Freze 3

UNIVERSAL RAM-HEAD KNEE-TYPE MILLING MACHINES 6T82Ш, 6T83Ш

Service Manual

6T82Ш-0.00.00 РЭ

Part I

FREZE
ELEKTRIK
MEKANIK
Resmi

CONTENTS

Since efforts are continually made to improve the reliability and performance of the product, minor changes may be introduced without special notice.

1. GENERAL

Stock No. _____

Model_____

Date, put into regular service_____

Universal ram-head knee-type milling machines 6T82III and 6T83III (Fig 1 and 2) are intended for a variety of milling operations in piece production.

The machines are suitable for making metal casting patterns, dies, press-moulds, gauges, templets, cams, etc.

The spindle head is carried by an advancing ram and can swivel to any angle in two mutually square planes, thus making it possible to machine diverse surfaces, as well as large work pieces that oversize the machine table.

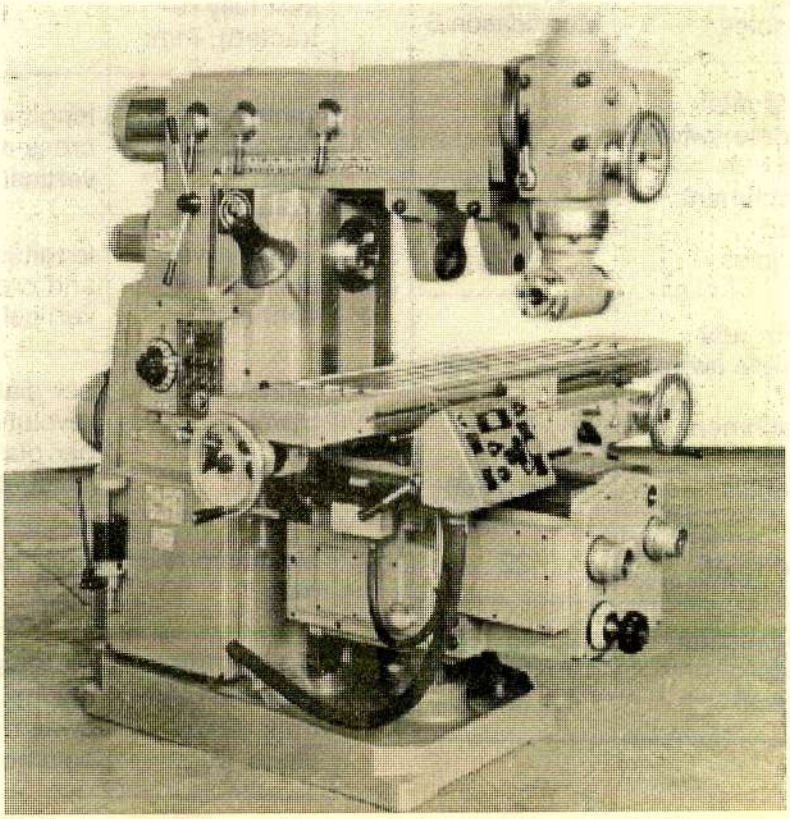
The horizontal spindle of the machine can be used for plane milling with face or plain milling cutters. Operation with either or with both of the spindles is practicable. When arbor supports are provided the machines can be used as conventional plain horizontal millers.

The processing capacities of the machines can be extended due to the use of a dividing head, rotary (indexing) circular table and other attachments.

Possibility of setting up the machine for a variety of semiautomatic and, fully automatic operating cycles makes it possible to practise multiple machine-tool handling and to use these machines to good advantage for performing diverge jobs involved in lot production.

The machines can be delivered to countries with cold, moderate and tropical climate.

BE SURE TO STRICTLY ADHERE TO ALL PRESCRIPTIONS AND RECOMMENDATIONS SET FORTH IN THIS MANUAL.



2. SPECIFICATIONS

2.1 Principal Characteristics and Capacity to GOST 165-81

Characteristics		Rating value	
		6T82Ш	6T83Ш
Accuracy class to GOST 8-82		II (high)	II (high)
Table working surface, mm:	width length	320 1250	400 1600
Number of T-slots		3	
Width of T-slots, mm:	central side	18 H8 18 H12	
Spacing of T-slots, mm		63	100
Maximum table travel, mm:	longitudinal cross vertical	800 320 420	1010 400 420
Spindle nose to GOST 2464481 (taper to GOST 15945-82)	horizontal spindle swivel and attachment head spindles	50 Series 4, Modification 6 40 Series 3, Modification 5	
Number of spindle rotation frequencies:	horizontal spindle swivel and attachment head spindles	18 11	
Range spindle rotation frequencies, min^{-1}:	horizontal spindle swivel and attachment head spindles	31.5 to 1600 50 to 1600	
Number of table feed rates		22	
Range of table feed rates, S, mm/min:	longitudinal cross vertical	12.5 to 1600 12.5 to 1600 4.1 to 530	

Characteristics		Rating value	
		6T82Ш	6T83Ш
Proportional slow-rate feed, mm/min		1/2S	
Table rapid traverse speed, mm/min:	longitudinal cross vertical	4000 4000 1330	
Distance from horizontal spindle axis to table working surface, mm:	minimum maximum	30 450	
Distance from horizontal spindle axis to ram ways, mm		155	190
Distance from swivel head spindle axis to column ways, mm:		260 to 820	260 to 900
Distance from swivel head spindle nose end to table (with spindle quill fully retracted), mm:	minimum maximum	125 545	160 580
Table travel per dial graduation, mm:	longitudinal, cross and vertical	0.05	
Table travel per dial revolution, mm:	longitudinal and cross vertical	6 2	
Spindle quill travel, mm:	per dial revolution per dial graduation	6 0.1	
Maximum spindle quill travel, mm:		80	
Spindle head swivel in table transverse plane, deg.:	towards column away from column	45 90	

Characteristics		Rating value	
		6Т82Ш	6Т83Ш
Spindle head swivel in table longitudinal plane, deg.		360	
Attachment head swivel, deg.		360	
Swivel scale graduation value of spindle heads, deg.		1	
Maximum mass of workpiece and attachment admitted, kg		400	630
Overall dimensions, mm:	length	2280	2570
	width	1965	2252
	height	1970	2040

Characteristics		Rating value	
		6Т82Ш	6Т83Ш
Mass (electrical equipment inclusive), kg		3550	4400
Corrected acoustic power level, dBA		102	102
Maximum diameter of milling cutter accommodated (for rough machining), mm:	horizontal spindle	160	200
	vertical spindle	75	75

For the tooling and fitting dimensions of the machine refer to Figs 3 to 8.

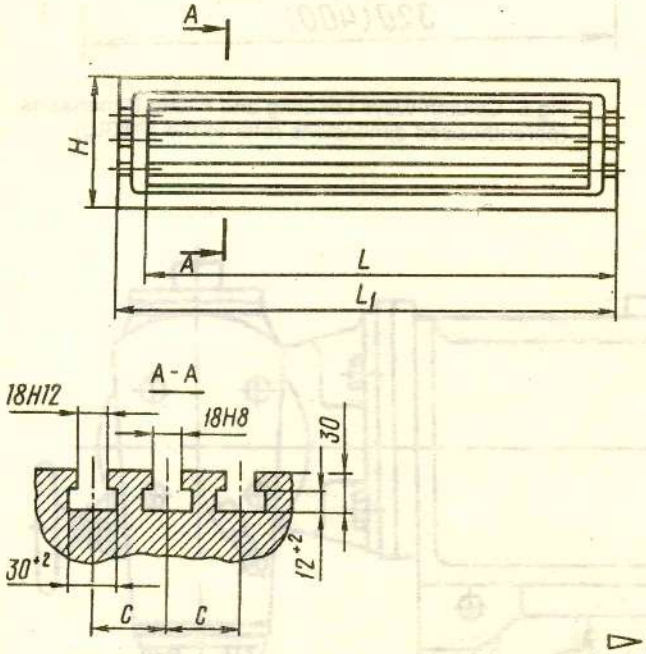


Fig. 3. Table Locating and Fitting Dimensions

Dimension, mm	6Т82Ш	6Т83Ш
H	320	400
L	1250	1600
L_1	1325	1700
C	63	100

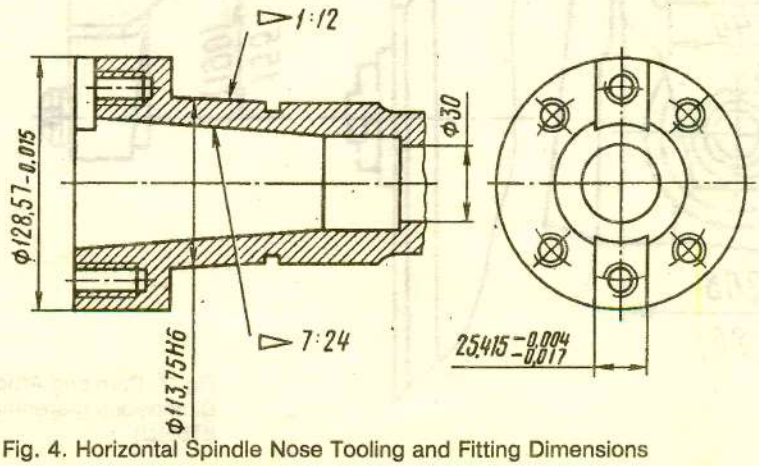


Fig. 4. Horizontal Spindle Nose Tooling and Fitting Dimensions

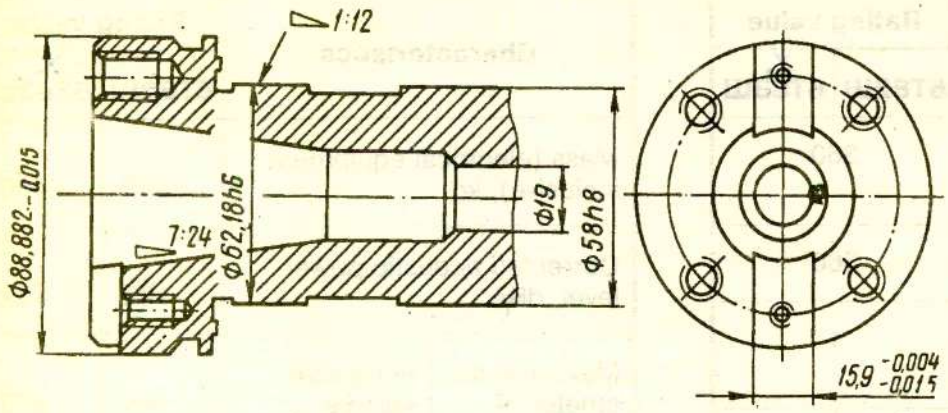


Fig. 5. Swivel Head Spindle Nose Tooling and Fitting Dimensions

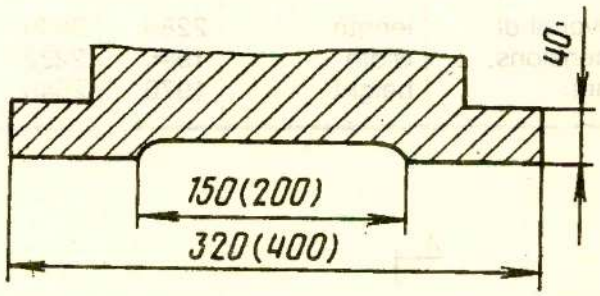


Fig 6. Column Ways Locating and Fitting Dimensions (parenthesized dimensions refer to the 6T83Ш)

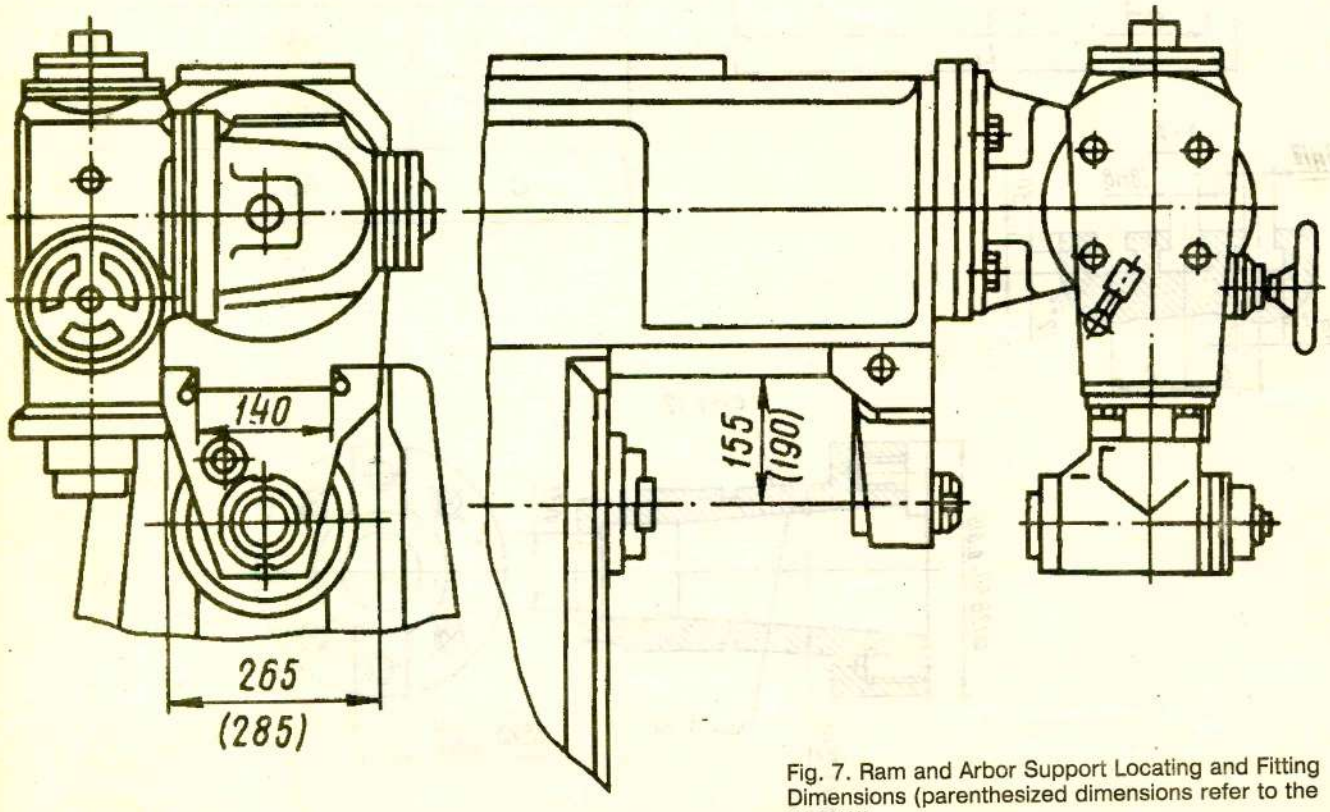
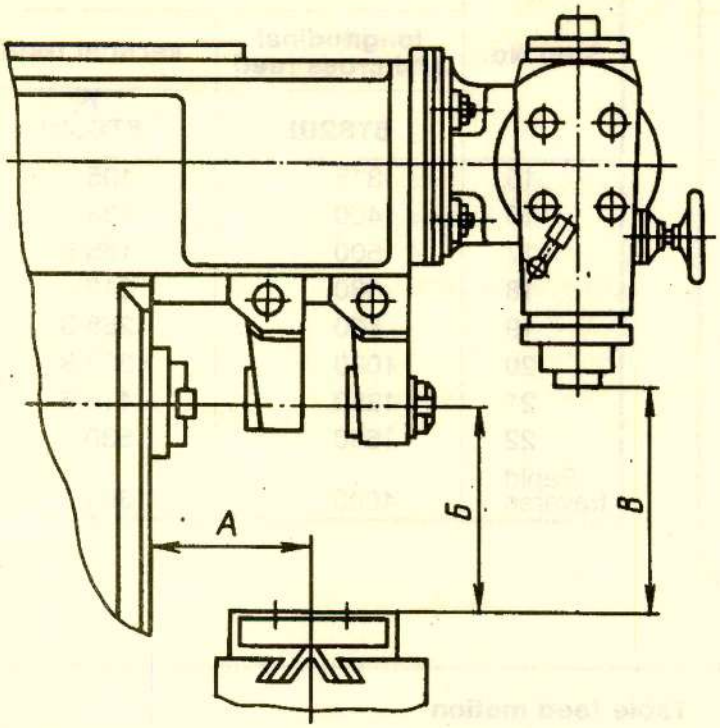


Fig. 7. Ram and Arbor Support Locating and Fitting Dimensions (parenthesized dimensions refer to the 6T83Ш)



Dimension, mm	6Т82Ш	6Т83Ш
А	230...550	260...660
Б	30...450	30...450
В	125...545	160...580

Fig. 8. Working Space Dimensions

2.2. Mechanical Structure of Machines

Mechanical characteristics of horizontal spindle primary motion

Spindle rotation frequency, min^{-1}	Maximum perissible torque on spindle, kN*m		Maximum permissible drive power on spindle, kW	
	6Т82Ш	6Т83Ш	6Т82Ш	6Т83Ш
31.5	1070	1430	6.93	9.25
40	1070	1430	6.93	9.25
50	1070	1430	6.93	9.25
63	1070	1430	6.93	9.25
80	845	1130	6.93	9.25
100	675	901	6.93	9.25
125	540	721	6.93	9.25
160	418	558	6.90	9.20
200	332	430	6.82	9.10
250	267	356	6.86	9.15
315	210	280	6.82	9.10
400	165	220	6.80	9.05
500	131	175	6.75	9.00
630	101	135	6.52	8.70
800	79	105	6.50	8.65
1000	61.8	82.5	6.35	8.45
1250	48.5	64.6	6.22	8.30
1600	35.6	47.5	5.85	7.80

Mechanical characteristics of swivel head and attachment head primary motion

Step No.	Frequency of spindle forward and reverse rotation, min-1	Power on spindle, kW
1	50	1.0
2	70	1.6
3	100	2.1
4	140	3.0
5	200	3.0
6	280	3.0
7	400	3.0
8	560	3.0
9	800	3.0
10	1120	3.0
11	1600	3.0

Mechanical characteristics of feed motion

Step No.	Table feed rate, mm/min	
	longitudinal and cross feed	vertical feed
	6Т82Ш	6Т83Ш
1	12.5	4.1
2	16	5.3
3	20	6.6

Step No.	Table feed rate, mm/min	
	longitudinal and cross feed	vertical feed
	6T82Ш	6T83Ш
4	25	8.3
5	31.5	10.5
6	40	13.5
7	50	16.6
8	63	21
9	80	26.6
10	100	33.3
11	125	41.6
12	160	53.3
13	200	66.6
14	250	83.3

Step No.	Table feed rate, mm/min	
	longitudinal and cross feed	vertical feed
	6T82Ш	6T83Ш
15	315	105
16	400	133
17	500	166.6
18	630	210
19	800	266.6
20	1000	333.3
21	1250	416.6
22	1600	530
Rapid traverse	4000	1300

Maximum cutting force admitted by the feedmechanisms

Maximum cutting force admitted by feed mechanisms, N	Table feed motion					
	longitudinal		cross		vertical	
	6T82Ш	6T83Ш	6T82Ш	6T83Ш	6T82Ш	6T83Ш
	15000	20000	12000		5000	8000

2.3. Main Data of Electrical Equipment

Characteristics		Rating value	
		6T82Ш	6T83Ш
Number of electric motors per machine		5	
Primary motion drive motor:	type	АИР132S4	АИР132M4
	power,kW	7.5	11
	rotation frequency, min^{-1}	1455	1460
Swivel head spindle drive motor:	type	АИР100S4	
	power,kW	3.0	
	rotation frequency, min^{-1}	1435	
Table feed drive motor:	type	АИР100S4	
	power,kW	3.0	
	rotation frequency, min^{-1}	1435	

Characteristics		Rating value	
		6T82Ш	6T83Ш
Power-assisted tool clamping drive motor:	type	АИР56B4	
	power,kW	0.25	
	rotation frequency, min^{-1}	2760	
Centrifugal pump drive motor:	type	П-25МIОУХЛ4	
	power, kW	0.12	
	rotation frequency, min^{-1}	2770	
Aggregate power of motors installed, kW		13.87	17.37

Other types of electric motors of similar specifications can also be used

3. STANDARD AND OPTIONAL EQUIPMENT

Code designation	Item	Qnty		Remarks
		6Т82Ш	6Т83Ш	
	Machine assembly	1	1	
	Items supplied as standard equipment			
	Dismantled Components			
	Guard	1	1	
	Handwheel	1	1	
	Control lever	1	1	
	Shield	1	1	
	Protection device	1	1	
	Chip-and-drip pan	1	1	
	Protective casing	1	1	
	Tools			
	Double-ended wrenches GOST 2639-80:			
	7811-0007ПСІ	1	1	
	7811-0023ПСІ	1	1	
	7811-0041ПСІ	1	1	
	Pliers ДК 177	1	1	
	Pliers ДК 178	1	1	
	Wrench 22 ПИ643	1	1	
	Wrench 45 ПИ643	1	1	Integral set
6Р82.ОП.30	Socket wrench	1	1	Integral set
	Tommy bar 2 ПИ643	1	1	Integral set
	Special wrench for electral cabinet	1	1	
	Accessories			
	Lybricating			
	Syringe Ш2 ТУ37.372.054-88	1	1	
	Arbor GOST 13785-68:			
	6222-0032	1	1	Integral set
	6222-0039	1	1	
	Arbor GOST 15067-75			
	6225-0148	1		Integral set
	Rings GOST 15071-75:			
	6030-0834	3		Integral set
	6030-0836	4		Integral set
	6030-0837	7		Integral set
	Arbor GOST 15068-75			
	6225-0179	1		Integral set
	Sleeve GOST 15072-75			
	6010-0227	1		Integral set
	Rings GOST 15071-75:			
	6О30-0834	1		Integral set
	6О30-0836	6		Integral set
	6030-0837	10		Integral set

Code designation	Item	Qnty		Remarks
		6Т82Ш	6Т83Ш	
	Arbor GOST 15068-75			
	6225-0179		1	Integral set
	Sleeve GOST 15072-75			
	6010-0228		1	Integral set
	Rings GOST 15071-75:			
	6030-0834		1	Integral set
	6030-0836		6	Integral set
	6030-0837		10	Integral set
	Arbor GOST 15068-75			
	6225-0184		1	Integral set
	Sleeve GOST 15072-75			
	6010-0232		2	Integral set
	Rings GOST 15071-75:			
	6030-0862		2	Integral set
	6030-0864		3	Integral set
	6030-0865		4	Integral set
	6О30-0866		4	Integral set
6Р82Ш.ОП.002	Arbor dia. 22	1	1	
6Р82Ш.ОП.003	Arbor dia. 27	1	1	
6Р82Ш.ОП.005	Draw-in rod	1	1	
6Р82Ш.ОП.007	Draw-in rod	1	1	
6Р82Ш.ОП.008	Draw-in rod	1	1	
6Р82Ш.ОП.010	Draw-in rod	1	1	
6Р82Ш.ОП.154	Adapter sleeve M3	1	1	
6Р82Ш.ОП.155	Adapter sleeve M2	1	1	
6Р82К.93.100/41А	Grip	2	2	
	Washer 24.65Г.05 GOST 6402-70	2	2	
	Spare Parts			
6М82.7.516	Seal	2		
6М82.7.517	Seal	1		
6М82.7.518	Seal	1		
6М82.7.519	Seal	2	2	
6М83.7.93	Seal		2	
6М83.7.94	Seal		1	
6М83.7.95	Seal		1	
	Set of spare parts for control cabinet	1	1	
	Fuses			
	PVD1-2A	8	8	
	PVD1-4A	2	2	
	PVD1-6A	2	2	
	Service documents			
6Т82Ш.000.000 РЭ	Service Manual of Machine			Number of copies as per Order Specs
6Т82Г.000.000 РЭ1	Electrical Equipment Service Manual			
6Т82Г.000.000 РЭ2	Acceptance Certificate			
	Items supplied as optional extras			

Code designation	Item	Qnty		Remarks
		6T82Ш	6T83Ш	
	Accessories			
	Machine vice, hand-operated, swivel-type, with straight jaws, of high accuracy 7200-0220-02П GOST 14904-80	1	1	
	Universal dividing head			
	УДГ-Д-250	1		
	УДГ-Н-160		1	
	Slotting head ПИ695П	1	1	
6P82Ш.Э1.74.000	Rotary circular table, with power-operated gear reducer, dia. 400 mm	1	1	
6P82.ОПВ.01 6P82.ОПВ.50	Casing Screw	1 1		To guard change gears of the УДГ-Д-250 universal dividing head
6P83.ОПВ.01 6P82.ОПВ.50	Casing Screw		1 1	To guard change gears of the УДГ-Н-160 universal dividing head
	Arbors GOST 13785-68:			
	6222-0033 (dia. 22)	1	1	
	6222-0034 (dia. 27)	1	1	
	6222-0035 (dia. 32)	1	1	
	622-0037 (dia. 40)	1	1	
	Adapter sleeves GOST 13790-68:			
	6103-0003 M3	1	1	
	6103-0004 M4	1	1	
	6103-0005 M5	1	1	
	Arbor GOST I5068-75			
	6225-0181 (dia. 40)		1	Integral set
	Rings GOST 15071-75			
	6030-0848 (B=10)		1	Integral set
	6030-0850 (B=20)		5	Integral set
	6030-0851 (B=30)		4	Integral set
	6030-0852 (B=60)		3	Integral set
	Sleeve GOST 15072-75			
	6010-0231 (dia. 71)		1	Integral set

4. SAFETY PRECAUTIONS

4.1. Requirements to be observed by attending personnel.

DO NOT start operating this machine unless and until getting conversant thoroughly with the present Manual.

Only persons familiar with the general safety engineering rules adopted for milling operations, with the particular features of this machine and with the safety precautions set forth in this Manual may be admitted to operate this machine.

4.2. Safety requirements to be observed during installation and repair jobs

4.2.1. ***Unpacking and handling.*** Refer to Section 8 of this Manual.

4.2.2. ***Installation.*** When installing the machine be sure to reliably fasten it and connect to a common earthing network. Check to ensure that the earthing circuits should be within 0.1 Ω.

4.2.3. ***Repair.*** Prior to commencing repair jobs involving removal of the covers from compartments housing traversable machine components (speed gearbox, feed gearbox, knee), as well as dismantling and removal of machine units, be sure to disconnect the machine from power mains.

4.2.4. When dismantling the screw-and-nut drive of the table vertical traverse, bring stop 1 (Fig. 9) under the knee to prevent it from falling.

4.2.5. When dismantling the knee unit in assembly with the table and saddle from the column, remove the knee guide strip only if the knee is suspended from a crane (Fig. 10).

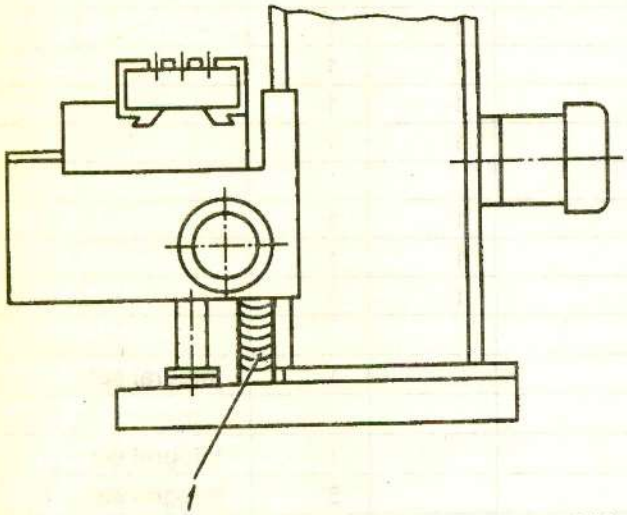


Fig. 9. Stop Put Under Knee When Dismantling Table Vertical Traverse Lead-Screw-and-Nut Drive

4.3. Safety requirements to principal machine constructional members and control systems

4.3.1. The operator may use only machine control members located on the outside surface of the machine. The electric cabinet door must be locked with a special key during machine operation. Only skilled electricians are permitted to open the electric cabinet door.

4.3.2. The extreme positions of the table longitudinal, cross and vertical traverse motions are limited by trip dogs. NEVER operate the machine unless the trip dogs are in position or the master controller is in good repair.

4.3.3. The spindle is decelerated and stopped automatically on pressing the STOP button, the spindle stopping time not exceeding 6 s.

4.3.4. Spindle disengagement is interlocked with the feed motion so that when spindle rotation and feed motion are disengaged simultaneously the spindle drive is disengaged somewhat later.

4.3.5. The table cross and vertical traverse control lever is interlocked with the feed drive. In the case of a manual table control (when the lever is pushed in) the electric circuit of the respective feed traverse is open.

The table longitudinal traverse handwheel located on the table end face, is spring-locked against spontaneous turning-on during power feed traverse. The duplicate handwheel located on the saddle front end is disengaged when longitudinal power feed traverse gear clutch is engaged.

Keep a regular watch on these safety and interlocking devices to see that they are in good repair; also check the locating surfaces of the

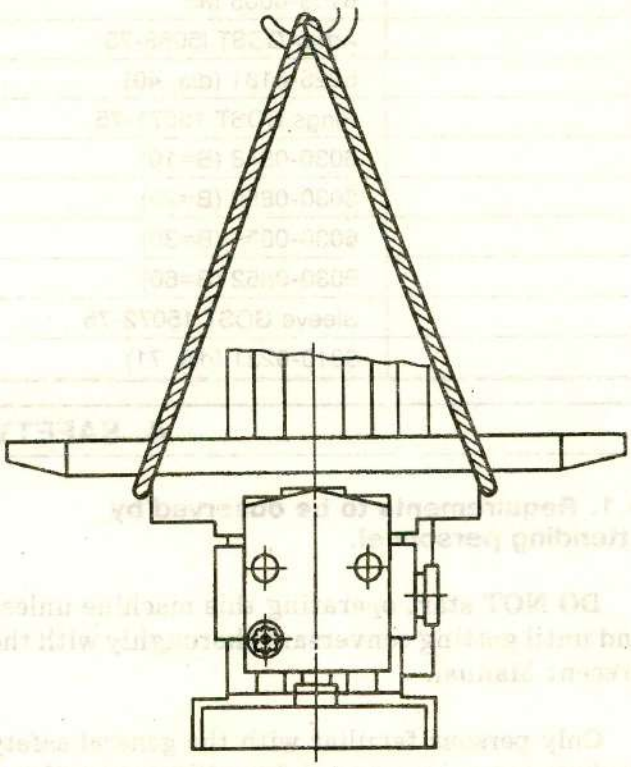


Fig. 10. Relieving Knee Weight with a Crane

handwheels, control levels and shaft journals on which they are set, for proper condition.

NEVER operate the machine unless all the interlocking devices are in good operative condition.

4.3.6. **NEVER** shift spindle rotation frequencies on the run.

4.3.7. Check to see that the coolant nozzle is locked in place reliably. **NEVER** retouch or reposition the nozzle in the course of milling or when the spindle is running.

4.3.8. **NEVER** perform any auxiliary operations (loading, unloading or measuring the workpiece being machined, etc.) unless the tool is at a standstill.

4.4. Protection Means and Safeguards Incorporated in Machine Construction

4.4.1. The machining zone is enclosed in a guard (Fig. 11a) which is adapted to protect the operator and those standing nearby the machine, against flying-off chips and coolant splashes. The guard comprises blinds 1 suspended from brackets 2. Provision is made in the guard design for changing the position of the blinds as for height by displacing the brackets along hinge 3.

When setting or removing the blinds bring them to the left and right at a required angle.

4.4.2. The cutter arbor outer end protruding beyond the arbor support is enclosed in a quick-to- remove guard (Fig. 12), which consists of removable guard 1 properly fixed in the recess of nut 2 with two pins 3.

NEVER operate the machine unless the safeguards are in position.

4.4.3. Prior to start operating the machine do not fail to see the knee ways guard as shown in Fig. 11b.

4.4.4. When operating with a circular table receiving rotation from the mechanical drive gear reducer, take care to cover the rotating pivoted shaft with a guard. **NEVER** operate the machine unless this guard is in position.

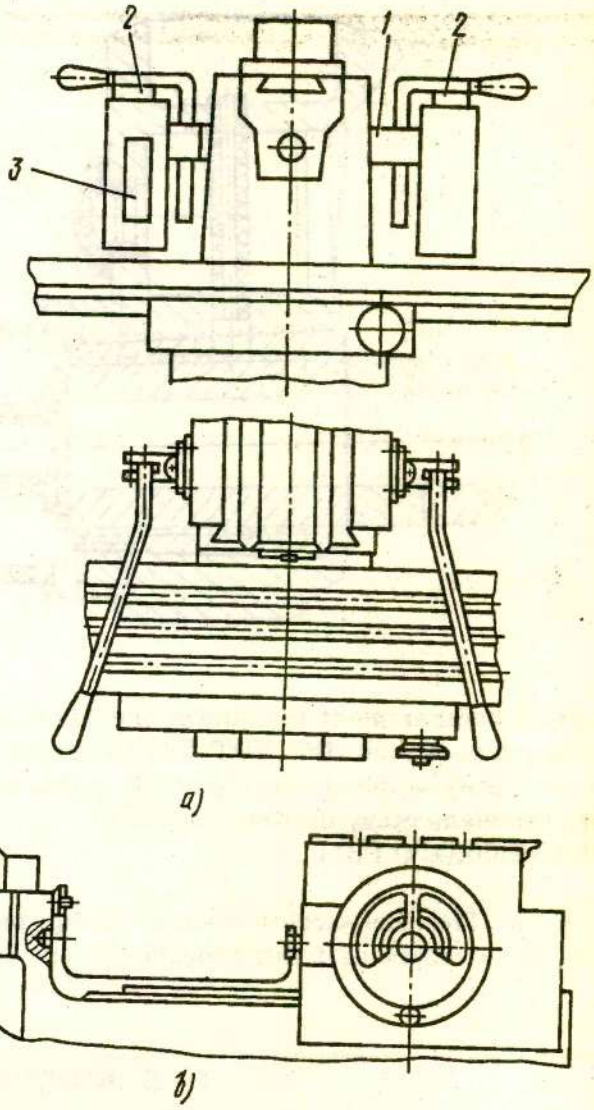


Fig. 11. Working Space Guard

4.4.5. The tool is clamped mechanically in the horizontal spindle.

Engagement of tool clamping/unclamping results in automatic spindle stopping to prevent the spindle from turning when the tool is being clamped.

NEVER operate the machine unless the spindle deceleration system is in good repair.

4.4.6. The spindles can be engaged only with the tool clamped. Reclamp the tool when the line circuit breaker has been tripped or the EMERGENCY STOP button has been pressed.

4.4.7. When a power-assisted workpiece clamping fixture is used in the machine, terminals are provided on the panel of the right-hand

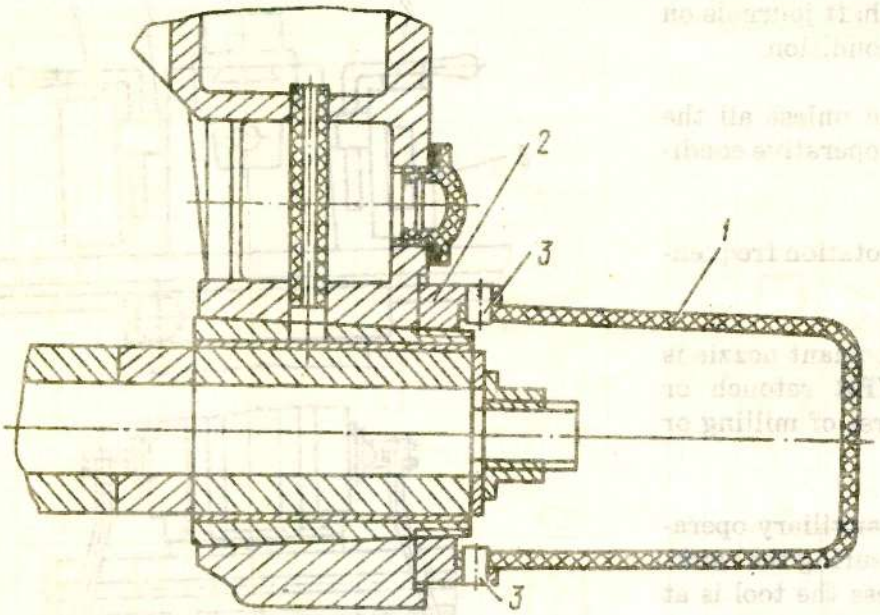


Fig. 12. Milling Cutter Arbor End Guard

machine compartment to connect the workpiece clamping monitors. **DO NOT** fail to remove a jumper between terminals 45 and 46 in this case (refer to elementary electric diagram 6T82Г-0.00.000 Р31).

4.4.8. The line circuit breaker is equipped with an interlock that disconnects the machine from power mains when the electric cabinet door is being opened.

4.4.9. The feed drive incorporates a safety clutch that prevents machine failure due to overloads or any obstacle to table traverse.

5. MACHINE COMPONENTS

A general view of the machine with reference to its components is illustrated in Fig. 13, while a list of machine components is given in Table 1 below.

List of Machine Components — Table 1

Code designation		Item	Ref. No. in Fig. 13	Remarks
6T82Ш	6T82Ш			
6T82Г.10	6T83Г.10	Column	1	
6P82.5	6P83.5	Change gearbox	2	
6T82Г-1.85A	6T82Г-1.85A	Side control panel	3	
6T82Ш.30	6T83Ш.30	Speed gearbox	4	
6P13K.93.100-06	6P13K.93.100-06	Electromechanical tool clamping fixture (complete set)	5	
6T82Ш-1.150	6T83Ш-1.150	Ram	6	
6T82Ш-1.310	6T82Ш-1.310	Swivel head	7	
6T82Ш-1.320	6T82Ш-1.320	Attachment head	8	
		Control cabinet	9	
6T82Г-1.70	6T83Г-1.70	Table and saddle	10	

Code designation		Item	Ref. No. in Fig.13	Remarks
6Т82Ш	6Т82Ш			
6Т82Г-1.41	6Т83Г-1.41	Slow-rate feed mechanism	11	
6Т82Г-1.82	6Т82Г-1.82	Main control panel	12	
6Т82Г.60	6Т83Г.60	Knee	13	
6Т82Г-1.40	6Т82Г-1.40	Feed gearbox	14	

6. DESIGN AND OPERATION OF MACHINE AND ITS COMPONENTS

6.1. A general view of the machine with reference to its controls is illustrated in Fig. 14.

A list of machine controls is contained in Table 2.

A list of pictorial drawings is represented in Table 3.

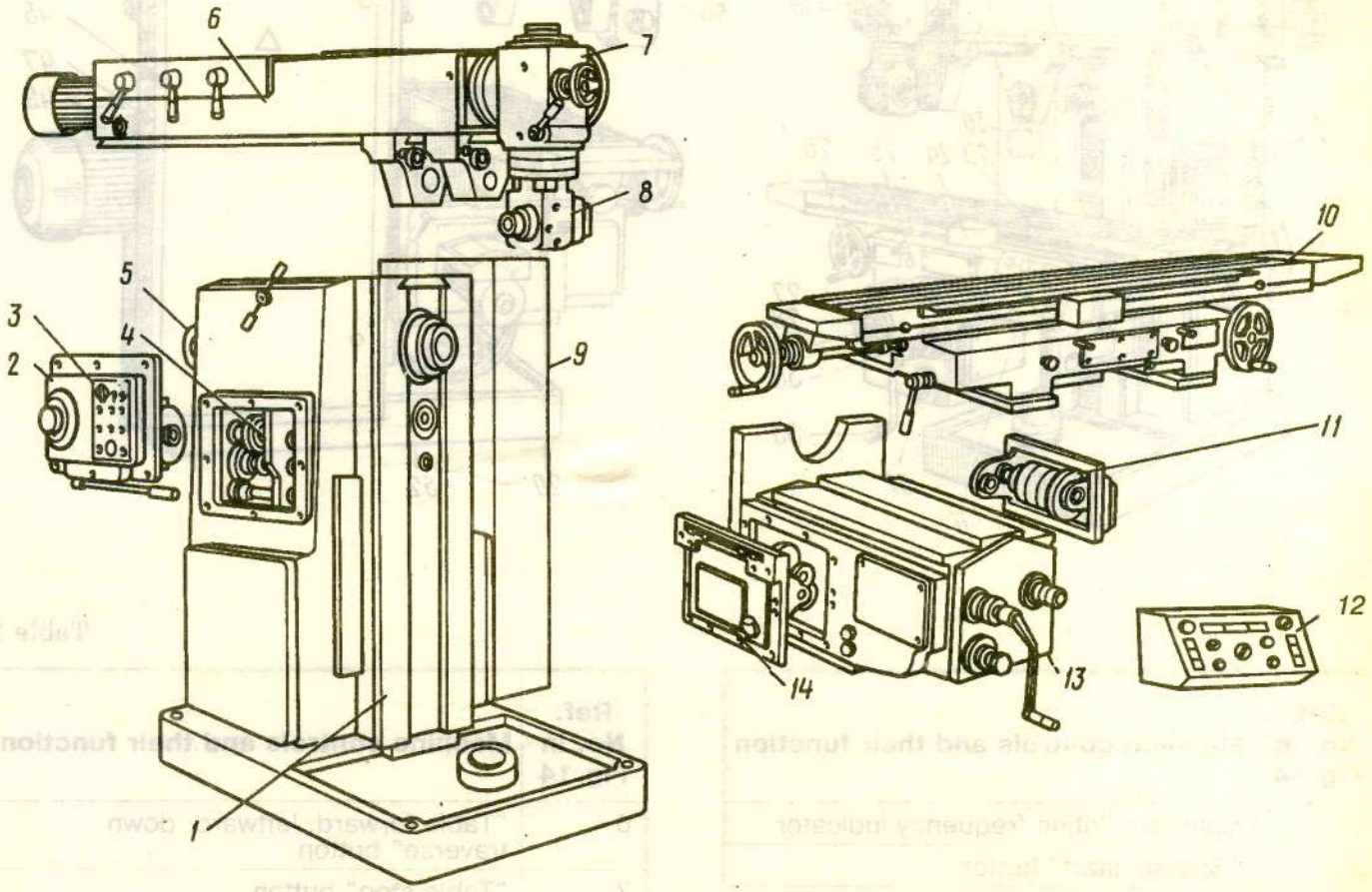


Fig. 13. Layout of Machine Components

Fig. 14. Layout of Machine Controls

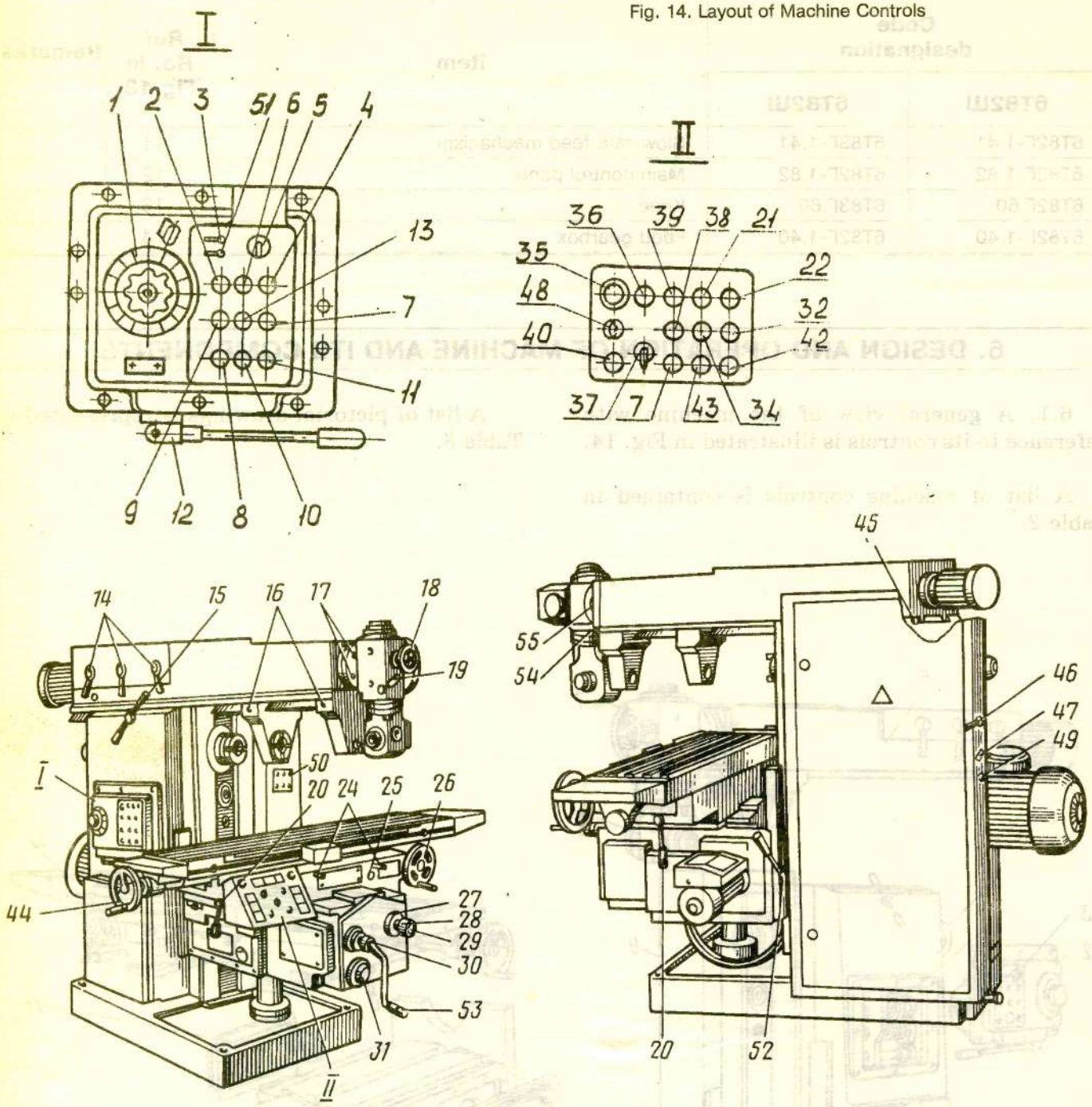


Table 2

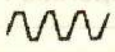
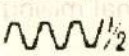
Ref. No. in Fig.14	Machine controls and their function
1	Spindle rotation frequency indicator
2	"Spindle start" button
3	"Tool clamping/unclamping" selector
4	"Table backward, rightward, upward traverse" button
5	Table traverse direction selector

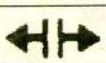
Ref. No. in Fig.14	Machine controls and their function
6	"Table forward, leftward, down traverse" button
7	"Table stop" button
8	"Spindle inching" button
9	"Spindle stop" button (duplicate)
10	"Emergency stop" button

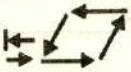
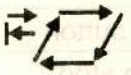
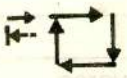
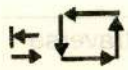
Ref. No. in Fig.14	Machine controls and their function
11	"Table rapid traverse" button (duplicate)
12	Spindle rotation frequency selector lever
13	"Swivel head spindle inching " button
14	Swivel head spindle rotation frequency selector lever
15	Ram manual traverse facility
16	Arbor support clamps
17	Swivel head clamp
18	Spindle quill extenstion handwheel
19	Spindle quill clamping lever
20	Saddle clamps
21	"Table leftward traverse" button
22	"Table rightward traverse" button
23	"Table longitudinal traverse stop" button
24	Table clamp
25	Table manual-to-power traverse selector
26	Table manual longitudinal traverse handwheel
27	Vernier ring
28	Table cross traverse mechanism dial
29	Table manual cross traverse handwheel
30	Table manual vertical traverse handwheel
31	Feed selector knob
32	"Table forward traverse" button
33	"Table cross traverse stop"button
34	"Table backward traverse" button
35	"Emergency atop" button
36	"Spindle start" button
37	Machine operation mode selector
38	"Slow-rate feed" selector
39	"Spindle stop" button
40	"Table rapid traverse and cycle start" button
41	"Table vertical traverse stop" button
42	"Table downward traverse" button
43	"Table upward traverse" button
44	Table manual longitudinal traverse handwheel (duplicate)
45	Ram-to-column clamp

Ref. No. in Fig.14	Machine controls and their function
46	Line circuit breaker
47	Spindle sense of rotation selector
48	Coolant pump ON-OFF switch
49	Attachment head spindle sense of rotation selector
50	Automatic cycles selector
51	Control panel selector
52	Knee clamping lever
53	Table manual vertical and cross traverse lever (detachable)
54	Attachment head clamping lever
55	Zero position locking

List of Pictorial Drawings Table 3

Pictorial drawing	Explanation
	Line circuit breaker
	Spindle with milling cutter
	Milling cutter
	Table (rectangular)
	Table (circular)
	Spindle clockwise rotation
	Spindle counterclockwise rotation
	Coolant pump
	OFF
	ON
	Engaged until kept depressed
	Rapid traverse
	Feed traverse
	Slow-rate feed

Pictorial drawing	Explanation
	Manual-control operation
	Nut backlash elimination
	Filling-in
	Ways lubrication
	**DO NOT** shift while on the run
	Illumination
	Handwheel
	Monitoring
	Tool clamping
	Tool unclamping
	Side panel
	Main control panel
	Insulation earth fault
	Earthing
	Leftward traverse
	Rightward traverse
	Traverse away from operator
	Traverse towards operator
	Upward traverse
	Downward traverse
	Cycle start
	Semiautomatic operation
	R.H. unidirectional milling

Pictorial drawing	Explanation
	L.H. unidirectional milling
	R.H. unidirectional milling with traverse reversal
	L.H. unidirectional milling with traverse reversal
	Reciprocating milling cycle
	Closed rectangular milling cycles
	Horizontal counterclockwise closed rectangular milling
	Horizontal clockwise closed rectangular milling
	Vertical clockwise closed rectangular milling
	Vertical counterclockwise closed rectangular milling
	Electric cabinet closed
	Electric cabinet open
	Spindle rotation frequency per minute

6.2. Gearing Diagram (Fig. 15)

The horizontal spindle and the attachment head spindle receive rotation from individual flange- mounted electric motors through elastic couplings.

Spindle rotation frequency is changed by sliding the cluster gears along the splined shafts.

The horizontal spindle and the attachment head spindle have eighteen and eleven different rotation frequencies, respectively.

Figs 16 and 17 represent graphic charts of spindle rotation frequencies to illustrate the design of the primary motion mechanism.

A list of gears, worms and lead-screws to the gearing diagram is specified in Table 4.

List of Gears, Worms and Lead-Screws

Table 4

Located in	Ref. No. in Fig.15	Number of gear teeth or worm and leadscrew starts	Module or pitch, mm
Speed gearbox	1	27	3
Ditto	2	53	3
Ditto	3	35	4
Ditto	4	27	4
Ditto	5	37	4
Ditto	6	46	4
Ditto	7	26	4
Ditto	8	38	4
Ditto	9	38	3
Ditto	10	69	4
Ditto	11	19	4
Ditto	12	82	3
Ditto	13	16	4
Ditto	14	32	4
Ditto	15	22	4
Ditto	16	19	4
Ditto	17	17	4
Ditto	18	13	3
Table and saddle	19	1	6
Ditto	20	1	6
Ditto	21	15	2.76
Ditto	22	20	2.76
Ditto	23	25	2.64
Ditto	24	20	2.64
Ditto	25*	15	3
Ditto	26*	50	1.5
Ditto	27	50	1.5
Ditto	28	50	2
Ditto	29	1	6
Ditto	30	25	2
Ditto	31	18	2
Ditto	32	24	2
Ditto	33	30	3
Knee	34	78	2
Ditto	35	1	6
Ditto	36	1	6
Ditto	37	51	3
Knee	38	51	3
Ditto	39	20	2
Ditto	40	25	2
Ditto	41	27	2.5
Ditto	42	48	2.5
Ditto	43	57	2.5
Ditto	44	41	2.5
Ditto	45	57	2.5
Ditto	46	18	3
Ditto	47	30	3
Ditto	48	57	2.5
Ditto	49	78	2
Ditto	50	57	2.5
Ditto	51	78	2
Ditto	52	78	2
Ditto	53	55	2
Ditto	54	38	2
Ditto	55	38	2
Ditto	56	48	2.5
Ditto	57	78	2
Ditto	58	78	2
Ditto	59	52	3
Ditto	60	66	2
Ditto	61	22	2
Ditto	62	52	3
Ditto	63	1	6
Ditto	64	1	6
Ditto	65	30	2.5
Ditto	66	34	2.5
Ditto	67	40	2.5
Ditto	68	12	2.5
Ditto	69	38	2.5
Ditto	70	20	2.5
Ditto	71	21	2.5
Ditto	72	40	2.5
Ditto	73	19	2.5
Ditto	74	23	2.5
Ditto	75	28	2.5
Ditto	76	40	2.5
Ditto	77	40	2.5
Ditto	78	31	2.5
Ditto	79	30	2.5
Ditto	80	17	2.5

Located in	Ref. No. in Fig.15	Number of gear teeth or worm and leadscrew starts	Module or pitch, mm
Knee	81	36	2.5
Ditto	82	51	2.5
Ditto	83	24	2.5
Ditto	84	18	2.5
Slow-rate feed mechanism	85	19	2.5
Ditto	86	53	2.5
Ditto	87	22	2.5
Ditto	88	22	2.5
Yoke	89	72	2
Ditto	90	28	2
Ditto	91	52	2
Ditto	92	48	2
Ditto	93	34	2
Ditto	94	66	2
Ditto	95	58	2
Ditto	96	42	2
Ditto	97	49	2
Ditto	98	51	2
Ditto	99	33	2
Ditto	100	67	2
Ditto	101	59	2.5
Ditto	102	21	2.5
Swivel head	103	27	2.8
Ditto	104	27	2.8
Ditto	105	28	2.8
Ditto	106	28	2.8
Attachment head	107	19	3
Ditto	108	19	3

* Gear clutch members

Note. Machines with the electrical equipment rated for a 60-Hz current supply feature the following number of gear teeth in the gears: No. 1-24; No. 2 - 56; No. 39 - 18; No. 40 - 25; No. 93 - 30; No. 94 - 62; No. 95 - 70; No. 96 - 38; No. 97 - 53; No. 98 - 47.

The feed motion drive, incorporating the rapid traverse, working feed motions and slow traverse kinematic chains, is powered from a flange-mounted electric motor situated on the knee right-hand side. The feed gearbox provides for 22 different feed rates by means of four double-rim cluster gears and a single-rim sliding gear for countergearing engagement; these feed rates are Imparted to the drive output shaft provided with a rapid traverse engagement clutch, a working feed traverse engagement clutch and a ball-type safety clutch. Then motion is transmitted from the gear rim of safety clutch 53 to the change gearbox which distributes motion between the lead-screws; the change gearbox incorporates two control electromagnetic clutches rotating in the opposite directions, for each of the table traverse axes. Thus, table traverse in a desired direction is ensured by engaging the respective clutch in the change gearbox.

Rapid traverse motions are obtained by engagement of rapid traverse clutch 43 and the feed drive motor, rotation from this motor being translated via bevel gears 39, 40 to shaft 11, and via gear 42 to the gear rim of clutch 43; the gear rim is free to roll over shaft XI and is adapted to interact with the rapid traverse engagement electromagnetic clutch.

Working motions are actuated by engagement of feed clutch 45, with the motor running and the rapid traverse clutch disengaged. The rotation frequency of output shaft XI with the feed traverse engaged depends on the position of the sliding cluster gears in the feed gearbox.

When power-driven motions of the machine table are engaged the travelling starts with time delay up to 2 s.

Slow-rate motions are obtained by decreasing the main feed rate two-fold with the use of a step- down gear reducer composed of input gear 86, intermediate gears 85, 87 and output gear 88. Rotation to the input of the stop-down gear reducer is translated via clutch 45 gear which rolls freely over shaft XI. With the slow-rate feed clutch engaged rotation is transmitted from the gear reducer to gear 44 rigidly linked to shaft XI. The rapid traverse and working feed clutches are disengaged when the slow-rate feed traverse is engaged.

Manual setup motions of the table are actuated by handwheel 26 or 44, those of the saddle and knee, by detachable lever 53 (Fig. 14), and of the swivel-head spindle quill, by handwheel 18.

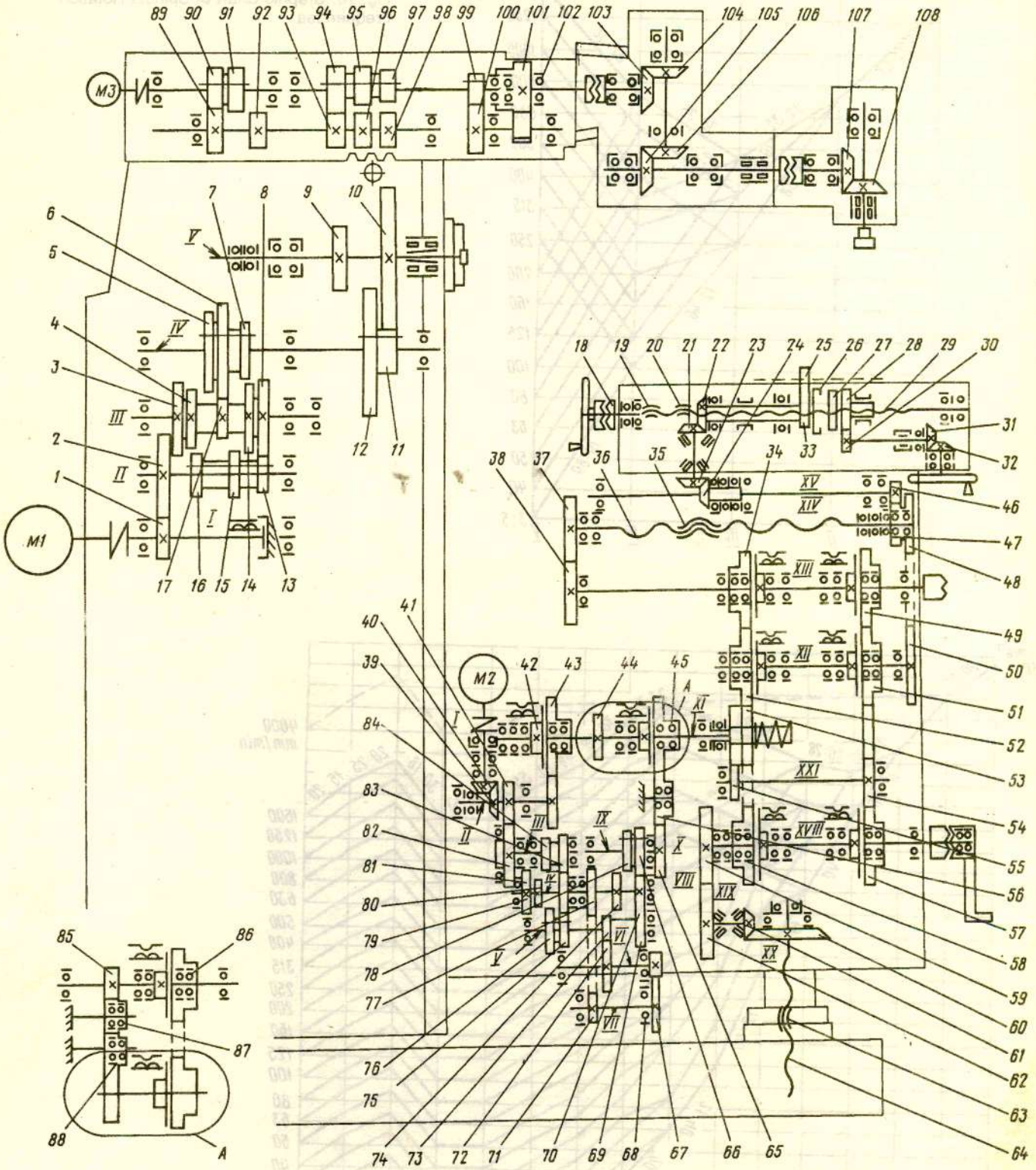


Fig. 15. Gearing Diagram

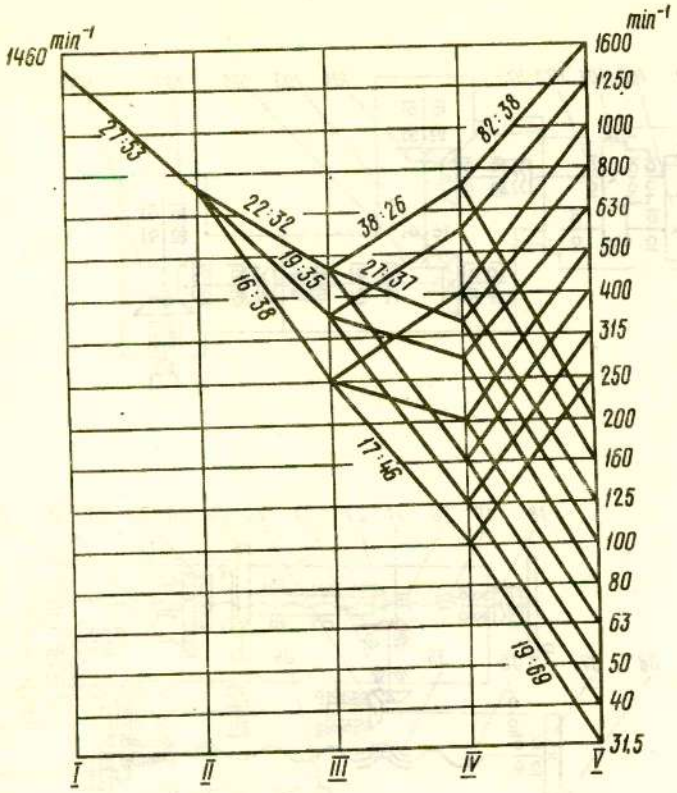


Fig. 16. Graphic Chart of Spindle Rotation Frequendea

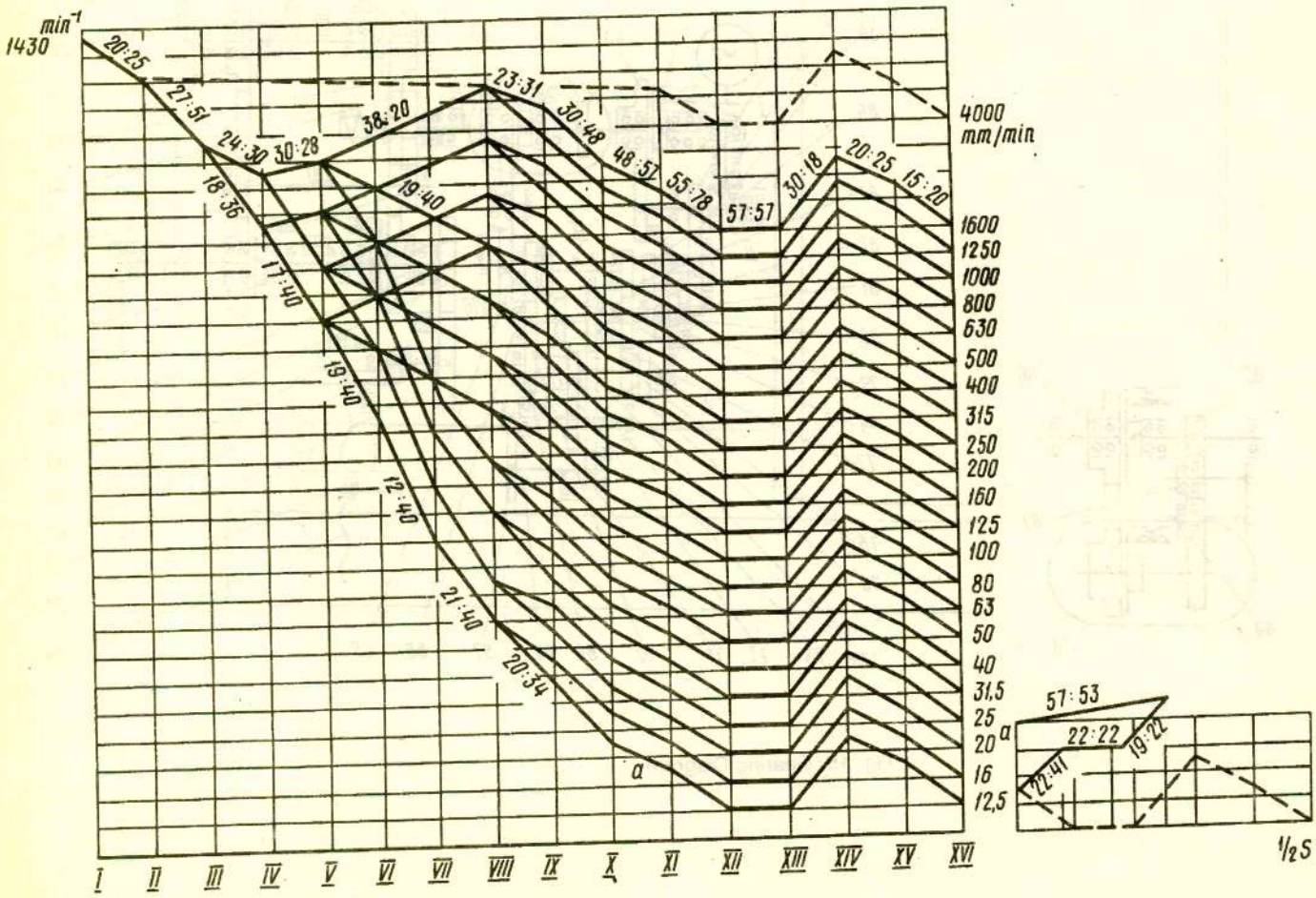


Fig. 17. Graphic Chart of Longitudinal and Cross Feeds

Fig. 17 represents a graphic chart illustrating the kinematic structure of the machine feed mechanism (vertical feed rates being one-third the longitudinal and cross ones), while Fig. 18 depicts a graphic chart of the swivel head spindle rotation frequencies.

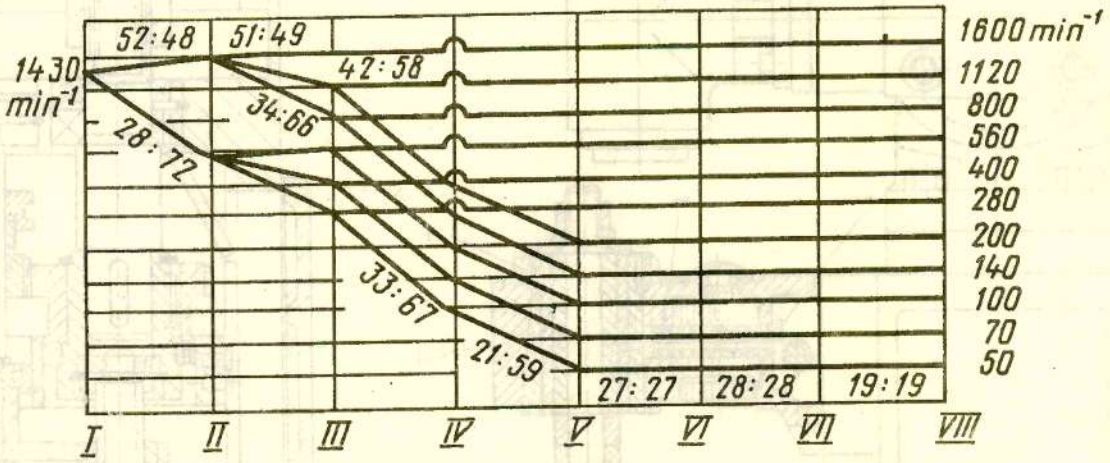


Fig. 18. Graphic Chart of Swivel Head Spindle Rotation

6.3. Brief Description of Machine Assembly

6.3.1. Column

The column is a basic assembly unit on which all machine components and mechanisms are installed.

The rigid design of the column is attained due to its highly developed footing and numerous stiffening ribs.

The column has vertical ways for the knee and horizontal ways for the ram.

A strip with trip dogs is provided on the column left-hand side to limit the knee travel.

An electric cabinet is provided on the column right-hand side.

The primary motion drive and tool clamping drive motors are flange-mounted on the column rear surface.

The column interior houses an oil tank. The column rests on a footing which serves also as the support of the knee elevating screw. The rear portion of the footing carries a coolant pump.

6.3.2. The ram is an individual assembly unit accommodating the speed gearbox (Fig. 20) of the swivel head spindle. Spindle rotation frequencies are changed by sliding the cluster gears along the splined shafts from levers 14 (Fig. 14) as instructed in the index plates provided on the levers.

The ram is traversable along the column ways from handwheel 15. Prior to moving the ram give screw 45 four or five revolutions backwards until easy running is attained.

Whenever it becomes necessary to use this machine as a plain horizontal miller, arbor supports can be installed on the ram ways (Fig. 19). Since the hole in the arbor support to receive a bearing is bored individually for every particular machine, it is not recommendable to transpose arbor supports from one machine to another.

As a rule, the 6T82III makes use either of arbor supports I or II, while the 6T83III uses arbor support II in cases where heavy machining condition are encountered, the 6T83III can be equipped with two arbor supports II.

6.3.3. The swivel head is held to the ram through intermediate plate 1 by bolts brought into an annular T-slot and is centered by an annular recess (Fig. 20).

The swivel head is locked in zero position with respect to the ram flange. To swivel the head release it from zero locking by rotating the locking pin nut and pulling out pin 55 (Fig. 14).

The swivel head spindle receives rotation from the ram speed gearbox through jaw clutch

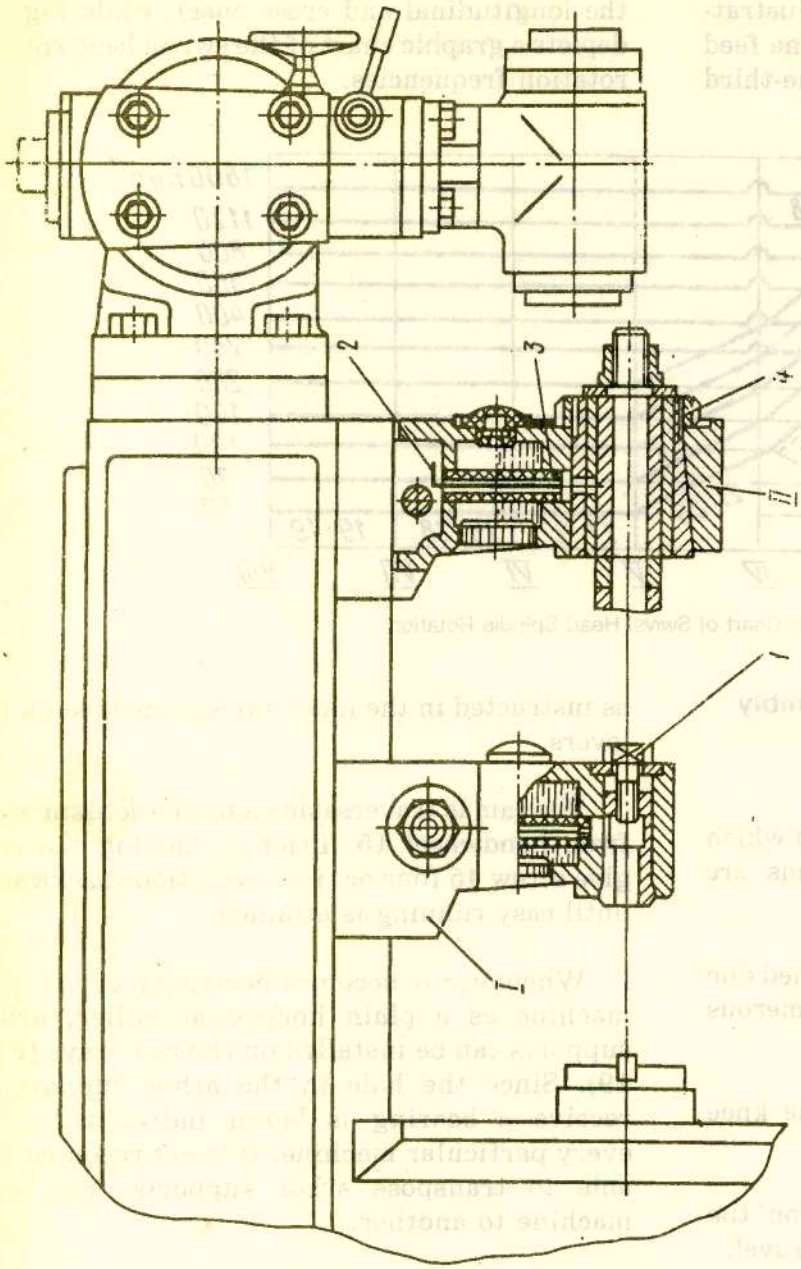


Fig. 19. Ram and Arbor Supports

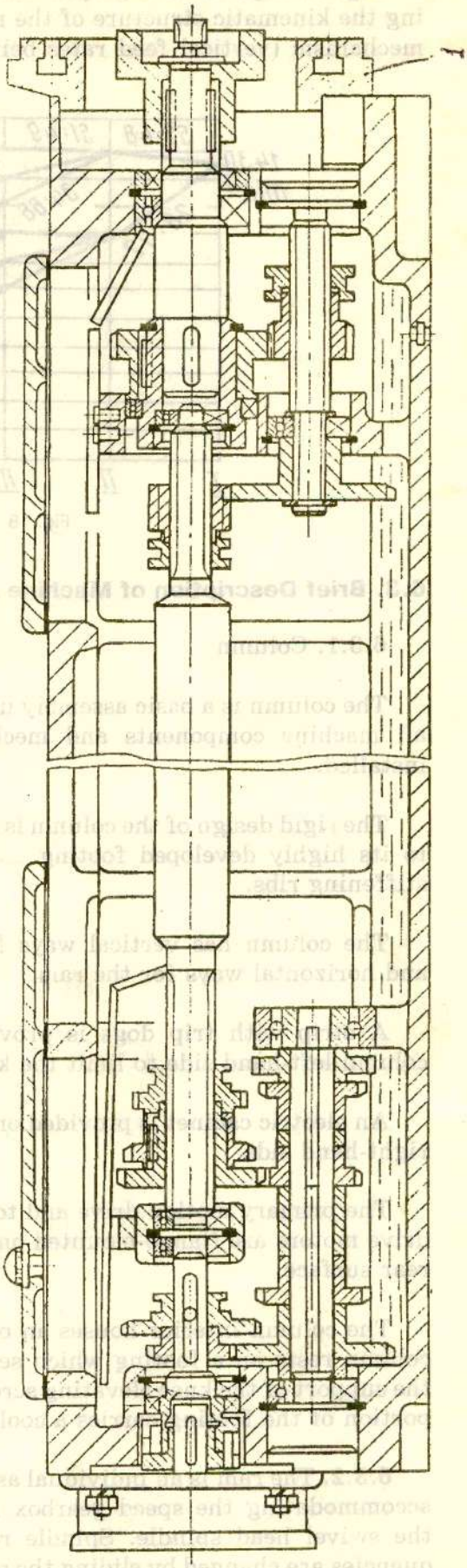


Fig. 20. Swivel head Spindle Speed Gearbox

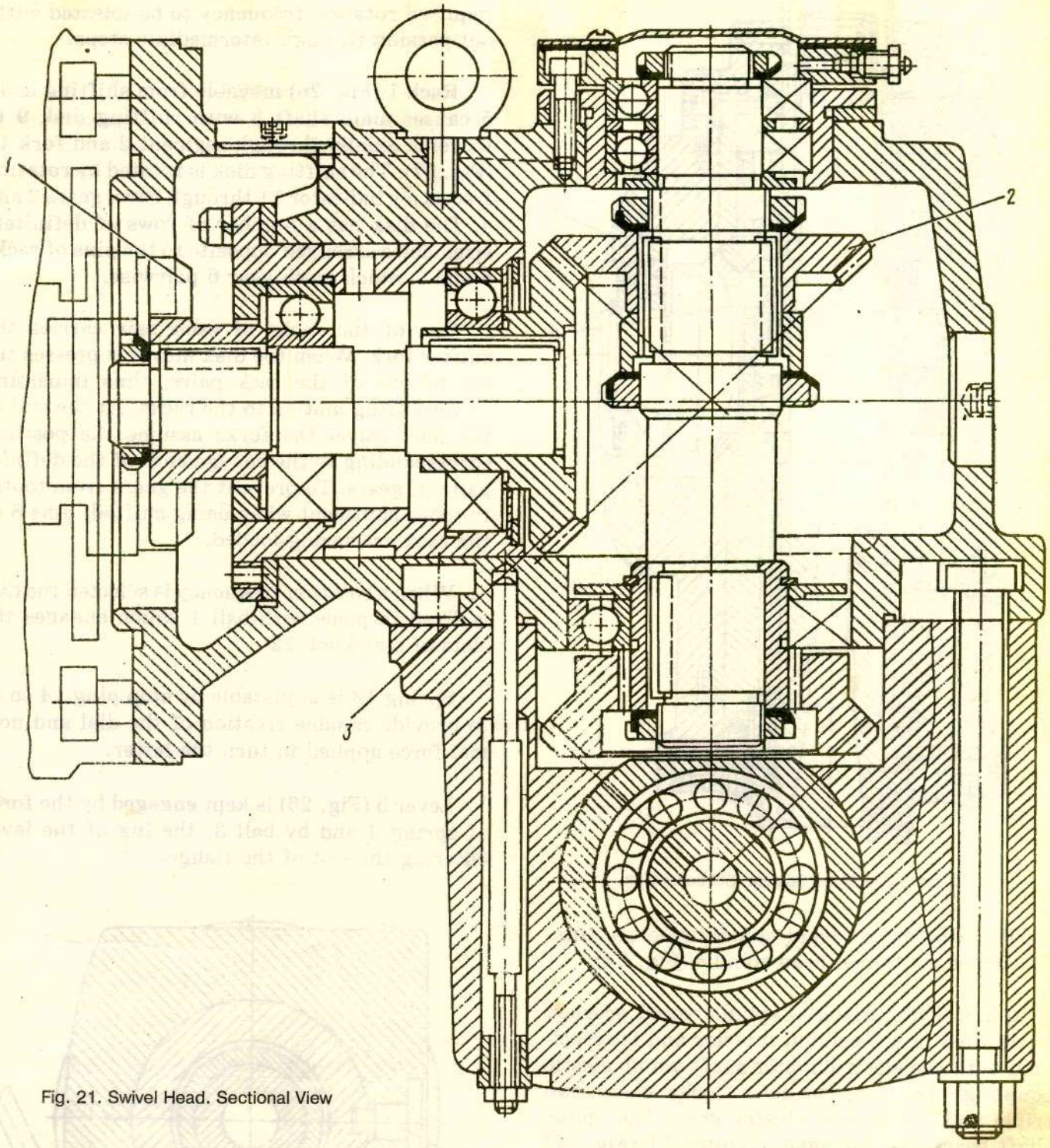


Fig. 21. Swivel Head. Sectional View

I and bevel gears 2, 3 (Fig. 21) and 4, 5 (Fig. 22).

The spindle is in fact a two-support shaft mounted in an extensible quill.

The swivel head spindle quill is traversable from a handwheel which is linked, through a worm and a pinion, to the rack cut on the spindle quill.

The quill clamping mechanism consists of a fixed stop 1 (Fig. 23) and rod 2.

6.3.4. The attachment head is secured on the swivel head by means of a T-slot.

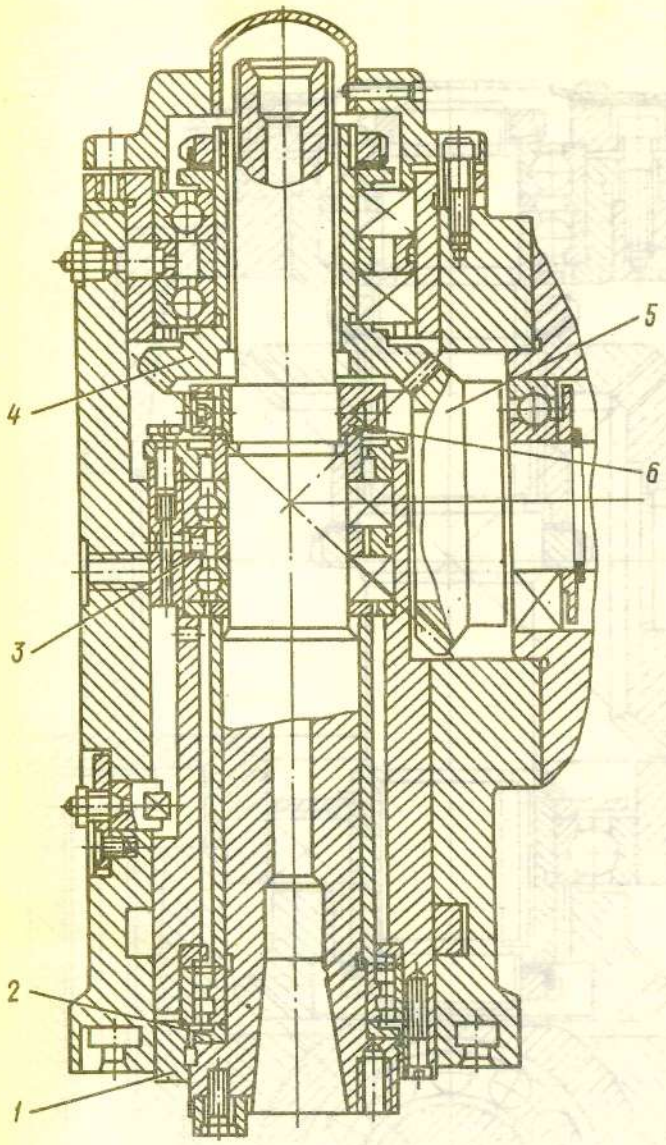


Fig. 22. Swivel Head Spindle. Sectional View

The attachment hand spindle receives rotation from the swivel head spindle (Fig. 24).

6.3.5. The horizontal spindle speed gearbox is situated in the column interior and is associated with the electric motor shaft via an elastic coupling. The intermediate shafts carry two triple and one double cluster gear. The motor shaft bears electromagnetic clutch 11 (Fig. 25) for the spindle to brake for stopping.

The speed gearbox can be inspected through an observation port on the gearbox right-hand side.

The spindle of the machine is in fact a two-support shaft the geometric accuracy of rotation of which depends to a great extent on bearings 2 and 4.

6.3.6. The speed change gearbox enables a required rotation frequency to be selected without passing through intermediate steps.

Rack 1 (Fig. 26) movable from shifting lever 5 causes main shaft 3 with shifting disk 9 to traverse axially through segment 2 and fork 10 (Fig. 27). The shifting disk is rotated by rotation frequency indicator 11 through bevel gears 2 and 4. The disk has a number of rows of definitely sized holes arranged opposite to the pins of racks 5 and 7 which mesh gear 6 pairwise.

One of the racks of each pair carries the shifter fork. When the disk moves it presses the pin of one of the rack pairs, thus imparting reciprocating motion to the racks. At the end of the disk travel the forks assume the position corresponding to the engagement of the definite pairs of gears. To prevent the gears from tooth-to-tooth abutment when being shifted, pins 8 of the rack are spring-loaded.

When a rotation frequency is selected the dial is fixed in place with ball 1 which engages the slots of star knob 12.

Spring 13 is adjustable by stop plug 14 so as to provide reliable fixation of the dial and normal force applied to turn the latter.

Lever 5 (Fig. 26) is kept engaged by the force of spring 4 and by ball 3, the lug of the lever entering the slot of the flange.

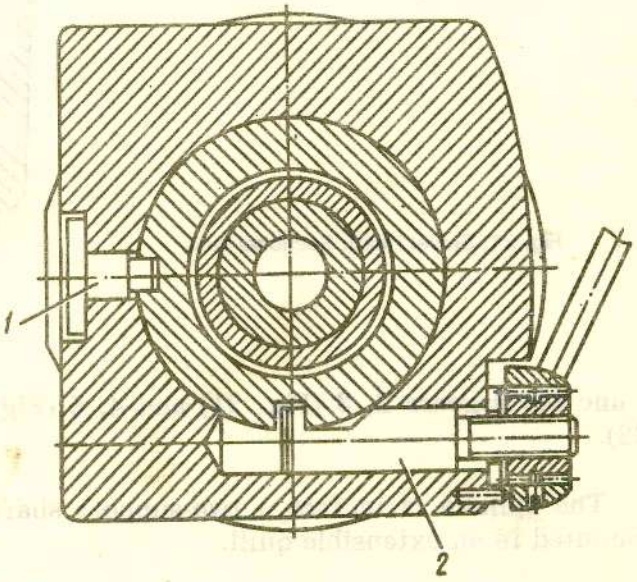


Fig. 23. Swivel Head Sleeve Clamping

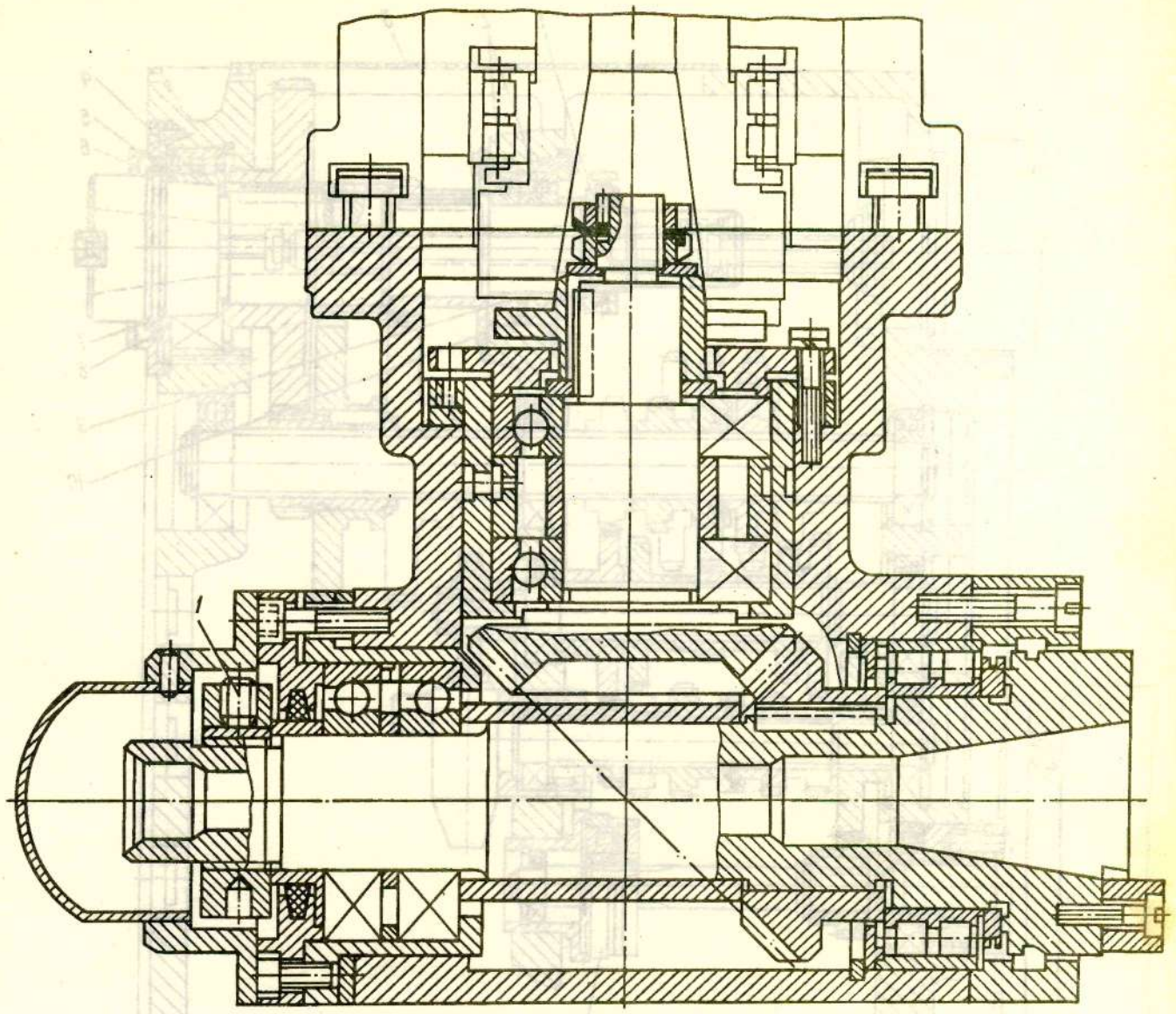


Fig. 24. Attachment Head Spindle. Sectional View

Correspondence of rotation frequencies selected to the values read off the indicator is attained due to a definite position of bevel gears 2 and 4 (Fig. 27) in mesh. Correct gear meshing is attained according to matchmarks provided on the adjacent tooth face and tooth space, or by setting the indicator and the disk with the shifter forks to the position corresponding to a rotation frequency of 31.5 min^{-1}.

Check to see that the backlash in the bevel gears in mesh should not exceed 0.2 mm since the disk could turn through 1 mm due to such an amount of backlash.

The speed change gearbox is splash-lubricated from the speed gearbox lubricating system by the oil fed by the pipe in the column top portion. Remember that lack of oil might result in an abnormal overheating of the shifter fork side plates, which in turn might lead to jamming the forks, their mutilation or breakage.

6.3.7. The feed gearbox provides for table traverse along three coordinate axes. Rotation to feed gearbox input gear 1 (Fig. 28) is imparted by gear rim 5 (Fig. 30) set on knee shaft 7. Feed rates obtained as a result of shifting the cluster gears involved, are transmitted through output gear 3 (Fig. 28) and idler gear 20 (Fig. 30), to feed engagement clutch 18 set on rapid traverse chain output shaft 16 accommodated in the knee. The feed gearbox and rapid traverse chain are protected against failure due to overloads by ball-type safety clutch 22. The amount of torque developed by the clutch is adjusted by changing the tension of the springs acting upon the balls accommodated in the slots on the gear face.

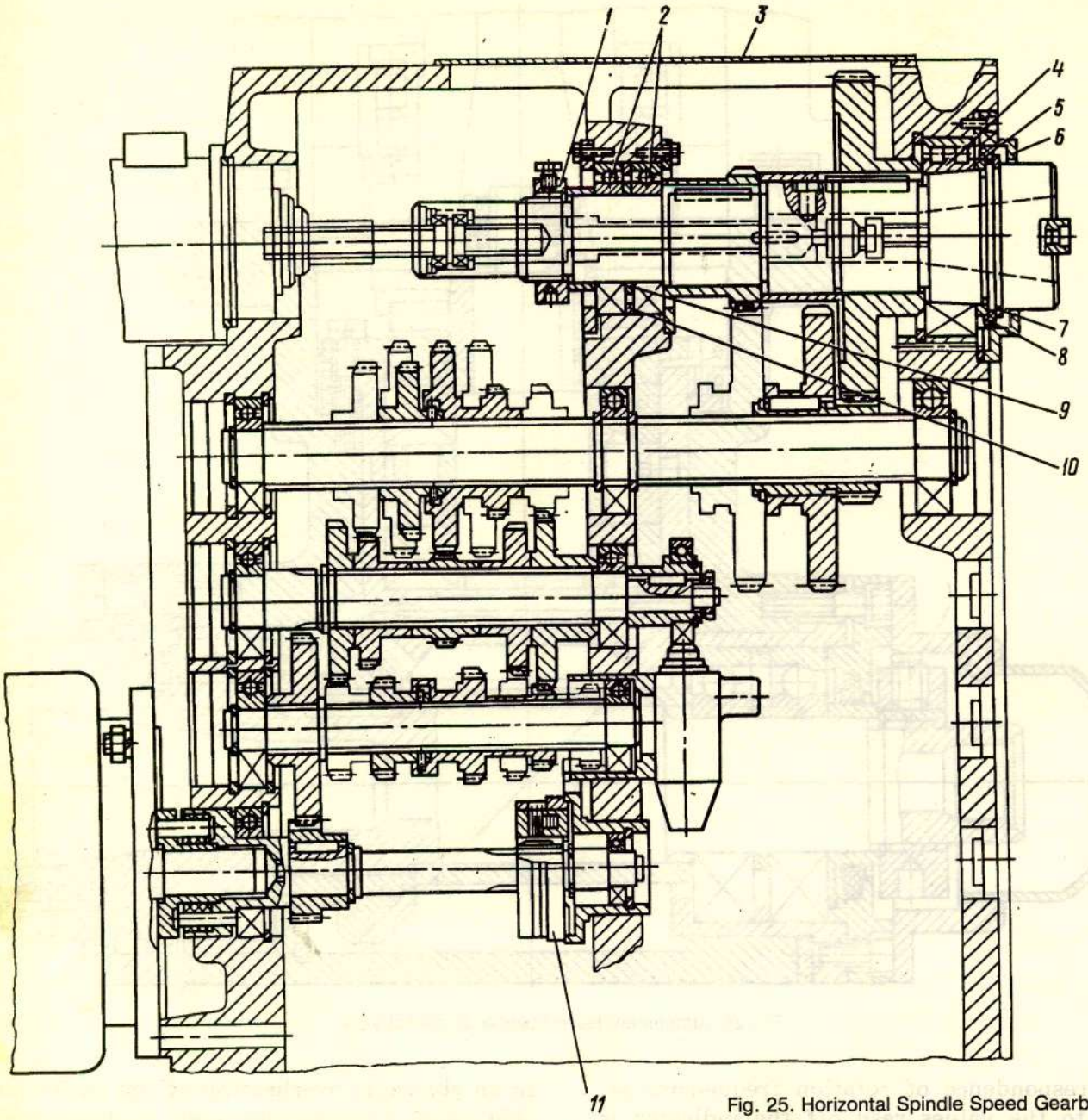


Fig. 25. Horizontal Spindle Speed Gearbox

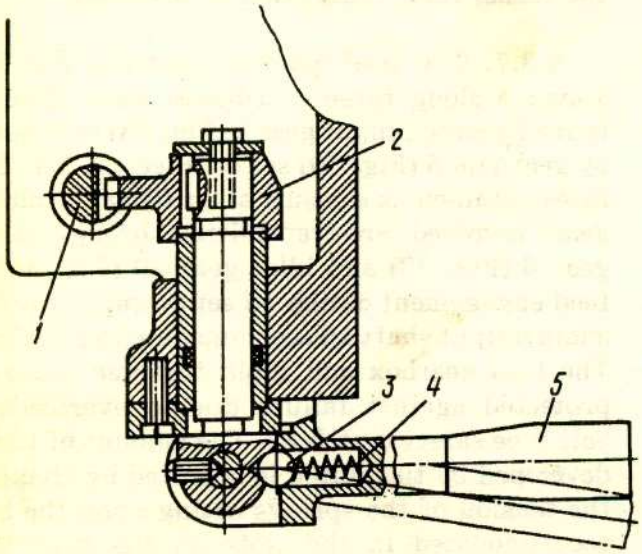


Fig. 26. Rotation Frequency Changing Mechanism

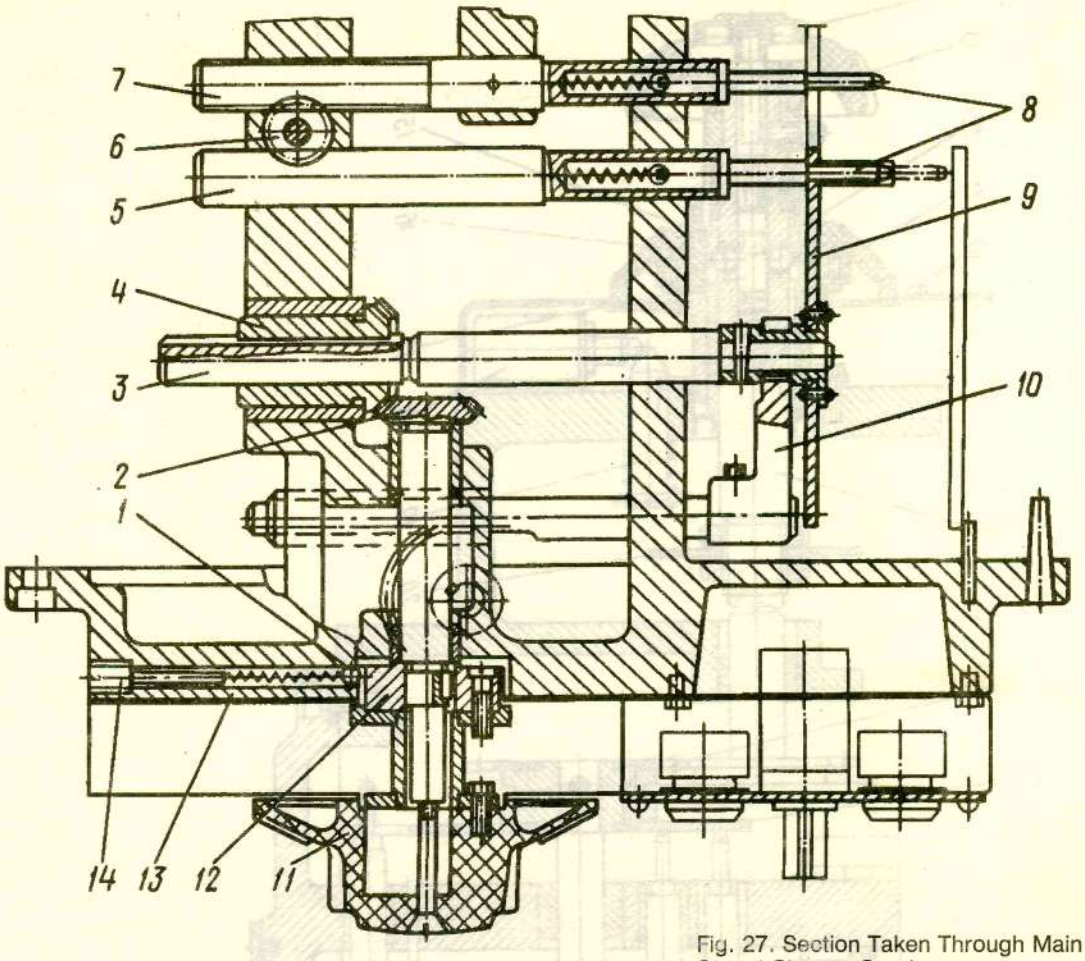
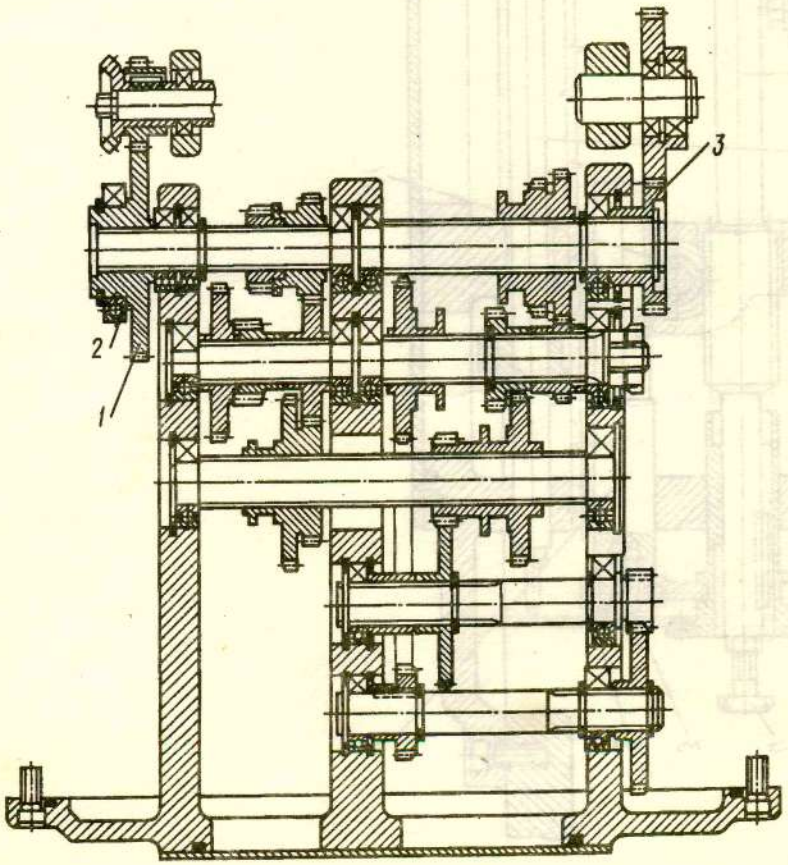


Fig. 27. Section Taken Through Main Shafts of Speed Change Gearbox



28. Feed Gearbox

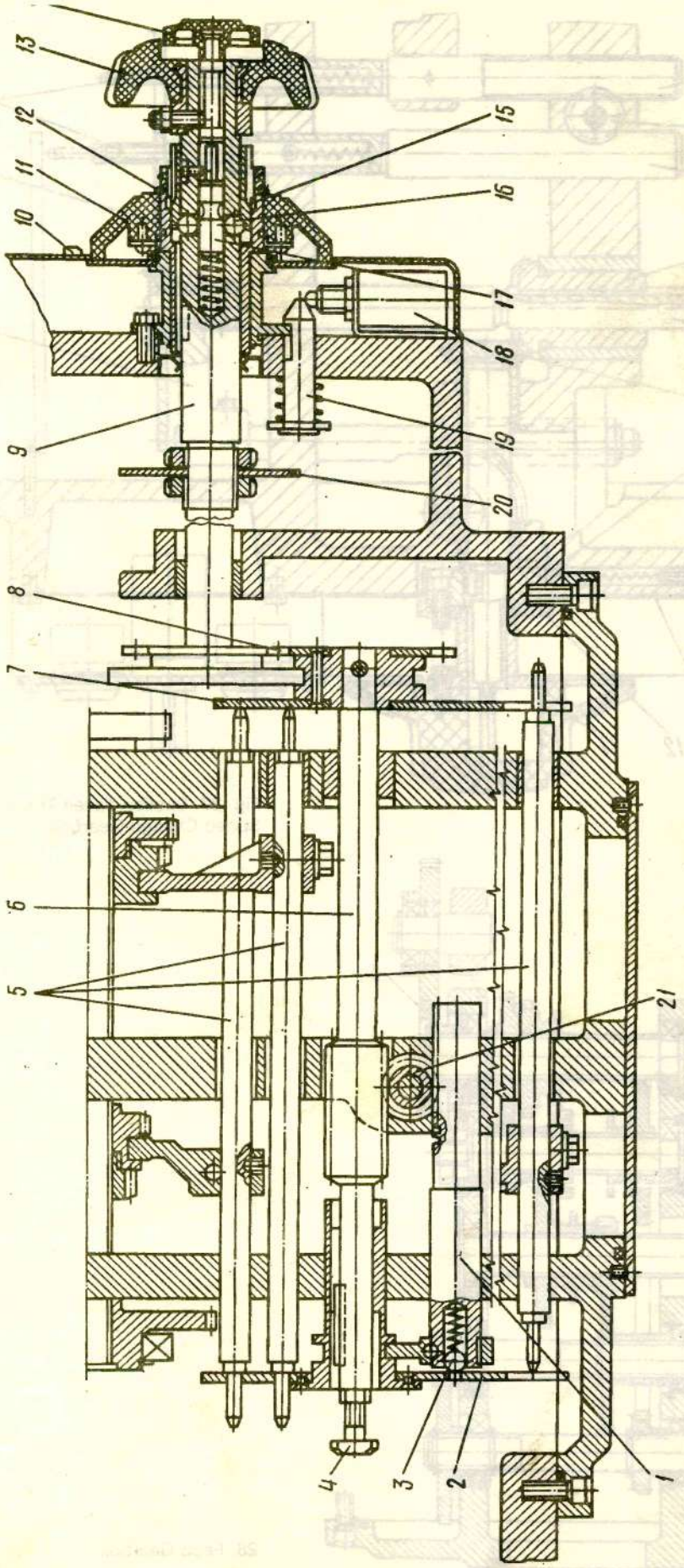


Fig. 29. Feed Change Mechanism. Sectional View

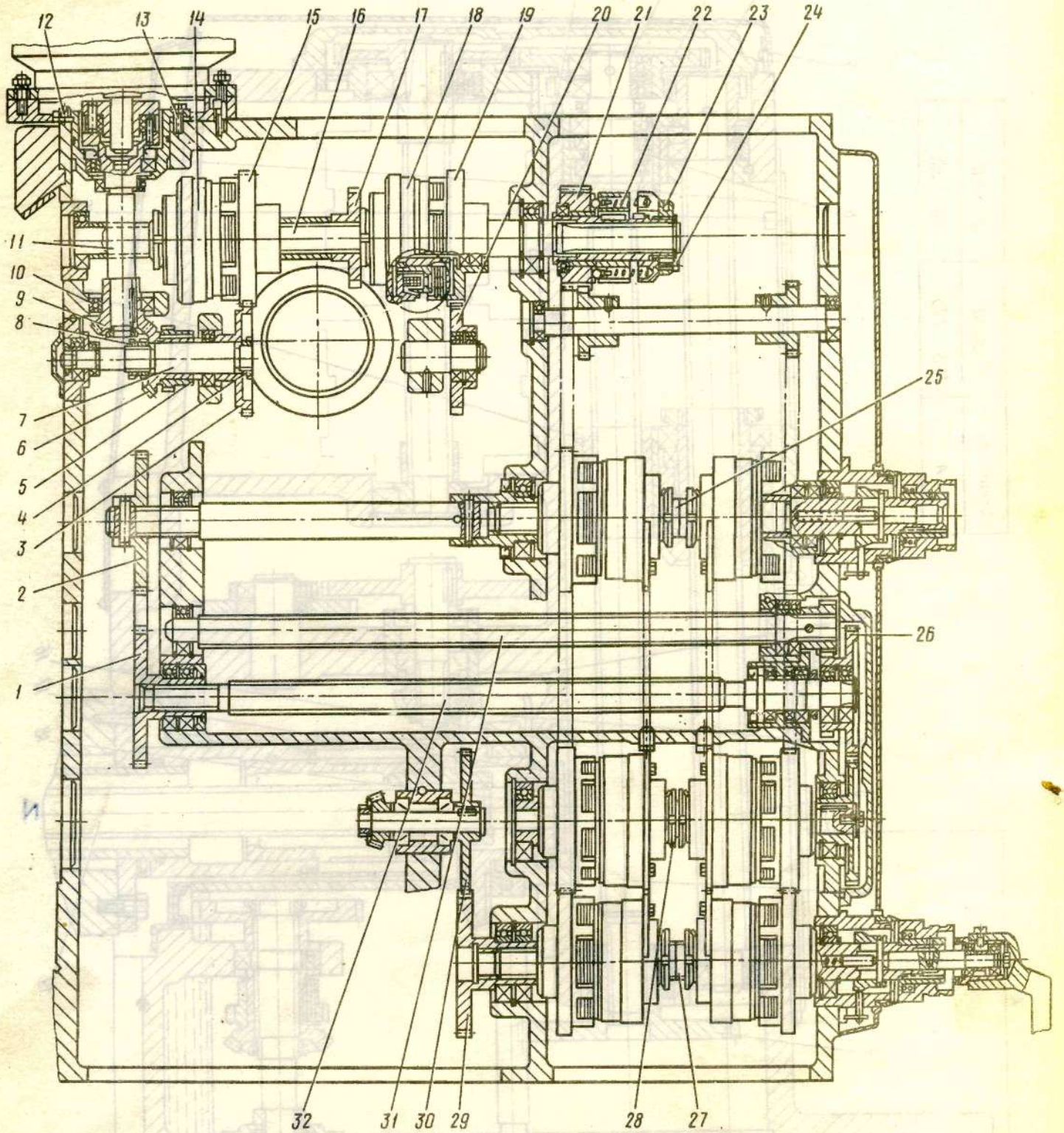


Fig. 30. Knee. Developed View

Dimension, mm	6T82 Ш	6T83 Ш
A	165... 175	190... 200

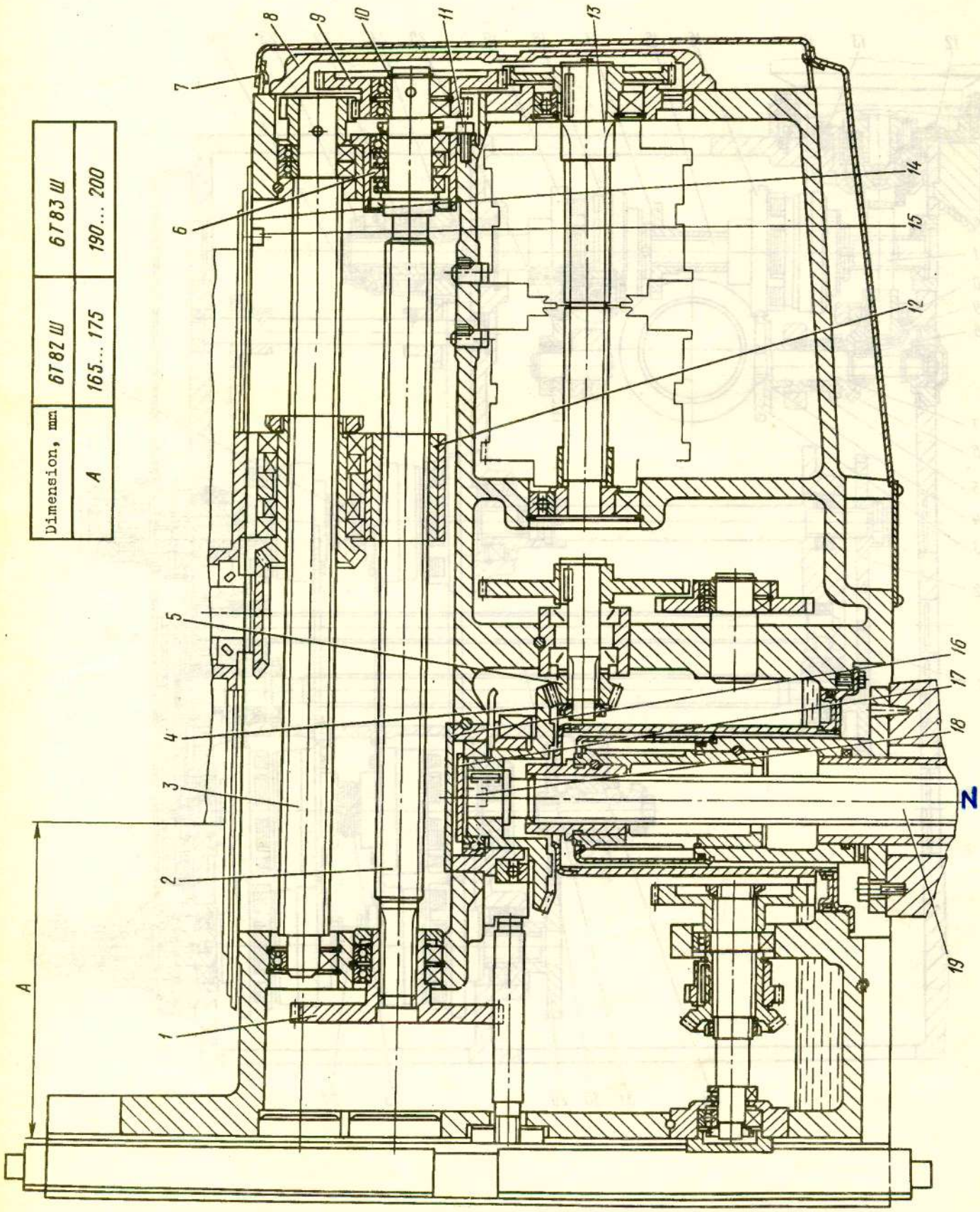


Fig. 31. Knee. Sectional View Taken Through Vertical Traverse

When the feed mechanism is overloaded the balls overcome the tension of the springs and fall out of the slots, so that gear 21 starts slipping over shaft 16, with the result that feed traverse ceases.

The safety clutch is considered to be adjusted correctly if it does not operate when the table is elevated rapidly simultaneously with the rapid traverse of any other machine operative unit along any of the coordinate axes.

To attain proper flatness of joint between feed gearbox and knee, the rectangle groove is provided along connecting flange perimeter in which packing oil-gasoline-resistant rubber cord dia. 5 mm is placed.

Oil is fed to the feed drive units by a plunger oil pump actuated from bull bearing 2 fitted over an eccentric hub of input gear 1 (Fig. 28).

6.3.8. The feed shifting mechanism (Fig. 29) incorporates disk 7 rigidly linked to shaft 6, and disk 2 of bar 5 carrying shifting forks, the latter disk being traversable along the shaft axis. When feed shifting occurs the disks travel towards each other to act upon the end faces of the bars and cause the latter and the cluster gears being shifted, to move axially. A preset direction of travel of the bars (that is, to the right or left) is provided due to holes in the disks, arranged opposite to the respective bar end faces. The hub of disk 7 has a circular recess and carries gear 8, both of them being for association of the feed shifting mechanism with control shaft 9.

To shift a feed rate press button 14 and pull knob 13 all the way out. As a result shaft 9 will draw behind shaft 6 with disk 7. Disk 2 associated with shaft 6 through rack 1 and pinion 21 will in this case move in the opposite direction until its hub comes to rest against screw 4 and the ends of the bars will be disengaged from the disks. Then turn knob 13 about its axis and set a required feed rate on dial 11 by putting it against indicating pointer 10.

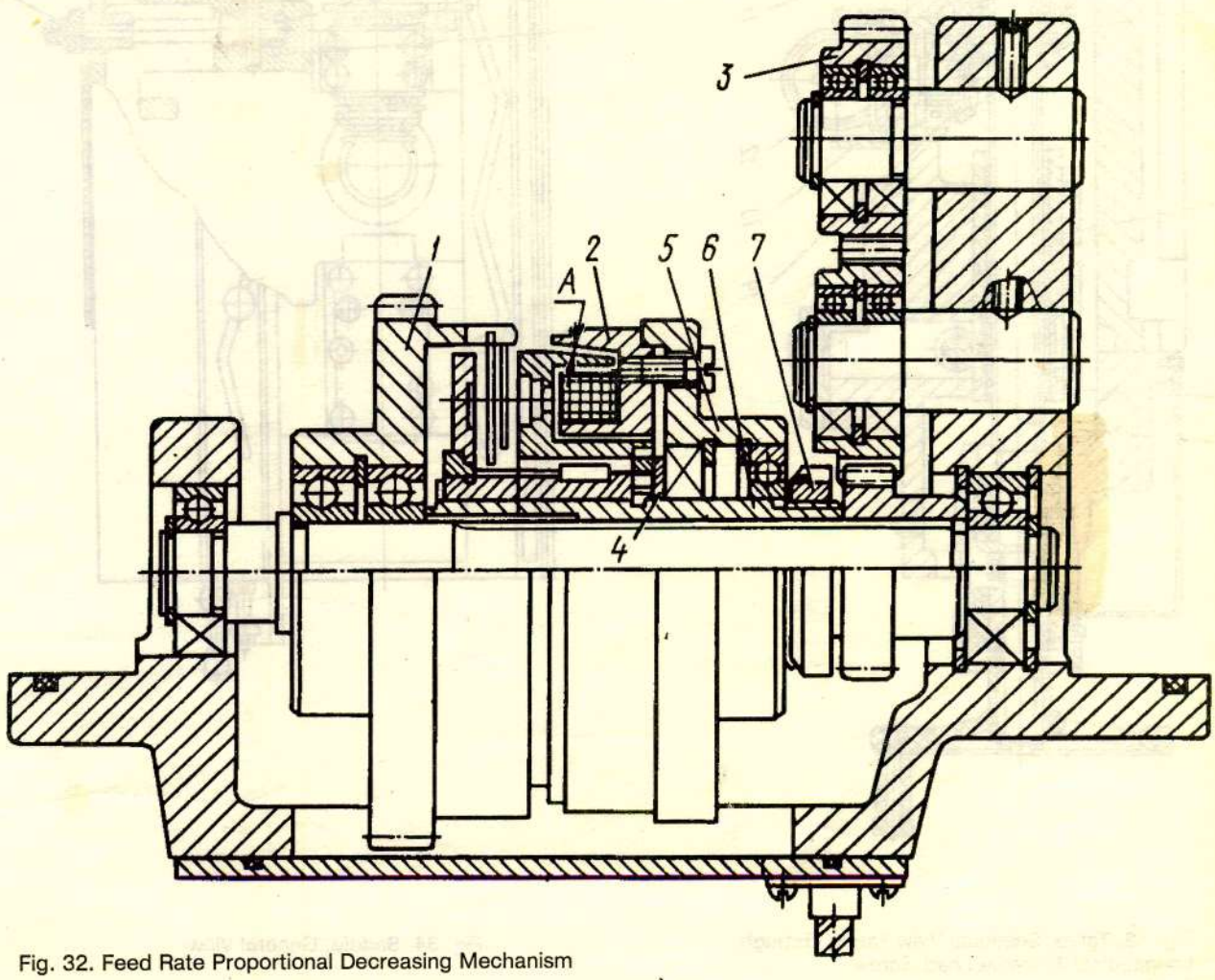


Fig. 32. Feed Rate Proportional Decreasing Mechanism

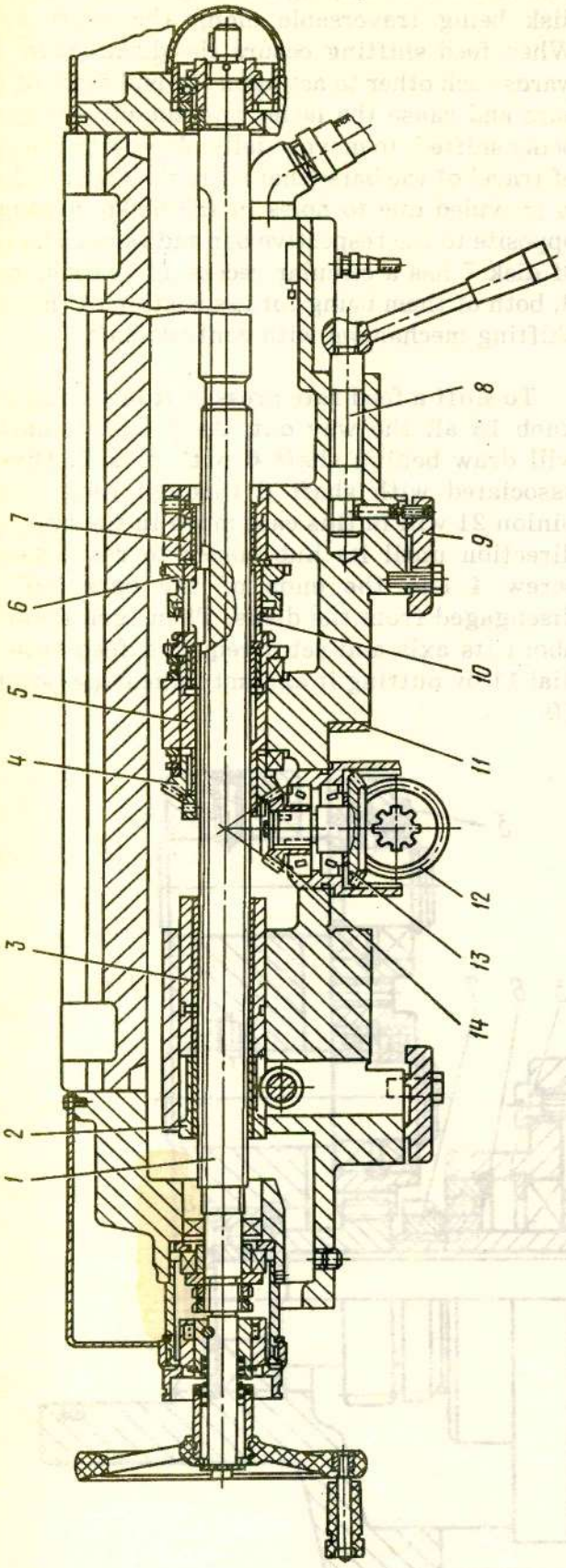


Fig. 33. Table. Sectional View Taken Through Longitudinal Traverse Lead-Screw

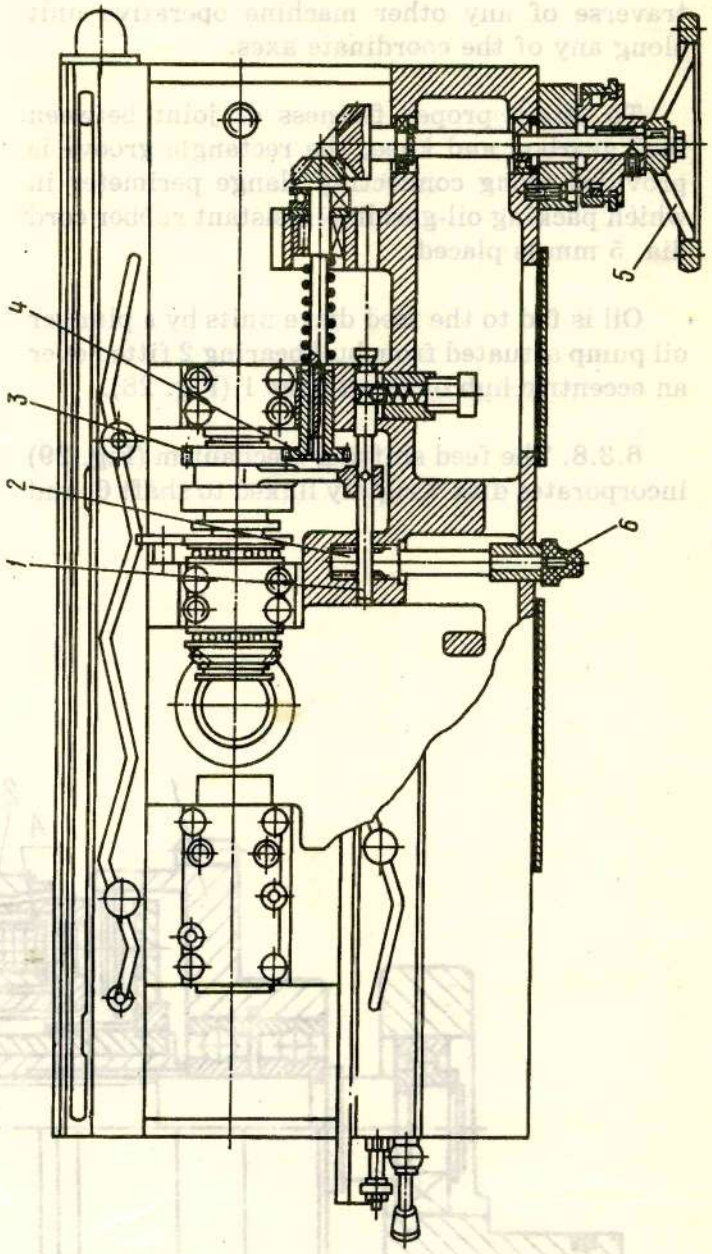


Fig. 34. Saddle. General View

Feed rates are shifted by axially moving the knob into the initial fixed position. If the knob fails to be returned right home repeat pulling of the knob. As a result, disk 20 acts through plunger 19 to close the contacts of limit switch 18 that effect momentary switching on of the feed electric motor, whereupon the knob will be returned into the initial position readily.

To prevent from axial displacement of disks 2 and 7, shaft 9 is locked in the engaged position by two balls 16 and sleeve 15. With button 14 pressed the balls engage the annular recess in shaft 17 and release shaft 9.

The feed change disks are locked in swivelled position by spring-loaded ball 3 lodged in the hole of rack 1.

6.3.9. The knee is a basic machine component which integrates all the feed kinematic chains. Accommodated directly in the knee housing are the rapid traverse chain, the change gearbox for imparting motion to the lead-screws, and the feed change mechanism control shaft. Flange-mounted on the knee left-hand side is the detachable feed gearbox with the oil filler sleeve; located on the same knee side are also the oil pump indicator and the knee oil tank level sight gauge. Located on the knee right-hand side are the slow-rate feed gear reducer, the feed drive motor and the branch box situated behind the motor protective shield and intended for supply the electromagnetic clutches.

Provision of the branch box with terminal strips makes it possible to test the circuit of any feed drive electromagnetic clutch for continuity without opening the knee.

The front face of the knee carries the control button for intermittent oil feed to the table ways and saddle ways. The feed change knob is located here, too.

The knee housing is divided by a transverse partition into two compartments. The front compartment accommodates the change gearbox clutches for imparting motion to the lead-screws. Access to the clutches for inspection or repairs is gained through side ports, i.e., through the right-hand port to the safety clutch and the cross traverse clutches, through the left-hand port, to the vertical traverse clutches.

The longitudinal traverse clutches are installed or dismantled through an opening in the knee front wall closed with the supporting flange of the clutch shaft bearing.

When dismantling the shafts with the cross and vertical traverse clutches do not disturb the original setting-up of the position of the interlocking limit switches which disengage the electromagnetic clutches in case the detachable lever for setup motions is used.

The rapid traverse chain incorporates two pairs of constant-mesh gears set on shafts 11, 7 and 16 (Fig. 30). Gears 9, 6 and 3 of these pairs are rigidly coupled to shafts 11 and 7, while driven gear 15 is free to rotate about shaft 16 and is locked-in with this shaft when rapid traverse clutch 14 is engaged.

Apart from the rapid traverse engagement clutch, shaft 16 carries feed engagement clutches 18, gear 17 to mesh with the output gear of the slow-rate feed gear reducer, as well as safety clutch 22 through which rotation is transmitted to the change gearbox imparting motion to the lead- screws.

The change gearbox has two clutches featuring oppositely rotating drive gear rims, for each coordinate axis of the operative unit traverse. Rotation from clutch shaft 25 is transmitted through gears 2 and 1 to cross traverse lead-screw 32, while to the vertical traverse lead-screw rotation is imparted by shaft 27 through spur gear pair 29, 30 to bevel gears 5 and 4 (Fig. 31).

Rotation to the longitudinal traverse lead-screw is translated from shaft 28 through double cluster gear 26 loosely set on the cross traverse lead-screw extension, to splined shaft 31.

Further on rotation is transmitted via two pairs of bevel gears 12, 13 and 14, 4 (Fig. 33) to quill 10 associated with longitudinal traverse lead-screw 1 through a draw key.

6.3.10. The proportional feed rate deceleration mechanism (Fig. 32) is intended for two-fold reduction of the feed rate in the case of radial infeed milling, or cutter overtravel.

Gear 1 of the feed rate deceleration mechanism is the input one, while gear 3 18 the output

one. The input gear is in mesh with gear 19 (Fig. 30) which is free to roll over shaft 16, the output gear being in mesh with gear 17 locked in place on the same shaft.

The feed rate deceleration mechanism is put in operation by clutch 2 (Fig. 32), with the result that the feed clutch is disengaged. The mechanism is turned in operation by selector 38 on the main control panel or by button 8 (Fig. 14) on the side control panel in the case of manual machine control, and by a trip dog provided on the table face and adapted to actuate the bank of trip limit microswitches, in the case of an automatic cycle.

When engaging the slow-rate feed motion manually by the button, or automatically by the trip dog, the duration of the slow-rate feed traverse depends on the button depressing time or on the length of the trip dog.

6.3.11. The table and saddle (Figs 33, 34) provide for the table longitudinal and cross traverse motions.

Lead-screw 1 (Fig. 33) obtains rotation through the draw key of quill 10 mounted in sleeve 7. Quill 10 receives rotation, through splines, from gear clutch member 6 upon its engagement with gear clutch member 5 rigidly locked to bevel gear 4. Clutch member 5 has a gear rim with which the circular table drive gear is meshed. Clutch member 6 has a gear rim to impart rotation to the longitudinal feed screw when actuated by the handwheel 5 (Fig. 34). Rotation to the gear rim is imparted by gear 4 which is spring-loaded to ensure against tooth-to-tooth abutment. Gear rim 3 of the clutch member can be meshed with gear 4 only when clutch member 6 is disengaged from clutch member 5 (Fig. 33), the meshing being effected by travelling rack 1 (Fig. 34) of switch 6, secured on shaft 2.

It is in the above-described manner that the handwheel is locked out.

Nuts 2 and 3 of lead-screw 1 (Fig. 33) are located in the saddle left-hand portion. Right nut 3 is locked with two pins in the saddle housing; left nut 2 resting against the right nut with its face when being rotated by a worm, eliminates backlash in the screw-and-nut pair.

The table is engaged with the lead-screw through brackets which are positioned on the table and faces according to the actual lead-screw position and fixed in place with locating pins. Thrust bearings are mounted at the opposite lead-screw ends so as to prevent buckling stress on the latter. When installing the lead-screw establish a 1000 to 1250 N (100 to 125 kgf) preload on the lead-screw by the nuts.

The saddle is clamped on the knee ways by means of strips 9 acted upon by the eccentric of shaft 8.

6.3.12. The tool electromechanical clamping fixture (Fig. 35) is for holding the milling cutter in the machine spindle.

The cutter is drawn in or knocked out by means of movable rod 3 located inside spindle 5. Reciprocating motion is imparted to rod 3 due to its threaded joint with splined shaft 2 which obtains rotation from head 1 of the tool electromechanical clamping fixture. A T-shaped head is provided at the end of rod 3, adapted to engage the T-slot of grip 4 turned into the cutter arbor.

Milling cutters are set on arbors depending on their size and type (Fig. 36).

Grip 1 (Fig. 36) should be so positioned that its T-slot be square with the guide slots of the arbor or of cutter 3 and a dimension of 43±1.5 mm be observed.

A list of arbors and adapter sleeves supplied with the machine is given in Section 3 "Standards and Optional Equipment".

To clamp a milling arbor in the spindle proceed as follows: fit the arbor with the cutter into the spindle taper hole and turn it through 90° to connect it to the head of rod. Set selector 3 (Fig. 14) to "Tool clamping", whereby the arbor with the cutter is drawn into the spindle. The completion of the clamping is judged by the clicking of the mechanism jaw clutch.

To unclamp the tool do as follows: stop the spindle by button 13 (Fig. 14) or 39 taking care to see that the spindle comes to a complete standstill. Set selector 3 to "Tool unclamping" and keep it in that position until the milling arbor comes out of the spindle for a maximum

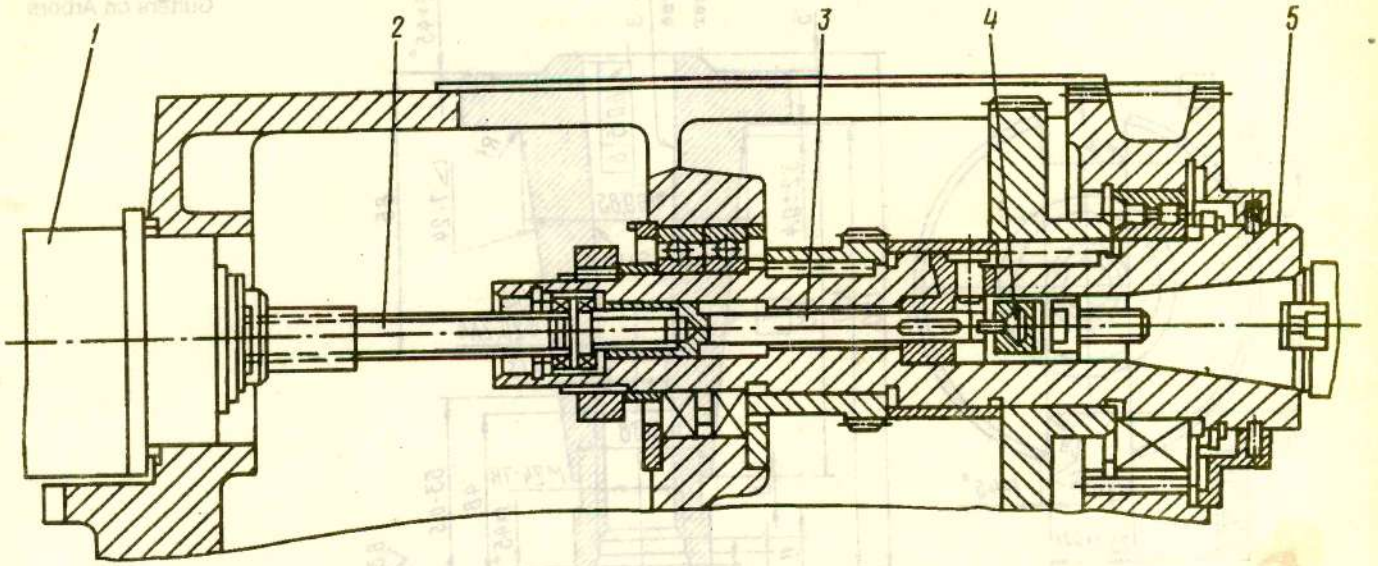


Fig. 35. Electromechanical Tool Clamping Fixture

length of 15 to 20 mm, that is, until the arbor disengages the spindle driving keys.

If the arbor comes out of the spindle for a greater length, shaft 2 (Fig. 35) might be turned out of rod 3 completely. Such being the case press the rod lengthwise its axis so that the threaded end of the shaft be free to turn into the threaded hole of the rod.

CAUTION. CLAMP THE TOOL IN THE SPINDLE BEFORE STARTING THE SPINDLE FOR THE FIRST TIME.

While the tool clamping the spindle rotation frequency set on the dial should not exceed 400.

When testing the spindle for free rotation without a milling, make rod 3 draw in idly until the jaw clutch clicks, thus imitating tool clamping, as otherwise the spindle will fail to start.

A 7:24 taper sleeve (Fig. 37) is for taper-shank end mills having No. 5 Morse taper.

6.3.13. To clamp milling cutter in the swivel- and attachment head spindles make use of draw-in rods operated manually.

7. LUBRICATING SYSTEM

The lubrication chart is shown In Fig. 38. A list of the lubricating system components and of the lubrication points is specified in Table 5.

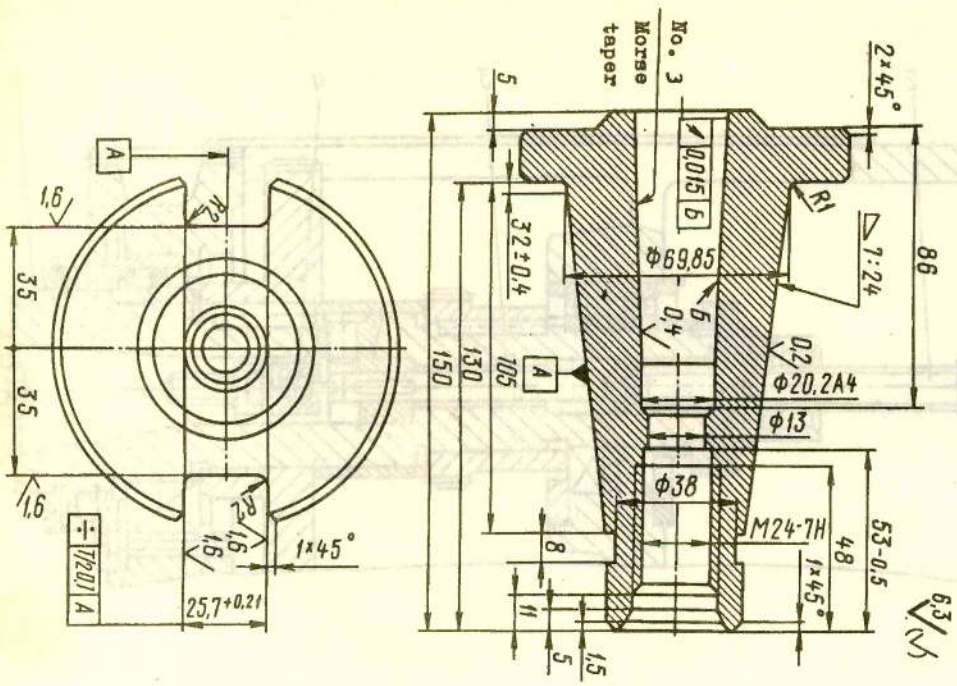
7.1. LUBRICATING SYSTEM FUNCTIONAL ANALYSIS

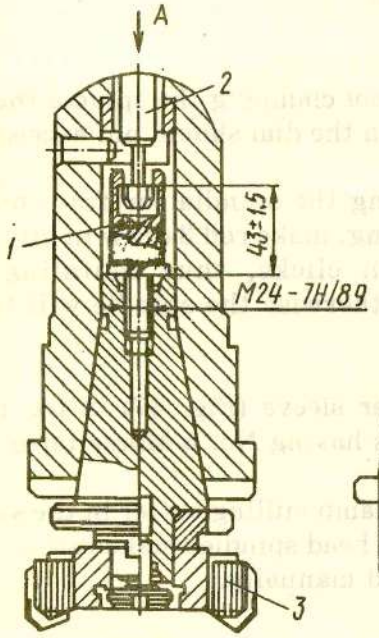
The following systems are provided to lubricate the machine:

7.1.1. A centralized system for lubricating the gears and bearings of the speed gearbox and the components of the change gearbox.

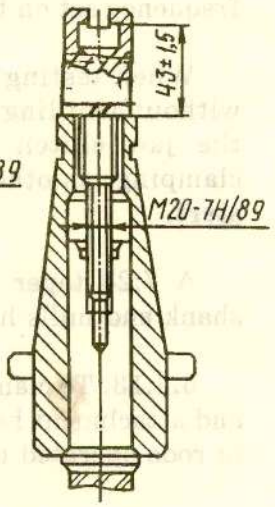
The system incorporates oil tank 2 accommodated in the column, oil strainer filter 4, plunger pump 6 and oil header 8. The pump (Fig. 39) of the system is actuated by an eccentric cam mounted on one of the speed gearbox snuffs.

Fig. 36. Setting Milling Cutters on Arbors

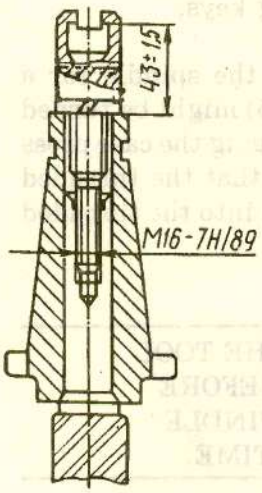


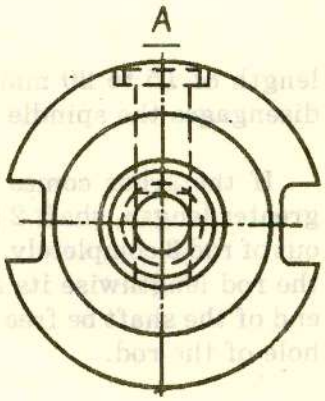


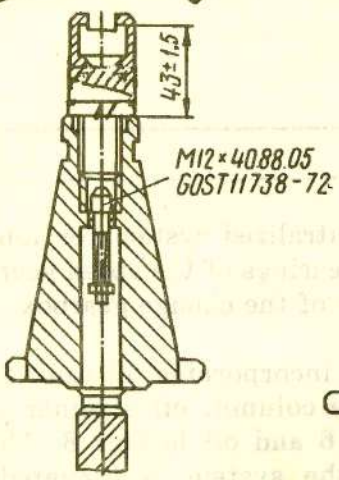
No. 4 Morse taper



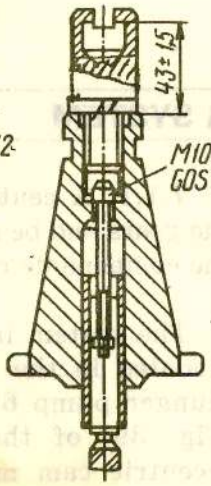
No. 5 Morse taper



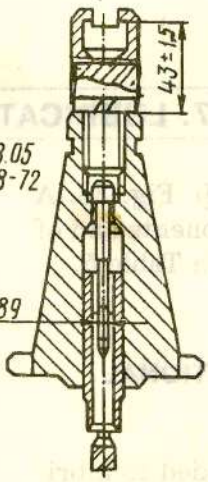




No.3 Morse taper

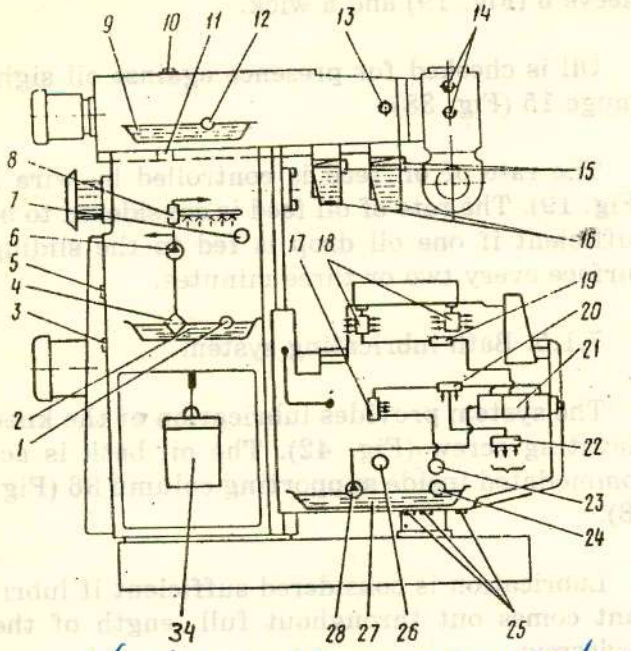


No.2 Morse taper



No.1 Morse taper

Fig. 37. Adapter Sleeve



Yağlama noktaları ve rezervuarları

Oil feed and oil level in the tank are checked visually against oil sight gauges 1 and 7.

7.1.2. A centralized system for lubricating the gears and bearings of the feed gearbox, knee, knee ways, saddle ways and table ways.

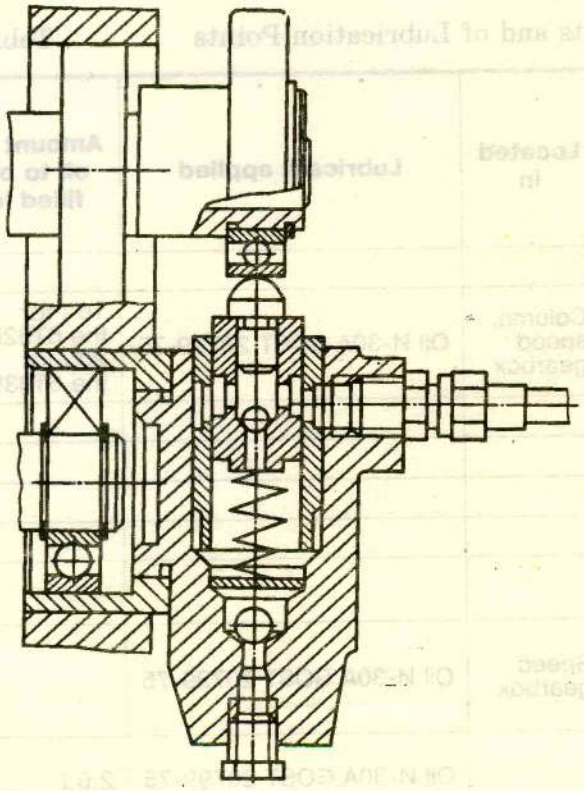


Fig. 39. Speed Gearbox Lubrication Pump

Yağlama Pompası

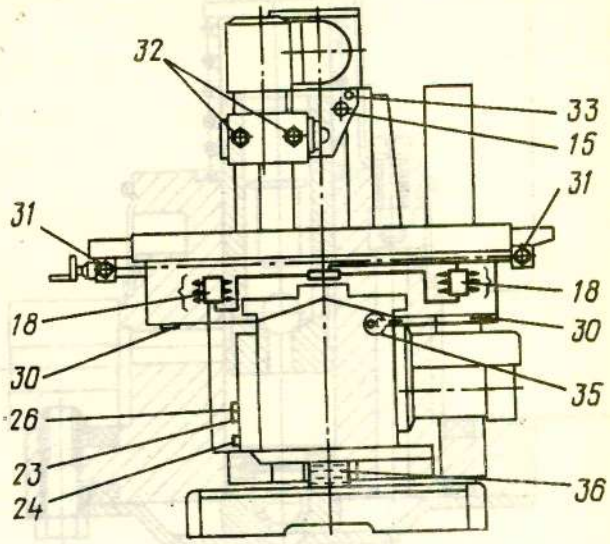


Fig. 38. Lubrication Chart

The system incorporates oil tank 27 accommodated in the knee, plunger pump 28, control spool valve 21, oil headers 20, 17, 18, 19, 22. The design of the knee lubrication pump is illustrated in Fig. 40.

Oil is checked for presence in the tank against oil sight gauge 24 (Fig. 38), oil pump operation being checked against oil sight gauge 23.

The table ways are lubricated by pressing button 35.

7.1.3. Intermittent lubricating system

The system is provided for lubrication of bearings 31 of the table longitudinal traverse lead- screw end supports, ram bearings 13 and respective bearings 14 and 32 of the swivel and attachment heads. Lubrication is effected manually through a compression grease gun.

Knee vertical ways intermittent lubrication by means of oil pump.

The lubrication is effected by seven or eight depressions on lever 1 (Fig. 41) once or twice a shift depending on intensity of vertical traverse use. Let the knee assume the topmost position.

Sufficiency of lubrication is checked visually by appearance of oil on the ways.

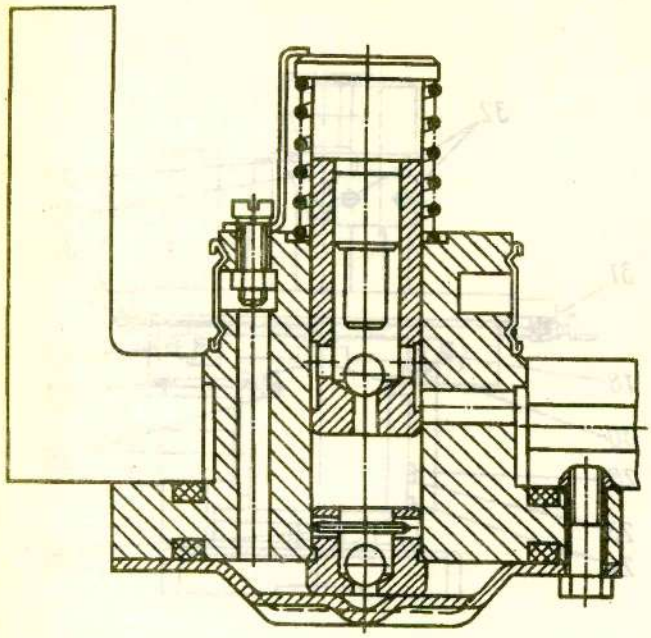


Fig. 40. Knee Lubrication Pump

Oil is checked for presence in the tank once a month.

7.1.4. Drop-feed lubricating system

The system is intended for lubricating the arbor support bearings. Oil is fed to the bearing from the arbor support recess via an oilway in sleeve 3 (Fig. 19) and a wick.

Oil is checked for presence against oil sight gauge 15 (Fig. 38).

The rate of oil feed is controlled by wire 2 (Fig. 19). The rate of oil feed is considered to be sufficient if one oil drop is fed to the sliding surface every two or three minutes.

7.1.5. Bath lubricating system

The system provides lubrication of the knee elevating screw (Fig. 42). The oil bath is accommodated inside supporting column 36 (Fig. 38).

Lubrication is considered sufficient if lubricant comes out throughout full length of the leadscrew.

7.1.6. Splash lubricating system for ram speed gearbox gears, bearings and other components.

The system incorporates oil tank 9 located in the ram, and oil sight gauge 11 (Fig. 38).

List of Lubricating System Components and of Lubrication Points — Table 5

Ref. No. in Fig. 38	Description	Lubrication interval	Lubricated components	Located in	Lubricant applied	Amount of oil to be filled in
1	Oil sight gauge					
2	Column oil tank	Replace oil every three months		Column, speed gearbox	Oil И-30А GOST 20799-75	16 *l* for the 6T82Ш 20 *l* for the 6T83Ш
3	Oil drain holes					
4	Oil strainer					
5	Oil filler hole					
6	Plunger pump					
7	Speed gearbox pump operation indicator					
8	Oil header	Continuous lubrication	Speed gearbox gears, brake clutch	Speed gearbox	Oil И-30А GOST 20799-75	
9	Ram oil tank	Replace oil every three months			Oil И-30А GOST 20799-75	2.0 *l*
10	Oil filler hole					

Ref. No. in Fig. 38	Description	Lubrication interval	Lubricated components	Located in	Lubricant applied	Amount of oil to be filled in
11	Oil drain hole					
12	Oil sight gauge					
13	Grease fitting 1.3.Ц6 GOST 19853-74	Once a month	Ram front bearing	Ram	Grease OHa Ka 2/11-3 OST 38.01145-80	0.1 kg
14	Grease fittings 1.3.Ц6 GOST 19853-74	Once a month	Front and rear bearings	Swivel head	Grease OHa Ka 2/11-3 OST 38.01145-80	0.3 kg
15	Oil sight gauge					
16	Oil tank of arbor supports	Replenish as required				0.6 *l*
17	0il header	Continuous lubrication	Feed electromagnetic clutches, vertical lead- screw bearings and bevel-gear drive	Knee	Oil И-20A GOST 20799-88	
18	0il header	Regularly once a shift	Saddle top and bottom ways, lead-screw and its drive bearings, gears	Table and saddle	Oil И-20A GOST 20799-88	
19	0il header					
20	0il header	Continuous lubrication	Cross traverse electromagnetic clutch	Knee	Oil И-20A GOST 20799-88	
21	Control spool valve					
22	0il header	Continuous lubrication	Longitudinal and vertical traverse electromagnetic clutches, feed gearbox gears	Knee	Oil И-20A GOST 20799-88	
23	Knee lubrication pump operation indicator					
24	Oil sight gauge					
25	Oil drain hole					
26	Oil filler hole	Replenish as required				
27	Knee oil tank	Replace every three months		Knee	Oil И-20A GOST 20799-75	10 *l* for the 6T82Ш 14 *l* for the 6T83Ш
28	Plunger pump					
29	Oil drain hole					
30	Grease fittings					
31	Grease fittings 1.3.Ц6 GOST 19853-74	Regularly once a month	Supports of table lead-screw	Table and saddle	Grease OHa Ka 2/11-3 OST 38.01145-80	

Ref. No. in Fig. 38	Description	Lubrication interval	Lubricated components	Located in	Lubricant applied	Amount of oil to be filled in
32	Grease fittings 1.3.Ц6 GOST 19853-74	Once a month	Attachment head bearings	Attachment head	Grease OHa Ka 2/11-3 OST 38.01145-80	0.2 kg
33	Oil filler hole	Replenish oil as required		Ram arbor supports	Oil И-20A GOST 20799-88	0.6 *l*
34	Lubrication station	Regularly once a shift	Lubrication of knee vertical ways	Knee	Oil ТЭП-15 GOST 23652-79	1.3 *l*
35	Control spool valve engagement button	Regularly once a shift	Lubrication of table-and- - saddle mechanism and ways	Knee		
36	Vertical traverse lead-screw pedestal oil tank	Replace oil every 5000 operating hours	Leadscrew	Knee	Oil ТЭП-15 GOST 23652-79	1.3 *l*
37	Swivel head interior	During inspections or repairs			Konstalin fat grease 4T-1 GOST 1957-74	3 kg
38	Attachment head interior	Ditto			Konstalin fat grease 4T-1 GOST 1957-74	0.5 kg

Note. If no afore-listed lubricants are available, use only such equivalent oils and greases that feature principal characteristics fully complying with those specified above.

7.2. Lubricating System Installation and Operating Instructions

Before starting the machine fill the column oil tank through filler hole 5 (Fig. 38) with oil, grade И-30A GOST 20799-75 until its level reaches the midsection of oil sight gauge 1.

Fill the knee tank through filler hole 26 with on, grade И-20A GOST 20799-75 until its level registers the midsection of oil sight gauge 24. **DO NOT** overfill the tank above the above-mentioned level.

Fill the ram tank through filler hole 10 with oil, grade И-30A GOST 20799-75 until it reaches the midsection of oil sight gauge 13.

Fill the arbor support oil bath filler hole 33 with oil, grade И-30A GOST 20799-75 until its level registers the midsection of oil eight gauge 15.

Pack table longitudinal traverse lead-screw bearings, ram bearings, bearings of the attachment and swivel heads with grease, grade OHa Ka 2/11-3 OST 38.01145-60 through grease fittings 32, 14, 13, 31 using a pressure gun.

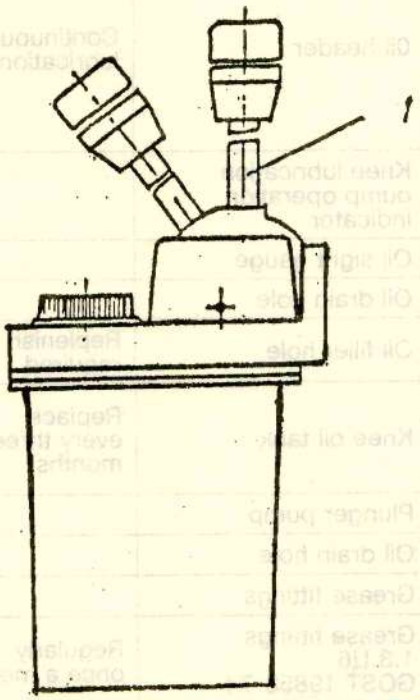


Fig. 41. Knee Vertical Ways Lubrication Pump

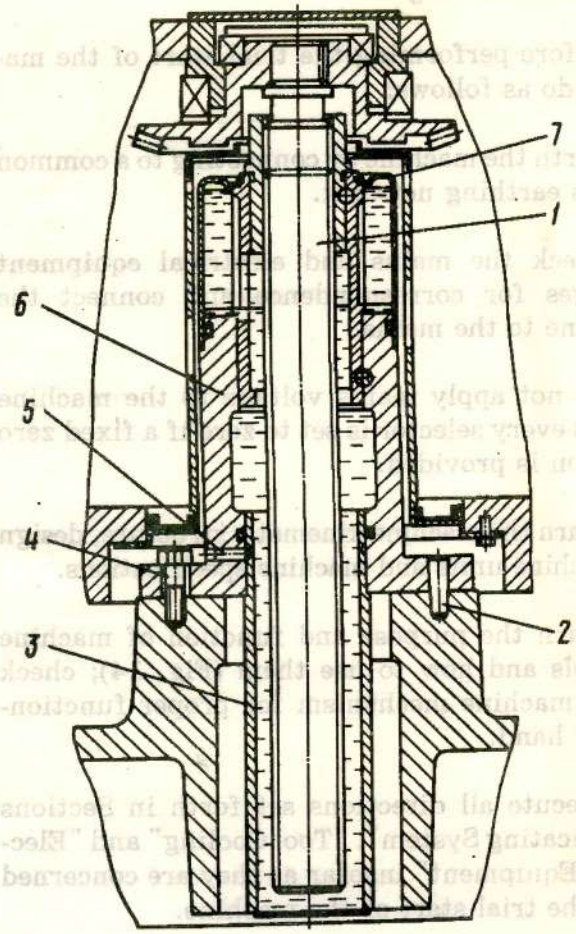


Fig. 42. Vertical Traverse Lead-Screw Lubricating System

Fiil the oil bath of the vertical traverse lead-screw pedestal with oil grade ТЭП-15 GOST 23652-79 through filler hole 7 (Fig. 42). **DO NOT** surpass the specified oil level in that bath as otherwise the surplus oil will run down onto the machine footing.

Two or three minutes after starting the machine oil should appear in the respective pump operation indicators both during primary start or in the course of regular service. Keep a constant watch on the oil feed through the oil sight gauges.

CAUTION. NEVER OPERATE THE MACHINE UNLESS THE LUBRICATING SYSTEM IS IN GOOD REPAIR.

Replace oil in the column, ram and knee tanks a week after the machine has been put in regular service, for the second time, after a month of operation, further on change oil every three months of operation throughout the service life.

Top up oil to the specified level as fast as it is consumed.

Let oil out through drain holes 3, 11, 24 (Fig. 38).

Flush oil tank 3 (Fig. 42) of the knee elevating screw pedestal as frequently as once a year. To this end let the knee assume the topmost position. Place a wooden block 150x150 mm in cross section and 420 to 450 mm long on the machine footing under the knee bottom within the zone of the column vertical ways. Then manipulate the knee manual traverse lever to let the knee seat onto the wooden block, back off holding screws 4 and remove pins 2. Next turn pedestal 6 manually onto vertical lead-screw 1 until oil tank 3 comes out of the machine footing. Put an oil pan under the screw pedestal, back off screw 5, and move oil tank 3 down. After flushing reverse the disassembly procedure for re- assembly of the unit and fill the tank with fresh oil through filler hole 7.

8. INSTALLATION

8.1. Unpacking

The machine can be delivered either in at wooden case, or without it with partial protection of certain parts.

If the machine is delivered in a wooden case, begin unpacking with removing the top panel of the case, and then - the sides. Be sure not to damage the machine with unpacking tools. Check whether all machine parts and accessories, listed in the Packing Sheet, are present.

8.2. Handling.

While handling the machine packed in a wooden case insert sliding ropes exactly as

marked on the case. The ropes must be able to safely carry the weight equal to that of machine gross weight.

The unpacked machine should he handled as shown on fig.43. Before handling be sure that all movable parts and units of the machine are fast locked. The saddle the table must be moved closely to the knee ledge.

Avoid strong jerks while handling the machine to the site of installation and while lowering it upon foundation.

Before installation the machine must be carefully doomed from antirust compound applied on exposed surfaces. Traces of antirust compounds are removed with cleaning tissue dipped in gasoline GOST 1012 or white-spirite TU38.1011026.

Avoid cleaning plastic parts.

To avoid corrosion cleaned non-painted surfaces should be covered with thin layer of industrial oil И-30А GOST 20799-88.

8.3. Erection

The machine is allowed to be erected directly on a concrete flooring at least 300 mm thick; otherwise a concrete foundation must be prepared (Fig. 44) in order to obtain quiet and accurate machine operation.

The depth of foundation depends on the nature of subsoil. The foundation should be provided with pockets for the anchor bolts and with a pit to receive coolant drained out of the column footing.

Set the machine true on the foundation using steel levelling wedges. Once the machine has been levelled finally, grout it with cement mortar and after the latter has solidified, hold the machine with anchor bolts.

For the place of earthing installation and power supply input from shop's mains refer to Section " Electrical Equipment".

8.3.1. Installation accuracy.

Take care to see that machine levelling accuracy be within 0.04 mm/1000 mm, with the table in the middle working position.

8.4. Preparation for Primary Start and Trial Starting

Before performing the trial start of the machine do as follows:

Earth the machine by connecting to a common shop's earthing network.

Check the mains and electrical equipment voltages for correspondence and connect the machine to the mains.

Do not apply mains voltage to the machine unless every selector is set to zero if a fixed zero position is provided.

Learn the machine kinematic structure, design of machine units and machine specifications.

Learn the purpose and function of machine controls and how to use them (Fig. 14); check every machine mechanism for proper functioning by hand.

Execute all directions set forth in Sections "Lubricating System", "Tool Cooling" and "Electrical Equipment" insofar as they are concerned with the trial start of the machine.

To make a deeper insight into the machine operation let it run idle, check machine controls for proper functioning, carry out trial shifting of spindle rotation frequencies, table feed rates, check the lubricating system for proper operation against oil sight gauges.

CAUTION
NEVER OPERATE
THE MACHINE UNLESS OIL
APPEARS IN THE OIL SIGHT GAUGES.

If the horizontal spindle rotation frequency selector lever fails to assume its fixed position when shifted, this indicates that the gears fail to get in mesh. Such being the case, press button 8 (Fig. 14) "Spindle inching" located on the change gearbox, with the result that a momentary motor switching on occurs, whereby the gears will be free to mesh normally when shifted.

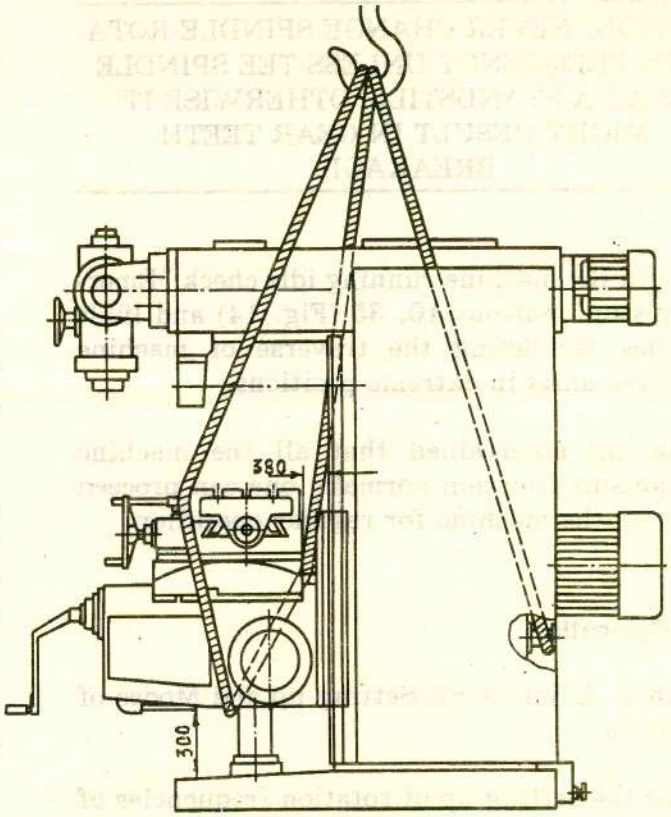


Fig. 43. Machine Handling Diagram

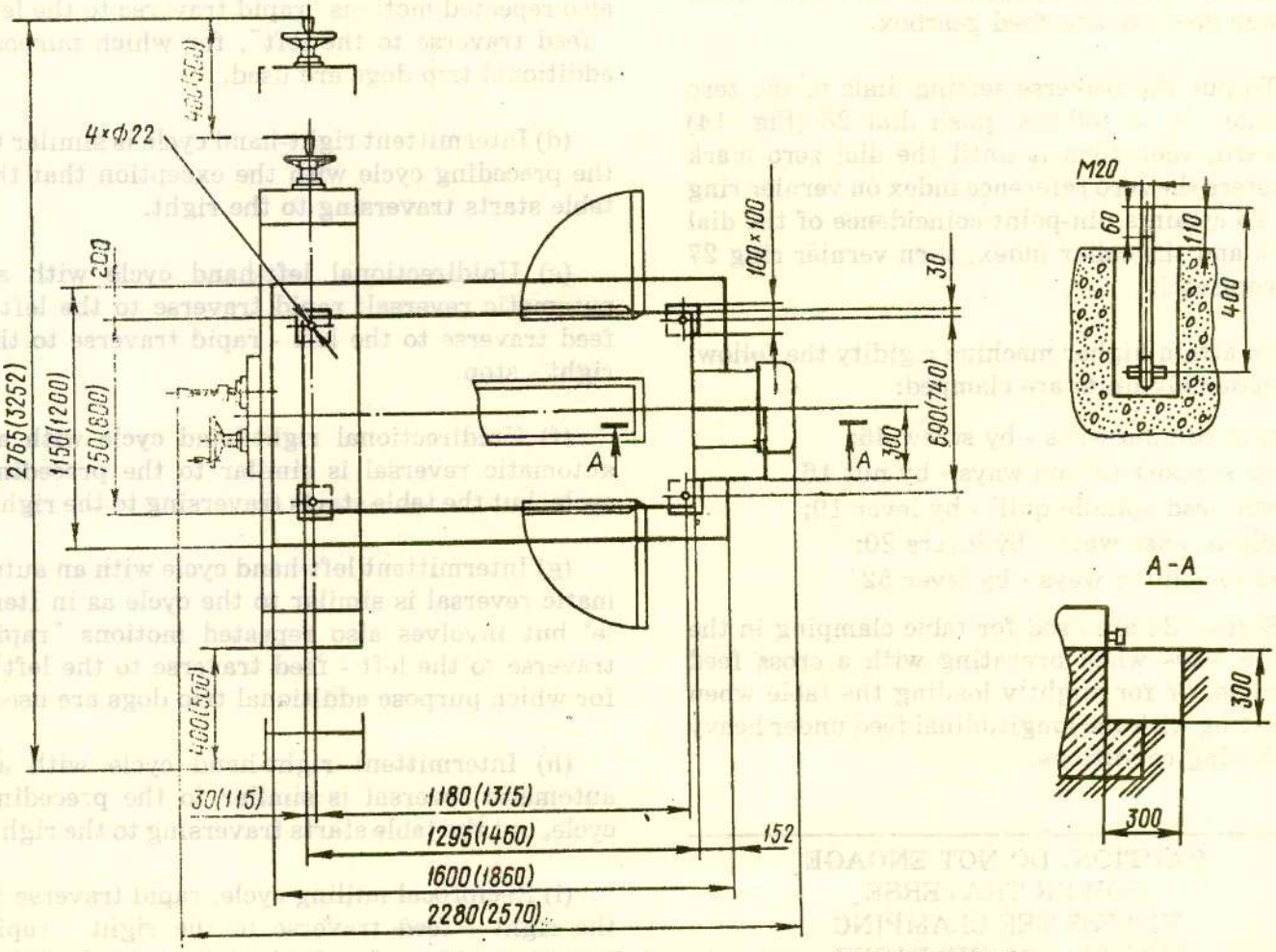


Fig. 44. Machine Erection Drawing (parenthesized dimensions refer to the 6T83Ш)

CAUTION. NEVER CHANGE SPINDLE ROTATION FREQUENCY UNLESS TEE SPINDLE IS AT A STANDSTILL, OTHERWISE IT MIGHT RESULT IN GEAR TEETH BREAKAGE.

With the machine running idle check "Emergency stop" buttons 10, 35 (Fig. 14) and limit switches restricting the traverse of machine operative units in extreme positions.

Having ascertained that all the machine mechanisms function normally one can proceed to set up the machine for regular operation.

8.5. Operation

8.5.1. Adjustment, Setting up and Modes of Operation

For the setting up of rotation frequencies of machine spindles and table feed rates refer to the afore-stated description of the ram, speed change gearbox and feed gearbox.

To put the traverse setting dials to the zero position do as follows: push dial 28 (Fig. 14) forward, then turn it until the dial zero mark registers the zero reference index on vernier ring 27. To attain a pin-point coincidence of the dial mark and the collar index, turn vernier ring 27 appropriately.

To attain higher machine rigidity the following assembly units are clamped:

Ram to column ways - by screw 45;
Arbor support to ram ways - by nut 16;
Swivel head spindle quill - by lever 19;
Saddle to knee ways - by levers 20;
Knee to column ways - by lever 52.

Screws 24 are used for table clamping in the saddle ways when operating with a cross feed traverse, or for slightly loading the table when operating with the longitudinal feed under heavy machining conditions.

CAUTION. DO NOT ENGAGE POWER TRAVERSE UNLESS TEE CLAMPING LEVERS ARE RELEASED.

For milling cutter clamping in the machine spindles refer to Section 6 above.

8.5.2. Automatic table traverse cycles

The following table traverse cycles are provided in the machine:

(a) Simple left-hand cycle! rapid traverse to the left - feed traverse to the left - stop - rapid traverse to the right "rapid traverse (cycle)"- stop.

Whenever the workpiece is to be withdrawn from the cutter on the rapid traverse for convenient removal, one more trip dog is made use of to change over from feed traverse to the left to rapid traverse to the left.

(b) Simple (unidirectional) right-hand cycle is similar to the left-hand cycle, with the exception that the table starts traversing to the right.

(c) Intermittent left-hand cycle is similar to the unidirectional left-hand cycle but involves also repeated motions "rapid traverse to the left - feed traverse to the left", for which purpose additional trip dogs are used.

(d) Intermittent right-hand cycle is similar to the preceding cycle with the exception that the table starts traversing to the right.

(e) Unidirectional left-hand cycle with an automatic reversal: rapid traverse to the left - feed traverse to the left - rapid traverse to the right - stop.

(f) Unidirectional right-hand cycle with an automatic reversal is similar to the preceding cycle, but the table starts traversing to the right.

(g) Intermittent left-hand cycle with an automatic reversal is similar to the cycle as in Item 'e' but involves also repeated motions "rapid traverse to the left - feed traverse to the left", for which purpose additional trip dogs are used.

(h) Intermittent right-hand cycle with an automatic reversal is similar to the preceding cycle, but the table starts traversing to the right.

(i) Reciprocal milling cycle: rapid traverse to the right - feed traverse to the right - rapid traverse to the left - feed traverse to the left -

rapid traverse to the right, and so on. The direction of the starting table traverse depends on which extreme position is assumed by the table before beginning of the cycle. In this case one of the master controller contact pins should be depressed by the trip limit switch.

The machine is also suitable for operating on an automatic closed rectangular milling cycle:

(a) Horizontal closed rectangular milling cycle beginning with table traverse to the right:

table (rapid traverse to the right - feed traverse to the right) - saddle (feed traverse towards the column) - table (feed traverse to the left) - saddle (feed traverse away from the column) - table (rapid traverse to the left - stop).

(b) Vertical closed rectangular milling cycle beginning with table traverse to the right:

table (rapid traverse to the right - feed traverse to the right) - knee (down feed traverse) - table (feed traverse to the left) - knee (up feed traverse) - table (rapid traverse to the left - stop).

In both cases the milling process occurs in a counterclockwise direction.

Each of the afore-described operating cycles may be carried out with a slow-rate feed. Table traverse motions on automatic cycles are controlled by trip dogs acting upon the contact pins of the respective master controllers. To set up the machine for automatic operation arrange trip dogs to suit the adopted machining cycle and the size of the workpiece to be machined, then put the table into the initial position according to the scheme of the cycle. In this case the trip dog restricting table travel at the end of the cycle, should depress the corresponding contact pin of the master controller. Next set selector 37 (Fig. 14) to "Automatic cycle".

CAUTION. TABLE TRAVERSE MOTIONS ALONG THREE COORDINATE AXES SIMULTANEOUSLY ARE NOT ALLOWED).

Choose a desired operating cycle using selectors 50.

If the cycle involves a slow-rate table feed, set selector 38 to "ON".

Fig. 45 illustrates the function of the master controller contact pins with reference to a selected operating cycle.

To start the cycle press button 40 "Table rapid traverse" located on the main control panel.

The right- and left-hand cycles are stopped automatically from a trip dog at the and of cycle. To stop these cycles at any intermediate points, or to stop the reciprocal milling cycle, make use of buttons 7 and 10 on the side control panel or of button 39 or the main control panel.

Each cycle can be repeated only from the initial position.

Fig. 46 illustrates some exemplary machine setups for automatic operating cycles.

Three types of trip dogs are used to control table longitudinal traverse, and one type, for table cross and vertical traverse. The dogs can be turned through 180 so as to depress the master controller contact pins arranged symmetrically with respect to the dog axle.

Each trip dog controlling the table cross and vertical traverse depress two adjacent master controller contact pins at a time.

Since the purpose and function of trip dogs may be different depending on the adopted cycles scheme, keep a close lockout for correspondence of trip dog arrangement with the position of limit switches determining the kind of the operating cycle practised.

8.6. In-Service Readjustments

While in regular service, some machine components need readjustment to restore their normal performance.

8.6.1. Adjustment of clearance in arbor support bearing

The clearance adjustment in the arbor support bearing is carried out by means of nut 4 or

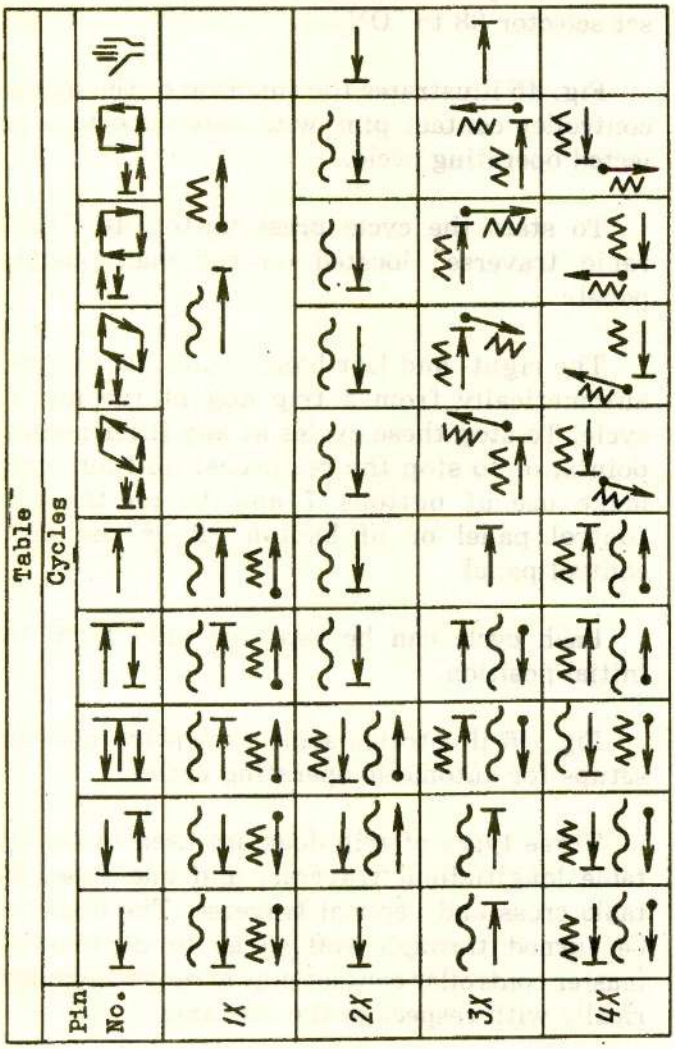
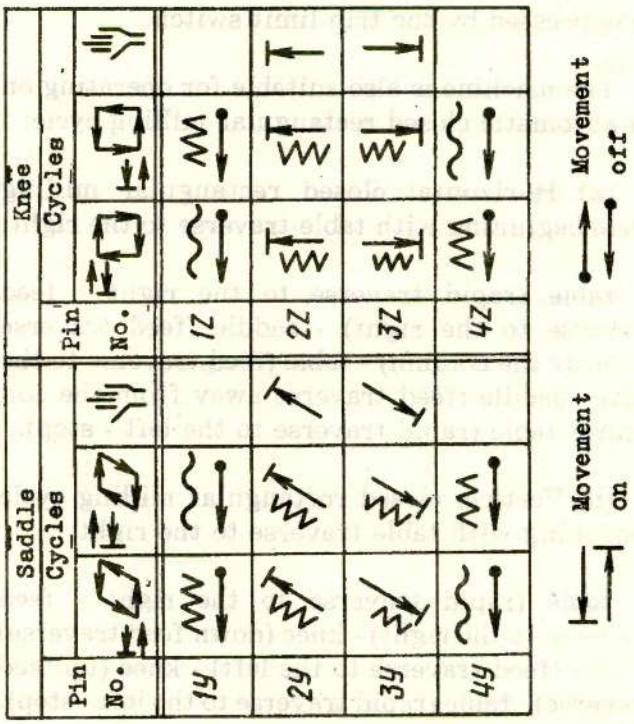


Fig. 45. Operating Cycles Diagram and Function of Master Controllers



screw 1 (Fig. 19) depending on the degree of heating of the bearing.

Check the bearing for proper clearance by running the spindle at a maximum rotation frequency.

8.6.2. Adjustment of spindles' bearings (Fig. 25)

Axial clearance in the horizontal spindle (Fig. 25) is adjusted by regrinding semirings 9 and 10. Excess clearance in the front bearing is eliminated by regrinding semirings 5 and retightening nut 1.

To adjust spindle bearings proceed in the following order:

with the ram displaced, remove cover 3 or the side cover of the access port on the right side of the machine, unlock and undo nut 1;

remove flange 6, snap ring 7, ring 8 and the semirings;

eliminate excess clearance by drawing nut 1 tight.

Once the clearance in the spindle bearing has been checked, let the spindle run idle at a maximum rotation frequency for one hour;

measure the amount of clearance between the bearing and the spindle shoulder, then regrind the rings as required. Note, that in order to eliminate a 10-μm radial clearance the semirings should be reground for about 120 um;

fit the semirings in place and check the nut for reliable locking;

fit parts 8, 7, 6, 3 in their respective places.

Axial clearance in the swivel head spindle (Fig. 22) is adjusted by regrinding ring 3. Excess

CAUTION. During operation with manual control it is good practice:
1. To remove or rearrange trip dogs 3, 4, 5 and 6 to prevent mechanism from unjustified wear.
2. Set selectors 50 (Fig.14) in the middle position.

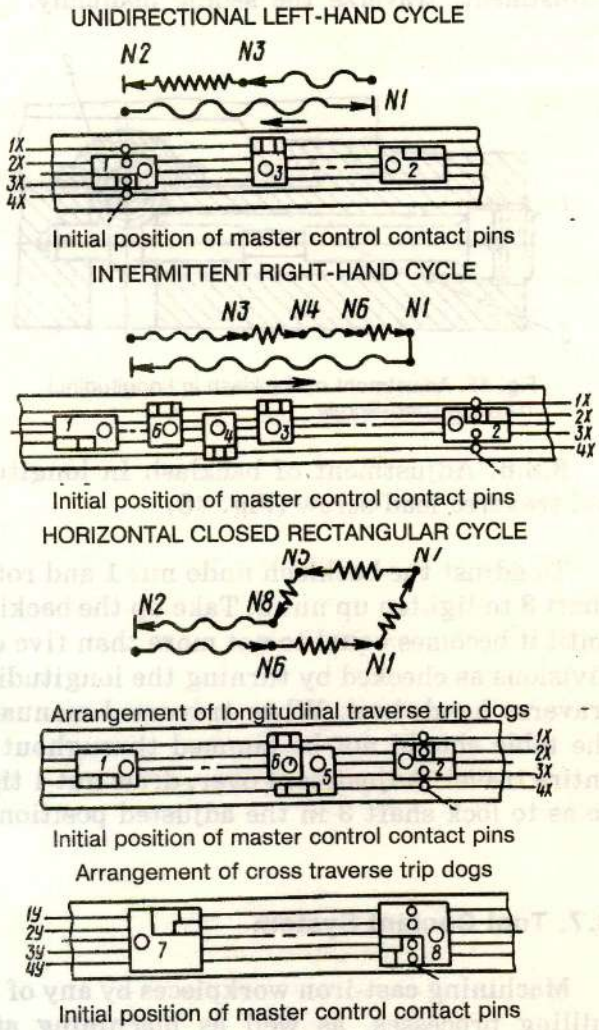


Fig. 46. Machine Adjustment for Automatic Operating

radial clearance in the front bearing is eliminated by regrinding semirings 2 and drawing nut 6 tight.

To adjust proceed in the following order:

- let the spindle quill advance;
- remove flange 1;
- undo nut 6;
- remove semirings 2;
- turn out the threaded plug on the right-hand side of the head housing;
- unlock nut 6 by turning out the locking screw through an access hole;

using a steel rod lock the nut. Rotate the spindle by its key to tighten up the nut, thereby displacing the inner race of the bearing. Having checked the clearance, let the spindle run idle at a maximum rotation frequency for one hour;

measure the amount of clearance between the bearing and the spindle shoulder, then regrind semirings 2 as required.

Remember, that regrinding the semirings by about 120 μm will eliminate a radial clearance of 10 μm;

- fit semirings 2 in place and lock them. Turn flange 1 in position.

The spindle quill clamping mechanism incorporates positive stop 1 (Fig. 23) and pull-rod 2.

The attachment head spindle obtains rotation from the swivel head spindle.

Clearance in the attachment head spindle bearings is adjusted by nut 1 (Fig. 24).

Having checked the clearance in the bearings, let the spindle run idle at a maximum rotation frequency.

8.6.3. Adjustment of horizontal spindle speed change gearbox (Fig. 27).

The rotation frequency selection dial is locked in place with ball 1 which engages the slots of star knob 12. Spring 13 is adjusted for tension by thrust plug 14; adjustment over, check the dial for positive locking and proper effort to be applied for dial rotation.

8.6.4. Adjustment of feed drive safety clutch

To adjust the feed drive safety clutch take access through the port on the knee right-hand side (Fig. 30).

To adjust the clutch, undo screw 24 and rotate nut 23 clockwise so as to increase the torque magnitude.

The safety clutch is considered adjusted properly if it does not operate with simultaneous knee rapid upward traverse and rapid traverse of some other machine operative unit along any of the coordinate axes.

The adjustment is considered to be proper if during cut-tip milling by plain milling cutter it is possible to mill cast iron СЧ 15 under the following cutting conditions.

	Model 6T82Ш	Model 6T83Ш
Cutter diameter, mm	110	110
Number of teeth	8	8
Width of milling, mm	100	100
Depth of milling, mm	15	15
Number of rotations per min	63	63
Longitudinal feed by dial, mm/min	125	125

Under these conditions periodical clicks in the clutch may be heard.

8.6.5. Adjustment of table, saddle and knee taper gibs (Fig. 47)

Excess clearance in the table and saddle ways is taken up by taper gibs. To adjust table taper gib

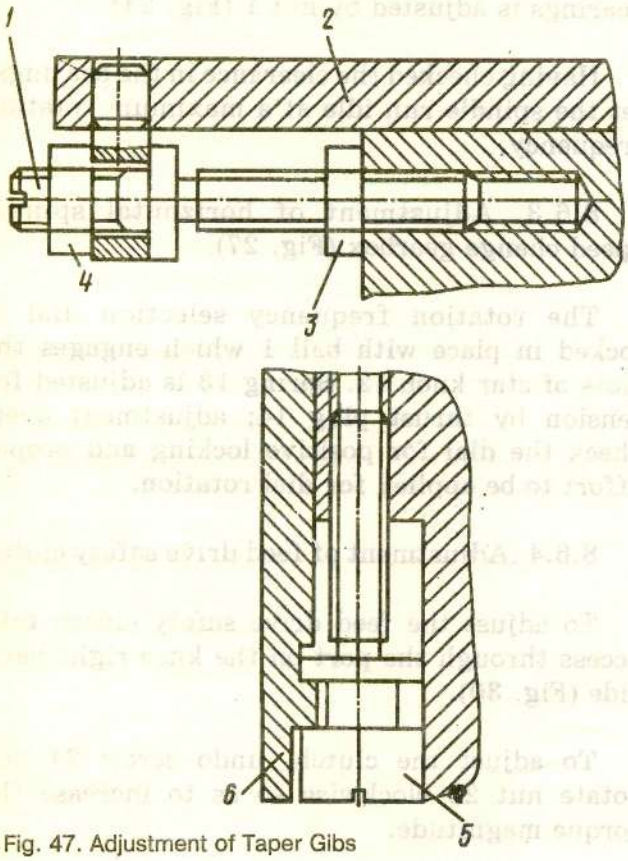


Fig. 47. Adjustment of Taper Gibs

2 slacken nuts 3, 4 and draw screw 1 tight with a screwdriver. Having checked the clearance for correct adjustment by manually traversing the table, draw the nuts tight reliably. Clearance in the saddle ways is adjusted by taper gib 6 by means of screw 5. To check for proper clearance adjustment, traverse the saddle manually.

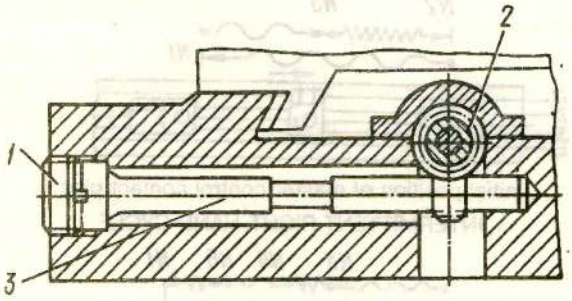


Fig. 48. Adjustment of Backlash in Longitudinal Traverse Lead-Screw

8.6.6. Adjustment of backlash In longitudinal traverse lead-screw (Fig. 48)

To adjust the backlash undo nut 1 and rotate shaft 3 to tighten up nut 2. Take up the backlash until it becomes equal to not more than five dial divisions as checked by turning the longitudinal traverse handwheel. When traversed manually, the table should not be jammed throughout its entire travel. Adjustment over, draw nut 1 tight so as to lock shaft 3 in the adjusted position.

8.7. Tool Coolant System

Machining cast-iron workpieces by any of the milling processes, as well as machining steel workpieces with cemented-carbide tipped cutting tools are carried out without cooling the tool. Coolant is recommended to be applied for machining steel workpieces with high-speed steel milling cutters.

Cutting fluid is fed directly to the machining zone due to adequate manoeuvrability of the nozzle positioning system. With nut 1 (Fig. 49) slackened, the coolant nozzle can be swivelled at any angle and adjusted for height. To adjust the nozzle along the ram, undo nut 3 beforehand. When positioning the nozzle, take care that the nozzle should not interfere with the milling cutter.

Cutting fluid is pumped from the coolant tank located in the machine footing and runs down along the table slots and pan, flow through the

hole in the table into the saddle duct to be returned through a flexible hose to the coolant tank in the machine footing. The cutting fluid discharge hole of the table is protected against clogging with chip heap by a detachable shield. A screen is provided before the discharge holes. There is a screened cover on the footing pan for the cutting fluid to accumulate. Fresh cutting fluid is charged through the same screened cover.

NEVER REMOVE THE COVER AS OTHERWISE THE COOLANT TANK MIGHT BE CLOGGED AND THE COOLANT POMP DAMAGED

The coolant pump is started and stopped by switch 49 (Fig. 14). The rate of the cutting fluid flow is controlled by cock 2 (Fig. 49) which can shut off coolant supply for a period not longer than 10 minutes. For more prolonged shut-off periods stop the coolant pump.

Maximum quantity of the pumped coolant fluid is 6 to 8 1/min.

Dismantle the coolant system regularly (every six months) and flush it for cleaning.

Cutting fluid is drained out of the footing tank through outlet 4 for regular cleaning of the tank; a pit must be provided in the machine foundation to accommodate a receptacle for the drained- off coolant.

In case of major repairs the coolant tank is flushed after the knee and column have been dismantled.

TAKE CARE TO HOLD THE COOLANT NOZZLE IN PLACE RELIABLY; NEVER RETOUCH OR REPOSITION THE NOZZLE IN THE COURSE OF THE MILLING PROCESS

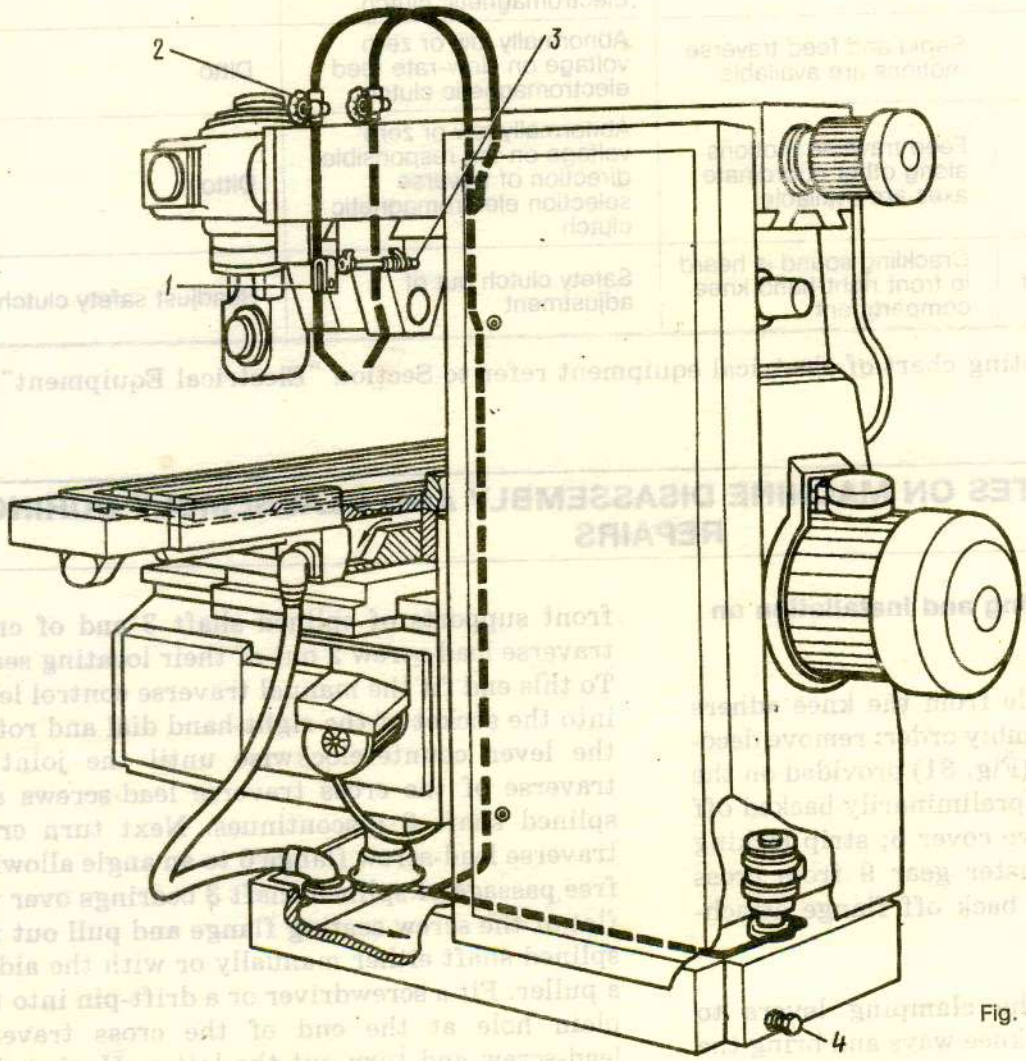


Fig. 49. Tool Cooling System

9. TROUBLE SHOOTING

Some troubles may develop in the machines many of which are due to failure to observe the requirements set forth in this Service Manual.

Prior to eliminating troubles make familiar with the below-stated list of possible troubles, as well as with Section 6 of this Manual.

Trouble Shooting Chart

Trouble	Symptom	Probable cause	Remedy
No lubrication of speed gearbox, or of feed motion mechanisms	No oil appearing in pump operation checking sight glass, or oil appears but scarcely Table ways are lubricated inadequately, or are not lubricated at all	Lack of oil in oil tank Clogged lubrication pump strainer Lubrication pump or entire system at fault	Fill in oil to the midsection of oil sight gauge Clean strainer Check lubrication pump and system components for proper functioning, dismantle for repair if necessary
With feed motor running no feed traverse occurs No feed along any coordinate axis	Rapid traverse motions are available. Rapid traverse motions are available	Feed selector knob fails to be turned right home Abnormally low voltage or no voltage whatever on feed electromagnetic clutch	Bring knob to a fixed position Check for presence of normal mains voltage; Check the responsible clutch for serviceability
No rapid traverse motions	Feed traverse motions are available	Abnormally low or zero voltage on rapid traverse electromagnetic clutch	Ditto
No slow-rate feed traverse	Rapid and feed traverse motions are available	Abnormally low or zero voltage on slow-rate feed electromagnetic clutch	Ditto
No feed traverse along one of the coordinate axes	Feed traverse motions along other coordinate axes are available	Abnormally low or zero voltage on the responsible direction of traverse selection electromagnetic clutch	Ditto
Safety clutch clicks down under normal feed load	Crackling sound is heard in front right-hand knee compartment	Safety clutch out of adjustment	Readjust safety clutch

For the trouble shooting chart of electrical equipment refer to Section "Electrical Equipment".

10. SPECIAL NOTES ON MACHINE DISASSEMBLY AND REASSEMBLY DURING REPAIRS

10.1. Saddle Dismantling and Installation on Knee

To remove the saddle from the knee adhere to the following disassembly order: remove decorative stamped cover 7 (Fig. 31) provided on the knee front end, having preliminarily backed off its holding screw remove cover 8; strip locking ring 10 and double cluster gear 9 from cross traverse lead- screw 2; back off flange attachment screws 11.

Then manipulate the clamping levers to clamp the saddle on the knee ways and bring the front supports of splined shaft 3 and of cross traverse lead-screw 2 out of their locating seats. To this end fit the manual traverse control lever into the socket of the right-hand dial and rotate the lever counterclockwise until the joint in traverse of the cross traverse lead-screws and splined shaft 3 discontinues. Next turn cross traverse lead-screw flange 6 to an angle allowing free passage of splined shaft 3 bearings over the flat of the screw seating flange and pull out the splined shaft either manually or with the aid of a puller. Fit a screwdriver or a drift-pin into the plain hole at the end of the cross traverse lead-screw and turn out the latter. Having dis-

mantled taper gib 11 (Fig. 33) and disconnected strips 9, lubrication and coolant hoses and electric wiring conduits, place rope slings on the saddle and take it out of the knee ways.

To reinstall. the saddle onto the knee reverse the dismantling procedure, taking notice of some specifics of the cross traverse lead-screw installation. In order that the splined shank of lead-screw 2 should fit into the splined hole of gear 1 (Fig. 31), turn the lead-screw into nut 12 after the saddle and taper gibs have been installed, the saddle being released. If the lead-screw in assembly with flange 6 fails to fit into the knee boring completely, apply rocking motion through 60 to the right and left to the saddle using the manual traverse lever inserted into the socket of the knee right-hand dial, and simultaneously move the saddle manually towards the knee vertical ways. As a result, the splined shank of the lead-screw will enter the splined hole of gear 1. Further reassembly procedure needs no explanation.

10.2. Dismantling and Installation of Feed Gearbox

To dismantle the feed gearbox the generally adopted routine is to be observed with due account of hoisting means available.

Provision is made in the top portion of the mating flange for two M12 threaded holes to receive eye-bolts, closed with threaded plugs.

With a view to attaining correct operation of the feed gearbox after repairs and reassembly, proceed to lock the shifting forks on bars 5 (Fig. 29) against axial displacement in the last instance.

Before securing the forks in position turn the shifting disks about their axis of rotation so that the matchmarks provided on one of the surfaces of each disk be arranged square with the mating surface of the feed gearbox. This done, shift the disks all way in towards each other. Set the sliding cluster gears of the feed gearbox to the position as shown in Fig. 20, whereupon lock the forks in place on the bars.

The afore-mentioned position of the cluster gears and shifting disks corresponds to a rate of feed equal to 50 mm/min. Set the same feed rate against the setting dial on the knee front face before reinstalling the feed gearbox. Having installed the feed gearbox be sure to check actual feed rate for consistency with that set against the dial.

If the actual feed rate disagrees with the preset one, bring wire locking ring 12 (Fig. 29) out of its groove, displace dial 11 all the way towards yourself and rotate it about its axis until the feed rate value on the dial corresponding to the actual one stands opposite the index pointer.

This done, push the dial all the way forward and refit ring 12 into its groove.

10.3. Dismantling and Installation of Feed Drive Motor Shaft

Prior to dismantling motor shaft 11 (Fig. 30) remove the motor shield, the feed drive motor and, whenever necessary, also the terminal box located above the motor. Having backed off screws 13 displace the shaft axially, by means of a puller, until bearing 10 thrusts against abaft 16. Then incline shaft 11 towards the knee bottom to bring it out of the boring. To install the shaft in place reverse the dismantling procedure.

To adjust backlash in bevel gearing (gears 9 and 6) make use of screws 12, 13 and nuts 8, 4.

10.4. Disassembly and Reassembly of Speed Change Gearbox

To dismantle and take down the speed change gearbox resort to the generally adopted practice as instructed in Item 6.3.6. Two M12 threaded holes are provided on the top portion of the gearbox face to receive eye-bolts.

Two workers are to be involved in installing the speed change gearbox onto the machine column, one of whom should guide the gearbox to the column opening, while the other should stand on opposite side to check, through an inspection hole, whether the shifting forks are brought in register with the annular slots in the speed gearbox cluster gears. To provide access to the inspection hole during installation procedures the cabinet is turnable about its vertical axis. Before turning the cabinet back off the stop screw located on the cabinet rear wall close to

the left-hand end. The afore-mentioned preparatory work having been carried out, install the speed change gearbox onto the column.

10 .5. Special Notes on Replacement of Electromagnetic Clutches During Repairs

The machines make use of Series contactless electromagnetic clutches to GOST 21573-76. The primary motion drive employs brake clutch 086-1B.

The feed drive involves rapid traverse, working feed, vertical and cross traverse engagement clutches ЭТМ104-12, feed rate decreasing clutch ЭТМ094-1Н2, longitudinal traverse clutch ЭТМ114-12.

When replacing feed drive electromagnetic clutches take care to define gap clearance A (Fig. 32) between the clutch rotatable and stationary components, equal to $0.35^{+0.07}$ mm for the ЭТМ094-1Н2 and to $0.4^{+0.08}$ mm for the ЭТМ104-1Н2 and ЭТМ114-1Н2, which is attained due to appropriately selected thickness of spacer ring 4 for each certain clutch.

For this: attach coil 2 of a new clutch to flange 5 and slip the latter; together with bearings, on bush 6 after first setting in its nest new ring 4 which is thicker by 50-80 %. Using a feeler, measure the actual gap "A" and then, from the results of measurement, calculate the required thickness of ring. Increasing (decreasing) ring thickness by 0.2 mm will increase (decrease) gap "A" by 0.05 mm.

Having set a ring of necessary thickness measure gap "A", tighten up and lock nut 7.

Tighten the nut until axial backlash in bearings disappears (overtightening is objectionable).

An increased "A" gap will result in lower torque (decrease) and in failure of clutch due to binding of rotatable and immovable parts of the clutch.

10.6. Dismantling of Vertical Traverse Lead-screw

To dismantle vertical traverse lead-screw 19, first set the saddle at distance A apart from the column vertical ways (Fig. 31).

Using a screwdriver raise bottom shield 14 (Fig. 31) by 6 or 7 mm simultaneously pulling it forward. As a result, restrictor pin 15 comes out of the knee recess. Then advance the saddle together with the shields as far as it will go in order to expose the knee recess closed with cover 16, wherein the lead-screw support is mounted. Next dismantle splined shaft 3 and lead-screw 2 as instructed in Para. 10.1, back off the screws holding cover 16, and remove the latter. Unlock washer 17 and turn mushroom knob 18 out.

Before removing the vertical traverse lead-screw disengage column 6 (Fig. 42) from its base and turn it onto screw 19 as instructed in Section 7 (Para. 7.2).

CAUTION. WHILE SO DOING BE SURE TO SET THE KNEE TO A STOP (Fig. 9).

To dismantle the lead-screw along with the column, lightly tap against the lead-screw with a drift pin to let the screw disengage from the locating seat of gear 4 (Fig. 31).

To reassemble the lead-screw reverse the dismantling procedure.

For the layout of bearings refer to Fig. 51.

A list of rolling bearings is specified in Table 6 below.

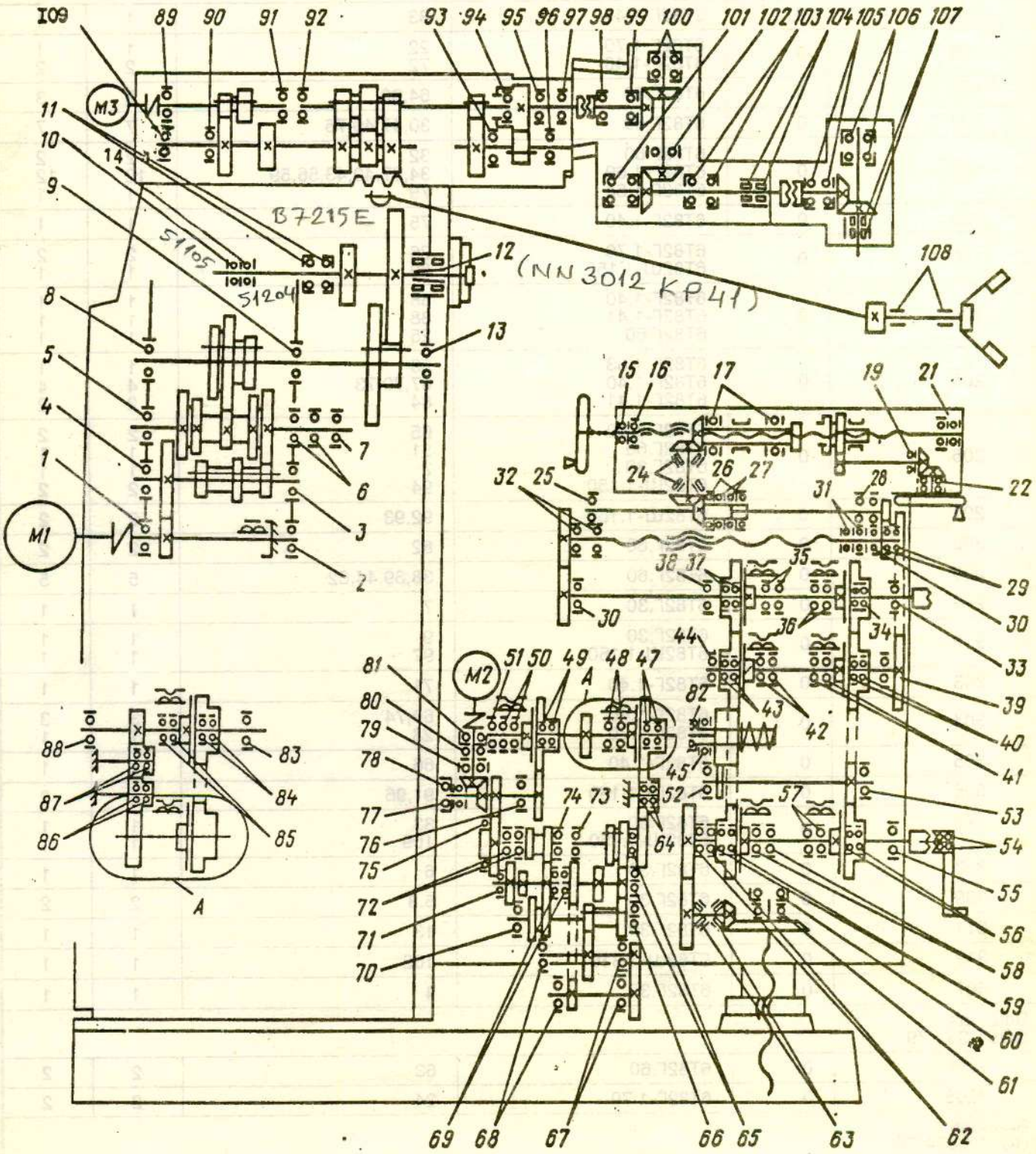


Fig.51. Layout of Bearings

List of Rolling Bearings

Table 6

Designation	Tolerance class	Located in	Ref. No. in diagram	Quantity	
				6Т82Ш	6Т83Ш
Bearings GOST 8338-75					
104	0	6Т82Г-1.41	83	1	1
105	0	6Т82Г-1.70 6Т82Г-1.40	22 72	1 2	1 2
106	0	6Т82Г.60	64,90	3	3
107	0	6Т82Г.60	30,47,49,76	7	7
108	0	6Т82Г.60 6Т82Г-1.69 6Т82Г-1.64	32 34,37,40,43,56,59 79	2 12 1	2 12 1
109	0	6Т82Г-1.40	75	1	1
110	0	6Т82Г-1.70 6Т82Ш-1.150	26 89	2 1	2 1
204	0	6Т82Г-1.40 6Т82Г-1.41 6Т82Г.60	68 88 25	1 1 1	1 1 1
205	0	6Т82Г-1.63 6Т82Г-1.40 6Т82Г-1.41	53 67,70,73 84	1 4 2	1 4 2
206	0	6Т82Г-1.40 6Т82Г.60 6Т82Г.30 6Т82Ш-1.150	65 51 2 94	2 1 1 2	2 1 1 2
207	0	6Т82Ш-1.150	92,93	2	2
208	0	6Т82Г.60	82	2	2
209	0	6Т82Г.60	38,39,44,62	5	5
210	0	6Т82Г.30	7	1	1
212	0	6Т82Г.30 6Т82Ш-1.150	9 97	1 1	1 1
303	0	6Т82Г-1.40	71	1	1
304	0	6Т82Г-1.40 6Т82Г-1.70	69,74 23	3 1	3 1
305	0	6Т82Г-1.40	66	1	1
306	0	6Т82Ш-1.150	91,96	2	2
307	0	6Т82Г.30 6Т82Ш-1.150	33 109	1 1	1 1
308	0	6Т82Г.30	6	1	1
309	0	6Т82Г.30	5.8	2	2
311	6	6Т82Г.30	13	1	1
312	0	6Т82Ш-1.310	102	1	1
407	0	6Т82Г.30	4	1	1
Bearings GOST 333-79					
7205	0	6Т82Г.60	63	2	2
7208	0	6Т82Г-1.70	24	2	2
Bearings GOST 6874-75					
8104	0	6Т82Г.60	77	1	1
8105	0	6Т82Г-1.70	19	1	1

Designation	Tolerance class	Located in	Ref. No. in diagram	Quantity	
				6Т82Ш	6Т83Ш
8105	0	613К.93	14	1	1
8107	0	6Т82Г-1.64	80	1	1
		6Т82Г.60	31	2	2
8110	0	6Т82Г-1.70	27	2	2
		6Т82Г.60	45	1	1
8113	0	6Т82Г.60	60	1	1
		6Т82Г-1.70	17	2	2
8120	0	6Т82Г.60	61	1	1
8204	0	6Р13К.93	10	1	1
8209	0	6Т82Г-1.70	15,21	2	2
Bearing GOST 831-75					
46109	0	6Т82Г-1.64	81	1	1
46204	0	6Т82Г.60	78	1	1
46208	6	6Т82Ш-1.310	100	2	2
		6Т82Ш-1.320	105	2	2
	5	6Т82Ш-1.320	106	2	2
46210	5	6Т82Ш-1.310	103	2	2
46212	6	6Т82Ш-1.310	99,101	3	3
46215	5	6Т82Г.30	11	2	2
46309	0	6Т82Ш-1.310	96	1	1
Bearing GOST 7242-75					
60106	0	6Т82Г.60	28	2	2
60202	0	6Т82Г.60	54	2	2
60205	0	6Т82Г.60	29	2	2
60206	0	6Т82Г-1.70	16,20	2	2
60208	0	6Т82Г.60	33,55	2	2
60209	0	6Т82Г.60	39	1	1
60212	0	6Т82Г.30	1	1	1
Bearing GOST 8338-75					
1000904	6	6Т82Г-1.41	87,96	4	4
1000916	6	6Т82Ш-1.150	95		
7000107	6	6Т82Г-1.41	85	2	2
7000109(709)	0	6Т82Г.60	48,50	4	4
		6Т82Г-1.69	35,36,42,41,57,58	12	12
Bearing GOST 7634-75					
3182112	4	6Т82Ш-1.310	104	1	1
		6Т82Ш-1.320	107	1	1
3182122	4	6Т82Г.30	12	1	1