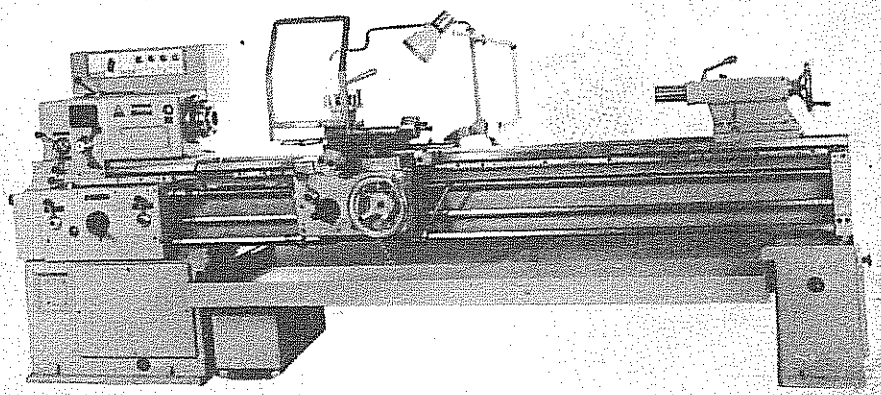
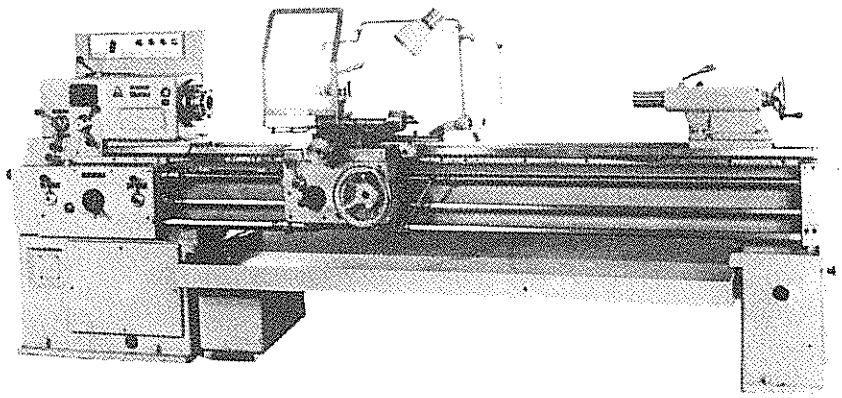
TOS

OPERATION AND MAINTENANCE INSTRUCTION MANUAL



SN 40B-45B-50B

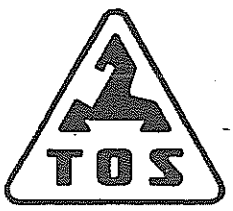
SN 40 B – 45 B – 50 B



ATTENTION!

Feed change, gear and lever shifting IN THE POSITION OFF ONLY!

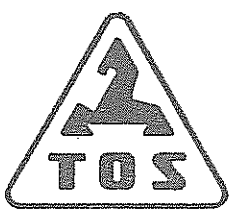
TOS


TOS

Serial number of machine

stamped on the guide ways or on the machine bed

As the machines, accessories and tools are constantly being improved, this Operating Instruction may differ in detail with the machine supplied. Therefore, whenever you order a spare part, state always besides the number of the respective part, found in this handbook, also the above serial number of the machine.



PREFACE

in handing you these Operating Instructions dealing with the erection, operation and upkeep of the machine, we would like to ask you to get well acquainted with its contens before putting it into service. This handbook would fail its purpose, if it did not reach the foreman and the operator who will be responsible for the machine. It is essential to have a thorough knowledge of all the controls of the machine before starting it for the first time. You will save time and avoid defects if you strictly follow the instructions contained in this handbook. Before being dispatched from our works, each machine is subjected to a severe test with regard to its performance. You will be satisfied with the performance of the machine if you follow the instructions contained in this handbook. We wish you successful work with our machines.

The operational instructions belongs to the standard equipment of the machine. When the machine is moved from one factory to another or when the machine is scrapped, it is necessary to hand over or discard the instruction manual simultaneously. While the machine is working in the respective factory, the instruction manual is kept in the chief mechanic's department, which is responsible for keeping it up to date.

The operational instructions is intended mainly for members of the repair and maintenance staff, methods and process plannig department, foremen and instructors of work.

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I. MAIN DATA OF THE MACHINE

Type of machine:		universal centre lathe		
Models:		SN 40B	SN 45B	SN 50B
Manufacturer:		TOS Trenčín		
Year of manufacture:		----------		
Serial No.:		----------		
Turning length:	mm	1000	1500	2000
Overall length of machine:	mm	2575	3075	3575
Overall width:	mm		1100	
Overall height:	mm	1410	1435	1460

Weight of machine with standard equipment

t. d.			
1000	1580 kg	1625 kg	1645 kg
1500	1680 kg	1725 kg	1745 kg
SN 50B kg 2000	1780 kg	1825 kg	1845 kg

Operating voltage of electric motors: according to order

Total power of machine without extra equipment:
6,6 kW for 50 Hz

The machine is suitable for normal turning operations as well as for screw cutting, recessing, boring and copy turning. It can be employed for both single piece and large batch production and also as a special - purpose machine.

26. Longitudinal stop drum
27. Indexing attachment for the spindle
28. Toolpost grinder for external and internal grinding
29. Spline and gear milling attachment
30. IKS rear hydraulic copying attachment

Inventory No. of the machine:
Supplier:
Order No.:
Date of order:
Date of delivery:
Guarantee valid till:
Place and date of erection:

Entries on the removals of the machine:

SN 40B - 45B - 50B

Standard equipment

Item No.:	Denomination	Pcs	Note
1.	Electrical equipment		Including electric motor and transformer
2.	Driving plate	1	
3.	Flange for chuck	1	∅ 200 mm for SN 40B — 45B ∅ 250 mm for SN 50B
4.	Reduction sleeve for spindle	1	
5.	Centre Morse 5	2	
6.	Chip pan	1	
7.	Cooling equipment with tank and pump	1	
8.	Upper slide with a 4-way toolpost	1	a/ metric b/ inch system
9.	Set of change gears /Table 9/ - list on page 12	7	for a/ metric b/ inch feeds and threads
10.	Set of operating tools		
11.	Spare shear pins for leadscrew	5	
12.	Operational instructions	1	
13.	Lighting equipment for 24 Volts /without bulb/	1	

II. OPTIONAL EQUIPMENT AND SPECIAL EXECUTION OF MACHINE

Item No.:	Denomination	Note
1.	Driving plate with divisions for cutting multi-start threads	for tapered or threaded work spindle nose /to be specified in the order/
2.	Face plate with 4 jaws and mandrel for assembly and disassembly	
3.	Plain face plate	
4.	Hand-operated collet chuck	
5.	Universal chuck with 3 or 4 jaws	∅ 200 mm for SN 40B – 45B ∅ 250 mm for SN 50B
6.	Upper slide with American toolholder	∅ 200 mm for SN 40B – 45B ∅ 250 mm for SN 50B
7.	Upper slide with plate-shaped holder	in a/ metric b/ inch system
8.	Rear toolholder	
9.	Vertical adjustable carriage	
10.	Boring table	
11.	Bar for taper turning	
12.	IKS-I hydraulic copying attachment with separate motor in versions:	a/ rear /longitudinal/ b/ face /transversal/ metric or inch system.

Item No.:	Denomination		Note
13.	IKS-I hydraulic copying attachment IKS-I rear and face		When both rear and face copy attachments are ordered, they have a common hydraulic pump.
14.	Spring-loaded centre		
15.	Threading dial		
16.	Longitudinal stop drum		
17.	Indexing attachment for spindle		
18.	Toolpost grinder for external and internal grinding		With a separate electric motor
19.	Spline and gear milling attachment		With a separate electric motor
20.	Live centre Morse No. 5		
21.	Chip guard		
22.	Universal chuck guard		
23.	Steady rest ∅ 10—115 mm		
24.	Follow rest ∅ 10—115 mm		
25.	Fixed micrometric stop		
26.	Large steady rest	SN 40B—45B SN 50B	∅ 100—∅ 180 mm ∅ 170—∅ 250 mm
27.	Three jaw driving plate SUH /20x85/		especially suitable for use with spring loaded centre and IKS-I hydraulic copying attachment
28.	Change gears for special pitches.		a/ metric machine b/ machine in inches
29.	Foundation bolts and wedges		
30.	Flanges for special chucks		

31. Four-jaw face plate with guideways.

When optional equipment is supplied additionally, it is necessary to fit it or to drill holes for fixing.

32. Chest for tools /with a shaped palette/ without the tools.

33. Chest /with a shaped palette/ with the tools.

Special execution of SN 40B — SN 45B — SN 50B machine

1. Machine in inches
2. Camlock spindle, Camlock D1 type
3. Moving screws in inches - metric dials
4. Threading gear box arranged for 13 TPI without using change gears
5. Reduced headstock of SN 50B 1:7.55
6. Cross stop
7. Micrometric cross stop
8. Machine with reduced speed tange 11.2 - 1000 r.p.m.
9. Cover of guideways.

III. SPECIFICATION /WITH STANDARD EQUIPMENT/

1. Working capacity		SN 40B	SN 45B	SN 50B
Swing over bed	mm	400	450	500
Swing over carriage	mm	220	270	270
Swing in gap width of gap in front	mm	600	650	700
of face plate	mm	230	230	230
Height of centre over bed	mm	200	225	250
Distance between centres	mm	1060	1560	2060
Turning length	mm	1000	1500	2000
Maximum permissible torque			kpcm	12 000
Bottom speed value for the above torque			r.p.m.	45
Maximum weight of workpiece loaded at speed 45 r.p.m.			kg	300
Between centres - " -			kg	200
Between centres and steady rest - " -			kg	200

2. Spindle		
Spindle diameter in front bearing	mm	80/82.5
Diameter of bore: throughgoing	mm	50.8
Front spindle nose: internal taper Morse	No.	6

external spindle nose: a/ 170 ČSN 20 1011
b/ 6 inch Camlock D1 ASA B59/1954 internal taper Jarno No. 18; Table D

3. Spindle speeds

Number of speeds in the normal range 12

Number of speeds in the reduced range 12

Speeds of the normal range	r.p.m.	45-2,000
Speeds of the reduced range	r.p.m.	22-1,000
Coefficient of spindle speed stepping		1.4
Transmission ratio of countershaft		1:8

4. Cutting feed of carriage:

Number of steps: a/ longitudinal 38
b/ transverse 38

Range of longitudinal feeds /see tables/:

a/ with drive from spindle	mm/rev.	0.05—0.8
b/ with drive from counter-shaft	mm/rev.	0.64—6.4
c/ with drive from spindle	inch/rev.	0.002—0.024
d/ with drive from counter-shaft	inch/rev.	0.019—0.242

Range of transverse feeds:

a/ with drive from spindle	mm/rev.	0.025—0.4
b/ with drive from counter-shaft	mm/rev.	0.32—3.2
c/ with drive from spindle	inch/rev.	0.001—0.012
d/ with drive from counter-shaft	inch/rev.	0.0095—0.121

Disengaging force - longitudinally		kp 800
	across	kp 480

5. Threads see tables :

Metric:	number		29
	pitches	mm	0.5 — 40
Whitworth:	number		35
	threads per 1"		1 — 80
Diametral Pitch:	number		31
	threads per 1" dia		2 — 72
Modul threads:	number		26
	pitch in modules		0.25 — 20

Set of change gears:	SN 40B	SN 45B	SN 50B
a/ for machine in metric system	30/1.5	30/1.5	30/1.5
	120/1.5	120/1.5	120/1.5
	48/1.5	60/1.5	80/1.5
	71/1.25	71/1.25	71/1.5
	113/1.25	113/1.25	113/1.5
	64/1.25	55/1.25	50/1.5
	40/1.25	88/1.25	
b/ for machine in inches	30/1.5	30/1.5	30/1.5
	48/1.5	60/1.5	127/1.5
	127/1.5	127/1.5	62/1.25
	62/1.25	62/1.25	105/1.25
	105/1.25	105/1.25	80/1.5
	71/1.25	71/1.25	71/1.5
	113/1.25	113/1.25	113/1.5

6. Leadscrew:

Metric thread	TR 40 x 6 z
inch ACME thread	40 x 4 T.P.I.

7. Carriage:

Feed to cross slide	mm	300
Feed to tool slide	mm	140
Pitch of traverse slide leadscrew:		
metric system		TR 20 x 4 L.H.
inch system		ACME 20 x 5 T.P.I. /L.H.
Pitch of tool slide leadscrew:		
metric system		TR 14 x 3 L.H.
inch system		ACME 14 x 8 T.P.I. /L.H.
One division of graduated ring on transverse slide equals /measured on diameter/		0.05 mm /metric leadscrew/ 0.002" /inch leadscrew/
One division of graduated ring on tool slide equals:		
a/ metric leadscrew	mm	0.02
b/ inch leadscrew	inch	0.001
Dimensions of the four-way revolving toolpost	mm	132 x 132
Number of locked positions of the revolving toolpost		8
Maximum tool section	mm	20 x 32

8. Tailstock:

Tailstock sleeve diameter	mm	70
Feed of tailstock sleeve	mm	180
Internal taper of tailstock sleeve	Morse No.	5

Transverse travel of tailstock to either side	mm	12
Thread of feed screw		TR 20 x 40 L

9. Dead centre of spindle

Taper	Morse No.	5
Apex angle of centre		60°

10. Dead centre of tailstock

Taper	Morse No.	5
Apex angle of centre		60°

11. Reducing sleeve of spindle

External taper	Morse No.	6
Internal taper	Morse No.	5

12. Cooling equipment

Capacity of coolant tank	litres	70
Output of electric pump	litres/min.	10
Output of pump motor	kW	0.115
Speed of pump	r.p.m.	2800

13. Chip-pan

IV. SPECIFICATION OF OPTIONAL EQUIPMENT

1. Rests

diameter swing in steady rest	mm	10-115
diameter swing in follow rest	mm	10-115

2. Graduated driving plate

External diameter	mm	250
Number of divisions on the circumference		120
Distance from driving pin to centre of plate	mm	105

3. Face plate with 4 jaws

		SN 40B	SN 45B	SN 50B
External diameter	mm	400	450	500
Max. dia. of external gripping	mm	320	360	410
Max. dia. of internal gripping	mm	400	450	490
Number of clamping jaws		3x4	3x4	3x4

4. Plain face plate

External diameter	mm	400	450	500
Number of clamping slots		16	16	16

5. Air-operated clamping

System of control			pneumatic	
External dia. of clamping chuck	mm	200	200	250
Max. dia. of external gripping	mm	3-208	3-208	10-262
Max. dia. of internal gripping	mm	42-246	42-246	54-326
Max. stroke of jaws measured on dia.	mm	12	12	12
Number of jaws		3x3	3x3	3x3
Gripping power of jaws at 6 kp/cm^2	kg	4 350	4 350	4 350
Pressure required	kp/cm^2		4 - 6	

6. Hand operated collet chuck

Number of collets in standard set /round/		18
Diameter of collets	mm	Ø 7, 8, 9, 10, 11, 12, 14, 16, 18, 20, 22, 24, 25, 28, 32, 36, 40, 45
Collets available on request:		
square	mm □	16, 18, 20, 22, 25, 28, 32
hexagonal	mm ⬡	10, 11, 12, 14, 17, 19, 22 27, 30, 32, 36

7. Upper slide with American toolpost

Max. tool section	mm	32 x 20

8. Upper slide with a plate-shaped toolpost

		SN 40B	SN 45B	SN 50B
Max. tool section	mm		32 x 25	

9. Rear toolpost

Adjustability: transverse	mm	70
longitudinal with single-toolholder	mm	170
with two simple tool-holders	mm	110
with a double toolholder	mm	140
Toolpost dimensions:		
simple type	mm	60 x 150
double type	mm	85 x 150
Max. section of tool	mm	32 x 20

10. Vertically adjustable carriage		SN40B	SN45B	SN50B
Dimensions of clamping carriage			325 x 205	
Number of clamping slots on the carriage			4	
Number of centering slots on the clamping carriage			1	
Clamping block dimensions	mm		200 x 120	
Number of clamping slots on the clamping block			1	
Clamping carriage swivels in vertical position to either side			$\pm$ 45°	

Clamping carriage swivels advanced to its uppermost position to either side in horizontal position		± 90°
Working traverse of the clamping carriage	mm	160

11. Boring table

Distance of table surface from the turning centreline	mm	104	129	129
Dimensions of clamping table	mm	590 x 350		
Number of clamping slots on the table		7		
Feed to clamping table	mm	300		

12. Bar for taper turning

Max. length of machining	mm	320
max. apex angle		30°

13. IKS-1 hydraulic face and rear copying attachment

refer to separate operational instructions

	SN 40B	SN 45B	SN 50B

14. Micrometric stops - longitudinal stop drum

Tripping system		mechanical
No. of longitudinal trip dogs		4
Max. spacing of dogs	mm	550

15. Indexing mechanism for spindle

Number of indexing plates	2
Number of holes in plate I.	37-55-69-77-81-83-93 39-47-57-63-73-87-96
ditto in plate II.	41-45-49-59-61-89-97 43-51-67-71-79-91-99

16. Toolpost grinder for external and internal grinding

refer to separate operational instructions

17. Spline and gear milling attachment

Output of the electric motor	kW	0.370
Speed of the electric motor	r.p.m.	2 800
Range of main spindle speeds	r.p.m.	56-90-140-224-355-560
Main spindle bore	mm	14
Internal taper of main spindle nose	Morse No.	3
Spindle stroke measured from machine axis		SN 40B — 45B - 195 SN 50B - 170
Main spindle swivels in vertical plane to either side		± 90°
Number of indexing plates		2
Number of holes in indexing plate I		37-55-69-77-81-83-93 39-47-57-63-73-87-96
Ditto in index plate II		41-45-49-59-61-89-97 43-51-67-71-79-91-99

18. Hand-operated universal chuck		SN 40B	SN 45B	SN 50B
External diameter	mm	200	200	250
Max. dia. of external gripping	mm	200	200	250
Max. dia. of internal gripping	mm	200	200	250
Max. dia. of internal gripping	mm	50	50	63
Dia. of through-hole	mm	52	52	65
Number of clamping jaws		1x3	1x3	1x3
or		1x4	1x4	1x4

19. Live centre

Taper	Morse No.	5
Apex angle of centre		60°

20. Spring-loaded centre

Thrust force	kg	50—615
Max. axial stroke	mm	10
Dia. of centering portion	mm	32
Apex angle		60°

21. Packing meassurements /for 1000 mm between centres/

length	mm	2 850
width	mm	1 300
height	mm	1 760
kind		shipping case
contents boxed	cu. m.	6,5

Machine delivered with optional extras is packed in a proportionally larger case.

V. TECHNICAL DESCRIPTION OF THE MACHINE

The lathes of the SN-A series are intended in the first place, for small batch or piece production, as well as for repair shops, owing to their versatility and precision of work combined with cheir simple design and low price.
Their design meets the up-to-date demands of modern machining technology. The large working capacity of the machine as well as its possibility to be equipped with large range of special attachments cause that it is a machine of universal application. This lathe enables almost every kind of machining to be performed, i. e. turning, boring, taper turning, hydraulic copying, spline and gear milling, external and internal grinding, etc.
The lathes are supplied in metric or inch execution, either with an independent drive by an electric motor or fitted with a separate pulley for any kind of power drive. To those countries where the frequency of electric supply is 60 c/sec. a special pulley is supplied besides a special execution of the entire electrical equipment. The spindles are also supplied on request in optional designs:
a/ nose with flange, short taper and bayonet joint,
b/ Camlock type D1.
The carriage and slides have been designed with a view to allow the use of the rear, American and plate-shaped toolholders, these being supplied as optional equipment. The system of adjustable stop dogs enables exact longitudinal turning governed by stop dogs to be used with a notable increase of productivity in batch production.
Thread-cutting is arranged with a view to obtain the highest degree or economy, so that, with a minimum amount of changing gears, it is possible to cut all current kinds of metric, inch, module as well as DP threads. A high degree of precision is ensured by the rigidity of all the main elements of the machine, i. e. the bed, headstock, tailstock and slides. These two essential properties or machine tools, precision and rigidity, have been achieved by giving the machines the optimum shape and by employing the most convenient gear transmission systems. Operation and servicing are as simple as possible. The external appearance of the machine satisfies the most exacting estetic demands.

VI. GEAR TRAIN /TRANSMISSION LAYOUT/

Fig. 6 shows the gear train of the entire machine. The arrangement and sequence of the individual gears in the gear box for spindle drive as well as in the thread cutting gearbox and apron may be seen from it. The speed diagram /Fig. 6, pos. 1/ applies to the normal range of spindle speeds 45 — 2 000 r.p.m. and the diagram /Fig. 6, pos. 2/ applies to the reduced range of spindle speeds 22.4 — 1 000 r.p.m. The speed ranges can be changed by changing the gears Z_1, Z_2. From the speed diagrams, the increase or decrease of speeds of the individual shafts, as well as the starting speed of the spindle are apparent. With regard to the metric system, the feeds and threads are in conformity with Table 6, position A, and in the case of the inch system, the feeds and threads are according to the same Table, in position B.

VII. TRANSPORT OF THE MACHINE

Before being dispatched from the works, the machine is attached to wooden skids /Fig. 3, pos. 1/ on which it is transported to the site of erection. The machine is then transported on rollers or slung on a crane. In the latter case hemp ropes /pos. 2/ are employed. In order to prevent damage to the operating levers, the leadscrew and feed shaft on the front side of the machine, and wooden blocks should be inserted /pos. 3/ between the said parts and the carrying rope. The coolant tank and chip pan are detachable and are transported separately.
When slinging, the machine should be properly balanced. Any balance disproportions should be improved by traversing the carriage.

VIII. ERECTION OF THE MACHINE, FOUNDATION PLAN

Levelling the machine into its accurate position is the first condition of its precise work. It is, therefore, necessary, well be-

fore of the arrival of the machine, to prepare a solid foundation of rammed concrete according to turning length /see Fig. 2/. This foundation should be sufficiently deep, with a view to the weight of the machine and the bearing capacity of the soil, in order to prevent its subsequent deformation. The machine itself is then levelled by means of set screws /pos. 3/, for which the machine frame is provided by threaded bores M 16; the levelling is then checked according to the test chart. Between the set screws and foundation the steel pads /pos. 2/ should be inserted. After the machine has been levelled, thin cement mortar is poured under it, and when it has solidified sufficiently, the nuts /pos. 1/ of the foundation bolts, are evenly tightened, while the machine is continuously checked with regard to its correct transverse and longitudinal position.

IX. ELECTRICAL EQUIPMENT AND CONNECTION TO THE MAINS

1. Wiring diagrams Fig. 7a, 7b.

The switch gear panel built in the box consists of switches S1, S2, the relays F1, F2, the terminal board D1, D2, the fuses P1, P2, P3, P4, P5 and P6 the transformer T1 and resistors R1 and R2. The push-button panel built into the front wall of the box fig. 7 consist of the push-buttons A1, H2, A2 for the starting and arresting of the machine, the signal lamp H1 for the optical checking of the machine voltage and the knob A3 for the starting and arresting of the coolant pump.
The switch V1 is built in the box of common push pannel.
In the box on the left side of the operating elements on the rear walt a socket plate is build in with socket for connection ot the next 3-phase appliance e. g. the milling or grinding attachment IKS-I - hydraulic copying attachment, etc. only if this attachment is ordered by customer.
The motor M1 for the main drive is enclosed in the rear section of the front pedestal under a special cover. M2 is the motor of the coolant pump. The supply from the main switchboard in the shop

should be run through a channel in the floor, termonated by a tube /Fig. 7/.
It is essential to keep the machine reliably earthed down according to the regulations valid for the specific line system, to which the machine is connected. For this purpose serves the screw located next to the terminal board D1. Any other interference into the electrical equipment should be omitted as this could lead to serious failures and injuries.
CAUTION! The supply switchboard D1 is live even when the main switch is switched off.

X. INSTRUCTIONS ON SERVICING THE ELECTRICAL EQUIPMENT, ON FAILURES AND ON HOW TO GET RID OF THEM

Before being sent oft from the works, the machine is tested and fitted with the respective fuses, with the overcurrent thermal protection /breakers/, set up according to the rated current value of the motor. The repairing of failures in the electrical equipment should be entrusted only to a skilled expert.
If the machine is out of operation for a longer time it is essential to check it before putting it into operation again: the condition of the electrical /equipment through idle run, the mechanical function of the electrical gear, etc.

XI. CONTROL OF THE MACHINE

When engaging the pilot switch V /Fig. 7/ the machine is connected to the mains, however, the motor does not run. The lamp for the illumination of the machine can shine and the sockets are live. On depressing the push-buttons A1 /start/, the motor begins to run and the signal lamp H2 glows. The motor can be instantaneously stopped by pressing the push-button A2 or by turning the main switch into position 0.

SN 40B - 45B - 50B

Elements of electric equipment

Mark	Purpose	Output kW	Voltage V	Current A	Speed r.p.m.	Freq. c/sec.	Type
M1	Main	5,5	220/380	19,5/11,3	1460	50	QAP 132-S-4
			415	10.3			
	drive		500	8.6			
M2	Pump	0.115	220/380	0.50/0.25	2800	50	P1-2COA1
			415	0.25			
			500	0.18			

Mark	Function /pieces/	Voltage V	c/sec.	A of fuse	Type
P 1	Fuses of main	220	50	25	E 27
		380	50	20	E 27
	motor /3/	400-415	50	20	E 27
		440-500	50	15	E 27
		550	50	10	E 27
		220	60	35	E 33
		400-415	60	20	E 27
		440-500	60	15	E 27
		550	60	10	E 27
P 2	Fuses of pump	220	50	6	E 27
		380	50	4	E 27
	/3/	400-415	50	4	E 27
		440-550	50	2	E 27
		220	60	4	E 27
		400-415	60	4	E 27
		440-550	60	2	E 27
P 3	Fuses of	220	50	10	E 27
		380	50	10	E 27
	socket /3/	400-440	50	10	E 27
		500-550	50	10	E 27
		220	60	10	E 27
		400-440	60	10	E 27
		500-550	60	10	E 27
P 4	Fuses of	220	50	1	No. 48B
	transformator	220	60	1	No. 48B
	control /2/	380	50	1	No. 48B
P 5	Operating	220	50	0,6	No. 048A
	fuses /2/	220	60	0,6	No. 048A
P 6	Fuses of	24	50	2,5	No. 048A
	lighting /2/	24	60	2.5	No. 048A

Mark	Function	Voltage	c/sec.	Type
F 1	Overcurrent thermal protection of main motor	220	50	R 101 - 23
		220	60	R 101 - 23
		380	50	R 101 - 15
		400	50	R 100 - 10
		400	60	R 101 - 15
		415	50	R 100 - 10
		415	60	R 101 - 15
		440	50	R 100 - 10
		440	60	R 100 - 10
		500	50	R 100 - 10
		500	60	R 100 - 10
		550	50	R 100 - 7
		550	60	R 100 - 10
F 2	Overcurrent thermal protection of pump motor	220	50	R 100 - 0.5
		220	60	R 100 - 0.5
		380	50	R 100 - 0.23
		400-415	50	R 100 - 0.23
		400-415	60	R 100 - 0.23
		440	50	R 100 - 0.23
		440	60	R 100 - 0.23
		500	50	R 100 - 0.23
		500	60	R 100 - 0.23
		550	50	R 100 - 0.23
		550	60	R 100 - 0.23

XII. DESCRIPTION OF THE MAIN SUB-ASSEMBLIES, THEIR OPERATION AND MAINTENANCE

The SN lathes are machine tools of high output, reliability and lasting working precision; they possess a sufficiently wide range of speeds to be able to utilize economically carbide tipped tools at high cutting speeds as well as to cut threads with tools made of tool steel. The machine is driven by individual electric motor protected by a cover Fig. 4, pos. 25. The main switch of the machine is easily visible and accessible /Fig. 1, pos. 18/. The electrical switchgear situated in electrical box becomes easily accessible after the cover has been removed. The design of the machine meets all requirements for modern machining techniques.

1. The gearbox /Fig. 1, pos. 9/

The gearbox forms a separate assembly unit attached to the rear bed side and bolted together with the headstock. The lower portion of the gearbox serves as an oil tank. The gear box takes its drive from a V-belt pulley keyed on to the clutch shaft. The multi - dial clutch /Fig. 12, pos. 1/ transmits the torque from the driving shaft on to the respective gears in the gearbox. It serves also for reversing the direction of spindle rotation.
By disengaging the clutch, the multidisc brake /Fig. 12, pos. 15/ is automatically operated by the lever /Fig. 4, pos. 1/ which serves for a quick stopping of the machine. The clutch is shifted by lever /Fig. 4, pos. 1/ on the apron. The recpective speeds are easy to change. By means of 3 levers 12 spindle speeds can be selected. For positioning of the levers see Table Fig. 10.
One lever /Fig. 4, pos. 3; Fig. 12, pos. 3/ fitted to the upper gearbox wall controls the shifter /Fig. 12, pos. 6/ of the twin gear. Both the second and the third lever /Fig. 4, pos. 2; Fig. 12, pos. 2/ are located on the front gearbox wall. The former controls the shifter /Fig. 12, pos. 7/ of the sliding triple gear, the latter /Fig. 1, pos. 8/ that of the sliding twin gear. The gearbox is designed with regard to employing the reduced speed range. For the alternative speed ranges see Fig. 6, pos. 1, 2. The changeover from one range to the next one is effected by changing of the corresponding gears /Z1, Z2, Fig. 6, 12, pos. 9/,

which are readily accessible after the lateral guard has been removed and the cover /Fig. 12, pos. 10/ lifted. In the branch of the feed and tread-cutting drive two sliding gears are included: one of these serves to reverse the feed direction, the other one to select the gear ratio, either 1:1 or 8:1. The direction of feeds is controlled by the lever situated at the front of the gearbox /Fig. 4, pos. 4; Fig. 12, pos. 4/ and the transmission 8:1 is controlled by the lever /Fig. 4, pos. 5; Fig. 12, pos. 5/ attached to a common shaft and by the lever for reversing the feed direction. The change gears for feeds and thread cutting are easily accessible after the cover /Fig. 4, pos. 6/ has been lifted. The gears are secured by a washer and a spring lock washer /Fig. 13, pos. 6/; this arrangement enables quick changing of the gears.

Set-up of the multi-disc clutch

The clutch becomes accessible after the cover /Fig. 12, pos. 11/ at the rear of the gearbox has been removed. As the clutch has been pre-set in the factory, it is not recommended to alter the setting if not necessary. If its pull has become insufficient after prolonged operation, it can be readjusted by tightening the bearing nut /Fig. 12, pos. 12/. The nut is secured by a screw /Fig. 12, pos. 13/ against loosening. By turning the nut through 15° the clearance in the clutch is reduced by 0.083 mm.
The clutch should be set up so as not to slip when engaged and not to heat up when disengaged.
It is not permitted to let the clutch slip with the intention of reducing the spindle speed for turning.
If the oil in the gear box heats up excessively, it is necessary - in addition to other tests - to check the clearance in the clutch and in the brake.

2. The headstock /Fig. 1, pos. 8/ and bearing adjustment

The sub-assembly of the headstock froms separate rigid part of the machine. It is attached to the guideways of the bed and is bolted to the gearbox. Its top surface serves as a rest for tools and gauges. At the front the main spindle runs in an adjustable NNK double row roller bearing, its rear portion being mounted in two

single row ball bearing with angle contact which enable both radial and axial play to be eliminated. The distance between the front and rear bearings has been chosen with a view to optimum conditions as to main spindle deformation and the precision of the antifriction bearings employed. Thus extraordinary rigidity and precision of the main spindle has been obtained. The spindle is driven from the gearbox, through a clutch with internal gearing /Fig. 11, pos. 10/, which transmits only one pair of forces. Consequently, the spindle is not subjected to bending stress. Electrical box accommodates push-buttoms /Fig. 1, pos. 20, 21/ and a signal light /Fig. 1, pos. 22/. The front spindle nose carries a flange with a short taper and a bayonet joint, which enables quick change of the driving or clamping elements. If desired by the customer, a spindle with Camlock D1 in accordance with ASA can also be supplied.

Adjustment of main spindle bearings

During spindle assembly /Fig. 11, pos. 1/ the play of the NNK double row bearing /pos. 2/ of higher accuracy is eliminated by taking out the split ring /pos. 3/ against which the bearing bears whereupon through an opening provided in the rear headstock wall the nut /pos. 5/ is tightened, the latter forcing the internal bearing race into the spindle taper by means of a distance sleeve /pos. 6/. The split ring is then ground to the desired size previously ascertained by measuring and re-inserted. The first nut /pos. 5/ is then tightened again.
The locking screw of the second nut /pos. 5a/ is loosened and then the second nut /pos. 5a/ tightened to the first nut /pos. 5/ and then locking screw again tightened. The nut /pos. 5a/ is held to prevent its rotation and the nut /pos. 5/ is rotated tight in the reverse direction and made solid with the nut /pos. 5a/ by an impact, whereby both said nuts have been secured against loosening.
It should be noted that adjustment of the bearings and elimination of their play should only be carried out by an experienced specialist.
In addition one of the adjusting nuts /pos. 5a/ is locked against loosening radially by a friction washer tightened by a screw against the spindle tread.

If the machine is duly serviced and operated, the radial play of the front bearing need not be readjusted. If after several years of operation, the play, influencing the surface finish of the handled work, has increased and if the wear of the internal race in the roller bearing has exceeded to 0.01 mm, it is pointless to try to reduce the radial play by further forcing the internal race on to the taper, as such a bearing no longer complies to the required precision and should be replaced. Thrust is taken up by a ball bearing with angle contact /Fig. 11, pos. 7/, mounted next to another ball bearing with angle contact /Fig. 11, pos. 8/ which takes up radial forces in the rear portion of the headstock. As it becomes necessary from time to time to take up the ball bearing which takes up the thrust, another couple of nuts are mounted on the spindle, equally accessible through the opening provided for assembly. The nuts /5 and 5a/ are secured against loosening by a similar procedure as described for the nuts of the front NNK - bearing.
The pre-stressing of the bearing must never be too high /100 - - 150 kg/, as this would cause the bearing to heat up and be damaged. The spindle can be taken out after the bolts which connect the headstock to the bed and the gearbox, have been loosened and after the headstock has been shifted along the bed through a distance which provides acces to the claw clutch /Fig. 11, pos. 10/ with the corresponding split distance ring /Fig. 11, pos. 9/, in order to enable them to be taken out. After the rear adjusting nuts have been loosened, the spindle is pushed 4 mm backward, which enables the split ring, against which the rear bearing bears, to be taken out, and dismantling of the entire headstock to be effected.

3. The thread-cutting gearbox /Fig. 1, pos. 10/

The thread-cutting gearbox is attached to the bed as a selfcontained assembly. At the front it is protected by a cover which houses three levers for selection of threads and feeds. Its design is universal for both metric and inch threads. Both module and DP threads are cut by the second set of change-gears. The design incorporating a Norton-type lever has been substituted by a system of two shafts in an enclosed box, with engagement of feed rates and threads by means of a rocker arm mechanism.

By a lever Fitted on top of the thread-cutting box /Fig. 13, pos. 1; Fig. 4, pos. 7/ metric or inch threads are selected. Feed rates and thread pitches are selected by a lever /Fig. 13, pos. 3; Fig. 4, pos. 8/ together with a directional lever /Fig. 13, pos. 3; Fig. 4, pos. 9/ according to a plate attached to the upper wall of the box. Another lever /Fig. 13, pos. 4; Fig. 4, pos. 10/ serves to transmit the drive either to the leadscrew or to the feed rod. The third position of this lever indicates cutting of Whitworth thread 19 t.p.i. In order to protect the transmissions between the spindle and the leadscrew from being damaged during the thread-cutting operation /by striking of the carriage against the tailstock or another fixed obstacle/, the leadscrew is provided with a shear pin /Fig. 13, pos. 5/. If the maximum admissible feeding force is exceeded, the shear pin is parted, whereby the connection between the leadscrew and the thread-cutting gearbox is interrupted. The torn shear pin must be replaced. It becomes readily accessible when, after the elastic lock pin /Fig. 13, pos. 7/ has been released, the ring /Fig. 13, pos. 8/ is pushed aside. During turning operation, with a feed taken from the feed rod the transmissions are protected against overload by a stripping device installed in the apron.

4. The Apron /Fig. 1, pos. 14/

The apron is a totally enclosed box traversing the carriage and saddles mechanically. The longitudinal feed by hand is obtained by turning the handwheel /Fig. 14, pos. 1; Fig. 4, pos. 22/ which is provided with a graduated collar/Fig. 14, pos. 2/ with minimum readings of feed in 0.1 mm, for machines arranged in the inch system in 0.005"; the graduated collar can be released by means of the nut /Fig. 14, pos. 3/, rotated at will and tightened again in position. The longitudinal feed to the apron is produced by the generating movement of a pinion /Fig. 14, pos. 4/ along a rack. For power feed, the hexagonal feed rod /Fig. 14, pos. 5; Fig. 4, pos. 11/ driven from the thread-cutting box, carries a slidably mounted worm /Fig. 14, pos. 6/ which, through a worm gear /Fig. 14, pos. 7/ and a tripping mechanism, drives the pinion /Fig. 14, pos. 4/. The feed motion tripping system is controlled by a directional lever /Fig. 4, pos. 12; Fig. 14, pos. 8/. It returns automatically to its neutral position in the case of overload.

By shifting the lever to the right or to the left, the longitudinal feed corresponding to the direction of lever shifting, is engaged. By shifting the lever upwards a transverse feed movement towards the workpiece is engaged, by shifting the lever downwards a transverse feed movement away from the workpiece is engaged, the direction, to which the lever has been shifted, thus corresponding symbolically to the direction of feed.
With the normal direction of spindle rotation, i. e. in an anticlockwise direction when viewed from the tailstock, the lever /Fig. 4, pos. 4/ must be shifted to the left, with the reversed sense of rotation it must be shifted to the right, in order to make the rod turn always in an anticlockwise direction when viewed from the tailstock side. In the case of the carriage striking against a fixed stop, or in the case of exceeding the permissible limit of component of the cutting force, the feed is disengaged, the directional lever returning to its neutral position. To disengage the feeds in the case of overload, gear transmissions /Fig. 14, pos. 9/ are used, the tooth correction of which is arranged so as to make the circumferential forces push the clutch gear /Fig. 14, pos. 10/ out of mesh. The arresting springs /Fig. 14, pos. 11/ which limit the maximum force of disengagement are set to a correct value as indicated in the Machine Specification, point 4. The hand-operated lever on the front side of the apron /Fig. 4, pos. 13; Fig. 14, pos. 12/ engages and disengages the nut /Fig. 14, pos. 16/ of the leadscrew /Fig. 4, pos. 14/. The apron also carries a lever for controlling the multidisc clutch of the gearbox /Fig. 4, pos. 1/. This lever is secured against involuntary shifting and the lever is arranged for automatic locktailstock. On request, the lever can be arranged for automatic locking in its neutral position. It is impossible to engage the feed simultaneously with the leadscrew nut. The two levers /Fig. 4, pos. 12, 13/ are interlocked. On the left hand wall of the apron there is the oil filling orifice with a plug and seal /Fig. 14, pos. 20/.

5. Carriage and Saddles /Fig. 1, pos. 11/

The saddles are designed for universal equipment. They can be fitted with a swivelling four-way toolpost, a plate-shaped or American tool holder for one tool. The slide /Fig. 15, pos. 1/ moves on the prismatic guideways of the bed. The clearance in the slide

ways is adjusted by a wedge-shaped gib strip /Fig. 15, pos. 2/. The carriage can be locked to the guideways by means of screws /Fig. 15, pos. 3/. In the transverse direction, the carriage can be moved either by power feed controlled by a directional lever /Fig. 4, pos. 12/ or by a handwheel /Fig. 15, pos. 4, Fig. 4, pos. 2/ provided with a graduated collar /Fig. 15, pos. 5/. This graduated collar can be released with the corresponding nut /Fig. 15, pos. 6/, turned at will and locked again. On the cross slide /Fig. 15, pos. 7/ rests the swivel slide /top slide, Fig. 15, pos. 8/, which in turn carries the toolpost /Fig. 15, pos. 9/. The top slide can be swivelled after loosening the 4 nuts /Fig. 15, pos. 10/. Precise positioning is effected with the aid of a scale. The longitudinal feed is produced by actuating the handwheel /Fig. 15, pos. 11; Fig. 4, pos. 24/ fitted with a graduated collar /Fig. 15, pos. 12/ with readings equal to half the amount of the cross feed. The clearance in the guideways of the swivelling top slide as well as that in the guides of the cross slide is set by means of wedge-shaped gib strips /Fig. 15, pos. 13-14/.
Covers for guideways are delivered for the special request only. /Fig. 15, pos. 15/. The top surfaces of the carriage slide are provided with treads for attaching a follow rest, a support for the coolant supply and illumination of the machine /Fig. 1, pos. 12/.

6. The Tailstock /Fig. 1, pos. 13/

The tailstock is of special patented rigid design and its shape is in perfect harmony with the machine as a whole. It slides on the interior prismatic guideways of the machine. The tailstock is locked to the bed by means of an eccentric with the aid of a lever on the rear side of the tailstock. The distance from the bed can be set from the bottom of the tailstock. By means of screws the tailstock is firmly locked to the bed. The centre sleeve of the tailstock is provided with a scale showing the distance of pull-out; it is moved lengthwise by the handwheel /Fig. 4, pos. 17/ through a screw. By a lever /Fig. 4, pos. 18/ the tailstock sleeve can be locked in any position. The front end of the tailstock sleeve can take a centre /Fig. 4, pos. 19/ with Morse No. 5 taper. It is driven out by pulling the tailstock sleeve inwards until the centre strikes against the end of the screw, or by means of a wedge. For steep taper turning, the tailstock can be deflected from the longi-

tudinal axis of the bed. First screws /Fig. 4, pos. 20/ are loosened, whereupon the screw /Fig. 4, pos. 21/ is rotated by means of a wrench until the desired deflection is obtained and then the screws /Fig. 4, pos. 20/ are retightened.

7. The Bed /Fig. 1, pos. 1/

The bed of the machine is designed to possess a high degree of rigidity. The carriage and tailstock prismatic guideways possess the guaranteed hardness complying with the acceptance conditions laid down for machine tools, After gap outaking from the bed there is possible to machine parts of bigger diameters. A smooth flow of chips is enabled by openings slanting toward the rear through which the chips pass into the chip tray /Fig. 1, pos. 3/ which rests in slats and can be easily pulled out /see Fig. 1, pos. 4/ between the front /Fig. 1, pos. 5/ and the rear /Fig. 1, pos. 6/ stands. The coolant drips from the tray into the coolant tank /Fig. 1, pos. 7/ which is situated on the floor under the chip tray.

8. Cooling attachment

The cooling equipment consists of a centrifugal pump, coolant tank /Fig. 1, pos. 7/, and outlet pipe /pos. 16/. The coolant is pumped by the centrifugal pump and force-delivered through the armoured flexible hose to the outlet nozzle. The rest for the outlet pipe is fixed on the machine carriage and provided with a cock, as well as a ball-joint arrangement allowing the direction of the coolant flow to be set. The rest serves also for carrying the lighting unit /pos. 17/. The used coolant flows through a sieve back into the tank, situated on the floor, below the chip pan.

XIII. TEST RUN OF THE MACHINE

1. Prior to starting the machine, this operational instructions should be read carefully and with due attention so that the opera-

tor could be informed about all the machine elements. Next, all the blank surfaces which are protected by an anticorrosive coat, must be cleaned with benzene. Special care should be paid to the guideways of the bed and slides in order to remove all impurities and dust. After a thorough cleaning all the guideways must be well lubricated with oil. As the machine is dispatched without an oil filling, all the oil tanks must first be filled and lubrication applied to the individual lubricators according to the lubrication chart /Fig. 5/.

2. The correct function of all the control levers and operating elements of the machine must be checked, the travel of the slides and carriage by hand testing, whereupon the spindle is checked for smooth and easy running.

3. Only then can the machine be started and kept running at a low speed for about half an hour. If the direction of spindle rotation is not identical to the direction of the starting lever position /Fig. 4, pos. 1, 1a/, i.e. with the spindle rotating forwards, when the lever is shifted upwards, it is necessary to interchange two of the lead-in cables on the terminal board of the driving motor. Then the thread-cutting gearbox and the apron can be successively engaged. Next the function of power to interchange two of the lead--in cables on the terminal board of the driving motor. Then the thread-cutting gearbox and the apron can be successively engaged. Next the function of power feeds at higher speed is tested. The control levers for engaging speeds and feeds must slide in smoothly and effortlessly. Speed changing while the machine is running is inadmissible. This would damage the gear wheels.

XIV. COPYING ATTACHMENT /Fig. 30/

A copying attachment is delivered as an optional equipment. The type IKS-I is used. As the IKS-I represents a separate unit, its functions, system, operation and other important data are speci-

fied in a separate operational instructions accompanying the copying attachment.

XV. THREAD CUTTING

Thread cutting is, in principle, possible when selecting a feed, that is identical to the pitch of the thread to be cut. The feed movement of the apron for thread cutting is, however, produced by the leadscrew instead of the feed rod. This is achieved by shifting the levers /Fig. 4, pos. 10/ according to the instruction plate attached to the thread-cutting gearbox and by putting the nut into mesh with the leadscrew by means of the lever /Fig. 4, pos. 13/. The desired pitch is selected according to Table 8, 9, by shifting the levers /Fig. 4, pos. 4, 7, 8, 9/ in accordance with the respective letters and figures. Next, it is necessary to change the pick-off gears with due regard to the respective size of machine /SN 40A, 45A, 50A/, types of threads /metric, Whitworth, module and Diametral Pitch/ and with regard to the system of the machine /metric, inch system/ as per Tables 8, 9.
When cutting threads with lever /Fig. 4, pos. 5/ set for the 8:1 ratio, higher spindle speeds cannot be employed according to the values indicated on the plate for normal range /Fig. 6, pos. 1, from 250 r.p.m. upwards/ and for reduced range /Fig. 6, pos. 2, from 125 r.p.m. upwards/. By employing the higher spindle speeds, the 8:1 ratio would be eliminated.
If the threading dial, which is supplied only on request with the machine, is not employed for thread-cutting, the thread-cutting operation can be interrupted by disengaging the leadscrew nut only if the pitch of the thread to be cut is contained without remainder in the leadscrew pitch, e.g. 0.5; 0.75; 1; 1.5; 2; 3; 6 mm. In all other cases it is necessary to return the carriage to its starting position by return traverse. This is effected by shifting the lever /Fig. 4, pos. 1/ into its opposite position. First, however, the tool must be retracted from the work. When setting-up the machine according to the values given in the tables for multi-start threads, an n-times larger pitch should be selected in the table than specified.

Example: A 4 - start module thread for module 2,
2 x 4 = 8

The levers are set according to the tabular value Mod. B, by which the lead for a 4-start thread with a 2 mm module is obtained.

Consequently the actual lead of thread is:

$2 \cdot \pi \cdot 4 = 8 \cdot \pi$, where π = the constant.

For Diametral Pitch threads, unless the actual lead for multi-start thread is indicated, a n-times smaller value taken from the table, should be used.

XVI. NOMOGRAPH OF CUTTING SPEEDS /Fig. 10A/

The chart of cutting speeds indicates the dependence of the machined stock diameter /d - mm/ and the cutting speed /v/m/min./ on the speed /n/min./.

$$v = \frac{\pi \cdot d \cdot n}{1\,000} \qquad n = \frac{1\,000 \cdot v}{\pi \cdot d}$$

Example: Diameter to be machined d = 178 mm.

v = 140 m/min.

$$n = \frac{1000 \cdot 140}{3.14159 \cdot 178} = 250 \text{ r.p.m.}$$

XVII. LUBRICATION OF THE MACHINE

The lubrication of the machine is diagrammatically given in Fig. 5. Any omission of proper lubrication endangers the function and accuracy of the machine. The machine is designed for automatic lubrication of its essential elements. Nevertheless, manual lub-

rication cannot be entirely dispensed with, and thus it is up to the user of the machine to pay every possible attention to manual lubrication of the respective points.
The oil level should be checked continuously and the used oil replaced with a new oil at the prescribed intervals. The oil reservoirs should be filled only up to the middle of the oil gauges. The gearbox and the headstock have a common lubrication system by pressure oil supplied by the gear pump /Fig. 5, pos. 1; Fig. 12, pos. 14/, driven by the clutch shaft of the gear-box. Oil is filled into the gearbox through an inlet in its top wall, closed by a plug with venting holes /Fig. 5, pos. 2, Fig. 12, pos. 16/.
The lower portion of the machine server simultaneously as an oil reservoir. The strainer /Fig. 5, pos. 3/ designed as a slot filter is accommodated in the lower portion of the gearbox and is readily accessible for cleaning. It is necessary during the run of the machine to turn for several times the lever of the filter. The oil is drained after the plug for the oil outlet /Fig. 5, pos. 4, Fig. 12, pos. 17/ has been removed. The oil gauge on the rear wall of the gearbox /Fig. 5, pos. 5/ indicates the height of the oil level, which must reach high enough for gears of the clutch shaft to be dipped in oil and, by splashing, to form an oil mist which serves to lubricate all the elements of the gearbox.
The delivery piping /Fig. 5, pos. 6, Fig, 12, pos. 8/ passes from the gear pump through the gearbox into the headstock to lubricate the front and rear bearings /Fig. 5, pos. 7; Fig. 5, pos. 8/. The front wall of the headstock carries an oil gauge Fig. 5, pos. 9/, for checking the lubrication. The oil which through the bearings into the headstock returns by gravity into the gearbox. On the front wall of the headstock below the plug there is a regulation screw serving to regulate the quantity of oil flowing to the front bearing. The thread-cutting gearbox has its own lubrication circuit. Its body forms an oil tank into which oil is filled through an opening in the upper wall. The filling hole is then closed with a plug /Fig. 5, pos. 10; Fig. 13, pos. 9/. Oil is delivered by a piston pump /Fig. 5, pos. 11/ driven through a cam /Fig. 13, pos. 10/. The pump, which forms one unit with the strainer, is bolted to the bottom wall of the box by 3 screws. By loosening these screws and one connection, the pump can be easily dismantled for the strainer to be cleaned. The delivery piping /Fig. 5, pos. 14/ passes outside to the upper portion of the box through the oil gauge /Fig. 5, pos. 12; Fig. 13, pos. 11/, which checks

the function of the lubrication, whereupon the oil continues through a distribution pipe along the whole length of the box /Fig. 5, pos. 13/. Through holes drilled in the distribution pipe oil flows on to the gears and is also splashed on to the shifters and the bearings. An oil gauge /Fig. 5, pos. 15; Fig. 13, pos. 12/ on the cover serves to check the oil level. The oil draining is effected through the bottom wall of the gearbox, close to the pump /Fig. 5, pos. 16; Fig. 13, pos. 13/.

The apron also has separate pressure lubrication. Pressure oil is supplied by a piston pump /Fig. 5, pos. 17; Fig. 14, pos. 13/ in the way as with the thread-cutting gearbox, driven by a cam /Fig. 14, pos. 14/ through a transmission, from the feed rod. The pump delivers oil only with the feed rod rotating. From the delivery pipe, which serves as an oil distributor, the oil is splashed to the lubrication points. The gears are submerged in the oil which is splashed and creates a kind of a mist lubricating all gliding points of the apron.

The hole with its plug /Fig. 5, pos. 20/ for filling can be found on the left hand side of the apron. The oil gauge /Fig. 5, pos. 21/ for checking the oil level is on the front cover of the apron. The outlet plug /Fig. 5, pos. 22/ is in the bottom of the apron. All the remaining lubrication points are lubricated manually, such as those on the slides, tailstock, etc., are indicated in the lubrication chart /Fig. 5/. The bed guideways are lubricated by an oil can prior to starting work as well as when finishing work, after the machine has been cleaned.

Group of the machine	Points to be lubricated	No. of filling point	No. of draining point	No. of. gauge	Quantity to be filled approx
1. Headstock and gearbox	Bearings, gear transmissions, shifters	2	4	5.9	12 1
2. Thread-cutting gearbox	Gear transmissions, shifters, bearings	10	16	12;15	5,6 1
3. Apron	Gear transmissions, bearings, leadscrew	20	22	21	4.1 1
4. Bed	Guideways	-	-	-	0.21 1
5. Carriage and slides	Guideways, feed screws	-	-	-	0.2 1
6. Tail-stock	Slideway of the tailstock sleeve, pin of lever	-	-	-	0.1 1

Frequency of replacement for 8-hours operation	Kind of oil /brand/ visc. E at 50° C	Mobil Socony Vacuum Oil Co	Shell	B P
1. First after 1 month, next every 6 months	OL-J3 /3.5°E/ ČSN 65 6610	DTE OIL .MEDIUM	Vitrea OIL 27	Energol HP 30
2. - " -	OL-J4 /4.7°E/ ČSN 65 6610	Etna HM /4.6°E/ 50° C/	Vitrea 31 /4.5° E/ 50° C/	BP Energol CS 100 /4.7°E/ 50° C/
3. - " -	- " -	- " -	- " -	- " -
4. Twice a day	OL-P4A /6.5°E/ ČSN 65 6611	Vactra 2 /5.5°E at 50° C/	Tonna 33 /5.5°E/ 50° C/	BP Energol HP 20 -C /5.2° E/ 50° C/
5. Once a day	- " -	- " -	- " -	- " -
6. Once a day	OL-P4A /6.5°E/ ČSN 65 6611	Vactra 4 /12.8°E/ 50°/	Tonna 72 /13.0°E/ 50° C/	BP Energol HP 60 - C /14.5°E/ 50° C/

Method of lubrication:

headstock, gearbox, thread-cutting gearbox and apron - automatically

bed, carriage, slides and tailstock - manually

Remark: The figures given in the chart conform with the figures given in Fig. 5.

XVIII. BEARINGS EMPLOYED

Machine group	Bearing mark and number	Type	Dimensions	Number of pcs in a group
Headstock	7217/P5T		85x150x28	1
	7215/P5T		75x130x25	1
	NN 3016K/ZP52	ČSN 02 4700	80x125x34	1
Gearbox	6007	ČSN 02 4633	35x62x14	2
	6009	ČSN 02 4633	45x75x16	2
	6204	ČSN 02 4636	20x47x14	2
	6205	ČSN 02 4636	25x52x15	1
	6206 C6	ČSN 02 4636	30x62x16	7
	6207 C6	ČSN 02 4636	35x72x17	4
	6208 C6	ČSN 02 4636	40x80x18	1
	6215	ČSN 02 4636	75x130x25	2
	6307	ČSN 02 4637	35x80x21	2
Thread cutting box	6004	ČSN 02 4633	20x42x12	3
	6006	ČSN 02 4633	30x55x13	2
	6008	ČSN 02 4633	40x68x15	5
	6204	ČSN 02 4636	20x47x14	1
	6205	ČSN 02 4636	25x52x15	3
	6206 C6	ČSN 02 4636	30x62x16	1
	51108	ČSN 02 4730	40x60x13	2
Carriage and slides	51103	ČSN 02 4730	17x30x 9	2
	51202	ČSN 02 4731	15x32x12	2
	51204	ČSN 02 4731	20x40x14	1
Tailstock	51205	ČSN 02 4731	25x47x15	1
Apron	6008	ČSN 02 4633	40x68x15	2
	6205	ČSN 02 4636	25x52x15	4
Bed	1205	ČSN 02 4651	25x52x15	1
	1304	ČSN 02 4653	20x52x15	1

XIX. SEALING RINGS EMPLOYED

Machine group	Mark	Czechoslovak standard	Dimensions	Pcs in a group
Headstock	Sealing rings	ČSN 02 9280.2	22x18	1
		ČSN 02 9280.2	30x22	1
Gearbox	Sealing rings	ČSN 02 9280.2	18x14	1
		ČSN 02 9280.2	15x11	2
		ČSN 02 9280.2	22x18	1
		ČSN 02 9280.2	24x20	2
		ČSN 02 9280.2	14x10	2
		ČSN 02 9280.2	12x 8	1
		ČSN 02 9280.2	28x20	1
		ČSN 02 9280.2	25x21	1
		ČSN 02 9280.2	40x32	3
		ČSN 02 9280.2	32x24	2
		ČSN 02 9281.2	65x 3	2
		ČSN 02 9281.2	80x 3	1
		ÚN 02 9401.0	30x40x7	1
		ÚN 02 9401.0	32x45x7	1
		ÚN 02 9401.0	50x72x12	1
		No. 1411/25	18x 4	1
		No. 11517/12	40x 3	1
		No. 11431/12	56x 3	6
		No. 637/6	74.5x3.5	1
		No. 11101/6	70x 3	1
		No. 6104/16	90x 3	1
Carriage	Sealing rings	ÚN 02 9401.0	28x38x 7	1
Thread cutting box	Sealing rings	ČSN 02 9280.2	43x35	1
		ČSN 02 9280.2	38x30	1
		ČSN 02 9280.2	32x24	2
		ÚN 02 9401.0	38x62x12	1
		ÚN 02 9401.0	38x56x12	1

Machine group	Mark	Czechoslovak standard	Dimensions	Pcs in a group
Apron	Sealing rings	ČSN 02 9280.2	36x28	1
		ČSN 02 9280.2	55x45	1
		ČSN 02 9280.2	20x16	1

XX. BELTS EMPLOYED -

Machine group	Sort	Width	Length	Number of pcs. in a set
Gearbox of SN 40B, 45B	Vee belt ČSN 1203/II	13 mm	1400 mm	4
SN 50B	Vee belt ČSN 1203/II	13 mm	1500 mm	4

XXI. LIST OF PARTS SUBJECT TO WEAR

Machine group	Part	Number of pcs in a group	Number stamped on part	Number of position in this manual
Headstock	Union ring	1	4 04 16 1391	Fig. 11/10
Gearbox	External friction plate	14	4 04 52 516	Fig. 12/19
	Internal friction plate	16	4 04 52 517	Fig. 12/20

Machine group	Part	Number of pcs in a group	Number stamped on part	Number of position in this manual
	External friction plate	6	4 04 52 518	Fig. 12/15
	Internal friction plate	5	4 04 52 519	Fig. 12/15
	Sleeve	1	4 04 21 619	Fig. 12/21
	Lever	30	5 04 52 761	Fig. 12/20
	Shifting block	2	5 04 35 649	Fig. 12/23
	Shifting block	1	5 04 35 650	Fig. 12/24
	Piston	1	5 04 15 462	Fig. 14/17
	Spring	1	4 04 51 236	Fig. 14/18
Thread cutting box	Pin	1	5 04 46 1071	Fig. 13/5
	Washer	1	4 04 60 967	Fig. 13/6
Carriage and slides	Leadscrew/metric longit.	1	4 04 38 408	Fig. 15/20
	Leadscrew/inch longit.	1	4 04 38 409	Fig. 15/21
	Nut/metric	1	4 04 38 490	Fig. 15/22
	Nut/ inch	1	4 04 38 491	Fig. 15/23
	Screw/metric transverse	1	3 04 38 410	Fig. 15/16
	Screw/inch transverse	1	3 04 38 411	Fig. 15/17
SN 40A 45A	Nut/metric	1	4 04 38 486	Fig. 15/18
SN 50A	Nut/metric	1	4 04 38 488	Fig. 15/18

Machine group	Part	Number of pcs in a group	Number stamped on part	Number of position in this manual
SN 40A 45A	Nut/inch	1	4 04 38 487	Fig. 15/19
SN 50A	Nut/inch	1	4 04 38 489	Fig. 15/19
Apron	Half-Nut/metric	1	3 04 38 582	Fig. 14/16
	Half-Nut/inch	1	3 04 38 581	Fig. 14/16
	Piston	1	5 04 15 178	Fig.14/17
	Spring	1	4 04 51 557	Fig. 14/18
	Screw	1	4 04 38 465	Fig. 14/19
Bed	The lead screw, when worm out, can be reversed and used again.			

XXII. INSTRUCTIONS FOR ORDERING SPARE PARTS

When ordering spare parts the following data should be specified in order to facilitate carrying out of the order:

a/ Type of the machine /e.g. SN 40B/.
b/ Number stamped on the part or specified in this manual.
c/ Name of the group /e.g. saddle/.
d/ Serial number indicated on the name plate of the machine.
e/ Year of manufacture and dispatch, indicated on the name plate.
f/ An exact specification of the part in question /e.g. nut of the transverse slide/.
g/ Number of spare parts ordered.

XXIII. DESCRIPTION OF SOME OPTIONAL EQUIPMENT AND SPECIAL EXECUTION OF MACHINE

1. The graduated driving-plate /Fig. 16a/

This is employed for cutting multi-start threads. On the plate /pos. 1/ with a carrier /pos. 2/ a scale is engraved according to which the plate can be swivelled through any desired angle. The plate is locked in its set position by tightening the four nuts /pos. 3/, which via bolts /pos. 4/ force a washer against the plate /pos. 5/.

2. The 4-law face plate /Fig. 16b/

This is employed for turning large-diameter parts or those having an irregular shape. The parts to be turned are clamped by the jaws /pos. 1/, which serve for both external and internal gripping and swivel around a pin /pos. 2/. This pin also serves as a nut for the feed screw /pos. 3/, which makes the clamping jaws move towards and away from the centre. Each jaw is secured against falling out by a pad /pos. 4/ and a nut /pos. 5/, which is tightened so as to allow the jaw with its pad to move freely but without clearance along the face plate body /pos. 6/.
The plain face plate /Fig. 16c/ and plates /16a and 16b/ are provided with the corresponding hubs for both a spindle nose with a short taper and a bayonet pad.
With both the plain and 4-jaw face plates there is a top limit to the speeds, i. e.:

SN 40B	-	500 r.p.m.
SN 45B	-	355 r.p.m.
SN 50B	-	250 r.p.m.

3. Pneumatic chucking device /Fig. 17/

This consists of a chuck /pos. 1/ of 200 mm dia for the SN 40A and SN 45A model and of 250 mm dia for the SN 50A model, and of a clamping cylinder /pos. 2/ the piston of which is connected

through a rod with the transmission mechanism of the chuck. A flange /pos. 3/ locked by a nut is slid on to the rear spindle end to catch the cylinder. The controls consist of a control box /pos. 4/, compressed air supply /pos. 5/, piping to the air cylinder through a safety cylinder /pos. 6/, drain piping /pos. 7/ and 24 V power supply for signalling /pos. 8/.
The control box /pos. 4/ consists of a control lever /pos. 9/, pressure govenor /pos. 10/, pressure gauge /pos. 11/, lubrication regulator /pos. 12/, regulator /pos. 13/, signalling pressure drop below minimum of 4 kp/cm^2 /57 P.S.I./, and filling plug /pos. 15/. When the pressure drops below the preset value, it is indicated by the signal lamp /pos. 14/. An air filter is located inside the box. The box must be mounted vertically as shown. The power supply to the indicator lamp - a cable L4S 2x1 mm^2 /pos. 18/ is connected to terminal board D2, terminals No. 18 and 19.

4. Hand-operated collet chuck /Fig. 18/.

Collet chucking can be employed for a spindle nose provided with a flange and a short taper. The whole assembly is attached to the front spindle nose, like a chuck. It consists of the body itself /pos. 1/ containing three pinions /pos. 2/ with a hole for the spanner. The pinions are rotated by a threaded bevel gear /pos. 3/. As the gear is locked axially, its rotary movement makes the collet sleeve /pos. 4/ to move by means of the said thread. This sleeve pulls the collet /pos. 5/ onwards into the taper of the sleeve /pos. 1/, which causes the collet to close and thus to grip the workpiece. As the whole mechanism is selflocking, it cannot release the work before the gear has been rotated back by means of a wrench. The collet can be tightened and loosened only with the machine at a standstill.
Lubricator /pos. 6/ serves for lubricating the moving parts, the lubricant being supplied from a manual gun. For a higher constant accuracy of work it is recommended always to use the same pinion for clamping /it can be marked with colour paint/.

5. Top slide with an American toolpost /Fig. 19A/

This is supplied, if desired by the customer, with a special tool slide. Maximum tool section 32x20 mm.

6. Top slide with a plate-shaped toolpost /Fig. 19B/

This is supplied, if requested by the customer, with a special tool slide. Maximum tool section 32x25 mm.

7. Rear toolpost /Fig. 19C/

Turning with several tools is enabled by a rear toolpost /pos. 1/ attached to the cross slide by means of four screws /pos. 2/ slided in T-slots. The main body /pos. 1/ also carries T-slots containing blocks /pos. 3/ with screwed-in bolts /pos. 4/, which, in turn, fix one-sided /pos. 5/ or two-sided /pos. 6/ tool-holders. Maximum tool section 32x20 mm.

8. Vertically adjustable carriage /Fig. 20/

This carriage is used for clamping workpieces in which grooves, splines or plane surfaces running in various directions are to be bored or milled with a tool fixed in the spindle. After the top swivel slide has been removed, the vertically adjustable carriage is fitted in the rear T-slots of the cross slide by screws, T-shaped nuts /pos. 1/ and two screws M12x30. /When this carriage is ordered additionally, two threads M12 must be tapped in the cross slide/. Caution - when taking off this carriage. These two screws are covered and thus cannot be seen easily. The vertically adjustable carriage consists of a base plate /pos. 2/, a bracket /pos. 3/, which swivels round a spigot /pos. 4/ of the base plate and, finally, of the carriage proper /pos. 5/ which is pivoted on the bracket /pos. 6/. The clamping surface of the carriage is provided with T-slots as well with a prismatic slot for clamping round bars. As equipment an auxiliary angle iron /pos. 7/ is supplied with a clamping surface perpendicular to the surface of the carriage. The carriage is vertically adjusted by means of screw with a square and a graduated ring /pos. 9/, actuated by a crank /pos. 8/. After the carriage has been positioned, it is locked by a lever /pos. 10/. The swivelling arrangement of the carriage in vertical plane and that of the bracket in the horizontal plane make this attachment universally adaptable for a wide range of different operations. The maximum vertical traverse is 170 mm.

9. Boring table /Fig. 21/

This is employed for clamping workpieces which are to be bored by means of a tool clamped in the spindle. After the cross slide has been removed, the boring table /pos. 1/ together with a new nut /pos. 2/ for transverse travel of the table, controlled by the handwheel of the cross slide, is mounted. The clamping surface of the table measuring 350x590 mm is provided with T-slots. Maximum traverse of the table is 290 mm. Maximum clamping height from spindle centreline to the table:

SN 40B - 104 mm
SN 45B - 129 mm
SN 50B - 129 mm

10. Bar for taper turning /Fig. 23/

This is an important supplement to an universal lathe for precision taper turning up to 320 mm in lenght and 30° apex to either side. To the rear wall of the slide there is attached the main body /pos. 1/, inside which there is mounted a holder /pos. 2/, adjustable along the machine axis and connected by means of a pull rod /pos. 3/ to the bracket /pos. 4/. The bracket is adjustable along the bed. The pull rod /pos. 3/ is locked in the bracket by adjusting nuts pos. 5.
The extended screw of the cross slide /pos. 7/ pivots in the body /pos. 8/ and slides along the guideways /pos. 9/. The body /pos. 8/ is connected by means of a pin pos. 10 to the sliding block /pos. 11/, which in turn can be adjusted along the gib piece /pos. 12/ fitted with an adjusting wedge /pos. 13/. The latter gib piece can be swivelled through 15° to either side.
For coarse setting of conicity, a scale for angular positioning /pos. 14/ serves; fine setting is effected by means of gauge bloks. The gib is then locked in position by means of screws /pos. 15/. After the pull rod /pos. 3/ in the bracket /pos. 4/ has been loosened, the previously set transverse movement of the carriage is discontinued, whereupon cylindrical turning is possible. For precision of tapers, high quality tools should be employed, as a worn tool tip causes dimensional departures from the desired shape of the workpiece.

11. Hydraulic copying attachment /Fig. 30/

This attachment serves for rear or face copyturning using a template or a master. It is a selfcontained unit consisting of a hydraulic pump and a motor /pos. 1/, a copying slide /pos. 2/ and a template /or a master/ holder /pos. 3/. When the copying attachment is supplied for both rear and face copying, it is necessary to change the stylus /pos. 4/ for a shorter one, the template holder and an intermediate plate when face copying. In this case, it is possible to use a flat template.
The whole copying slide is mounted on the cross slide with the aid of an intermediate plate /pos. 5/ the height of which is with the

SN 40B	-	43 mm
SN 45B	-	68 mm
SN 50B	-	69 mm

A detailed description, including operational instructions, are contained in a separate service manual supplied with the machine.

12. Threading dial /Fig. 25/

This is employed to advantage mainly for cutting long threads, where substantial time economy is achieved as it not necessary to reverse the machine run in order to bring the carriage to its starting position. The leadscrew nut is disengaged after one cutting pass has been completed and the carriage is brought to its starting position by means of the handwheel.
The threading dial is fitted with change gears with 20 and 21 teeth for metric and 16 and 24 teeth for inch screws. There are also interchangeable dials /Fig. 25, pos. 236-237-238/. By setting the individual drums and gears the complex calculation of divisions is eliminated, which is necessary where one universal drum is available. By means of a leadscrew with a metric lead of thread only metric threads can be cut with the threading dial. In the same way, only threads with an inch lead can be cut when a leadscrew with an inch thread is employed.
The threading dial can be put out of mesh with the leadscrew when the nut M 12 /Fig. 25/ has been loosened and the gear swung out of mesh.

Before starting work with the dial the respective gear must be put into mesh with the leadscrew and firmly tightened by the nut. 326. After both the bearings /Fig. 25, pos. 945/, have been thoroughly lubricated, the interchangeable dial is put in position, whereupon the upper nut /Fig. 25, pos. 326/, is tightened. If the setting has been effected according to the tabular values corresponding to the thread to be cut, the leadscrew nut is then engaged by the lever /Fig. 4, pos. 13/, on each division.

For metric threads the following applies:

1. Dial B is divided into 20 and 10 divisions - the respective gear A engaging with leadscrew has 20 teeth
2. Dial divided into 5 and 4 divisions - dtto
3. Dial B divided into 7 and 3 divisions - the respective gear A has 21 teeth.

The first figure on the dial indicates the maximum lead of the thread, the second indicating the number of divisions into which the dial is divided.
In the following table, column A indicates the teeth numbers of the gear which, during thread cutting, engages with the leadscrew, column B indicates the dial suitable for the maximum lead of thread as well as the number of divisions of the dial and column C indicates the lead of threads which enable the nut to be engaged on each division of the respective dial.
The indication 6/n, etc., means that the highest value represents a multiple of the next leads.

A	B	C						
20	6-20	6	3	2	1.5	1	0,75	6n
		0.5						
20	12-10	12	6	4	3	2	1	
		0.75	0.5					12n
20	24-5	24	12	8	6	4	3	2
		1.5	1	0.75		0.5		25n

A	B	C							
20	30-4	30	15	10	6	5	1	3	
		2.5	2	1.5		0.75	0.5		30n
21	18-7	18	9	6		4.5	3		
		2	1.5	1		0.75	0.5		18n
21	42-3	3	2	1		0.75	1.5		
		1.75	0.5	6		3.5	7		42n
		14							

The table has been compiled on the following principle: It is a common rule to calculate on which division of the dial the nut can be engaged.

1. Example: Lead of the thread to be cut 12 mm, pitch of the leadscrew 6 mm.
For metric threads there is a relation:

$$\frac{\text{pitch of the thread to be cut}}{\text{pitch of the leadscrew}} = \frac{12}{6} = 2 \text{ leadscrew revolutions,}$$

i.e per 2 leadscrew revolutions, the carriage advances through 12 mm and the gear rotates by 2 teeth. As in this particular case /see the second line of the table/ a 20 teeth gear has been inserted and it is desired to engage on each division of the dial, a 10--stroke division should be employed, i. e. on each second gear tooth, which means also on each second leadscrew revolution. All other threads with lower values of leads are contained in 12 and the nut can consequently be engaged also on each of the said 10 divisions /strokes/.

2. Exemple: $\frac{\text{pitch of the thread to be cut 7 mm}}{\text{pitch of the leadscrew 6 mm}} = 1\frac{1}{6}$ of

leadscrew revolution per 7 mm of carriage travel. Converted into whole revolution values of the leadscrew, this means that per 7 revolutions of the leadscrew, the carriage advances through 7x6 mm. In order to be able to engage again each of the dial divisions, a 21-teeth gear should be inserted, as this is a multiple of

7 and a dial divided into 3 divisions. From one division to next, 7 revolutions of the leadscrew are necessary. The same procedure must be followed for values of thread leads which are not contained in the above table; when necessary, an additional gear can be made or, after each cutting pass, the corresponding number of divisions should be added on the dial, one division of which corresponds to one leadscrew revolution.
For inch threads and leadscrew with inch leads it should, similarly as with metric threads, be found on which division of the threading dial the nut can be engaged prior to the next cutting pass.
In the case we are concerned in, the leadscrew lead is 1/4", which means 4 threads per 1", and the gear which engages the leadscrew and rotates the dial has 24 teeth.
If the number of threads of the screw to be cut can be divided by 4 without a remainder then the leadscrew nut can be engaged in any position of the chasing dial, B, e.g. 4, 8, 12, 16, 20, 24, 28, 32, 36, 40 threads per 1 inch, etc. If the number of threads of the screw to be cut is not a multiple of 4, but still en even number, the leadscrew nut can be engaged on each of the 12 chasing dial divisions, or on each second of 24 divisions, e.g. 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, threads per 1 inch, etc.
If the number of threads of the screw to be cut is an odd number, the leadscrew nut can be engaged on each fourth of 24 divisions, or on each division of a dial divided into 6 divisions, e.g. 1, 3, 5, 7, 9, 11, 13, 15 threads per 1 inch, etc.
If the number of threads of the screw to be cut is expressed in halves, e.g. 2 1/2, 3 1/2, 4 1/2 threads per inch, the leadscrew nut can be engaged on each eight of the 16 divisions, or on each division of a dial divided into 2 divisions, while the gear has 16 teeth.
In order to enable the nut to be engaged without calculation on any division /Stroke/, the double-sided dials are interchangeable.
If the number of threads of the screw to be cut is expressed in quarters, e.g. 1 1/4, 1 3/4, 2 1/4, 2 3/4 threads per I. inch, the nut can be engaged on each sixteenth of the 16 divisions, or after one whole revolution of a dial with only one division while the gear has 16 teeth..

For inch threads the following applies:
1. Dial B is divided into 24 and 12 divisions, the corresponding gear A has 24 teeth.

2. Dial B is divided into 2 and 1 division, the corresponding gear A has 16 teeth.

3. Dial B is divided into 6 divisions, the corresponding gear A has 24 teeth.

In the following table, the column A indicates the numbers of teeth of the gear which engages with the leadscrew while the thread is being cut and the column B indicates the respective numbers of divisions of the dial.

n - indicates the divisibility of the number of threads per i inch.

A	B	C							
24	24	4	8	12	16	20	24	28	4n
			32	40	44	48	56	80	
24	12		2	6	10	14	18	22	2n
24	6		1	3	5	7	11	19	2n ± 1
16	2		1 1/2		2 1/2	3 1/2		4 1/2	
			5 1/2					n 1/2	
16	1		2 1/2		4 1/4	1 3/4		2 3/4	3/4

13. Longitudinal stop drum /Fig. 26 /

The stop attachment serves for precision longitunal turning of stepped parts with the aid of a fixed stop. The attachment consists of a threaded multi-spline shaft /pos. 1/, a bearing /pos. 2/, a stop bearing /pos. 3/ which is adjustable and locked in position by a tooth clamp /pos. 4/, adjustable stops /pos. 5/, adjustable set-screws /pos. 7/ and finally a stopplate /pos. 6/. The stops are secured against axial displacement by being inserted in the thread of the spline shaft and tightened, together with set--screws, by a screw /pos. 8/ with packing piece.
If you need turning long piece accurately, in that case we recomend to you handmooving of carriage to drum stops. With that method you prevent springing of longitudinal stop drum.

14. Indexing attachment to the spindle /Fig. 27/

When the indexing attachment is used, the speed-change gears controlled by the lever 3 /Fig. 4/ must be out of mesh with the spindle. This indexing attachment is used for various kinds of milling work, where the pitches are to be spaced to high precision limits. It consists of a chuck, the circumference of which carries a worm gear /pos. 1/ which engages with a worm /pos. 2/ mounted on body proper /pos. 3/, which in turn is locked to the bed by means of an adapter /pos. 4/ with 2 screws. The transmission ratio between the worm and the wheel is 1:40. The worm can be disengaged after the 4 screws /pos. 5/ have been loosened and brought back into engagement with the aid of a cam /pos. 10/ and thus backlash can be eliminated to a minimum in order to obtain the highest possible precision of indexing. The worm is keyed on a shaft which carries on its nose a simple indexing arrangement /Fig. 27, pos. 6/. With each mechanism two double-sided indexing plates are supplied, to enable indexing within 2 - 100 divisions, according to the table Fig. 24. In order to lock the spindle against involuntary rotation, the hand lever of the indexing attachment /Fig. 27, pos. 8/ is fitted with an arresting device pos. 9. The indexing plates are provided with the following numbers of precisely spaced holes on the respective circules:

1st plate	37 - 53 - 59 - 77 - 81 - 83 - 93
	39 - 47 - 57 - 63 - 73 - 87 - 96
2nd plate	41 - 45 - 49 - 59 - 61 - 89 - 97
	43 - 51 - 67 - 71 - 79 - 91 - 99

In column A of Table 24 the desired number of divisions is found into which the toothed or catch disc, pin or spline shaft is to be divided, e.g. 28 teeth.
In column B is found the respective circle with spacing holes 49 - 63 - 77 - 91, whereupon the handle with catch is slid into the circle selected.
The values in the C column indicate how many times the crank /handle/ should be turned for one indexing, in this case:

$1\frac{21}{49} - 1\frac{27}{63} - 1\frac{33}{77}$ or $1\frac{39}{91}$ with an identical result.

These several values enable in some cases the same division to be made on the same side of the indexing plate without having to turn it. The whole number indicates the full number of revolutions of the crank, the fraction indicating the number of divisions 21 on the circle 49. The range of these 21 divisions is set between the two arms of the indicator, the position of which is then locked by a round nut. The calculation proceeds as follows:

The ratio of the worm transmission being $\frac{40}{1}$, the number of crank revolutions for 28 divisions has to be found:

$\frac{40}{28} - 1\frac{21}{49}$, etc. = 1 complete revolution and 21 additional divisions on the circle 49. By enlarging this fraction the said further possible values are obtained.

The column D indicates the position according to the scale on circular surface of the indicator. In order to prevent errors in the calculation of divisions and the resulting distance between the indicator arms, the scale on its face has 200 divisions /of which 170 divisions are usually marked/. In the given case it amounts to 86 divisions of the total 200, when calculating as follows: the 49th part of the whole circle of 200 divisions is $\frac{200}{49}$ and, as the number of divisions on the indicator has to be 21, the number of divisions on the indicator will be $\frac{200 \times 21}{49} = 85.7$.

The nearest whole number is 86 which checks the correctly spaced arms of the indicator.

15. Toolpost Grinder for external and internal grinding /Fig. 28/

The grinder can be used for face, cylindrical and internal grinding, according to the grinding wheel selected. It consists of a support /pos. 1/ to the front portion of which there is attached a grinding wheel spindle /pos. 2/, arranged for micrometric adjustment. This attachment enables an infeed of the spindle by 1/100 mm.

A flange-mounted sleeve /pos. 3/ with fixed grinding wheel is fitted to the tapered spindle nose and locked by a screw. Chattering of the grinding wheel can be compensated by inserting of an ad-

justable weight. The spindle runs in ball bearings and is driven from a foot-mounted electric motor situated on the support /pos. 1/, by a flat belt. The belt is tightened by moving the electric motor. The grinding wheel is dressed with the aid of arbor /pos. 4/ fitted in the tailstock sleeve and supported by the centre in the spindle. The diamond holder /pos. 5/ is inserted into the arbor.

16. Central Lubrication of Carriage and Slides

The lubrication of the main parts of the carriage is effected automatically, by rotary motion of the feed rod. The oil is drawn in from the oil tank in the apron by the piston pump and delivered through a pressure pipe to hand-operated distributor. By turning the distributor dial to the individual positions, all the main parts of the carriage can be lubricated. All points having been lubricated, the dial has to be set to its zero position, whereby the central lubrication is put out of operation. The lubricated points are diagrammatically given on the lubrication plate, fixed at the front of the apron. The lubrication of the apron is described in chapter XVII - machine lubrication.

17. Spline /keyway/ and gear milling attachment /Fig. 29/

It consists of a main body /pos. 1/ which is pivoted on the cross slide instead of the upper swivelling slide, the other components being a gearbox /pos. 2/, a head /pos. 3/ and an electric motor /pos. 4/. The head, together with the gearbox, are vertically adjustable by a handwheel /pos. 5/ provided with graduated collar /pos. 6/. The gearbox is driven by a V-belt from an electric motor 0.37 kW at 2 800 r.p.m. with a two-step pulley /pos. 7/.
A triple sliding gear /pos. 8/, controlled by a hand lever /pos. 9/, allows to select 6 spindle speeds from 56 to 560 r.p.m. The spindle /pos. 10/ is driven through a bevel gearing /pos. 11, 12/ around which it can turn, together with the head, through 360°. It has an interior Morse No. 3 taper and runs at the front in an adjustable taper roller bearing and at the rear in a radial bearing. A thrust bearing takes up the thrust. The rear of the spindle carries an indexing mechanism with 2-100 division indexing range, see table Fig. 24. The indexing mechanism is used for milling

when the tool is clamped in the lathe spindle, the workpiece being in turn clamped in the spindle of the attachment. The indexing mechanism indexes the spindle by means of a worm gearing with a 1:40 transmission ratio. The worm gear is locked to the spindle by tightening two screws M8 /pos. 13/.
For other kinds of operations, where the spindle rotates, the indexing mechanism is put out of operation by loosening the said screws. The whole indexing mechanism can be swivelled round the spindle and clamped in the desired position by a screw /pos. 14/. By tightening a hand crank /pos. 15/ on the head body the spindle is locked against the body.
The application of the indexing mechanism according to Table 24 is described in detail in the chapter 14 Indexing Attachment to the Spindle.

Notice:

If some defect accures during the guarantee period, customer is responsible to reclain the machine with exact description of damaged parts along with the number of machine. Checking department of TOS Trenčín will find out the right way how to remove the defect. In this case customer cannot dismount the machine.