

SHARP

VERTICAL BED TYPE MILLING & BORING MACHINE

KMA-1, KMA-2, KMA-3, KMA-3H
OPERATION MANUAL



MODEL KMA-3

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1. General instruction of machine

1-1 Specifications

(KMA-1)

Table 1

| | |
|---|--|
| CAPACITY | |
| Table Travel (longitudinal) | 1000mm(39-3/8 inch) |
| Table Travel (cross) | 380mm (14-15/16 inch) |
| Vertical spindle head travel(Vertical) | 500mm (19-11/16 inch) |
| Vertical spindle nose to table top | 100-600mm(3-15/16~23-5/8 inch) |
| Vertical spindle center to column front | 380mm (14-15/16 inch) |
| TABLE | |
| Table working area | 1700 x 380mm (67 x 14-15/16 inch) |
| T slot (Wide x No. x Pitch) | 18mm x 5 x 70mm (0.709 x5 x2-3/4 inch) |
| Table top to floor | 800mm(31-1/2 inch) |
| SPINDLE HEAD | |
| Spindle Nose | ISO R297 No.50 |
| Vertical Spindle speeds | 45-1500RPM (60Hz) 35-1250RPM (50Hz) |
| No. of Vertical spindle speed | 12 steps |
| Feeds (Vertical spindle) | 0.05-0.2(0.002-0.008)mm/rev(ipr) |
| FEED | |
| Rapid traverse (longitudinal & cross) | 2880mm/min (60Hz) 2400mm/min (50Hz) |
| Feed rates (longitudinal & cross) | 28-1000mm/min |
| Change of feed | Infinitely variable |
| MOTORS | |
| Vertical spindle | AC5.5kW (7-1/2HP)-4P |
| Feed | AC SERVO 1.3kW |
| Lubrication | 3.5W-2P |
| Cutting fluid | AC0.1KW (1/8HP)-2P |
| MACHINE SIZE | |
| Machine height | 2410(94-7/8)mm(in) |
| Floor space (longitudinal x cross) | 3200x1960(126x78)mm(in) |
| Net weight (approx.) | 4000(8,800)kgs(lbs) |
| Standard color | Gray |

Standard accessories:

- | | |
|----------------------------|--------|
| 1. Cutting fluid equipment | 1 unit |
| 2. Hand tool | 1 set |
| 3. Leveling block | 6 pcs. |
| 4. Leveling bolt & nut | 6 pcs. |
| 5. Draw-in bolt | 1 pc. |

Optional accessories:

- | | |
|---------------------|-------------------|
| 1. Digital read out | 2. Power draw bar |
|---------------------|-------------------|

1-2 Main dimension

Fig.1 The dimension of vertical boring & milling machine

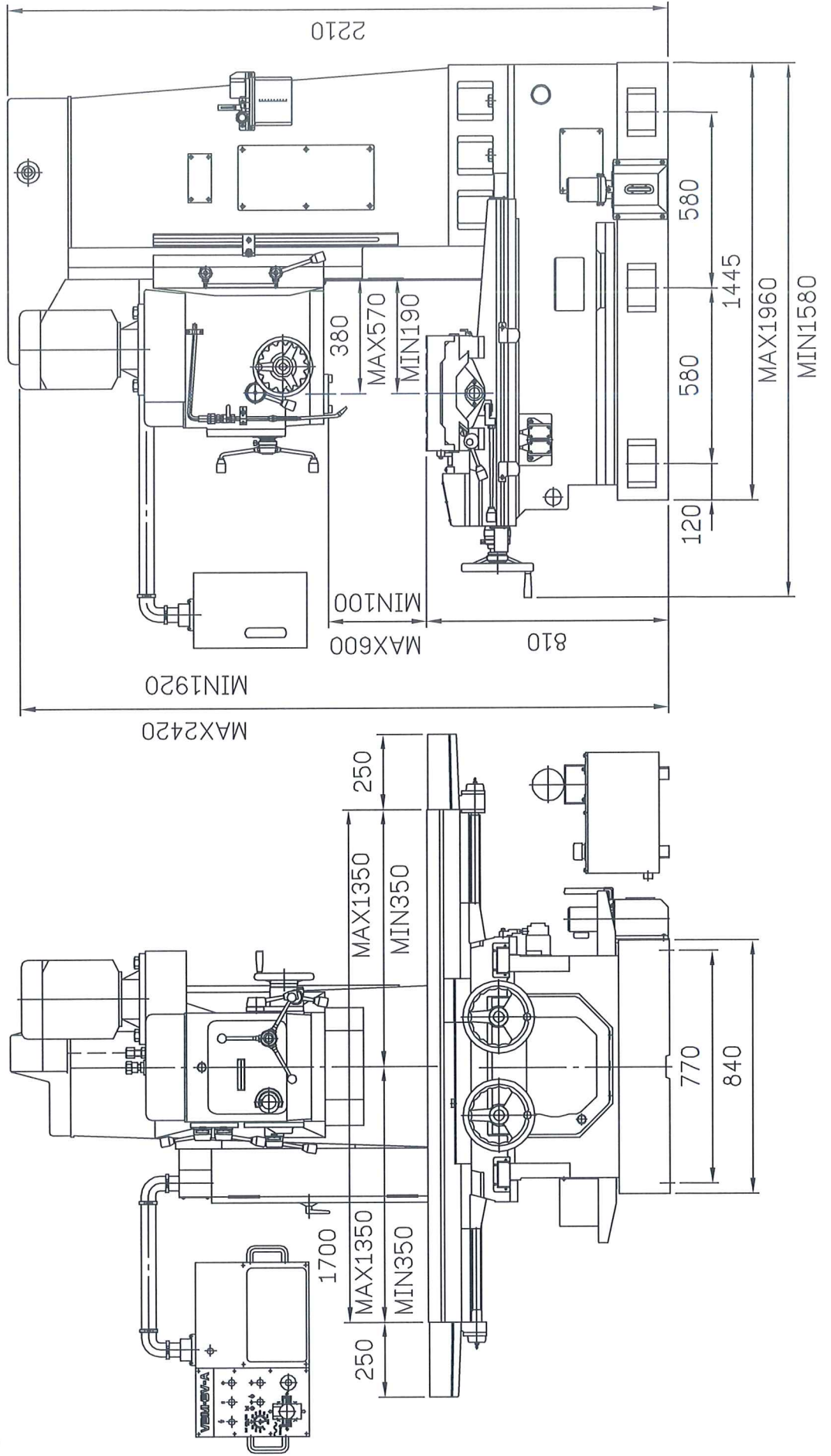


Fig. 2 Dimension of table

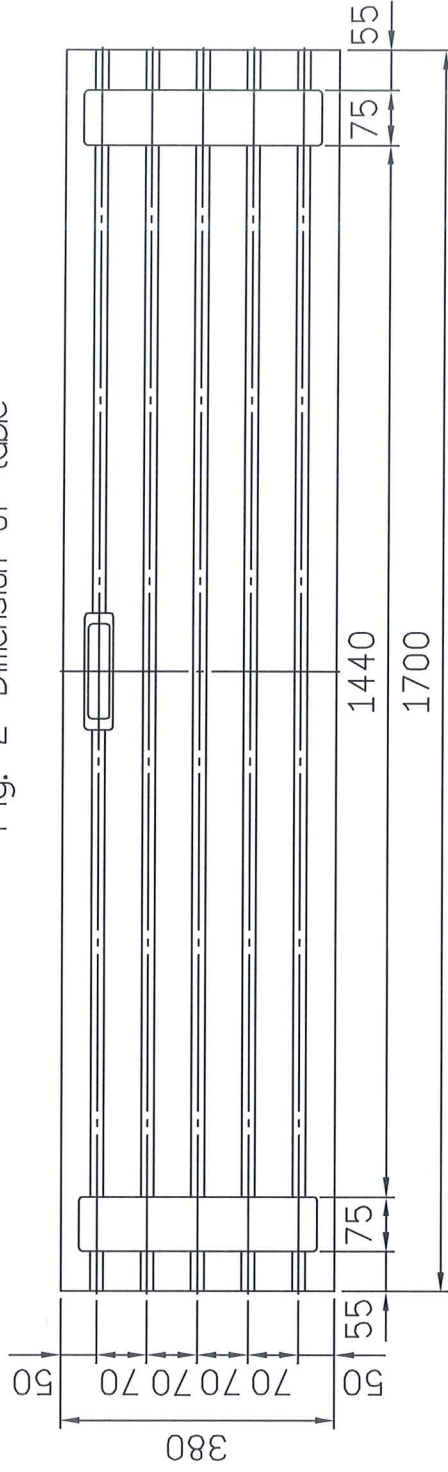


Fig. 3 Dimension of T-slot

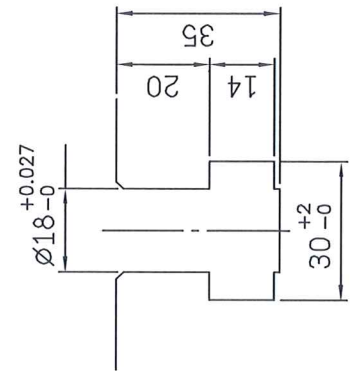
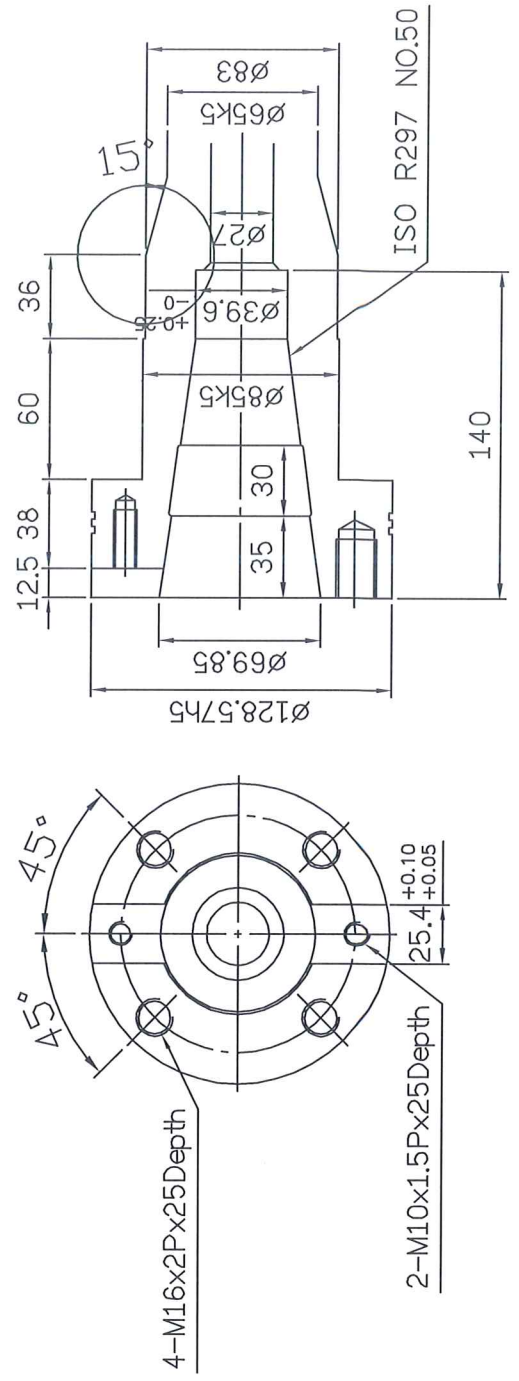


Fig. 4 Dimension of spindle nose



1-3 Name of Main parts (Fig. 5)

1. Upper cover of column
2. Column
3. Spindle head
4. Operator's box
5. 2-step speed change lever for main spindle
6. High low speed change lever for spindle
7. 3-step speed change lever for spindle head
8. Automatic feeding speed change knob for spindle head
9. Side cover of table
10. Lead screw of table feed
11. Working table
12. Clamping lever of working table
13. Saddle
14. Electrical wiring box
15. Oil pump for table and saddle sliding surface
16. Gear box
17. Bed
18. Limit switch for saddle feed stop
19. Cutting fluid pan
20. Motor for main spindle
21. Clamping lever for main spindle
22. Rapid feed hand wheel for spindle head
23. Micro feed speed change lever for spindle head
24. Micro feed hand wheel for spindle head
25. Automatic feed speed change lever for spindle head
26. Cutting fluid valve
27. Feed hand wheel for working table
28. Cutting fluid pump
29. Oil tank
30. Motor for lubrication
31. Oil feeding pump for sliding surface of spindle head

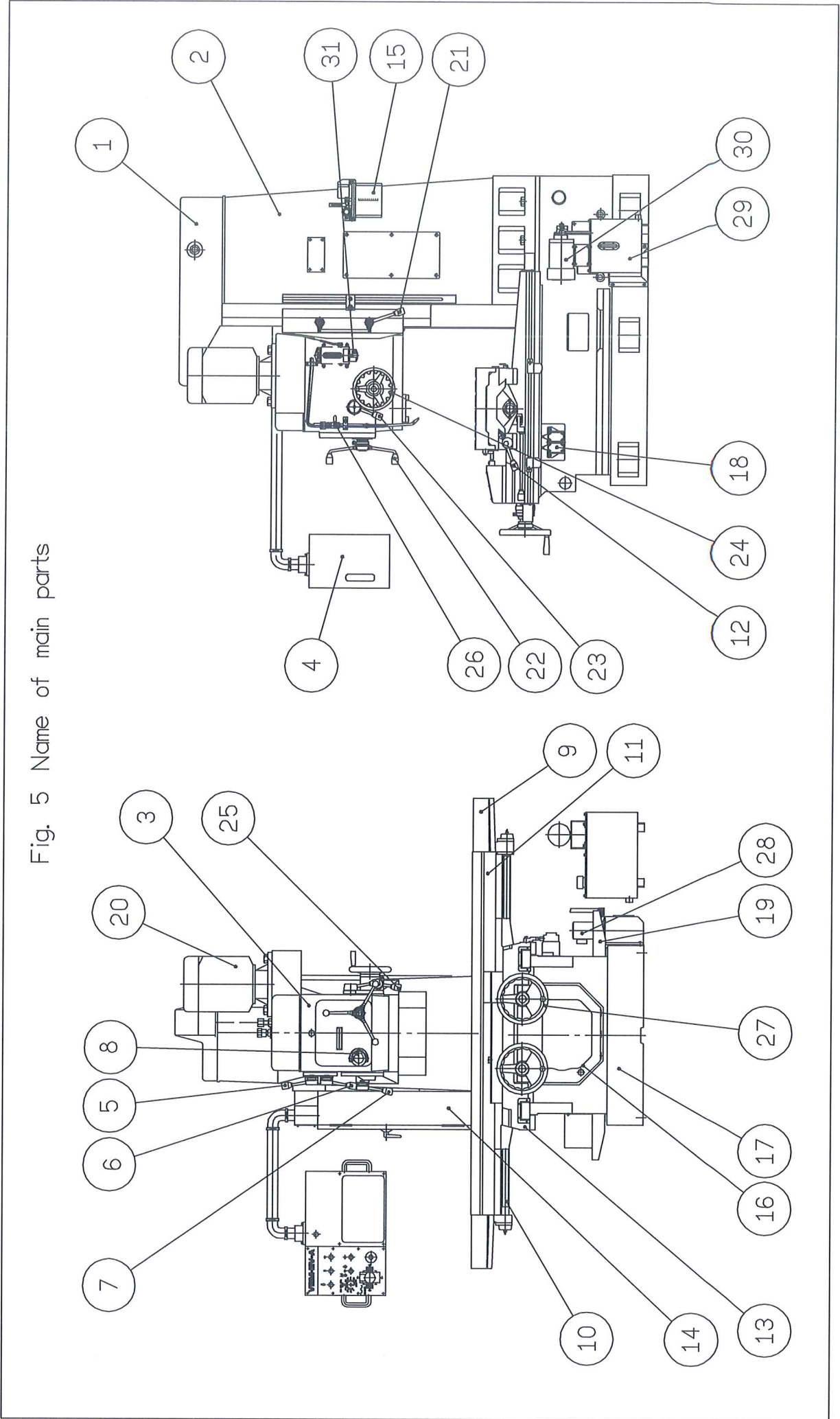

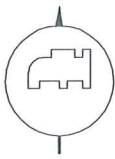


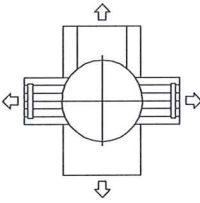
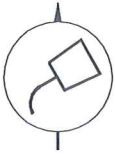


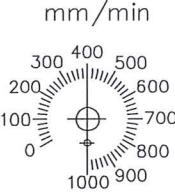



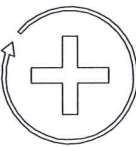
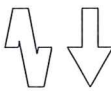

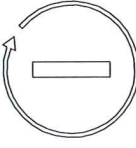


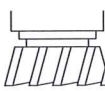
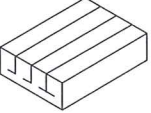


Fig. 5 Name of main parts

1-4 Symbols (Table 2)

Table 2 Symbols

| Symbols | Description | Symbols | Description |
|---|--|---|--|
|  | Starting switch "on" |  | Cutting fluid pump |
|  | The switch is "ON" while depressed | | |
|  | Stopping switch "off" | | |
|  | Automatic longitudinal and transverse feed |  | Lubricant pump |
| | |  | Danger (Electrical device) |
|  | Rapid feed |  | Automatic longitudinal and transverse feed |
|  | Normal feed | | |
|  | Low speed feed |  | Automatic vertical feed |
|  | Increase of spindle speed |  | |
| | |  | Feed amount per rotation |
|  | Decrease of spindle speed |  | Feed amount per minute |
| | |  | Revolutions per minute |
|  | Main spindle |  | Working table |

2. Installation of the machine

2-1 Transportation (Fig. 6)

Fix every part of the machine before hanging it. Especially pay attention to the fixation of spindle head and balancing weight (1).

Put the balancing weight at the position of side window of column by using the hand wheel for spindle head rapid feed (2). Then use bolts (3) to fix balancing weight from the holes of window.

Place the table to the middle position of machine, and move saddle close to the side of column. Move spindle head about 50mm upward by hand wheel for spindle head rapid feed and insert the support bar (4) between table and spindle head, hence the chain (7) is at loose condition. Both end of support bar should be cushioned with cloth or rubber to avoid unnecessary damage of machine.

Clamp saddle, table and spindle head in sequence in order to improve the stability of spindle head, and make the operating rapid feed lever, micro feed speed change lever(5) and automatic feed lever (6) in "feed" position. Use steel rope to lift the machine shown on (Fig. 6). Cloth or rubber should be cushioned between the rope and machine surface. Steel rope should not be touched the weak parts of the machine.

2-2 loosening the different units of machine (Fig. 6)

After the transportation is completed. Loosen the different units of the machine and be careful to remove the support bar & to stretch the chain (7) slowly. Put the automatic feed lever (6) of spindle head in loose condition, rapid and micro feed lever (5) in "feed" position. Loosen the clamp (8) of spindle head. At this time, check the chain whether contact the sprocket (9) tightly or not due to transportation.

Before removal of support bar and the chain in good condition. Grasp the hand wheel (12) of spindle head micro feed to move the spindle head upward for removing the support bar. Then move the spindle head downward slowly and smoothly until the chain is properly stretched.

Note: The chain cannot stand impact load or it would be broken.

Examine the chain in good condition once more, then loosen and remove the bolts (side window of column) for fixed balancing weight. But remember during spindle head downward before chain is stretched, the bolts of fixed balancing weight is absolutely not allowed to take out. Finally loosen the clamp of the saddle and table (10) (11).

2-3 Leveling and foundation (Fig. 7)

The machine can be located at 200mm thick concrete floor or set on 350mm thick concrete foundation, to ensure the accuracy of the machine and prevent cutting vibration.

Shown on (Fig. 7) move the table to the middle position and clamp spindle head at the middle position of the column , then put the precision level (accuracy 0.02-0.05mm/1000mm) on the table to adjust the leveling of machine . After finishing the leveling. Pour the concrete into the anchor bolt holes , tighten the bolt after the concrete is completed rigid , check the machine leveling once more , clean the machine base (sands & scraps ets) then pour concrete between machine base and floor.

2-4 Cleaning the machine

The machine is protected by grease or antirust oil before shipment. But the machine should be cleaned with gasoline before putting the protecting oil.

2-5 Removal of pad-bond coating agent

The covers should be applied with pad-bond coating agent if need be. During taking them apart and putting them together again, you should remove all of the used pad-bond coating agent and replace with new ones .

Fig. 6 Method of lifting the machine

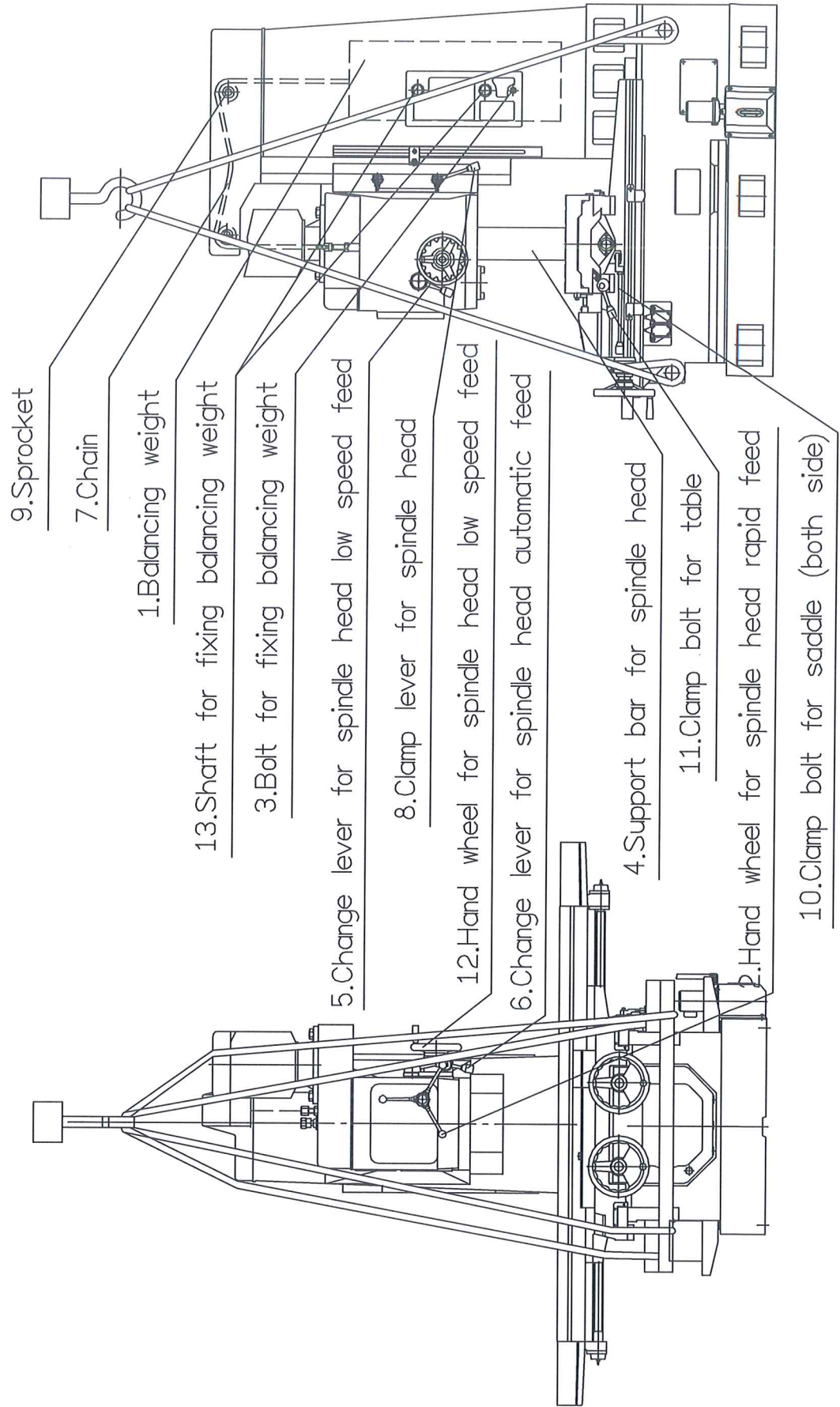
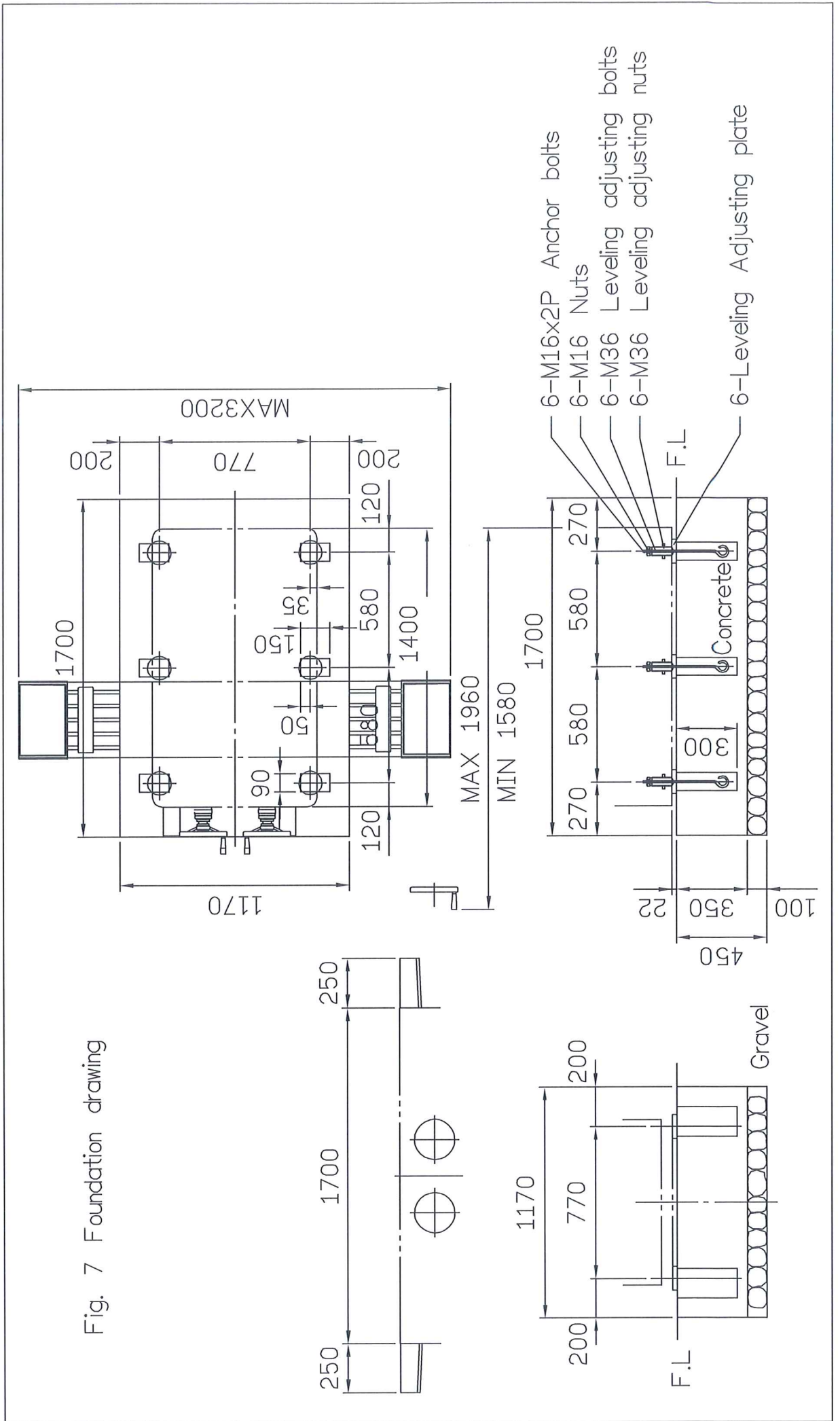


Fig. 7 Foundation drawing

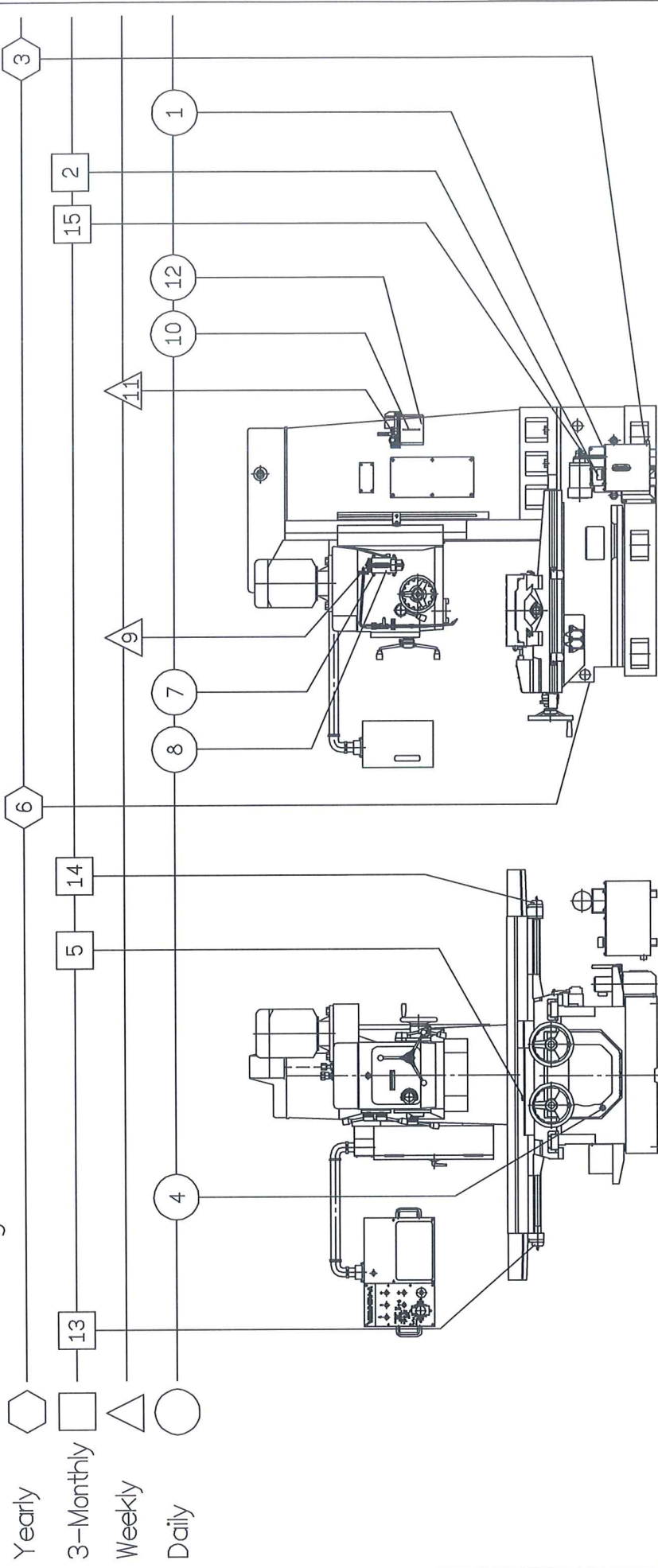


3. Lubrication

3-1 Refer to (Fig. 8 & 9 and table 3 & 4)

Check all of the lubricating portions of the machine which should be applied with suitable amount of oil in compliance with the regulation. When the machine is in operation, inspect again all of the moving parts in good lubricating condition in order to ensure the superior function.

Fig 8 Table of mechanical lubrication



| Machine Component | Spindle Head Gears | | Gear Box | | Spindle Head & Slide Ways | | Slide Ways & Feed Screw | | Bearing For Lead Screw | Oil Filter | | | | | |
|-------------------|--------------------|--------|----------|--------|---------------------------|--------|-------------------------|--------|------------------------|------------|--------|--------------------|--------|--------|------------------|
| Action Points | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Item | Symbol | Symbol | Symbol | Symbol | Symbol | Symbol | Symbol | Symbol | Symbol | Symbol | Symbol | Symbol | Symbol | Symbol | Symbol |
| Check | Daily | | | Daily | | | Daily | | | Daily | Weekly | Daily | | | |
| Fill | | 3-M | | | 3-M | | | | | | | | | 3-M. | |
| Clean & Replace | | | Yearly | | | Yearly | | | | | | | | | |
| Clean & Replace | | | | | | | | | | | | | | | |
| Lubricant | | CB32 | | | CB32 | | | | | | G68 | | | XM2 | |
| Quantity | | 6L | 12L | | 1.2L | 5L | | 0.02L | 0.3L | | 0.5L | 0.02L | Drops | Drops | |
| Remarks | | | | | | | Furnished Oil Hand | | | | | Furnished Oil Auto | | | On The Back Side |

TABLE 3 Instruction for correct lubricant

| | Application Fields | Properties | Symbol and Viscosity Grade | Kinematic Viscosity CST(40°C) | | | REMARKS |
|-------------------|---|--|----------------------------|-------------------------------|----------------------|----------------------|---|
| | | | | Mean. | min. | max. | |
| GEARS | Enclosed moderately loaded gear (spur gear, bevel gear) | Refined mineral oils with good oxidation stability | CB 32 CB 68 CB 150 | 32 68 150 | 28.8 61.2 135 | 35.2 74.8 165 | Pinion speeds(motor output) 2000-5000 rpm(within 3.7kw) 1000-2000 rpm(within 7.5kw) -1000 rpm(within 15kw) |
| | Enclosed heavily loaded gears (worm and wheel) | Refined oils with good oxidation stability and with improved load-carrying ability | CC 150 CC 320 CC 460 | 150 320 460 | 135 288 414 | 165 352 506 | Worm speeds 2000- rpm 1000-2000 rpm -1000 rpm |
| | Spindles bearings and associated clutches | Refined mineral oils with superior anticorrosion and anti-oxidation performances. | FC 2 FC 10 FC 22 | 2.2 10 22 | 1.98 9.00 19.8 | 2.42 11.0 24.2 | Shaft speeds(shaft dia) 10000- rpm(-30mm) 2000-10000 rpm(30-150mm) -2000 rpm(150- mm) |
| SLIDEWAYS | Slide ways | Refined mineral oils with improved lubricity and tackness performance preventing stickslip | G 68 G 220 | 68 220 | 61.2 198 | 74.8 242 | Slide way(surface pressure) Horizontal(under 4kgf/cm ²) Vertical(under 4kgf/cm ²) |
| | | | HL 32 HL 68 | 32 68 | 28.8 61.2 | 35.2 74.8 | Oil temperature(Rated pressure) 0-50°C(under35kgf/cm ²) 15-65°C(under35kgf/cm ²) |
| HYDRAULIC SYSTEMS | Hydraulic systems | Refined mineral oils with superior anti-corrosion, anti-oxidation and antiwear performances. | HM 32 HM 68 | 32 68 | 28.8 61.2 | 35.2 74.8 | Oil temperature(Reted pressure) 0-50°C(under140kgf/cm ²) 15-65°C(under140kgf/cm ²) |
| | | | HG 32 HG 68 | 32 68 | 28.8 61.2 | 32.2 74.8 | Oil temperature(Reted pressure) 0-50°C(under70kgf/cm ²) 15-65°C(under70kgf/cm ²) |
| GREASE | Hydraulic and Slide ways | Premium quality greases with superior anti-oxidation and anti-corrosion properties. | XM 1 XM 2 | 310 - 340 265 - 295 | Viscosity (25°C) SSU | | Centralized systems Cup or hand gun |

| TABLE 4 THE GENERAL LUBRICANTS FOR MACHINE TOOL | | | | | | |
|---|--------|----------------------------|---------------|------------------|----------------------|--------------------------|
| | SYMBOL | CPC | ESSO/EXXON | SHELL | MOBIL | DAPHNE |
| Gears | CB32 | R32 | Teresso 32 | Tulus Oil C32 | DTE Oil Light | Mechanic Oil 32 |
| | CB68 | R68 | Teresso 68 | Tulus Oil C68 | DTE Oil Heavy Medium | Mechanic Oil 68 |
| | CB150 | R150 | Teresso 150 | Tulus Oil C150 | DTE Oil Extra Heavy | Mechanic Oil 150 |
| | CC150 | R150 | Spartan EP150 | Omda Oil 150 | Gear 629 | CE Compound 150S |
| | CC320 | R320 | Spartan EP320 | Omda Oil 320 | Gear 632 | CE Compound 320S |
| | CC460 | R460 | Spartan EP460 | Omda Oil 460 | Gear 634 | CE Compound 460S |
| Bearings | FC2 | | | High Spin Oil C2 | Velcrite Oil NO.3 | Mechanic Oil 2 |
| | FC10 | R12 | Spinesso 10 | Telus Oil C10 | Velcrite Oil NO.6 | Mechanic Oil 10 |
| | FC22 | R22 | Spinesso 22 | Telus Oil C22 | Velcrite Oil NO.10 | Mechanic Oil 22 |
| Slide Ways | G68 | Slide way oil | Febis K68 | Tonna T68 | Vactra Oil NO.2 | Multiway 68C |
| | G220 | Slide way oil | Febis K220 | Tonna T220 | Vactra Oil NO.4 | Multiway 220C |
| Hydraulic System | HL32 | R32 | Teresso 32 | Telus Oil C32 | DTE Oil Light | Hydraulic Fluid 32 |
| | HL68 | R68 | Teresso 68 | Telus Oil C68 | DTE Oil Heavy Medium | Hydraulic Fluid 68 |
| | HM32 | 32AW | Nuto HP32 | Telus Oil 32 | DTE 24 | Super Hydraulic Fluid 32 |
| | HM68 | 68AW | Nuto HP68 | Telus Oil 68 | DTE 26 | Super Hydraulic Fluid 68 |
| | HG32 | | Powerex DP32 | Tonna Oil T32 | Vacuoline Oil 1405 | Multiway 32 |
| | HG68 | | Powerex DP68 | Tonna Oil T68 | Vacuoline Oil 1408 | Multiway 68 |
| Grease | XM1 | Gulfarown Grease E.P. NO.1 | Listan 1 | Alvania Grease 1 | Mobiluz EP1 | Cornex Grease NO.1 |
| | XM2 | Gulfarown Grease E.P. NO.2 | Listan 2 | Alvania Grease 2 | Mobiluz 2 | Cornex Grease NO.2 |
| C.P.C. China Petroleum Co. , Ltd. | | | | | | |

4. Cutting fluid pump device (Fig. 10)

Cutting fluid pump (P1) located on the right side of machine is operated by witch button (P2) on the operation panel. It will rotate in left position together with spindle or rotate in right position by itseIf. Volume of cutting fluid is about 8 Gal, injected from pan (P3) until the gauge (P7) reaches the upper limit. Release the plug (P8) to change the cutting fluid.

Cutting fluid nozzle (P6) s located on the right side of spindle head, held by nozzle clamper (P4). The nozzle direction is adjustable and easy to take apart. The injection quantity is controlled by a valve (P5), increased in counterclockwise, and decrease in clockwise.

To the spindle head

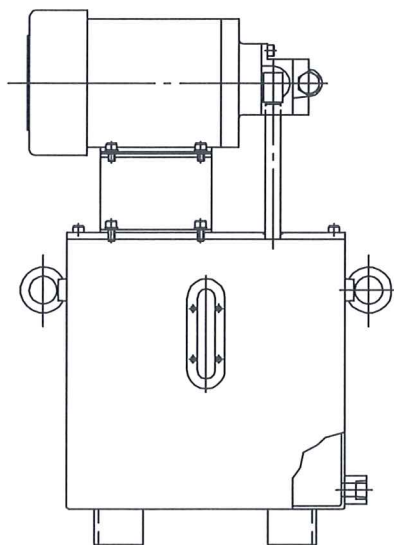
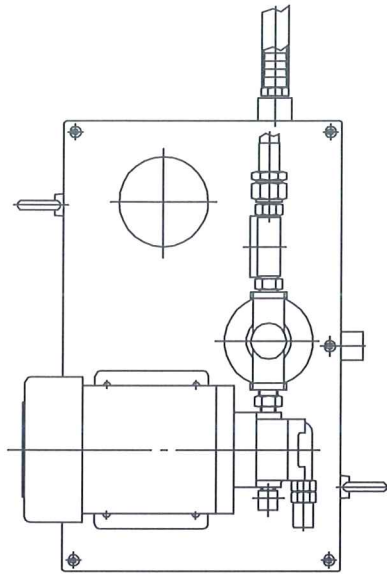
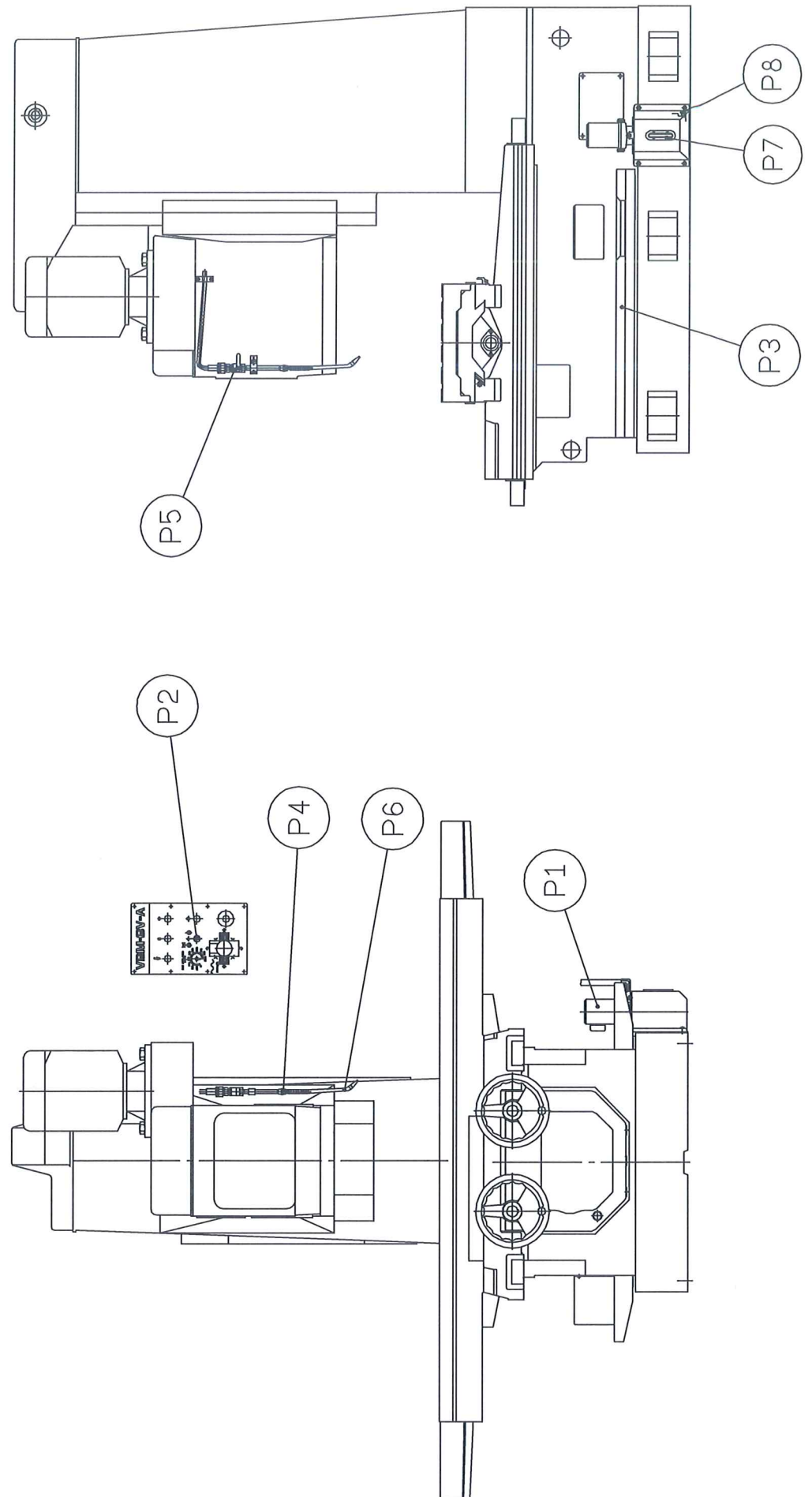


Fig. 9 Configuration of lubricant pump

Fig. 10 Cutting fluid pump system



5. Running Operation

5-1 Preparation for operation

1. Before starting this machine, you should clean up the following items; (a) sliding surfaces (b) circumference and bore of spindle (c) table surface.
2. According to oil recommendation (Fig. 8 Table 3, 4) check the amount oil storing in various vessels and inspect the lubricating condition of different sliding parts.
3. According to the electrical wiring program (Fig. 11) .The power source (220V, 60Hz) may connect to the R.S.T. terminal board of electrical control box.
4. Push the no fuse breakers to "ON" position; the pilot lamp on control panel should be light.

5-2 Running operation of spindle (Fig. 12, 13 & 14)

Loosen the clamber of spindle head (C1) (Fig. 13) before operation, clamping in left "A" direction and unclamping in right "B" direction.

(A) Rapid feed of spindle head (by hand) Turn the hand wheel (H7) of spindle head rapid feed to right side to move spindle head downward and to left side to move it upward . 30mm displacement per revolution of hand wheel . Each graduated scale is 0.5mm on the collar (H9) of hand wheel. When the scale is calibrated to the zero point and fixed, then the reading, represents the displacement .

(B) Micro speed feed for spindle head Micro feed change lever (H6) of spindle connects to downward "B" direction and disconnects to upward "A" direction. To turn micro feed hand wheel (H8)of spindle to right side to move spindle head upward and left side to move spindle head downward . The displacement of each revolution is 3mm.

(C) The stop and start of spindle There are three switches (S2), (S3), (S4) used for control. (S2) is starting switch. (S3) is inching switch. (S4) is stopping switch.

(The rotation of spindle one direction only. It can't be reverse).

First push (S3) switch several times to make sure the spindle head lubricated inside by oil pump.

Then start the (S2) switch for normal operation. You can stop the machine by switch (S4) if necessary.

(The start and stop switches spindle would be linked with oil pump).

(D) Rotating speed change of spindle

The rotation speed change of spindle will be controlled by three change lever (H1), (H2) and (H3) positions. If you want to change the speed, first stop the motor of spindle.

If you intend to turn the main spindle by hand. First put the speed change lever (H3) in neutral position.

(E) Automatic Feed of Spindle Head

The spindle head automatically feed can be operate by the feed direction change lever (H5) and spindle head manual or automatic feed change lever (H6). Lever (H5) can select right direction downward or left direction (upward). Lever (H6) will set "A" direction for manual feed and push lever to "B" direction for automatic feed. The spindle head can automatically feed in spindle rotation, and cannot move when the spindle is stopped.

(F) Automatic feed speed change of spindle head

Speed change handle (H4) turns to the right or left for changing automatic feed speed of spindle head, and obtain 5 step feed speed . The speed change handle can be operated during the rotation of spindle or automatic feed.

(G) Stopping of spindle head automatic feed

This operation could be used only when the spindle is downward. After the adjustment of automatic feed device of spindle head is finished , push the piston rod (D2) to right "B" direction . And the stop block of spindle is fixed on determined position (Fig. 14) . The spindle head stops feed automatically when spindle head goes down to the piston rod (D2) and contact the stop block (D1).

When automatic feed stops, you can feed by hand to make the stop block (D1) and piston rod separately.

5-3 Hand feed of table and saddle (Fig. 16)

Before operation, loosen the clamping lever (C2) of table and clamping bolts (C3) of saddle.

(A) Push the table feed handwheel (E1) to mesh clutch for rotation. It will move the table to right in clockwise, and left in counterclockwise.

Push the saddle feed handwheel (E2) to match clutch for rotation. It will move the saddle to backward in clockwise and forward in counterclockwise.

Handwheel will move forward or backward 6mm in each revolution. Each handwheel has 0.02mm scale knob (E7), (E8)

When scale knob is calibrated to the positive zero and the set screw is fixed, the reading represents the displacement.

(B) Starting and Stopping Operation of Table Automatic Feed

Check the proper operation of the table feed stop block (D3) , (D4) and table feed limit switches (Li1), (Li2) and saddle feed stop block (D5), (D6) and saddle feed limit switches (Li3), (Li4).

Adjust and fix the feed stop block (D3), (D4) or (D5), (D6) on the desired position.

When starting switch (S5) on the operation panel moving to right, left, forward or backward, the table will move to right, left, forward or backward. If the starting switch (S5) is in neutral position, the table will stop feeding. Besides, the table will be stopped also by table feed stop block (D3), (D4) contact limit switch (Li1) (Li2), and saddle feed stop block (D5), (D6) contact the limit switches (Li3), (Li4).

In case of emergency, press the emergency stop switch (S6), all of the powers are shut down.

(C) Automatic Feed Speed Change of Table

Automatic feed speed of table can be adjusted by control knob (S7), increase feeding in clockwise, and decrease feeding in counterclockwise.

Operator can adjust the knob to a satisfied feed speed based on the actual situation.

The knob is scaled in mm/min.

(D) Automatic Feed Direction of Table

Automatic feed of table in this machine is controlled by switch (S5). Its feed direction is the same as switch direction, right, left, forward, backward.

(E) Table Rapid Feeding

Table rapid feeding is also controlled by switch (S5) press the button and pushes to operate in the direction based on actual requirements. Rapid feed speed is 2800mm/min.

(F) Automatic Feed Stop

Left-right direction elbow (D3), (D4) and back-forth direction elbow block (D5), (D6) can identify the fixed position.

F-1. Stop the Feed of Table Moving Toward To Left Side

When the elbow block (D3) devices on the right side in front of table touch the limited switch (Li1),

The electrical circuit of feed motor will be interrupted, and the movement of table will stop at once.

At this time, if the switch (S5) is operated to "B" direction the motor will be started in reverse direction.

F-2. Stop the Feed Of Table Moving Toward To Right Side

When the elbow block (D4) devices on the left side in front of table touch the limited switch (Li2), the

electrical circuit of feed motor will be interrupted, and the movement of table will stop at once. At this time,

if the switch (S5) is operated to "A" direction the motor will be started in reverse direction.

F-3. Stop The Feed Of Saddle Moving Toward to Forward

When the elbow block (D6) devices on the rear side in right side of saddle touch the limited switch (Li4) the electrical circuit of feed motor will be interrupted, and the movement of saddle will stop at once. At this time, if the switch (S5) is operated to "C" direction, the motor will be started in reverse direction.

F-4. Stop The Feed Of Saddle Moving Toward To Backward

When the elbow block (D5) devices on the front side in right side of saddle touch the limited switch (Li3) the electrical circuit of feed motor will be interrupted, and the movement of saddle will stop at once. At this time, if the switch (S5) is operated to "D" direction, the motor will be started in reverse direction.

(G) Identification on Automatic Feed Stop

After the feed is stopped in each direction, if it is necessary to restart the feed at the same direction, please process in manual operation.

Automatic feed stop in each direction will be effective either on cutting feeding or rapid feeding.

If the elbow block and limit switch are under the following status, the switch (S5) has no action at all. So the motor in speed change box will be not started.

- (1) (D3), (Li1) and (D5), (Li3) operating same time.
- (2) (D4), (Li2) and (D6), (Li4) operating same time.

In above function, the elbow block and limit switch will be released by hand feed. When automatic feed is stopped, the switch (S5) must be place in neutral position.

When it is turned on again or power turned on and signal processed, the motor must be started according to the switch (S5) direction.

6. Clamping devices

In order to maintain better finishing and accurate surface, the following portions should be clamped tightly before cutting operation .

6-1 Spindle head clamping (Fig. 13)

The clamping operation of spindle head should be carried out by right side clamping lever (C1) turning to left "A" direction (But loose in right "B" direction) .

6-2 Table clamping (Fig. 16)

The clamping operation of table should be carried out by the attached wrench screwing the bolts (C2) of table's sliding parts tightly . (In the case of boring or drilling operation) .

6-3 Saddle clamping (Fig. 16)

The clamping operation of saddle should be carried out by the attached wrench screwing the bolt (C3) of saddle under table .(In case of boring or drilling operation) .

7. Maintenance:

After installation of the machine or in operation, you find the condition of the machine is abnormal. The following steps should be taken. (Inspection or adjustment) .

7-1 The level adjustment of the machine (Fig. 17)

1. Place the two levels of 0.02-0.05mm/1000mm accuracy on the table perpendicular to each other.
2. Loosen the nuts (A1) of anchor bolts (A2).
3. Loosen the leveling fixed nuts (L3).
4. Loosen the leveling bolts (L2) and adjust the level (6 leveling bolts to be adjusted).
Until this leveling is accurate.
5. Locking the leveling fixed nuts (L3) (don't rotate the leveling bolts).
6. Locking the anchor bolts with nuts (A1).
7. Recheck the air bubbles displacement on the lever. If no movement that is right, or should be readjusted.

7-2 Adjustment of spindle (Fig. 18)

If you find the spindle is loose or temperature rise of spindle bearing. The readjustment should be taken carefully.

1. Take apart the cover of spindle head (HC1).
2. Loosen the fixed nuts (N1).
3. Screwing the adjustable nuts (N2) not so loose, not so tight (Because of temperature rise of bearing).
4. Screwing the fixed nuts (N1), (Preventing the adjusted nuts (N2) from loose).
5. Reassembling the spindle head.

7-3 Adjustment of V-Belt of spindle transmission (Fig. 19)

After longtime service the V-Belts will be loose, so the adjustment should be taken according to the following steps.

1. To take the window cover (HC3) of spindle head apart and observe the situation of V-Belt.
2. Loosen the 4 installation bolts (T1) of motor.
3. Through the window, adjustable bolts (T2) and move the position of motor (M1), you can feel the tension of V-Belts by finger suitable or not. If it is right, screw the installation bolts of motor tightly.
4. Reassembling the window cover (HC3).

7-4 Replacement of V-Belts of spindle transmission (Fig. 19)

The replacement of V-Belts should be taken when it is worn or broken. The following steps should be carried .

1. Open the window (HC3) of spindle head and observe the situation of V-Belts.
2. Take out the 4 installation bolts (T1) and adjustable bolts (T2) of motor.
3. Move the motor and take off the 5 used belts.
4. Replace with the new belts.
5. Move the motor to original position, installation bolts (T1) and adjustable bolts (T2) .
6. Adjust the belts tension by adjustable bolts (T2), until it is suitable condition (not loose or tight), if you find the 5 belts either loose or tight change loose one or tight one.
7. Reassemble the window cover (HC3).

7-5 Adjustment of automatic feed V-Belts of spindle head. (Fig. 18 & Fig. 20)

1. Take the cover (HC1) of spindle head apart .
2. Loosen the tension strength of support locking nuts (FT1) .
3. One hand use the wrench to screw the tension support (FT2) and make the belt tension to moderate condition . Other hand, tighten the support locking nuts (FT1).
4. Reassemble the cover of spindle head.

7-6 Adjustment of sliding surfaces of gib.(Fig. 21 , Fig. 23)

When sliding surfaces are loose, make a suitable adjustment.

(A) Adjustment of side gib of spindle head (Fig. 21)

1. Loosen all of locking nuts (K3).
2. Screw all of locking bolts (K2) to make moderate tight for side gib (Not too tight to slide the spindle head up and down , the condition of tightness should be consistent) .
3. Tighten the fixed nuts (K3).
4. Try to ascend and descend the spindle head and observe the tightness.

(B) Adjustment of gib inside of spindle head (Fig. 21)

1. Tighten the locking bolts (K8) of pressing bar.
2. Screw the bolts (K5) to adjust the inside gibs (K4).
3. Try to ascend and descend the spindle head and observe the tightness.

(C) Adjustment of gibs for table (Fig. 23)

1. Loosen the locking nuts (KT4).
2. Screw the lock bolts (KT2) gibs to adjust the position of gibs (KT1) .
3. Tighten the lock nuts (KT4).
4. Try to swing the table and observe the degree of tightness.

(D) Adjustment of gib of saddle (Fig. 23)

1. Loosen the locking nuts (KT7).
2. Screw the locking bolts (KT6) to adjust the position of gib .
3. Tighten all of the locking nuts (KT7).
4. Try to swing the saddle and observe the degree of tightness.

7-7 Adjustment of all feed lead screws (Fig. 22, Fig. 24)

After long time service the feed lead screw has been worn out and backlash increased gradually the adjustment should be taken if necessary.

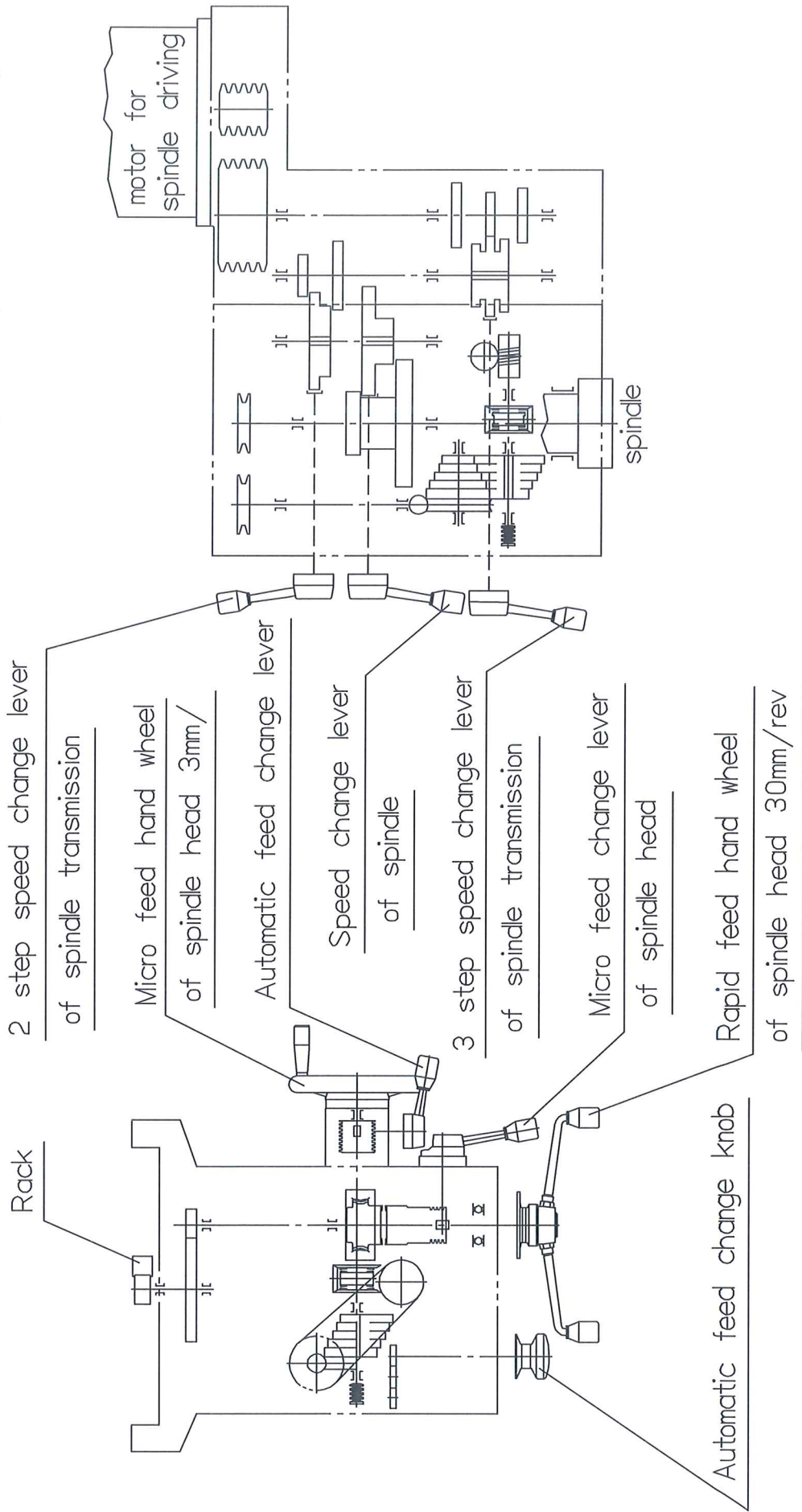
7-7-1 Adjustment of feed lead screw of table (Fig. 24)

1. Disassemble the side cover (TS1) of table and right & left feed lead screw support (TS2).
2. Push the table toward to left side to expose the feed nuts (N3).
3. Loosen the adjustable nuts (N3) of 3 bolts (N4) and adjust the position.
4. Screw the adjustable nuts (N3) toward "B" direction, and make the feed lead screw only for rotation without looseness see (Fig. 24) .
5. Tighten the adjustable nuts of 3 bolts.
6. Push the table to original position.
7. Reassemble the support (TS2) of feed lead screw and side cover (TS1) of table .

7-7-2 Adjustment of feed lead screw of saddle (Fig. 22)

1. Move the table to extreme front position.
2. Disassemble the bolts of end bearing of feed lead screw , and rotate the bearing downward .
3. Loosen the adjustable nuts of fixed bolts (N9) .
4. Use the $\varnothing 5$ mm diameter of steel bar (200mm long) to insert the outside hole of adjustable nut (N7), and rotate the nut to "A" direction (left hand) to reduce the backlash to minimum .
5. Try to swing feed hand wheel of saddle and observe the moderate amount of adjustment.
6. Tighten the adjustable nuts of fixed bolts (N9).
7. Recover the original position of bearing and lock it tight.

Fig. 12 Spindle head driving



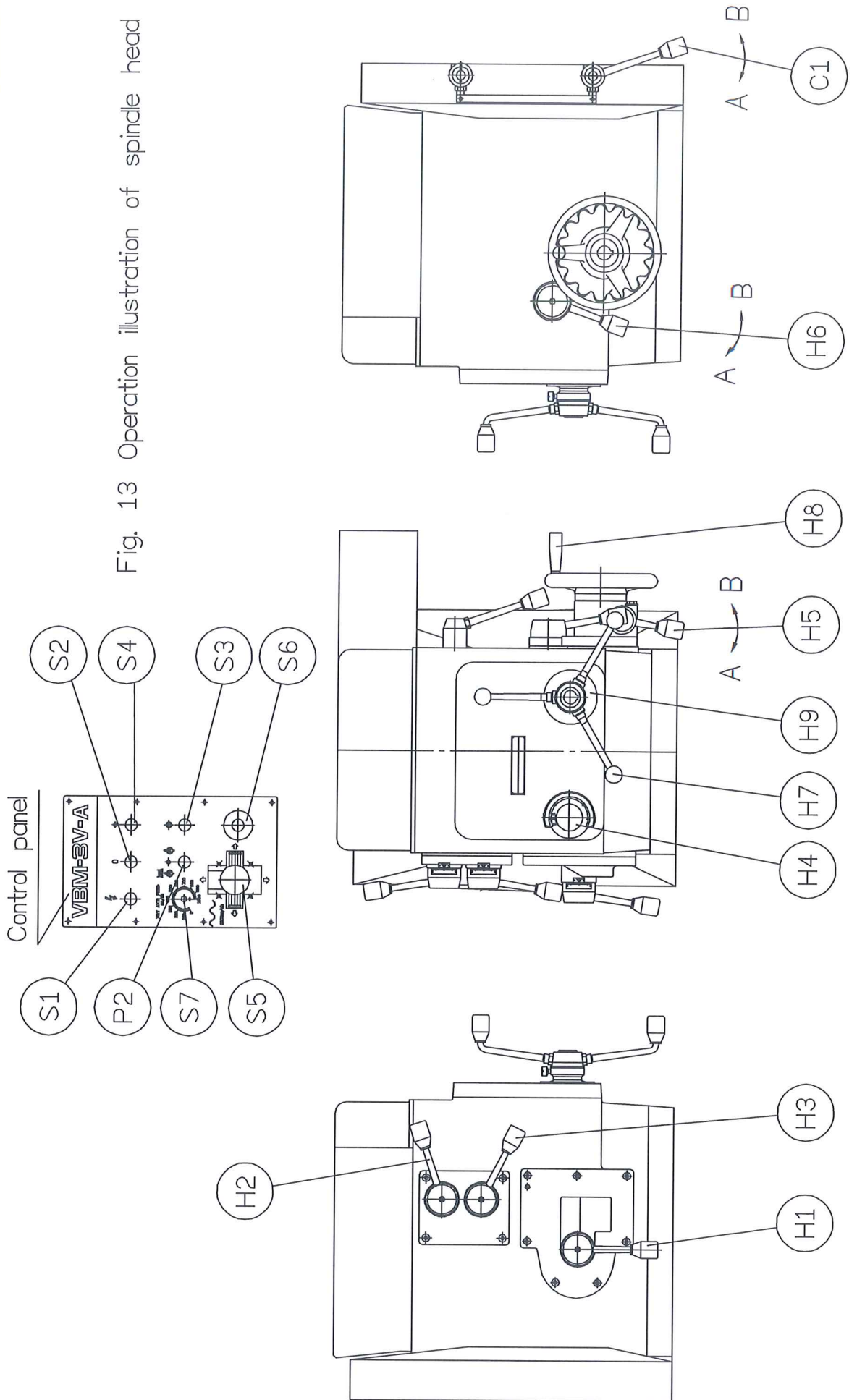


Fig. 13 Operation illustration of spindle head

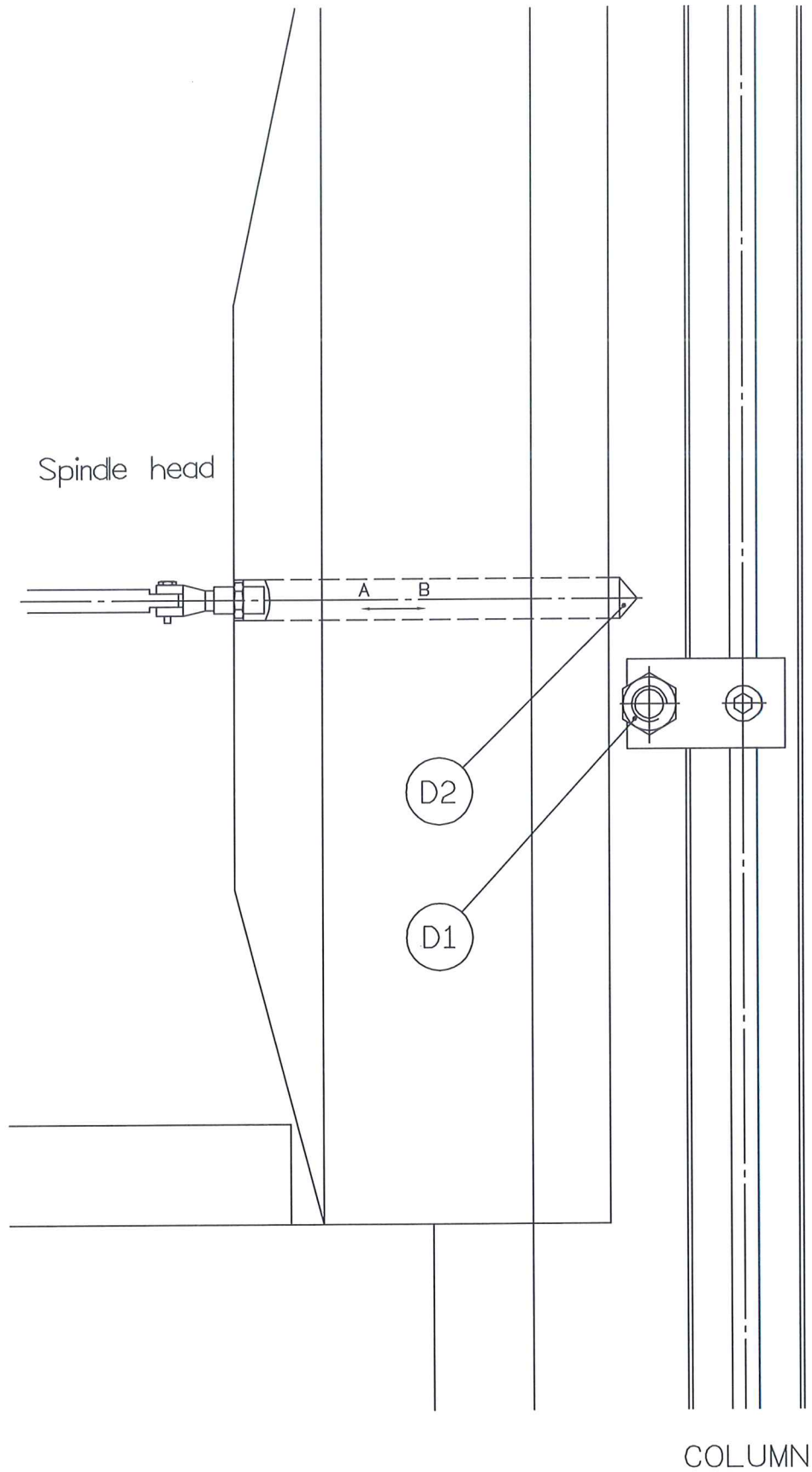


Fig 14. Setting relation of spindle head

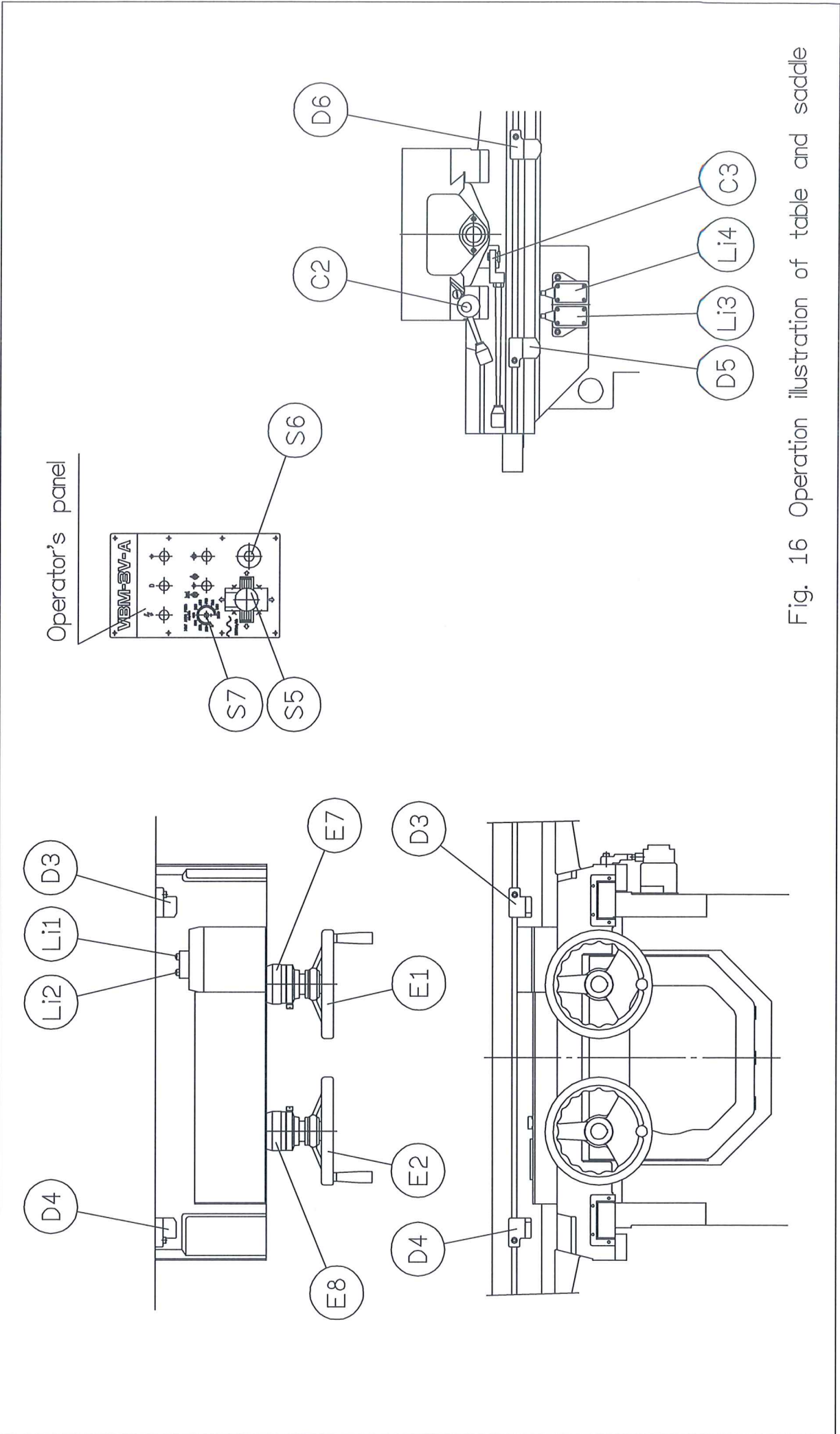


Fig. 16 Operation illustration of table and saddle

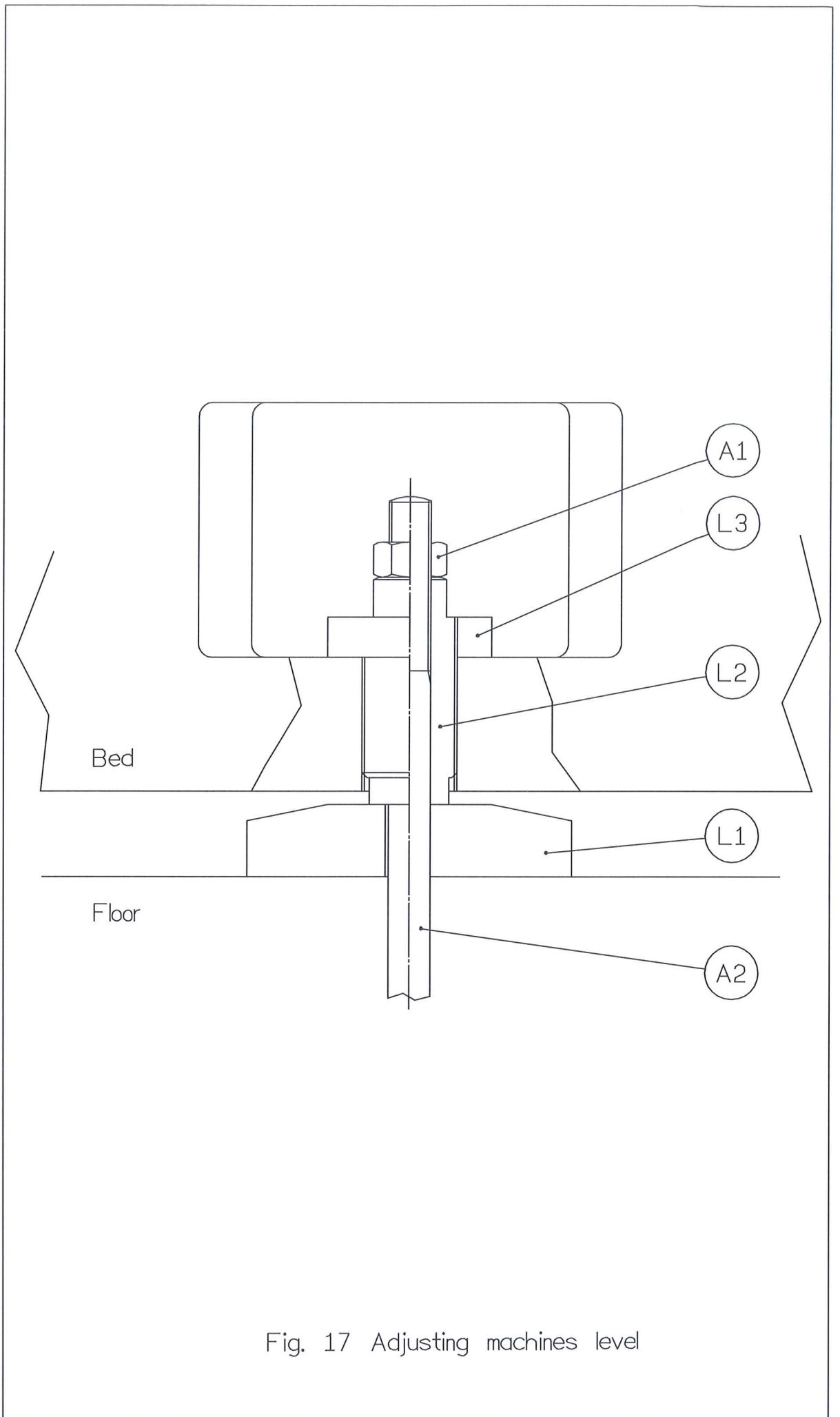


Fig. 17 Adjusting machines level

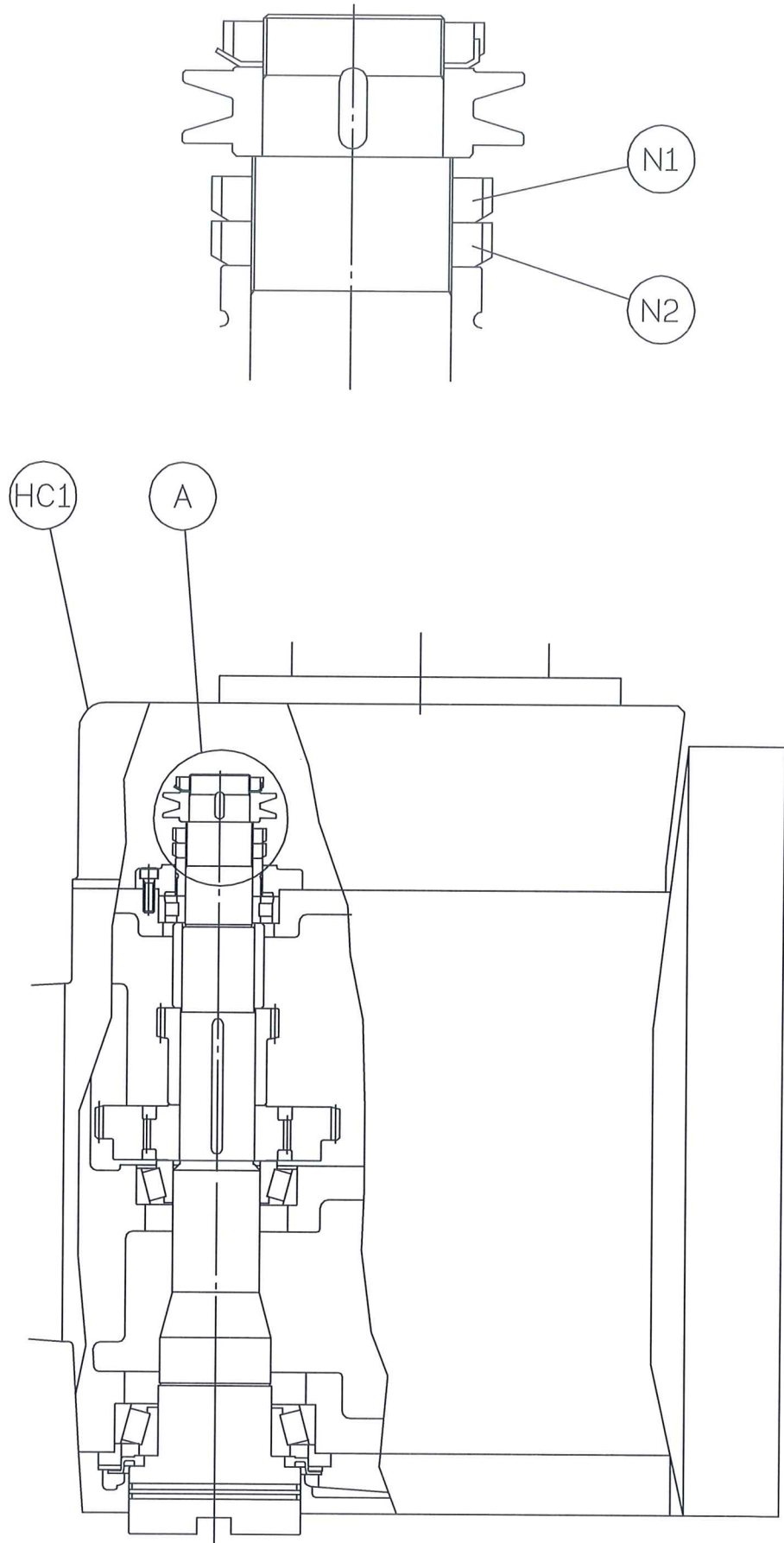


Fig. 18 Adjustment of main spindle

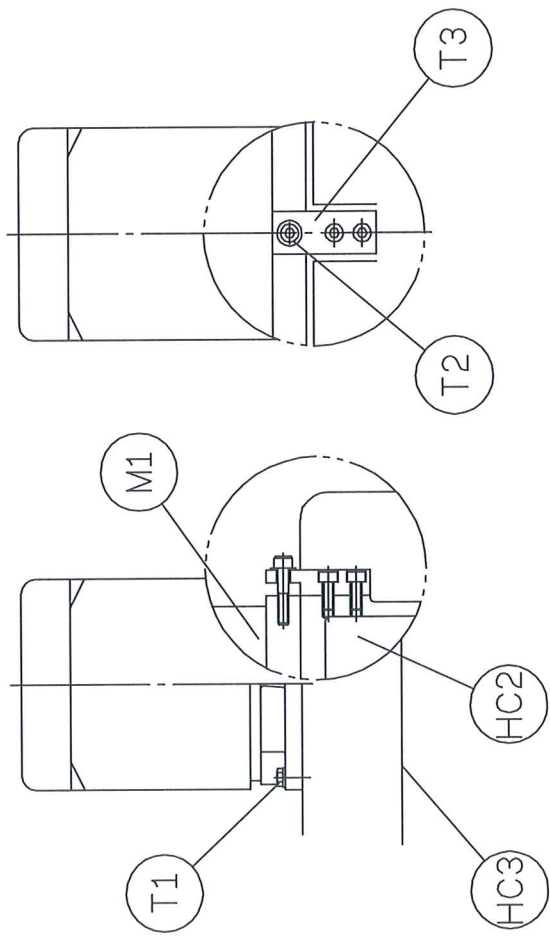


Fig. 19 V-belt adjustment of main spindle transmission

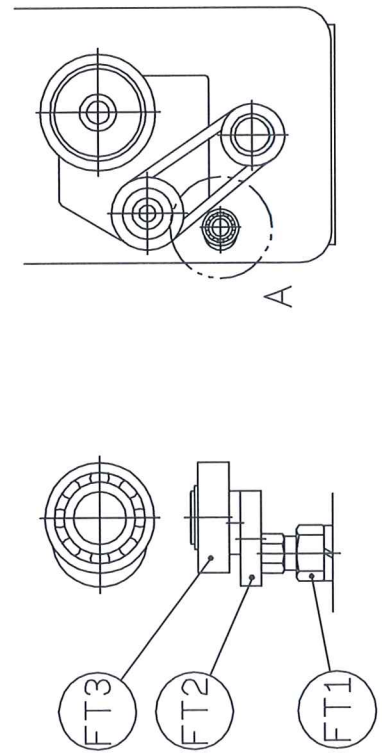


Fig. 20 V-belt adjustment of main spindle automatic feeding

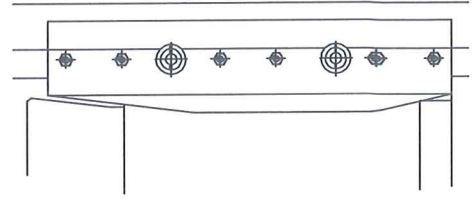
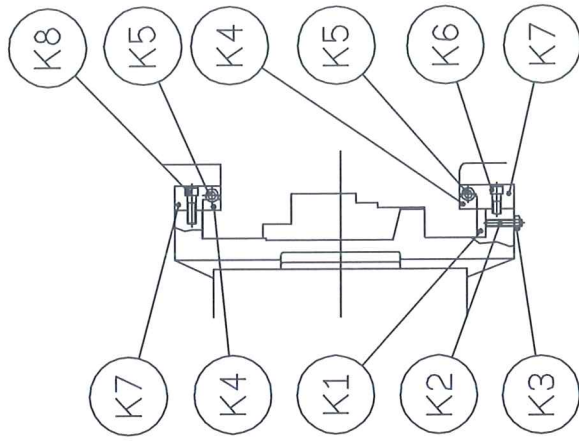


Fig. 21 Adjustment of slide gibs of main spindle

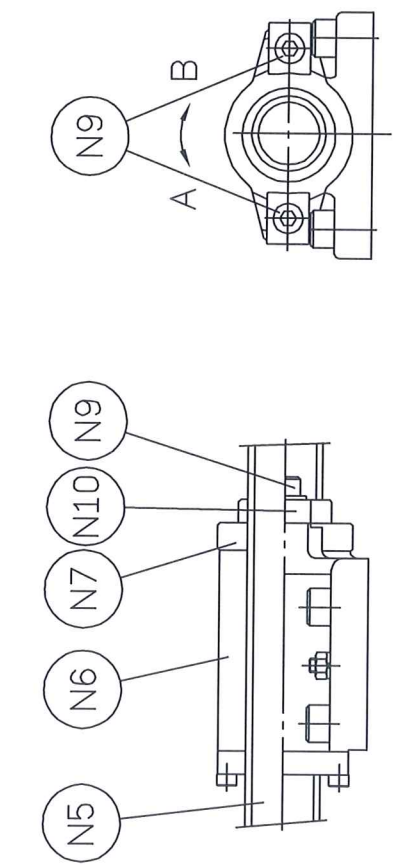


Fig. 22 Adjustment of feeding screw of saddle

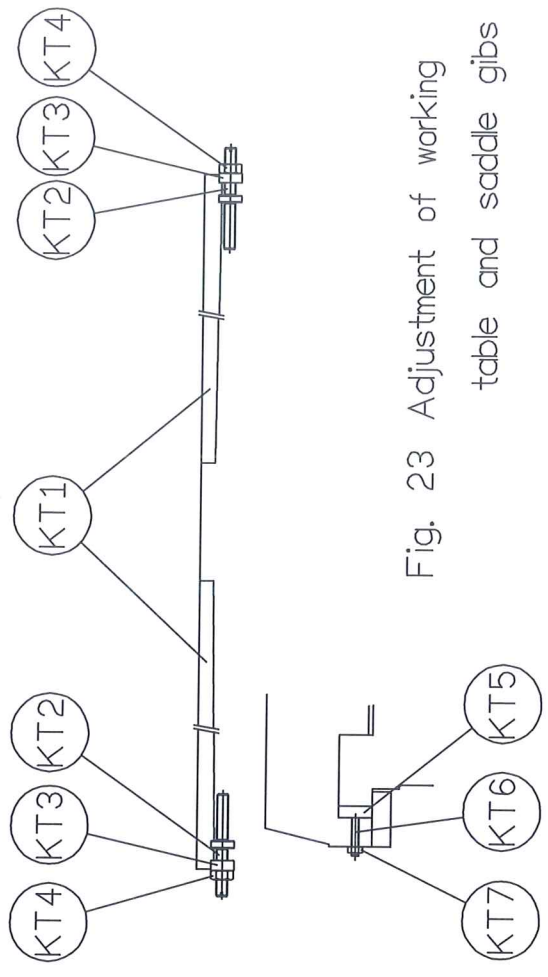


Fig. 23 Adjustment of working table and saddle gibbs

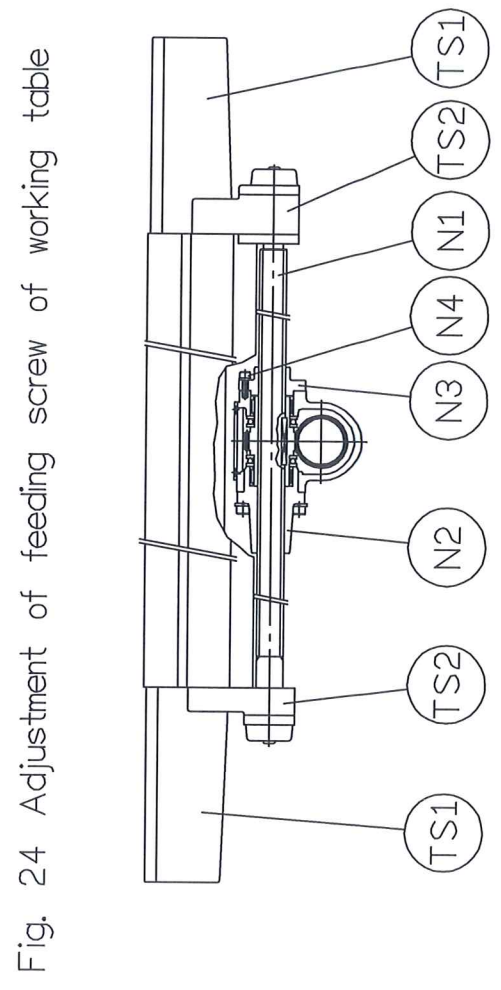
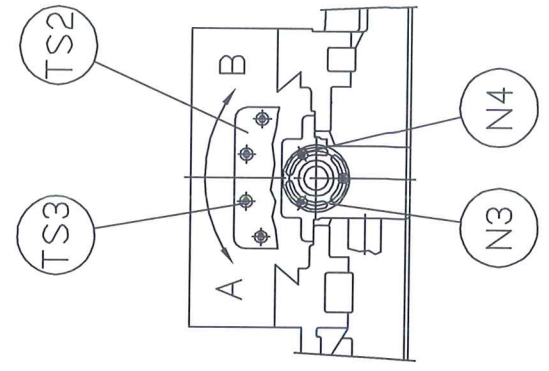


Fig. 24 Adjustment of feeding screw of working table



8. REFERENCE FOR MACHINING

8-1 CUTTING SPEED

The cutting speed of milling cutter can be found as follows :

$$V = \frac{\pi DN}{1000}$$

V = CUTTING SPEED (M/MIN)

D = DIAMETER OF CUTTER (MM)

N = REVOLUTION OF CUTTER PER MINUTE (R.P.M) .

The cutting speed is accorded to metal of workpiece ,metal of cutter and some condition of machining . The followings are the considerations for machining:

- (1) For longer life time of the milling cutter, using the lower cutting speed.
- (2) For rough cutting surface using lower cutting speed and higher feed ; for fine cutting surface using higher cutting speed and lower feed .
- (3) When some special workpiece to be cut, it is better to use medium cutting speed at first, then increase the speed . Gradually up to adapting condition.

The suitable cutting speed is shown in table 6 .

8-2 FEED

The table feed is based on the revolution of cutter per minute, number of teeth in cutter and feed per cutting edge. It can be found as follows:

$$S = N \times S \times Z$$

S = FEED PER MINUTE (MM / MIN)

N = REVOLUTION OF CUTTER (R.P.M)

Z = NUMBER OF TEETH (EDGE) .

S = FEED PER CUTTING EDGE (MM / TOOTH-R) .

The feed of per cutting edge is used usually to account the table feed .

The suitable feed per cutting edge for high speed steel , and tungsten carbide steel is shown in chart 7 .

8-3 DEPTH OF CUTTING

The depth of cutting varies with different kinds of cutting surfaces which is shown probably in table 8 .

TABLE 8 DEPTH OF CUTTING

| KIND OF CUTTING SURFACE | DEPTH OF CUTTING |
|-------------------------|------------------|
| FINE CUTTING SURFACE | 0.3-0.5 |
| GENERAL CUTTING SURFACE | 0.5-1.5 |
| ROUGH CUTTING SURFACE | 1.5-5 |

Table 6

| Work | | Cutting speed | | | |
|--------------------------------|-------------|-------------------------|---------|----------------------------|----------------------------|
| Material | | Brinell hard-ness HB | | High-speed steel cutter | Super-hard alloy cutter |
| | | | | m/min | m/min |
| Special steel | Hard | 300 | 400 | 13 15 | 30 50 |
| | Tough | 220 | 300 | 15 23 | 50 75 |
| | Annealed | 180 | 220 | 23 35 | 75 108 |
| Low-carbon steel | Malleable | 152 | 197 | 28 46 | 90 130 |
| | Cuts well | 150 | 180 | 35 46 | 108 130 |
| Cast iron | Hard | 220 | 300 | 15 23 | 50 75 |
| | Medium hard | 180 | 220 | 23 33 | 75 108 |
| | Soft | 150 | 180 | 35 46 | 108 130 |
| Brass and Bronze | | 150 | 250 | 21 46 | 63 130 |
| | | 100 | 150 | 46 83 | 130 200 |
| | | 80 | 100 | 83 116 | 200 330 |
| Magnesium and its alloys | | | 116 500 | | |
| Aluminum and its alloys | | | 66 500 | | |
| Plastic | | | 66 500 | | |

Note: The above table should be regarded as a general criterion. Attention must be paid to the following when operating the machine.

Table 7-1

| Milling cutter | Work | | Feed amount per tooth mm | | | | | | |
|----------------------------------|----------------------|---------------------|--------------------------|---|--------------------------------------|----------|---------------|--------------------------|--|
| | Quality of materials | Brinell hardness HB | Face milling cutter | Plane milling cutter with helical teeth | Slotting saw and side milling cutter | End mill | Formed cutter | Saw blade milling cutter | |
| High-speed steel milling cutters | Special steel | Hard | 0.1 | 0.075 | 0.075 | 0.05 | 0.05 | 0.025 | |
| | | Tough | 0.13 | 0.125 | 0.1 | 0.075 | 0.05 | 0.05 | |
| | | Annealed | 0.2 | 0.175 | 0.125 | 0.1 | 0.025 | 0.05 | |
| | Low - carbon steel | Malleable | 0.25 | 0.2 | 0.13 | 0.125 | 0.075 | 0.075 | |
| | | Cuts well | 0.3 | 0.25 | 0.175 | 0.13 | 0.1 | 0.035 | |
| | | | | | | | | | |
| | Cast iron | Hard | 0.27 | 0.2 | 0.13 | 0.13 | 0.1 | 0.075 | |
| | | Medium hard | 0.325 | 0.25 | 0.175 | 0.175 | 0.1 | 0.0075 | |
| | | Soft | 0.4 | 0.325 | 0.225 | 0.2 | 0.125 | 0.1 | |
| | Brass and bronze | Hard | 0.225 | 0.225 | 0.13 | 0.125 | 0.075 | 0.05 | |
| | | Medium hard | 0.35 | 0.35 | 0.2 | 0.175 | 0.1 | 0.075 | |
| | | Cuts well | 0.55 | 0.55 | 0.325 | 0.27 | 0.175 | 0.125 | |
| Magnesium and its alloys | | 0.55 | 0.45 | 0.325 | 0.27 | 0.175 | 0.125 | | |
| Aluminum and its alloys | | 0.55 | 0.45 | 0.325 | 0.27 | 0.175 | 0.125 | | |
| Plastic | | 0.375 | 0.3 | 0.225 | 0.175 | 0.125 | 0.1 | | |

Table 7-2 (Continue)

| Milling cutter | Work | | Feed amount per tooth mm | | | | | | |
|--------------------------------|----------------------|-----------------------|--------------------------|---|--------------------------------------|----------|---------------|--------------------------|-------|
| | Quality of materials | Brinell hardness (HB) | Face milling cutter | Plane milling cutter with helical teeth | Slotting saw and side milling cutter | End mill | Formed cutter | Saw blade milling cutter | |
| Sper-hard alloy milling cutter | Special steel | Hard | 0.25 | 0.2 | 0.13 | 0.125 | 0.075 | 0.075 | |
| | | Tough | 0.3 | 0.25 | 0.175 | 0.13 | 0.1 | 0.075 | |
| | | Annealed | 0.35 | 0.27 | 0.2 | 0.175 | 0.1 | 0.1 | |
| | Low - carbon steel | Malleable | 152 197 | 0.35 | 0.27 | 0.2 | 0.175 | 0.1 | 0.1 |
| | | Cuts well | 150 180 | 0.4 | 0.325 | 0.225 | 0.2 | 0.125 | 0.1 |
| | | | | | | | | | |
| | Cast iron | Hard | 220 300 | 0.3 | 0.25 | 0.175 | 0.13 | 0.1 | 0.075 |
| | | Medium hard | 180 220 | 0.4 | 0.325 | 0.25 | 0.2 | 0.125 | 0.1 |
| | | Soft | 150 180 | 0.5 | 0.4 | 0.3 | 0.25 | 0.13 | 0.125 |
| | Brass and bronze | Hard | 140 250 | 0.25 | 0.2 | 0.13 | 0.125 | 0.075 | 0.075 |
| | | Medium hard | 100 150 | 0.3 | 0.25 | 0.175 | 0.13 | 0.1 | 0.075 |
| | | Cuts well | 80 100 | 0.5 | 0.4 | 0.3 | 0.25 | 0.13 | 0.125 |
| Magnesium and its alloys | | | 0.4 | 0.45 | 0.3 | 0.25 | 0.13 | 0.125 | |
| Aluminum and its alloys | | | 0.4 | 0.45 | 0.3 | 0.25 | 0.13 | 0.125 | |
| Plastic | | | 0.3 | 0.3 | 0.225 | 0.175 | 0.125 | 0.1 | |

10. TROUBLE SHOOTING

Table 9

| Trouble | Possible causes | Correction |
|---|--|---|
| 1. Running out of cutter | <ol style="list-style-type: none"> 1. Not accurate for cutter edges 2. Not accurate for cutters' holder 3. Dirty inside the spindle hole | <ol style="list-style-type: none"> 1. Regrinding the cutter edges 2. Replace new one 3. Clean it |
| 2. Chatter | <ol style="list-style-type: none"> 1. Tool shank too long or too fine 2. Leak of rigidity in the machine, fixture or work piece 3. Spindle bearing too loose or worn 4. Feed rate too high 5. Dull of cutter 6. Cutting angles of cutter nor proper 7. Back-lash of feed screw too loose 8. Gib of table too loose | <ol style="list-style-type: none"> 1. Replace suitable one 2. Improve rigidity 3. Adjust or change it 4. Reduce feed rate 5. Re-sharpen it 6. Grind it 7. Adjust by the adjustable nut 8. Adjust by the adjustable screws |
| 3. Poor surface finish | <ol style="list-style-type: none"> 1. Feed too high 2. Dull tool 3. Speed too low 4. Insufficient number of cutter teeth | <ol style="list-style-type: none"> 1. Reduce feed or increase cutting speed 2. Re-sharpen it 3. Increase surface speed of cutter 4. Adding more teeth for cutter |
| 4. Vibration | <ol style="list-style-type: none"> 1. Loose of leveling screws 2. Torn or mismatch of V-belt 3. Motor out of balance 4. Unbalance of pulley | <ol style="list-style-type: none"> 1. Tighten it 2. Replace with new set 3. Replace it 4. Replace it |
| 5. Cutter burns | <ol style="list-style-type: none"> 1. Insufficient lubricants 2. Speed too high | <ol style="list-style-type: none"> 1. Add more sulfur base oil 2. Reduce speed |
| 6. Teeth bearing | <ol style="list-style-type: none"> 1. Feed too high 2. Lack of rigidity of work piece | <ol style="list-style-type: none"> 1. Reduce feed 2. Improve design of work piece or fixture |
| 7. Out of dimension of work piece after taking off from fixture | <ol style="list-style-type: none"> 1. Not suitable of fixture 2. Some residual stress in the inside of work piece 3. Rough surface | <ol style="list-style-type: none"> 1. Improve design of fixture 2. Improve heat treatment 3. Refinishing |
| 8. Stepped machining surface | Center line of spindle not in perpendicular to table or slide way of carriage or bed. | Readjust it correctly |

11. MAINTENANCE SCHEDULE

Table 10

| ITEM | POSITION | FREQUENCY | | | |
|--|---|-----------|--------|---------|--------|
| | | DAILY | WEEKLY | MONTHLY | YEARLY |
| 1. LUBRICATION | ACCORDING TO TABLE 3 | 1 | 1-2 | | |
| 2. ACCURACY | ACCORDING TO ACCUR A-INSPECTION CHART | | | | 1 |
| 3. CLEANING AND CORROSION PROTECTION | ALL SLIDDING SURFACES, TABLE SURFACE, T-SLOTS, SPINDLE NOSE, SPINDLE HOLE, ALL EXPOSED FINISHING SURFACES | 1 | | | |
| 4. ADJUSTING OF GIBS | TABLE, SADDLE, SPINDLE, HEAD | | | 2 | |
| 5. ADJUSTMENT OF FEEDING SCREWS | TABLE, SADDLE, SPINDLE, HEAD | | | 1 | |
| 6. ADJUSTING OF FIXED MECHAN-ISM | TABLE, SADDLE, SPINDLE HEAD | | | 2 | |
| 7. LEVELLING AND TIGHTEN | FOUNDATION BOLT & SETTING SCREWS | | | | 2 |
| 8. TEMPERATUR E OF BEARINGS CHECK UP | SPINDLE, GEAR BOX, BEARINGS MOTORS AND HYDRAULIC SYSTEM | | | 1 | |
| 9. VIBRATION AND SOME ABNORMAL MOVEMENT CHECK UP | MOTORS, HYDRAULIC SYSTEM, GEARS AND SOTHER TRANSMISSION | | 1 | | |
| 10. ELECTRIC CIRCUIT CHECK UP | MOTORS, SWITCHSCON-NECTING POINTS OF WIRE, PUSH BUTTONS | | | 1 | |



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