

**EMSIL TECHTRANS Ltd.
ORADEA**

Horizontal Boring and Milling Machine with RAM type 2xAFP-200

Technical Book

-Mechanical part-

- 2007 -

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FOREWORD

The technical book is a guide available for those interested in order to make known the construction, the exploitation and rational maintenance of the machine.

*The productive unit guarantees the well function of the machine during the warranty period mentioned in the delivery contract. **The warranty granted by the producer is valid provided the beneficiary respects the rules established for transportation, setting on foundation, setting in function, maintenance and exploitation of the machine.***

This obligation of the constructive unit ends if there are made any unauthorized by the producer interventions during the warranty period.

At the beneficiary's solicitation for certain details regarding the machine construction and functioning there will be made references to the notes used in the technical book

The present Technical Book is an integrating part of the machine, according to current valid Norm

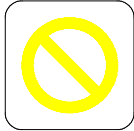
EMSIL TECHTRANS Ltd. declines any responsibility for possible inadvertences in the technical book due to editing or printing errors.

The machine executants' reserves the right to make modifications in comparison with the construction details mentioned in the technical book, in order to improve the quality of the product.

The information contained in this book is submitted to modifications without previous notice.

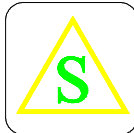
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THE SEMNIFICATION OF THE SYMBOL USED IN THIS BOOK



Delay signal

Identifies the working methods or the operations that are forbidden, because it is possible for the operator to be in danger.



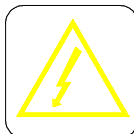
Safety operation signal

Identifies all the necessary procedures taken to prevent staff injuring.



Warning signal

Identifies working methods, which must be thoroughly followed in order to avoid possible machine devices and tools deterioration.



Electrical part warning signal

Identifies the procedures that have to be followed or avoided in order to assure the safety of electrical operating staff.

1.MACHINE GENERAL INFORMATION

1.1.Identification dates

1.1.1.Machine identification

Model: 2XAFP 200
Type: AFP200
Machine series: E001220
Modernization year: 2006

1.1.2.Machine producer dates

Name: S.C. EMSIL TECHTRANS S.R.L.
Adress: Nr.8/B Fabricilor St. Oradea
Zip code 410125 Romania
Telephone: 0040/259-422221;
Fax: 0040/259-413756;

1.2.Intervention request instructions. Spare parts

The machine producer, S.C.EMSIL TECHTRANS S.R.L., both, assures technical assistance and spare parts for warranty period and the entire normal utilization of the machine.

In the intervention request the following items will be necessarily mentioned:

- machine model**
- machine series**
- the type of the encountered problems**
- whether the machine is or isn't in warranty period.**

In the spare parts request the following items will be necessarily mentioned:

- machine model**
- machine series**
- solicited spare parts**
- whether the machine is or isn't in warranty period.**

If the intervention, respective spare parts are no longer in warranty they will be charged for.
Warranty is defined in 1.4.

1.3.Compliance declaration

PRODUCER

EMSIL TECHTRANS Ltd.

Address: 8/B FABRICILOR St.

Code: 410125 City. ORADEA Country: ROMÂNIA

Tel.: (040-259)422221 Fax: (040-259)413756

REPREZENTATIVE

Name: _____

Address: _____

Code: _____ City: _____ Country: _____

Telephone: _____ Fax: _____

Product Type _____

Serial number _____ Fabrication year _____

S.C. EMSIL TECHTRANS S.R.L. declares that this product corresponds to the safety and quality requests, to the technical specifications in present agreement and annexes.

Date: _____

General manager
ing. MINZAT SILVIU

1.4.Warranties.

The providing enterprise guarantees the machine well function for 12 months from setting in function, but no more than 18 months from delivery, with respect conditions presented in utilization instruction from this machine-book.

The machine warranty period also refers to the eventual machine accessories. The warranty consists of the defects remedy and eventual replacing the damaged parts, in case the damage appeared during normal maintenance and exploitation conditions, due to same hidden construction or materials vices.

The providing enterprise guarantees the machine execution precision degree only if the machine didn't get knocked or suffered deterioration during transportation and machine handling by the beneficiary, and if it is set on a foundation executed in conformity with the indications in this machine book.

The machine warranty is cancelled in the following situations:

- machine wrong handling;
- machine improper utilization for its destination;
- the omission of the machine safety devices;
- violation of the instructions and warning mentioned in the utilization manual;
- insufficient maintenance;
- machine modifications made by the user;
- disassembling the machine subassemblies or their elements in order to make adjustments or repairs without the producer approval;
- violation of general health and safety norms .

1.5. Usage domain

The RAM horizontal boring and milling machine type **2xAFP 200** is addressed to cogging down and chipping finishing processing the casting and welded (high weight and gauge) pieces with complex technological process, through milling, boring, drilling, etc. operations and are characterized by a high processing degree and a high quality of the processed surface.

Some of the pieces that can be processed with this machine are:

- casting pieces type cases and pieces specific to machine construction industry, automobile and tractor industry etc.;
- big dimensions welded pieces;
- casting or forged pieces with big dimensions and complex surfaces that necessities interpolation processing etc;

The chosen options for principal moves and feed allow a large range of speed and continuous adjustable feed that determine some advantage in economic machine exploration.

Usage of intensive metal removal and tools with ceramic inserts is possible by reason of high rigidity of machine and great power at principal electric motors.

The precision of processed pieces is assured by:

- in front side with 2+1 angular- contact ball bearings by high precision .
- in back sides with a cylindrical rollers bearing with conic annular bore and on the other side by the guide and compensation system of the tailstock and headstock .

Principal commands of machine are concentrated on desk command emplace on operator mobile cab.

1.6. Machine description and way of running (drawing 1.6/a, b, c)

The horizontal boring milling machine with Ram type **2xAFP 200** is built from 2 machines AFP 200 horizontal boring milling, installed on the same bed whereon are moving in tandem.

Regarding that the two machines are moving on the same part of the bed, for avoid the collision beetwen them is provoding un disposition for interlock with cams and limitswitches who not admities the closeness of 2 machines under a limit distance, then when are in the same space of work.

Each of two machines (pl.1.6/a, b, c) have in component the mobil bed laid-down on the column sledge who is moving on the machine's bed. The headstock is set in the cantilever on the right side of the bed and it moves vertically on its guides.

The bed is constructed in a modular structure form by 5 frames of machine sections. Each part is a casting ribbed piece with diagonal ribs. The part attachment it's made with double ended threaded bolts and the alignment between them with cylindrical fitting pin disposed in 2 planes.

The guides' faces are protected with plane telescopic guard, witch assures protection to the bed and to the resulted oil from the hydrostatic lubrication too.

The column sledge is maded by welded construction by steel, hard ribbest, assured piece a high rigidity.

The sledge moving on the bed is accomplished by pinion double-gear rack mechanism. On higher side of sledge is stiff mounted the bed with alignment screws and dowel pin. Also, on the slegde is mounted the hydraulic group for balancing of headstock.

The column is maked by cast construction, with doubles walls, hard ribbest, resulting the best characteristics holding at efforts and vibrations.

Beetwen the two lateral guides is emplaced the ball screw for moving on vertical of headstock. The screw bearings are fixed on the column with help of screws, gads and pins.

On the front part of the column is rigide emplaced the measuring rod and in the back side are placed the cams, the portcable for Y axis.

The headstock contains next main subassembly:

- the headstock case;
- The ram with boring shaft and tool unlock mechanism;
- the intermediary shaft;
- the speed gearbox
- the main shaft drive;
- the W -axis feed mechanism;
- the Z- axis feed mechanism;
- The w-axis measure.

The rotative speed of milling shaft involve the boring shaft is received from a main spindle motor through a speed gearbox and an intermediary shaft. The speed gearbox can achieve the desired rotative speed at main shaft (at tool) starting from the motor rotative speed range. The intermediary shaft transmit the rotation between the outgoing shaft of the speed gearbox and milling shaft.

To move the ram on horizontal direction is used the W-axis feed mechanism, and to move on same direction the boring shaft is used the Z-axis feed mechanism.

The W-axis feed measure is made with a linear encoder and on the Z axis with a rotative encoder, the motor encoder.

The mobile cab of the operator is emplaced in front of the headstoke and can move on vertical direction independently of headstoke move. also it can move on horizontal direction to the piece to be processed.

Inside of the mobile cab is emplaced the command desk of the machine.

For transversal moving of the column X-axis, it is utilized the feed mechanism of double pinion and rack without clearance and for other movement (for axis Y, Z, W), is used a screwball actioned by some ALPHA servomotor, FANUC type.

The construction form of the bed, column and headstock case offers the machine a high rigidity that allows processis needing an intense chipping regime and finishing processes.

The machine can be equipped with fixed or rotative tables function of beneficiary options.

The machine function is electric commanded by a numerical command equipment .

1.7. Technical and constructive features

A) Base machine:

1.	<u>AFP 200 1</u> Boring spindle: - clamping shank cone - pull stud - boring shaft diameter - milling shaft diameter - speed range - spindle drive - Z1 axis (boring shaft stroke) - Z1 axis feed mechanism	ISO 50 mm mm rot/min kW mm	(DIN 69871) (DIN 69872) 203.2 334,5 1-1500 100 1100 servomotor –30 Nm/4000 rpm PG 200 reduction gear i = 1:5
2.	The headstock: - Y1 axis (headstock vertical stroke) - Y1 axis feed - équilibrage	mm	4000 servomotor – 50 Nm/3000 rpm PG 500 reduction gear i = 1:7 with hydraulic cylinder
3.	The ram: - Dimensions - W1 axis - W1 axis feed mechanism	mm x mm mm	530x600 900 servomotor – 30Nm/4000rpm PG 200 reduction gear i = 1:5
4.	The column: - X1 axis (column movement) - X axis feed mechanism	mm	12.800 servomotor – 40 Nm/4000 rpm reduction gearbox i = i:191.57
5.	<u>AFP 200 2</u> Boring spindle: - clamping shank cone - pull stud - boring shaft diameter - milling shaft diameter - speed range - spindle drive - Z2 axis (boring shaft stroke) - Z2 axis feed mechanism	ISO 50 mm mm rot/min kW mm	(DIN 69871) (DIN 69872) 203.2 334,5 1-1500 100 1100 servomotor –30 Nm/4000 rpm PG 200 reduction gear i = 1:5
6.	The headstock: - Y2 axis (headstock vertical stroke) - Y2 axis feed - équilibrage	mm	5000 servomotor – 50 Nm/3000 rpm PG 500 reduction gear i = 1:7 with hydraulic cylinder
7.	The ram: - Dimensions - W2 axis - W2 axis feed mechanism	mm x mm mm	530x600 900 servomotor – 30Nm/4000rpm PG 200 reduction gear i = 1:5

8.	The column: - X2 axis (column movement) - X axis feed mechanism	mm	12.800 servomotor – 40 Nm/4000 rpm reduction gearbox $i = i:191.57$
9.	Machine table: - 3+3 fixed table - maximum loading - T channel:	mm x mm kg nr x mm	2000x6000 10.000/m ² 8x42
10.	Rotative table 2000x2500/2500 -table surface -positions indexing table -maximum loading -T channel -distance between channels -U1 axis (stroke table) -B1 axis (table rotation) -action table: -U1 axis (translation) -B1 axis (rotation)	1 pc. mmxmm kg nr x mm mm mm (°)	2000x2500 continuous/ 360° 30.000- uniform distributed on table 11x28 160 2500 360 servomotor-50Nm/3000 rpm reduction with belt $i=1:2.25$ servomotor-50Nm/3000 rpm mechanical reduction and pinion- toothed wheel. $i=1:861.9979$
11.	Rotative table 3000x3000/2500 -table surface -positions indexing table -maximum loading -T channel -distance between channels -U1 axis (stroke table) -B1 axis (table rotation) -action table: -U2 axis (translation) -B2 axis (rotation)	1 pc mmxmm kg nr x mm mm mm (°)	3000x3000 continuous/ 360° 60.000- uniform distributed on table 12x28 250 2500 360 servomotor-50Nm/3000 rpm reduction with belt $i=1:2.25$ servomotor-50Nm/3000 rpm mechanical reduction and pinion- toothed wheel. $i=1:861.9979$
12.	Axis feed: - X 1,X2 axis; - Y1,Y2 axis - Z1,Z2 axis ; - W1,W2 axis ; - U1,U2 axis ; - B1,B2 axis	mm/min mm/min mm/min mm/min mm/min grade/min	0 – 8000 0 – 8000 0 – 8000 0 – 6000 0- 4000 0 - 400
13.	Loading gauge dimensions : - length - width - height - weight (without MRD)	mm mm mm kgf	26.000 5.000 10.000 242.000

B) Accessories:

1.	The milling head: - cone milling shaft - pull stud - power - manual rotating in X-Y plane - manual rotating at 45 degree incline plane at 45° - milling spindle rotative speed - maximum rotative speed accepted - weight	Kw (°) (°) rot/min rot/min kg	ISO 50 DIN 69871 DIN 69872 40 ±180 ±180 10-1500 (narrow by machine) 2000 300
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1.8. Noise level



Sonorous intensity

Sonorous intensity measurements relative to that send out by the machine were made with a sonometer. The tests confirmed an 80 dB sonorous intensity. So at the witness test, the machine has a reduced acoustic pollution.

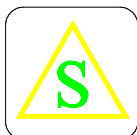
In case the sonorous intensity gets over 85 dB due to processing, personal ways protection will be used for the operator as stipulated in the norms which refer to this thing.

2.GENERAL SECURITY AND PROTECTION MEASURES

All the instructions and warnings related to protection and safety from this chapter as well as those related to the way of operating have a general character. For more detailed instructions and warnings, see all the chapters of this book, where these are exposed more concretely and detailed, have to be consulted.

The horizontal boring and milling machine was designed and built in conformity with safety norms in vigour.

2.1 General security warnings.

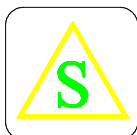


The machine **can be a risk source** if it is used:

- in an incorrect way;
- without respecting the warnings and indications stipulated in this book;
- by an unqualified staff or unspecialised maintenance staff.

Possible dangers:

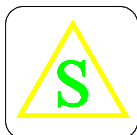
Body or life threatening;
Danger for the machine and for equipment integrity;
Running machine danger;
Only the instructed and right full staff must use the machine.



If repairs or maintenances have to be made and the security devices removed, always check first that the energy sources are coupled out of power.

In this purpose, must deactivate:

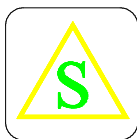
- the electric installation by pressing the shut down button on CNC and by turning the main switch on the electric box;
- the hydraulic installation with its accumulator discharge valve;
- other installations (if any) with the suitable commands, in conformity with specific instructions for the attached installation.



All the interruption and electrical discharge devices must be protected during the operations so that it wouldn't be possible to activate them accidental or by unauthorized staff.

At the end of the work it is extremely important to reassemble the safety devices .

2.2. Machine transport instructions



The machine pulling-up and transportation must be made only with the equipment crane or charging gantry crane and using the means (ropes, cables etc.) and ways specified in 3.1. present manual.

Other systems that can compromise the operators' safety are strictly forbidden. The operators who transport and move the machine must be authorized for this kind of operations.

2.3. Setup instructions



The machine-processed parts have been protected against atmospheric agents through suitable treatments. Before machine level-ling and setting in function it is necessary to remove the protective layer by using solvents like improved gasoline or **tri-chlorine-ethane**. Avoid chloride and the **di-chlorine-methan** because of their toxicity.

The machine-positioning place must have foundation characteristics and empty spaces as mentioned and described in the specific paragraphs, which refer to the foundation.

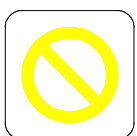
The machine must be installed horizontal, with a bench level set on the machine table and guides. It is important for a correct functioning of the machine ,protection against indirect contacts, so connect corectly the machine to the electrical network.

The electrical connection will be made in conformity with the specific instructions, stipulated in the electrical part of the technical book.

The machine user must accomplish and check that machine ground connection is appropriate to the specifical norms.

After the connection, manufacture the user must check if the engines direction of rotation respects the directions displayed of rotation respects the directions displayed on the plates or if the rotation isn't bi-directional.

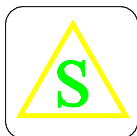
2.4. Machine modification interdictions.



Any machine modification made by the user or/and the maintenance person is forbidden for security reasons.

EMSIL TECHTRANS Ltd., declines any responsibility in case of unauthorized modifications.

2.5. Security test.



After the first set in function of the machine and then at 500 hours intervals, each safety and emergency device functioning and emergency check-up must be made. The parts that need to be checked up are:

- the safety at projection interlock;
- the end of stroke interlock;
- the projections, doors integrity etc.;
- emergency button functioning.

2.6. Protection measures against presumptive risks.



Risks due to processing.

Take all user personal safety measures when the processing sends:

- toxic smoke;
- noise over the allowed limit (80 dB);
- for dry processing of materials like: graphite, cast iron, high magnesium content alloys and others stipulated in accidents prevention dispositions.

In order to limit the smoke and powder take care of tools grinding.

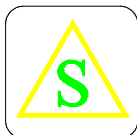
In order to avoid overheating in working area remove quickly the chips.

In this purpose use an adequate smoke and powder aspirating system.



Fire risks.

The machine functioning and use destination does not present a fire risk. Some special processing may cause such a risk and that's why it is adequate to have a suitable extinguisher near the working area and machine users must be instructed for such a risk.



Explosion risks

The machine functioning and use destination does not present an explosion risk.

3. MACHINE SET UP

3.1. Transportation (drawing 3.1/a, b, c)

The machine is transported from the purveyor to the beneficiary in a container proper to transport conditions and duration.

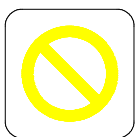
The purveyor contrives the necessary transport container, so that the machine will get to the beneficiary in proper conditions.

At the beneficiary, after unpacking, the next rules must be taken into account:



The transport is made with the help of a crane or a gantry crane from the equipment respecting the following:

- before beginning the machine transportation it must be checked if the crane transportation capacity is sufficient in order to lift the machine.
- the crane hook must have a safety seal;
- cables suitable to the load which has to be lifted, cables that do not have flaws and have the suitable length;
- the sensitive parts of the machine will be protected by wood pieces and in order to avoid the machine paint deterioration pieces of cotton will be used where necessary ;
- the machine must have in a perfect horizontal line in order to avoid its overturning at the crane start or stop;
- the bars for the chine transport must be made of steel (not cast iron) and must have minimum 100 mm in diameter;
- it must be checked if the bars are long enough, so the cables won't drop it during transportation;
- will be use especial devices for transport the components who require this thing.



The staffs that achieve the operation must be specialized or the purveyor declines his responsibility.

The maximum weight of the machine is given in 1.7., Technical and constructive features.

It is recommended for the machine to be lifted by the crane in conformity with drawings: 3.1/a, b, c.

3.2. Unpacking and cleaning

After the beneficiary receives the machine, it will be unpacked and checked if there were no averages during transportation.

It must be also checked if in the container there are all the pieces mentioned on the inventory.

If there are any averages after transportation, the society that made the transport and the purveyor society must be announced.

For the protection of the exterior unpainted parts as well as for the unprotected guides, it would be applied through spraying a vaseline film, at the construction society. This vaseline will be wiped off

and the machine will be cleaned next. For cleaning, it mustn't be used wire brasher, metallic blades or other objects or materials, which can damage the protected surfaces.

3.3. Machine foundation and setting up

3.3.1. Foundation

The machine's foundation is the existing one.

The machine is installing on the foundation whom is functioning before modernization.

3.3.2. Machine assembling on the foundation .

It is recommended that the machine set up on the foundation to be made by the purveyor. In case that the beneficiary wants to set up the machine on the foundation himself it is better to address the purveyor for instructions.

3.4.Machine horizontal adjustment

In order to adjust the machine horizontality these have to be followed: it will be worked on the adjustment device(crimping pliers under bed) until the guides bed horizontality is obtained in the two directions: longitudinal and transversal, at the mentioned accuracy values. After that, with the help of the lock nut the adjustment, bushing will be blocked and the foundation screws nuts will be tighten.

Note: After 2 months from the machine, setting in function its horizontality will be checked and adjustment will be made, if necessary.

3.5.Empty spaces for a proper running



Before positioning the machine it is important for empty spaces to be left around it in order to be possible to use it convenient and to be able to maintain it in security conditions.

For this purpose, the length must be at least 800 mm, plus maximum dimensions of the machine internal movements (protectors, carriage, crane etc.).

For the 2xAPF 200 machine necessary space it's delimited by the existent ground in the foundation, which must be secured by o protection balustrade, with one access way at the lateral side only when the machine is stoped.

Around the tables, assure necessary space for manipulation and transportations of the pieces.

3.6. Control and inspection condition

Machine performances parameters and necessary precision test for a good function will be made according to conditions from machine original technical book.

The probe piece will be make according machine's original technical book and the semiproduc(material) will be assured by beneficiary.

3.7. Machine delivery

Machine delivery will be making after a complete check of all requested parameters (geometrical, positioning accuracy, repeatability and backlash retrace) and after execution of probe pieces. With one consent between the parts, the probe pieces can be replaced with others. Can't be solicited unilateral measurements or another probes pieces that can't be found in present standards or not agree at it by both sides.

4. MACHINE CONSTRUCTION DESCRIPTION

4.1. The bed

The bed is a caste construction, strongly ribbed, realized as a caisson construction with ribs on diagonal, giving the piece a high rigidity. The bed sustains in the superior part the weight of the sledge column-column-headstock assembly.

The bed has on superior side 3 hydrostatic plane guides on which the sledges bed is sliding. The lateral guiding is realised with high capacity follower rolls. The guides closing is made with closing plaques on what are mounted some follower rolls.

The guiding surface of the bed are superficially hardened in hydrostatic guiding zone and plated with hardened in mass plaques in follower rolls guiding zone.

The elements of bed assembling are constructed in modular system to realise different stroke is used parts of 4 or 5 meters.

To obtain the total length of 24 000 mm the bed is composed from 4 parts of 5 m and one of 4 m.

In space between the front and the middle guide are emplaced the cog racks meshing with pinions of the reduction gearbox fixed on sledge assuring the column sledge feed on bed. On lateral-back side of bed is emplaced the measuring rod of axis and stroke limiters and the port cable chain guided by a support fixed on bed.

The bed is protected by 3 telescopic guards , from what two telescopic guards fixed at the ends of the bed and at the column sledges and the thirth one is positionend between the two columns sledge, the end of it being fixed on the sledge.

4.2. The column sledge

The column sledge is a steel caste construction strongly ribbed, giving the piece a high rigidity.

The horizontal guides on the bed are plated with bronze plaques with required surface for hydrostatic guide (the boxes), closed by plaques with roller tappets mounted on it. The lateral lead guide is realised with follower rolls mounted in projected boxes in the sledge.

The sledge movement on the bed is made by double pinion -cog rack mechanism.

On superior side of sledge is strong fixed the column with screw and dowel pin. On the sledge is also fixed the hydraulic group of headstock equilibration.

On back part of the column sledge is fixed a platform for easy access to the electrical cabinet and

a ladder for access on the platform.

From the right end of the sledge and in the back side of it is fixed a platform for access to mobile machine cab. On this platform is fixed the down end of the column ladder.

4.3. The column

The column is realised from two distinguish part which are then assembled. The column is a caste construction with double walls strongly ribbed fact that assures it a optimal resistance and vibration characteristic. On column is fixed the column guideway that is also a cast iron composition. The guides surface are superficially hardened in hydrostatic guiding zone and plated with hardened in all mass plaque, in the cam roller follower-guiding zone.

Between the lateral guides is the screwball used for the headstock vertical feed. The screw bearing are fixed on the column through screws and dowels.

On the front side of the column, there are emplacement the measuring rod and in the backside, there are the fingerstalls and cable chain for Y-axis.

On upper side of the column is fixed the headstock hydraulic equilibration-sustaining platform from which is fixed the equilibration cylinder inside of column.

This platform contains the equilibration system rollers. The ladder is attached of the platform assuring the access in the column or on the operator mobile cab.

4.4. The headstock (drawing 4.4.)

The headstock is one of the machine most important machine subassembly and contains next subassembly:

- the headstock case;
- The RAM with boring shaft and tool unlock mechanism;
- The intermediary shaft
- The gearbox ;
- the main drive;
- The W-axis feed mechanism;
- The Z-axis feed mechanism
- The measurement rod for W-axis;

The headstock case is built from more cases casted or welded, with a structure that can assure good resistance characteristics at efforts and vibrations.

The rotation of the milling shaft includes also rotation of boring shaft is received from the main drive motor through a gear box and an intermediary shaft.

The speed gear box helps us to obtain the desired rotative speed at the cutting tool starting from the motor rotation domain. The intermediary shaft assures the movement transmission between the outgoing shaft from the gear box and milling shaft.

To move the ram on horizontal direction is used the W-axis feed mechanism, and to move the boring shaft on same direction we have the Z-axis feed mechanism.

The measure of displacement on W-axis is made with a linear measuring rod and on Z-axis is made with the motor encoder.

On the case there are also fixed the closing guides in two planes and the cradle feet on screw nut ball for Y-axis.

The clearance between the headstock and vertical beam is adjustable with two conical gads and fine-tune screws.

4.5. The transmission gearbox (drawing 4.5/a, b, c, d, e)

The transmission gearbox is emplaced inside the headstock case and is driven through a intermediary ROTEX couple by a servomotor ALPHA Spindle type with continuous variation of rotative speed, with the same characteristics:

- Nominal **power** 100 kw
- Revolution **domain**:
 - low rotation stage:
 - 1-1000 rpm – at constant couple; 955Nm maximum torque
 - 1000 -3000 rpm – at constant power;
 - high rotation stage:
 - 1-2000 rpm – at constant torque; 477 Nm – maximum torque
 - 2000-4000 rpm – at constant power;

The gearbox has 3 rotating ranges, realised with two sliding actioned.

The gearbox is represented in drawing 4.5/a in a developed section. From this drawing can be identified the gear wheels, the bearing used for bearings and sealing elements.

In drawing 4.5/b is represented the hydraulic cylinder for actioning the slide.

The hydraulic cylinder 1 has 3 position and action on the slide 1 that also has 3 positions.

The hydraulic cylinder 2 has 2 position and action on the slide 2 that also has 2 positions.

The rotation speed obtained are next:

The domain	Condition	Revolution (rpm)		Mobil gear movement	
		the main shaft	the motor shaft	Left sliding	Right sliding
I	a	$1 \div 65.4$	$15.3 \div 1000$	Right	Left
	b	$65.4 \div 196$	$1000 \div 3000$		
II	b	$196 \div 614$	$957.3 \div 3000$	Right	Right
III	b	$614 \div 1500$	$984.5 \div 2405$	Middle	Right

a – the revolution adjustment at constant moment (for motor shaft < 1000);

b – the revolution adjustment at constant power (for motor shaft > 1000);

In drawing 4.5/c is presented the kinematical scheme of rotation speed transmission from the motor till the main shaft.

In drawing 4.5/d is presented the rotative speed diagram.

In drawing 4.5/e is presented the power and moment diagram at the boring spindle when motor is used in continuous regime (S1) zone domain.

4.6. The Ram (drawing 4.6; 4.8/a)

The Ram with rectangular section is mounted in the headstock and moves longitudinally from this in the W-axis direction. In the ram is cradle fitted the milling shaft and the boring spindle mounted inside it, that rotate in same time with milling shaft and move on longitudinal way with the RAM and even in addition of it on Z-axis direction. The feed of the ram move also the boring shaft due to fact that is cradle fitted in the ram extension. Due to that fact moving the Z and W axis is cumulating.

The ram is leaded by hydrostatic guides in the headstock in vertical and horizontal plane, having the guiding surface superficially hardened and grinders. The ram feed is assured with W-axis feed mechanism through a screw ball, the nut box being rigid fixed on inferior side of the ram.

The milling spindle is cradle fitted with 2+1 bearings in front part by two radial axial ball bearings of high precision and backside by a cylindrical roller bearing with annular bore conical.

Main movement is absorbed from the last tubular arbour of the gearbox, by milling spindle through two helical spur gears. The milling spindle is cradle fitted in the ram and feed once with it. On the last splined arbour on the gear box, is sliding axial with the ram and transmit the movement from the gearbox to milling arbour, the gear wheel from the first gear pair moves. Been cradled in the ram milling

arbour advance once with it.

The warmth produced in twins conic bearings is eliminating trough the oil that lubricate the bearings that circulate near the exterior surface of the bearings. The oil that luibricate and cooled the bearings is refresh by a oil thermostatic cooling installation.

Milling spindle trough four bronze gadsrotates the boring spindle guided on two bronze-bushed bearing inside the milling spindle.

At posterior side the boring spindle is guided in a support by duad bearings with conical rollers (drawing4.8/a) that has also a heat exchanger connected to oil thermostatic cooling installation.

The oil thermostatic cooling installation assure the cooler of principal shaft bearings and all mechanisms from the headstock

Trough inside of the boring spindle is realised the tools clamping or releasing with the releasing tool device. (Drawing 4.8/a)

4.7. The intermediary shaft (drawing 4.7)

The intermediary shaft assure the connection between the outgoing shaft of speedbox and milling shaft.

4.8. The tool clamping device (drawing 4.8/a, b, c)

For clamping and fixing tool in boring spindle cone, machine is equipped with an automatic tool clamping device nippers-retention knob type, DIN 69872 , mechanical realized with a helical spring. Tool releasing is hydraulic with a hydraulic cylinder put behind the headstock case and a core bar system emplaces inside of the boring spindle.

The clamping force of tool is 2200-2500 daN.

The clamping cylinder is presented in detail in drawing 4.8/b.

The indexing system of main shaft is also part of this assembly and is detailed presented in drawing 4.8/c.

4.9. Feed mechanisms

4.9.1. The bed feed mechanism-(X axis)(drawing 4.9.1)

The X-axis feed mechanism is emplaced on the column sledge and is composed from:

- servomotor alpha 40/4000 rpm;
- differential reduction gear box with gear wheel $i=1:191.57$;
- pinion and rack assemble;

The rotation move from alpha servomotor is transmitted through the differential reduction gear to the duad helical teeth pinions engaged with the cog rack fixed on bed and transform the rotation in translation move of sledge on the bed and the column implicit along of bed.

4.9.2. The headstock feed mechanism- (Y axis)(drawing 4.9.2)

The headstock feed mechanism is placed superior side of the bed.

Its components are:

- servomotor alpha 50/3000 rpm, with brake;
- plannetary reducer box PG500 (ZF) $i=1:7$;
- ball screw $\phi 125$ mm with pitch 20 mm;

The headstock movement is realized on combined guides: the main guide is a hydrostatic guide and lateral guiding and closing is realised by a cam follower guide.

The feed mechanism is transmitted at headstock trough the ball screw mechanism that transforms the rotation in translation moving the headstock on the column. The ball screw is placed between the column guide ways being fixed axial at both sides and the screw nut is fixed in headstock case.

4.9.3. The ram feed mechanism- (W axis) (drawing 4.9.3)

The ram feed mechanism is placed on the inferior face of the headstock and its components are:

- Servomotor alpha 30/4000 rpm;
- plannetary reducer box PG200 (ZF) $i=1:5$;
- Ball screw $\phi 80$ mm with pitch 10 mm;

The ram movement is realized on hydrostatic guides on vertical and horizontal planes,

having the guiding surface superficial hardened and grinded.

The feed is transmitted to ram with a screwball-nut mechanism that transforms the rotation from motor in translation moving of the ram inside the headstock case. The screwball is emplaced near the ram inside the case being axially fixed at both sides and the nut is attached to the headstock case.

4.9.4. The boring spindle feed mechanism- Z axis (drawing 4.9.4)

The boring spindle feed mechanism is placed in the back face of the headstock and is composed by:

- servomotor alpha 30/4000 rpm;
- planetary reducer box PG200 (ZF) $i=1:5$;
- ball screw $\phi 80$ mm with pitch 10 mm;

The boring spindle movement in the ram is realized through sliding on two bronze-bushed bearing inside the milling spindle. At posterior side the boring spindle is cradle fitted in a support by twin conical rollers bearings and the support is guided with help of the roller way on the existent guides in back face of the case.

The feed is transmitted to boring spindle from motor through screw-nut ball mechanism that transform the rotation in linear feed inside of milling spindle from ram. The screwball is emplaced in backside of case being fixed axially at both sides and the nut is fixed in the support in which is cradle fitted the end of boring spindle.

The boring spindle feed mechanism with the boring spindle is moving with ram when the ram is moving, that means that the strokes on the W and Z axis will cumulate.

4.10. Headstock equilibration (drawing 4.10)

The weight equilibration of the headstock assembly is hydraulically made, with the help of one hydraulic cylinder (1) emplaced inside of column. The link between the hydraulic cylinder and headstock case is made with two sprays each with 3 cables, each cable connects the headstock case at one end and the column sledge at the other through a support attached at the end of the core bar of equilibration cylinder, at level from the platform on the column and of core bar that connects the level to column sledge. In addition at front spray, between the connecting core bar and column sledge exist a hydraulic cylinder (2) that can pretension better the front spray to compensate the ram falls. The pressure modification is made with a proportional valve commanded from NC.

The cables are guided in superior part of the column with two rollers fixed in platform on column

and inside of column are guided through two rollers mounted on the fixed support at the end of core bar of equilibration cylinder. The cable has a prescribed working time of 18 months in secured conditions, after this period it must be verified. If it doesn't correspond with security norm (have the tendency to smash off at the headstock end, or destroyed wire), it must be replaced.

4.11. Motion limitations

The stopping of the mobile elements at the end of the stroke on each of the four axes X, Y, Z, W is made by the actuation of the micro-switches set on these elements.

At each stroke end is assembled a cam prop, with one or two cams. At the two cam ends, the inferior realise the reference function and the other the average function. At the one cam end this realise the average function.

4.12. Handle milling head (drawing 4.12)

The handle milling head could be added to the machine, by fixing it by a flange, on the squared ram.

The milling head can be oriented spatially through two-plane rotation, first parallel with XY (A) and the other declined at 45 degree (B). The rotating of the head on two planes is manually realized and controlled by gradation existent in the two rings. The capture of tool in cone of milling shaft is mechanic realized, with disk spring pack (10), and release of tool is hydraulic made with hydraulic piston (11), through the pressure bearing type axial ball bearing (12), code 51106, comprehension the disk spring pack (10).

After the head clamping, the Z and W axes could only be actuated in a synchrony way. The main motion is got from the brooch and it is transmitted to the main shaft through next kinematical circuit: in broche cone is captured the fluted carrier plate and rotate the bevel gear pair (1). Through axle (2) and the bevel gear pair (3), the rotary movement is sent to main shaft (4).

Each axis is cradled axial and radial cause of bevel gear pair (1) and (3):

- Incoming axis of the head has a cradle fed by two radial-axial ball bearing (5), code 7018;
- Acclivity axis has two cradle feet, one axial-radial form by two radial-axial ball bearings (6), code 7213B, and cradle feet by radial bearing ball (7), code 6008-z.
- Out coming axis (main shaft), has two radial-axial cradle feet, first from 3 radial-axial ball bearing (8), code 7020 B; and the back cradle have 2 radial-axial ball bearing (9), code 7014C.

The value of rotating angle of rotate in two planes for desired acclivity is presented in annex 1.

4.13. Systems of shifting measurement

For the move measurements on X, Y, W axis is used HEIDENHAIN linear encoders type LB382C-for X and Y-axis and type LC192F for W-axis. For the Z-axis, measurement is used the existent measure at the driving motor at the Z-axis feed.

4.14. The machine guides

The headstock guidance on the column is assured by main hydrostatical guides and by lateral guides leading with rollers elements.

The ram guiding in the headstock is hydrostatical realised in horizontal and vertical plane, the ram has the guiding surfaces superficially hardened and grinded.

The main guides of the bed and of column are superficially hardened and the counter-guides are plate with hardened superficially and grinding plaque steel.

On the counter guides at the column and bed is rolling the guiding elements with roller mounted on the closing plaques of the headstock respective of the column-sledge.

The box for hydrostatic guides are plate with bronze plaque mounted on the sledge and on the headstock and inside of headstock for ram guiding.

4.15. The tool cooling installation

The tool cooling installation is made to obtain a better durability of the chipping tools by cooling and to make easier the eliminating of the chips from the working zone.

The eliminating of the chips and the chipping process heat is getting to a better productivity and quality.

The cooling unit is composed of a gear pump, assembled on the cooling liquid's tank. The gear pump is delivering the cooling liquid through a flexible pipe which comes out from the tank, goes through the port cables support from the X, Y, Z axis and by a pipe fixed at the headstock and through a flexible pipe arrives to the tool. Between the pipe and the flexible pipe there is a tap.

The liquid, which cooled the tool, falls on the machines table, and through the tables grooves

and the discharge spouts, assembled at the two ends of the table, arrives to the gathering of groove of the foundation, and from here it is getting in the cooling liquid's tank.

The liquid is filtered of impurities through a clipboard assembled for this on the table, and through an air suction also, placed in the tank.

4.16. The command desk (drawing 4.16)

According to the contouring control system equipment and to the beneficiary preferences, it will be assured the accordant CNC box.

The command desk is fixed to its support and it can be rotated around its axis above 180 °, to assure a more comfortable position for the operator according to the treating process, treated piece, etc. In case is necessary the operator presence near work-piece he can give commands from an electronic catch handle attached to command desk.

4.17. The mobile cab (drawing 4.17)

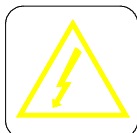
During machine functioning, the operator will be sitting inside of the mobile cab. The mobile cab can independently move on vertical direction, the operator can positionate it in an optimal position for watching the chipping process. Also the operator cab can move on horizontal direction to the processing piece with 700 mm. In front part of the cab is located a sliding door that can be opened only when the chipping process is stopped. In backside of the cab is situated another door for access to the cabine from the ladder or from the platform. On this door is made the evacuation of the cab.

From the mobile cab roof is fixed the CNC support for the machine command.

5. MACHINE CONTROLLING AND RUNNING

5.1. Actuation and utilization directions

a) Before the machine setting in function the next operations are necessary:



- before connecting it to the power network, it must be checked to see if the machine tension and running frequency comply with the tension and frequency from the network;

- after the machine connection at the electrical network it must be checked if the rotation direction of the electrical engines comply with the one indicated on the suspended command panel. If it is necessary the rotation direction of the engines will be switched;

- the checking of the protection cutting-off switches will be made after a detailed examination of the machine book-electrical part. This check up will be repeated at large intervals of time and obligatory after each electrical equipment intervention;



- it will be checked if all the oil basin are filled up to the level barred on the level indicator and some oil will be added if necessary.

- it will be checked the sustantation function (X, Y, W-axis) and existence of lubrication

- accurate function of the micro-switches of the stroke end will be checked;

- it will be checked the noises, vibrations etc. of the machine

After these check-ups the machine can be started up

b) During the machine use the following rules must be respected:



- the medium conditions will be assured coresponding to a good functions of machine (temperature, humidity, dust, smoke, gases);

- it will be assured a cutting conditions adequate to machine;

- the machine will be protected of sunlight and heat sources, and the processing pieces will be stored in the house, before being set on the machine in order to have, as much as possible, the temperature from the house where the machine is placed;

- tools with damaged cone will not be introduced into the main shaft cone;

- the rammer holder cone, the main shaft coned bore must be cleaned before performing the clamping operation;

- the processing pieces will be properly fixed on the machine table in order to avoid shifting and deformation during processing;

- the table will be carefully protected by trying to avoid placing the tools on its surface and measures will be taken in order not to generate shocks that might damage the table surface smoothness;

- the machine exterior parts and especially the ones where the chips reach must be cleaned weekly;

- the functional surfaces, unprotected by telescopic guards, will always be kept clean. Using the machine with damaged guides wipers is not allowed;
- special attention must be given to equilibration chains well-fair and maintenance;
- machine cleaning with compressed air is forbidden;

c) After a long period when the machine wasn't used, the following measures will be taken:

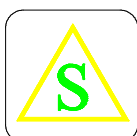


- all the machine parts will be lubricated;
- the state of guides and chief screws cleanliness will be checked;
- the oil level from the lubrication installation and its will function will be checked;
- the machine should run in empty at low speed;
- all the manual and automatic commands will be checked;

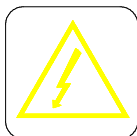
5.2 Work protection instruction



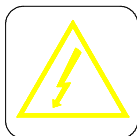
The workmen which will use the machine will receive a detailed training on the machine running way, tools and pieces clamping, commands knowledge and the machine in general. These workers will be trained to know the machine safety rules, which are specific for machines with a mobile column, the use of the machine without this training being forbidden.



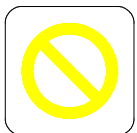
When executing the mounting, using and maintaining of the electrical equipment of the machine the rules regarding the machine specific security technique will be respected. All the boxes of the electrical equipment as well as the machine must be tied to the ground in conformity with the norms.



It is forbidden to use the main switches while the machine is in function.



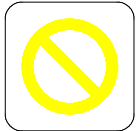
The covers of the electrical equipments **and of the engines will not be removed while the machine is in function.**



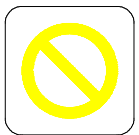
Gasoline must not be used for machine cleaning because burnable vapours might penetrate the electrical installation which might cause explosions and fires.



The pieces to be processed will be fixed on the machine table or on devices using “T” screws and clamps.



It is forbidden to tighten nuts with damaged spanners or by using spanner extensions.



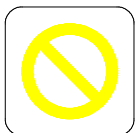
It is forbidden to use welded or damaged screws.



The equilibration system chains of the headstock being wearing pieces will be checked in conformity with the exploitation instructions in order to prevent their tear during running.



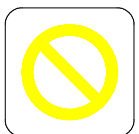
In the machine reception process will be stipulated the machine situation regarding work protection.



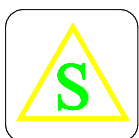
It is forbidden to remove the chips with the hand, or with the help of improvised tools.



A special attention will be given to pieces stacking and their using with the crane.



It is forbidden to use unsharpened tools or having other flaws.



If during processing strong vibration occur the machine must be shut down and measures will be taken to eliminate them.

5.3. Running -in period

The running-in period should be of approx. 250 hours of running. It is recommended that during the running-in tests the machine to be used in two shifts.

During running-in tests evidence will be kept on the processed pieces, on the working regimes used, on the precision obtained with the pieces and on different observations referring to the machine behaviour in this period.

It is recommended that the machine solicitation to be made following the next stages:

First stage

-will contain cca. 70 hours, period during which the working regimes will be chosen so that the absorbed power will not excel 30% of the main actuation motor nominal power;

Second stage

-will contain cca. 100 hours, period during which the working regimes chosen will not excel 60% of the main actuation motor nominal power;

Third stage

-will contain cca. 80 hours, period during which the chosen working regime will not excel 80% of the main actuation motor nominal power;

After finishing the running-in tests the oil from the headstock case must be changed. Then the machine can be used at full power.

5.4. Loading machine chart (drawing 5.4)

In loading machine chart drawing 5.4 can be observed the possibility of loading according the principal kinematic scheme function of headstock position on column and the ram stroke in headstock.

From diagram is obviously that the power at milling spindle is to vary inversely as the strokes of headstock and ram.

5.5. Command elements

5.5.1. Electric box

The electric box is placed in the back side of the machine column, being projected with a general switch for coupling and uncoupling from the 380 V alternative current electric networks.

5.5.2. Desk

The desk contains the keyboard and the screen of the computational command equipment, and is detailed in electrical book

5.6. Machine start up, running and shut down

5.6.1. Machine startup

- the electrical installation from the electrical box will be put under tension;
- the command scheme will be put under tension;
- the machine will be started up using the buttons from the command desk ;

5.6.2. Machine running

The command buttons functioning and normalisation, as well as the actuation order are described in the Machine Book – Electrical Part.

5.6.3. Machine shut down

- stopping the working functions
- stopping the command scheme
- uncoupling from the network

In case of averages during machine running period the machine will be shut down using the mushroom button from the command desk.

In case the machine does not respond to the commands check first the screen for error messages form NC that indicate eventual damages and only then try to fix the problems. If the damages cannot be found require qualify personal for intervention after the installation is no longer under tension.

5.7. Safety devices

The machine has three types of safety devices:

- safety device against overcharging;
- safety device for stroke limitation;
- safety device against incorrect handling;
- safety device when on ram is mounted special accessories;

5.7.1 .Safety device against overcharging

In order to avoid the overflow of the normal couple which solicit the feed mechanisms, the 4 servomotors which actuate the 4 axes, they have projected with sensors which switch off the motor in case of overcharge.

The main motors also have thermic protection in ultra-fast fuses.

Besides these, some protections there are in the varieties power for circuits limitation to the motors, etc.

5.7.2. Safety devices for stroke limitation.

On the machine, there are 4 stroke limiters, one for each moving direction. Their description was made in chapter 4.10.

- interlocking device for X axis for common working space.

Due to the fact that the two machines has a common bed portion where both can move, to avoid the colission between them a safety device was projected with mocroswitches and cams, that doesn't allow the two slide to move to each other under a minimum safe distance necessary when both are in common work space.

5.7.3. Safety devices against incorrect handling.

In the electrical scheme there are stipulated some safety interlocks that do not allow any incorrect handling or any simultaneous moving commands that could lead to accidents. Their purpose is to protect the user and the machine.

There are stipulated some interlocks:

- the feed on any axis, in conventional regim, forbidden the feed on any other axis;
- the main motor will not rotate unless the mobile gear position is confirmed, at its end of stroke;
- all the safety device switches must be confirmed to be able to start the machine
- other interlocks are described in electrical machine book.

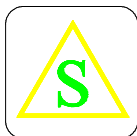
5.7.4. Safety devices when on ram is mounted special accessories

5.7.4.1. The milling head mounted on ram

The safety device is made from a micro-switches that in case of machine functioning without accessories is pushed by a cover that overlap the frontal surface of ram hindering the milling head mounting before remove this cover. When the milling head is mounted the cover will be take off from the ram releasing the micro-switches that denies boring spindle feed in ram. From this moment the ram feed is made only together with boring spindle feed with the same speed feed to eliminate any relative movement between its.

6. THE MACHINE MAINTENANCE

6.1. Security rules and norms



Around the machine must be enough space for intervention and periodical maintenance works.

The floor around the machine must be clean and non slippery.

For any specific repair interventions Emsil Techtrans Ltd. should be contacted.

For maintenance operation in high positions use tools like: ladder, helmets, safety ropes, etc.

Use a mobile lamp for interventions inside the machine and in the areas without light- in case there is not enough light.

Place on 0 the main switch before any intervention at the electrical part.

6.2. General maintenance

For general maintenance you must make:

- periodical revisions and check-ups;
- accidental repairs;
- current repairs;
- medium repairs;
- overhaul repairs;

The repairs schedule, the intervals between repairs will be made by the beneficiary in conformity with the norms in operation.

During warranty period the purveyor unit, Emsil Techtrans Ltd. will make the accidental repairs.

In case of stagnation due to the purveyor, warranty terms prolongation can be made on common agreement.

The periodical revisions and check-ups should be made respecting. The maintenance instructions on each assembly, system, installation or equipment.

6.3. Periodical check-up

During the first months of running, the oil used for lubrication will deteriorate faster due to initial wear of the pieces, and also due to pieces and head case interior washing etc, that's why you must not forget check-up carefully to make first oil replacement after 15-30 days.

During the first 6 months of running must be checked that there aren't any oil leaks at pipes connections at tightening etc., in case of need the hydraulic joints, O-rings, cups etc. will be tightened or changed.

If there is any damage each piece from the damaged assembly will be checked studying the causes that generated this damage.

The entire sites filters screen from wire net can fill with impurities. Replace and clean it. A special attention must be accorded to the oil that enters in servo-valve from ram and boring spindle compensation circuit.

During the sixth mounts period replacement or wash of the filtrate cartridge is made in same time with oil.

Also before each oils replacement must open all the seeing cover of tanks that will be washed and air blowing. The magnetically separators will be take off and clean with blowing air. Only after those operations you can refill the tank with oil.

6.3.1.Daily routine check-up

Before machine start-up an exterior check-up will be made, the machine will be cleaned of chips and dust, and the oil level from the receivers will be checked also.

After the machine start-up the noise made by the advance mechanisms and gear box will be checked, in order to find any possible oil at guides, bearings, gears etc. which would be the result of oil leak etc.

Check all the manometer pressure indications.

6.3.2.Weekly check-up

It will be checked the general cleaning of the machine and around it, the oil from the tanks will be checked and supplemented if necessary, the guides guards will be cleaned and lubricated, the sieve from the cooling fluid collector channel will be cleaned.

The filter indicator will be checked. For filters that the red domain is indicated clean it. These will be checked weekly for three months after the functioning start and after this period once at two weeks.

6.3.3.Trimester check-up

The guides telescopic guards and used oils state will be checked. The sieves will be dismantled and cleaned.

The guides, the ball screws nuts and the bearings lubrication will be checked (if these are greased). The existence of guides transmission clearance and also of cogged belt wear and tension will be checked. At each subassembly check the draining, hydraulic joints and hydraulic system component and tight to the hydraulic joints.

6.3.4.Annual check-up

The machine general state will be checked:

- the existence of clearances exceeding the allowed values;
- the existence of lubrication;
- oils check-up;
- telescopic guides guards check-up;
- the guide cleaner check-up and replace the used or rifts ones;
- the bed guides check-up and eliminate the faeces or facings from each hole draining of oil from bed;
- the supply cable from the equilibration and its lubricate.

6.4. Adjustments

The mechanical parts adjustment refer in principal to the main shaft bearings, the feed drives and adjustments of the clearance from the guides.

6.4.1 Adjustment of the conical gads of the column sledge (drawing 6.4.1)

For the conical gads adjustment of the column-sledge proceed in next way:

- unscrew the nuts (3);
- dismount the plaques (4);
- take off and grind the tooling allowance (2) at desired quota;
- mount back at its place the tooling allowance (2), the plaque (4) and tight the screws (3) and assure it with the screwed pin (1).

6.4.2 Adjustment of the conical gads of the headstock and the ram (drawing 6.4.2)

The next operation will be done:

- unscrew the screws (2);
- dismount the plaques(4);
- take off and grind the tooling allowance (3) at desired quota;
- mount back in reverse order the element mentioned upstairs;
- assure it with the screwed pin (1).

6.4.3 Adjustment of the differential reduction gear X-axis (drawing 6.4.3/ a, b)

For reduction gear adjustment of the X-axis doesn't necessary the feed motor to be mounted instead the hydraulic sustentation must function.

For adjustment proceed in this way:

1. The screws 32 position and conic annular are tighten with a moment of 10 Nm
2. Fang the electro pump and the electro valve from sustentation hydraulic circuit that should realize a pressure about 12 atmosphere
3. Disconnect the electro pump and after the pressure indicate on manometer became 0 unscrew the screws 32.
4. With two pry help, rotate simultaneous the disk 20 clockwise and the disc 19 counterclockwise. In this way the pistons 25 are pushed into the cylinders.
5. Tight the screws 32. refuel the sustentation hydraulic circuit and check if the disk 19 and 20 to stay still. If the moves repeat operation 3,4,5. Proceed at total kinematics clearance value doing next operations;
6. After the sustentation hydraulic is checked and it is working and X-axis is blocked with some pry rotate clockwise with one rotation (drawing 6.4.3/b).
7. Keeping the pry fixed (without rotating the motor shaft) mark on case her position. Then mount a comparator and adjust it at "0" .
8. rotate the pry counterclockwise till the comparator needle moves out from 0. trace on reduction gear case the new position of pry.
9. continue the pry rotate counterclockwise with ½ revolution.
10. rotate the pry clockwise till farewell to the scratch marked on case at point 8 and adjust the comparator to the "0".

11. still rotating the pry clockwise till farewell to the scratch marked on case at 7 is obtained the total value of the clearance from kinematics chain that have to be slower than 0.02 mm.
12. if the kinematics clearance value is biggest that 0.02 mm, return to points 3÷11. After the second adjustment the clearance is still biggest increase the pressure value from the hydraulic circuit with 2-3 bar and restart all operations described at points 3÷11.

7. Anexe list

7.1 List of bearings (valide for one machine)

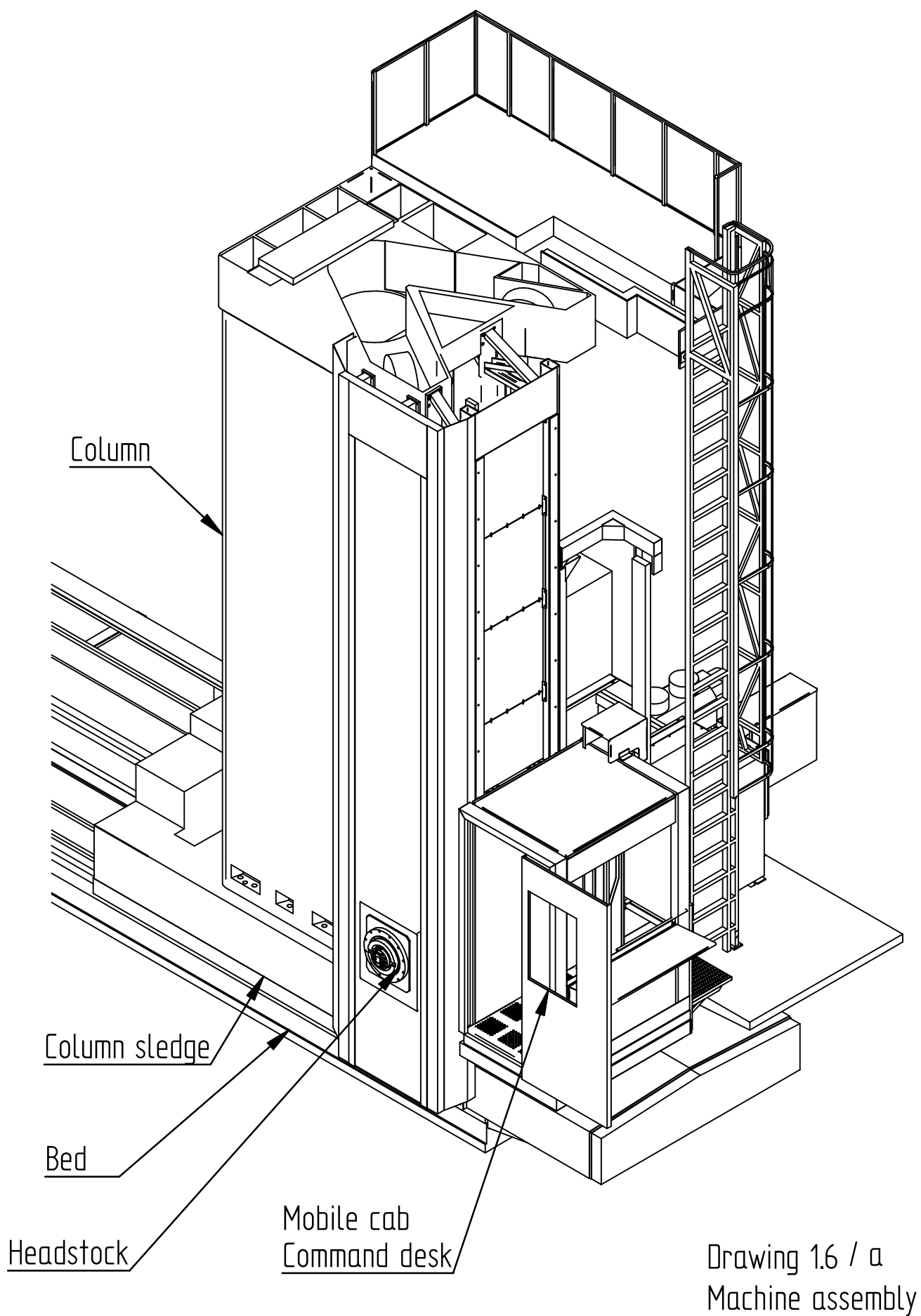
No	Bearing Code	Bearing name	Dimensions	Drawing	Quantity	Supplier
1	B 71956 C.T.P4S.UL	radial-axial ball bearing	280x380x46	Dwg. 4.6	3	FAG
2	NNU 4948 SK.M.SP	Radial roller bearing with conical hole	240x320x80	Dwg. 4.6	1	FAG
3	NU 2220 ECP P6	Cylindrical roller bearings	100x180x46	Dwg. 4.6	1	SKF
4	NU 1024 ML P6	Radial roller bearing	120x180x28	Dwg. 4.6	2	SKF
5	7221 ACD/P4A-DB-B	radial-axial ball bearing	105x190x36	Dwg. 4.6	1 set=2 pcs.	SKF
6	7038 CD/P4A-DB-B	radial-axial ball bearing	190x290x46	Dwg. 4.6	1 set=2 pcs.	SKF
7	7010 ACD/P4A-DB-B	radial-axial ball bearing	50x80x16	Dwg.4.5/a	1 set=2 pcs.	SKF
8	7014 ACD/P4A-DB-B	radial-axial ball bearing	70x110x20	Dwg.4.5/a	1 set=2 pcs.	SKF
9	7012 ACD/P4A-DB-B	radial-axial ball bearing	60x95x18	Dwg.4.5/a	1 set=2 pcs.	SKF
10	7215 ACD/P4A-DB-B	radial-axial ball bearing	75x130x25	Dwg.4.5/a	1 set=2 pcs.	SKF
11	7216 ACD/P4A-DB-B	radial-axial ball bearing	80x140x26	Dwg.4.5/a	1 set=2 pcs.	SKF
12	7018 ACD/P4A-DB-B	radial-axial ball bearing	90x140x24	Dwg.4.5/a	1 set=2 pcs.	SKF
13	71918 ACD/P4A-DB-B	radial-axial ball bearing	90x125x18	Dwg.4.5/a	2 set=4pcs.	SKF
14	71920 CD/P4A-DB-A	radial-axial ball bearing	100x140x20	Dwg.4.5/a	1 set=2pcs.	SKF
15	6224 P6	Radial ball bearing	120x215x40	Dwg.4.7	1	SKF
16	NU 226 P6	Radial roller bearing	130x230x40	Dwg.4.7	1	FAG
17	30219 A P6	Radial-axial roller bearing	95x170x34.5x32	Dwg.4.8/a	2	FAG
18	6006 2RSR	Radial ball bearing	30x55x13	Dwg.4.8/c	2	
19	6209 RSR	Radial ball bearing	45x85x19	Dwg. 4.9.1	2	
20	6308	Radial ball bearing	40x90x23	Dwg.4.9.1	1	
21	3210	radial-axial with 2 rows ball bearing	50x90x30.2	Dwg. 4.9.1	1	
22	32210 A	radial-axial roller bearing	50x90x24.75	Dwg. 4.9.1	2	
23	32216 A	radial-axial roller bearing	80x140x35.25	Dwg. 4.9.1	1	
24	32211 A	radial-axial roller bearing	55x100x26.75	Dwg. 4.9.1	1	
25	32016 X	radial-axial roller bearing	80x125x29	Dwg. 4.9.1	4	
26	32228 A	radial-axial roller bearing	140x250x71.75	Dwg. 4.9.1	4	

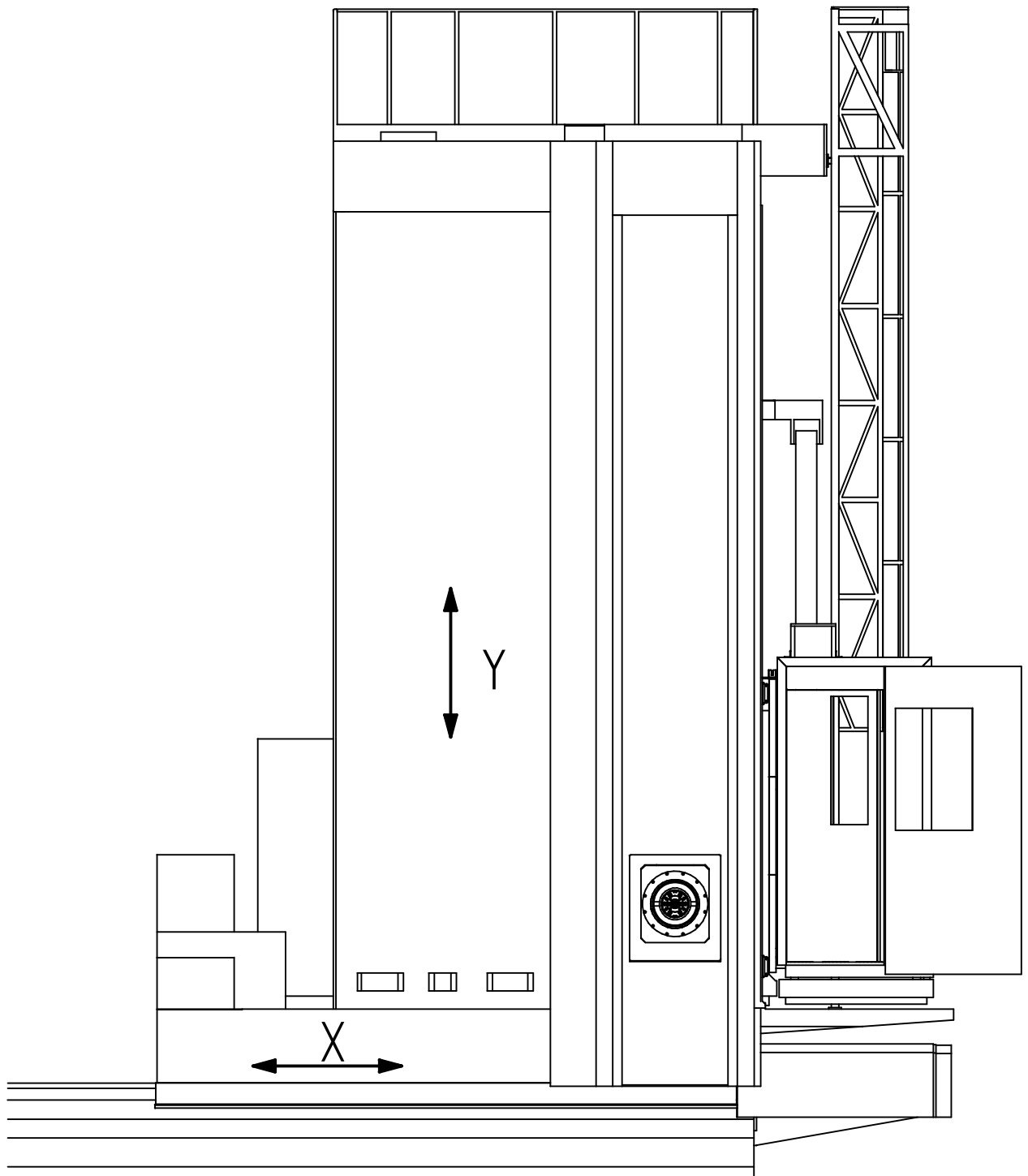
No	Bearing Code	Bearing name	Dimensions	Drawing	Quantity	Supplier
27	22220	spherical roller bearings K type	100x180x46	Dwg. 4.9.2	1	
28	29420	Axial spherical roller bearings	100x210x67	Dwg. 4.9.2	2	
29	NU 1020 MA	Cylindrical roller bearings	100x150x24	Dwg. 4.9.2	1	
30	NU 1018 MA	Cylindrical roller bearings	90x140x24	Dwg. 4.9.2	1	
31	6210	Radial ball bearings	50x90x20	Dwg. 4.9.2	2	
32	3208	Angular contact ball bearings double row	40x80x30.2	Dwg. 4.9.2	2	
33	32020 X	Tapered roller bearings	100x150x32	Dwg. 4.9.2	2	
34	7311 B.TVP	Angular contact ball bearings	55x120x29	Dwg. 4.9.3	1	FAG
35	7312 B.TVP	Angular contact ball bearings	60x130x31	Dwg. 4.9.3	1	FAG
36	51412 FP	Axial ball bearings	60x130x51	Dwg. 4.9.3	1	FAG
37	6214	Radial ball bearings	70x125x24	Dwg. 4.9.3	1	FAG
38	7312 B.TVP	Angular contact ball bearings	60x130x31	Dwg. 4.9.4	1	FAG
39	51412 FP	Axial ball bearings 514	60x130x51	Dwg. 4.9.4	1	FAG
40	3210 B.TVH	Angular contact ball bearings double row	50x90x30.2	Dwg. 4.9.4	2	FAG
41	NJ 2220 MA	Cylindrical roller bearings	100x180x46		8	
42	NJ 320 MA	Cylindrical roller bearings	100x215x47		2	
43	NJ 314 E	Cylindrical roller bearings	70x150x35		2	
44	51114	Axial ball bearings	70x95x18	Dwg. 4.16	2	FAG
45	-	Ball	ø 10	Dwg. 4.16	1	

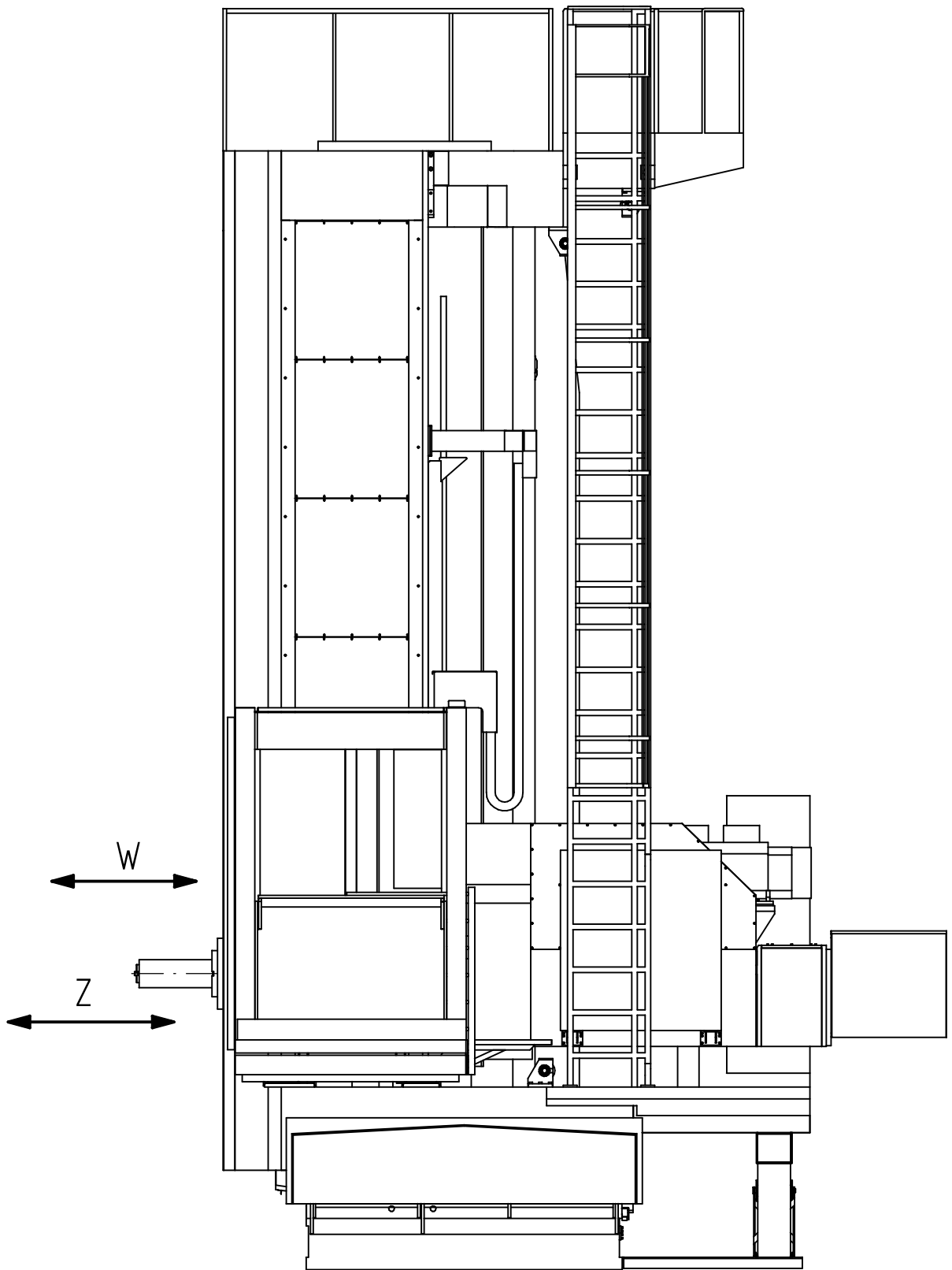
7.2 Sealing elements list (for one machine)

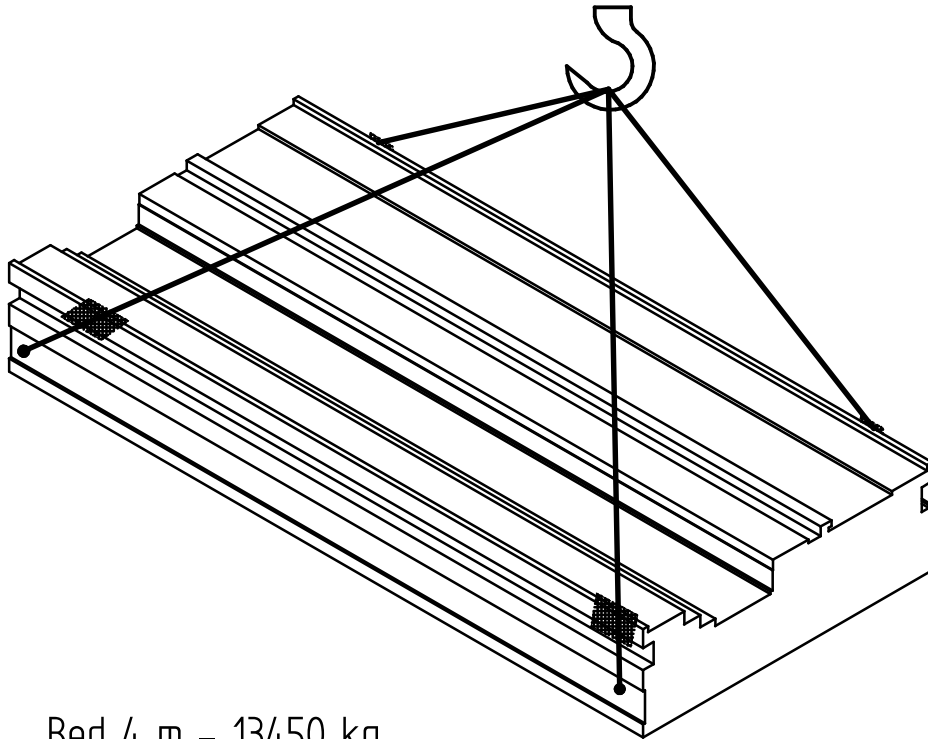
No.	Denumire	Code	Dimensions	Drawing	Quantity	Supplier
1	Scraper	WSA 100300-N9MN	30x40x7/10	Dwg.4.5/b	1	Busak
2	Scraper	WSA 200300-N9MN	40x50x7/10	Dwg.4.5/b	1	Busak
3	Turcon-Glyd-Ring	PG 4400400-T46-N	40x29x4.2	Dwg.4.5/b	2	Busak
4	Turcon-Glyd-Ring	PG 4400550-T46-N	55x44x4.2	Dwg.4.5/b	1	Busak
5	Turcon-Glyd-Ring	RG 4300300-T46-N	30x40.7x4.2	Dwg.4.5/b	1	Busak
6	Turcon Stepseal	2K RSK 200300-T46-N	30x40.7x4.2	Dwg.4.5/b	4	Busak
7	Varilip	TP A1 00800-T25 -1N	80x100x10	Dwg.4.5/a	1	Busak
8	Varilip	TP A2 00150-T25-1N	15x30x7	Dwg.4.5/a	1	Busak
9	O-ring	ORAR 00128	37.77x2.62	Dwg.4.5/b	2	Busak
10	O-ring	ORAR 00162	145.72x2.62	Dwg.4.5/a	1	Busak
11	O-ring	ORAR 00154	94.92x2.62	Dwg.4.5/a	1	Busak
12	O-ring	ORAR 00150	72.69x2.62	Dwg.4.5/a	1	Busak
13	O_ring	ORAR 00224	40.04x3.53	Dwg.4.5/a	2	Busak
14	O-ring	ORAR 00156	107.62x2.62	Dwg.4.5/a	1	Busak
15	O-ring	ORAR 00159	126.67x2.62	Dwg.4.5/a	1	Busak
16	O-ring	ORAR 00153	88.57x2.62	Dwg.4.5/a	1	Busak
17	O-ring	ORAR 00160	133.02x2.62	Dwg.4.5/a	1	Busak
18	O-ring	ORAR 00260	164.69x3.53	Dwg.4.5/a	1	Busak
19	Turcon-Double-Delta-Seal	GS55403-0700	70x81.4x7	Dwg.4.8/b	2	Busak
20	Turcon-Double-Delta-Seal	GS55404-1100	110x98.6x7	Dwg.4.8/b	1	Busak
21	O_ring	ORAR 00108	6.02x2.62	Dwg.4.8/b	1	Busak
22	O_ring	ORAR 00243	104.37x3.53	Dwg.4.8/b	1	Busak
23	O_ring	OR 3503970	39.70x3.50	Dwg.4.8/b	1	Busak
24	Oil-seal	AD110x140x13 DIN3760 design A	110x140x13	Y-axis	1	Busak
25	Oil-seal	AD110x150x15 DIN3760 design A	110x150x15	Y-axis	1	Busak
26	Oil-seal	AD125x160x15 DIN3760 design A	125x160x15	Y-axis	1	Busak
27	Oil-seal	AD150x180x15 DIN3760 design A	160x180x15	Y-axis	1	Busak
28	O_ring	ORAR 00335	69.22x5.33	Y-axis	1	Busak
29	O_ring	ORAR 00220	34.52x3.53	Y-axis	1	Busak
30	O_ring	ORAR 00368	196.22x5.33	Y-axis	2	Busak
31	O-ring	OR 5721930	219.3x5.7	X-axis	1	Busak
32	O-ring	OR 5509500	95.0x5.5	X-axis	1	Busak
33	Turcon Roto-glid ring	GS 56132-0900-239-8307	-	X-axis	2	Busak
34	O-ring	ORAR 00115	17.2x2.62	X-axis	8	Busak
35	Oil-seal	AD80x105x13 DIN3760 design A	80x105x13	Z-axis	1	Busak
36	Oil-seal	AD80x105x13 DIN3760 design A	80x105x13	W-axis	1	Busak
37	O_ring	ORAR 00230	63.09x3.53	W-axis	1	Busak

8. DRAWINGS

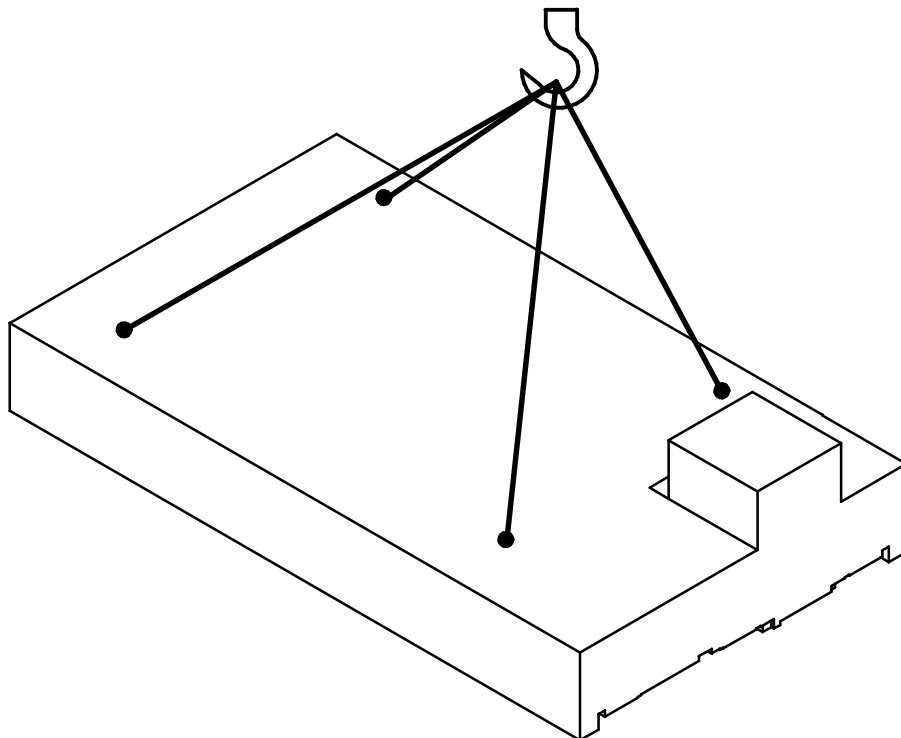




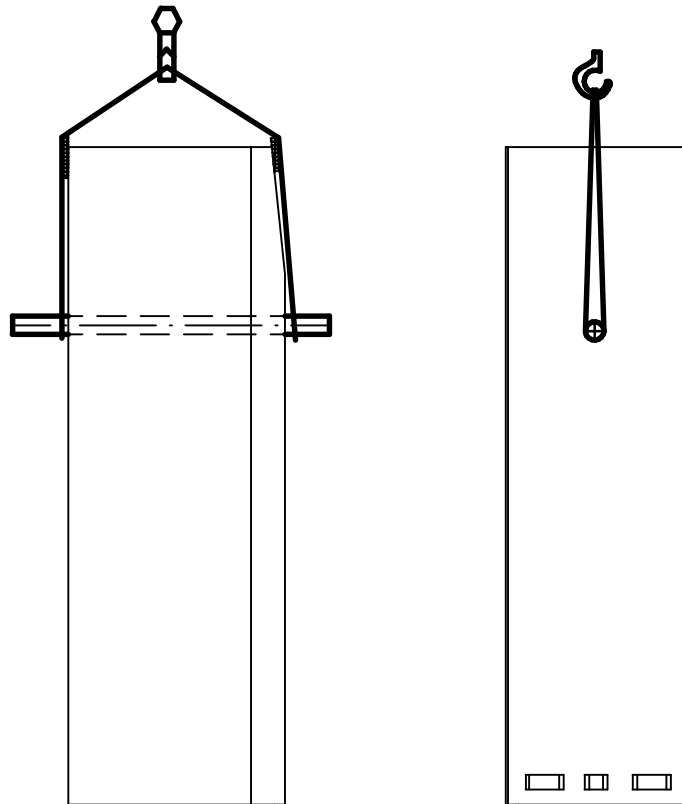




Bed 4 m – 13450 kg
Bed 5 m – 17100 kg

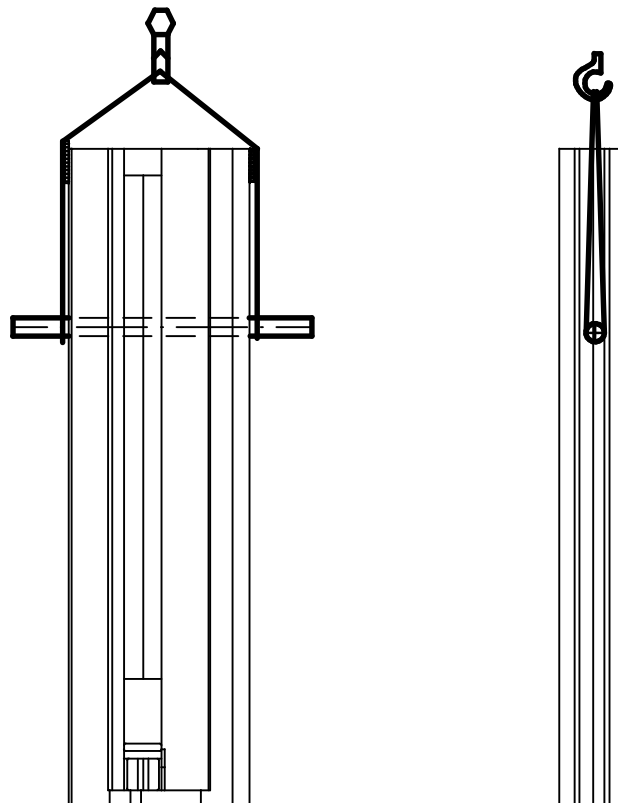


Column sledge – 16050 kg



Column 6200- 28000 kg

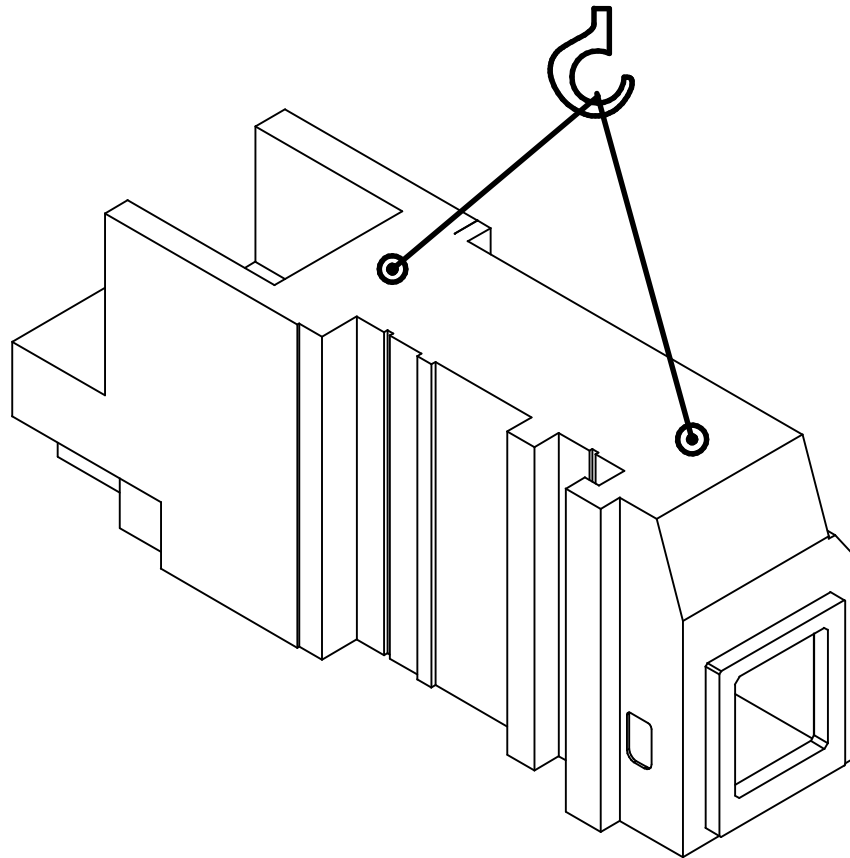
Column 7200- 34000 kg



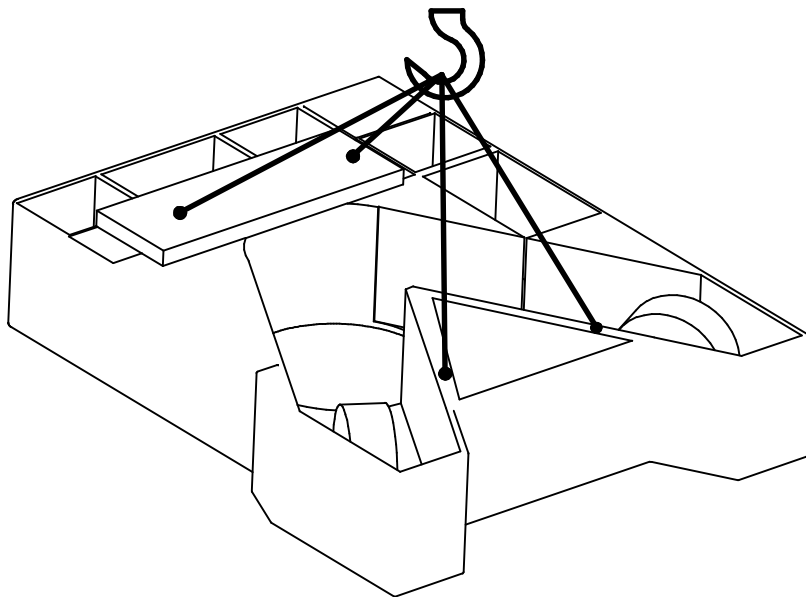
Column guide 6200 - 12000 Kg

Column guide 7200 - 15000 kg

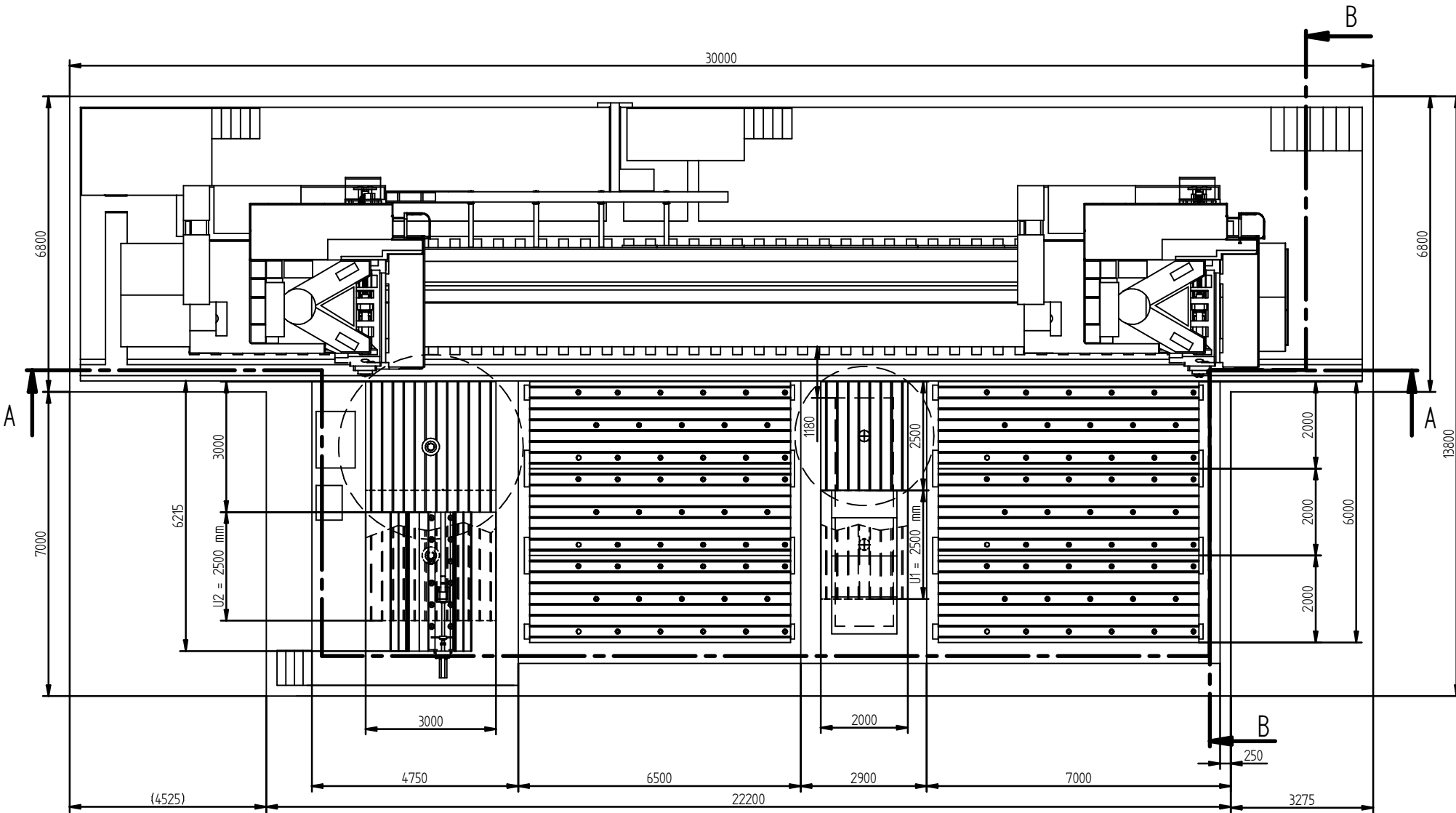
Drawing 3.1 / b
Machine transport



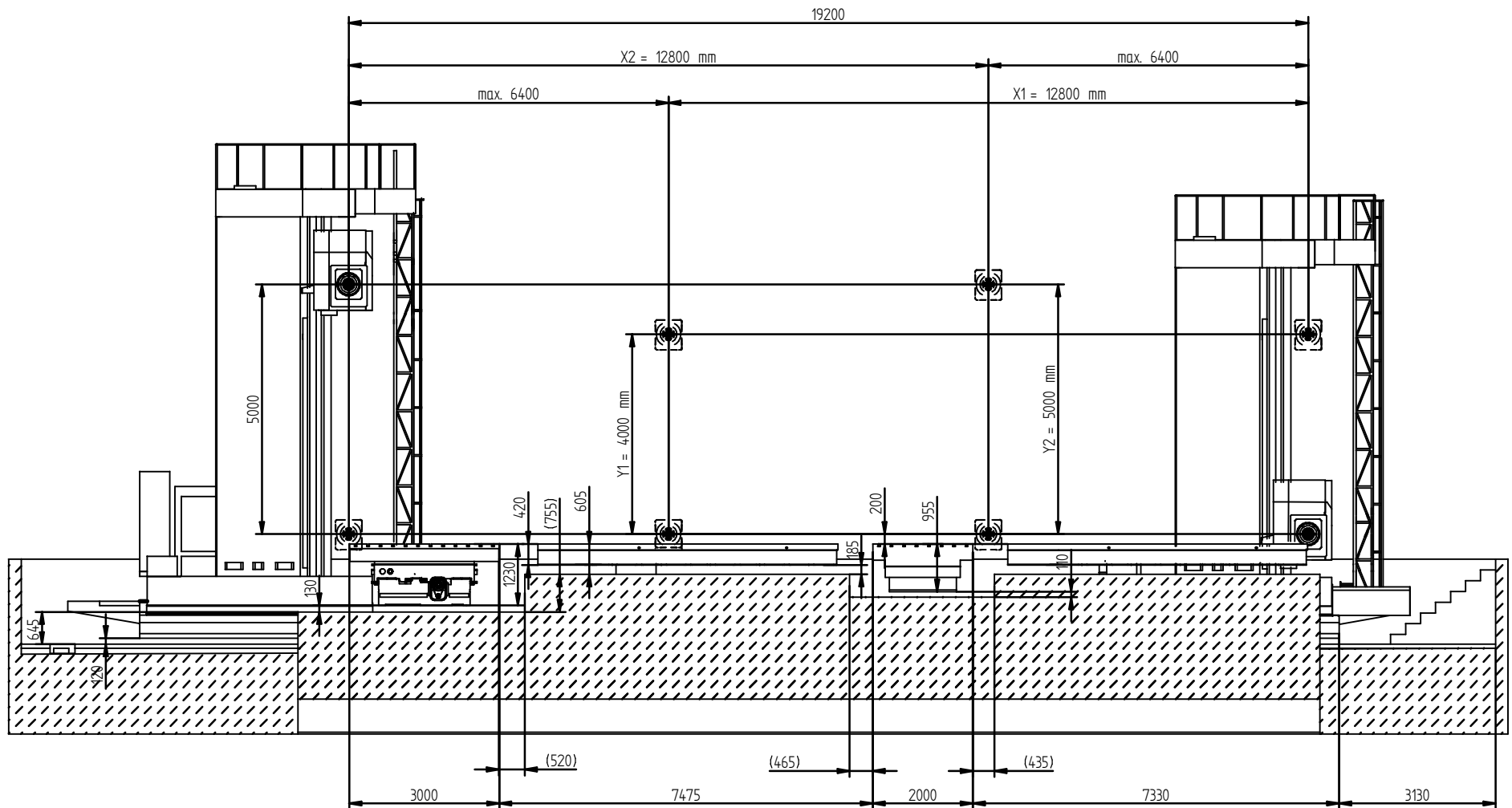
Headstock- 18500 kg



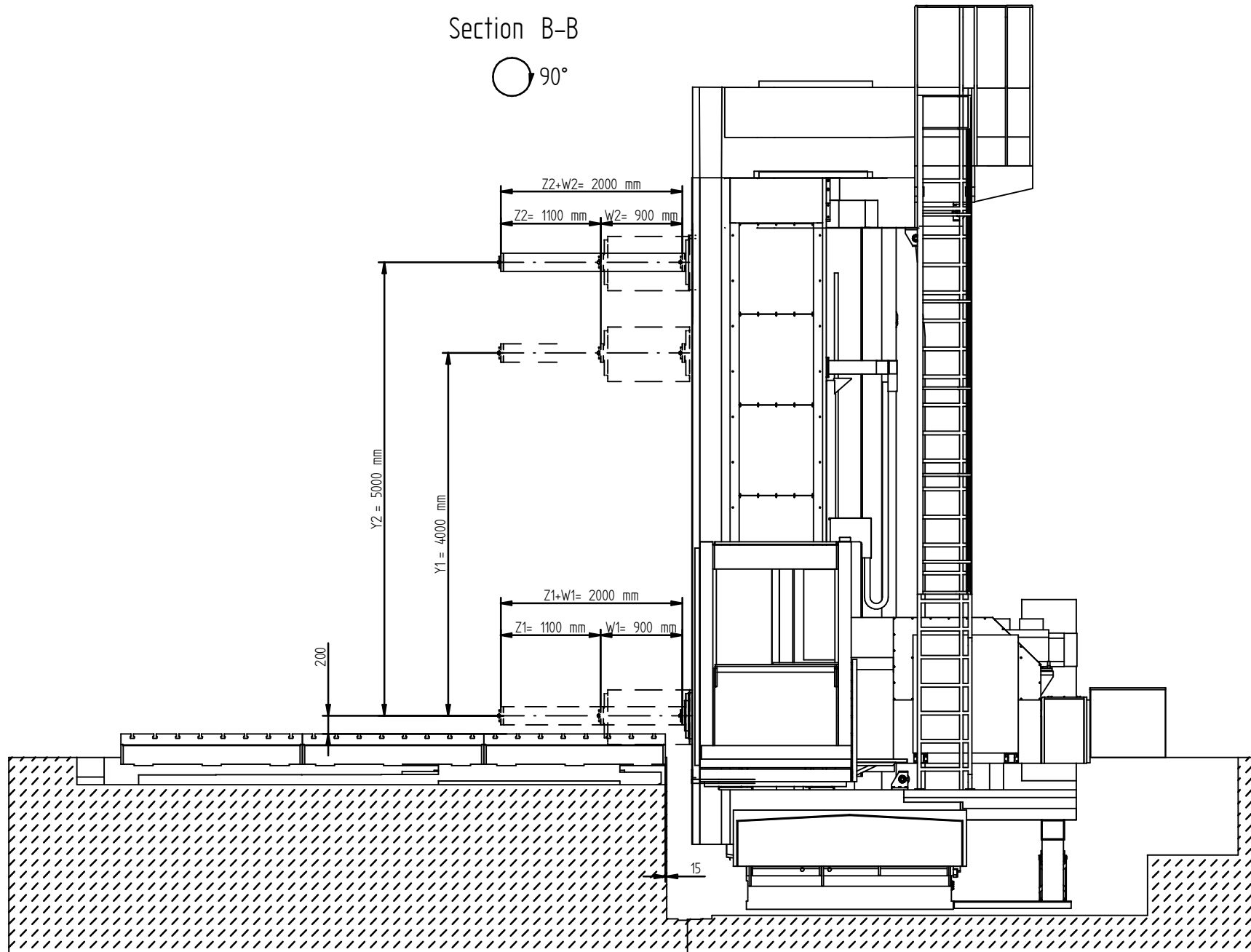
Column cover - 4770 kg

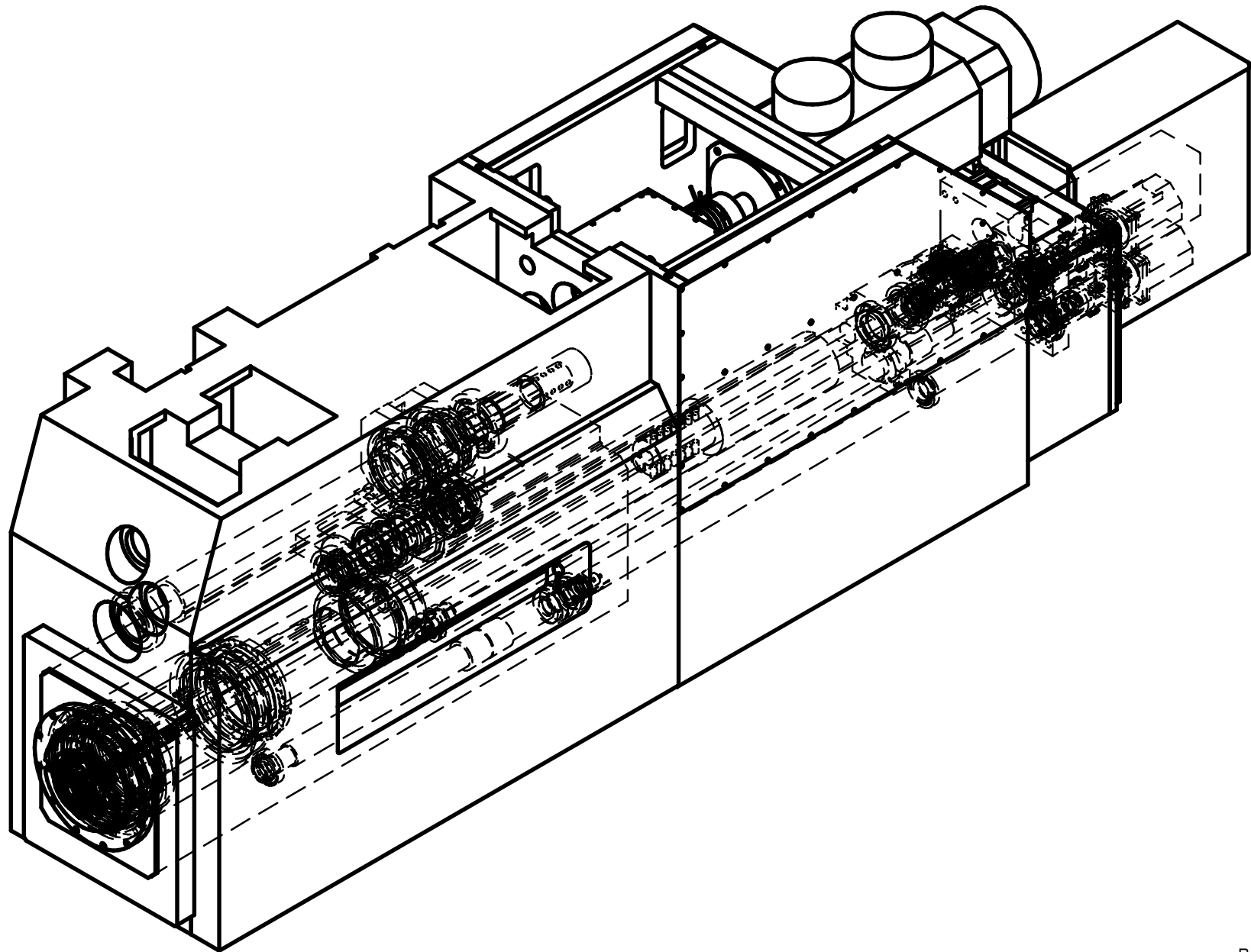


Section A-A

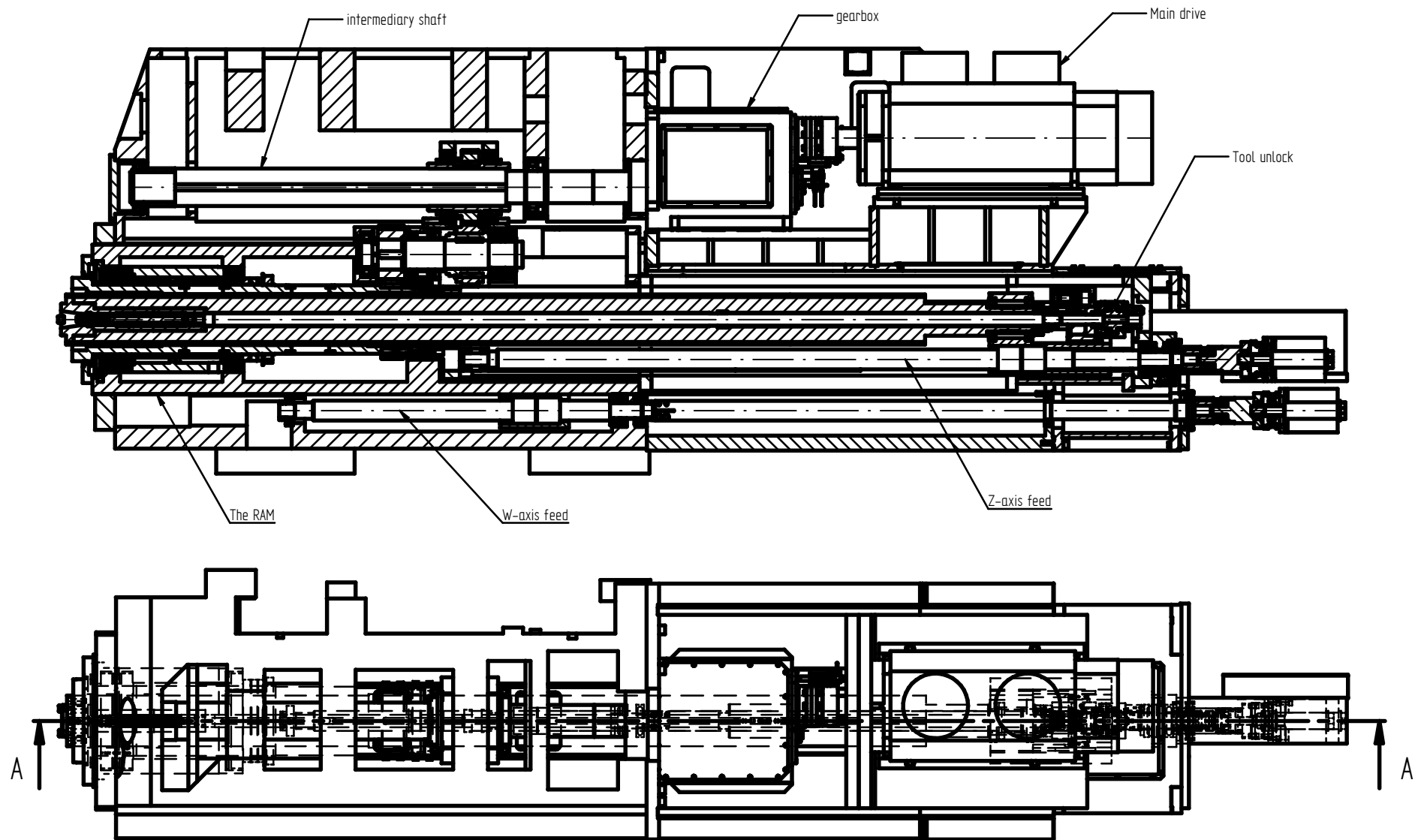


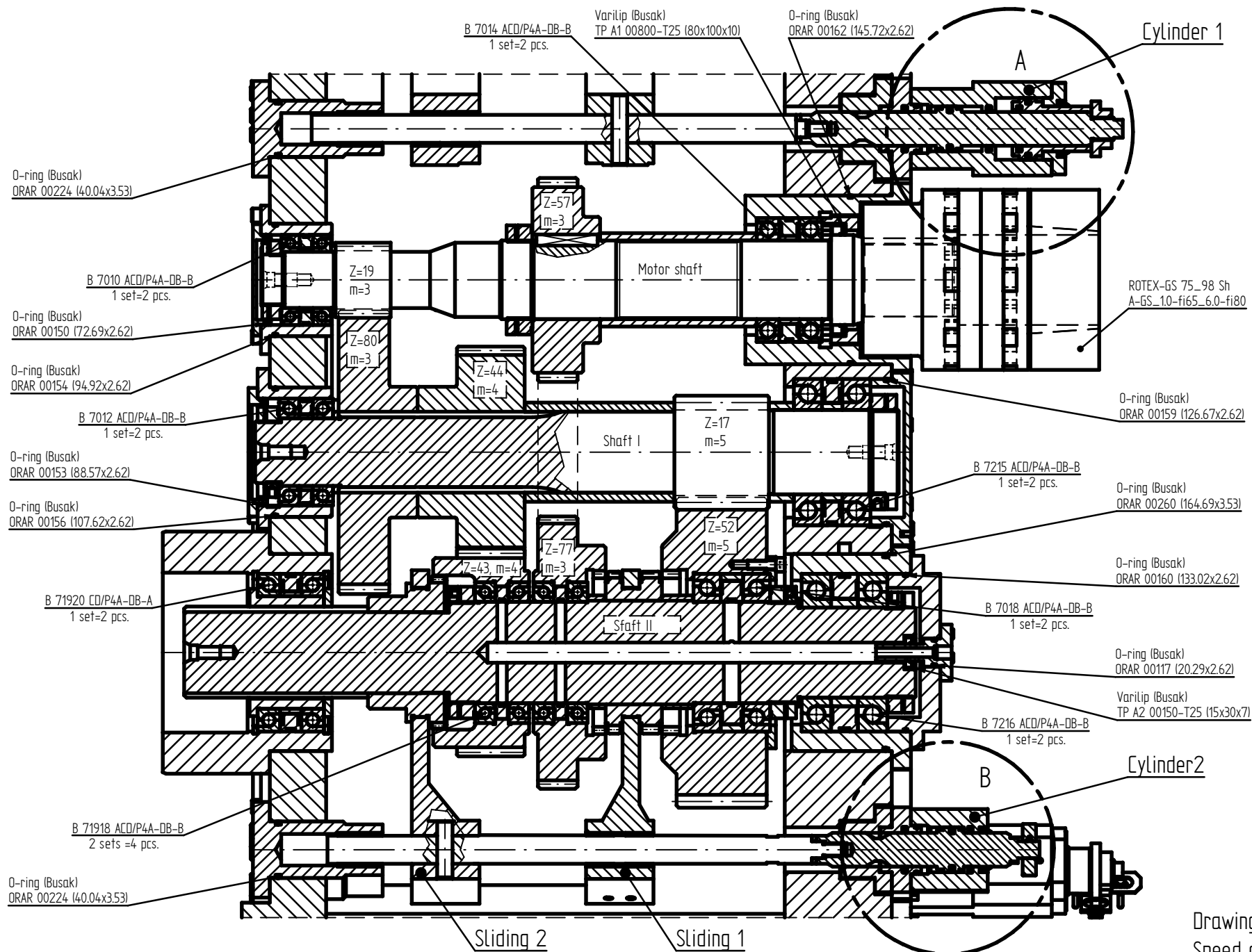
Section B-B



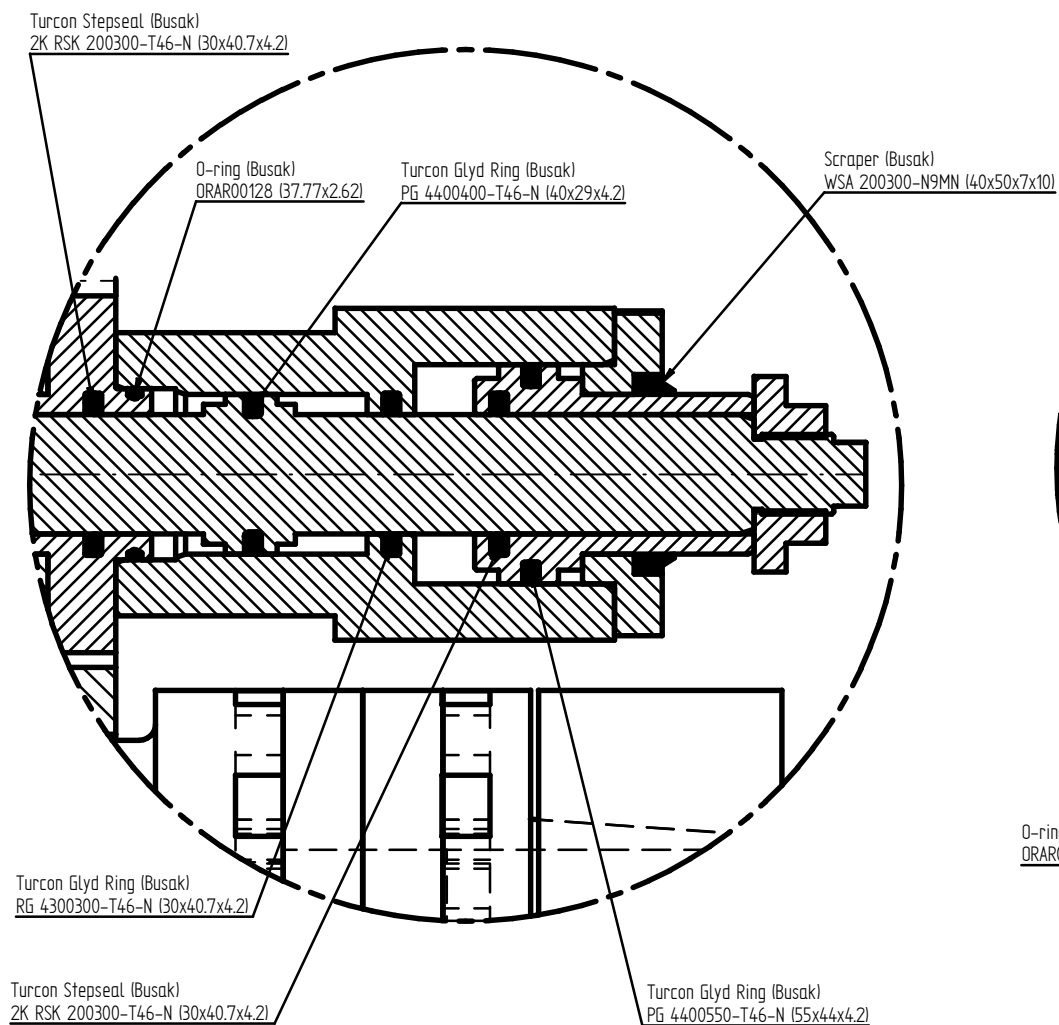


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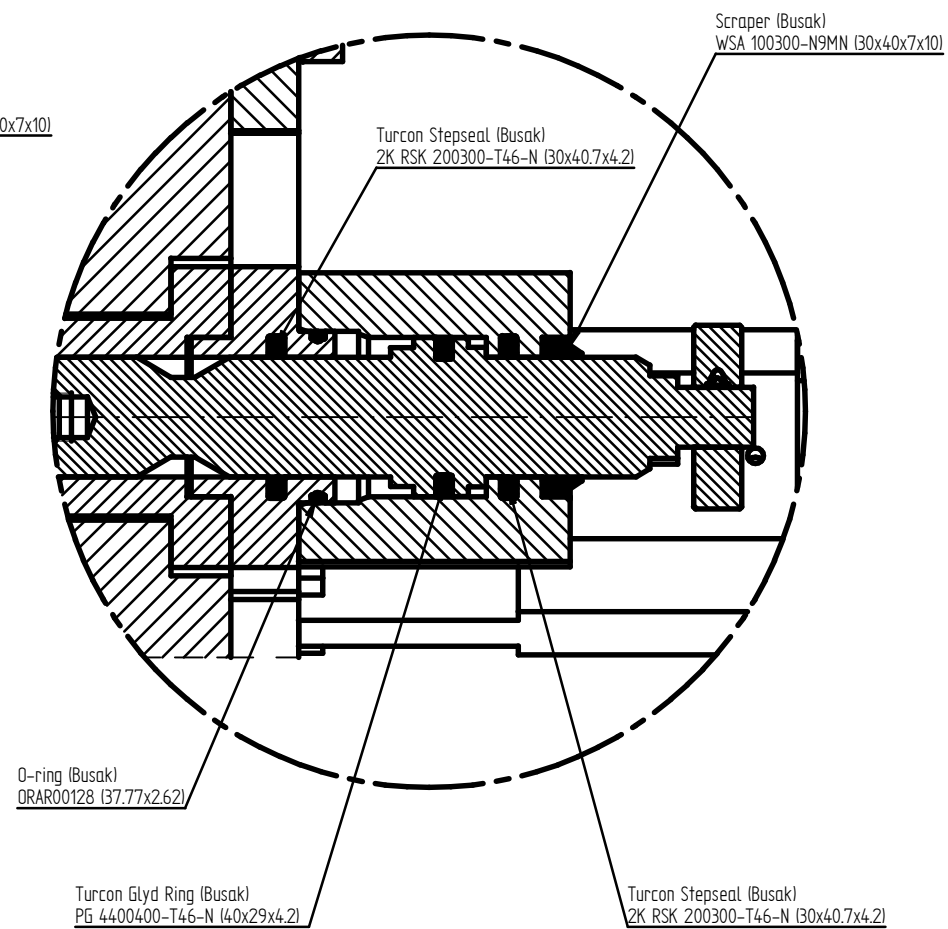




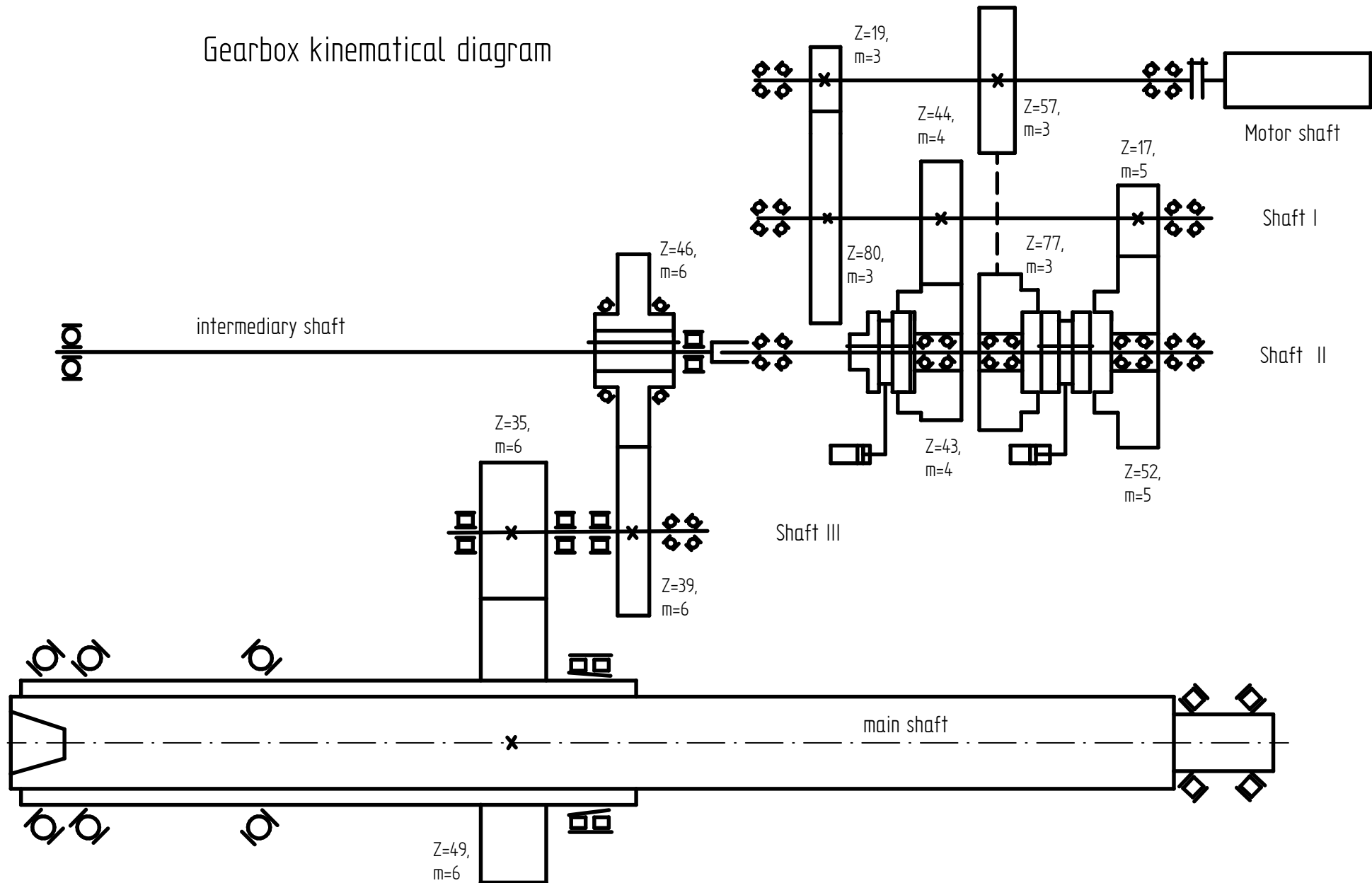
Detail A



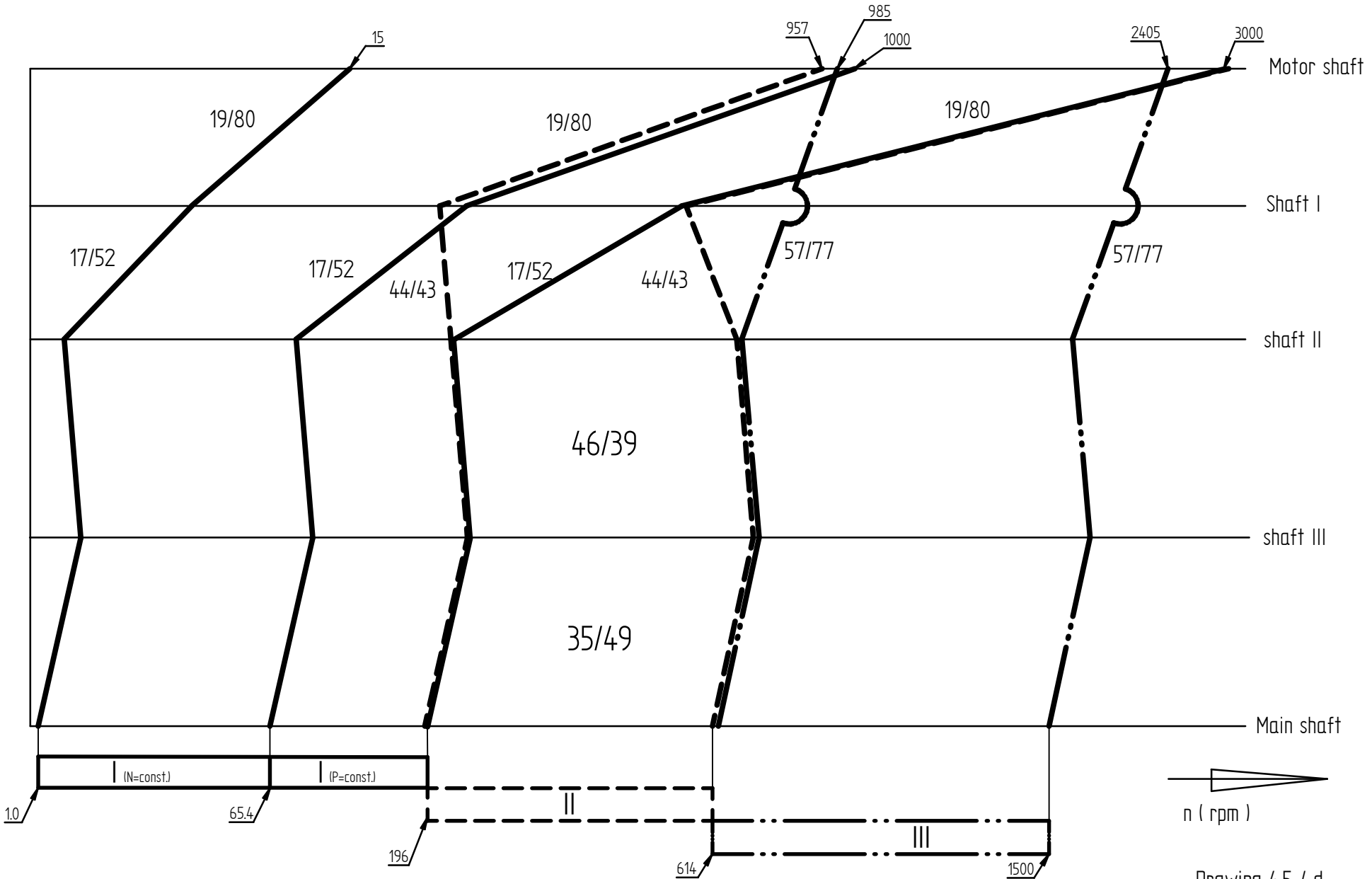
Detail B



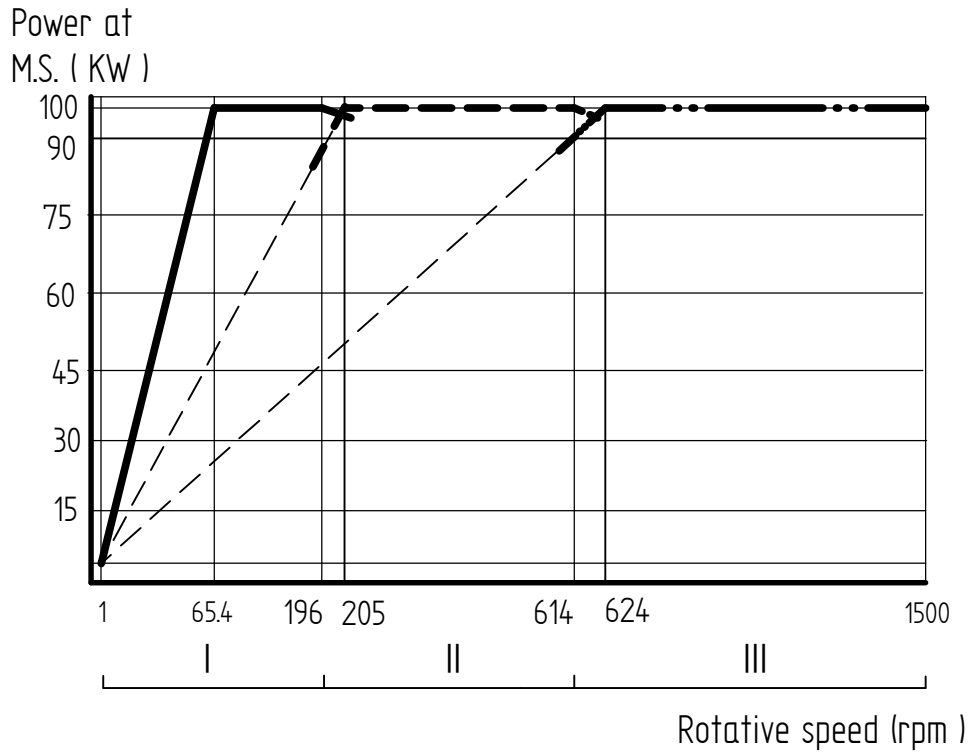
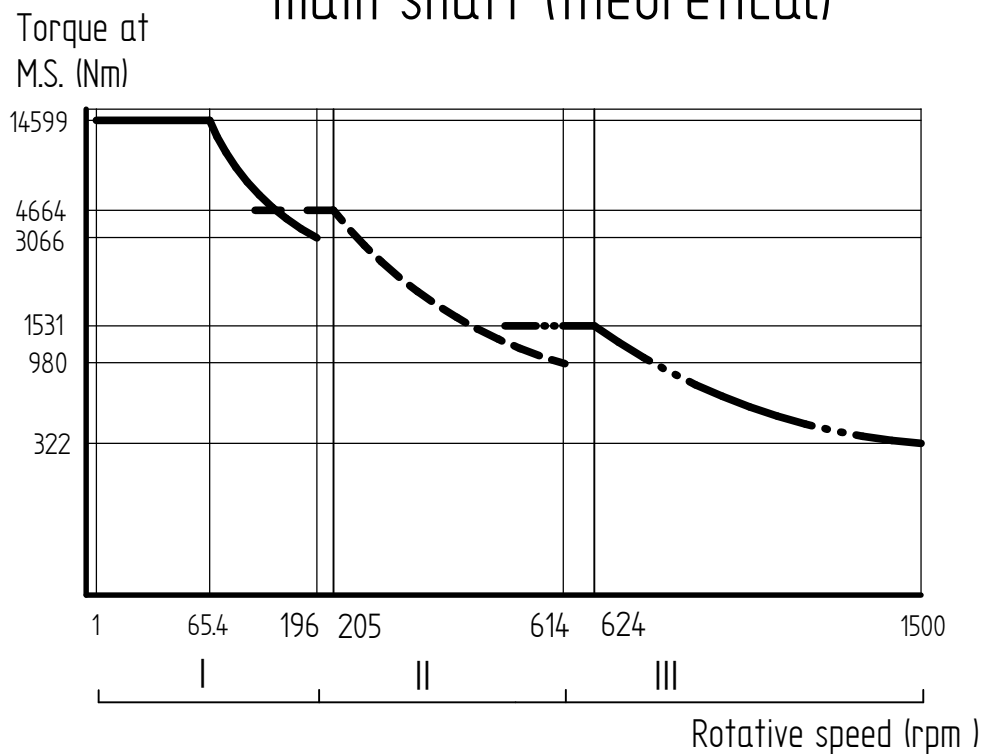
Gearbox kinematical diagram



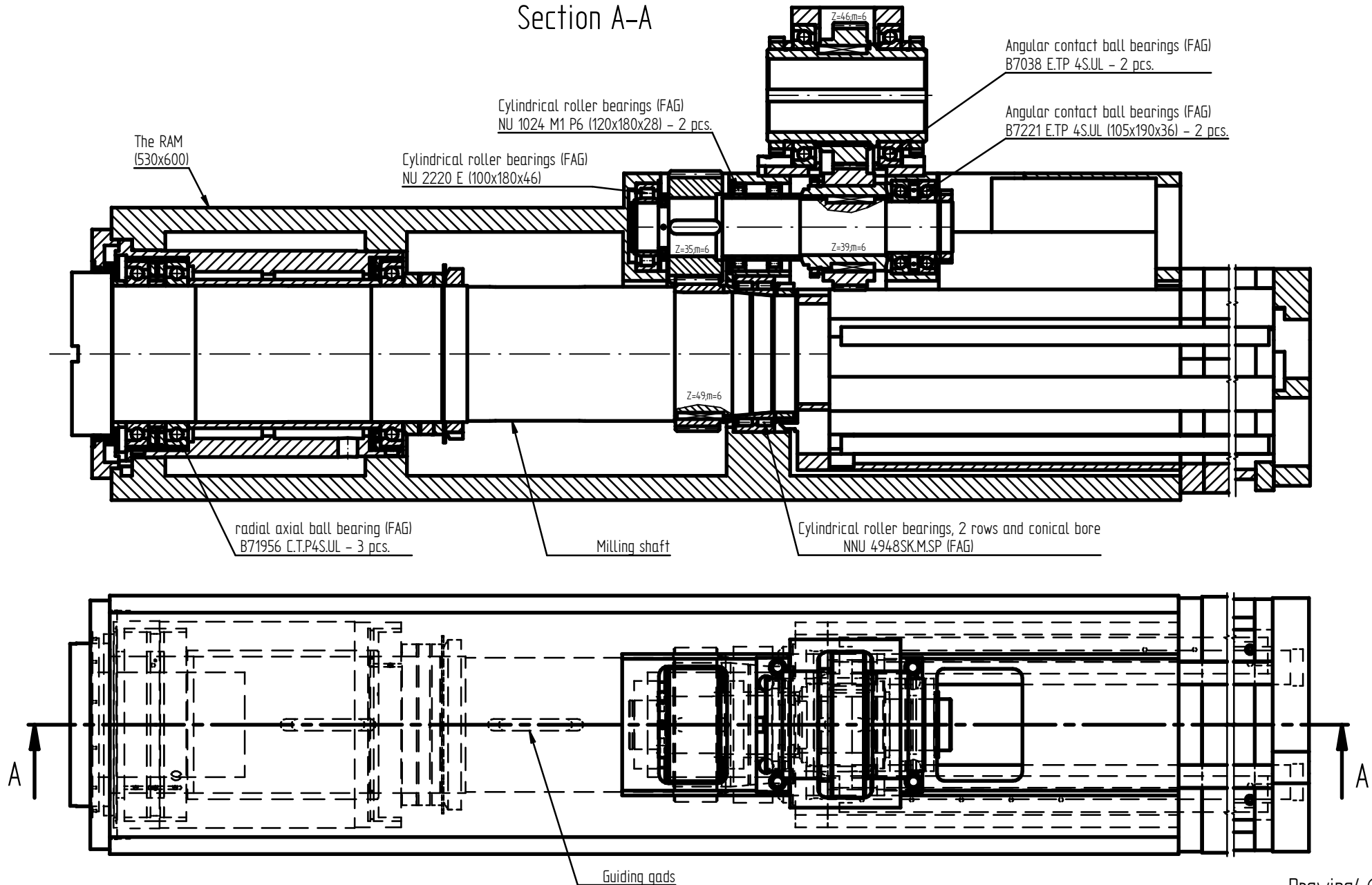
Rotative speed diagram

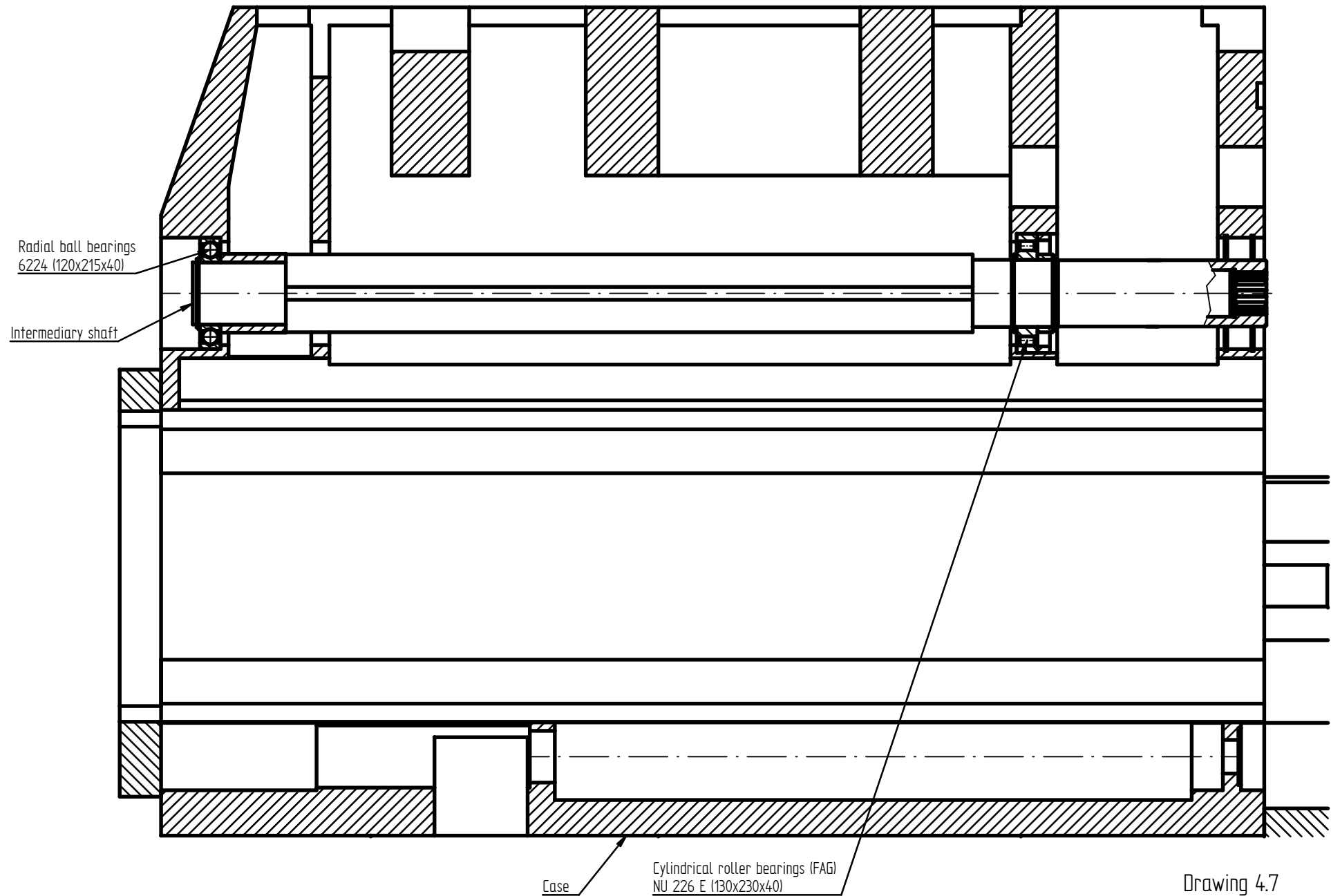


Power diagram at main shaft

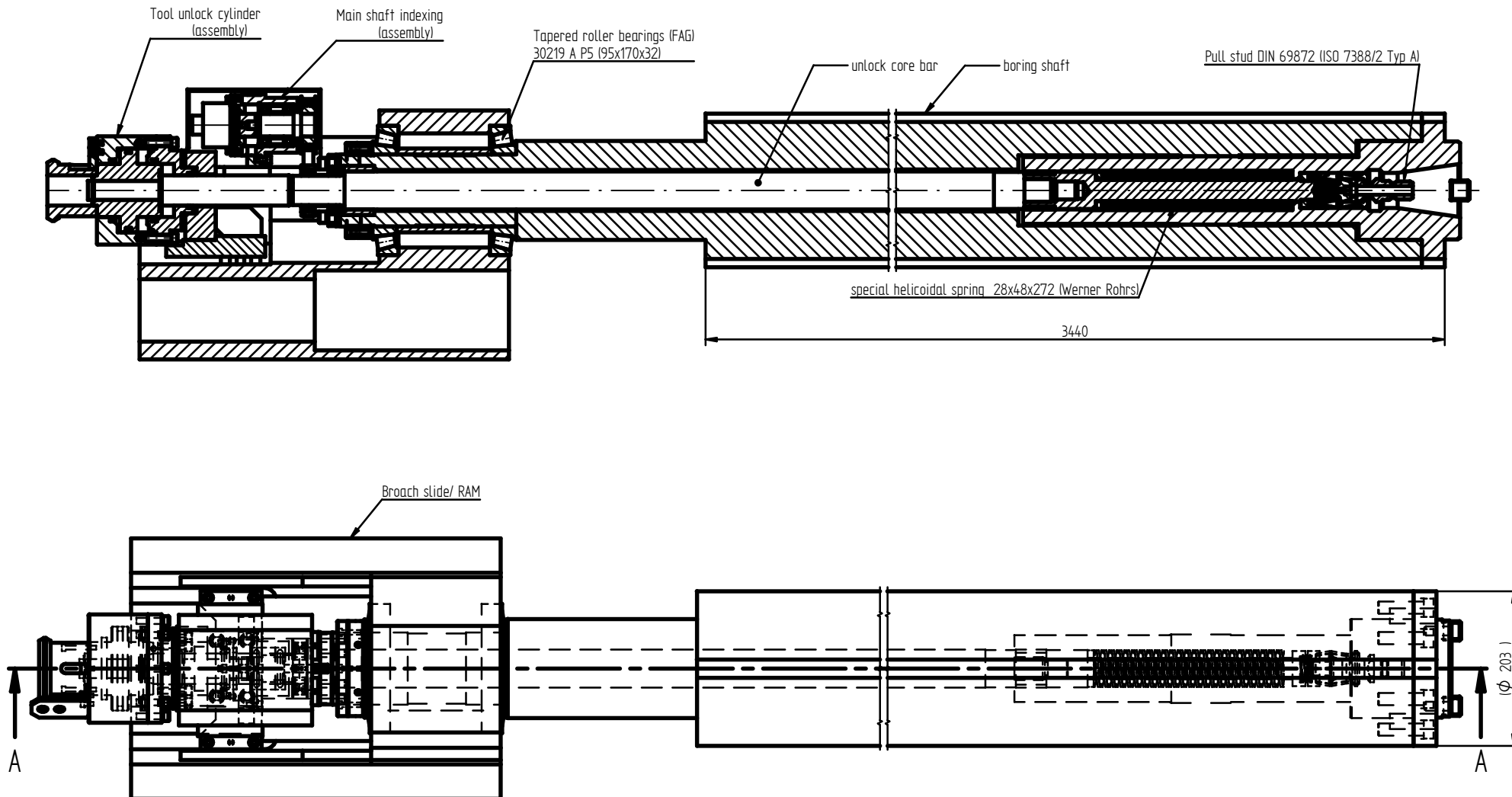
Torque diagram at
main shaft (theoretical)

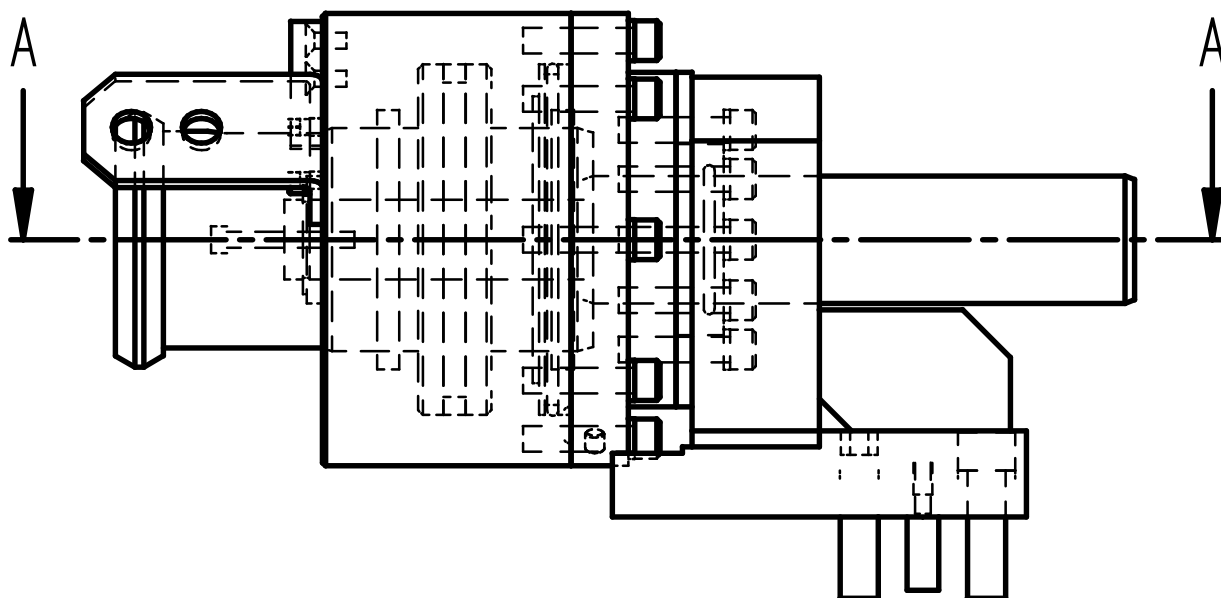
Section A-A



Drawing 4.7
Intermediary shaft

Section A-A

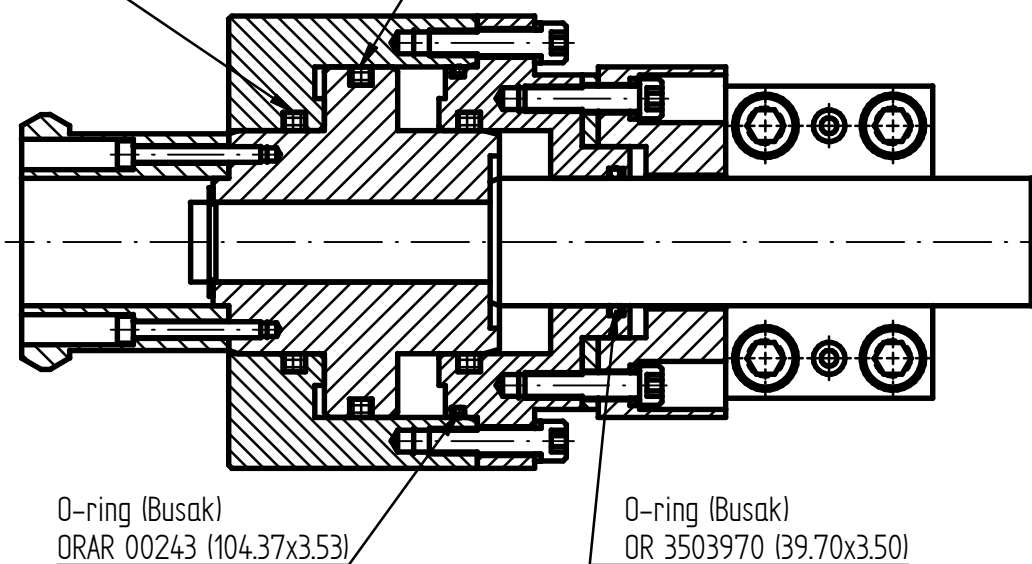




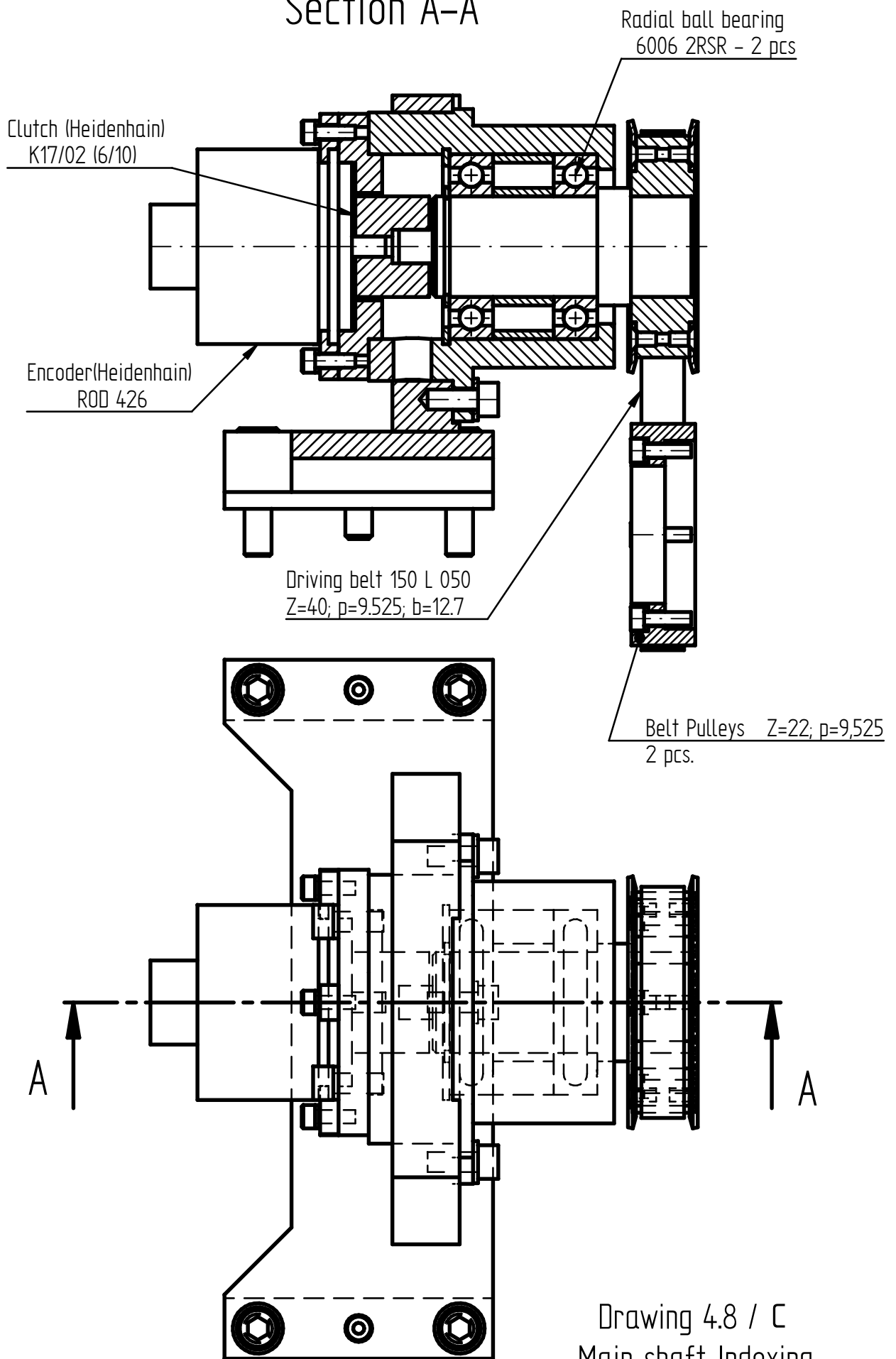
Section A-A

Turcon-Double-Delta-Seal (Busak)
GS55403-0700 (70x81.4x7) - 2 pcs

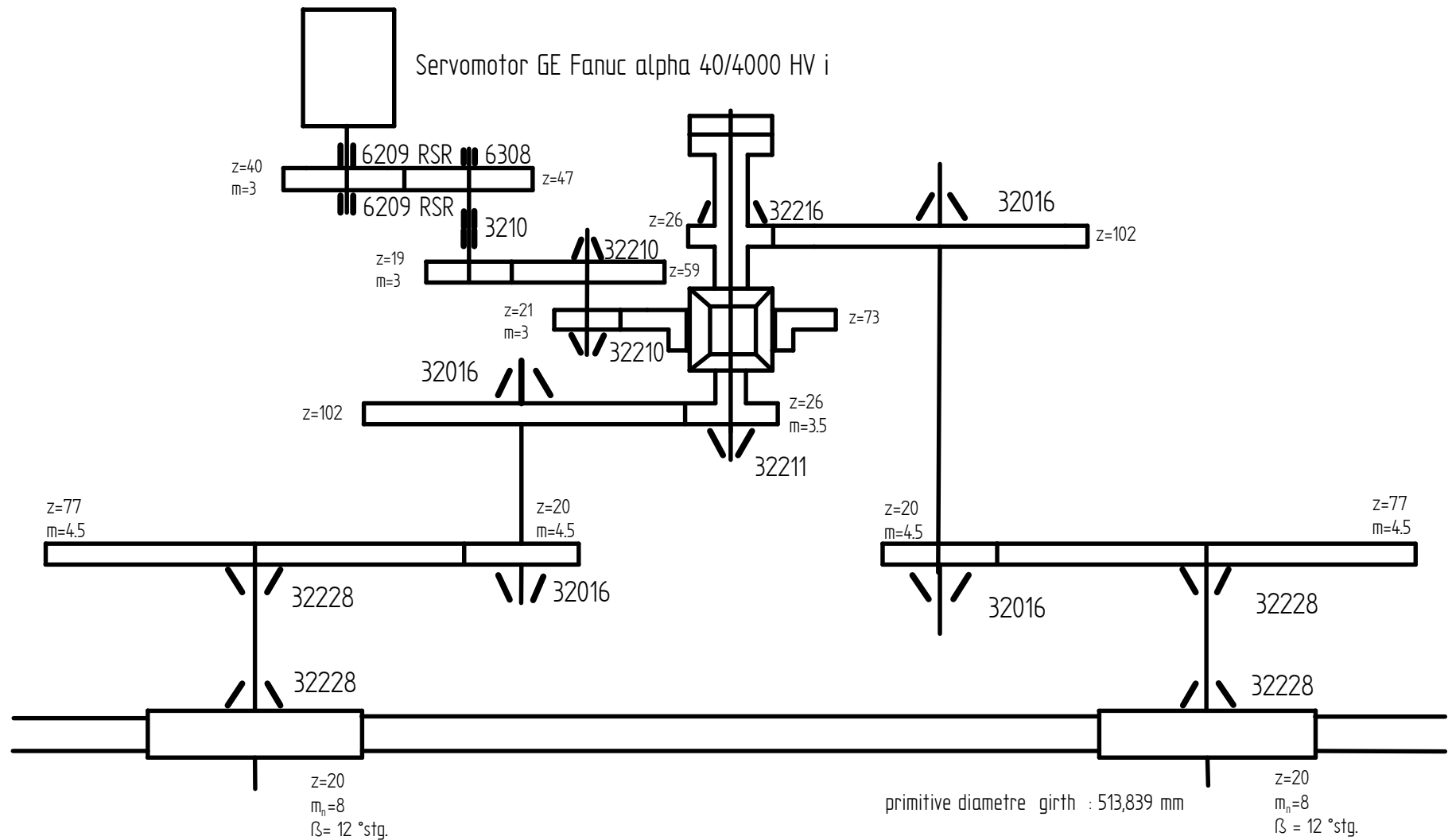
Turcon-Double-Delta-Seal (Busak)
GS55404-1100 (110x98.6x7)



Section A-A



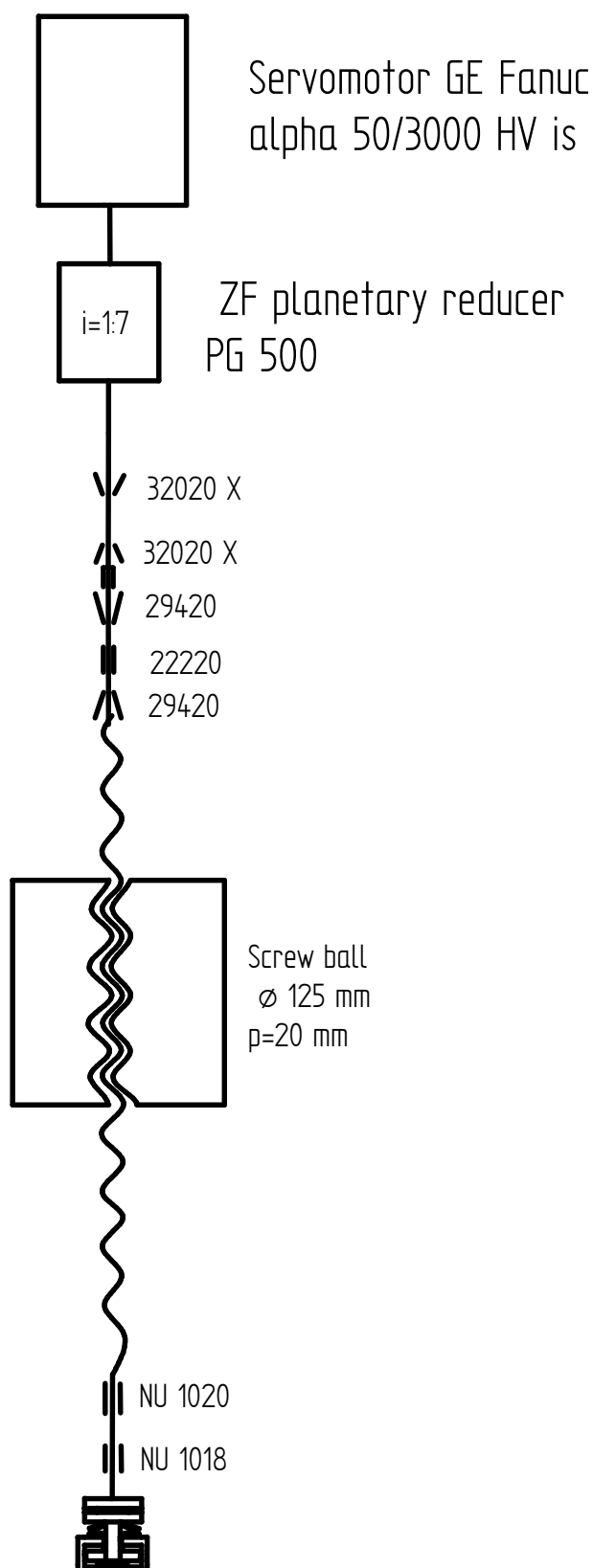
Kinematical chart for the X-axis feed



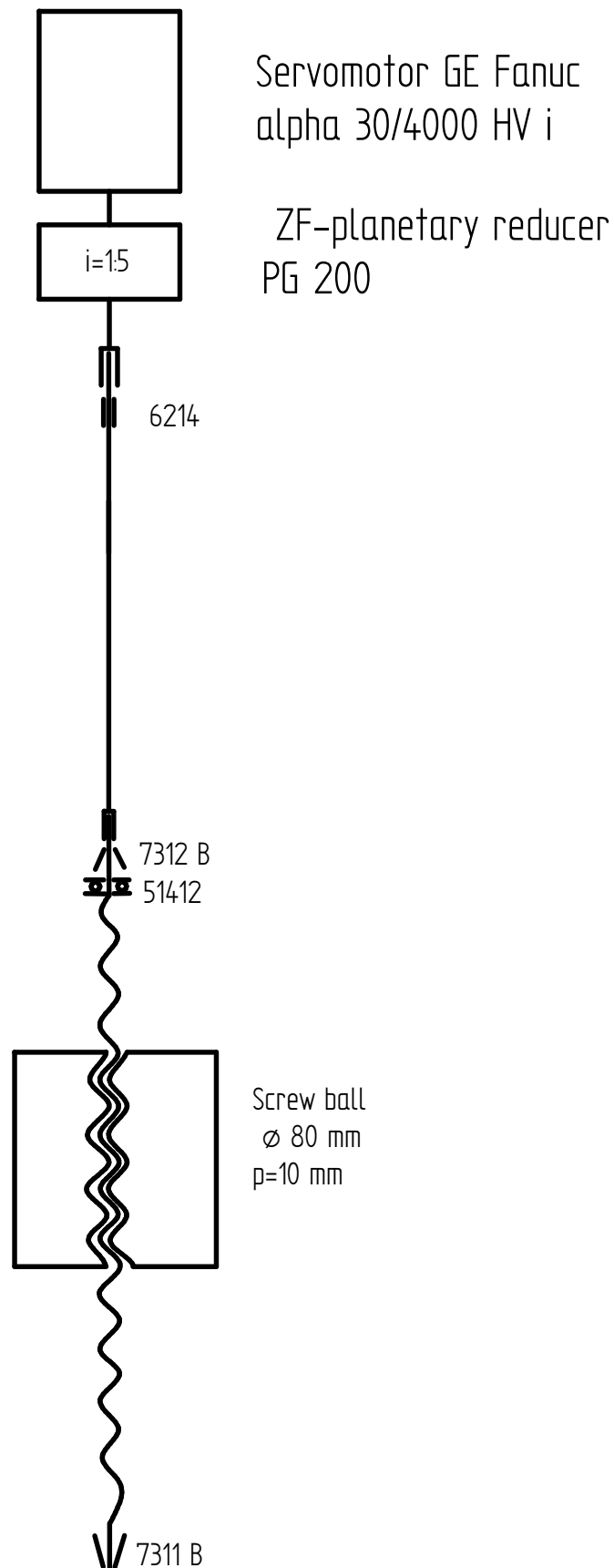
Total reduction ratio is 1 : 191.57

Slide movement at one motor rotation is 3.213 mm

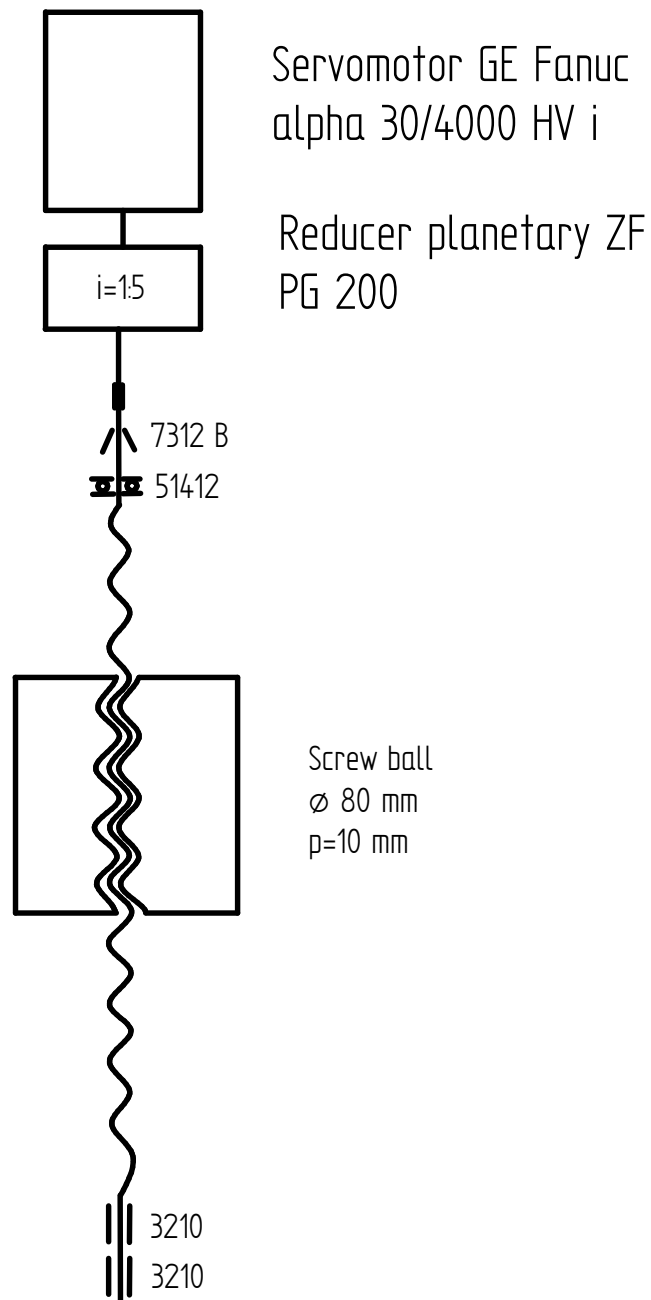
Kinematical scheme of Y-axis feed

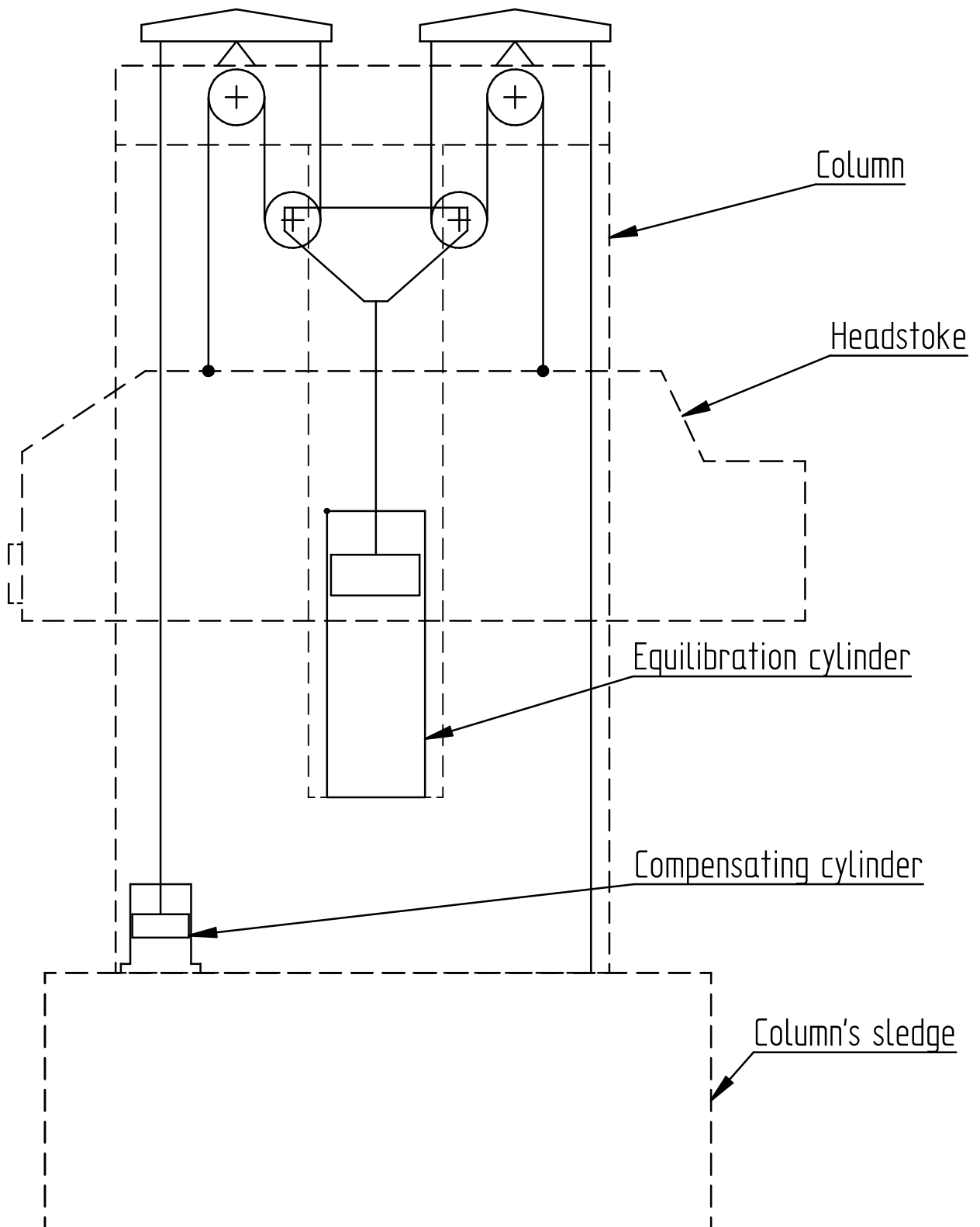


W-axis feed kinematical scheme

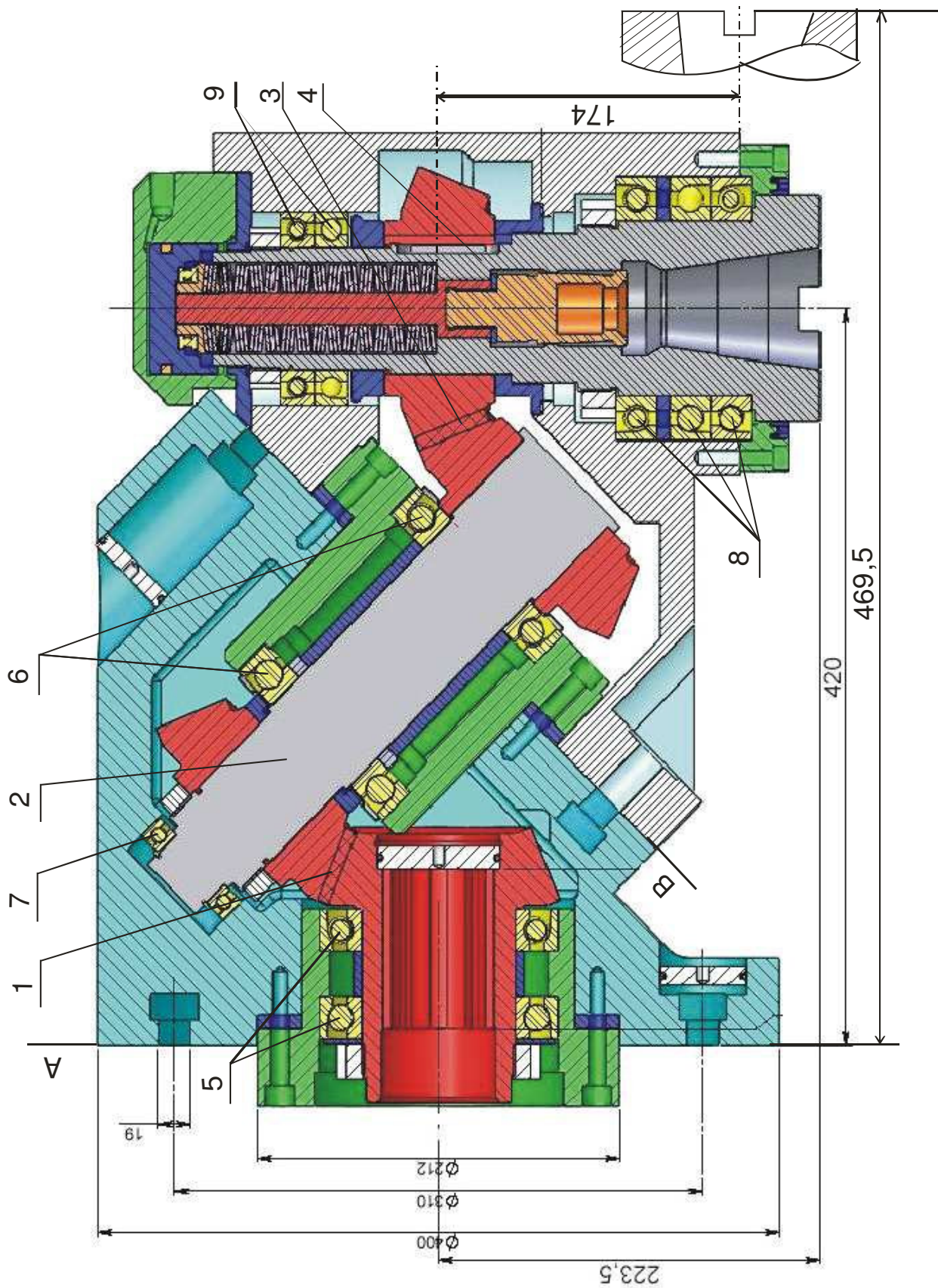
Drawing 4.9.3
W-axis feed

Kimenatical scheme Z-axis feed

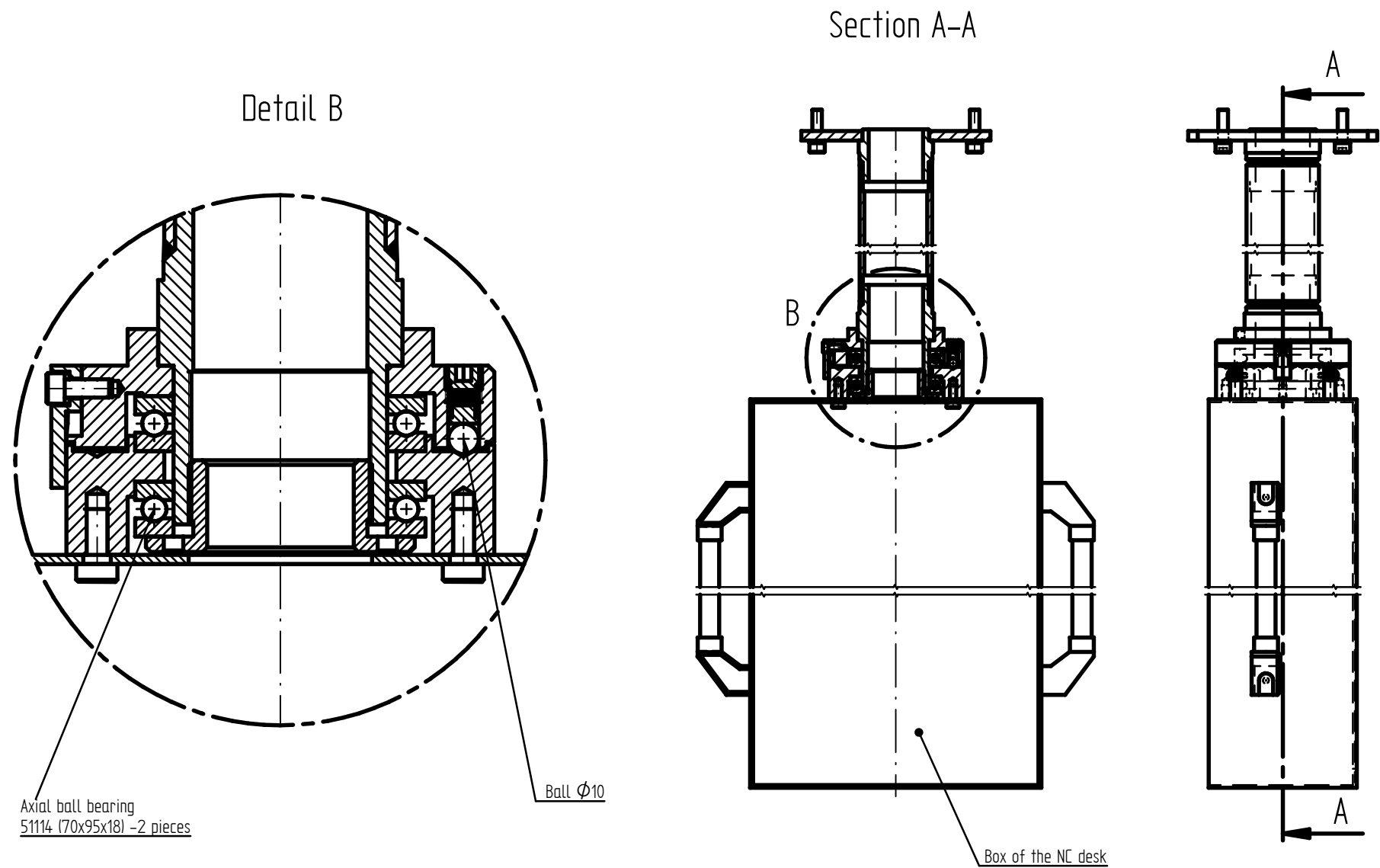


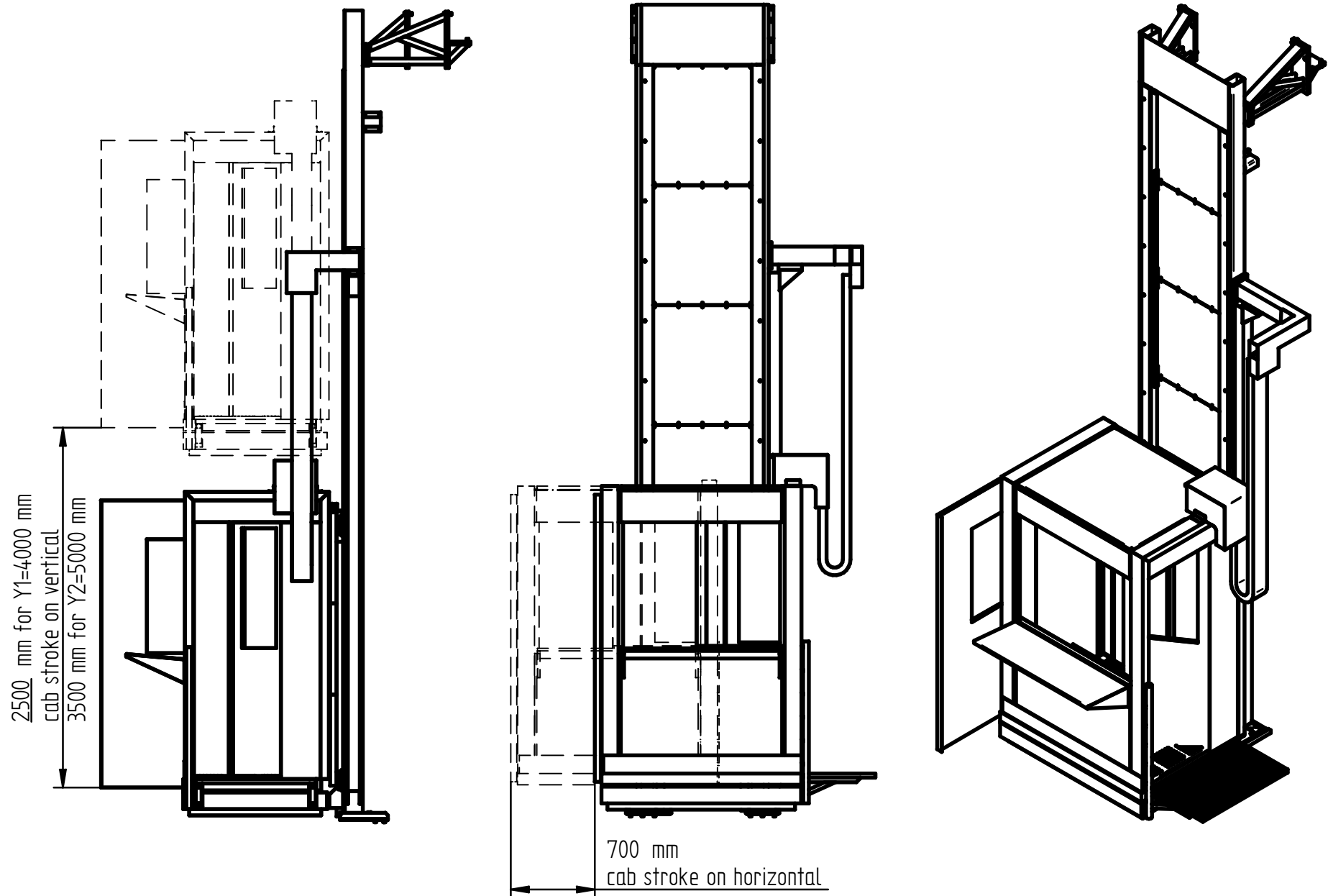


Drawing 4.10
Headstock equilibration



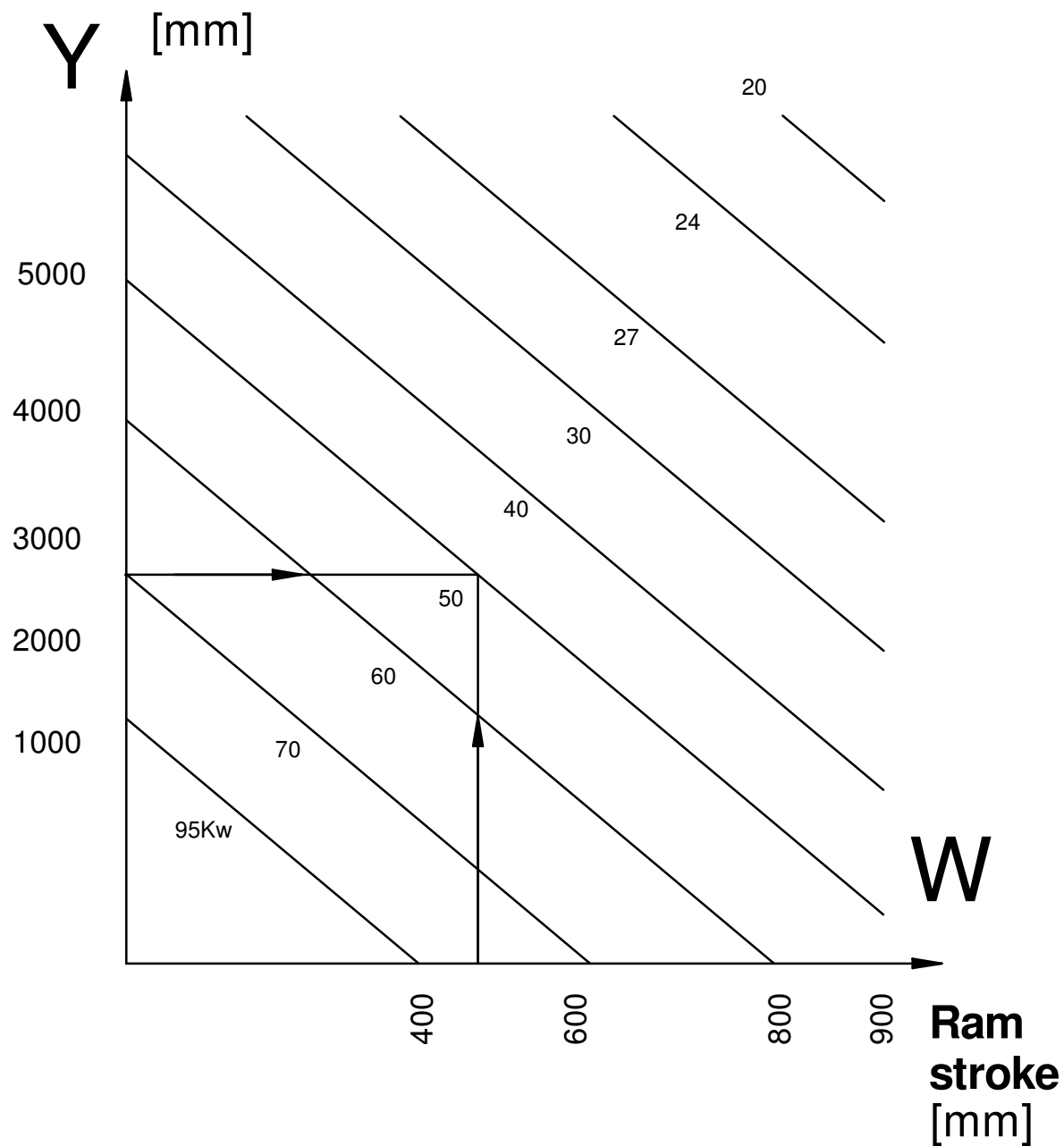
Drawing 4.12
Universal manual milling head



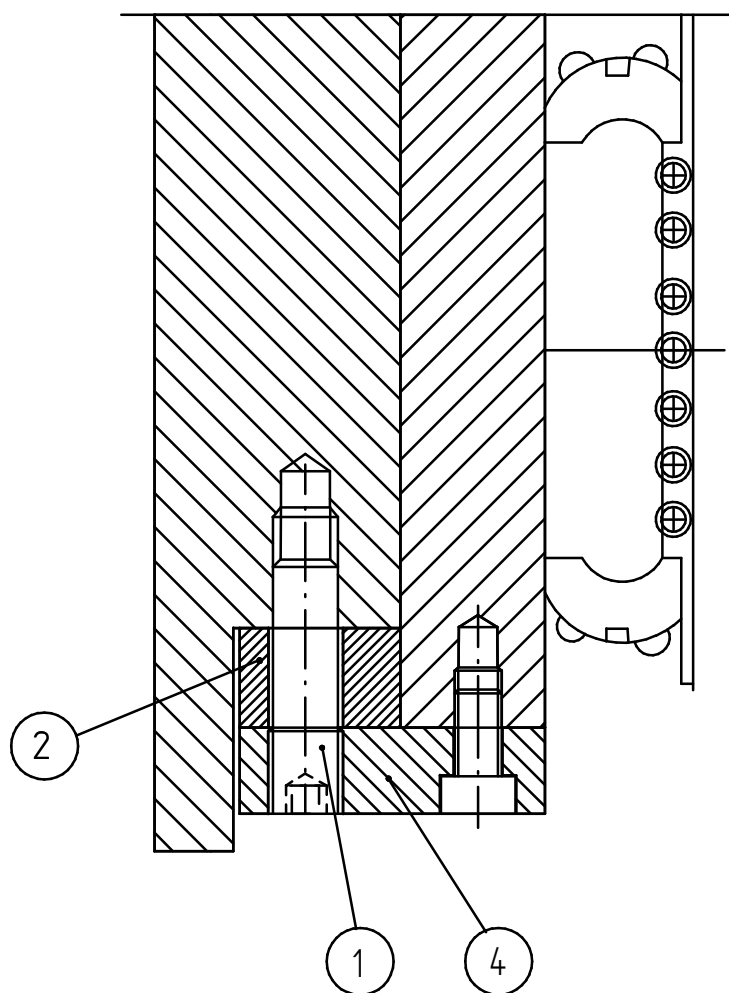
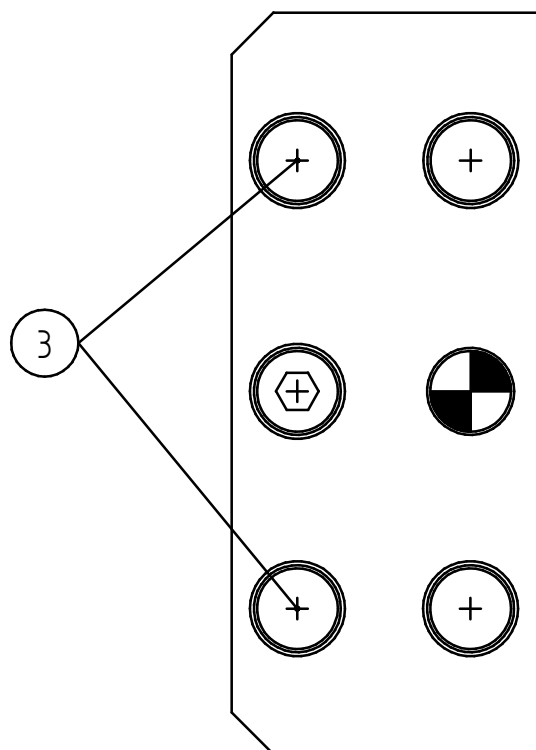


Drawing 4.17
Mobile cab

Headstoke stroke

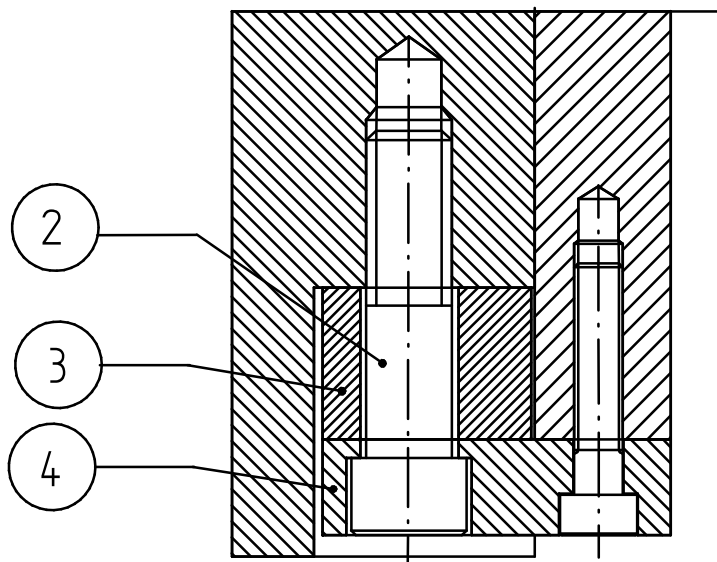
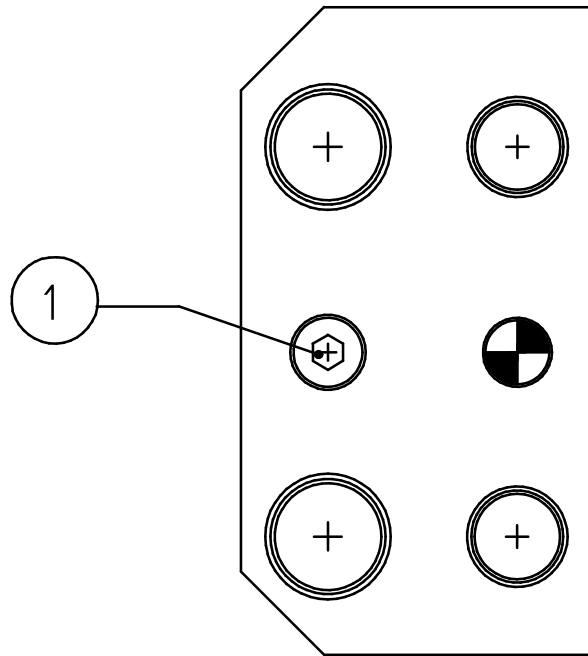


Drawing 5.4
Machine loading diagram

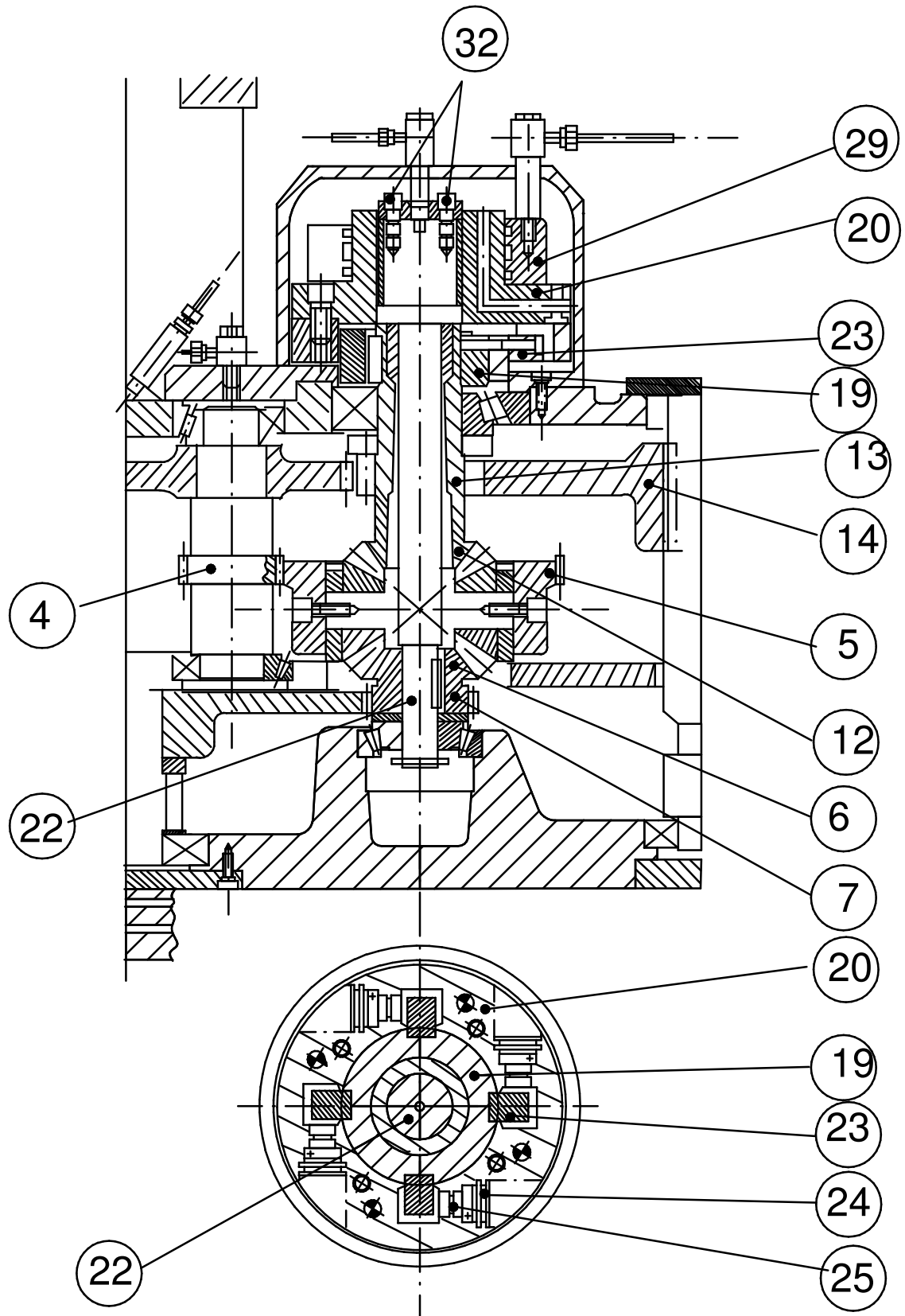


Drawing 6.4.1

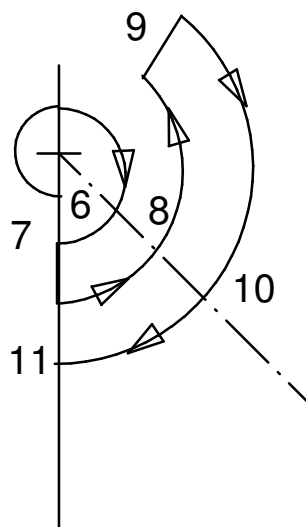
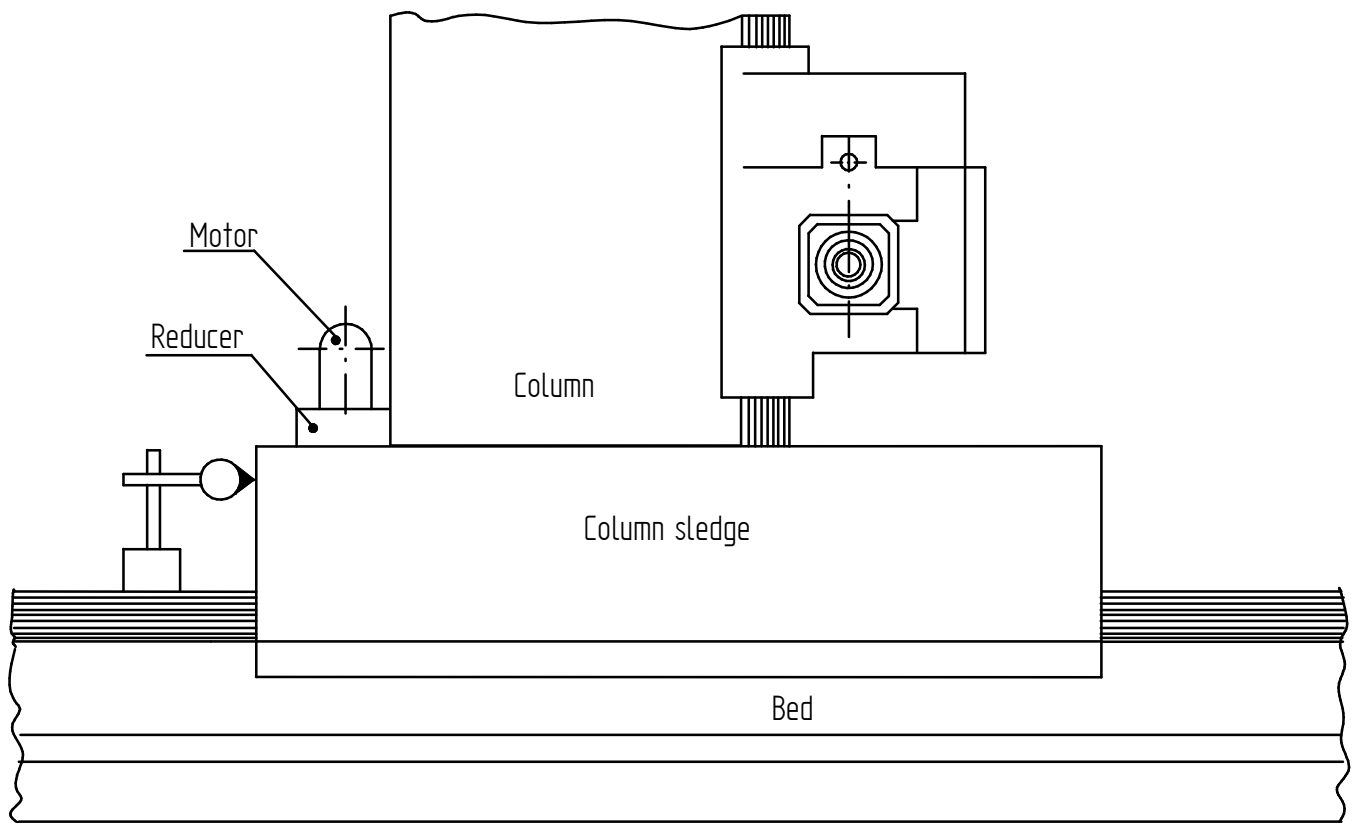
Gads adjustment at column sledge



Drawing 6.4.2
Gads adjustment of headstock and RAM



Drawing 6.4.3 / a
X-axis reducer adjustment



Drawing 6.4.3 / b
X-axis reducer adjustment

