SHARP

PRECISION MACHINE TOOLS

HORIZONTAL MILLING MACHINE

OPERATIONS MANUAL / PARTS LIST **UH**-3 MILL

CONTENTS

1. General Instruction of Machine

1-1 Appearance

Fig. 1

1-2 Features

(1) The power and rapid feed movements in all three axis are operated by one motor through a feed gear unit.

(2) Backlash eliminator for climb milling is supplied to increase cutting stability. The table feed motion is protected against overload by an adjustable slipping clutch.

(3) The feed selection levers are positioned in front of the knee to facilitate quick and simple operation.

(4) All gears and shafts in the main spindle drive are hardened and ground.

(5) High quality castings are used throughout ensuring excellent accuracy and finish on the slide ways.

(6) The universal head (optional) can perform vertical milling or any angle cutting.

1-3 Specifications (UH-3)

Table			
Working surface length x width			1300 x 300 mm
Travel longitudinal x cross x vertical			950 x 320 x 470 mm
T-slot nominal size x No. x pitch			16mm x 3 x 70 mm
Feeds (12 steps)	Longitudinal x cross	50Hz	11-517 mm/min
	Vertical	50Hz	6-263 mm/min
Rapid traverse	Longitudinal x cross	50Hz	2467 mm/min
	Vertical	50Hz	1267 mm/min
Swivel table (left & right)			45deg
Universal spindle head (optional)			
Spindle nose			ISO R297 No.40
Spindle speed			36-1415 RPM
Change of spindle speed			12 steps
Distance from spindle end to table			0-470 mm
Distance from center of spindle to column			360 mm
Horizontal spindle			
Spindle nose			ISO R297 No.40
Spindle speed (12 steps)		50Hz	36-1415 RPM
Distance from center of spindle to over arm			135 mm
Distance from center of spindle to table			0-470 mm
Motors			
For horizontal spindle			AC3.7kW-4P
For table feed and rapid traverse			AC2.2kW-4P
For cutting fluid pump			AC0.1kW-2P
Machine size			
Overall height			1710 mm
Floor area			670 x 1200 mm
Net weight (approx.)			2350 kgs

1-3 Specifications (UH-3)

Table			
Working surface length x width			1500 x 300 mm
Travel longitudinal x cross x vertical			1050 x 320 x 470 mm
T-slot nominal size x No. x pitch			16mm x 3 x 70 mm
Feeds (12 steps)	Longitudinal x cross	50Hz	11-517 mm/min
	Vertical	50Hz	6-263 mm/min
Rapid traverse	Longitudinal x cross	50Hz	2467 mm/min
	Vertical	50Hz	1267 mm/min
Swivel table (left & right)			45deg
Universal spindle head (optional)			
Spindle nose			ISO R297 No.40
Spindle speed			36-1415 RPM
Change of spindle speed			12 steps
Distance from spindle end to table			0-470 mm
Distance from center of spindle to column			360 mm
Horizontal spindle			
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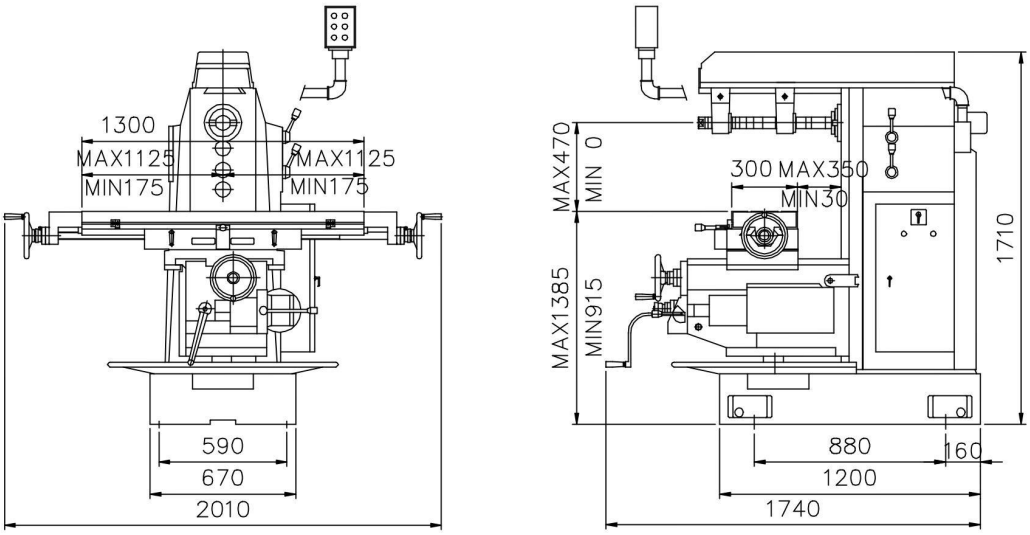
Spindle speed (12 steps)		50Hz	36-1415 RPM
Distance from center of spindle to over arm			135 mm
Distance from center of spindle to table			0-470 mm
Motors			
For horizontal spindle			AC3.7kW-4P
For table feed and rapid traverse			AC2.2kW-4P
For cutting fluid pump			AC0.1kW-2P
Machine size			
Overall height			1710 mm
Floor area			670 x 1200 mm
Net weight (approx.)			2350 kgs

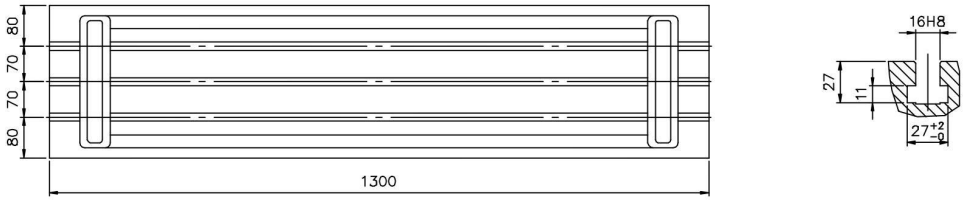
1-3 Specifications

Table			
Working surface length x width			51-3/16 x 11-13/16 in.
Travel longitudinal x cross x vertical			37-3/8 x 13 x 1/2 in.
T-slot nominal size x No. x pitch			5/8 in. x 13 x 2-3/4 in.
Feeds (12 steps)	Longitudinal x cross	50Hz	7/16-20-3/8 ipm.
	Vertical	50Hz	3/16-10-3/8 ipm.
Rapid traverse	Longitudinal x cross	50Hz	97-1/8 ipm.
	Vertical	50Hz	49-7/8 ipm.
Swivel table (left & right)			45deg
Universal spindle head (optional)			
Spindle nose			
Spindle speed			
Change of spindle speed			
Distance from spindle end to table			
Distance from center of spindle to column			
Horizontal spindle			
Spindle nose			ISO R297 No.40
Spindle speed (12 steps)		50Hz	36-1415 RPM
Distance from center of spindle to over arm			5-5/16 in.
Distance from center of spindle to table			
Motors			
For horizontal spindle			AC3.7kW-4P
For table feed and rapid traverse			AC2.2kW-4P
For cutting fluid pump			AC0.1kW-2P
Machine size			
Overall height			67-5/16 in.
Floor area			26-3/8 x 47-1/4 in.
Net weight (approx.)			2350 kgs

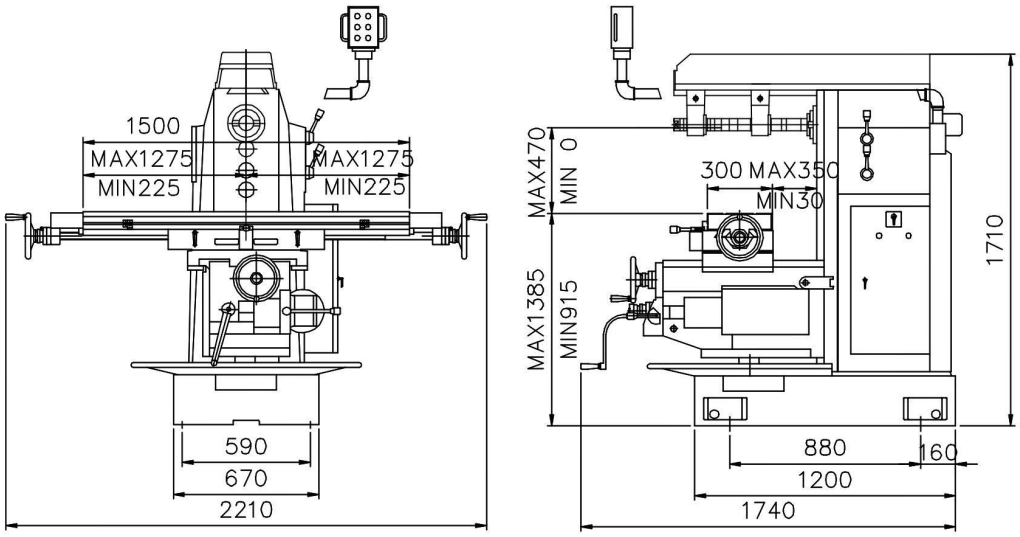
1－4 External view (UH-3)



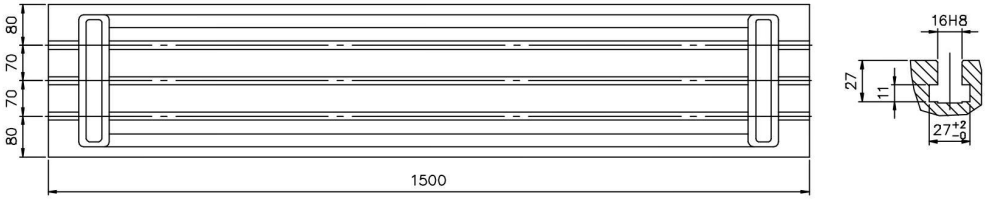
1－4－1 Table dimensions (UH-3)



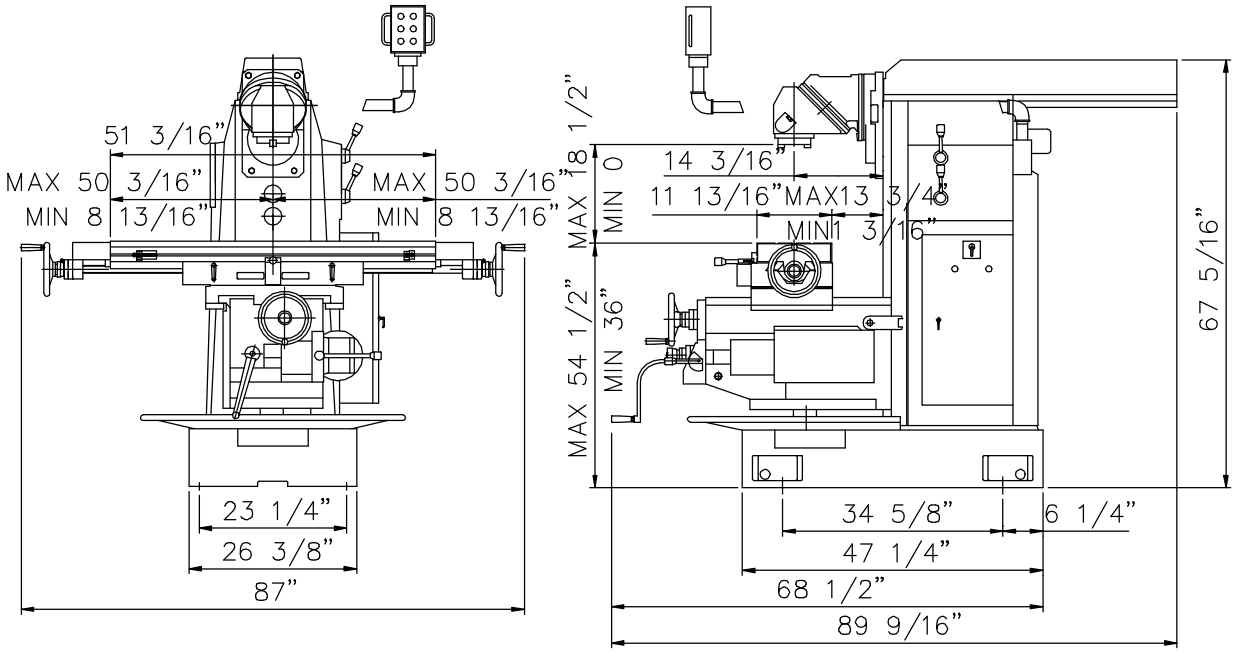
1－4 External view (UH-3)



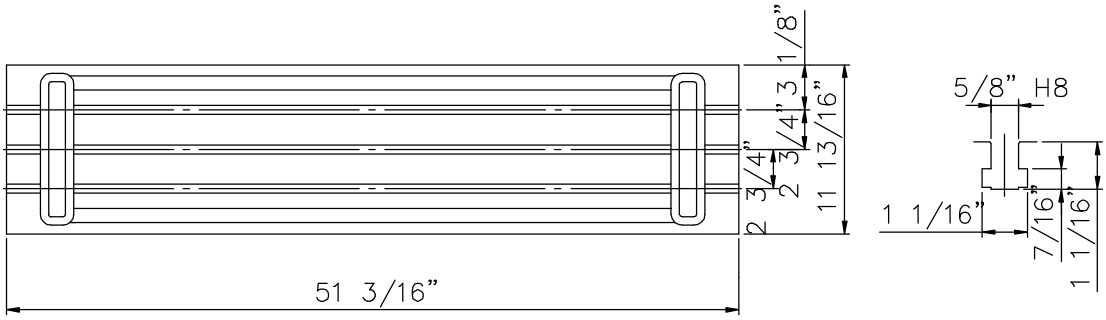
1－4－1 Table dimensions (UH-3)



1—4 External view



1—4—1 Table dimensions

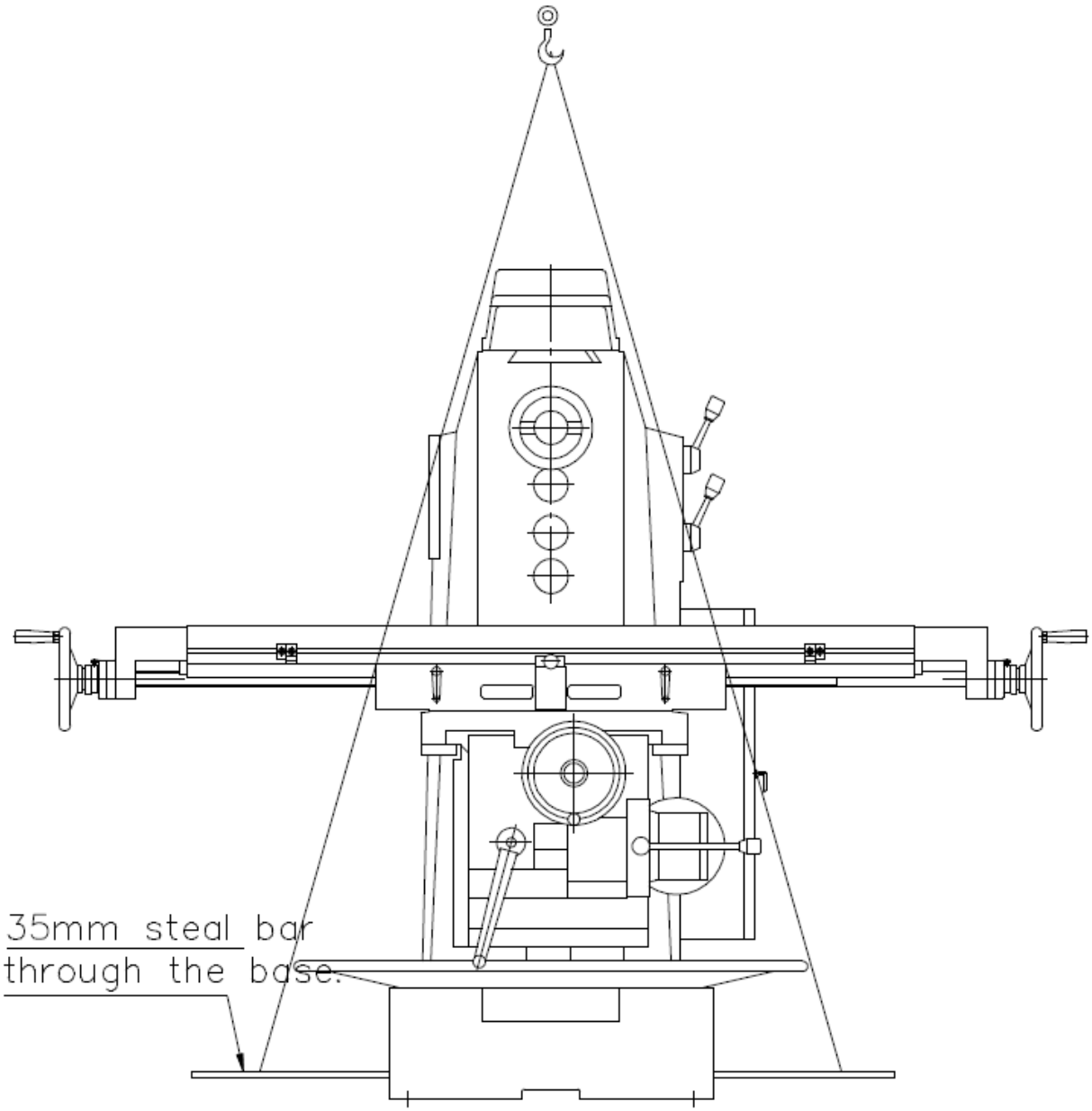


2. Installation and preparation

2-1 Transportation of the machine

Make certain the load is on balance and that the sling does not touch the table or head before lifting.
If a crane is used in lifting, exercise care that none of the mechanism is damaged.
When lifting the machine, insert two round bars of about 35mm in diameter and use a wire suspension rope, be certain that they are strong enough to safety carry the weight of the machine.
The finished surface of the machine must be protected by using wooden blocks and cloth.

Fig. 2



2-2 Inspection and cleaning

After you received the machine, please check if the packing contents all the accessories you ordered. 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

1) Always supply lubricating oil to designated oiling points before starting.
2) Confirm that the work and setting jigs do not strike anything before actuating table feed.
3) 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 Lard olive oil colza oil soybean oil,
Vegetable oil castor oil
(2) Capacity of the cutting oil tank is about 9.25 gallon.
(3) Cutting oil should be supplied through an oil strainer into the cutting oil intake provided on the lower part of the column.

Warning: 1. To avoid fire, prohibited use low flash point cutting oil for machining magnesium, aluminum or similar pyrophoric or explosive articles.
2. Do not dump waste cutting fluid at any place. Dispose the waste fluid under regulation of local low for environmental protection.

2-6 Wiring

The power cable should be connected to the terminals R.S.T. (1) (Fig.4). On completion of the connection, turn on the power switch provided on the cabinet.
After finishing the above preparations, start the main spindle. (See section for spindle starting, spindle stopping).
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 cable.

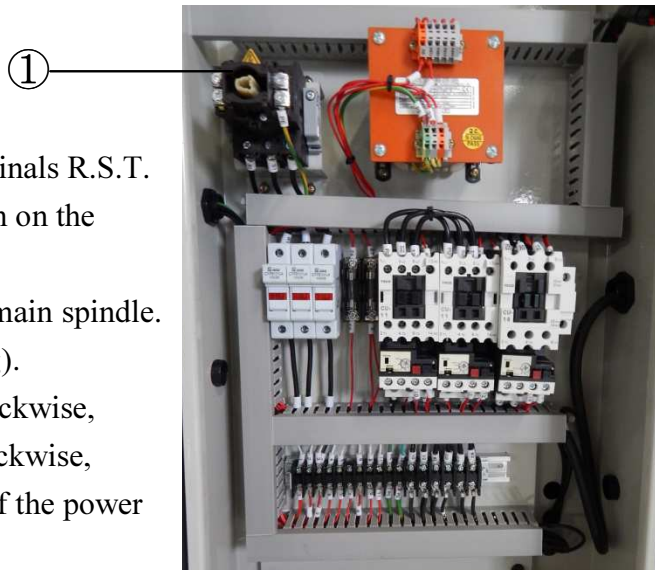


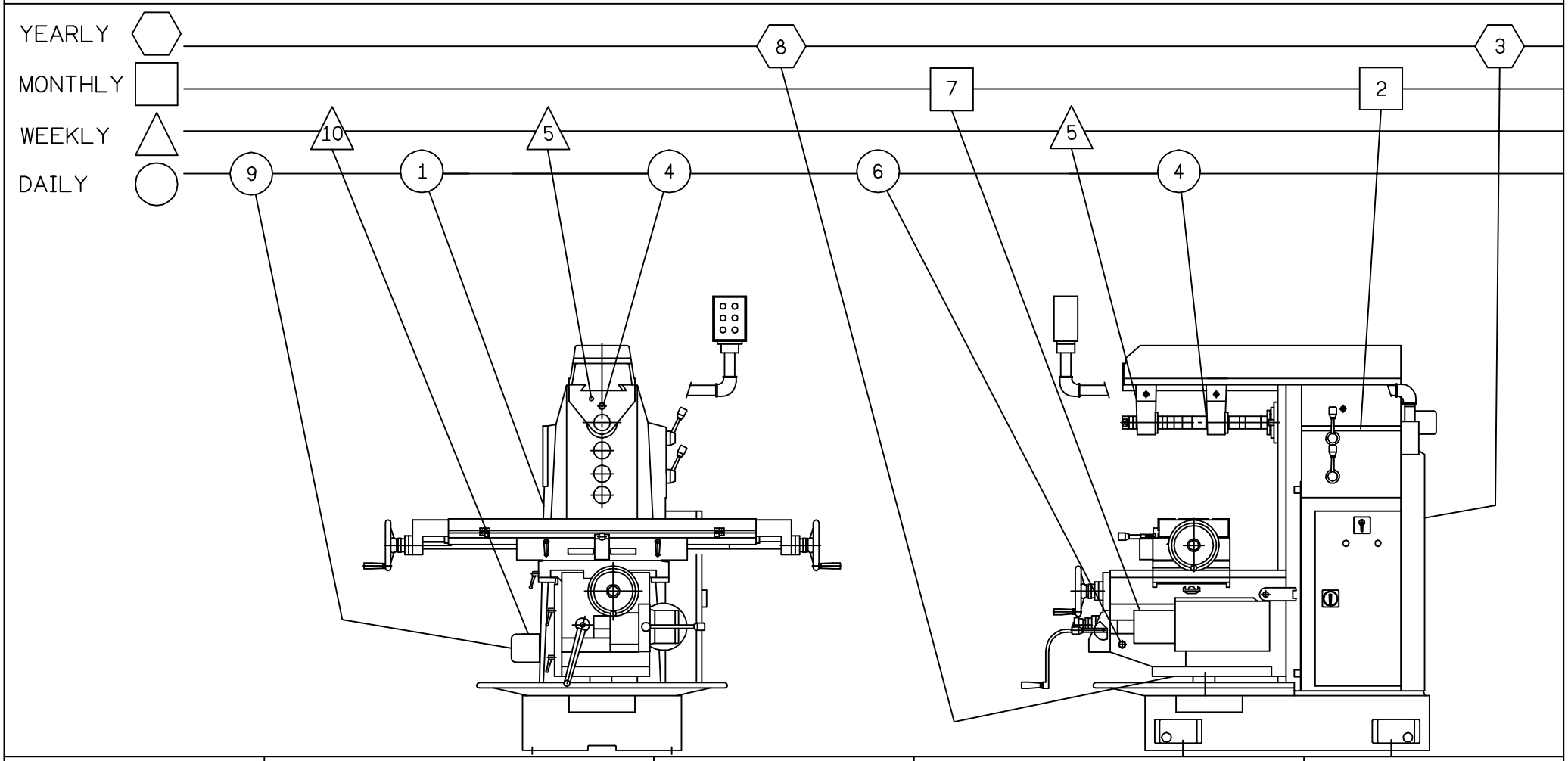
Fig. 4

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 gears and sideways.
The lubrication oil to be used for each part is also listed in tables 2, and 3, it can be used for selecting the correct lubricant to keep the machine in its best condition.

Table-1

LUBRICATION INSTRUCTIONS



	Spindle gears			Arbor support		Table feed gears			Slide ways	
Machine components	1	2	3	4	5	6	7	8	9	10
Symbol / Item										
Check	Daily			Daily		Daily			Daily	
Fill		Nonthly			Weekly		Monthly			Weekly
Clean & Replace			Yearly					Yearly		
Lubricant	CB32			CB32		CB32			G68	
Quantity		0.3L	1L		0.3L		0.3L	1L		0.3L
Remarks										

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Table - 2 **The general lubricants for machine tool**

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

Table - 3 **Instruction for correct lubricant**

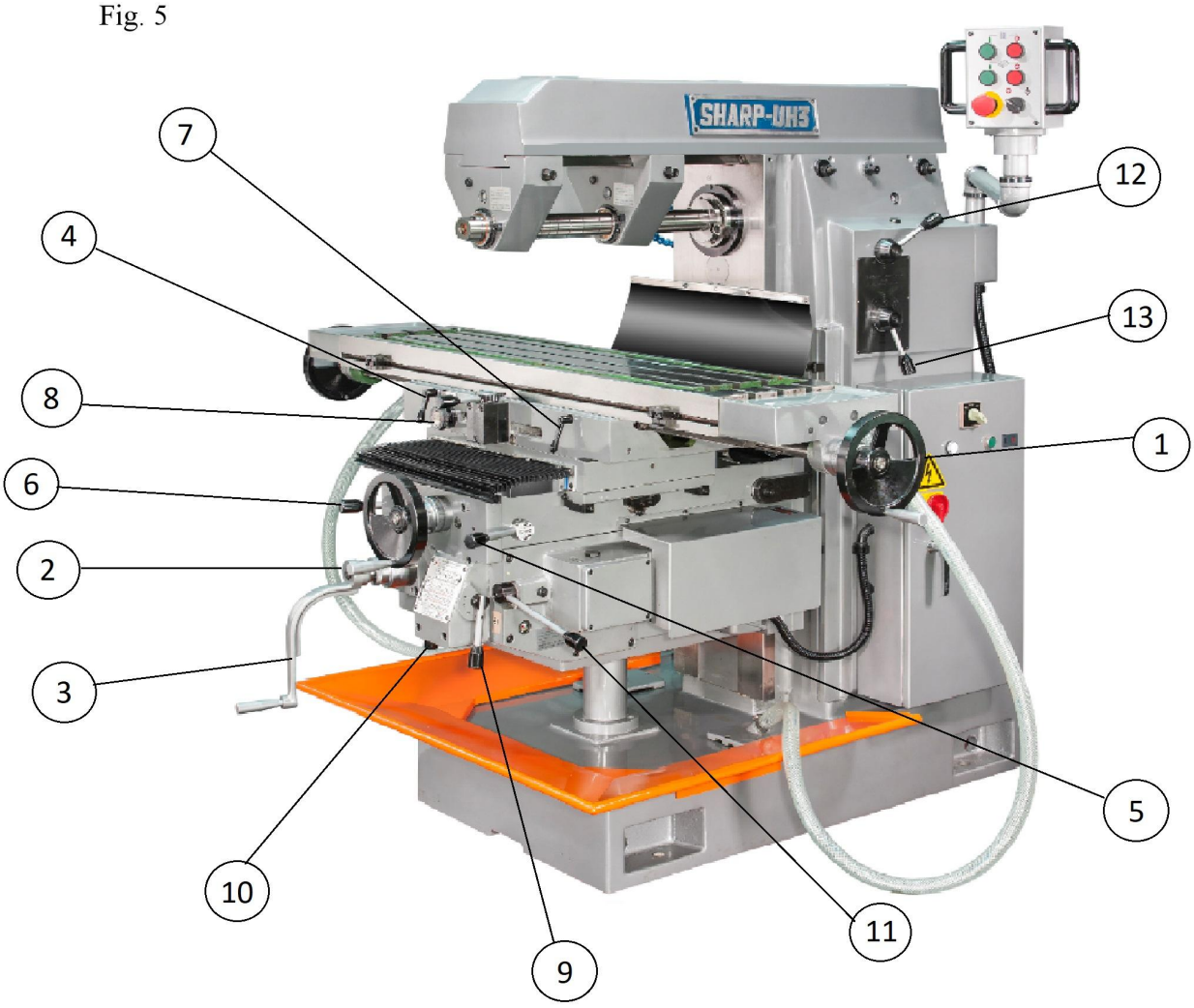
	Application Fields	Properties	Symbol and Viscosity Grade	Kinematic Viscosity CST (130℉)			REMARKS
				Mean.	min.	max.	
GEARS	Enclosed moderately loaded gear (spur gear, bevel gear)	Refined mineral oils with good oxidation stability.	CB 32 CB 68 CB 150	32 68 150	28.8 61.2 135	35.2 74.8 165	Pinion speeds(motor output) 2,000-5,000rpm(within 5HP) 1,000-2,000rpm(within 10HP) -1,000rpm(within 20HP)
	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 2,000- rpm 1,000-2,000rpm -2,000rpm
BEARINGS	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.) 10,000- rpm(1/8 in) 2,000-10,000rpm(1/8-5.7/8 in) -2,000rpm(5.7/8 in)
SLIDE WAYS	Slide ways	Refined mineral oils with improved lubricity and tackiness performance preventing stick-slip.	G 68 G 220	68 120	61.2 198	74.8 242	Slide way (surface pressure) Horizontal (under57Ib/in^2) Vertical (under57Ib/in^2)
HYDRAULIC SYSTEMS	Hydraulic systems	Refined mineral oils with superior anti-corrosion and anti-oxidation performances.	HL 32 HL 68	32 68	28.8 61.2	35.2 74.8	Oil temperature (Rate pressure) 0-148℉ (under500Ib/in^2) 85-175℉ (under500Ib/in^2)
		Refined mineral oils with superior anti-corrosion, anti-oxidation and anti-wear performances.	HM 32 HM 68	32 68	28.8 61.2	35.2 74.8	Oil temperature (Rate pressure) 0-148℉ (under2000Ib/in^2) 85-175℉ (under2000Ib/in^2)
	Hydraulic and Slide ways	Refined mineral oils of HM type with anti-stick-slip properties.	HG 32 HG 68	32 68	28.8 61.2	32.2 74.8	Oil temperature (Rate pressure) 0-148℉ (under1000Ib/in^2) 85-175℉ (under1000Ib/in^2)
GREASE		Premium, quality greases with superior anti-oxidation and anti-corrosion properties.	XM 1 XM 2	Viscosity (102℉) SSU 310-340 265-295			Centralized systems Cup or hand gun

3. Handing the main operating parts

3-1 Name of each part

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

Fig. 5



3-2 Electric operation panel (Fig. 6)

1. Horizontal spindle start button
2. Horizontal spindle stop button
3. Table feed motor start button
4. Table feed motor stop button
5. Emergency stop button
6. Cutting oil pump switch

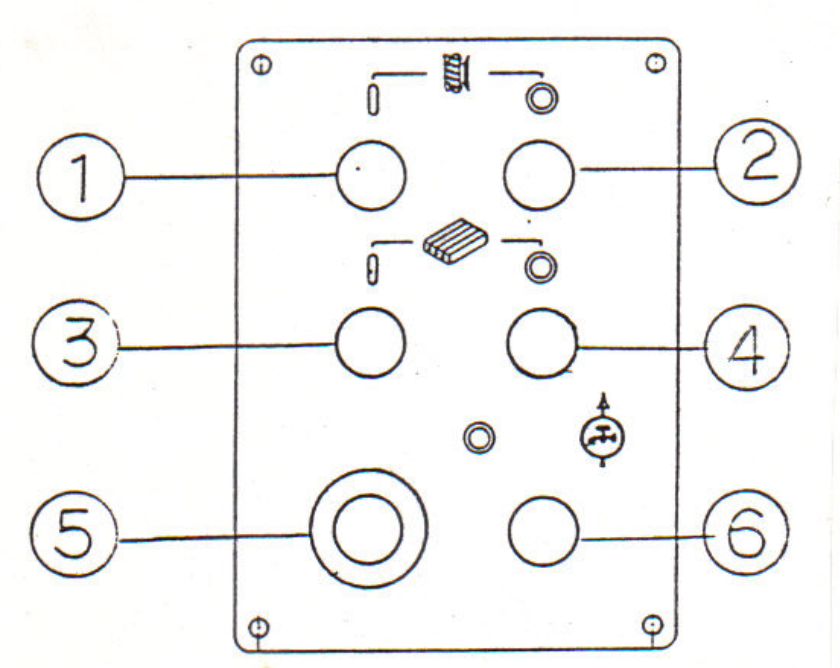


Fig. 6

3-3 Start and stop for horizontal spindle

Push the horizontal spindle start button (1) (Fig. 6) to run the spindle.
Push the horizontal spindle stop button (2) (Fig. 6) to stop the spindle.

3-4 Start coolant system

The machine is provided a coolant system. Turning the coolant oil pump switch (6) (Fig. 6) to the right and the cutting oil can be provided.

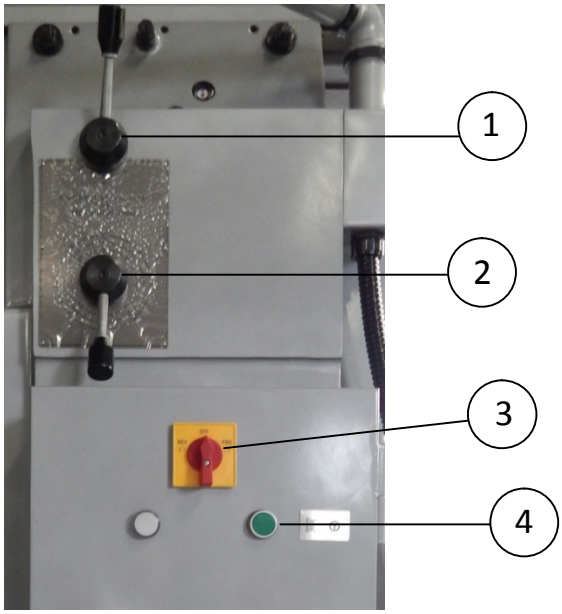
3-5 Emergency stop

This button (5) (Fig. 6) is pushed to put a stop in case of emergency. If this button is pushed, all the movements of the mill are stopped immediately. It is released when push this button again.

3-6 Change of horizontal spindle speed

Move lever (1)(Fig.7) to position ↘ . ↓ or ↙ depending upon the spindle speed range required,and move lever (2)(Fig.7) to the position of the particular speed reuqired.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 (2)(Fig.6). Turn spindle rotated direction switch (3)(Fig.7) to position 1 or 2 and then intermittently press the inching button (4)(Fig.7), at the same time moving lever (2)(Fig.7) until the required gears are engaged. It should be noted that the feed motor will automatically stop when the inching button is operated.

Fig. 7



3-7 Table feed

3-7-1 Operation of manual feed

Operate longitudinal feed by hand wheel (1) (Fig.5), cross feed by habd wheel (2) (Fig. 5), and vertical feed by hand lever (3) (Fig. 5).

If directional changing lever (4) (Fig. 5) at central frontof 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	0.02 mm (0.001 inch)	5mm (0.2 inch)
Cross feed	Forward(go far from operator)	0.02mm (0.001 inch)	
Vertical feed	Upward	0.01mm (0.0005 inch)	1.2mm (0.05 inch)

3-7-2 Operation of cross power feed

Start feed motor by turning button (3) (Fig. 6) and then lever (5) (Fig.5) upwards for the saddle to feed towards the column, and for the saddle to feed away from the column move lever (5) (Fig.5) downwards.

3-7-3 Operation of vertical power feed

Start feed motor by turning button (3) (Fig. 6) and then move lever (6) (Fig. 5) upward to feed the knee upwards to move lever (5) (Fig. 5) downward, to feed the knee downward.

3-7-4 Operation of longitudinal power feed

Start feed motor by turning button (3) (Fig.6) and then move lever (6) (Fig.5) and then move lever (4) (Fig.5) right for the table to feed from the left move the right and for the table to feed from right to left mover lever (4) (Fig. 5) to left.

3-7-5 Choice of feed speed

Feeding speed is dependent on the spindle speed, material of work piece, tips if 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.
Turning the switch (3) (Fig. 6) to "ON" position to start the table longitudinal feed motor. Move lever (10) (Fig. 5) to position A, B or C dependent upon feed range required and move lever (9) (Fig. 5) 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 the table is moving.
2. Before stopping the spindle or when the table auto feed is not used push back the feed engagement lever (4) (5) (6) (Fig. 5) to neutral.

3-7-6 Operation of rapid traverse

This can be operated on any of the foregoing movements by having the fees 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 (11) (Fig. 5) upwards until the appropriate distance has been moved. Then lever (11) (Fig. 5) should be returned to its neutral position.

3-7-7 Backlash eliminator

The use of the backlash eliminator device allows “climb milling” to be carried out on this machine. The backlash eliminator controller (8) (Fig. 5) 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 (8) (Fig. 5) in the appropriate direction and at the same time rotate the table hand wheel. Continue turning the controller (8) (Fig. 5) 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.

3-7-8 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 (2) (3) (Fig. 8) on the outsides are safety stops which prevent over travel. These should not be moved.

The two inside dogs (4) (5) (Fig. 8) can be set at any position so that the table stops automatically in set range.

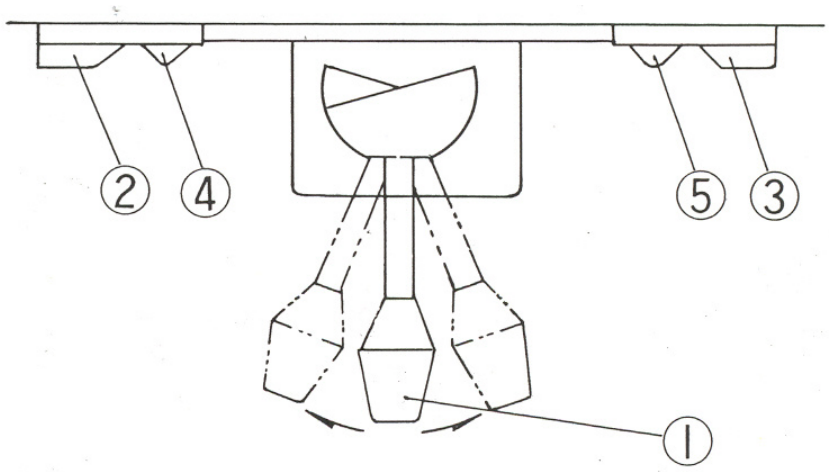


Fig. 8

3-7-9 Clamping of sliding surface

1) When longitudinal feed is not need, turn two clamp lever (3) (Fig.9) clockwise at front of saddle to tighten the table.
2) When vertical feed is not in use, turn clamp lever (2) (Fig.9) at rear of knee to tighten the knee.
3) When cross-feed is not in use, pull clamp lever (1) (Fig.9) under the left side of the saddle toward operator to lock the saddle.

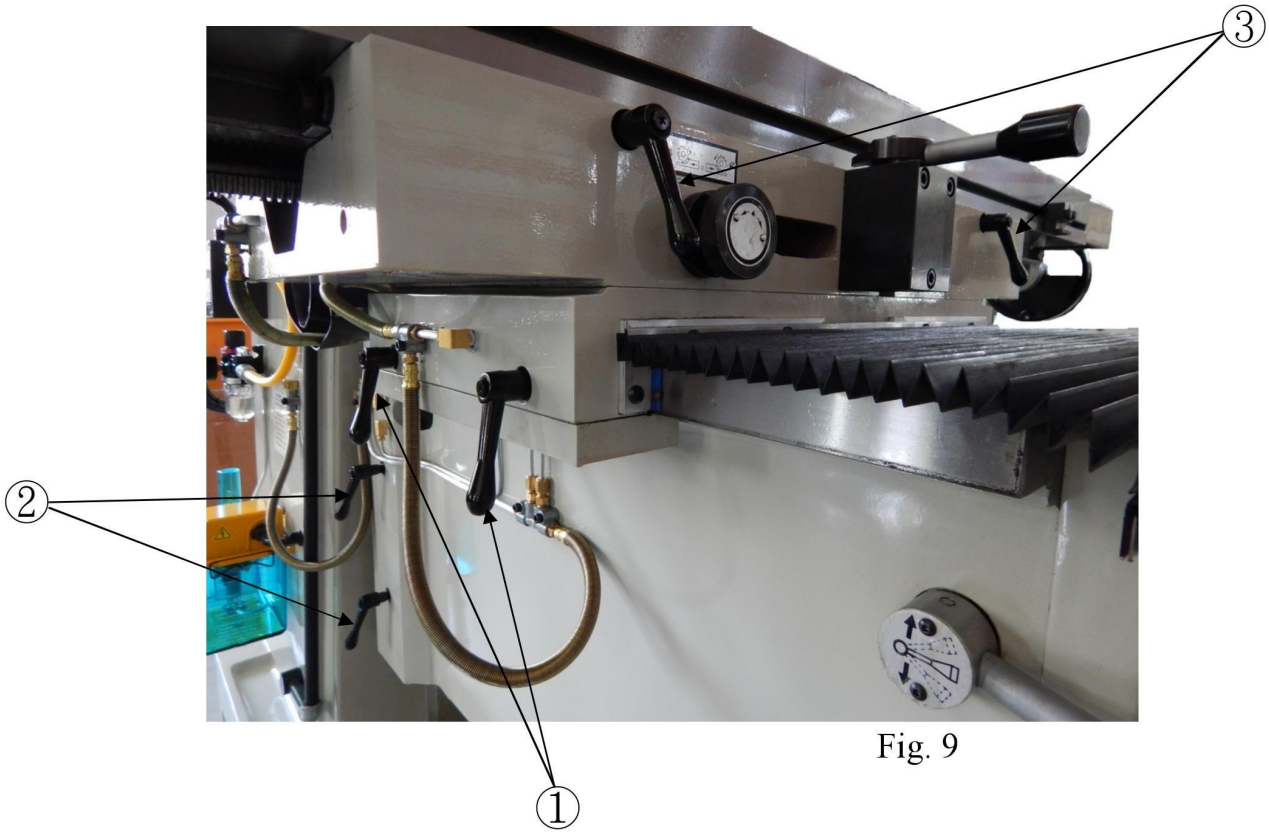


Fig. 9

3-7-10 Swiveling of table on horizontal plane (UH-3)

The table can be swiveled by turning the swivel base (1) (Fig. 10) located on the top of saddle. (3) (Fig. 10)

Procedure for swiveling:

1) Loosen the four nuts (2) (Fig. 10) on the front and rear of the swivel base.
2) Push the swivel base for the required angle either to left or right to swivel.
3) Tighten the four nuts (2) (Fig. 10) after obtaining the required swivel.

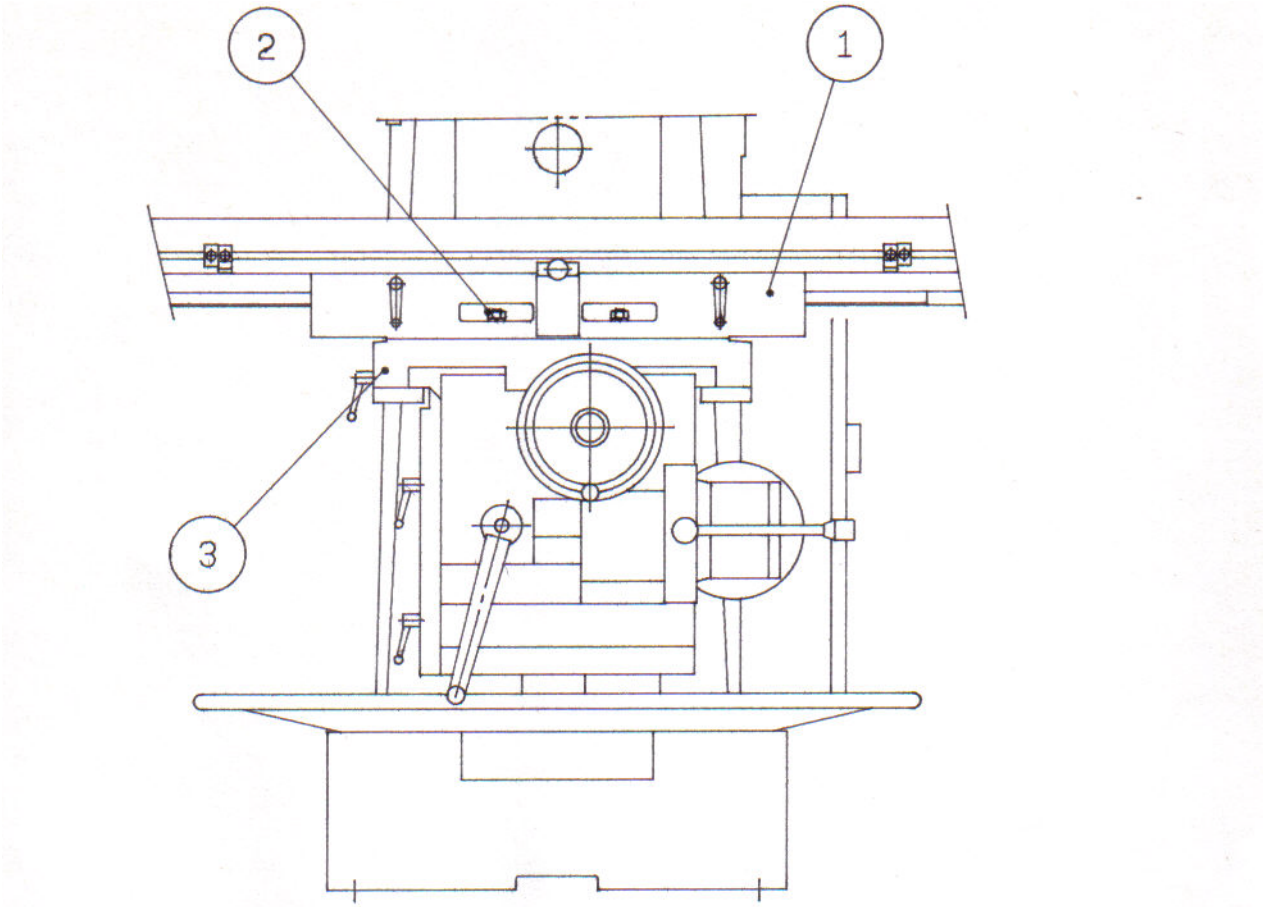


Fig.10

4. Safety device

4-1 Thermal relay

When electric current exceeding the rating, the thermal relay (2) (Fig. 11) is actuated automatically to stop the driving motor. If the thermal relay is actuated, located and correct the cause and reset the thermal relay by pressing the thermal relay reset push button.

4-2 Fuse

Fuses (1) (Fig. 11) are installed in the control box to protect electric circuits. If the machine dose 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.

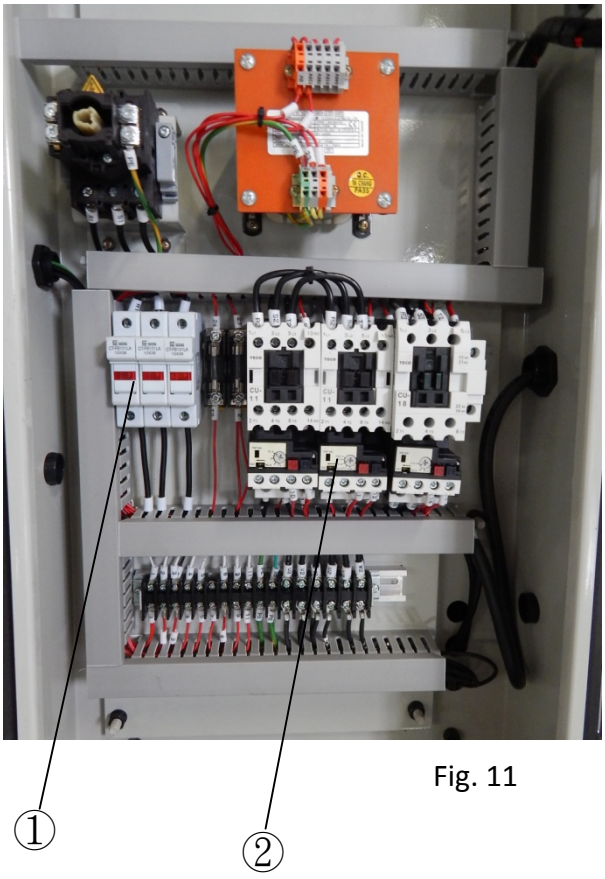


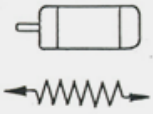
Fig. 11

5. Symbols

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

Table 4.

NO.	DESCRIPTION	SYMBOL
1	Main spindle	
2	Revolution per minute	
3	Feed amount per revolution	
4	Neutral	
5	Main spindle brake	
6	Main spindle without brake	
7	Table	
8	Feed (normal)	
9	Low speed feed	
10	Longitudinal feed	
11	Vertical feed	

NO.	DESCRIPTION	SYMBOL
12	Rapid feed	
13	Power pilot lamp	
14	Start	
15	Stop	
16	Emergency stop	
17	Table feed motor	
18	Cutting oil pump	
19	Vertical spindle clockwise rotation	
20	Vertical spindle counter clockwise rotation	
21	Vertical spindle automatic feed	

6. Suggested starting speed and feeds

6-1 Carbide cutters

Table – 5

CARBIDE CUTTERS							
MATERUAL		**FACE MILLS**	**SLAB MILLS**	**END MILLS**	**FULL & HALF SIDE MILLS**	**SAWS**	**FORM MILLS**
MALLEABLE SOFT/HARD	FEED PER TOOTH FEET PER MIN.	.005-.015 200-300	.005-.015 200-300	.005-.010 200-350	.005-.010 200-300	.003-.004 200-350	.005-.010 175-275
CAST STEEL SOFT/HARD	FEED PER TOOTH FEET PER MIN.	.008-.015 150-350	.005-.015 150-350	.003-.010 150-350	.005-.010 150-350	.002-.004 150-300	.005-.010 150-300
100-150 BR. STEEL	FEED PER TOOTH FEET PER MIN.	.010-.015 450-800	.008-.015 450-600	.005-.010 450-600	.008-.012 450-800	.003-.006 350-600	.004-.010 350-600
150-250 BR. STEEL	FEED PER TOOTH FEET PER MIN.	.010-.015 300-450	.008-.015 300-450	.005-.010 300-450	.007-.012 300-450	.003-.006 300-450	.004-.010 300-450
250-350 BR. STEEL	FEED PER TOOTH FEET PER MIN.	.008-.015 180-300	.007-.012 150-300	.005-.010 150-300	.005-.012 160-300	.002-.005 150-300	.003-.008 150-300
350-450 BR. STEEL	FEED PER TOOTH FEET PER MIN.	.008-.015 125-180	.007-.012 100-150	.004-.008 100-150	.005-.012 125-180	.001-.004 100-150	.003-.008 100-150
CI HARD 225-350 BR.	FEED PER TOOTH FEET PER MIN.	.005-.010 125-200	.005-.010 100-175	.003-.008 125-200	.003-.010 125-200	.002-.003 125-200	.005-.010 100-175
CI MED. 180-225 BR.	FEED PER TOOTH FEET PER MIN.	.008-.015 200-275	.008-.015 175-250	.005-.010 200-275	.005-.012 200-275	.003-.004 200-250	.006-.012 175-250
CI SOFT 150-180 BR.	FEED PER TOOTH FEET PER MIN.	.015-.025 275-400	.010-.020 250-350	.005-.012 275-400	.008-.015 275-400	.003-.004 250-350	.008-.015 250-350
BRONZE SOFT/HARD	FEED PER TOOTH FEET PER MIN.	.010-.020 300-1000	.010-.020 300-800	.005-.010 300-1000	.008-.012 300-1000	.003-.004 300-1000	.008-.015 200-800
BRASS SOFT/HARD	FEED PER TOOTH FEET PER MIN.	.010-.020 500-1500	.010-.020 500-1500	.005-.010 500-1500	.008-.012 500-1500	.003-.004 500-1500	.008-.015 500-1500
ALUM. AL. SOFT/HARD	FEED PER TOOTH FEET PER MIN.	.010-.040 2000 UP	.010-.030 2000 UP	.003-.015 2000 UP	.008-.025 2000 UP	.003-.006 2000 UP	.008-.015 2000 UP

Generally lower end of range used for inserted blasé cutters, higher end of range for index able insert cutters.

6-2 High speed steels cutters

Suggested starting speed and feeds

Table – 6

HIGH SPEED STEELS CUTTERS							
MATERUAL		**FACE MILLS**	**SLAB MILLS**	**END MILLS**	**FULL & HALF SIDE MILLS**	**SAWS**	**FORM MILLS**
MALLEABLE SOFT/HARD	FEED PER TOOTH FEET PER MIN.	.005-.015 60-100	.005-.015 60-90	.003-.010 60-00	.006-.012 60-100	.003-.006 60-100	.005-.010 60-80
CAST STEEL SOFT/HARD	FEED PER TOOTH FEET PER MIN.	.010-.015 40-60	.010-.015 40-60	.005-.010 40-60	.005-.010 40-60	.002-.005 40-60	.008-.012 40-60
100-150 BR. STEEL	FEED PER TOOTH FEET PER MIN.	.015-.030 80-130	.008-.015 80-130	.003-.010 80-140	.010-.020 80-130	.003-.006 70-100	.008-.010 70-100
150-250 BR. STEEL	FEED PER TOOTH FEET PER MIN.	.010-.020 50-70	.008-.015 50-70	.003-.010 60-80	.010-.015 50-70	.003-.006 50-70	.006-.010 50-70
250-350 BR. STEEL	FEED PER TOOTH FEET PER MIN.	.005-.010 35-60	.005-.010 35-50	.003-.010 40-60	.005-.010 35-50	.002-.005 35-50	.005-.010 35-50
350-450 BR. STEEL	FEED PER TOOTH FEET PER MIN.	.003-.008 20-35	.005-.008 20-35	.003-.010 20-40	.003-.008 20-35	.001-.004 20-35	.003-.008 20-35
CI HARD 225-350 BR.	FEED PER TOOTH FEET PER MIN.	.005-.012 40-60	.005-.010 35-50	.003-.008 40-60	.005-.010 40-60	.002-.004 35-60	.005-.010 35-50
CI MED. 180-225 BR.	FEED PER TOOTH FEET PER MIN.	.010-.020 60-80	.008-.015 50-70	.003-.010 60-90	.008-.015 60-80	.003-.005 60-70	.008-.012 50-60
CI SOFT 150-180 BR.	FEED PER TOOTH FEET PER MIN.	.015-.030 80-120	.010-.025 70-110	.004-.010 80-120	.010-.020 80-120	.002-.005 70-110	.010-.015 60-80
BRONZE SOFT/HARD	FEED PER TOOTH FEET PER MIN.	.010-025 50-225	.008-.020 50-200	.003-.010 50-250	.008-.015 50-225	.003-.005 50-250	.008-.015 50-200
BRASS SOFT/HARD	FEED PER TOOTH FEET PER MIN.	.010-.025 150-300	.008-.020 100-300	.005-.015 150-350	.008-.015 150-350	.003-.005 150-300	.008-.015 100-300
ALUM. AL. SOFT/HARD	FEED PER TOOTH FEET PER MIN.	.010-.040 300-1200	.015-.040 300-1200	.005-.020 300-1200	.010-.030 300-1200	.004-.008 300-1000	.010-.020 300-1200

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