

SHARP

PRECISION MACHINE TOOLS

GAT-113E2 9002 3000

VERTICAL & HORIZONTAL MILLING MACHINE

OPERATIONS MANUAL / PARTS LIST

VH3 MILL



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1. Outline of machine

1-1 Appearance (VH-3)



Fig. 1

1-2 Features

- (1) This machine is a vertical and horizontal combination milling machine. It is also able to do angular milling, drilling and boring ect.
- (2) The power and rapid feed movements are in all three axes and are operated by one motor through a feed gear unit.
- (3) Backlash eliminator for climb milling is supplied to increase cutting stability. The table feed motion is protected against overload by an adjustable slipping clutch.
NOTE: This clutch does not work when using the rapid travel.
- (4) The feed selection levers are positioned in front of the knee to facilitate quick and simple operation.
- (5) Push button lubrication is provided for all three slide ways and can be checked by the narrow slot in front of the table.
- (6) All gears and shafts in the main spindle drive are hardened and ground.
- (7) High quality castings are used throughout ensuring excellent accuracy and finish on the slide ways.
- (8) It is easy to change the vertical spindle speed infinitely to suit good machining conditions.
- (9) The automatic feed of the quill can do boring.

1-3 Specification

Table		
Working surface length × width		1,300×300mm
Travel longitudinal × cross × vertical		950×320×470mm
T-slot nominal size × no. × pitch		16mm×3×70mm
Feeds 12 steps	Longitudinal × cross 60 Hz	13~621mm/min
	Longitudinal × cross 50 Hz	11~517mm/min
	Vertical (60 Hz)	7~361mm/min
	Vertical (50 Hz)	6~263mm/min
Rapid Traverse	Longitudinal × cross 60 Hz	2,960mm/min
	Longitudinal × cross 50 Hz	2,467mm/min
	Vertical (60 Hz)	1,520 mm/min
	Vertical (50 Hz)	1,267 mm/min
Swivel table (left & right)		OPTIONAL
Vertical Spindle		
Spindle Nose		ISO R297 No.40
Spindle Speed		120-3,600rpm
Change of Spindle Speed		Infinitely variable
Quill feeds		0.048,0.096,0.192 mm/rev
Quill travel		130 mm
Swiveling angle of head(left & right)		45 deg
Cross travel ram		510mm
Horizontal rotating angle of ram		360 deg
Horizontal Spindle		
Spindle nose		ISO R297 No.40
Spindle speed		45-1,700 rpm
Distance from center of spindle to overarm		182mm
Distance from center of spindle to table		22-492mm
Motors		
For Vertical spindle		AC 3.7kW-4P
For Horizontal spindle		AC 3.7kW-4P
For table feed and rapid traverse		AC2.2kW-4P
Machine Size		
Overall height		2,550mm
Floor area		670×1,200mm
New weight(approx)		2,650kgs

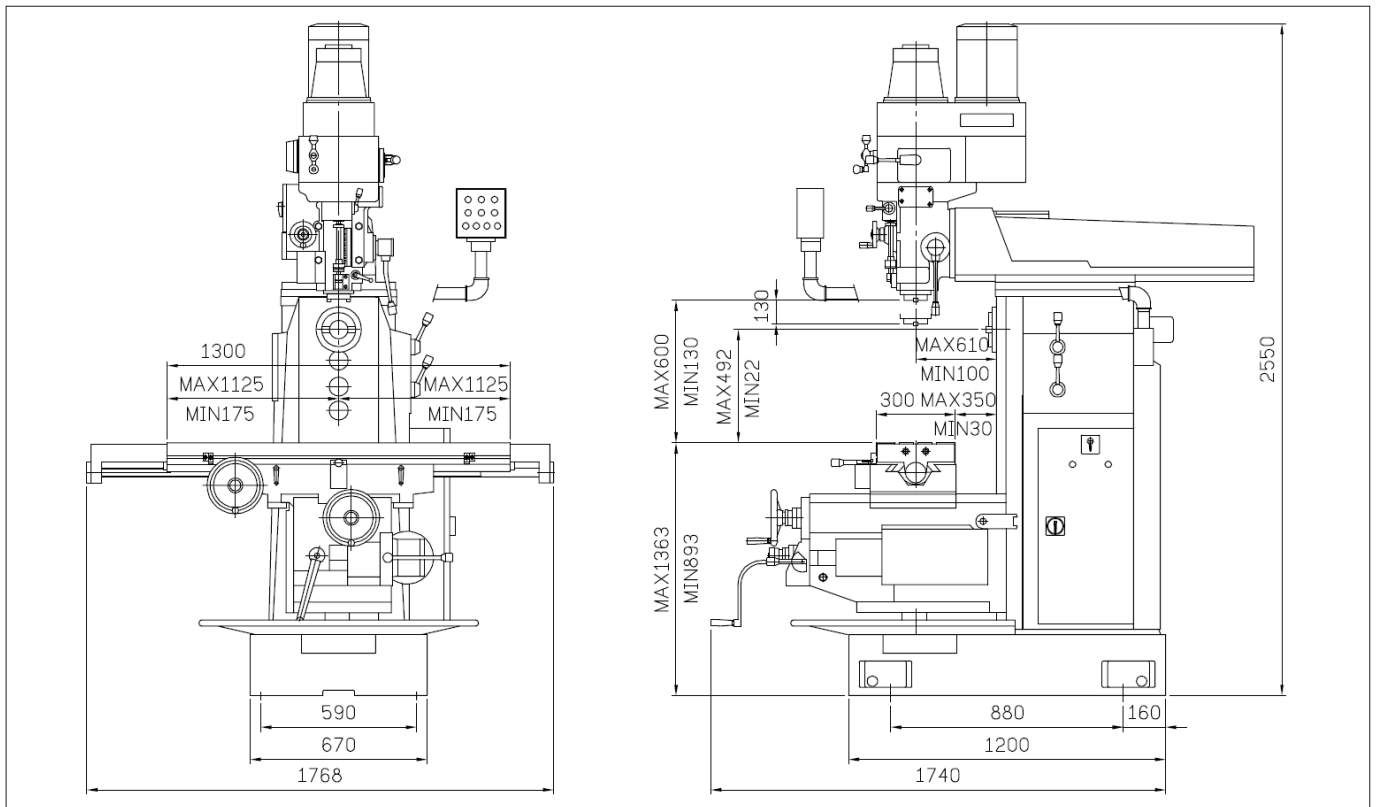
Standard accessories:

- | | |
|-----------------------------|--------|
| 1. Cutting fluid equipment | 1 unit |
| 2. Cutting arbor and sleeve | 1 unit |
| 3. Adjustment tools | 1 set |
| 4. Tool box | 1 set |
| 5. Chip pan | 1 pc |
| 6. Draw bar | 1 pc |
| 7. Leveling blocks | 4 pcs |
| 8. Leveling bolts | 4 pcs |

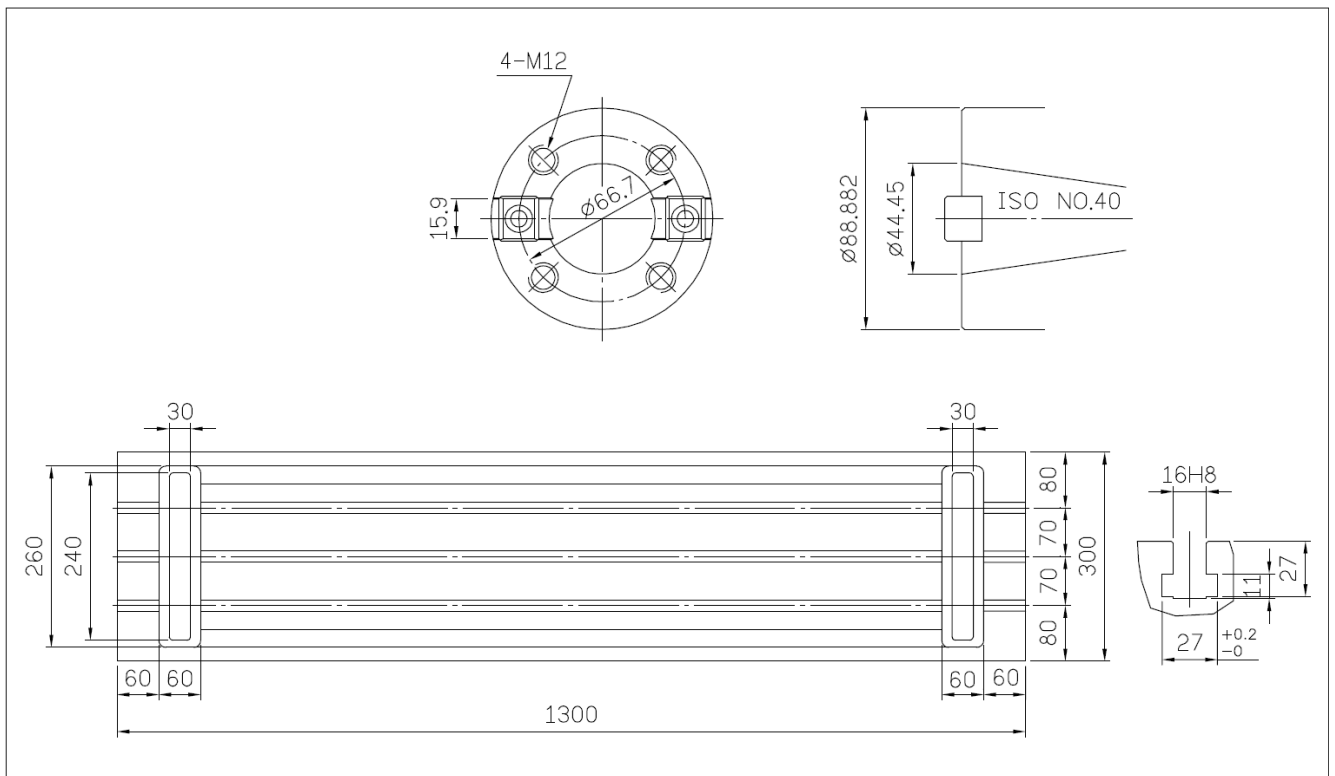
Options:

- | |
|-----------------------|
| 1. Digital read out |
| 2. Air power draw bar |

1-4 External view



1-4-1 Table and spindle nose dimensions

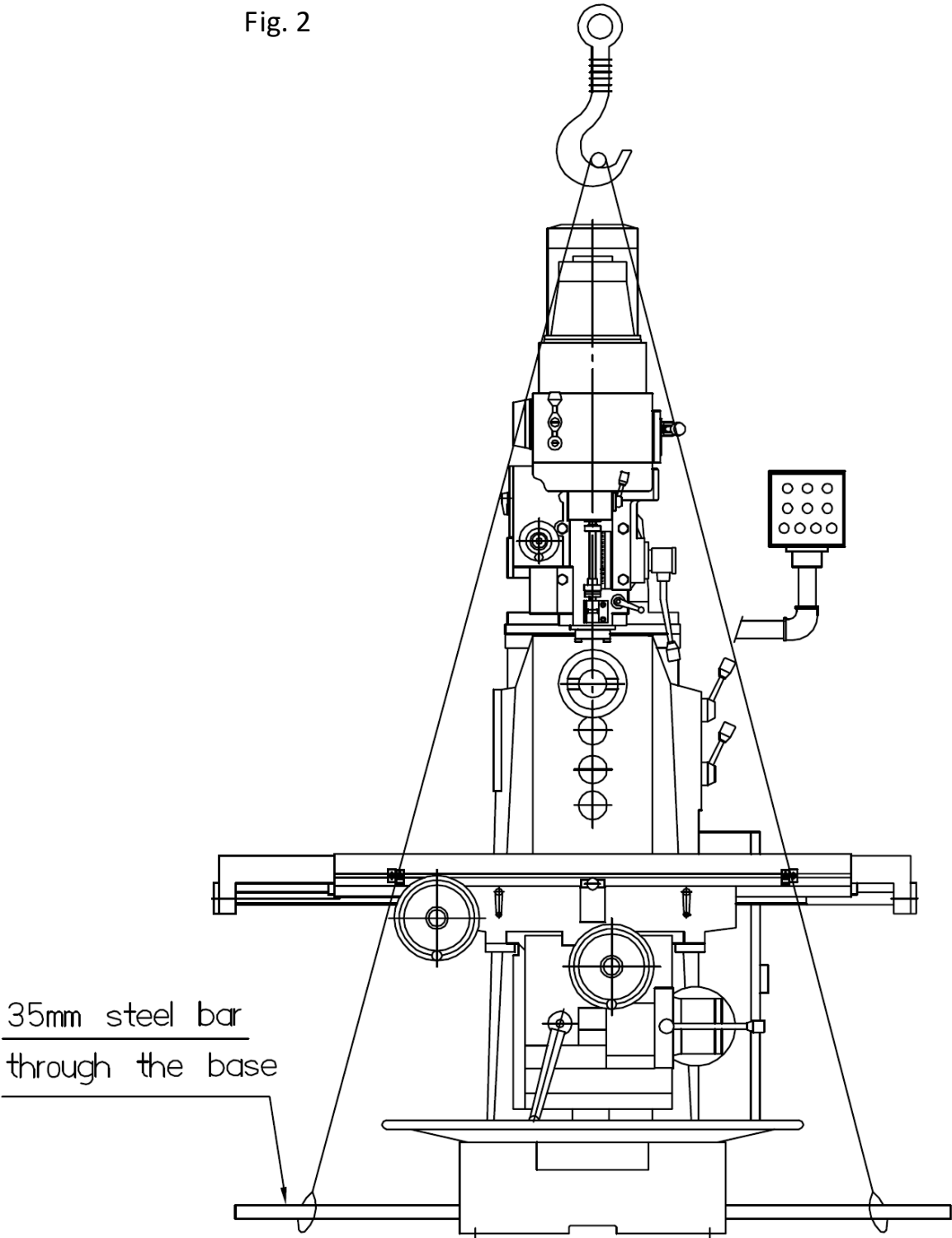


2. Installation and preparation

2-1 Transportation of the machine

When lifting the machine with a crane at the factory site, insert two round bars of about 1-3/8 inch in diameter and use a wire suspension rope of sufficient strength to bear a load of 6,600 lbs. Pieces of wood and cloth should be inserted at the points where the rope touches the machine to absorb impacts which may later influence the accuracy of the machine.

Fig. 2



2-2 Inspection and cleaning

When the machine is delivered, check for damage or shortages in the number of attachments. Then wipe off dirt and protective coating.

2-3 Storage and installation

The surrounding condition of storage is that

Temperature range: -25 °c to +75 °C

Relative humidity range: 30% to 95 % (non-condensing)

Damage from shock and vibration should be avoided

Ingress of solid bodies and liquid should be avoided

Four leveling bolt should be adjustment the machine level.

When installing the machine must be adjustment four leveling bolt (Fig.3) for level.

2-4 Maintenance and inspection

(1) Precautions for operating

- a. Always lubricate designated oil to designated oiling points before starting.
- b. Confirm that the work and setting jigs do not strike anything before actuating table feed.
- c. The power table longitudinal feed should not exceed the range limitations of the machine. Always set the automatic reversing dog on both sides within the moving range.

2-5 Cutting oil

There are two general types of cutting oil, i.e., water-soluble cutting oil and water-insoluble cutting oil, and these are further divided into many groups. As selection of the cutting oil depends on each cutting condition, particular trade names or groups cannot be specified here but it is necessary to observe the following:

- (1) Use of water-insoluble cutting oil.

Examples:

Mineral oil	Light oil, machine oil and spindle oil
Animal and vegetable oil	Lard, olive oil, colza oil, soybean oil and castor oil

- (2) The capacity of the cutting oil tank is approximately 9.25 gallons.
- (3) Cutting oil should be supplied through an oil strainer into the cutting oil intake provided on the lower part of the column.

2-6 Wiring

The power cord should be connected to the terminals R.S.T. (Fig. 4-2). On completion of the connection, turn on the power switch (Fig. 4-1) provided on the side of the power box and turn the spindle rotating direction indicating change over switch to the right.

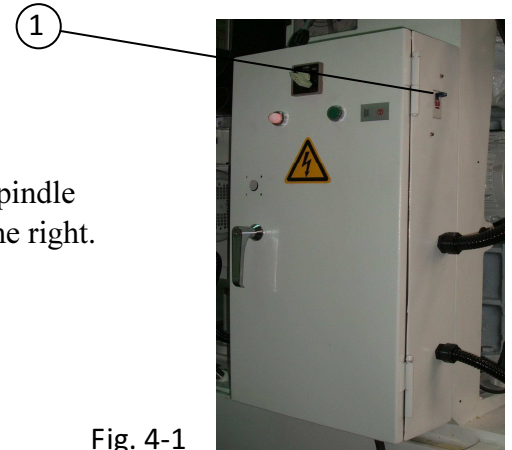


Fig. 4-1

After finishing the above preparations, start the main spindle. (See section for spindle starting, spindle stopping and spindle brake). If the rotation direction of the main spindle is clockwise, connections are correct. If rotation is counter-clockwise, exchange connections of two of the three wires of the power core.



Fig. 4-2

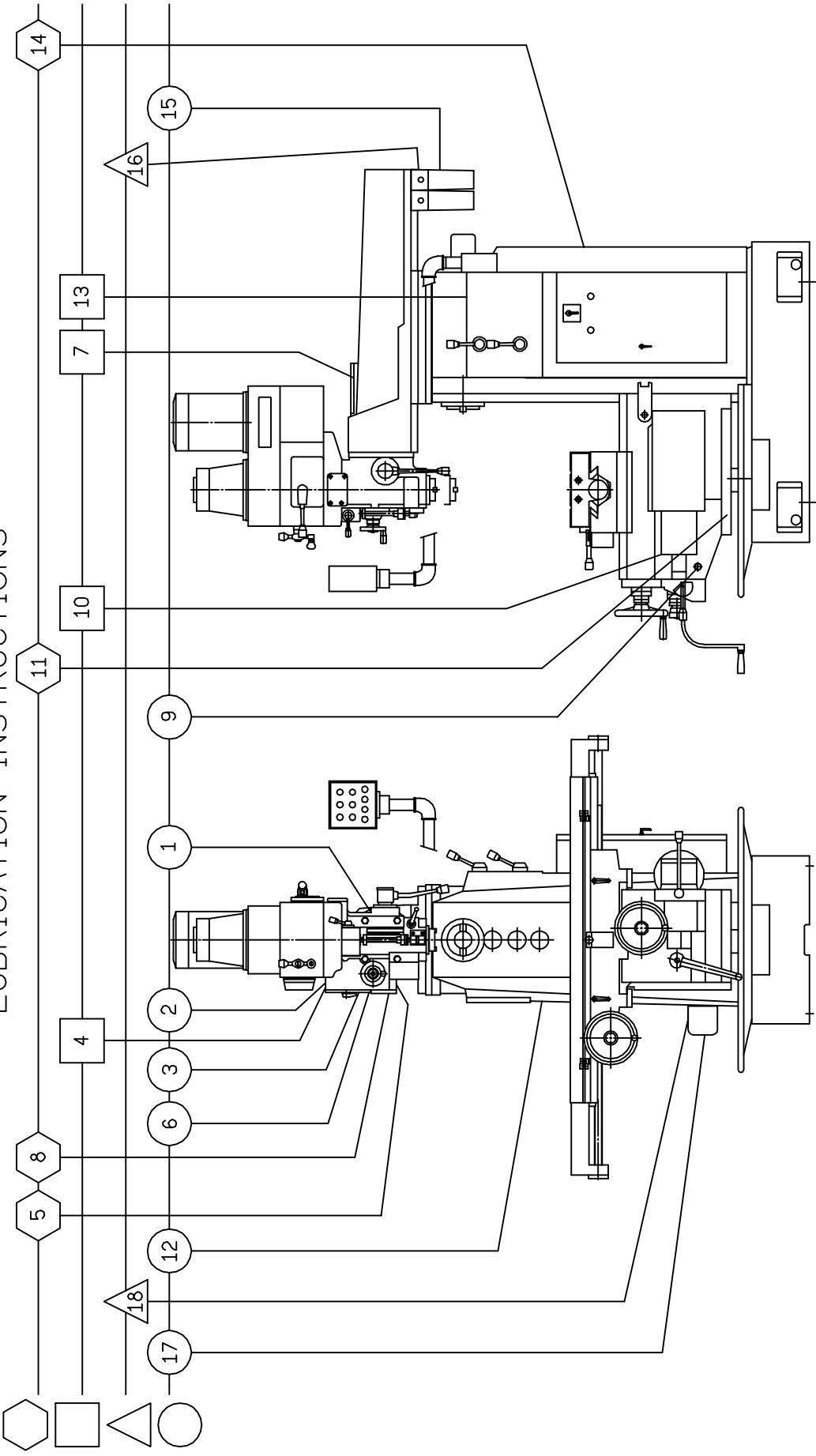
2-7 Lubrication

Prior to starting, each moving part must be lubricated with suitable lubricating oil. Refer to (Table.1) for instructions to lubricate the spindle head gears, quill and slide ways.

The Lubrication oil to be used for each part is also listed in Table 2 and 3. It can be used for selecting the correct lubricant to keep the machine in its best condition.

LUBRICATION INSTRUCTIONS

Table-1
 YEARLY
 MONTHLY
 WEEKLY
 DAILY



Machine components	Spindle quill (V)	Quill feed gears	Spindle gears (V)	Table feed gears	Spindle gears (H)	Arbor support	Slide ways
Item	1	2 3 4	5 6 7 8	9 10 11	12 13 14	15 16	17 18
symbol							
Check		Daily		Daily		Daily	Daily
Fill	Daily		Monthly	Monthly		Weekly	Weekly
Clean & Replace			Yearly	Yearly	Yearly		
Lubricant	CB32	CB32	CB32	CB32	CB32	CB32	G68
Capacity	0.04L	0.8L	4L	4L	40L	0.5L	0.5L
Remarks							

Table - 2 Instruction for correct lubricant

	Application Fields	Properties	Symbol and Viscosity Grade	Kinematic Viscosity (40°C)			REMARKS
				Mean.	min.	max.	
GEARS	Enclosed moderately loaded gear (spur gear, bevel gear)	Refined mineral oils with good oxidation stability.	CB 32	32	28.8	35.2	Pinion speeds(motor output) 2,000-5,000rpm(within 3.7kw) 1,000-2,000rpm(within 7.5kw) -1,000rpm(within 15kw)
			CB 68	68	61.2	74.8	
			CB 150	150	135	165	
GEARS	Enclosed heavily loaded gears (worm and wheel)	Refined oils with good oxidation stability and with improved load-carrying ability.	CC 150	150	135	165	Worm speeds 2,000- rpm 1,000- rpm -1,000rpm
			CC 320	320	288	352	
			CC 460	460	414	506	
BEARINGS	Spindles bearings and associated clutches	Refined mineral oils with superior anticorrosion and anti-oxidation performances.	FC 2	2.2	1.98	2.42	Shaft speeds (shaft dia.) 10,000- rpm(-30mm) 2,000-10,000rpm(30-150mm) -2,000rpm(150- mm)
			FC 10	10	9.00	11.0	
			FC 22	22	19.8	24.2	
SLIDE WAYS	Slide ways	Refined mineral oils with improved lubricity and tackiness performance preventing stick-slip.	G 68	68	61.2	74.8	Slide way (surface pressure) Horizontal (under4kgf/cm ²) Vertical (under4kgf/cm ²)
			G 220	120	198	242	
HYDRAULIC SYSTEMS	Hydraulic systems	Refined mineral oils with superior anti-corrosion and anti-oxidation performances. Refined mineral oils with superior anti-corrosion, anti-oxidation and anti-wear performances.	HL 32	32	28.8	35.2	Oil temperature (Rate pressure) 0-50°C (under35kgf/cm ²) 16-65°C (under35kgf/cm ²)
			HL 68	68	61.2	74.8	
			HM 32	32	28.8	35.2	
HYDRAULIC SYSTEMS	Hydraulic and Slide ways	Refined mineral oils of HM type with anti-stick-slip properties.	HM 68	68	61.2	74.8	Oil temperature (Rate pressure) 0-50°C (under140kgf/cm ²) 16-65°C (under140kgf/cm ²)
			HG 32	32	28.8	32.2	
			HG 68	68	61.2	74.8	
GREASE		Premium, quality greases with superior anti-oxidation and anti-corrosion properties.	Viscosity (102°F) SSU			Centralized systems Cup or hand gun	
			XM 1	310-340			
			XM 2	265-295			

Table - 3

The general lubricants for machine tool

	SYMBOL	CPC	ESSO/EXXON	SHELL	MOBIL	DAPHNE
GEARS	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
BEARINGS	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
SLIDEWAYS	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
HYDRAULIC SYSTEMS	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
GREASE	XM 1	Gulfcrowm Grease E.P. No.1	Listan 1	Alvania Grease 1	Mobilux EP 1	Cornex Grease No. 1
	XM 2	Gulfcrowm Grease E.P. No.2	Listan 2	Alvania Grease 2	Mobilux 2	Cornex Grease No. 2

3. Handling the main operating parts

3-1 Name of each part

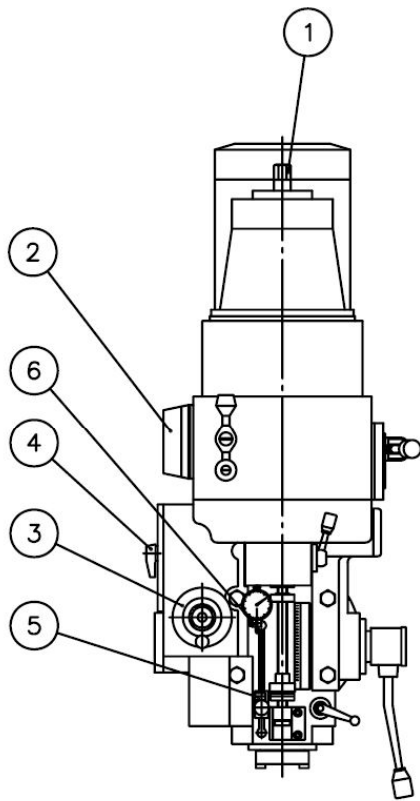


Fig.6

Fig. 6

- (1) Draw-in blot
- (2) Name plate for indicating spindle speed.
- (3) Hand wheel for main spindle vertical feed.
- (4) Main spindle vertical feed change over knob
- (5) Indicator stop
- (6) Indicator holder

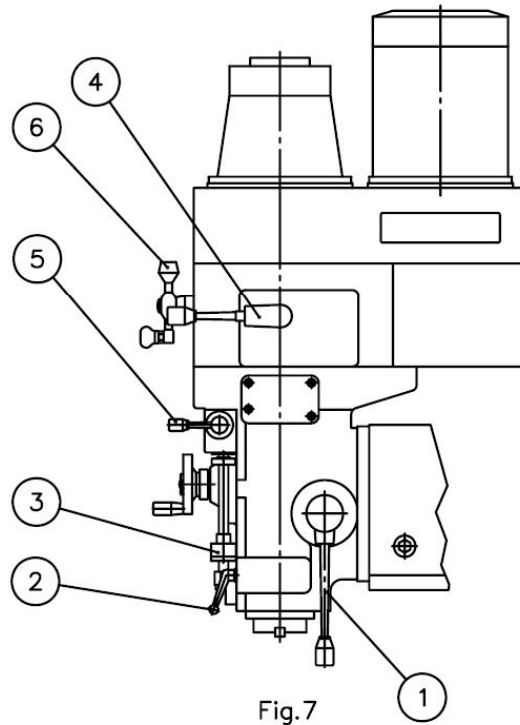


Fig.7

Fig. 7

- (1) Main spindle vertical rapid lever
- (2) Spindle quill clamping lever
- (3) Main spindle vertical adjustment stopper
- (4) High-Low speed shifter lever
- (5) Main spindle feed direction change-over lever
- (6) Variable speed handle

3-2 Electric operation panel (Fig. 8)

- (1) Operation ready button
- (2) Tapping and milling function switch
- (3) Emergency stop button
- (4) Horizontal spindle start button
- (5) Horizontal spindle stop button
- (6) Vertical spindle start button
- (7) Vertical spindle stop button
- (8) Table feed motor start button
- (9) Cutting oil pump switch
- (10) Spindle brake switch
- (11) Table feed motor stop button

3-3 Start, stop and brake for vertical and horizontal spindle

Steps to rotate the spindle: Push the horizontal spindle button (Fig. 8 (4)) or vertical spindle button (Fig.8 (6)) and the horizontal or vertical motor will start. Steps to stop the motor of vertical or horizontal spindle. Push the horizontal spindle stop button (Fig.8 (5)) or vertical spindle stop button (Fig.8 (7)). And the rotating spindle will gradually slow down and stop. If turning spindle brake switch (Fig.8 (10)) to right then the spindle will stop immediately.

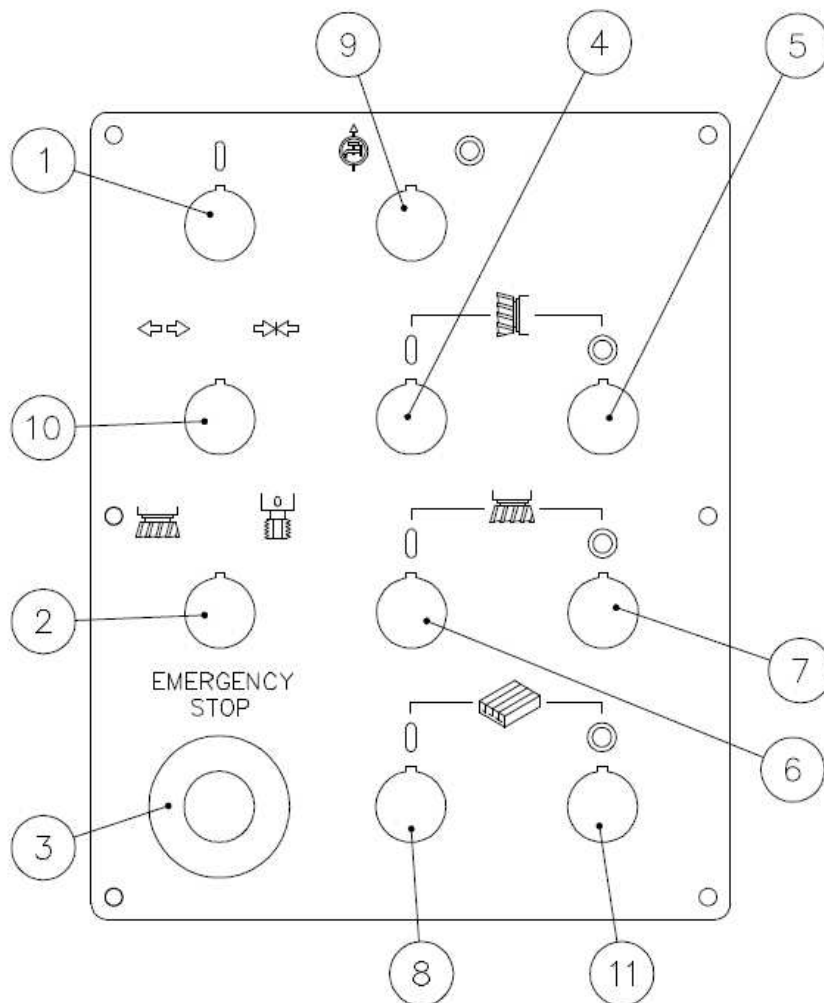


Fig.8

3-4 The tapping function of the vertical spindle

Steps to operate the tapping function: Turn button (Fig.8 (2)) to the right, and pull the tapping control lever (Fig.9) up for release (Counter-clock-wise), down for tapping (Clock-wise).



Fig. 9

3-5 Change of vertical spindle speed




The vertical spindle speed should be chosen according to work piece material, cutter diameter and cutter material tables 5 and 6 for you reference.

To change the vertical spindle speed, operate the high-low speed change lever (Fig.7-5) and rotating speed change handle (Fig.7-7).R.P.M. can be read out from the indicator (Fig.6 (2)). The rotating direction of the speed change handle is opposite to the direction of the indicator.

The brown area of the indicator represents low speed, the blue area represents high speed. Put the high-low speed change lever at the position “-“, when the vertical spindle R.P.M is at the low speed range (120-720 rpm).Put the high-low speed change lever at the position”+”, when the vertical spindle R.P.M.is at the high speed range (600-3600 rpm).

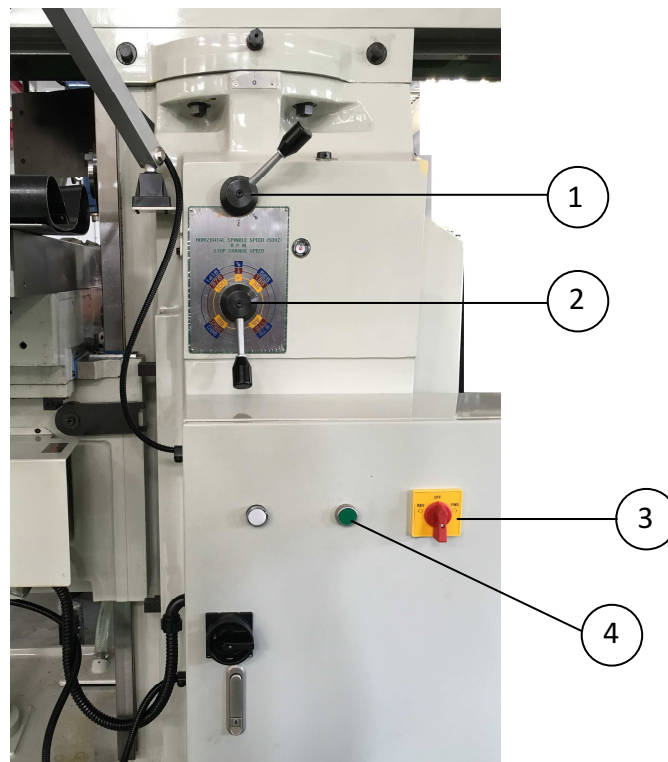
By putting the high-low speed change lever at the position “N”, the spindle gears can be then disengaged, and the vertical spindle can be rotated by hand. Operation of high-low speed change lever: hold the handle, push it slightly, the lock pin will then disengage, move the handle to a proper position, insert lock pin into the hole to fix lever.

3-6 Change of horizontal spindle speed

Move lever (Fig.10 (1)) to position  .  or  depending upon the spindle speed range required, and move lever (Fig.10 (2)) to the position of the particular speed required. Speed changes must not be made while the main motor is running.

To facilitate changing spindle speed, stop main motor by depressing horizontal spindle stop button (Fig.8 (5)). Turn spindle rotated direction switch (Fig.10 (3)) to position 1 or 2 and then intermittently press the inching button (Fig.10 (4)), at the same time moving lever (Fig.10 (2)) until the required gears are engaged. It should be noted that the feed motor will automatically stop when the inching button is operated.

Fig 10



3-7 Vertical spindle manual feed operation

There are two types of manual vertical spindle adjustment, namely, adjustment by hand wheel (Fig.11 (1)) and rapid adjustment by the main vertical spindle adjustment lever (Fig.12 (4)).

For general milling, the hand wheel for the vertical spindle adjustment should be used. The handle wheel for the vertical spindle adjustment is providing with a scale collar (Fig.12 (2)).

A full rotation of the collar denotes 3mm of feed and rotation per one division is 0.02mm of feed. If the scale collar is locked at an operational position with the clamping screw (Fig.12 (3)), the vertical feed amount can be read easily.

When using the main vertical spindle rapid adjustment, turn the knob to the right and the clutch will be engaged. Now the lever is ready for use. It is convenient to use the lever when it is necessary to affect spindle vertical feed quickly or when operation similar to that of a drilling machine is required.

The main vertical spindle rapid adjustment lever and hand wheel for the vertical spindle feed may not be used simultaneously.

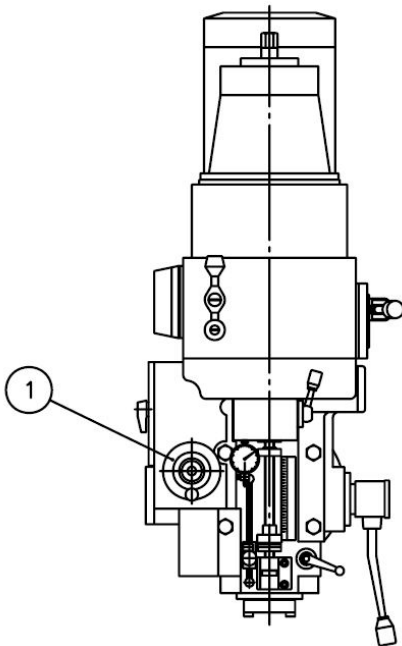


Fig.11

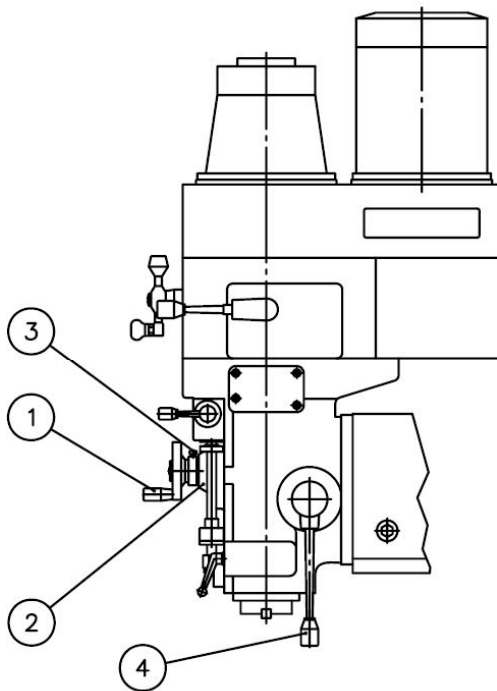


Fig.12

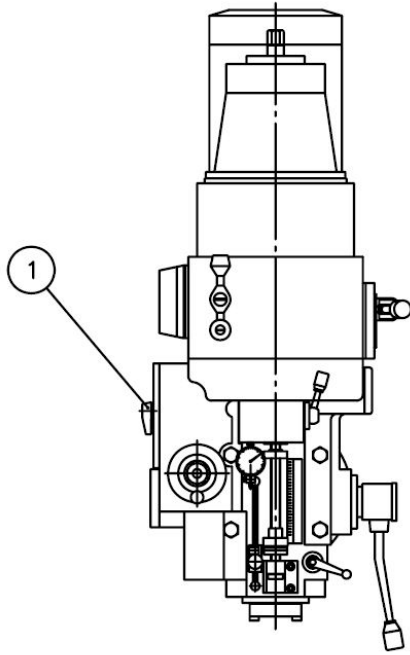


Fig.14

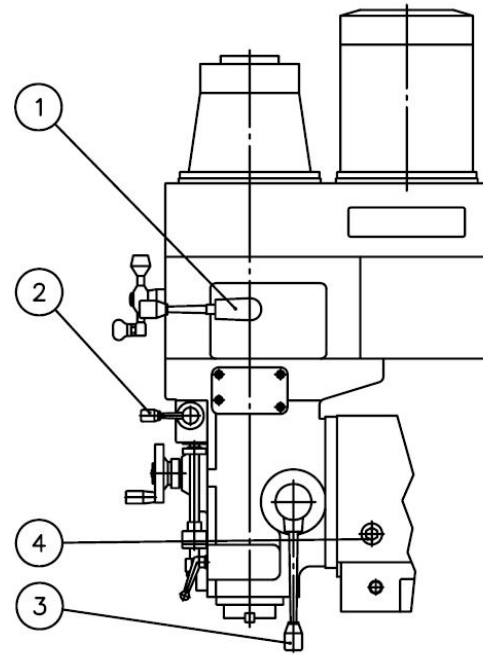




Fig.13

3-8 Operation of vertical spindle power down feed

The vertical automatic feed should be carried out in the following manner.

- (1) Stop rotation of the main spindle and align the shifter lever (Fig.13 (1)) with the mark + - on the name plate.
- (2) Select the necessary feed amount (0.048, 0.096, 0.192mm) per revolution with the vertical feed selection knob (Fig.14 (1))
- (3) Set the spindle feed direction lever (Fig.13 (2)) either to the up (Marked ) or down (Marked ) position from the stop position in accordance with the instructions given on the name plate.
- (4) Then push the spindle starting button (Fig.8 (6)) forward to start the spindle. The required automatic feed is thus obtained. Precaution for using the vertical spindle automatic feeding device: The spindle feeding direction change-over lever must always be at the stop position when the automatic feed is not in use.

3-9 Vertical spindle feed adjusting stopper

The stopping position for the spindle down feed is set by the spindle adjustment stopper (Fig.7 (3)) located on the front of the headstock.

By setting the stopper at the required position and locking it with a lock nut, products of uniform size may be obtained without individually measuring the work.

The stopper is provided with graduations on its periphery. One division of which indicates 0.01mm.

A full rotation of the scale shows 1 mm. The scale may also be used as a micrometer for fine adjustment.

3-10 Vertical spindle quill clamping

The spindle quill clamp lever (2) (Fig.7) should be clamped the quill when turned to the right and release the quill when turned to the left.

3-11 Fine reading device for main spindle vertical movement

When accuracy is required in vertical feed, the micrometer (Fig.15 (1)) should be clamped to the indicator holder (Fig.15 (2)) with the clamping screw (Fig.15 (3)), and the indicator stopper (Fig.15 (4)) should be fixed at a suitable height by the fixing knob (Fig.15 (5)) to read a fine cutting amount.

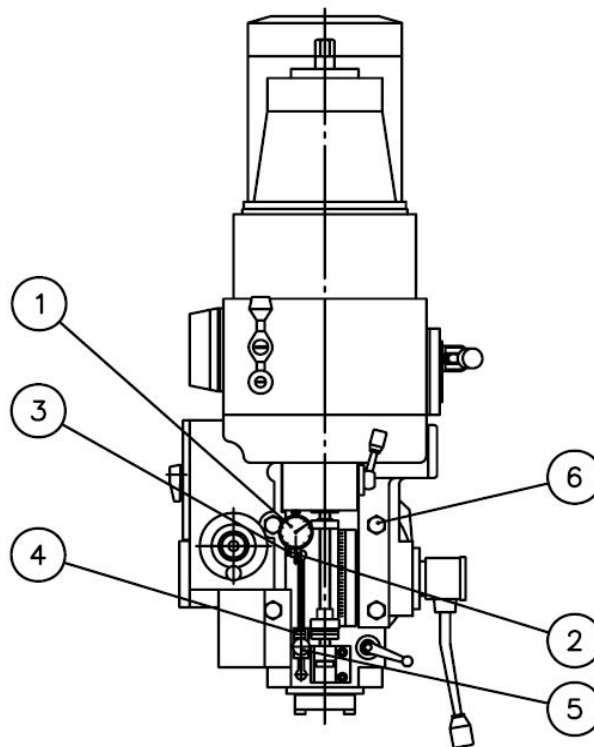


Fig.15

3-12 Vertical spindle head swiveling

Swiveling within the vertical plane of the spindle head is necessary when milling slanted work. Up to 45° of longitudinal swiveling is possible.

The spindle head should be swiveled in the following manner:

- (1) Loosen the 4 bolts (Fig.15 (6)) at the front of the spindle head.
- (2) Turn the spindle head swiveling worm (Fig.13 (4)) with a wrench to swivel the spindle head to the required angle while observing the scale.
- (3) Tighten the 4 bolts after obtaining the required swivel.

3-13-1 Swiveling of over arm on horizontal plane

The over arm can be swiveled by turning the swivel base (Fig.16 (2)) located on the top of the column.

Procedure for horizontal swiveling:

- (1) Loosen the four bolts (Fig.16 (1)) on the left and right side which secure the swivelbase to the column top.
- (2) Push the over arm for the required angle either to left or right to swivel.
- (3) After it has been swiveled to the required angle, secure the swivel base with the four bolts which were loosened previously.

3-13-2 Over arm transverse movement

The over arm may be moved transversely within a range of about 510mm. This cross movement should be carried out in the following manners.

- (1) Loosen the 2 bolts. (Fig.16 (3))
- (2) Move the over arm, transversely by turning the pinion rotation shaft (Fig.16 (4)) with a wrench.
- (3) Retighten the 2 bolts after obtaining the necessary movement to fix the over arm.

3-14 Over arm and arbor support brackets

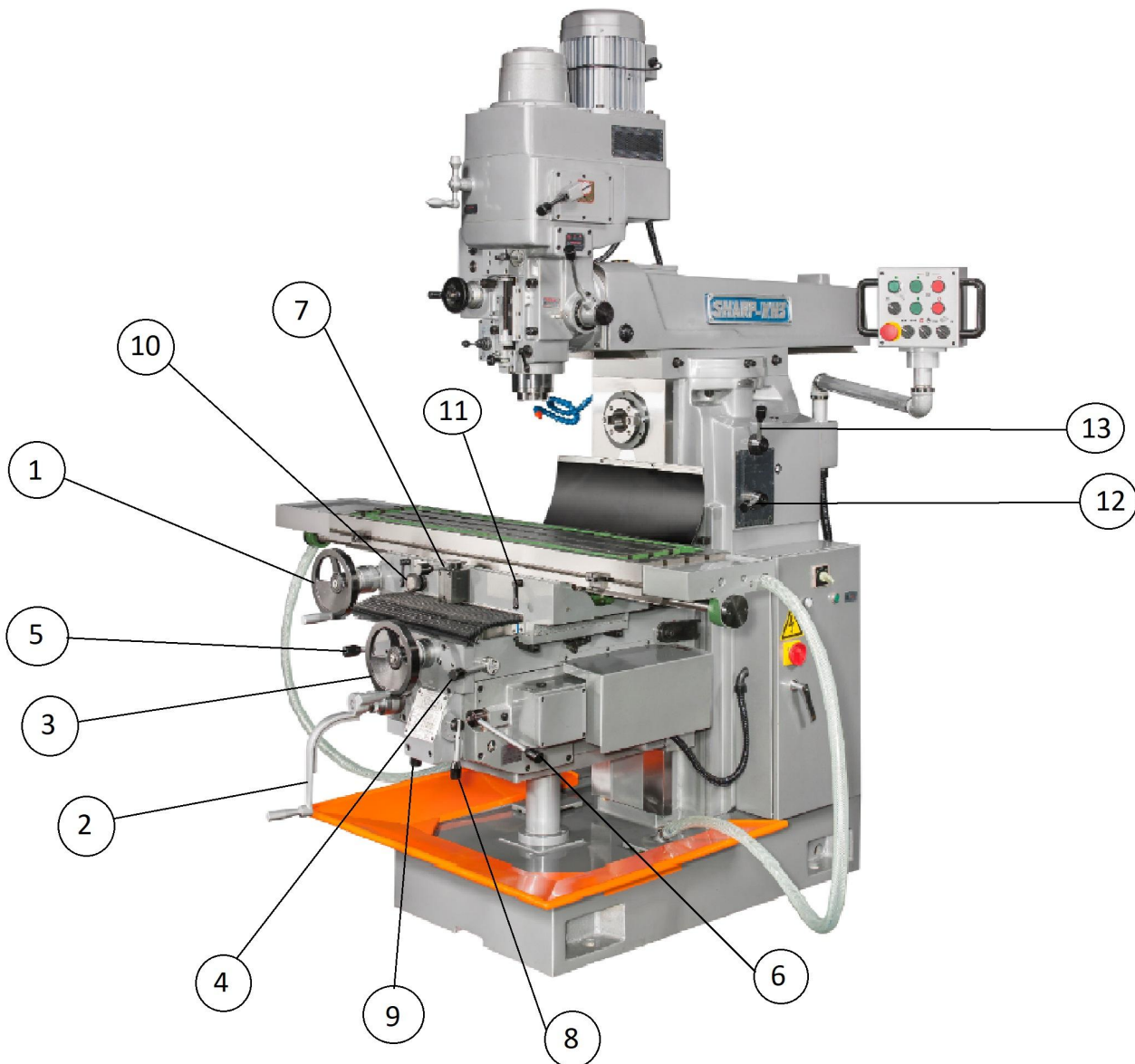
The column is provided with two over arm locking nuts at the right hand side and each arbor support bracket is provided with a locking nut. When the over arm has been positioned on the column as required, and the arbor support brackets positioned as required on the over arm, all four locking nuts must be tightened securely.



Fig. 16

3-15 Part's name of table feed

- (1) Longitudinal feed hand wheel (hand adjustment)
- (2) Vertical feed (hand adjustment)
- (3) Cross feed (hand adjustment)
- (4) Cross feed engagement lever
- (5) Vertical feed engagement lever
- (6) Rapid traverse engagement lever
- (7) Longitudinal feed engagement lever
- (8) Feed selection lever A
- (9) Feed selection lever B
- (10) Backlash eliminator control
- (11) Longitudinal clamp lever
- (12) Horizontal spindle speed selection lever
- (13) Horizontal spindle speed range selection lever



3-15-1 Operation of manual feed

Operate longitudinal feed by hand wheel (Fig.18 (1)), cross feed by hand wheel (Fig.18 (3)), and vertical feed by hand lever (Fig.18 (2)).

If directional changing lever (Fig.18 (7)) at central front of saddle is in neutral position, longitudinal manual feed can not be operated.

Chart of rotation of manual feed hand wheel and moving direction of working table.

Hand wheel Table	Rotation direction (clockwise)	Displacement One division	Scale collar One revolution
Longitudinal Feed	Right hand	0.01mm (0.001 inch)	2.5 mm (0.1 inch)
Cross feed	Forward(go far from operator)	0.02mm (0.001 inch)	5 mm (0.2 inch)
Vertical feed	Upward	0.01mm (0.0005 inch)	1.2mm (0.05 inch)

3-15-2 Operation of cross power feed

Start feed motor by push button (Fig.8 (8)) and then lever (Fig.18 (4)) upwards for the saddle to feed towards the column, and for the saddle to feed away from the column move lever (Fig.18 (4)) downward.

3-15-3 Operation of vertical power feed

Start feed motor by push button (Fig.8 (8)) and then move lever (Fig.18 (5)) upward to feed the knee upwards to move lever (Fig.18 (5)) downward, to feed the knee downward.

3-15-4 Operation of longitudinal power feed

Start feed motor by push button (Fig.8 (8)) and then move lever (Fig.18 (7)) right for the table to feed from the left to the right and for the table to feed from right to left move lever (Fig.18 (7)) to left.

3-15-5 Choice of feed speed

Feeding speed is dependent on the spindle speed, material of work piece, tips of cutter and diameter of cutter (Table 6). With this machine, 12 steps of cutting feed and rapid feed are carried out from the feed box which is under the side of saddle.

Push the button (Fig.8 (8)) to start the table longitudinal feed motor.

Move lever (Fig.18 (9)) to position A, B or C Dependent upon feed range required and move lever (Fig.18 (8)) to the position for the particular feed rate required. It is not necessary to stop the feed motor when changing the feed rate.

"WARNING"

- (1) Don't change feeding speed if table is moving.
- (2) Before stopping the spindle or when the table auto feed is not used push back the feed engagement lever (Fig.18 (4)(5)(7)) to neutral.

3-15-6 Operation of rapid traverse

This can be operated on any of the foregoing movements by having the feed motor running which is independent of the main spindle motor and moving the lever whichever direction engages the feed required into the correct position, and then moving lever (Fig.18 (6)) upwards until the appropriate distance has been moved. Then lever (Fig.18 (6)) should be returned to its neutral position.

3-15-7 Backlash eliminator

The use of the backlash eliminator device allows" climb milling" to be carried out on this machine. The backlash eliminator controller (Fig.18 (10)) is situated on the front of the saddle.

When climb milling is to take place with the cutter revolving clockwise and the table moving from right to left, the backlash eliminator control should be rotated counter - clockwise.

To set the backlash eliminator turn the controller (Fig.18 (10)) in the appropriate direction and at the same time rotate the table hand wheel continue turning the controller (Fig.18 (10)) until resistance is felt at the table hand wheel.

Do not over tighten the backlash eliminator.

The table must not be put into rapid traverse when the backlash eliminator is engaged.

3-15-8 Operation of dog

The auto-stop longitudinal feed is worked by dogs which are located in the T-slot front of table. The two fixed dogs (Fig.19 (2) (3)) on the outsides are safety stops which prevent over travel. These should not be moved.

The two inside dogs (Fig.19 (4) (5)) can be set at any position so that the table stops automatically in set range.

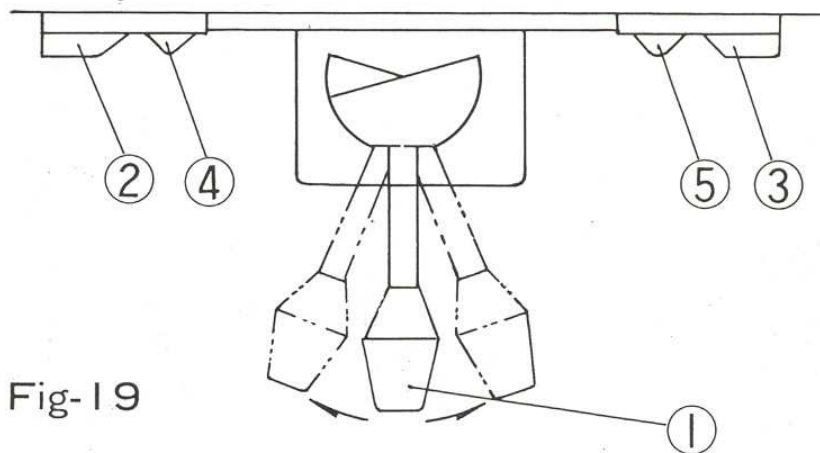


Fig-19

3-15-9 Clamping of sliding surface

- (1) When longitudinal feed is not need, turn two clamp lever (Fig.20 (3)) clockwise at front of saddle to tighten the table.
- (2) When vertical feed is not in use, turn clamp lever (Fig.20 (2)) at rear of knee to tighten the knee.
- (3) When cross-feed is not in use, pull clamp lever (Fig.20 (1)) under the left side of the saddle toward operator to lock the saddle.

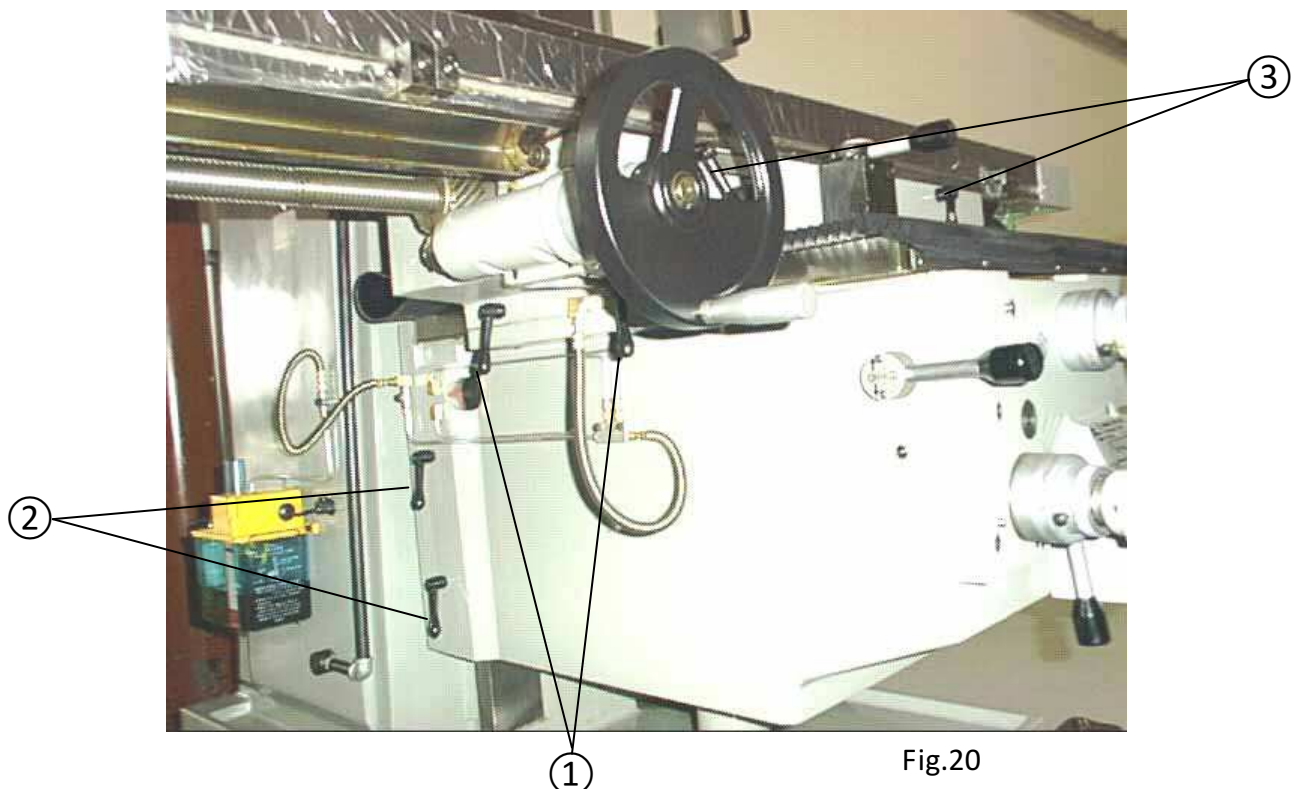


Fig.20

4. Safety devices

4-1 Thermal relay

When electric current exceeding the rating, the thermal relay (Fig.21) is actuated automatically to stop the driving motor. If the thermal relay is actuated, locate and correct the cause and reset the thermal relay by pressing the thermal relay reset push button.

4-2 Fuses

Fuses (Fig.21) are installed in the control box to protect electric circuits. If the machine does not start operation with the power source connected and no abnormality is indicated in each safety device, check the fuses. If fuses are blown, remove the cause before replacing the fuse.

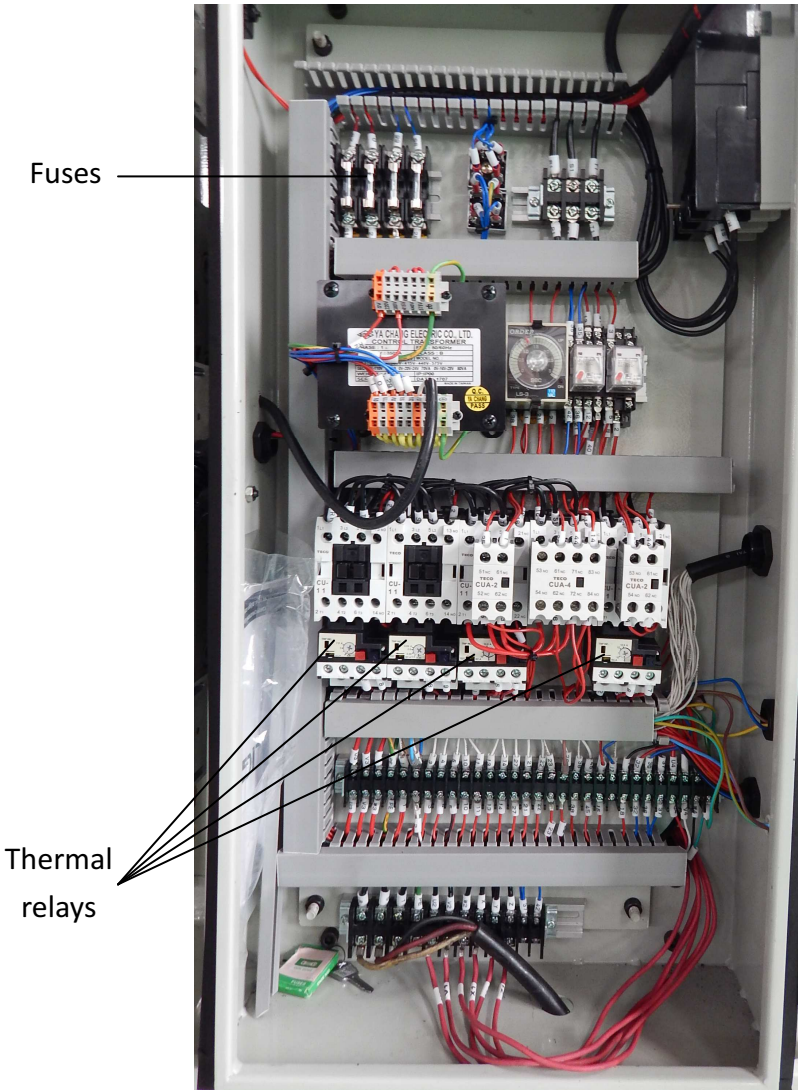











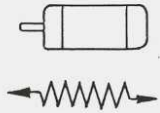











Fig.21

5. Symbols

The various movements and corresponding symbols used on this machine are indicated in Table 4.

Table 4.

NO.	DESCRIPTION	SYMBOL	NO.	DESCRIPTION	SYMBOL
1	Main spindle		12	Rapid feed	
2	Revolution per minute		13	Power pilot lamp	
3	Feed amount per revolution		14	Start	
4	Neutral		15	Stop	
5	Main spindle brake		16	Emergency stop	
6	Main spindle without brake		17	Table feed motor	
7	Table		18	Cutting oil pump	
8	Feed (normal)		19	Vertical spindle clockwise rotation	
9	Low speed feed		20	Vertical spindle counter clockwise rotation	
10	Longitudinal feed		21	Vertical spindle automatic feed	
11	Vertical feed				

6. Suggested starting speed and feeds

6-1 Carbide cutters

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	38-45	30-50	90-150
	Tough	220-300	45-70	50-75	150-225
	Annealed	180-220	70-110	75-108	225-325
Low carbon steel	Malleable	152-197	85-140	90-130	270-400
	Cut well	150-180	110-140	108-130	325-400
Cast iron	Hard	220-300	45-70	50-70	150-225
	Medium hard	180-220	70-100	75-108	225-325
	Soft	150-180	110-140	108-130	325-400
Brass and bronze	Hard	21-46	65-140	63-130	190-400
	Medium hard	46-83	140-250	130-200	400-600
	Soft	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.

6-2 High speed steel cutters

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	



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