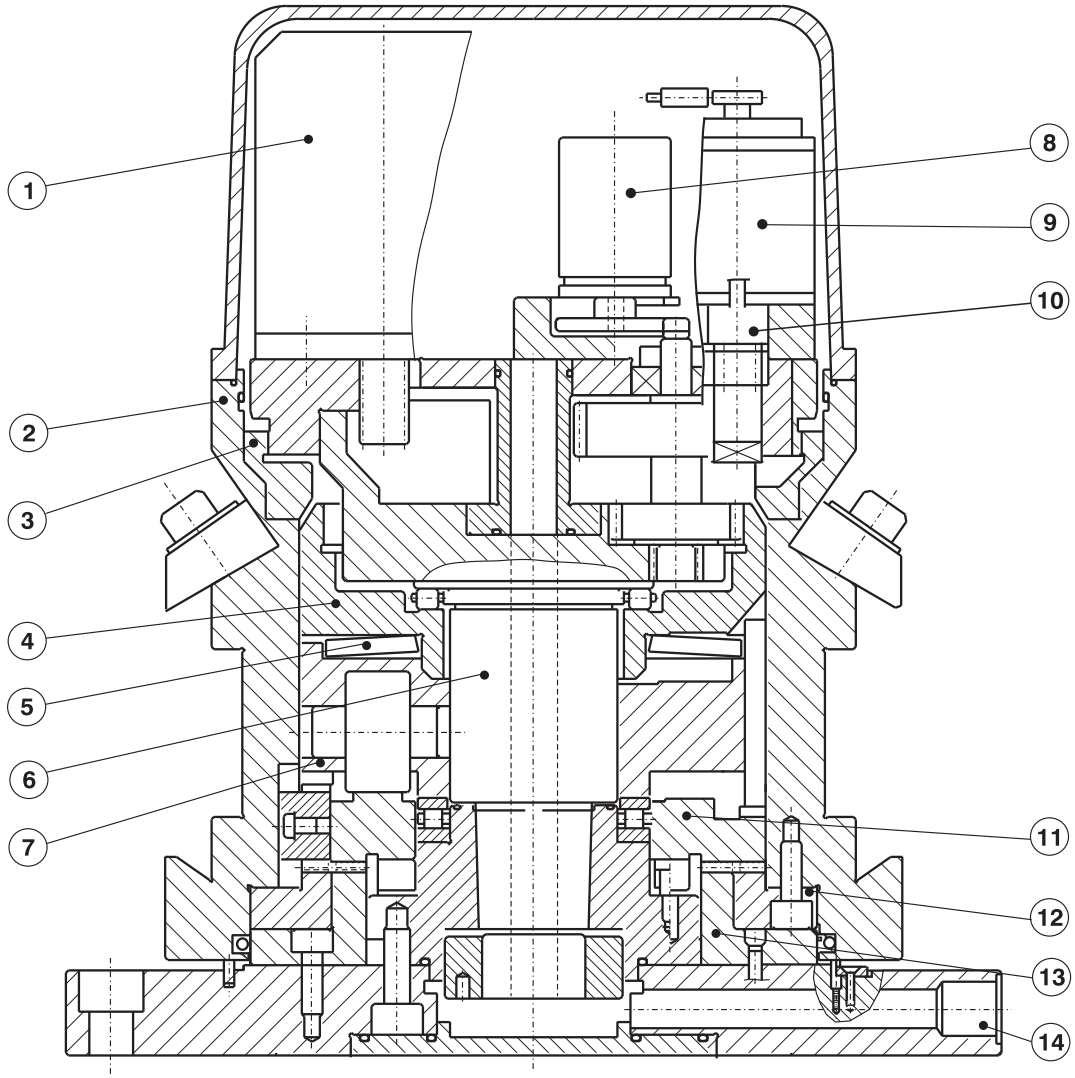


Fig 1.1

1. Torque Motor
2. Turret Body
3. Solenoid Ring
4. Internal Gear
5. Disc Spring
6. Main Shaft
7. Roller Housing
8. Encoder
9. Solenoid
10. Plunger
11. Sliding Coupling
12. Rotating Coupling
13. Fixed Coupling
14. Entry for Electrical wires.

2. Instruction for fitment on the machine

Sealing 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 the tool mounting surface of turret body. Clamping bolts should be tightened after aligning the sealing surface square to the lather axis. It is advisable to allow the turret to 'slip' in the event of accidental collision or overload. This 'slipping' absorbs some of the energy of collision, and reduces possible damage.

Oversize mounting holes facilitate turret alignment, and also allow slipping in case of overload.

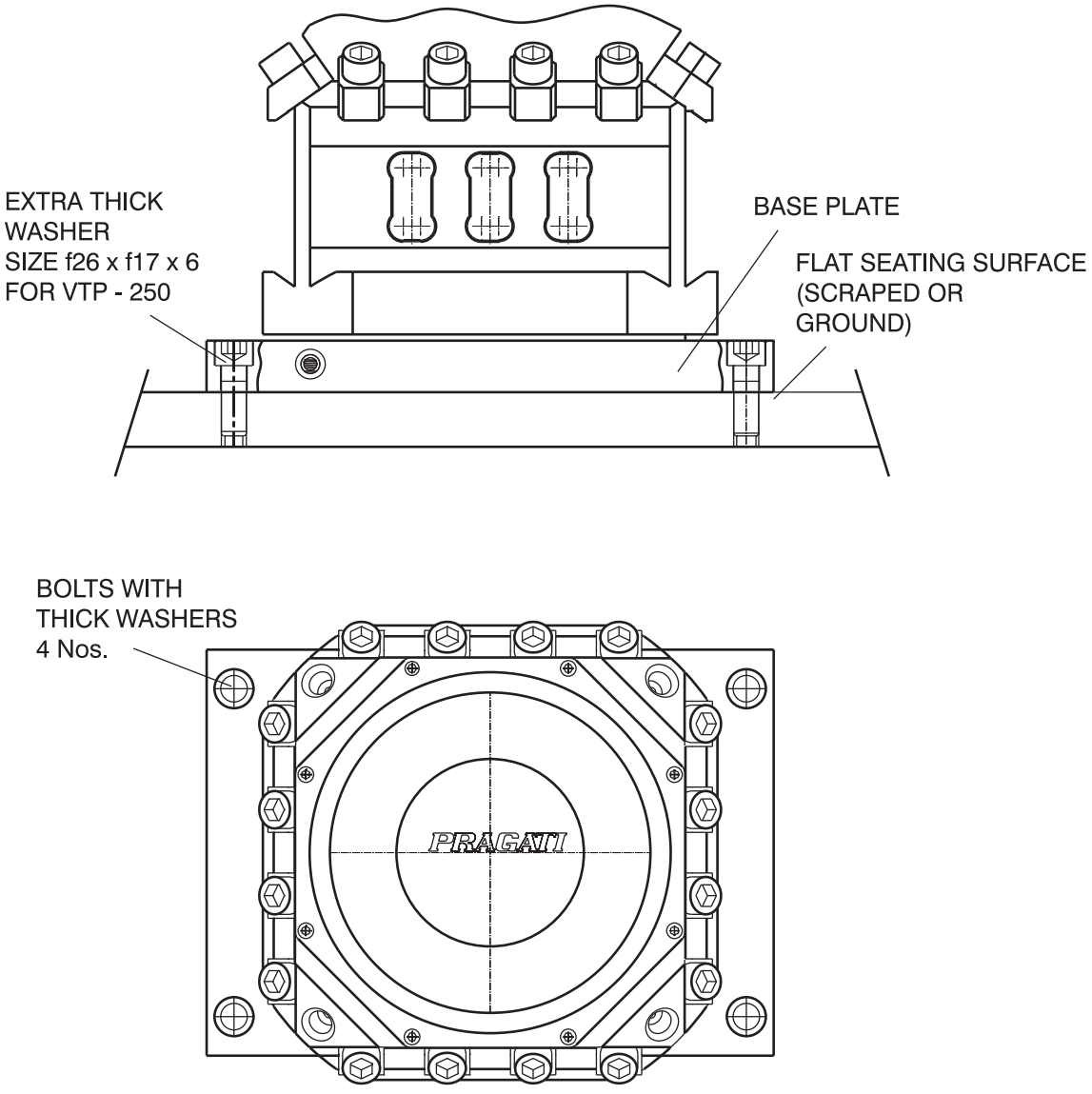


Fig 2.1

3. Operation of Coolant System

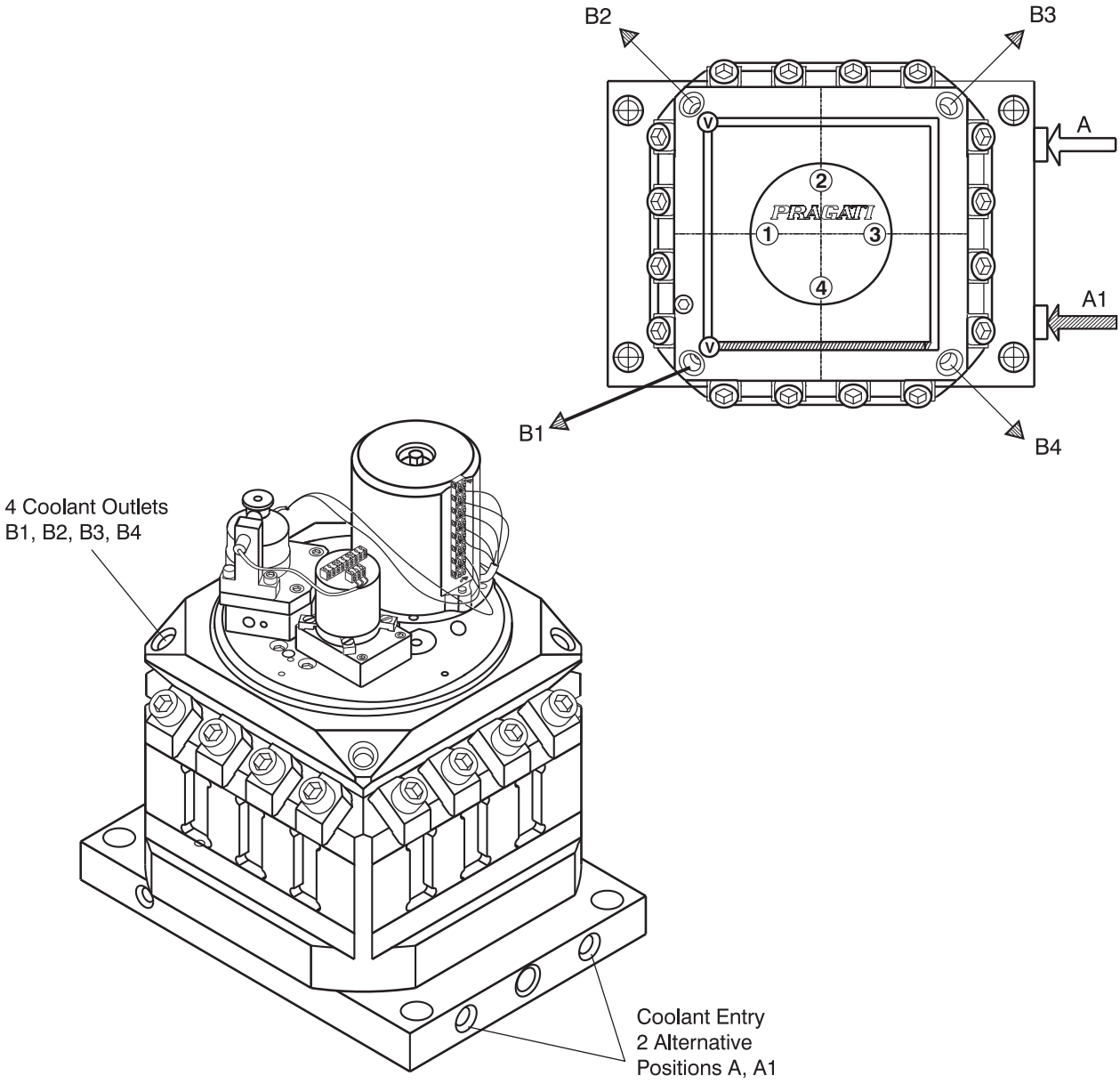


Fig 3.1

Coolant Entry Points
Turret has two alternative positions (A and A1) for the connection of coolant pipe. Coolant passes from the base to the turret body through spring loaded valves V and V1; depending on inlet position A2 or A1

Coolant Outlets
Turret has four coolant outlets B1, B2, B3 and B4 at the top of the body.

Coolant Cleanliness
Coolant passage within the turret body is narrow, and has a number of baffle plate valves 'D' and poppet valves 'C' in its passage. It is essential that the coolant be fairy clean, as it enteres the turret. Otherwise there is a possibility of clogging the passages.

Clean coolant also helps in increasing the life of valve buttons.

4. Replacement of valve buttons

Valve buttong rubs against the base of turret body, during indexing and is liable to wear.

Replacement procedure for valve button requires the turret unit to be lifted from the base; so that are valve assembly can be approached from the bottom face.

For replacement, remove cover (97), and take out the spring (96) and valve button (94).

Replace the buttons with new units.

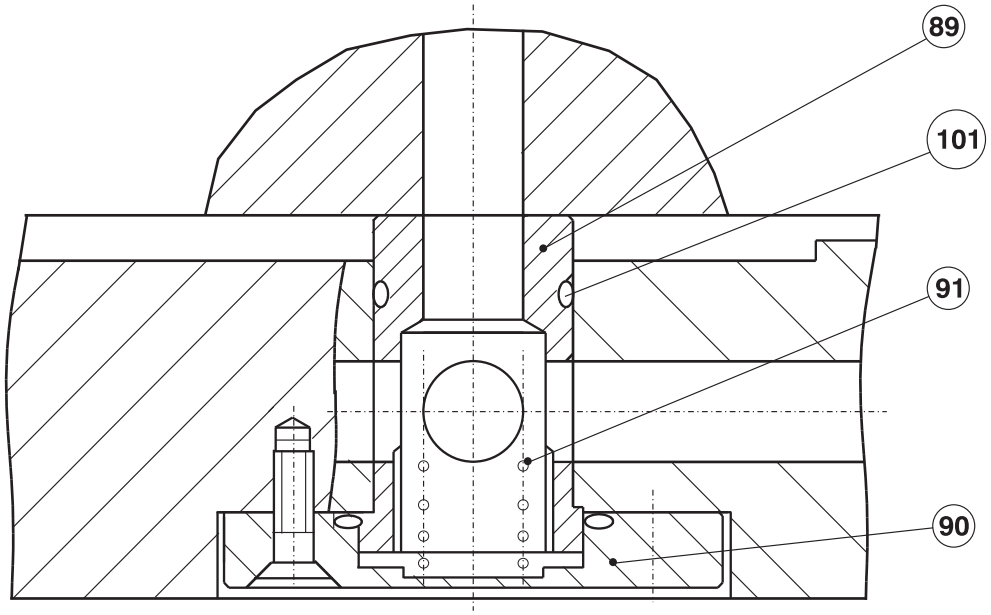
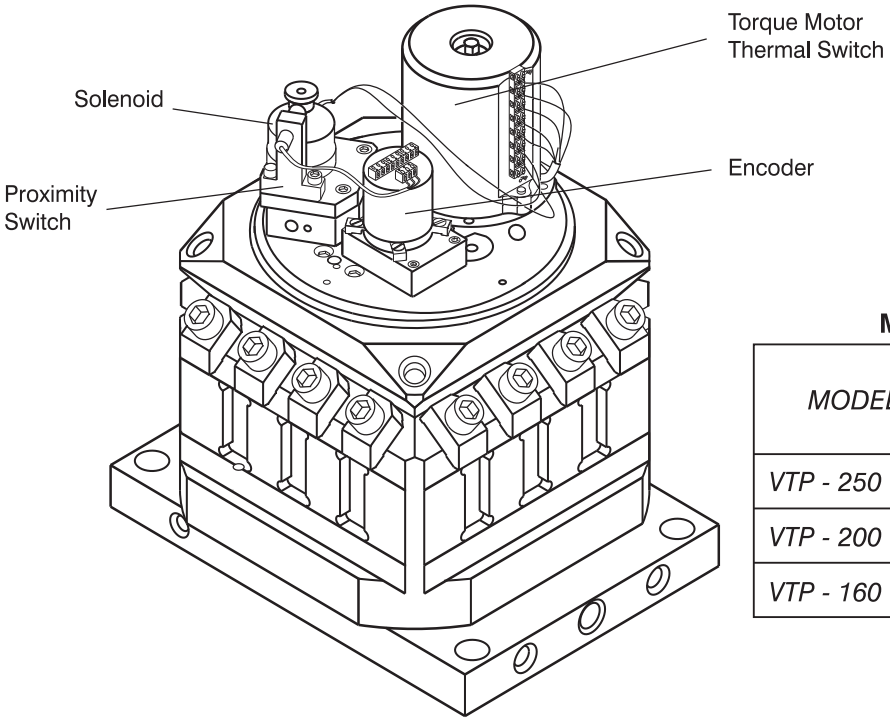


Fig 3.11

5. Details of electrical connection



MOTOR CURRENT

MODEL	VOLTAGE AC		
	415	220	110
VTP - 250	2.3	3.9	6.3
VTP - 200	1.6	3.0	5.0
VTP - 160	1.3	2.6	4.7

Fig 4.1

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 VTP-250 : 1.5 KVA VTP-200 : 1.2 KVA VTP-160 : 0.9 KVA	3 ~	RED YELLOW BLUE GREEN	M → PHASE - 1 M → PHASE - 2 M → PHASE - 3 E → EARTH
2	THERMAL SWITCH	OPENS AT 130° 2A 415 VAC NORMALLY CLOSED CONTACT		BLACK BLACK	T → + 24V DC T → BLUE Output
3	ABSOLUTE POSITION ENCODER	15-30 VDC RIPPLE 10% 350 mA (SUPPLY) 50 mA CHANNEL (LOAD) OUTPUT - PNP.			1 BIT1 WHITE 2 BIT2 YELLOW 3 BIT3 GREEN 4 T.CLAMP VIOLET 5 STROBE BLACK 6 PARITY PINK 7 'O' VDC BLUE 8 '24' VDC BROWN
4	PROXIMITY SWITCH	10-30 VDC RIPPLE 10% 200 mA (LOAD) OUTPUT-PNP-NO		BLACK BLUE BROWN	9 O/P → OUTPUT 10 11
5	SOLENOID FOR LOCKING	24 VDC, 50 WATTS STROKE LENGTH 8mm			13 24 VDC → RED (0.5sq.mm) 14 0 VDC → BLACK (0.5sq.mm)

6. Encoder Signals

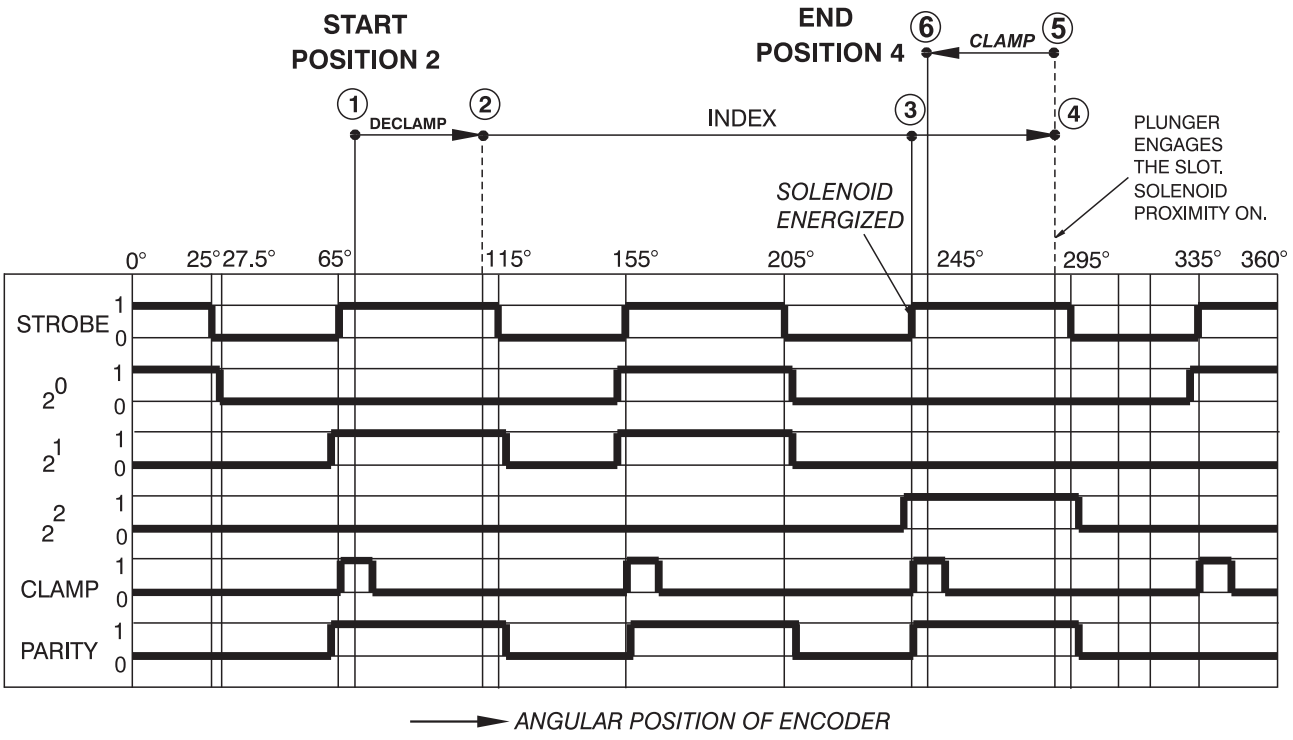


Fig 5.1

It is important to remember that encoder is connected to the internal gear (18), and not to the turret body (1). Turret body is stationary during 'Declamp' and 'Clamp' operation, but encoder moves along with internal gear.
Indexing from position No. 2 to position No. 4 :
Sequence of operation; and encoder signals :

(1) Start position. Motor switched ON. Encoder starts rotating along with internal gear, but turret body is stationary.

(2) Turret indexing movement starts. Encoder angular movement is now synchronised with angular movement of turret. PLC starts looking for coincidence. (i.e., demanded position = encoder feedback position).

(3) At some distance (40°) before the final position, encoder signals show that the desired position is approaching. That is to stay encoder feedback indicates coincidence. (demanded position = actual position). At this point, PLC should energize the solenoid.

(4) Desired physical position of turret reached. Solenoid plunger slides down into its slot to arrest the turret movement. Drive motor stalls. Solenoid proximity switch becomes ON. Motor is switched OFF.

(5) With the shortest possible delay, motor is switched ON in reverse direction. Turret remains stationary. Encoder rotates along with internal gear.

(6) After 40° of reverse rotation, turret is clamped in its new position, Encoder 'clamp' signal becomes ON. Motor is switched OFf and Solenoid is switched OFF. Cycle complete.

7. Hand cranking

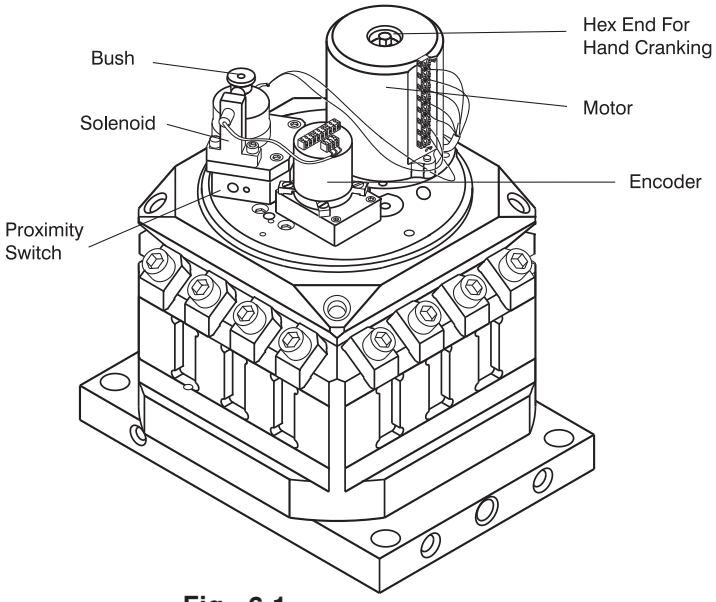


Fig 6.1

Turret can be indexed by cranking the rotor of electric motor by hand.
Hand cranking is required for setting the encoder in proper position.
Hand cranking is also helpful in inspecting the function of mechanical elements, after a re-assembly.

Procedure for hand cranking from one turret position to the next is as follows :

1. Disconnect 3 phase AC power supply of turret.

2. Remove turret cover. Hexagon head end of motor shaft is now accessible.

3. Use a suitable cranked spanner to crank the motor.

4. Start turning the motor in clockwise direction.

4.1 Initial 12 rotations of the motor will release the clamping pressure of disc spring; and disengage the sliding coupling.

4.2 Further cranking of motor will cause the indexing movement of turret. 90° Indexing requires 27 rotations of motor shaft.

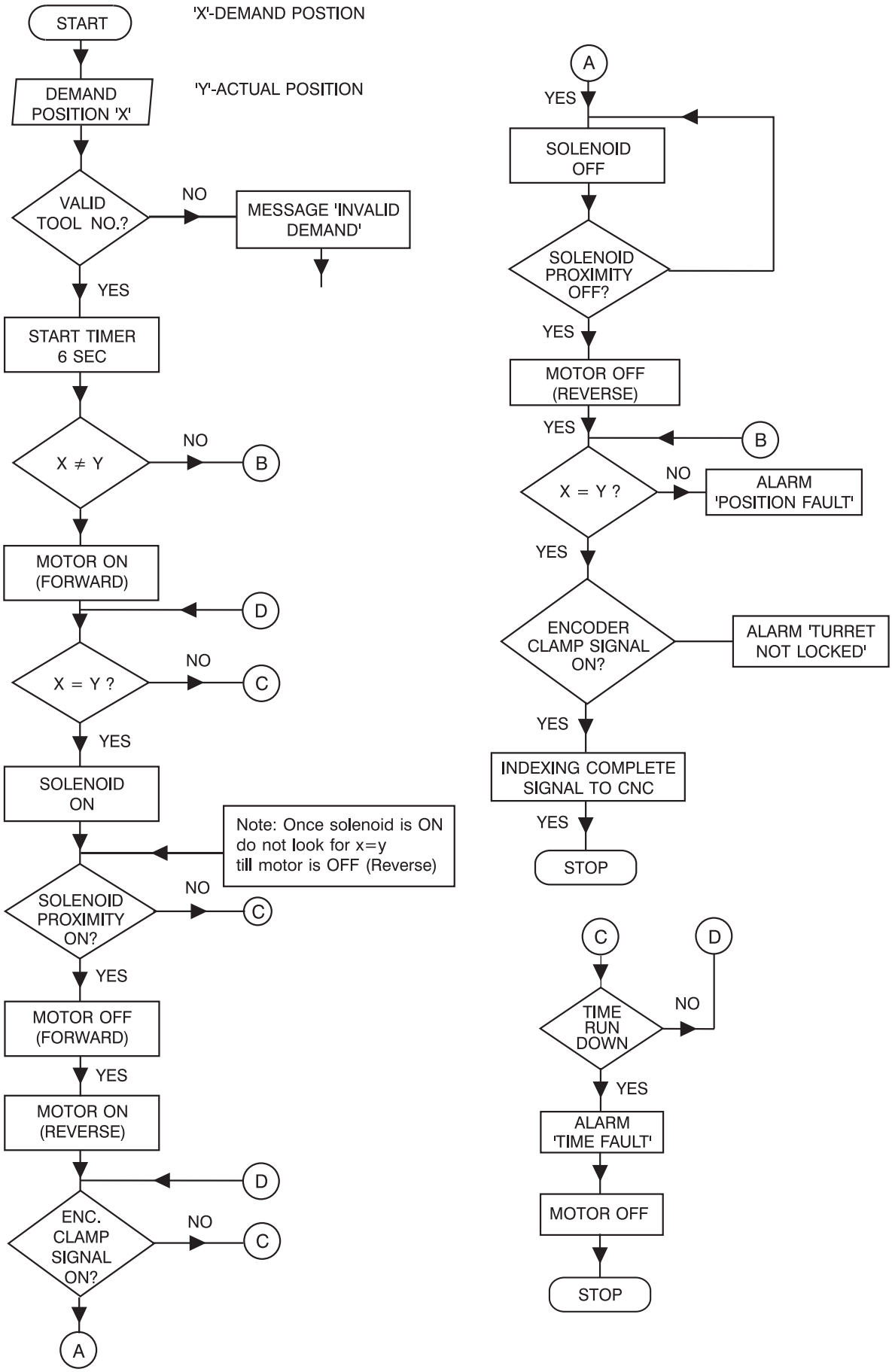
4.3 As the desired position approaches, push solenoid plunger by hand, and continue cranking. At the proper index position, solenoid plunger will go down, and will not allow further movement of turret.

4.4 At this point, reverse the direction of motor cranking. Initial 9.25 rotations will push the sliding coupling into engagement. Further 1.25 rotations will cause the cam to press the disc spring. This can be sensed by increased force required for hand cranking. Additional 1.5 rotations will complete the turret clamping in its new position. At this point, the hand can feel the dead stop.

4.4.1 At this position, if 24 DC voltage supply is 'ON' then, encoder feedback will confirm the new position; and 'clamp' signal of encoder will become 'ON'.

4.4.2 At this point, solenoid plunger should be free in its slot. If pressed, plunger should freely move into the slot. If released, plunger should come out under the action of its spring.

8. Flowchart for turret control



9. Requirements of turret control

Flow chart for turret control is given on page 11. Any modern PLC with scan time of 8 to 10 milliseconds) will be capable of handling the sequence as specified in flow chart.

9.1 Safety Features :

9.11 'Motor Overheat Signal'

Turret motor has been designed with a special winding, to allow a large number of 'starts, stops and reversals, per minute. However, the motor can get overheated. If it is allowed to run continuously for a long time, even on no load. As a saftey measure, a thermal switch embedded in motor windings. In the event of over heating, thermal switch should trip the motor contactor; and also give 'motor' overheaf signal to the control circuit. Motor contactor should be tripped, without depending on PLC software.

9.12 'Time Fault' Alarm

Time required for indexing varies from 1.5 to 5 seconds depending on number of indexes. So 5 seconds is the maximum time required for completing any indexing operation. If the 'Cycle Complete' signal is not received within 10 seconds after the 'Cycle start', then 'Time Fault' alarm should be generated.

9.13 'Turret Not Locked' Alarm

Turret clamp switch should be monitored at the end of indexing cycle. If the clamp signals missing, 'a feed hold' signal should be generated to stop the machine movements. Simultaneously, 'Turret Not Locked' alarm signal should be generated.

9.14 'Position Fault' Alarm

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.

9.15 'Invalid Demand' Alarm

A 4 position turret cannot react to a tool demand other than 1 to 4. If any other tool position (Say 6) is demanded; control should give out 'Invalid Demand' alarm.

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

9.2 '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.

9.21 'Inching' the motor is 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.

9.22 Tool indexing cycle on manual demand :

If the power falls during the indexing cycle, turret can stop in an unclamped position. It is then possible that valid encoder feedback is not available because the turret has stopped in an intermediate position. In such a case, control should provides 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.

10. Lubrication

Vertical Turrets are lubricated for life, using Kluber Isoflex Grease.

If the turret is opened for servicing, all internal components should be thorougly cleaned; and relubricated with grease; before re-assembly.

Following grease is recommended;

Kluber Isoflex NBU 15.

11. Adjustment of rotary encoder

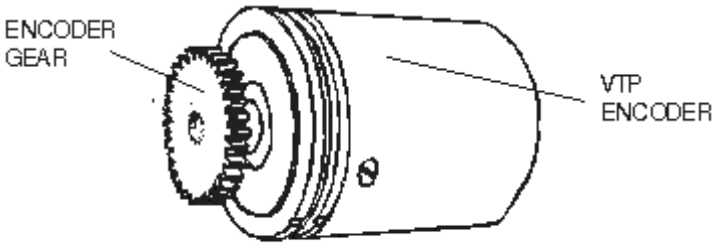


Fig 10.1

1. Hand crank the turret, and clamp it in position No. 1 (Refer 'hand cranking' page 10). Clamped position of the turret is sensed by Increased load on the hand lever, ultimately reaching a dead stop.

2. Check that the line mark on the face of gear is in line with the line mark on encoder shaft; as shown in the figure.

3. Align the orientation line mark on gear to white orientation mark on the body of encoder.

4. Hold the encoder assembly just above its sealing position, and align the orientation mark on encoder with orientation mark on the mounting block.

5. Carefully insert the encoder into its sealing position, so that encoder gear (12) meshes with pinion (11). Align the encoder mark, and clamp the encoder loosely in position.

6. Supply 24 VDC power to the encoder and observe the encoder outputs. Slowly rotate encoder in its position, and observe the 'clamp' signal. Clamp the encoder, so that it is rougly in the middle of clamp signal. At this point, encoder signals should indicate position No. 1; and clamp signal should be 'ON'.

7. Hand crank the turret in clockwise direction of next indexing 'Clamp' signal of encoder should remain 'ON' for at least one full revolution of motor shaft.

   Hand crank the turret, and clamp it in position No. 2. Observe the encoder signals and confirm that they are as per expectation.

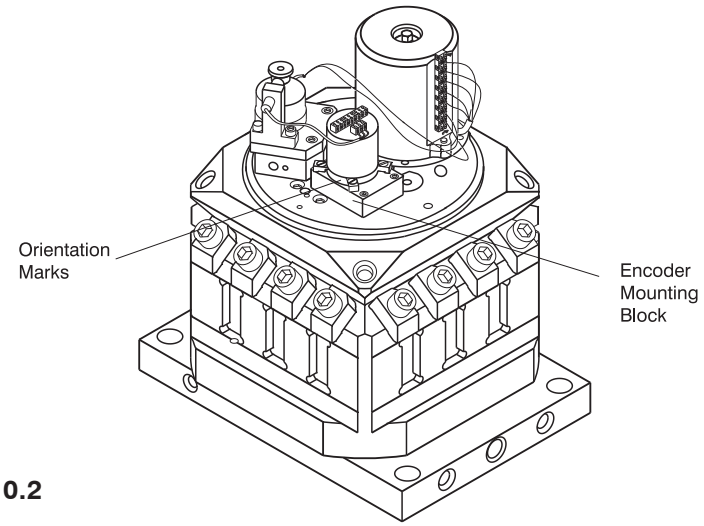


Fig 10.2

12. Adjustment of proximity switch

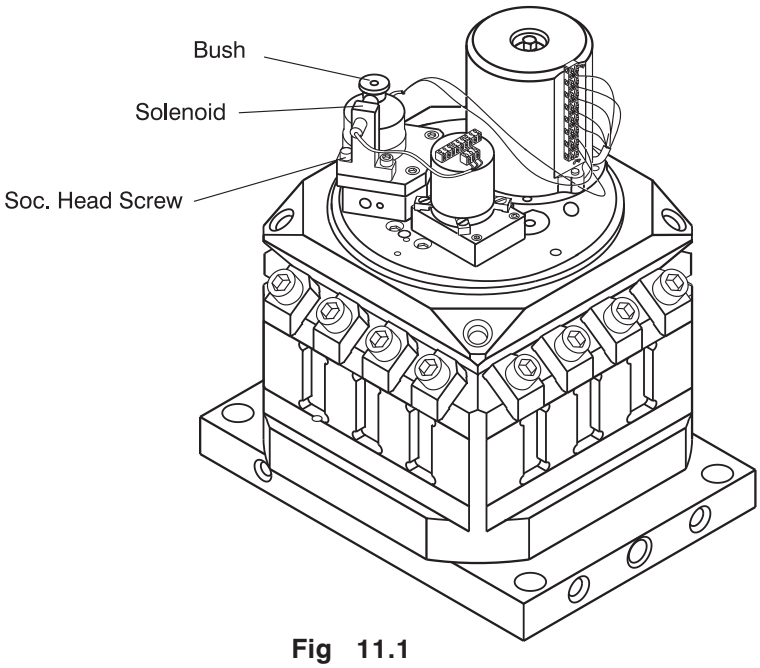


Fig 11.1

Proximity switch is mounted inside the plunger housing block with the help of a clamp.

To replace the proximity switch :

1. Release screw (93) and take out proximity switch along with its clamp (90).

2. Replace proximity switch in its clamp, taking care that length (L=23 mm) is maintained. Do not overlighten screw (89), otherwise the switch can get damaged.

3. Place the proximity clamp, along with proximity switch back into position. Push and release the solenoid plunger by hand to confirm proper functioning of the proximity switch.

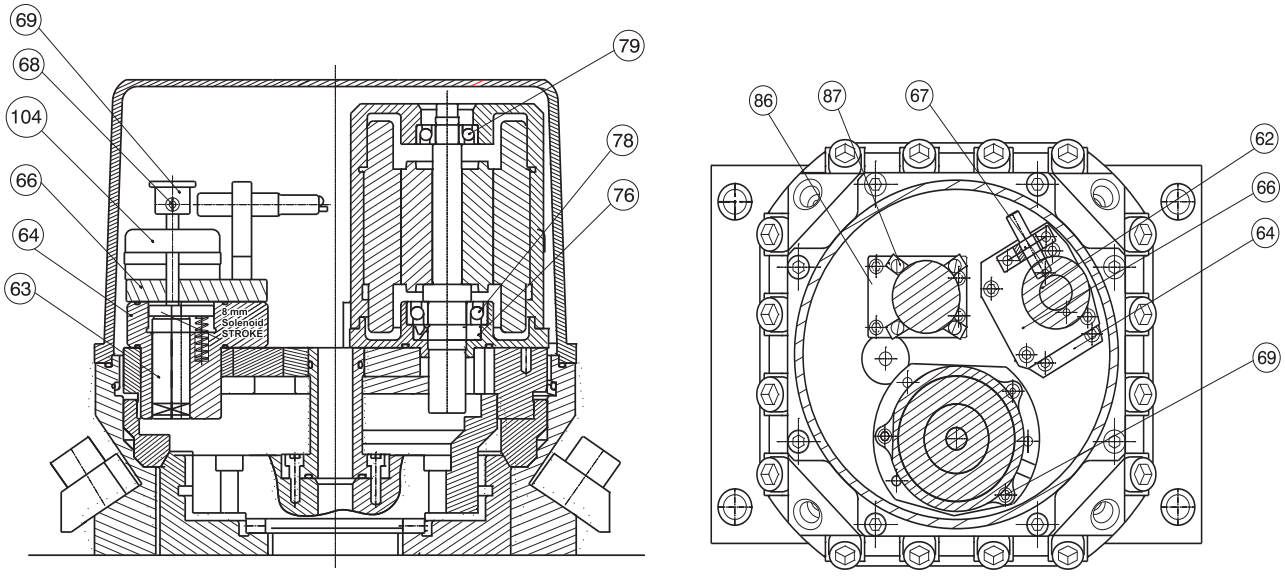


Fig 11.2

12. Assembly drawings

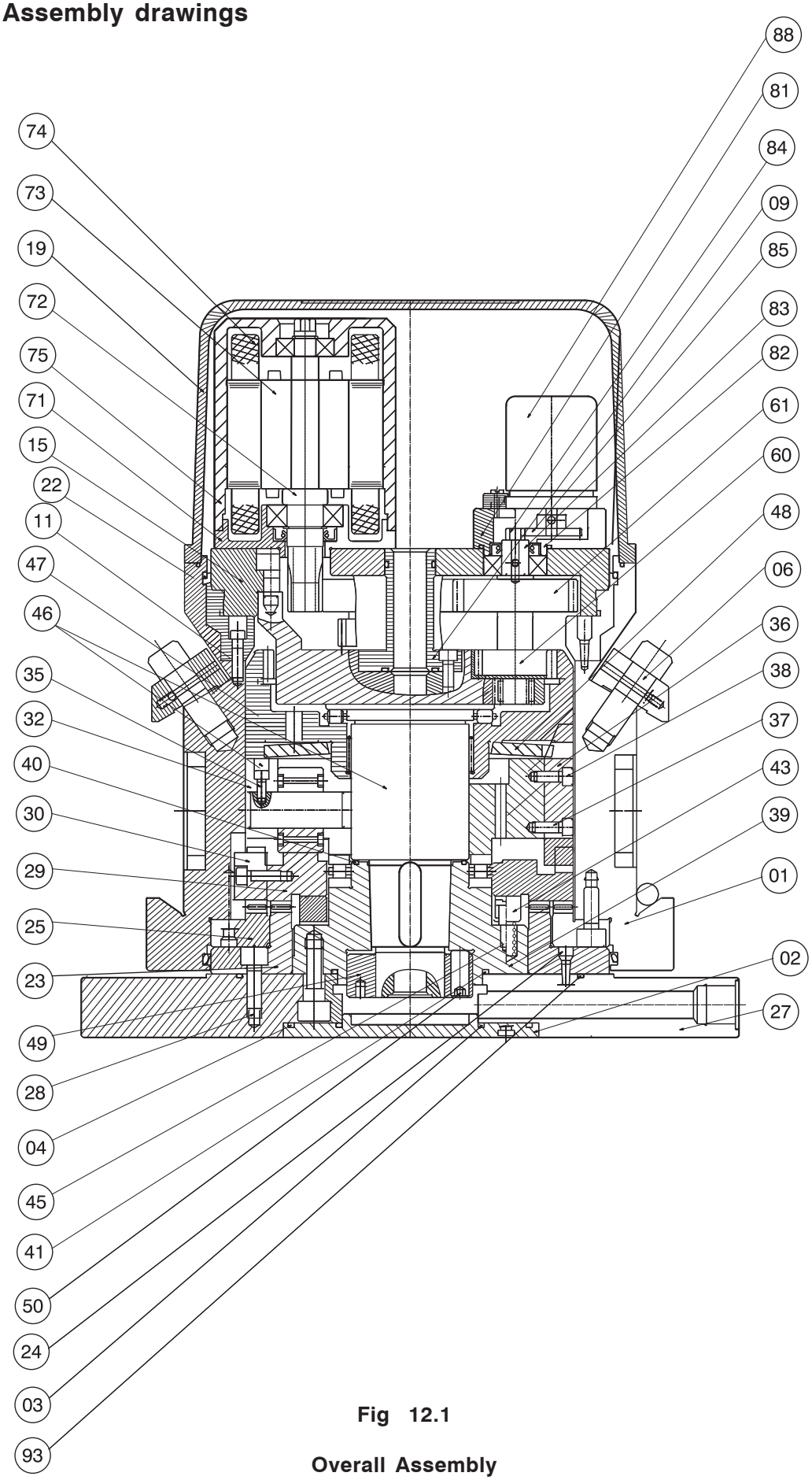


Fig 12.1

Overall Assembly

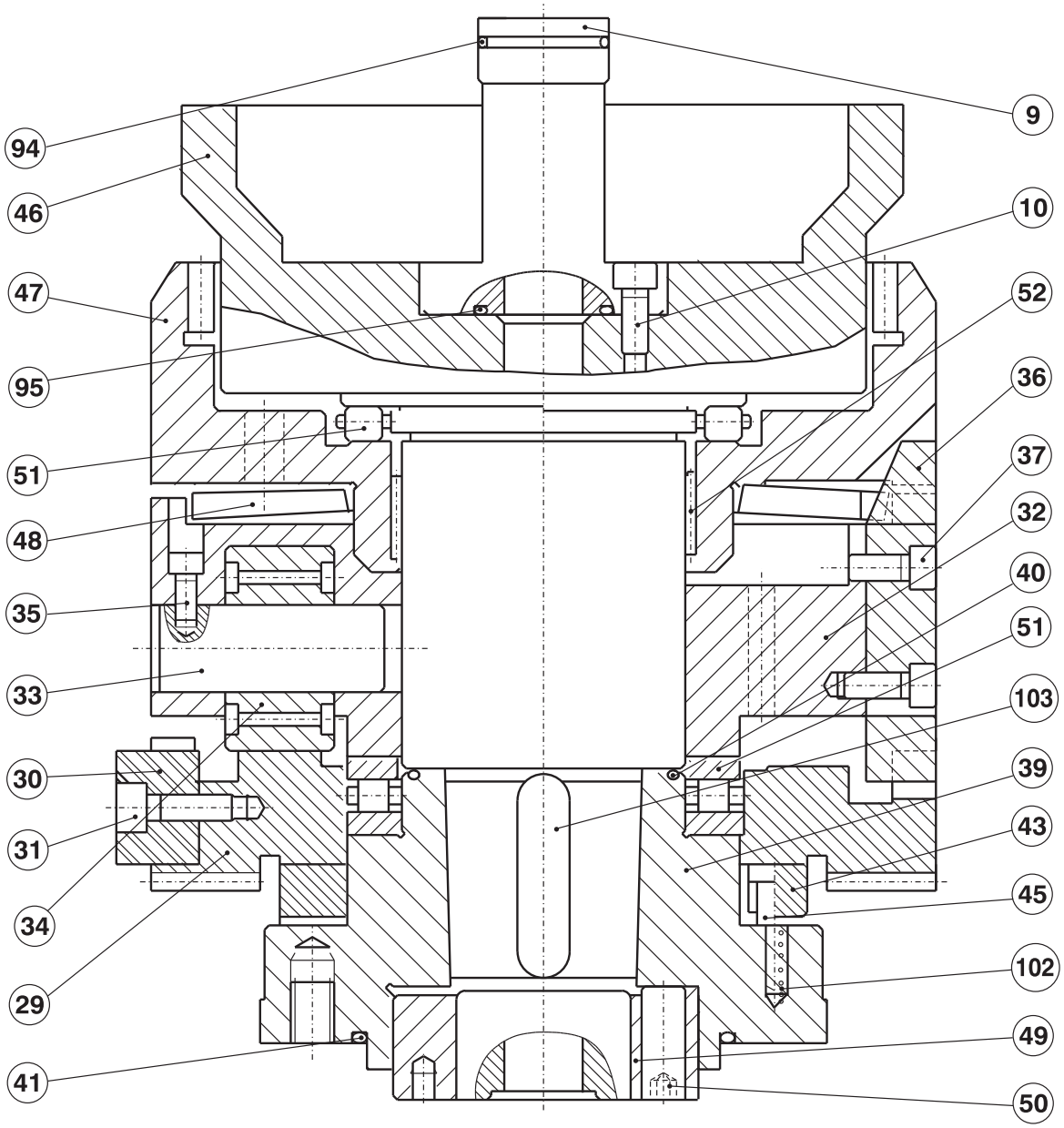


Fig 12.2

Spindle Assembly

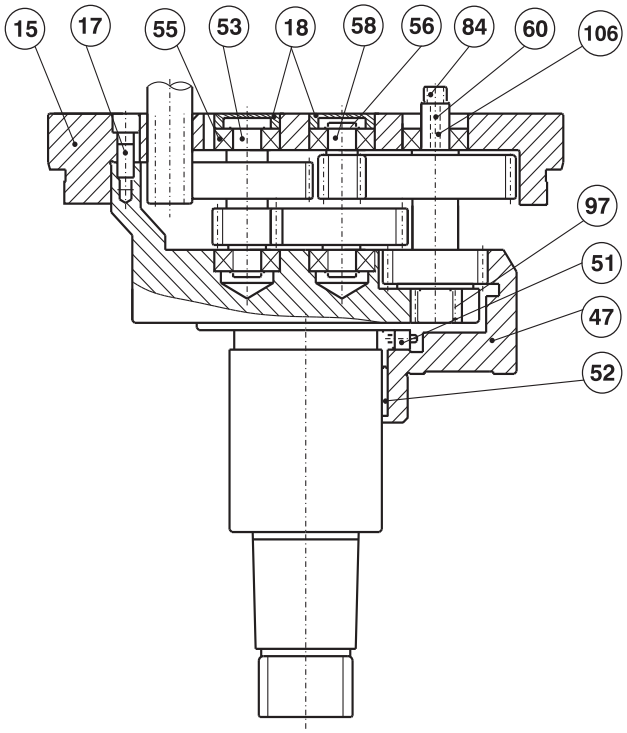


Fig 12.3

Gear Box Assembly

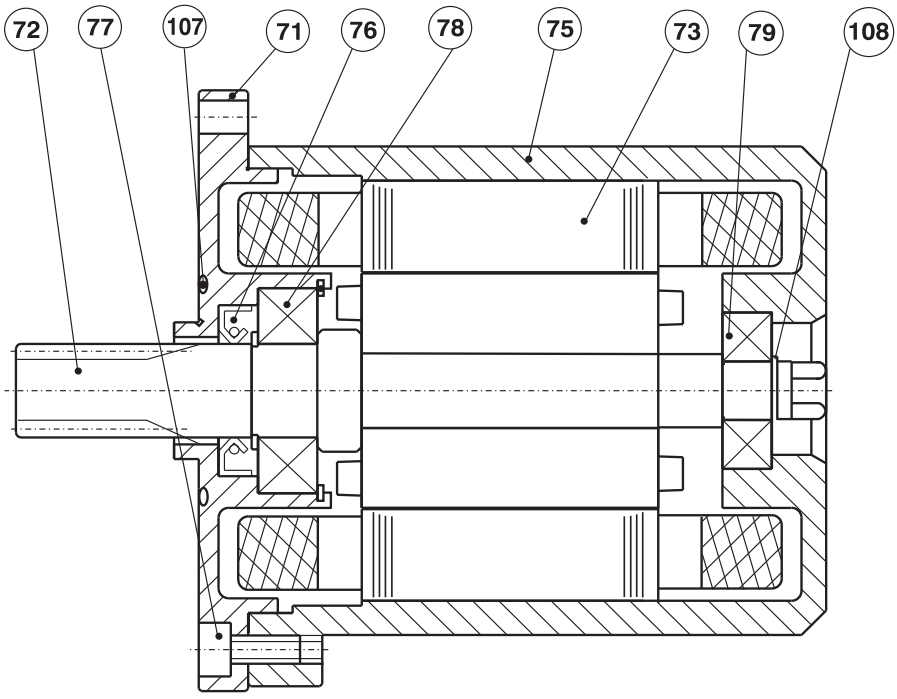
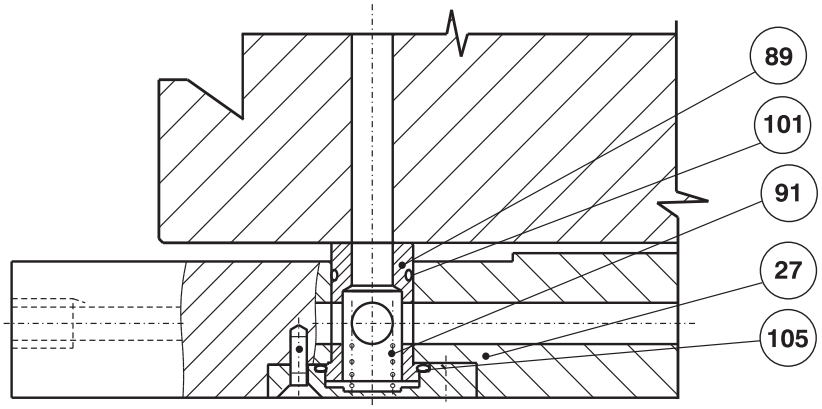


Fig 12.4

Motor Assembly



Spring loaded valve for coolant connection from base plate to turret body.

Fig 12.5

Coolant Poppet Assembly

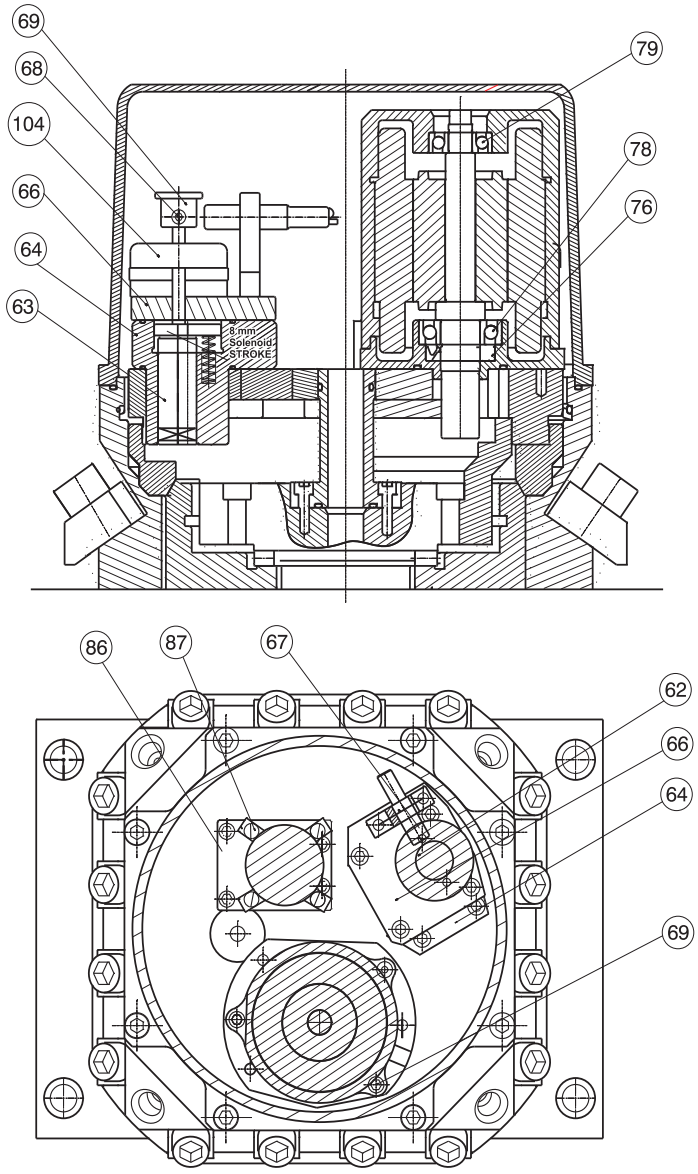


Fig 12.6

Solenoid and Plunger Housing Assembly

14 List of VTP Parts :

Sl. No.	Description	Make	Final Size	Quantity
1	Main Body	Pragati	Pragati	1
2	Bottom Cover	Pragati	Pragati	1
3	O - Ring	Pragati	75 x 81.8 x 1.8	1
4	O - Ring	Pragati	127 x 136.8 x 1.8	1
5	Soc. Hd. Screw	High Tensile (GRADE)	M 5 x 15	4
6	Clamp	Pragati	Pragati	16
7	Clamp Spring	Spring Steel	Ø 0.5 x Ø 6 x 9.8	16
8	Clamp Bolt M 16 x 1.5	Pragati	Pragati	16
9	Cable Duct	Pragati	Pragati	1
10	Soc. Head Screw	High Tensile (GRADE)	M 5 x 20	4
11	Solenoid Ring	Pragati	Pragati	1
12	Cyl. Pin	EN 353	Ø 8H8 x 30	2
13	Key For Solenoid Ring	Pragati	Pragati	2
14	Soc. Head Screw	High Tensile (GRADE)	M 6 x 20	12
15	Top Plate	Pragati	Pragati	1
16	Cyl. Pin 6H 8 x 42	Pragati	Ø 6H8 x 42	1
17	Soc. Head Screw	High Tensile (GRADE)	M 8 x 30	8/7
18	Bearing Cover	Pragati	Pragati	2
19	Top Dome	Pragati	Pragati	1
20	Soc. Head Screw	High Tensile (GRADE)	M 5 x 15	4
21	Turcon Seal	Pragati	220 x 228.8 x 6	1
22	Turcon Seal	VAKO	220 x 228.8 x 6	1
23	Fixed Coupling	Pragati	Pragati	1
24	Cyl. Pin	EN 353	Ø 6H 8 x 20	2

Sl. No.	Description	Make	Final Size	Quantity
25	Rotating Coupling	Pragati	Pragati	1
26	Cyl. Pin	EN 353	¢ 8H 8 x 20	2
27	Base Plate	Pragati	Pragati	1
28	Soc. Head Screw	High Tensile (GRADE)	M 8 x 25	14
29	Sliding Coupling	Pragati	Pragati	1
30	Drive Key Short	Pragati	Pragati	1
31	Soc. Head Screw	High Tensile (GRADE)	M 8 x 20	1
32	Roller Housing	Pragati	Pragati	1
33	Roller Ping	Pragati	Pragati	3
34	Roller	Steel	Pragati	3
35	Soc. Head Screw	High Tensile (GRADE)	M5 x 16	3
36	Drive Key Long	Pragati	Pragati	1
37	Soc. Head Screw	High Tensile (GRADE)	M 6 x 16	1
38	Soc. Head Screw	High Tensile (GRADE)	M 6 x 14	1
39	Main Flange	Pragati	Pragati	1
40	O - Ring	VAKO	¢ 57 x 2	1
41	O - Ring	UNBRAKO	¢ 80 x 3	1
42	AXi Cylinder RB	Steel	¢ 65 x ¢ 90 x 18	1
43	Spring Seat	Pragati	Pragati	1
44	Spring	Spring Steel	W1.4x0D11.5x53.6	4
45	Special Screw - M6x15	Pragati	Pragati	4
46	Main Shaft	Pragati	Pragati	1
47	Internal Gear	Pragati	Pragati	1
48	Disc Spring	INA	¢ 87 x ¢ 160 x 8	1
49	Lock Nut	Pragati	Pragati	1

Sl. No.	Description	Make	Final Size	Quantity
50	Soc. Head Grub Screw	High Tension Steel	M 10 x 25	4
51	Axial Thrust Bearing	Steel	Ø 70 x Ø 95 x 18	1
52	Needle Cage Bearing	Steel	Ø 65 x Ø 70 x 20	1
53	Gear Shaft II	Pragati	Pragati	1
54	Gear 2	Pragati	Pragati	1
55	Deep Groove BB	Steel	Ø 15 x Ø 35 x 11	5
56	External Circlip	C.I. Grade	Ø 23.2 x 1	4
57	Key	STD.	20 x 6 x 5	3
58	Gear Shaft III	Pragati	Pragati	1
59	Gear III	Pragati	Pragati	1
60	Gear Shaft IV	Pragati	Pragati	1
61	Gear 4	Pragati	Pragati	1
62	Solenoid Assy.	- -	- -	1
63	Plunger	Pragati	Pragati	1
64	Plunger Housing	Pragati	Pragati	1
65	Helical Spring	Spring Steel	OD 6 x W 0.7 x 30	2
66	Solenoid Mtg. Plate	Pragati	Pragati	1
67	Proximity Clamp	Pragati	Pragati	1
68	Bush	Pragati	Pragati	1
69	Soc. Head Screw	High Tension Steel	M 4 x 5	1
70	Motor Asssy.1440 Rpm	- -	- -	1
71	Motor Mtg. Flange	Pragati	Pragati	1
72	Motor Shaft	Pragati	Pragati	1
73	Rotor	Pragati	Pragati	1
74	Stator	Pragati	Pragati	1
75	Motor Housing	Pragati	Pragati	1
76	Turcon Seal	Pragati	Ø 20 x Ø 35 x 7	1
77	Soc. Head Screw	Spring Steel	M 6 x 25	3
78	Ang. Cont. BB	Steel	Ø 20 x Ø 42 x 12	1

Sl. No.	Description	Make	Final Size	Quantity
79	Ang. Cont. BB	Steel	Ø 12 x Ø 32 x 10	1
80	Encoder Assy.	SKF	- -	1
81	Encoder Mtg. Block	Pragati	Pragati	1
82	O - Ring	Pragati	Ø 35 x 2	1
83	Encoder Turcon Seal	Pragati	Ø 15 x Ø 28 x 7	1
84	Encoder Gear	Pragati	Pragati	1
85	Encoder Pinion	Pragati	Pragati	1
86	Encoder Clamp	Pragati	Pragati	4
87	Slotted Screw	High Tension Steel	M 4 x 10	4
88	Encoder	Br. Out.	-	1
89	Coolant Poppet	Pragati	Pragati	2
90	Poppet Cover	Pragati	Pragati	2
91	Coolant Spring	Spring Steel	W 1 x O8 x 12	2
92	Csk. Screw	High Tensile Steel	M 4 x 10	8
93	O - Ring	Pragati	Ø 185 x 2.5	1
94	O - Ring	Pragati	Ø 24 x 2.5	1
95	O - Ring	Pragati	Ø 24 x 2.7	1
96	O - Ring	Pragati	Ø 232 x 2.5	1
97	Drawn Cup Needle R8	Steel	Ø 15 x Ø 21 x 12	1
98	Hose Connector Block	Pragati	Pragati	1
99	Name Plate	Aluminium	Pragati	1
100	Liting Bar	Pragati	Pragati	2
101	O - Ring	Pragati	16 x 2	2
102	Spring	Pragati	12 x 10 x 55	3
103	Key	Pragati	45 x 12 x 10	1
104	Solenoid	Pragati	Pragati	1
105	O - Ring	Pragati	22 x 2	1
106	Grub Screw	Pragati	M 5 x 5	1
109	O - Ring	Pragati	40 x 25	1
108	Exl. Circlip	Pragati	Ø 11 x 1,1	1

LIST OF SPARE PARTS FOR VTP - 250, VTP - 200, VTP - 160

No.	*Part Name*	*Part No.*	*Assembly Reference*	*Qty*	*Drg. No.*	*Page No.*
			GROUP 'A' SPARES			
1	Electric Motor	-	Motor Assembly	1	12.4	18
2	Encoder	09	Main Assembly	1	12.1	16
3	Proximity Switch	91	Main Assembly	1	12.1	16
4	Cam follower roller	44	Spindle Assembly	3	12.2	17
			GROUP 'B' SPARES			
1	Oil Seal	77	Motor Assembly	1	12.4	18
2	Seal Ring	98	Brass poppet Valve Assembly	12	12.5	19
3	'O' Ring	45	Spindle Assembly	1	12.2	17
4	'O' Ring	62	Spindle Assembly	1	12.2	17
5	'O' Ring	70	Spindle Assembly	1	12.2	17
6	'O' Ring	40	Spindle Assembly	1	12.2	17
7	'O' Ring	75	Motor Assembly	1	12.4	18
8	'O' Ring	22	Main Assembly	1	12.1	16
9	'O' Ring	52	Main Assembly	1	12.1	16
10	'O' Ring	56	Main Assembly	1	12.1	16
11	'O' Ring	54	Main Assembly	1	12.1	16
12	'O' Ring	92	Solenoid Plunger Assembly	2	12.1	20
			GROUP 'C' SPARES			
1	'O' Ring	94	Coolant Poppet Assembly	2	12.5	19
2	'O' Ring	104	Coolant Poppet Assembly	2	12.5	19
3	Spring	95	Coolant Poppet Assembly	2	12.5	19