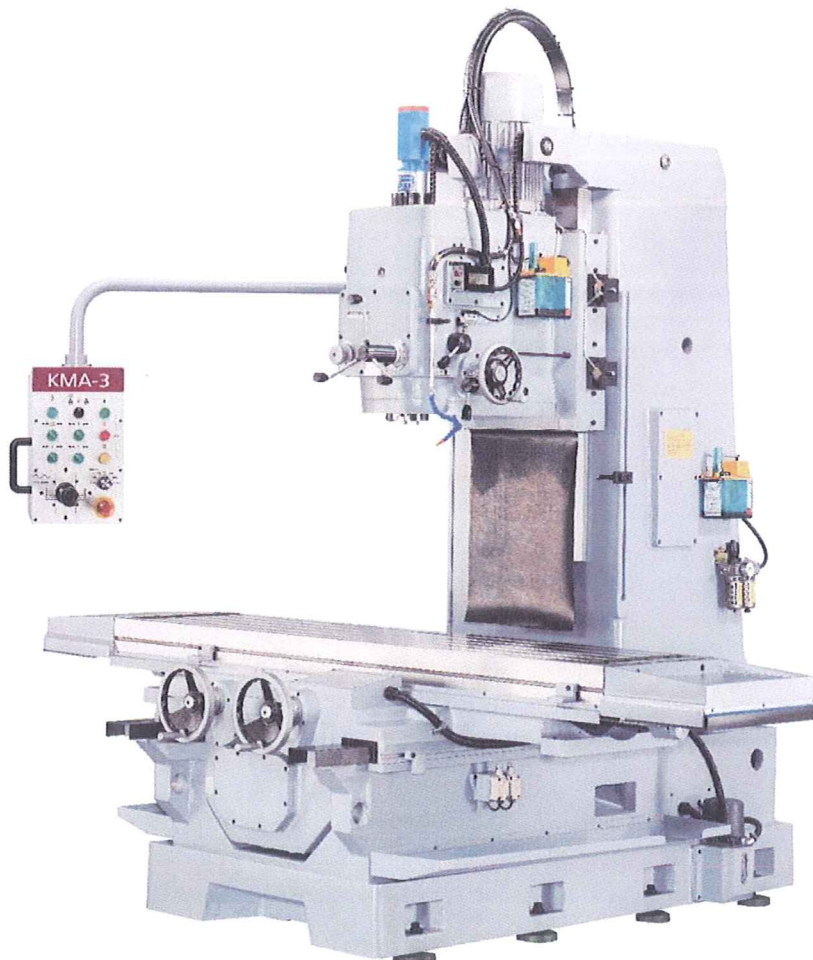


# SHARP

## VERTICAL BED TYPE MILLING & BORING MACHINE

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



MODEL KMA-3

AUG 08 2019

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## 1. General instruction of machine

### 1-1 Specifications (KMA-3)

<b>CAPACITY</b>	
Table Travel (longitudinal)	1500mm(59 in)
Table Travel (cross)	600mm (23-5/8 inch)
Vertical spindle head travel(Vertical)	700mm (27-9/16 inch)
Vertical spindle nose to table top	100-800mm(3-15/16~31-1/2 inch)
Vertical spindle center to column front	550mm (21-5/8 inch)
<b>TABLE</b>	
Table working area	2200 x 500mm (86-5/8 x19-11/16 inch)
T slot (Wide x No. x Pitch)	18mm x 5 x 90mm (0.709 x5 x3-9/16 inch)
Table top to floor	870mm(33-7/8 inch)
<b>SPINDLE HEAD</b>	
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)
<b>FEED</b>	
Rapid traverse (longitudinal & cross)	3300mm/min (60Hz) 2750mm/min (50Hz)
Feed rates (longitudinal & cross)	0-1000mm/min (60Hz)0-833m/min(50Hz)
Change of feed	Infinitely variable
<b>MOTORS</b>	
Vertical spindle	AC11kW (15HP)-4P
Feed	AC1.5kw (2HP)-6P
Lubrication	AC3.5kw (1/4HP)-2P
Cutting fluid	AC0.15KW (1/6HP)-2P
<b>MACHINE SIZE</b>	
Machine height	2870(113)mm(in)
Floor space (longitudinal x cross)	4,440x2,550(174-7/8x100-3/8)mm(in)
Net weight (approx.)	7,000(15,400)kgs(lbs)
Standard color	Gray

#### Standard accessories :

- |                          |        |
|--------------------------|--------|
| 1. Cutting fluid device  | 1 unit |
| 2. Tools and box         | 1 set  |
| 3. Leveling block        | 8 pcs  |
| 4. Leveling bolts & nuts | 8 pcs  |
| 5. Draw bar              | 1 pc   |

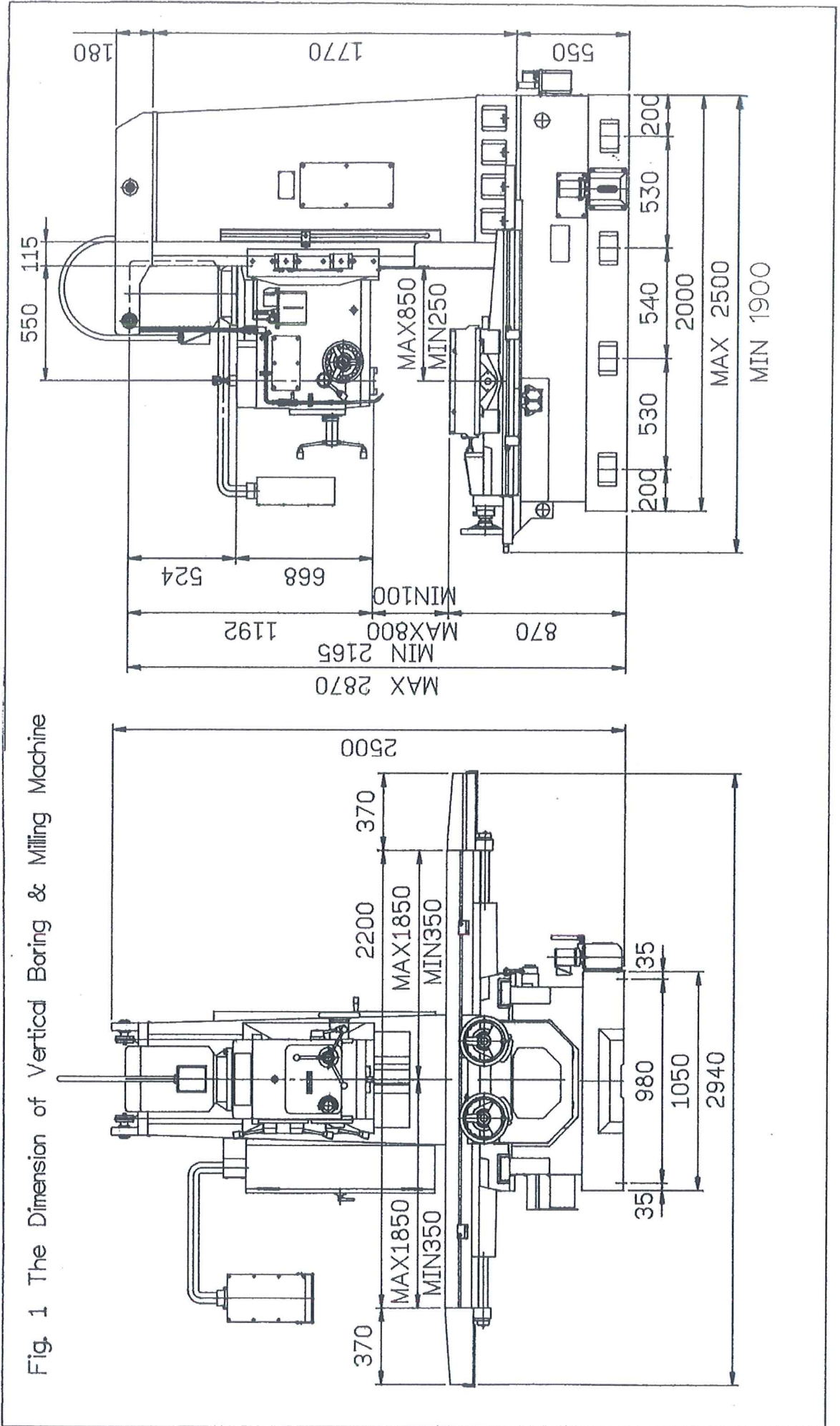
#### Optional Accessories :

- Digital read out
- Power draw bar



1-2 Main dimension

Fig. 1 The Dimension of Vertical Boring & Milling Machine



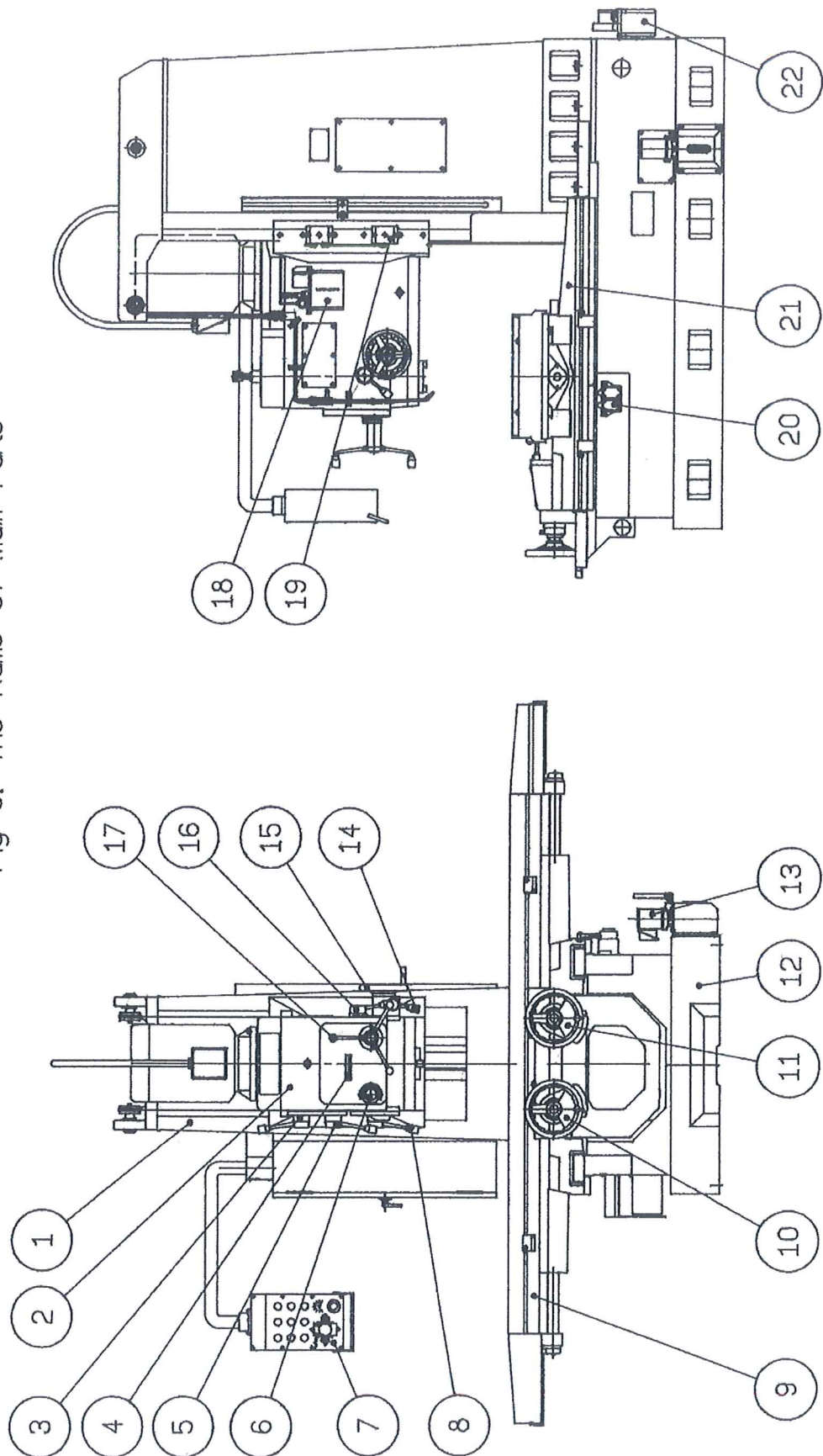




### **1-3 Name of main parts (Fig. 5)**

1. Column
2. Spindle head
3. 2-steps speed change lever for main spindle
4. Name plate for feeding speed
5. High-low speed change lever for spindle head
6. Automatic feeding speed change knob for spindle head
7. Operation panel
8. 3-steps speed change lever for spindle head
9. Table
10. Feeding hand wheel for table
11. Feeding hand wheel for saddle
12. Bed
13. Cutting fluid pump
14. Auto feed speed change lever for spindle head
15. Feeding hand wheel for spindle head
16. Starting switch of main spindle
17. Rapid feed hand wheel for spindle head
18. Lubrication pump for spindle head sliding surface
19. Clamping device for main spindle
20. Limit switch for saddle feed stop
21. Saddle
22. Lubrication pump for table and saddle sliding surface


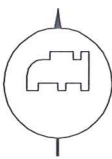



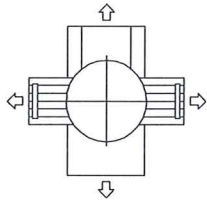


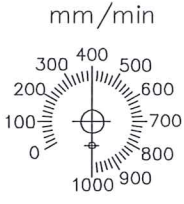


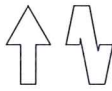
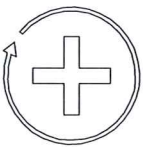


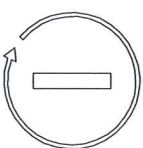


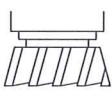
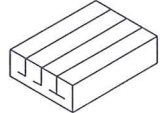
Fig 5. The Name Of Main Parts





1-4 Symbols (Table 2)

Table 2 Symbols

Symbols	Description	Symbols	Description
	Starting switch "on"		Cutting fluid pump
	The switch is "ON" while depressed		Lubricant pump
	Stopping switch "off"		
	Automatic longitudinal and transverse feed		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 damage of machine.

Clamp 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 weakparts of the machine.

### 2-2 Loosening the clamping units of machine (Fig. 6)

After the transportation is completed. Loosen the clamping units of the machine and be careful to remove the support bar and 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. 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. Crasp 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 can not 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.**

### **2-3 Leveling and Foundation (Fig. 7)**

The machine can be located at 200mm thick concrete floor or set on 600mm 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**

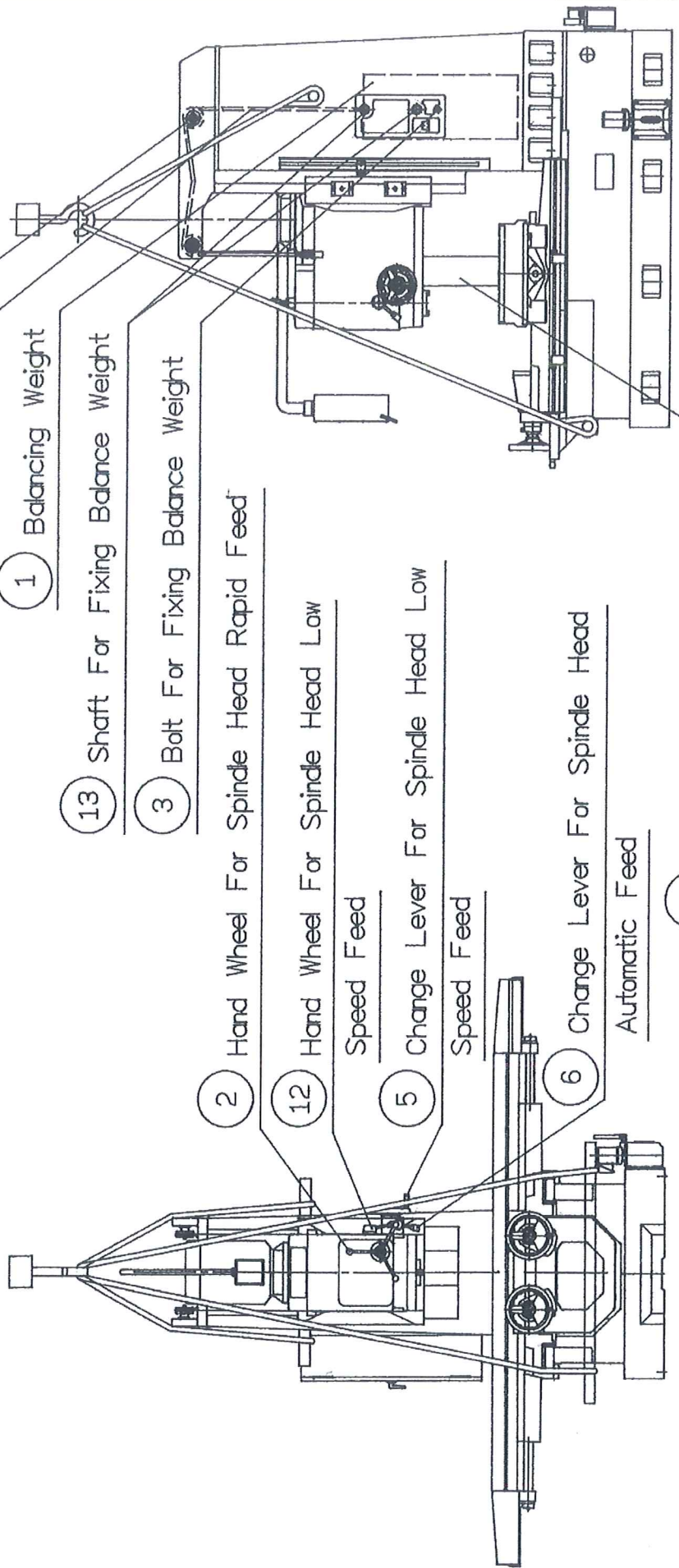
The machine is protected by grease or antirust oil before shipment. But the machine should be cleaned with gasoline before putting the protecting oil.

### **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



- 9 Sprocket
- 7 Chain
- 1 Balancing Weight
- 13 Shaft For Fixing Balance Weight
- 3 Bolt For Fixing Balance Weight
- 2 Hand Wheel For Spindle Head Rapid Feed
- 12 Hand Wheel For Spindle Head Low Speed Feed
- 5 Change Lever For Spindle Head Low Speed Feed
- 6 Change Lever For Spindle Head Automatic Feed
- 4 Support Bar For Spindle Head

Fig. 7 Foundation drawing

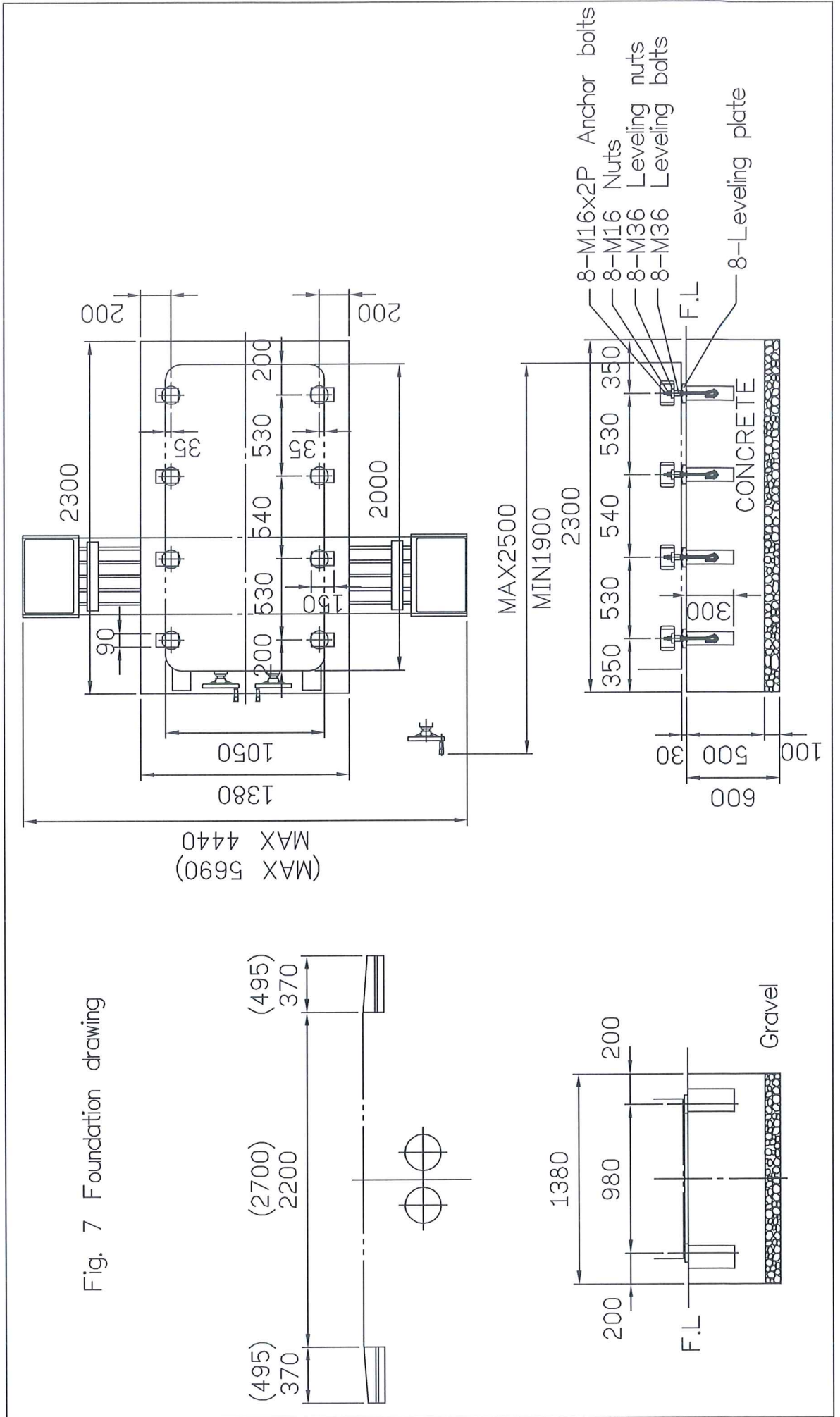
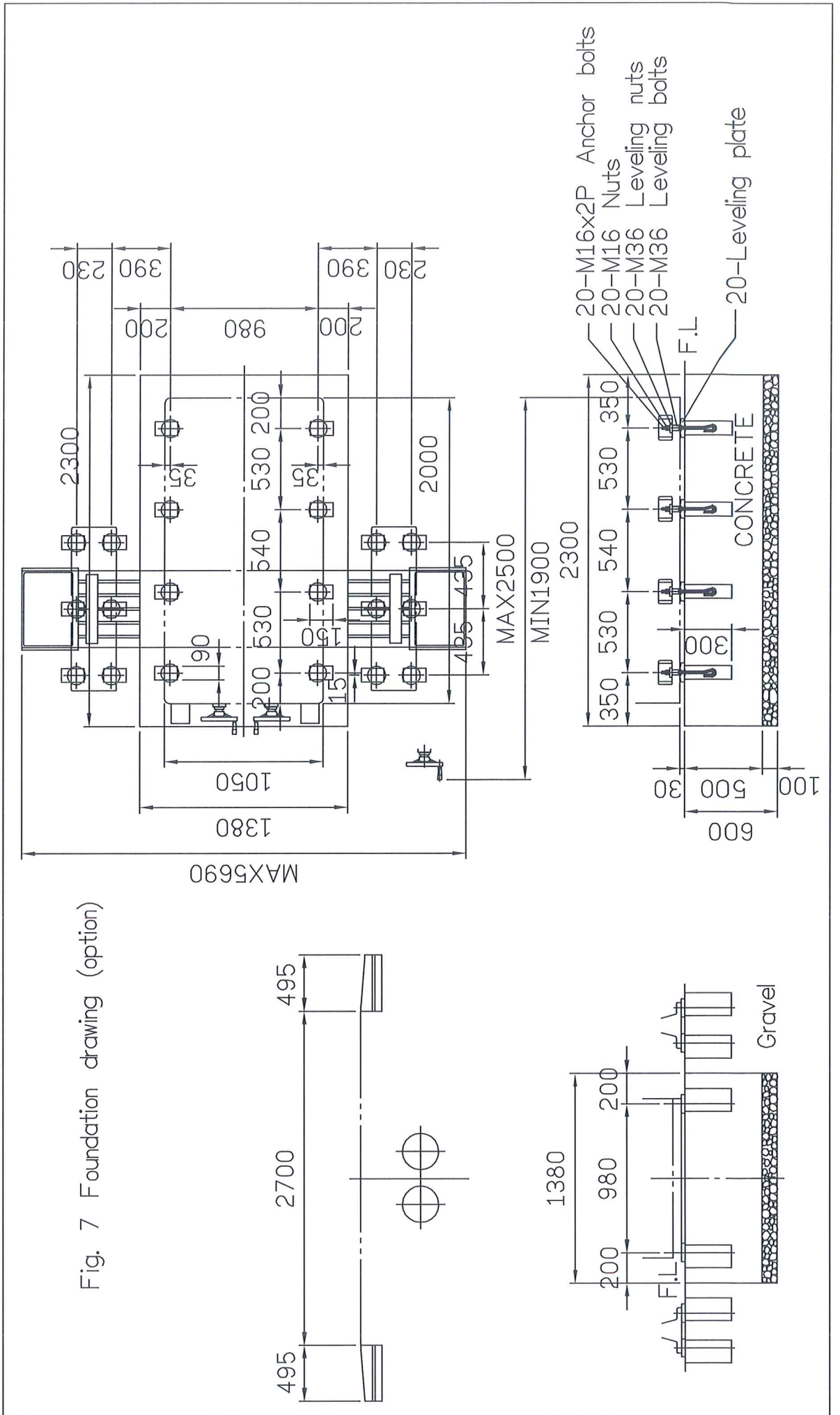


Fig. 7 Foundation drawing (option)

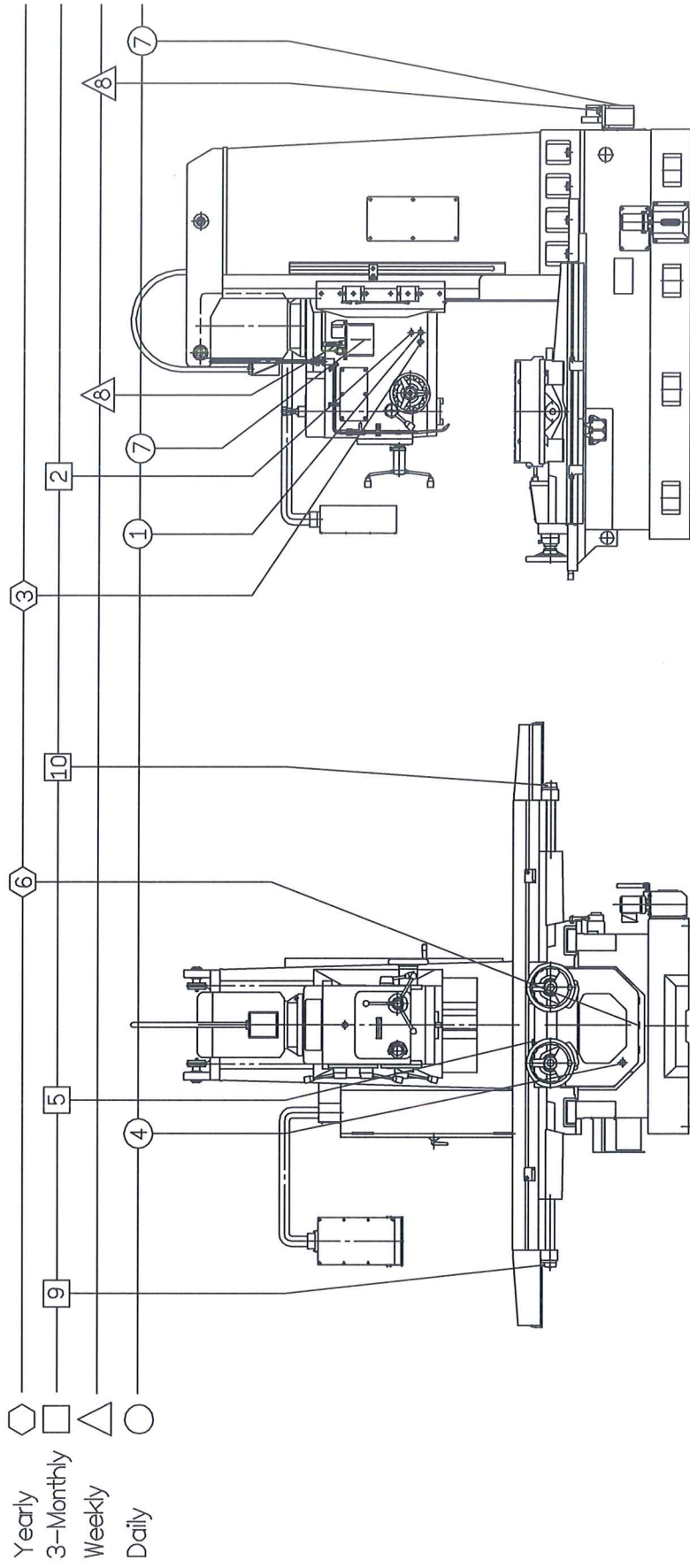




### **3 . Lubrication**

3-1 Refer to (Fig.8) 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



Action points	1	2	3	4	5	6	7	8	9	10
Symbol										
Item										
Check	Daily			Daily			Daily			
Fill		3-Monthly			3-Monthly			Weekly		3-Monthly
Clean & Replace			Yearly			Yearly				
Lubricant		CB32			CB32			G68		XM2
Quantity		6L	12L		1.2L	5L		0.5L		Drops
Remarks										

TABLE 3 Instruction for correct lubricant

	Application Fields	Properties	Symbol and Viscosity Grade	Kinematic Viscosity (40°C)			REMARKS
				Menn.	min.	max.	
GEARS	Enclosed moderately loaded gear (spur gear, bevel gear)	Refined mineral oils with good oxidation stability	CB 32	28.8	35.2	Pinion speeds (motor output) 2000-5000 rpm (within 3.7kw) 1000-2000 rpm (within 7.5kw) -1000 rpm (within 15kw)	
			CB 68	61.2	74.8		
			CB 150	135	165		
	Enclosed heavily loaded gears (worm and wheel)	Refined oils with good oxidation stability and with improved load-carrying ability	CC 150	135	165	Worm speeds 2000- rpm 1000- rpm -1000 rpm	
			CC 320	288	352		
			CC 460	414	506		
BEARINGS	Spindles bearings and associated clutches	Refined mineral oils with superior anticorrosion and anti-oxidation performances.	FC 2	1.98	2.42	Shaft speeds (shaft dia.) 10,000- rpm ( -30mm) 2000-10,000 rpm (30-150mm) -2000 rpm (150- mm)	
			FC 10	9.00	11.0		
			FC 22	19.8	24.2		
SLIDE WAYS	Slide ways	Refined mineral oils with improved lubricity and tackiness performance preventing stick-slip	G68	61.2	74.8	Slide way (surface pressure) Horizontal (under 4kgf/cm <sup>2</sup> ) Vertical (under 4kgf/cm <sup>2</sup> )	
			G220	198	242		
HYDRAULIC SYSTEMS		Refined mineral oils with superior anti-corrosion and anti-oxidation performance.	HL32	28.8	35.2	Oil perature (Rated pressure) 0-50 °C (under 35kgf/cm <sup>2</sup> ) 15-65 °C (under 35kgf/cm <sup>2</sup> )	
			HL68	61.2	74.8		
	Hydraulic systems	Refined moneral oils with superior anti-corrosion, anti-oxidation and antiwear performances.	HM32	28.8	32.2	Oil temperature (Reted pressure) 0-50 °C (under 140kgf/cm <sup>2</sup> ) 15-65 °C (under 140kgf/cm <sup>2</sup> )	
			HM68	61.2	74.8		
	Hydraulic and Slide ways	Refined mineral oils of HM type with anti-stick-slip propertcs.	HG 32	28.8	32.2	Oil temperature (Reted pressure) 0-50 °C (under 70kgf/cm <sup>2</sup> ) 15-65 °C (under 70kgf/cm <sup>2</sup> )	
			HG 68	61.2	74.8		
	Premium quality		Viscosity (25 °C) SSU				



Table - 4

## The general lubricants for machine tool

	<b>SYMBOL</b>	<b>CPC</b>	<b>ESSO/EXXON</b>	<b>SHELL</b>	<b>MOBIL</b>	<b>DAPHNE</b>
<b>GEARS</b>	CB 32	R 32	Teresso 32	Tellus Oil C 32	DTE Oil Light	Mechanic Oil 32
	CB 68	R 68	Teresso 68	Tellus Oil C 68	DTE Oil Heavy Medium	Mechanic Oil 68
	CB 150	R 150	Teresso 150	Tellus Oil C 150	DTE Oil Extra Heavy	Mechanic Oil 150
	CC 150	R 150	Spartan EP 150	Omala Oil 150	Gear 629	CE Compound 150S
	CC 320	R 320	Spartan EP 320	Omala Oil 320	Gear 632	CE Compound 320S
	CC 460	R 460	Spartan EP 460	Omala Oil 460	Gear 634	CE Compound 460S
<b>BEARINGS</b>	FC 2			High spin oil C2	Velocite Oil No. 3	Mechanic Oil 2
	FC 10	R 12	Spinesso 10	Tellus Oil C 10	Velocite Oil No. 6	Mechanic Oil 10
	FC 22	R 22	Spinesso 22	Tellus Oil C 22	Velocite Oil No. 10	Mechanic Oil 22
<b>SLIDE WAYS</b>	G 63	G 68	Febis K 63	Tonna T 63	Vactra Oil No. 2	Multiway 63C
	G 220	G 220	Febis K 220	Tonna T 220	Vactra Oil No. 4	Multiway 220C
<b>HYDRAULIC SYSTEMS</b>	HL 32	R 32	Teresso 32	Tellus Oil C 32	DTE Oil Light	Hydraulic Fluid 32
	HL 68	R 68	Teresso 68	Tellus Oil C 68	DTE Oil Heavy Medium	Hydraulic Fluid 68
	HM 32	32 AW	Nuto HP 32	Tellus Oil 32	DTE 24	Super Hydraulic Fluid 32
	HM 68	68 AW	Nuto HP 68	Tellus Oil 68	DTE 26	Super Hydraulic Fluid 68
	HG 32		Powerex DP 32	Tonna Oil T 32	Vacuoline Oil 1405	Multiway 32
	HG 68		Powerex DP 68	Tonna Oil T 68	Vacuoline Oil 1408	Multiway 68
<b>GREASE</b>	XM 1	Gulfcrown Grease E.P. No.1	Listan 1	Alvania Grease 1	Mobilux EP 1	Cornex Grease No. 1
	XM 2	Gulfcrown Grease E.P. No.2	Listan 2	Alvania Grease 2	Mobilux 2	Cornex Grease No. 2

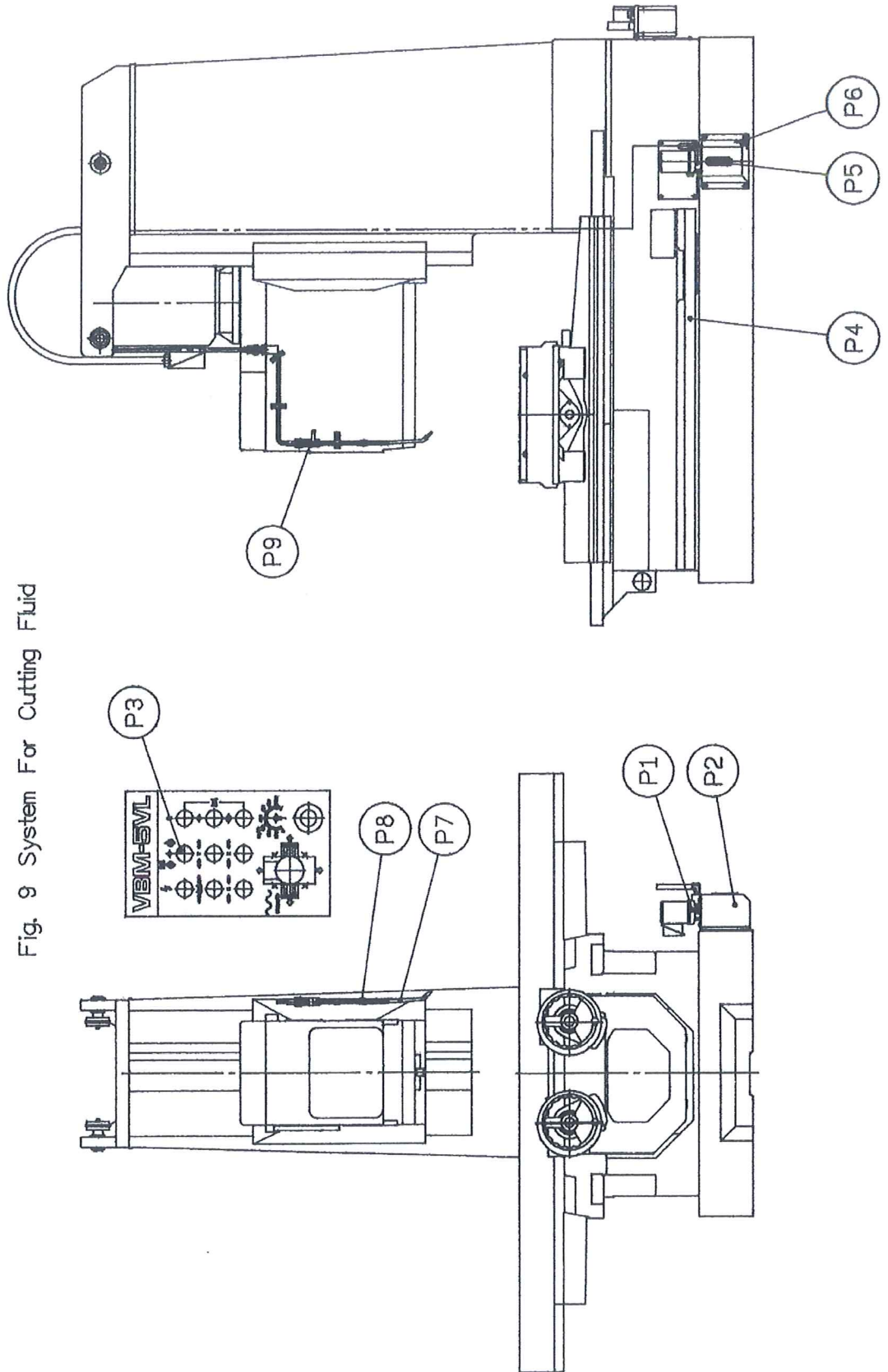
#### **4. Cutting Fluid Pump Device (Fig. 9)**

Cutting fluid pump (P1) located on the right side of the machine is operated by switch buttons (P3) on the operation panel. It will rotate in left position together with spindle, or rotate in right position by itself. Volume of cutting fluid is about 12 Gal, injected from pan (P4) until the gauge (P5) reaches the upper limit. Release the rotary plug to change the cutting fluid.

Cutting fluid nozzle (P7) is located on the right side of spindle head, held by nozzle clasper (P8). The nozzle direction is adjustable and easy to take apart.

The injection quantity is controlled by a valve (P9), increased in counter-clockwise, and decreased in clockwise.

Fig. 9 System For Cutting Fluid



## 5. Operation

### 5-1. Preparation For Operation

Before operating the machine, check and prepare the following items.

Items (1) and (2) are belonged to regular maintenance items.

- (1) Clean the dust or cutting scraps on each sliding surface and circumference and bore of spindle.
- (2) Inject oil to each sliding part according to the oil recommendation (Fig. 8 , Table 3 & 4), especially when the machine turned off for a long period.
- (3) Connect the power source (380V , 50HZ) to R.S.T terminals board of electrical cabinet according to the wiring diagram (Fig. 10).
- (4) Turn on the no-fuse breaker. The pilot lamps of operation panel will be lit up when the current is conducted.

### 5-2. Operation Of Spindle (Fig. 11)

Before operating the spindle, check the clamp of the spindle head switch (S11), and rotate to unclamp position (Fig. 13).

#### (A) Rapid Feed Of Spindle Head (by hand)

Turn the handwheel (H7) of spindle head rapid feed to clockwise to move spindle head downward and to counter-clockwise to move it upward.

The spindle head will move 30mm in each revolution. There is 0.5mm graduation scale (H9) on the collar. When the scale is calibrated to the zero point and fixed, then the readings represent the displacement.

#### (B) Micro Speed Feed Of Spindle Head (by hand)

Micro feed change lever (H6), of spindle is engagement in downward "B" direction and disconnects to upward "A" direction. Operate the micro feed handwheel (H8) of spindle to move the spindle head, downward in counterclockwise upward in clockwise . It will move 3mm in each revolution.

#### (C) The Start And Stop Of Spindle

The spindle will be started or stopped by switches (S4), (S5) and (S6). (S4) is starting switch, (S6) is inching switch, and (S5) is stopping switch. The spindle can only be rotated clockwise, and can't be rotated counterclockwise.

Starting switch (S4) can only be operated when everything gose right. Operate (S5) to stop the spindle.

In emergency case, it is also possible to operate the emergency switch (S9) on operation panel to stop the machine.



#### (D) Rotating Speed Change of Spindle

Spindle rotation speed can be changed by operating 3 steps change lever (H1), 2 steps change lever (H2) and high-low change lever (H3). There are 12 steps change speed as shown in specification. Do not operate the lever when the spindle is in rotation. It can be operated only when the spindle is stopped.

If the spindle is rotated manually, the high-low change lever should be placed in the middle 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 can not move when the spindle is stopped.

#### (F) Automatic Feed Speed Change Of Spindle Head

Automatic feed speed of spindle head can be changed by operating the speed change handle (H4) in clockwise or counterclockwise to achieve one of 5 step feed speeds.

Speed change handle can be operated whenever the spindle is in rotation or automatic feed.

#### (G) Stopping Of Spindle Head Automatic Feed

Spindle automatic feed can be only stopped in downward. Ensure the spindle stop block (D1) fixed in its proper position downward (Fig. 12), and push the piston rod (D2) to "B" direction, and push the lever (H5) to "B" direction. The spindle head goes down automatic.

The spindle head stops feed automatically when spindle head goes down to the piston rod (D2) and contact the stop block (D1).

When the automatic feed is stopped. It is necessary to release the stop block (D1) and set piston rod (D2) quite by hand.

### 5-3. Operation Of Table And Saddle (Fig. 13 , Fig. 14)

Before operation, rotate the table clamping switch (Fig.11) (S12), saddle clamping switch (Fig. 11) (S10) on the operation panel to unclamp position.

#### (A) Hand Feed Of Table And Saddle

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 mech clutch for rotation. It will move the saddle to backward in clockwise, and forward in counterclockwise.

Handwheel will move forward or backward 4mm 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 (L11), (L12) and saddle feed stop block (D5), (D6) and saddle feed limit switches (L13), (L14).

Adjust and fix the feed stop block (D3), (D4) or (D5), (D6) on the desired position. When starting switch (S8) 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 (S8) 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 (L11) (L12), and saddle feed stop block (D5), (D6) contact the limit switches (L13), (L14).

In case of emergency , press the emergency stop switch (S9), all of the power 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 (S8). 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 (S8) press the button and push to operate in the direction based on actual requirements. Rapid feed speed is 3300mm/min per minutes.

#### (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 (L11), the electrical circuit of feed motor will be interrupted, and the movement of table will stop at once. At this time, if the switch (S8) 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 (L12), the electrical circuit of feed motor will be interrupted, and the movement of table will stop at once. At this time, if the switch (S8) 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 (L14) the electrical circuit of feed motor will be interrupted, and the movement of saddle will stop at once. At this time, if the switch (S8) 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 (L13) the electrical circuit of feed motor will be interrupted, and the movement of saddle will stop at once. At this time, if the switch (S8) 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.

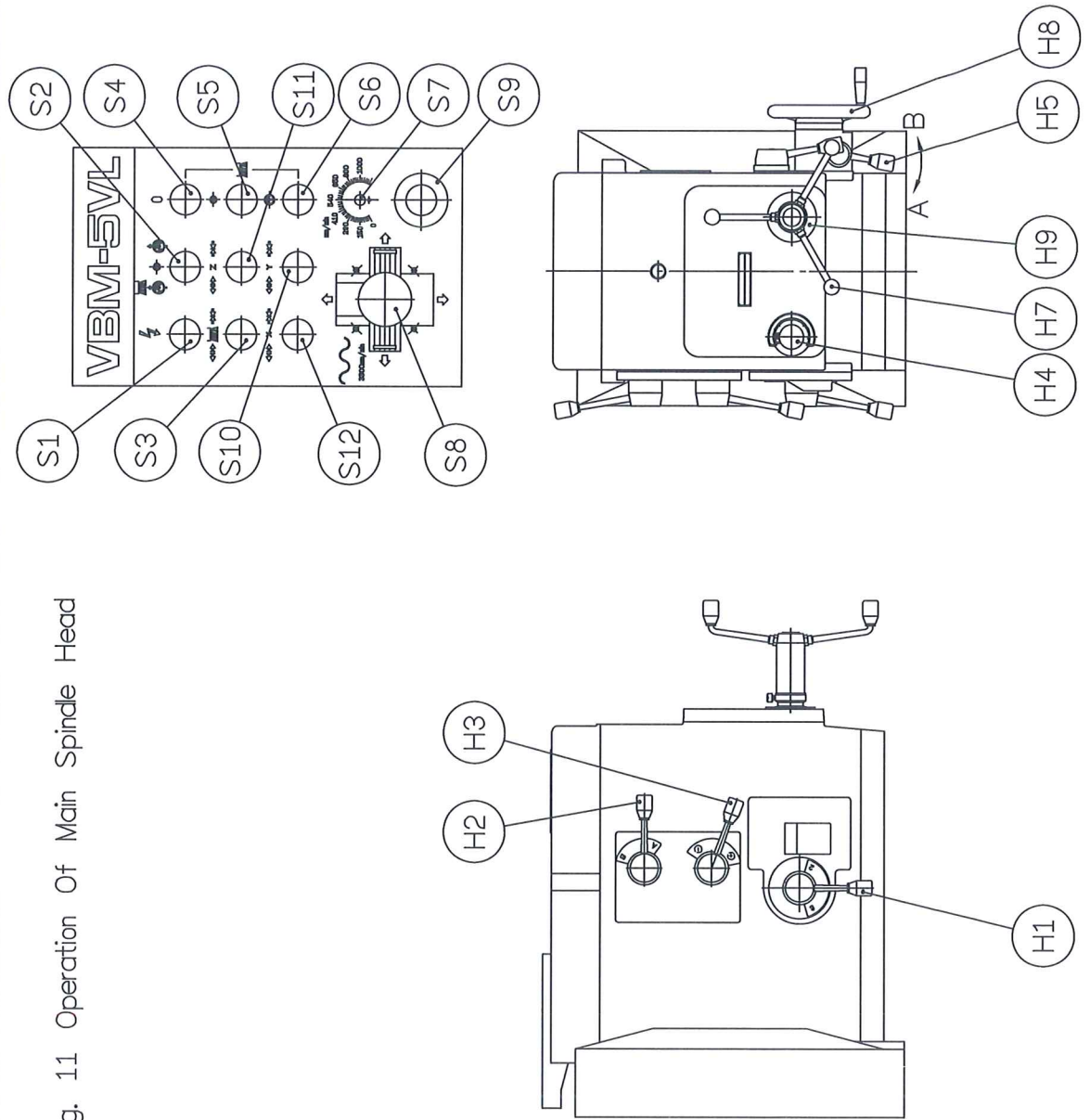
If the elbow block and limit switch are under the following status, the switch (S8) has no action at all. So the motor in speed change box will be not started.

- (1) (D3), (L11) and (D5), (L13) operating same time.
- (2) (D4), (L12) and (D6), (L14) 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 (S8) 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 (S8) direction.



Fig. 11 Operation Of Main Spindle Head



SCALE=1:14



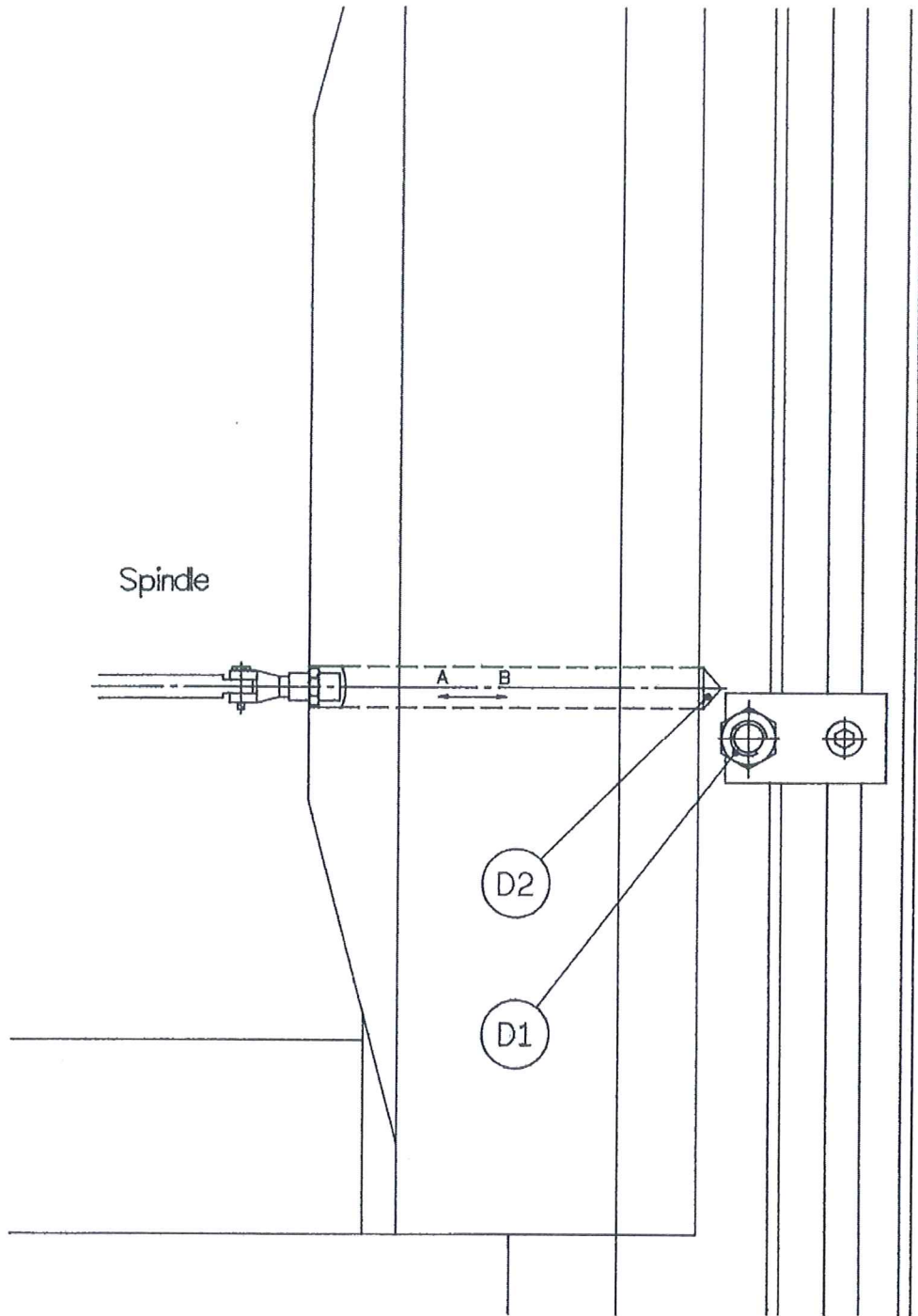


Fig. 12 Setting Relation of Spindle Head

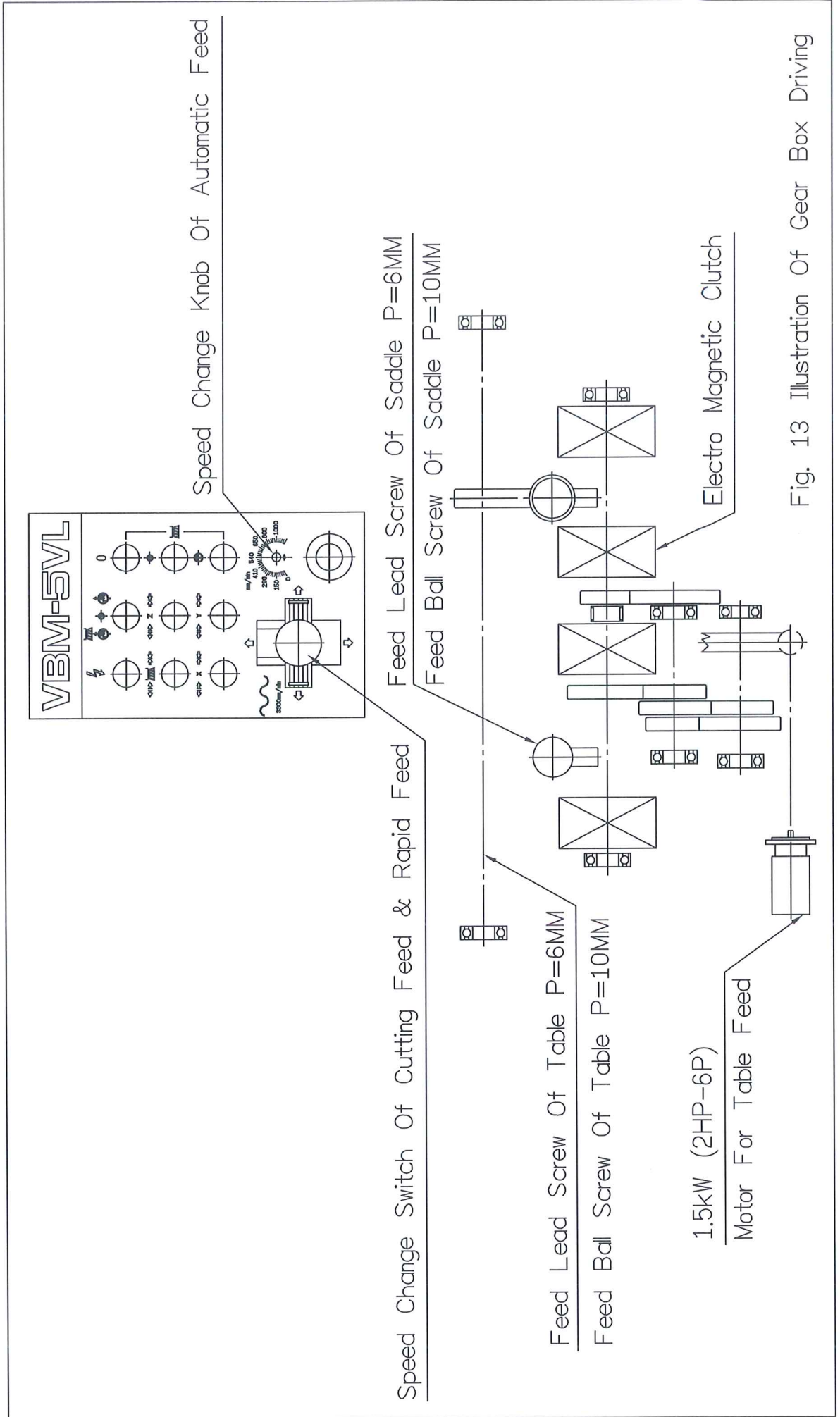
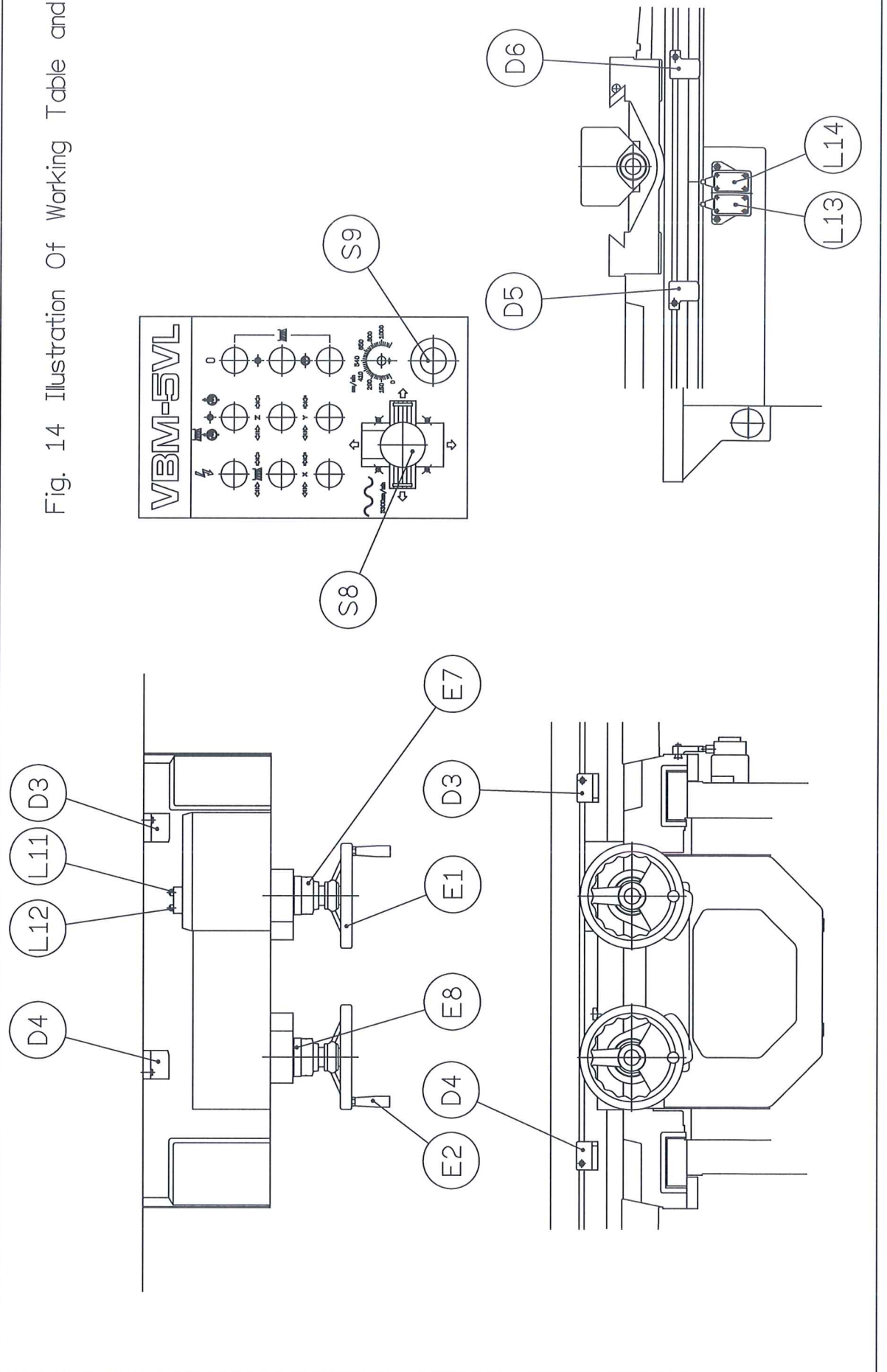


Fig. 13 Illustration Of Gear Box Driving

Fig. 14 Illustration Of Working Table and Saddle



## **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. 11)**

The clamping of spindle head should turn the clamping switch (S11) to right for clamping and turn to left side for unclamping.

### **6-2. Table clamping (Fig. 11)**

The clamping of table should turn the clamping switch (S12) (In the case of boring or drilling operation) to right for clamping and turn to left side for unclamping.

### **6-3. Saddle Clamping (Fig. 11)**

The clamping operation of spindle should turn the clamping switch (S10) to right side for clamping and turn to left side for unclamping.



## **7. Adjustment :**

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. 15)**

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 (8 leveling bolts to be adjusted) . Until the leveling is accurate.
5. Looking the leveling and fixed nuts (L3) (don't rotate the leveling bolts) .
6. Lock the anchor bolts with nuts (A1) .
7. Recheck the airbubbles displacement on the level

### **7-2. Adjustment Of Spindle (Fig. 16)**

If you find loose spindle 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 bolts (B1).
3. Screwing the adjustable nuts (N1) not so loose, not so tight (because of temperature rise of bearing).
4. Screwing the fixed bolts (B1), (Preventing the adjusted nuts (N1) loose).
5. Reassembling the spindle head cover.

### **7-3. Adjustment Of Automatic Feed V-belts Of Spindle head (Fig. 16 & Fig. 17)**

1. Take the cover (HC2) of spindle head apart.
2. Loosen the tension strength of locking nuts (FT1).
3. Use the wrench to screw the tension support (FT2) and make the belt tension to moderate condition. Then tighten the locking nuts (FT1).
4. Reassemble the cover of spindle head.

#### **7-4. Adjustment Of Sliding Surfaces Of Gib. (Fig. 18, Fig. 20)**

When sliding surfaces are loose, make a suitable adjustment.

##### **A. Adjustment of side gib of spindle head (Fig. 18)**

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. 18)**

1. Tighten the locking bolts (K8).
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. 20)**

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

#### **7-5. Adjustment Of All Feed Lead Screws (Fig. 19 , Fig. 21)**

If the feed lead screw has been worn out and backlash increased the adjustment should be taken if necessary.

##### **7-5-1. Adjustment Of Feed Lead Screw Of Table (Fig. 21)**

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 adjustable nut(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 23).
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.

### 7-5-2. Adjustment of Feed Lead Screw Of Saddle (Fig. 19)

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  $\phi 5$ mm diameter of steel bar (200mm long) to insert the outsidehole of adjustable nut (N3). 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.

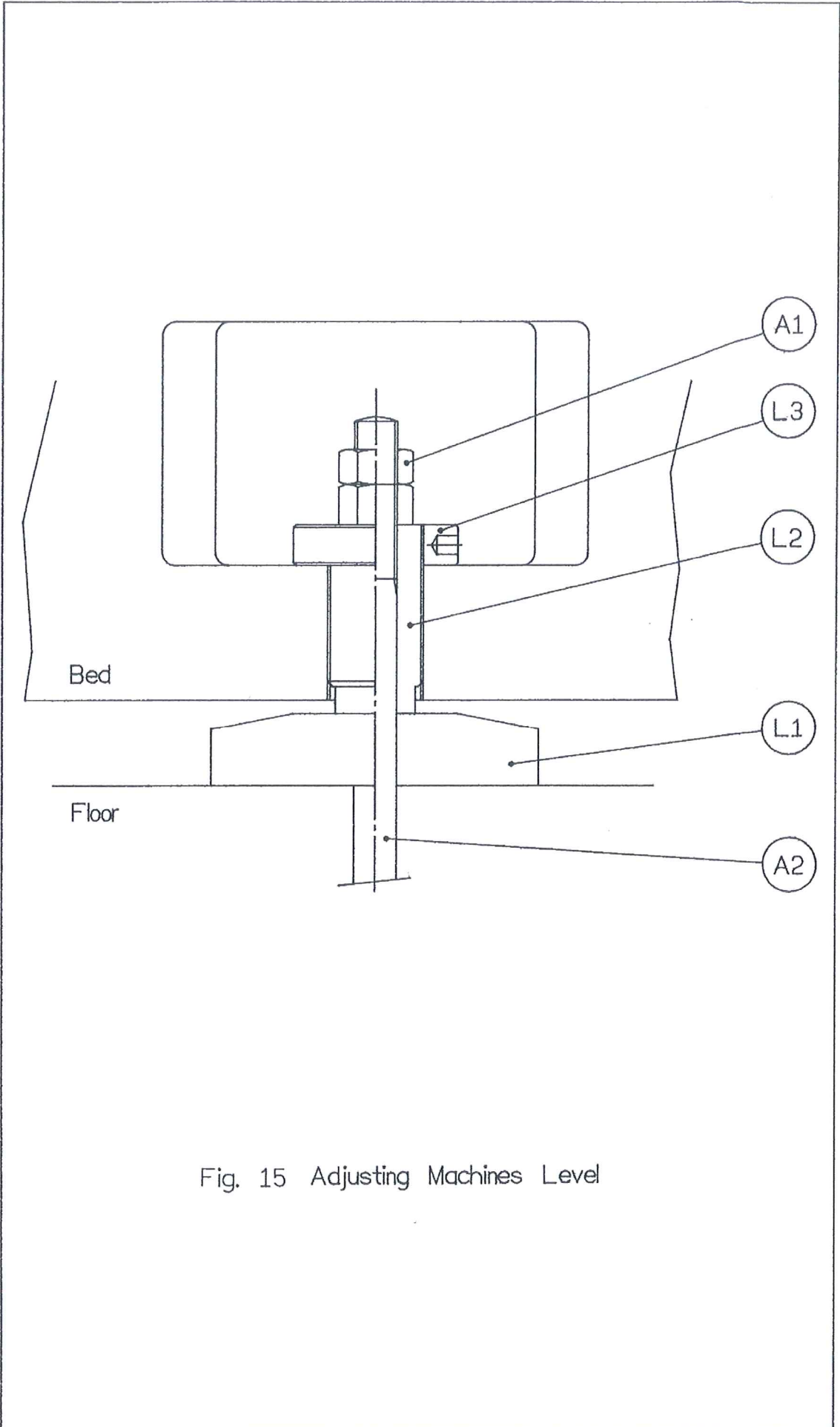


Fig. 15 Adjusting Machines Level



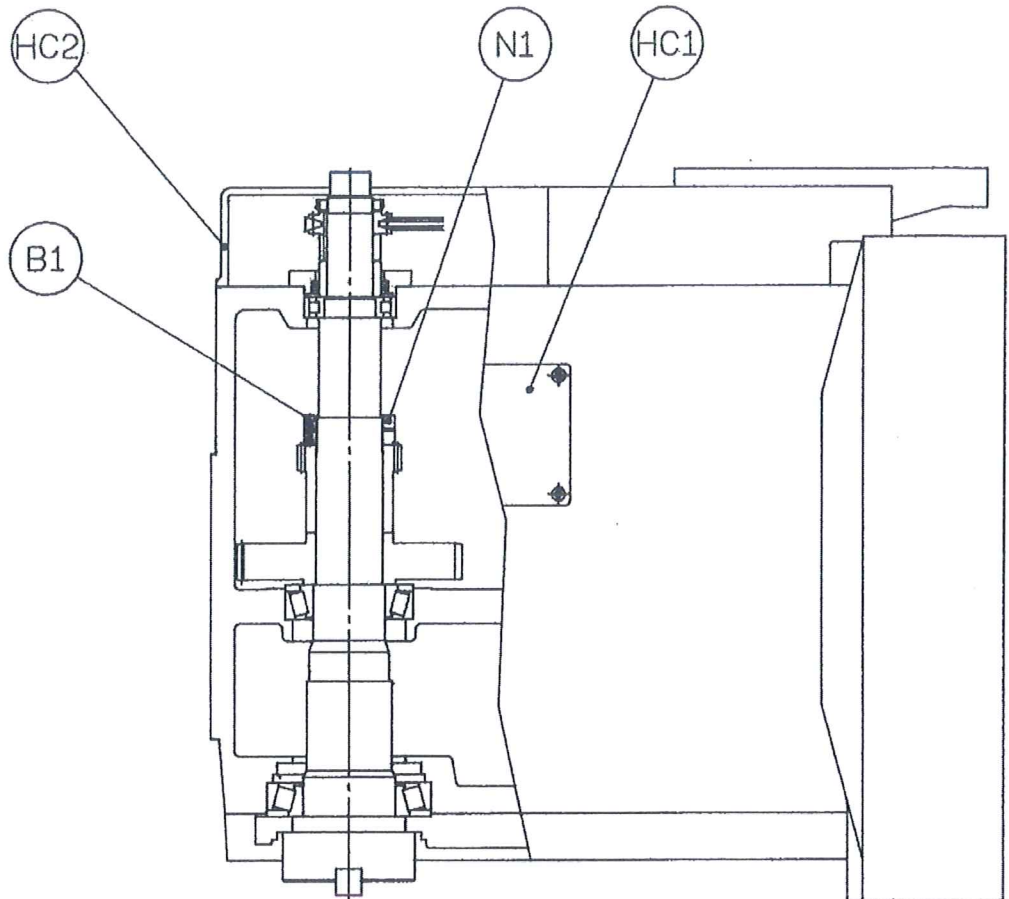


Fig. 16 Adjustment Of Main Spindle

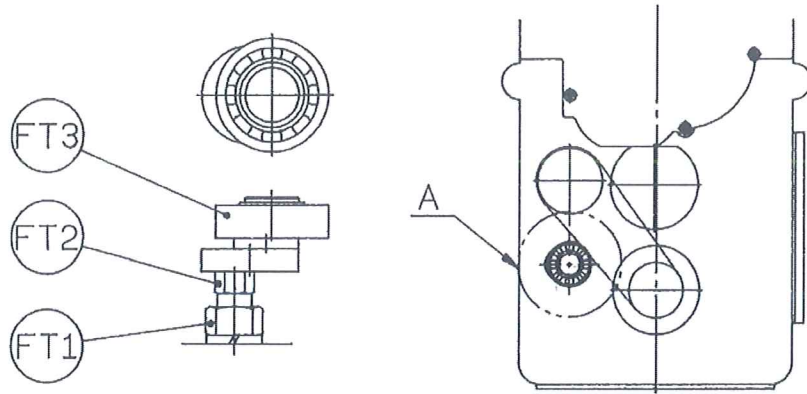


Fig. 17 V-Belt Adjustment Of Main Spindle Automatic Feeding

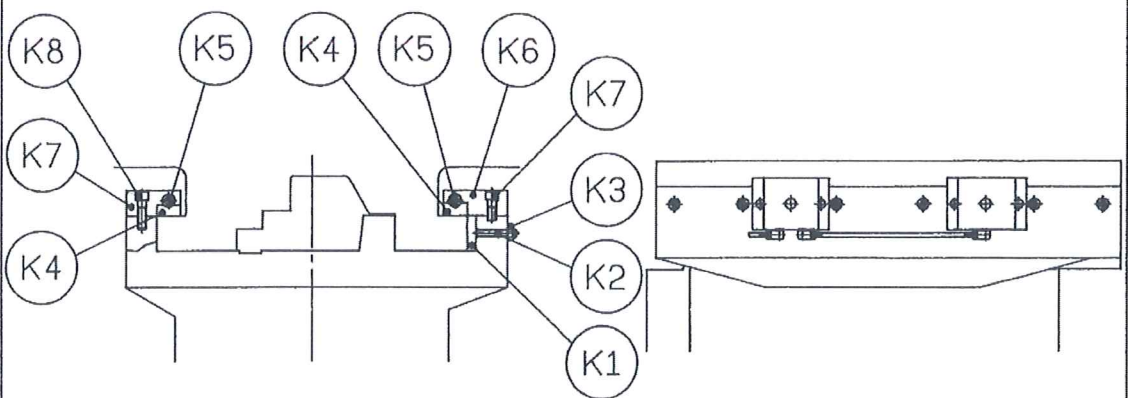


Fig. 18 Adjustment Of Slide Gibs Of Main Spindle

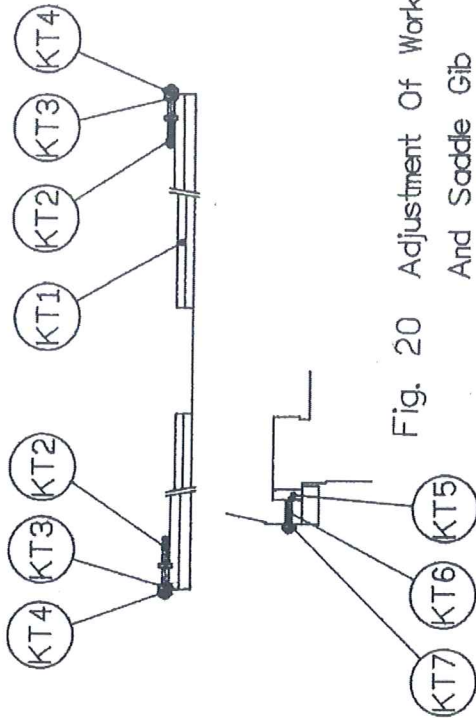


Fig. 20 Adjustment Of Working Table And Saddle Gib

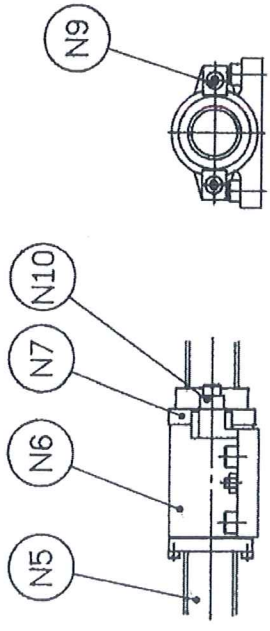


Fig. 19 Adjustment Of Feeding Screw Of Saddle

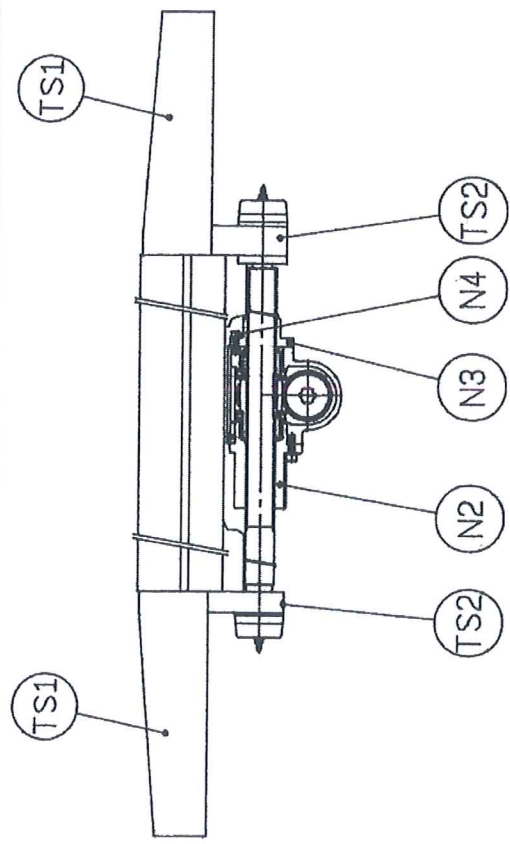
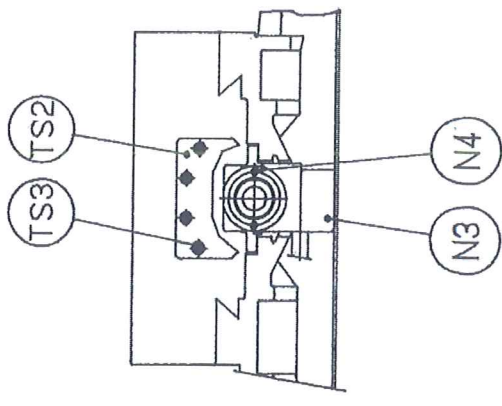


Fig. 21 Adjustment Of Feeding Screw Of Working Table



## 8. Machining Data

### 8-1. Cutting Speed

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

$$V = \pi DN / 1000$$

Where V: cutting speed (m/min)

D: cutter diameter (mm)

N: cutter rotation speed ( R.P.M.)

The cutting speed is related to metal of work piece, metal of cutter and some machining conditions. When cutting, please take the following items into consideration

- (1) Lower cutting speed can increase the lifetime of milling cutter.
- (2) Use lower speed and higher feed for rough processing, and higher speed and lower feed for fine-processing.
- (3) For new works, it is better to use a lower cutting speed at first than normal average. Then increase the cutting speed if it is necessary in actual situation.

Standard cutting speed is listed in table 5.



**Table – 5**

Working Piece			Cutting Speed			
Material		Brinell Hardness HB	High – Speed Steel Cutter		Super – Hard Alloy Cutter	
			M/Min	FT/Min	M/Min	FT/Min
Special steel	Hard	300-400	13-15	38-45	30-50	90-150
	Tough	220-300	15-23	45-70	50-75	150-225
	Annealed	180-220	23-35	70-110	75-108	225-325
Low carbon steel	Malleable	152-197	28-46	85-140	90-130	270-400
	Cut well	150-180	35-46	110-140	108-130	325-400
Cast iron	Hard	220-300	15-23	45-70	50-70	150-225
	Medium	180-220	23-33	70-100	75-108	225-325
	hard Soft	150-180	35-46	110-140	108-130	325-400
Brass and bronze	Hard	150-250	21-46	65-140	63-130	190-400
	Medium	100-150	46-83	140-250	130-200	400-600
	hard Soft	80-100	83-116	250-350	200-330	600-1000
Magnesium and its alloys						
Aluminum and its alloys						
Plastic						

**Note:** The above table should be regarded as a general criterion.

Attention must be paid to the following when operating the machine.

**Table – 6**

Milling cutter	Work Piece			Feed Amount Per Tooth MM.					
	Materials		Brinell hardness HB	Face milling cutter	Plane mill cutter helical teeth	Slotting saw and slide milling cutter	End mill	Formed cutter	Saw blade milling cutter
High – speed steel milling cutters	Special steel	Hard	300-400	0.1	0.075	0.075	0.05	0.05	0.025
		Tough	220-300	0.13	0.125	0.1	0.075	0.05	0.05
		Annealed	180-220	0.2	0.175	0.125	0.1	0.025	0.05
	Low carbon steel	Malleable	152-197	0.25	0.2	0.13	0.125	0.075	0.075
		cuts well	150-180	0.3	0.25	0.175	0.13	0.1	0.035
	Cast Iron	Hard	220-300	0.27	0.2	0.13	0.13	0.1	0.075
		Medium hard	150-250	0.325	0.25	0.175	0.175	0.1	0.075
Soft		150-180	0.4	0.325	0.225	0.2	0.125	0.1	
Brass and bronze	Hard	150-250	0.225	0.025	0.13	0.125	0.075	0.05	
	Medium hard	100-150	0.35	0.35	0.2	0.175	0.1	0.075	
	Soft	80-100	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 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	
Super – hard alloy milling cutter	Special steel	Hard	300-400	0.25	0.2	0.13	0.125	0.075	0.075
		Tough	220-300	0.3	0.25	0.175	0.13	0.1	0.075
		Annealed	180-220	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	150-250	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	150-250	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	
	Soft	80-100	0.5	0.4	0.3	0.25	0.13	0.125	
Magnesium and its alloys			0.5	0.4	0.3	0.25	0.13	0.125	
Aluminum and its alloys			0.5	0.3	0.3	0.25	0.13	0.125	
Plastic			0.57	0.3	0.225	0.175	0.125	0.1	

## 8-2 Feeding Speed

The table feed speed is calculated by cutter rotation speed, number of teeth in cutter and cutter feeding quantity, as shown in the following formular:

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

Where S: table feed speed (mm/min.)

N: cutter rotation speed (R.P.M)

Z: number of teeth

S: cutter feeding quantity. (mm/cutter)

Normally, the calculation is based on the feed of each cutter edge. The standard feed quantity of each high speed steel cutter and carbon cutter are listed in table 6.

## 8-3 Depth of Cutting

The approximated values of depth of cutting in various processing are list in Table 7.

Table 7 Cutting Depthing of Cutter

Processing	Depth of Cutting
Fine Processing	0.3-0.5
Regular Processing	0.4-1.4
Rough Processing	3-5

## 9. Symptoms and Actions for Various cutting Problems

Problem	Symptom	Action
1. Cutting is shifted	<p>Cutting tool is shifted.</p> <p>Tool installation is shifted.</p> <p>Handle is bending</p>	<p>Accurately grind the tool</p> <p>Decrease the tolerance between tool hole and handle diameter.</p> <p>Accurately grind the handle.</p> <p>decrease the turning force.</p> <p>clean the dust.</p>
2. Vibration in cutting	<p>Cutting Knife lifted the work.</p> <p>Handle is too long, too slim.</p> <p>Feeding screw backlash is loose.</p> <p>Work clamping is not proper.</p> <p>Cutting load is too heavy.</p> <p>Cutting vibration at Machine resonant frequency.</p>	<p>Use slip blade, changed into down-cutting.</p> <p>Increase handle toughness.</p> <p>Adjust proper backlash.</p> <p>Tightly clamp the work piece.</p> <p>Surcease shaft rotation speed cutting depth, and feeding quantity.</p> <p>Decrease the number of cutting blades.</p> <p>Decrease cutting frequency.</p>
3. Cutter is loose.	<p>Blade axis is far from cutter axis.</p>	<p>Select proper blades and axis.</p>
4. Work piece deformed after cutting	<p>Clamping is not proper.</p> <p>Table surface is not smooth.</p> <p>Work has resident stress.</p>	<p>Improve clamping method.</p> <p>Do not use heavy clamping force in fine processing.</p> <p>Repair the table surface.</p> <p>Curing the work.</p>
5. Plain cutting is not smooth	<p>Shaft axis is not perpendicular to the table or seat motion.</p> <p>Machine deform due to overheating.</p>	<p>Improve the angle between sliding surface and shaft axis.</p> <p>Decrease machine temperature</p>
6. Actual depth of cutting is different from settings	<p>Handle is bending in processing.</p> <p>Clamping is not hard, so that the work is deformed after cutting.</p>	<p>Increase handle hardness.</p> <p>Decrease cutting force.</p> <p>Improve work clamping.</p>



**10. Table of Machine Maintenance**

Item	Maintenance	Frequency				Remark
		Daily	Weekly	Monthly	Yearly	
1. Lubrication		1	1-2			Refer to Table 3
2. Machine accuracy						Refer to check list
3. Cleaning snit-rust	Sliding surface	1				
	Table surface T-slots	1				
	Spindle axis and inner hole	1				
	Machine surrounding	1				
	Other exposed processing area		1			
	Whole machine			1		
4. Adjusting of gibs	Gib on table, saddle and spindle			2		
5. Adjustment of feeding screws	Screw on table, saddle and spindle			1		
6. Clamp adjusting	Clamps on table, saddle and spindle			2		
7. Screw bolt	Base bolt and locking bolt				2	
8. Heating	Gear drive, bearing, rotator and hydraulic		1			
9. Malfunction vibration	Gear drive, bearing, rotator other parts		1			
10. Electrical parts	Rotator			1		
	Electric wires			1		
	Switches, push buttons			1		



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