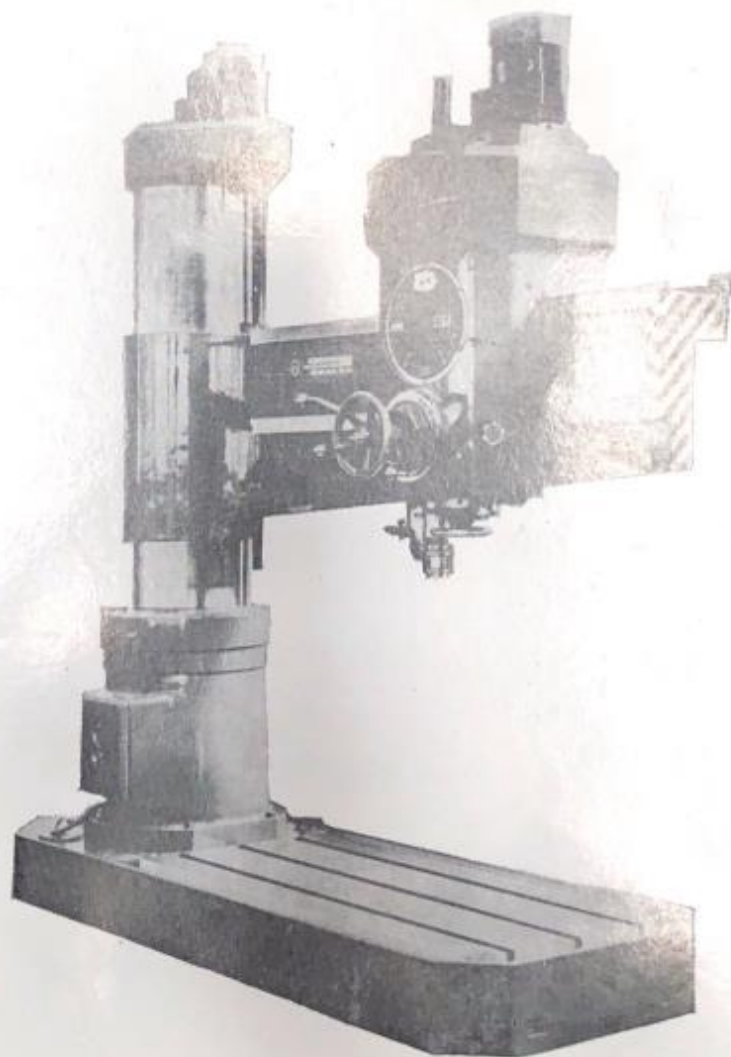


# **RADIAL DRILL POBEDA RB 70-1600**

## **MANUAL**



Based on Safety At Work Law, paragraph 45 (SAPV - Socialistic Independent Province of Vojvodina bylaw #10/79) and Issuing Certificates in Safety At work bylaw, paragraph 2 (SAPV bylaw #22/77), while based on research and approved statement #03-272/3 on day Feb-26-1981 the following is issued to:

IMM POBEDA 21000 NOVI SAD SFRJ JUGOSLAVIJA

(Motors and Machines Industry “Victory”) zip code, city name, Socialistic Federative Republic of Yugoslavia

**CERTIFICATE #175**

Of applied Safety At Work measures or generally acknowledged measures

For: RADIAL DRILL

Family, type, series and purpose: RB-70-1600

Year of production: 1998

**Technical data:** drilling diameter 56-80mm, cutting W-thread 2-21/2” (Whitworth thread – imperial, see Addendum), cutting fine threads 65-76mm, hole enlargement from dia 45mm to 90mm and dia 110mm to 130mm, drilling maximum radius 1800mm, drilling depth 400mm, spindle revolutions 14-1800 min-1 (rpm), step 0.0315-1.6 mm/rev, main spindle electric motor 5kW, required diameter of working area 4400mm, length x width x height (LWH) 2700 x 1020 x 3335mm, machine mass 4600kg

List of associated documentation: Construction documentation #22.0200.0000.03, Certificate of material quality, Warranty documentation, Manual and brochure.

Annotation: (leading engineers)

Kovach Miron, mechanical eng

Gojkovich Savo, electrical eng

For Institute

*(stamp and signature)*

*(Comment: page 2 and 3 not readable in original document)*

POBEDA

RADIAL DRILL

Belongs to

21000 Novi Sad – Yugoslavia

RB-70-1600

22.0200.7001.04

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*(Comment: document corrections)*

On page 37/48 in column “material”

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|                                  |                                     |
|----------------------------------|-------------------------------------|
| It says 50 kp/mm <sup>2</sup>    | should be 500 N/mm <sup>2</sup>     |
| It says 50-70 kp/mm <sup>2</sup> | should be 500-700 N/mm <sup>2</sup> |
| It says 12-18 kp/m <sup>2</sup>  | should be 120-180 N/mm <sup>2</sup> |
| It says HB=50                    | should be HB=500 N/mm <sup>2</sup>  |

On page 47/48      It says **Kp**      should be **N**

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|              |                 |
|--------------|-----------------|
| It says 1250 | should be 12500 |
| It says 2000 | should be 20000 |
| It says 3200 | should be 32000 |
| It says 5000 | should be 50000 |

Hydraulic scheme N<sup>o</sup> 70x1600

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|                               |                  |
|-------------------------------|------------------|
| It says 11 kp/cm <sup>2</sup> | should be 11 bar |
|-------------------------------|------------------|

Created      Approved      Issued

*(signature)*   *(signature)*   Jan-19-1981

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***Annotation: in further text original terminology “console” means “radial arm”***

## 1. INTRODUCTION

This instruction manual is mainly devised for technicians on the floor, whether they are operating the machine or performing maintenance. It's crucial to read through the *Manual* for correct usage and getting optimal production results.

Manual includes experience records that could be helpful in achieving your goals.

It's recommended this Manual is provided to a machine technician, maintenance technician or repair /service contractor, as well as process technologist to achieve optimal results.

If you go through this Manual thoroughly, machine can be assembled, set up in a designated space and deployed without help of a manufacturer's service specialist.

## 2. DELIVERY METHOD AND PACKAGING

Machine will be delivered either completely assembled or in sub-assemblies, depending on destination location, means of transportation, etc.

### 2.1 Delivery of complete machine assembly

If end user is located close to the manufacturer's site, machine will be transported fully assembled, without crate /dunnage, with appropriate mean of transportation and with a correct protection from damages.

In case of long delivery distances, machine will be packaged in wooden crate according to transport regulations.

### 2.2 Delivery of machine sub-assemblies

Sub-assemblies for delivery:

- a) Complete console with main spindle and spindle housing
- b) Complete main column
- c) Machine base
- d) Working table

## 3. MACHINE RECEIVING PROCESS

After removing transportation crate /dunnage, machine must be completely checked in order to detect damages during transportation. If there were any damages, they must be recorded and documented, and introduced to all involved parties.

While placing the machine in its designated spot, make sure rigging equipment (ropes, chains, hooks, clamps, etc) **do not touch** sensitive machine parts sticking out (spindles, hand wheels, levers, etc). If machine accessories are packaged in a crate, take them out and place them on a separate wooden pallet, to avoid any damage.

## 4. FOUNDATION

Machine foundation for radial drill RB-70-1600 should be done as per pic 2. If it's necessary to level upper base surface to the shop floor, then the base should be placed lower by appropriate measure. There should be an interspace calculated between foundation and machine base 25-30mm, so the machine can be horizontally leveled with shim plates and levels. You have to provide enough space for handling a hammer to place wedges under the machine.

Since the anchor bolts must be poured with concrete, after placing machine in horizontal position, it's recommended to provide inlet channels to anchor holes. These channels must be long enough, so the base plate (machine pedestal) does not cover them (see picture 2). Machine assembly can proceed only after the concrete is cured.

## **5. MACHINE INSTALLATION AND SET UP**

Remark: machine is easily tipped over if it's not secured into concrete, therefore console with spindle could rotate around column; proceed with installation only when the machine is secured with concrete anchor bolts.

### **5.1 Installation of fully assembled machine**

If the machine is moved around plant with industrial jack (lifting device), transportation should be done as per picture 5, so the base plate (machine pedestal) is horizontal at around 1m from the floor.

In this position, anchor bolts are installed and the machine should be placed on its foundation carefully. Make sure that anchor bolts are guided into their designated holes in foundation, right into the hole centers. If handled this way through, machine is ready to be horizontally leveled. To avoid unwanted stress in machine pedestal, spikes (wedges) must be arranged as per picture 3. Using spikes II and III bring the machine pedestal in horizontal position, at both longitudinal and transverse axis. The distance between spikes should be 300-350mm.

After placing the machine base in horizontal position, anchor bolts must be poured with concrete. When the concrete is cured, the machine base must be positioned perfectly horizontal, according to installation procedure. Machine base plate must be positioned over shim plates and anchor bolts must be tightened up, but it must be done carefully, so the base plate is not deformed /twisted. After this, machine base plate should be suffused (concrete poured underneath).

It's a slightly bigger problem if there is no industrial jack (lifting device) available. If such a case, anchor plugs made of grey cast iron should be installed in holes and then using rollers position the machine over the foundation and secure it with set screws into anchor plugs (poured with concrete beforehand).

After that, proceed with machine installation, as noted above.

### **5.2 Installation and assembly of machine sub-assemblies**

#### **5.21 Main column and machine base installation**

Base plate (machine base) lift up with a jack to 1-1.5m above ground and place anchor bolts in their position. Before placing machine base on its foundation, a piece of a flat iron bar 30x30x200mm must be placed between front anchor holes, longitudinal wise. After that, place the machine base carefully on the concrete foundation. Pay attention to the anchor bolts – they should easily slide into their holes. Arrangement of spikes /wedges for leveling should be as per picture 3. Proceed with machine base leveling as noted above.

After cleaning the surface of machine base, install the main column while moving it as per instructions on picture 7; main column is transferred over rail "T", which is secured with screws to the column shell. The lower surface of the main column must be cleaned up thoroughly before placing and securing the column with screws to the machine base.

### 5.22 Installation of console together with main spindle

Inspect the console collar for any damage that may have occurred during transportation. If any damages, they must be treated /repaired accordingly.

In order to install console on main column, it's necessary to open up the space in console using two spikes /wedges labeled "L" (see picture 9).

The proper way of transportation console with main spindle is depicted on picture 6.

While installing console on main column (well lubricated beforehand), make sure that guiding rod (flat spike) is perfectly aligned with a notch on column shell. After the console is fully engaged on column shell, remove "L" spikes /wedges. Then tighten up screws "K" (see picture 9) just enough to allow the console to slide freely on main column. Position the console at around 100mm from column locking ring. During this console movement, make sure there is no damage to the column shell. After that, lift up the console with a crane to approximately 300mm from the column flange and check for damages again. If there are any damages, remove the console from main column using spikes /wedges "L" and repair damages. Console re-installation should be done as noted above. If everything is all right, the console should be secured on column shell with "K" screws hard enough **not** to allow the console to slide down due to its weight. To make it safe, it's recommended to put a wooden log under the console (see picture 4).

**Attention: the console can be rotated around the main column only when the machine is secured to the foundation and suffused with concrete.**

### 5.23 Installation of lifting /lowering console drive

Clean up main column upper surface and lifting device lower surface "HW" (picture 4) and proceed with installation of lifting mechanism. The housing of lifting drive "HW" is placed on main column with conical pins and screws, so this part of installation is done. Built-in spindle carries mounting nut "Tr", which carries console "A" (see picture 10). Tension nut "Sm" is located under the mounting nut "Tr". Edge bar "AL" locks these nuts in top and bottom positions of tension nut "Sm", preventing them from moving. Screw the lifting spindle "Hs" into lifting device "Hw" (picture 8), but do not damage the bottom seal ring "SI", because it can cause oil leakage in lifting device "Hw".

#### **5.24 Installation of console spindle (main working spindle)**

After the motor is installed, hook up counterweight at the back side of spindle housing.

It's recommended to remove wire from the chain, which is attached to the tube – counterweight guide. Remove the holding bar with screws and nuts M3 from the bottom side of counterweight. Pull the counterweight on tube-guide, so the notches on counterweight are facing working side of console, then secure the chain with screws to the bar that's holding the counterweight.

Chain must be guided through the cut out on guide. Locking safety wire can be removed from engagement lever only after placing the counterweight protection; locking wire is located at the front of main spindle. If the engagement lever is in "ON /Engaged" position, it should be possible to easily move main spindle up and down by hand.

#### **5.25 Adjusting machine for correct functioning**

Level the machine with spikes /wedges into horizontal position, using label. During machine leveling, use the recommended standard procedure for receiving the machine. When the concrete for anchor bolts is cured, bring the machine in correct position according to the receiving rules. Machine base plate should be carefully placed onto shim plates and tightened up with anchor bolts, making sure that it's not twisted /deformed.

After this, machine base can be poured with fresh concrete.

#### **5.26 Adjusting blocking device and console lifting /lowering**

Remove square wooden log under the console, which served as protection. Rotate the spindle "Hs" (picture 10 page 28) by hand, until tension nut "Sm" is brought up to its top or most bottom position, so the edge bar "AL" is securely placed on sticking part of bushing "Ab".

Check the opposite direction too (upper or lower position).

In both case, striking surface of bar "AL" and bushing "Ab" must be equal. If there are significant differences, fine adjustments must be carried out, in following way:

Console A must be support with square wooden log again, remove fork screws "Gb", locking spindle "Sp" and locking screw pull to the right and then tie up fork "Gb" with screws again.

Remove snap ring Sg from tension nut Tr (picture 10) using special pliers. Pull the bushing Ab up and turn positioning nut Nm to the left or to the right (depending on where it's needed), then tie up bushing Ab with insert Ns to the positioning nut Nm. Reinstall snap ring Sg using pliers.

#### **EXAMPLE OF ADJUSTMENT**

Let's say, the nipple of bushing Ab 1.75mm is too high. Thread pitch on lifting spindle is 7mm, so that means if positioning nut Nm is turned  $\frac{1}{4}$  of circle (90 deg), the height of bushing nipple will move 1.75mm.

#### **5.27 Adjusting console tension (knee clamping)**

Locking or tightening of console collar is done with a special device, which is automatically unlocked if the console is activated (in motion – up or down).

Tightening screws "K" (picture 9) should be adjusted in such a way, so that a gauge plate 0.03mm thick cannot be inserted between column shell and console collar, if tightened properly.

Nuts for slot M must be adjusted in such a way that when console is unlocked, gauge plate 0.2mm can be inserted.

### 5.28 Main column and spindle locking

Hydraulic locking device is electro-hydraulic activated. For activating, use wing lever 2 (on picture 2), located in front of hand wheel 3. Pressing the wing lever on the left or right side will unlock or lock the machine. This device will lock /unlock main column and spindle, but not the console. (see paragraph 5.27).

The main column outer tube (shell) is axially tightened up with the column. Locking of main column and shell is done by a segment located between them. Locking the main spindle to the console is happening at the same time as locking the main column. Tightening of main spindle is done right if it's very hard to move the spindle along the console with hand wheel. While it's locked, main spindle is recessed in prism guide at sharp angle. This way, the contact gap between console and spindle is removed /non-existing, so the drilling force is directed upwards, towards the console. During drilling operation, main column and spindle must be locked, to avoid vibrations and unwanted oscillations from a drill bit. Both blocking devices must be set up in such a way that machine column is immobilized first and then the spindle.

## 6. ELECTRICAL EQUIPMENT (see associated electrical scheme 22.0202.6001.03)

During connecting to the power grid, pay attention to RST and Z phases, they must match with machine connections.

If this is not done correctly, motors may start rotating in a wrong direction. Consequences that may appear: the motor that moves the console might not be automatically shut off, which could cause machine break down.

### ATTENTION:

After connecting the machine to the power grid, the motor for console tiedown must be turned on first and then the motor for console lifting /lowering. If the machine is connected correctly, all the required functions should be working properly. In case when the lever in "Unlocked /Released" (originally "Otkoceno") position does not unlock machine column or spindle, it means the machine is connected incorrectly.

Spindle motor has a correct spinning direction if the oil in tank is noticeably dropping down, which could be observed on oil gauge. **The motor for console lifting /lowering should turned on only after checking all above mentioned devices and for a short period of time.**

If the console is moving in the opposite direction from how it's been set up, immediately shut it off with switch 13.

## 7. TECHNICAL DATA

|                                                             |                      |
|-------------------------------------------------------------|----------------------|
| 1. Drilling steel C0645                                     | up to dia 56mm       |
| 2. Drilling steel C0645 with short carriage return          | up to dia 65mm       |
| 3. Drilling in SL.22 ( <i>gray cast, see addendum</i> )     | up to dia 70mm       |
| 4. Drilling in SL.22 with short carriage return             | up to dia 80mm       |
| 5. Hole enlargement dia 45mm in C0645                       | up to dia 90mm       |
| 6. Hole enlargement dia 90mm in C0645                       | up to dia 110mm      |
| 7. Hole enlargement dia 55mm in SL.22                       | up to dia 110mm      |
| 8. Hole enlargement dia 110mm in SL.22                      | up to dia 130mm      |
| 9. Cutting imperial threads (W-threads) in C0645            | up to 2"             |
| 10. Cutting imperial threads (W-threads) in SL.22           | up to 2-1/2"         |
| 11. Cutting fine threads in C0645                           | up to M64x2 mm       |
| 12. Cutting fine threads in SL.22                           | up to M76x2 mm       |
| 13. Maximum drilling radius                                 | 1800mm               |
| 14. Maximum drilling depth                                  | 400mm                |
| 15. Pillar diameter                                         | 400mm                |
| 16. Maximum distance between working spindle and base plate | 1600mm               |
| 17. Minimum distance between working spindle and base plate | 500mm                |
| 18. Spindle spherical cone                                  | MK 5                 |
| 19. Machine base dimensions                                 | 2720 x 1020 x 220 mm |
| 20. Working spindle revolutions range                       | 14-1800 rpm          |
| 21. Number of spindle revolution adjustments                | 22                   |
| 22. Transmission coefficient                                | $g=1.25$             |
| 23. Carriage return (steps)                                 | 0.0320 mm/rev        |
| 24. Number of carriage return adjustments                   | 18                   |
| 25. Main power motor    - revolutions                       | 1440 rpm             |
| - power                                                     | 5.5kW                |
| 26. Console motor for lifting/lowering - revolutions        | 1425 rpm             |
| - power                                                     | 1.5kW                |
| 27. Motor for blocking    - revolutions                     | 1390 rpm             |
| - power                                                     | 0.55kW               |
| 28. Net weight                                              | 4600kg               |

|                                |                   |
|--------------------------------|-------------------|
| 29. Gross weight               | 5800kg            |
| 30. Required area volume       | 11 m <sup>3</sup> |
| 31. Working table - width      | 710mm             |
| - length                       | 710mm             |
| - height                       | 500mm             |
| - weight                       | 360kg             |
| 32. Working table slots        |                   |
| Top surface - number of slots  | 5                 |
| - width                        | T 20mm            |
| - distance                     | 140mm             |
| Side surface - number of slots | 3                 |
| - width                        | T 20mm            |
| - distance                     | 125mm             |
| 33. Cooling system – weight    | 17kg              |

## 8. LUBRICATION

### 8.1 Lubrication oil

The shape of the main spindle is designed as an oil tank. Gear pump sucks in oil over the mesh and pushes it into hydraulic bodies, who provide changes to rpm, carriage return, spinning direction of main spindle, as well as power to the spindle brake. Change of spinning direction is performed over a hydraulic lamellar couplings.

Oil inlet hole is located at the right side of spindle, and it's covered with a lid. Pour oil until its level reaches the bottom mark /hole on oil gauge. Oil level will decrease during machining operations and it's nothing of concern. Pour the oil up to the upper mark on oil gauge only at the first oil fill up and machine first start up, after first 5 min of running. Too much oil will create an unnecessary higher pressure in the spindle and oil leakage. Spindle should use hydraulic oil 4.5-5.5E at 50C degrees (INA-HIDRAOL 50HD). Perform oil change once a year and release machine oil using the plug at the bottom of spindle housing.

Lubrication scheme is shown on picture 13.

### 8.2 Cleaning oil mesh (oil strainer)

It's necessary to clean up oil mesh over time, located at the bottom of spindle housing. Using special pliers, unscrew threaded plug – mesh carrier. Release the oil through its outlet before cleaning the mesh.

## 9. MACHINE DESCRIPTION AND INSTRUCTIONS FOR FIRST RUN AND MAINTENANCE

### 9.1 Machine description

Main machine controls are shown on picture 1.

Box with electrical switches is located the bottom of the main column and inside is the main switch 13 and the coolant pump switch 14.

The console is moving up and down over the main column shaft while the motion is provided by threaded shaft. The shaft is situated inside lifting mechanism. Main spindle is powered by electrical motor over the gears. When the lever is in UP ("**gore**") position console is moving up, but when the lever is in DOWN ("**dole**") position console is moving down. If the lever (1.) is in neutral position (in the middle), the console is automatically locked. On the left side of spindle housing, above the engagement lever, there is ON/OFF button to turn the main spindle motor on or off. At the front side, in front of the hand wheel (3), there is a lever (2) for locking and unlocking main column and spindle. With lever (20) start the motor that will lock /unlock main column and spindle through electro-hydraulic system. Using hand wheel (3) move the spindle left-right over the console. Spindle tuning head (for adjustments) is located behind this wheel (3) and it has two engagement levers. If they are pushed against the spindle, mechanical carriage return (for drilling with spindle) is activated. If the levers are pulled back towards an operator (technician) the spindle head can be rotated manually, for quickly moving the spindle up and down. Plate with a scale (5) is located on spindle tuning head and it provides drilling depth adjustments. At the lower side of tuning head there is a hand wheel (6) for fine manual motion. Use lever (12) for engaging /disengaging carriage return clutch during automatic carriage return.

Use small hand wheel (7) to choose one of 22 spindle rpm settings. The chosen rpm setting can be checked at the eyesight window (8). Use small hand wheel (9) to pick one of 18 carriage return settings, which can be checked at eyesight window (10). Lever (11), located at the bottom right, is used to change the direction of spindle rotation as well as locking it.

### 9.2 Testing machine functionality

After the machine is positioned in its place and correctly set up for work, you have to test its functionality.

Check the following:

- a) Is the main power voltage correct? Fuses can withstand +10% of deviation
- b) Are the valid fuses installed?
- c) Is the machine not damaged, lubricated and filled up with correct oil?
- d) Is the spinning direction correct?
- e) Is the coolant tank filled with coolant liquid?
- f) Is the hydro power properly connected?

If all the check points are validated, machine can be turned on. First step is to turn on the main switch (13) to activate the main motor.

Using lever (1) move the console to appropriate height and using lever (2) unlock main column and spindle. Move the spindle left-right over the console with wheel (3). If the console with spindle needs to be rotated at certain angle, it's recommended to do it with wheel (3) – without rotating the wheel, of course.

When the spindle is brought to “working” area, lock the main column and spindle with lever (2) (while the console is automatically locked). It's recommended to select low spindle rpm with hand wheel (7) – for example 22,4. Levers (4) should be left in “automatic carriage return” position.

Spindle rotation direction is controlled by handle (11). If the lever is set at middle position, spindle should stop immediately. If the lever is set at right position (“*desno*”), the spindle will rotate in left direction. Rotation in left direction is 1.4 times faster than the same rpm in right direction.

Whether the spindle is rotating to the left or to the right, it could be moved up and down by lever (4). If the spindle is rotating without any issues during this trial, proceed with increasing rpm's.

When the spindle rotation is set to medium rpm around 125 rpm, while rotation is set to the right, the smallest carriage return 0.032mm/rotation can be achieved and checked at control sight (10).

With lever (12) set in left position and handle (4) engage automatic spindle carriage return.

Check if mechanical step (carriage return) of the spindle is correct using vernier or caliper and compare it with a scale on spindle head. If everything is all right, proceed with increased rpm's.

After all the functions are tested, machine is ready for work.

## **9.3 Operating manual**

### **9.3.1 General remarks**

Working with this machine is very simple. A technician who is working with the machine will become very familiar with all required features and settings after a relatively short period. In any way, technician should study tutorial in chapter (9.1). Quite often an unsuccessful operation is blamed on machine malfunction. There are several factors affecting machine performance (tooling, material used for production, machine spindle settings, etc).

During work, pay attention to how a drill bit is sitting in spindle conical head. To achieve appropriate incumbency, both spherical cones must be equal and geometrically very precise. To achieve best efficiency, drill bit should be sharpened with a special sharpening tool and not doing it by hand.

Possible errors may occur if a machined material is not secured properly. If material is deformed or twisted and not tightened up properly, drilled holes will be oval and not parallel between each other.

These few examples show how poor a machined part can get by applying inappropriate settings, regardless of machine precision and condition.

### **9.3.2 Example of simple drilling**

Task:

Drill a hole (blind hole – not a through hole) at 20mm dia, 12mm deep, in solid grey cast material, hardness HB=20kp/mm<sup>3</sup>, with rough top surface.

Tooling:

Spiral drill bit 20mm dia, made of high-speed steel

Work instructions:

Work piece must be fastened to the working table and the main spindle brought up to a drilling area, but the spindle should be in a top position. With this initial setting, machine is ready to start.

Using levers (4) bring the tip of a drill bit onto a hardwood piece or aluminum plate, which should be placed right beside processed piece and gently press drill bit against it.

This is to make sure drill bit is properly secured inside the spindle.

After that, bring the drill tip over drilling point, marked with a punch.

In order to set the drilling depth 12mm (the depth of cylindrical hole), it's necessary to take into account conical edge of the hole, which is around  $1/3$  of drill bit diameter. In this case it's an addition of  $20/3 = 6.6\text{mm}$ . The hole depth is 18.6mm. To set up this depth, the scale must be released with wing nut and then turn the loose end of scale until 18.6mm notch is aligned with 0 (zero) position – notch on scale. In this position, turn wing nuts back to move the plate with scale back into starting position. This setting is often too coarse, so to perform fine tuning use worm gearing located at the tangent to the scale pulley. At the end, terminal plug at the pulley must be pressed in (see picture 11). After fine depth tuning is done, it's necessary to lift up the spindle by a few millimeters with a lever (4) and turn on automatic carriage return with a designated lever. Pick appropriate records from chart (2), which in this case, would be:  $v=18\text{m/min}$  (???),  $n=280\text{rpm}$ ,  $s=0.25\text{mm/rev}$ . Data for rpm and carriage return are adjusted with hand wheels (7 and 9) and can be checked at control sights (8 and 10). Huge advantage of this machine is, that after this settings, operator can choose another set of parameters, for a next duty cycle, which provides for a significant time savings. If all the settings are completed, proceed with drilling operation as noted above. When the preset drilling depth is reached, carriage return is automatically disconnected, lever (12) automatically moves to "Disengaged" position ("*iskopcano*"), but the spindle is still rotating and doing drilling without carriage return. Turn hand wheel (6) for  $1/4$  of turn to the left, pull out engagement levers (4) and then the spindle with a drill bit can be pulled out from the whole. This would be the last step in drilling operation. If the parameters for duty cycle are set up and if using the same tool, spindle does not need to be stopped for next drilling operation. In case the lever (12) disengages by itself during drilling operation, that means the parameters for drilling are too high, or the tool (drill bit) is dull, or machined material has hardness too high. Lever (12) and carriage return clutch are adjusted to 1500kp of force that machine can take. **During drilling operation, avoid touching lever (12).** If the lever is hard fixed /blocked, the machine can break down.

### 9.3.3 Machining threads (cutting threads)

Cutting threads can be done with manual carriage return, using levers (4). To make sure automatic carriage return is not engaged, press the safety button at the head to lock the levers (4) into manual position. **During this, pay special attention to rotational direction set up of the spindle**, controlled by lever (11), which should be switched from the “right” position (originally “*desno*”) to the “left” (originally “*levo*”).

## 10. MACHINE MAINTENANCE

To get the most efficient results and to provide long lasting running period, machine must be meticulously maintained. Appropriate lubrication must be done once a week, as per instructions on (picture 13). Main spindle, inside its casing, could be contaminated with fine drilling chips or dust. Pay attention to this area and clean it from time to time.

Water pump for machine cooling, is located at the machine base. Coolant solution must not contain too much oil, because it may decrease cooling effects in drilling area. **It is recommended to exchange the coolant at least once a month.**

## 11. TROUBLESHOOTING

### 11.1 Strange noise occurs while lifting or lowering console

Perform: Adjust tensioning screws (K) on console shell (see picture 9).

### 11.2 Not enough throughput in oil pump

Most likely, oil strainer (mesh) has caught some dirt and it should be cleaned up. It is recommended to clean the strainer quite often; first step is to deplete oil completely and then pull out pipe connection to release the strainer (oil mesh).

### 11.3 Oil leak at main spindle

If oil drops are more intensive, there could be too much oil filled in, which could be checked at oil gauge.

Perform: Deplete excess oil or exchange the seal on main spindle.

### 11.4 Disassembling main spindle

After removing protection cap from counterweight, detach the chain from counterweight. Use a piece of wire at the end of chain to make it easier to reconnect counterweight during assembly. Main spindle should be supported with wooden log and remove adjustment head. Alongside, remove wing nut and hand wheel with straight terminal. After removing ring with scale, next step is to take out screws and cylindrical cotter pins from bearing flange and finally, remove adjustment head. Spindle can be taken out easily, after the chain, counterweight and wooden log are removed.

### 11.5 Main column additional tightening

After some time, it's necessary to tighten up main column. This adjustment is done by turning screws located under the protection ring by 1/6 of circle, which should be enough.

### 11.6 Main spindle additional tightening

Device for additional tightening is located on the left side of the spindle. Tightening is done by turning wheeled pin.

Both additional adjustments on main column and spindle should be done in following sequence: Main column first and the spindle.

## 12. MACHINE DISASSEMBLING

Basically, disassembling can be done in reverse order of assembling (see paragraph 5.2).

## 13. INCOMING INSPECTION

While receiving machine for production process, follow rules for incoming inspection.

**Parallel distance between machine base and spindle must not be controlled /checked with gauge installed in main spindle.** This would mean the console total angle is checked.

## 14. HYDRAULIC SYSTEM FOR MACHINE CONTROLS

For better understanding, use hydraulic scheme 22.0202.6002.02 which is added in annex. The bottom part of the spindle serves as an oil tank (RV). Geared pump (P) sucks the oil in from oil tank over filter (F) and fills in clutch housing. For correct functioning, oil pressure must be at 11 at (1at= 101.325 kPa=14.7psi). Oil pressure is regulated with safety valve (VS). Excess amounts of oil overflows from safety valves and is used for lubrication. The oil is coming through regulating valve (RP) into rotating distributor 6/3 (A), and then into cylinder (M). On cylinder's piston, there is a fork that activates clutch for changing direction of spindle rotation. The brake (Br) is mechanically activated by spring, and hydraulically deactivated by engaging the clutch.

Changing of rpm and carriage return is hydraulically controlled. RPM and carriage return settings can be done during work. Drilling parameters can be preset for *right* direction of spinning – *working direction*. If right direction is activated, oil flows over differential distributor 3/2 (D) and rotational distributor 6/3 (A) and under pressure flows through rotational distributor 11/22 (C) and moves cylinder pistons, that have forks (e, f, g, h) to control motion of shifting group of gears.

To choose a certain carriage return, use rotational distributor 10/18 (B). Through this distributor, oil is coming into cylinders and pushes appropriate pistons, that have forks (b, c, d) to control motion of shifting group of gears.

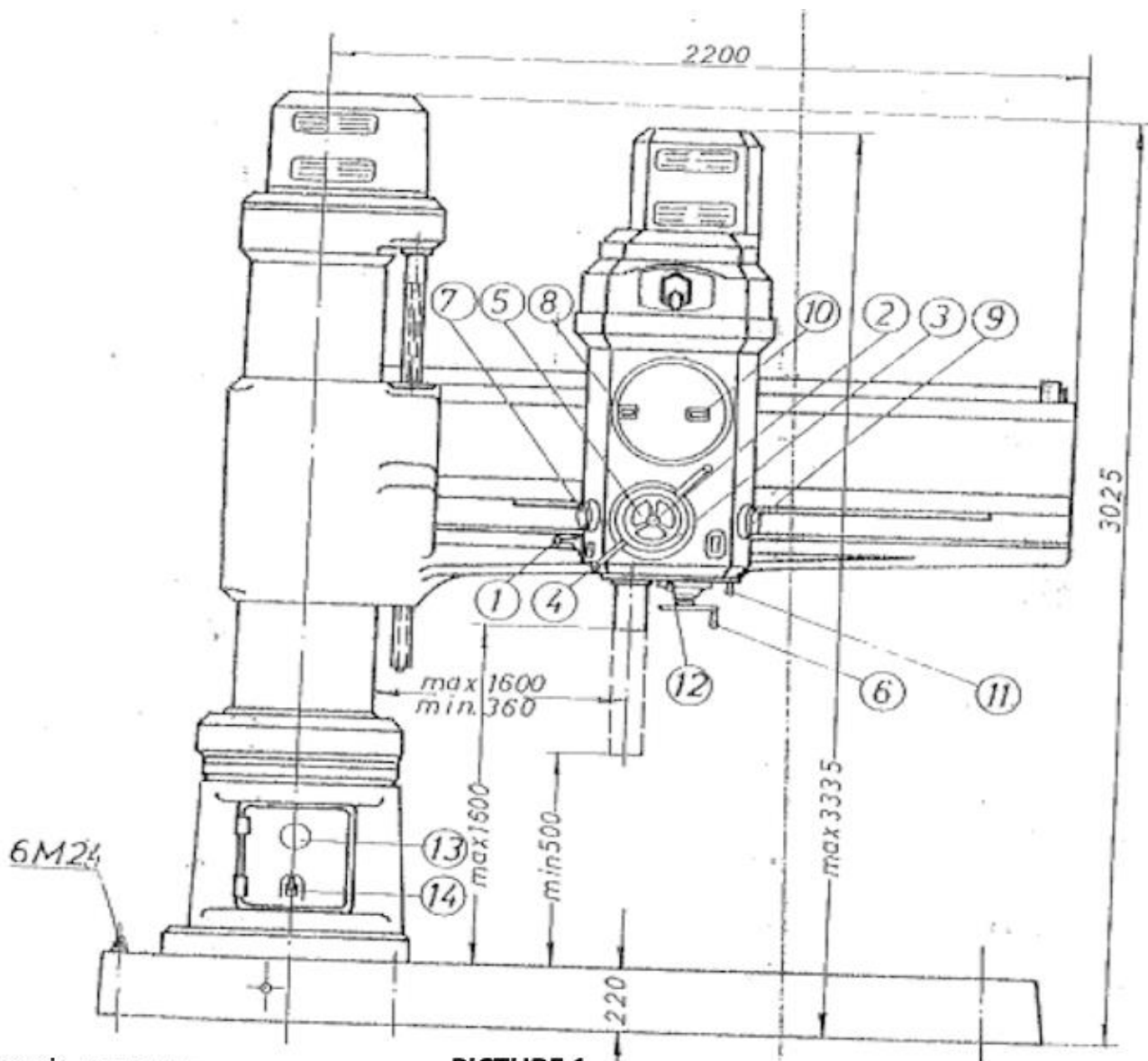
Hydraulic impulse doesn't last long, so the forks are fixed in a certain position with a snap ring and spring located on the guide. To move forks b, c, d, e, f, g, h and fork (a) to engage clutch, braking speed, deceleration, is adjusted with restriction valve (RP). Oil pressure formed in working cylinder (M), is applied to differential distributor 3/2 (D), and due to this pressure this distributor connects hydraulic lines and distributors B and C to the tank. This way, cylinders with pistons that carry forks b, c, d, e, f, g, and h, are unladen.

## 15. HYDRAULIC TIGHTENING SYSTEM

For better understanding the following section, consult hydraulic scheme 22.0202.6002.02 in addendum.

Hydraulic tightening system is located inside lifting drive housing, which is mounted on the top of the main column. Tightening drive locks up main column to the shell and main spindle to the console.

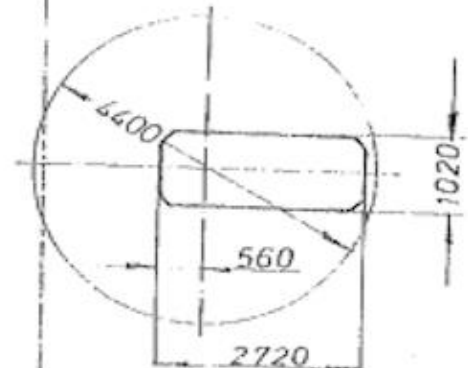
Bi-directional geared pump (P) is powered by electric motor with overlapping poles. The pump is transferring oil from one side of cylinder (M) to the other side, over the safety valve (VS), which creates necessary pressure for moving the piston. The piston has cogs on one side like a geared bar and it powers gear (R) that is using shaft and camshaft plates to activate lever system for locking and unlocking main column and spindle. Excess oil returns back to the tank over safety valve (VS), located in lifting drive housing. If the amount of oil on one side of piston (M) is not enough to move the piston, pump is taking more oil from the tank, and directional one-way valve (NV) at inlet line is opened. The other one-way valve prevents the oil to flow back into the tank.

Legend: *LEGENDA:*

PICTURE 1.

1. Handle for lifting and lowering main console with automatic tightening
2. Locking and unlocking spindle housing
3. Hand wheel for moving spindle housing
4. Handles for moving spindle head
5. Drilling depth adjustment
6. Hand wheel for manual carriage return
7. Choosing rpm using hydraulic power
8. Reading "n"
9. Choosing carriage return using hydraulic power
10. Carriage return control window
11. Clutch lever for left or right spindle direction
12. Carriage return clutch
13. Main switch
14. Coolant pump

NECESSARY SPACE  
 ПРИБЛИЖИТЕЛЬНЫЙ ПРОСТОР  
 1 : 100  
 1 : 100

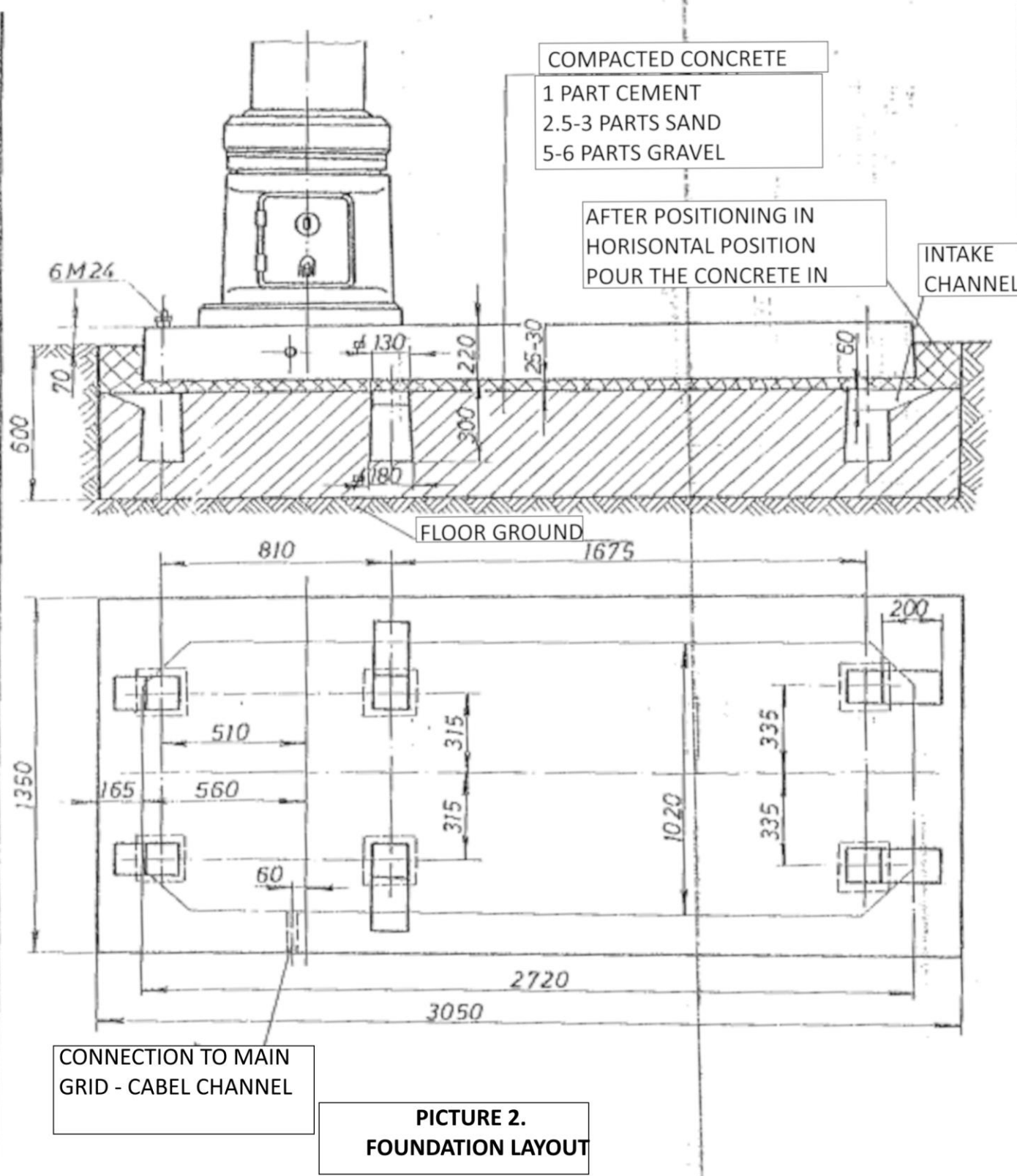


Name

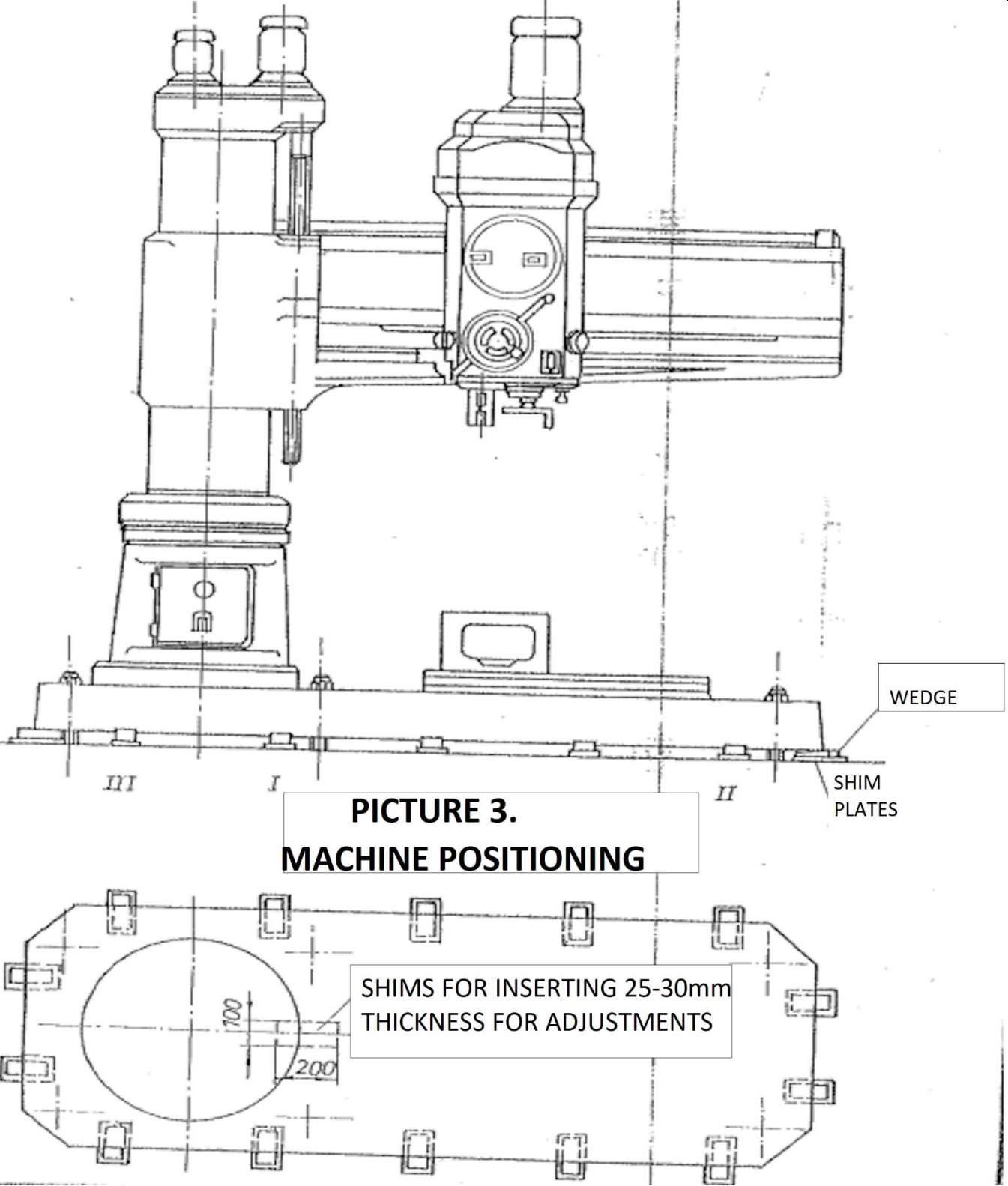
RADIAL DRILL RB70-1600

Number

22.0200.7001.04



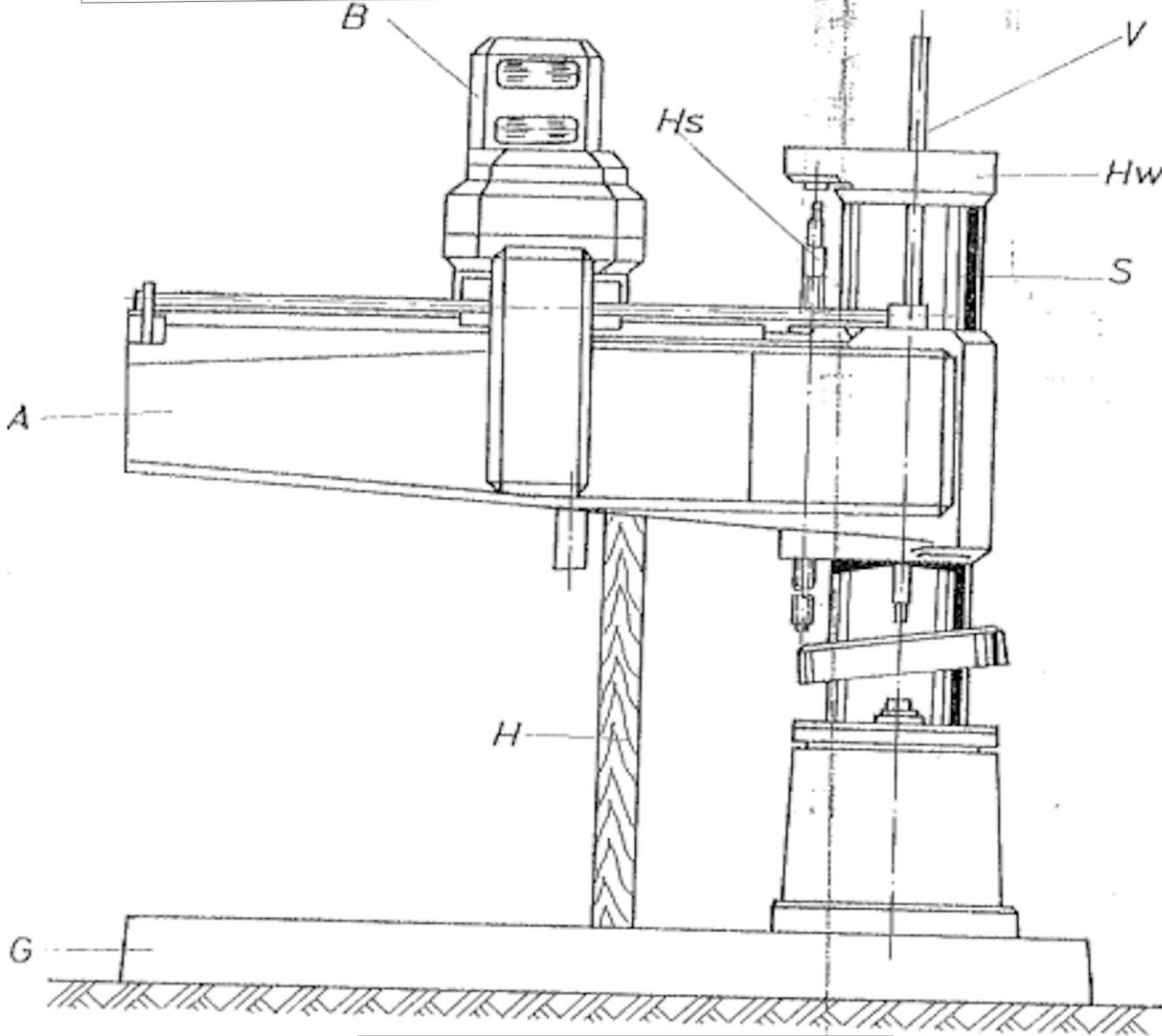
|  |                        |                 |
|--|------------------------|-----------------|
|  | Name                   | Number          |
|  | RADIAL DRILL RB70-1600 | 22.0200.7001.04 |



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|--|------------------------|-----------------|
|  | Name                   | Number          |
|  | RADIAL DRILL RB70-1600 | 22.0200.7001.04 |

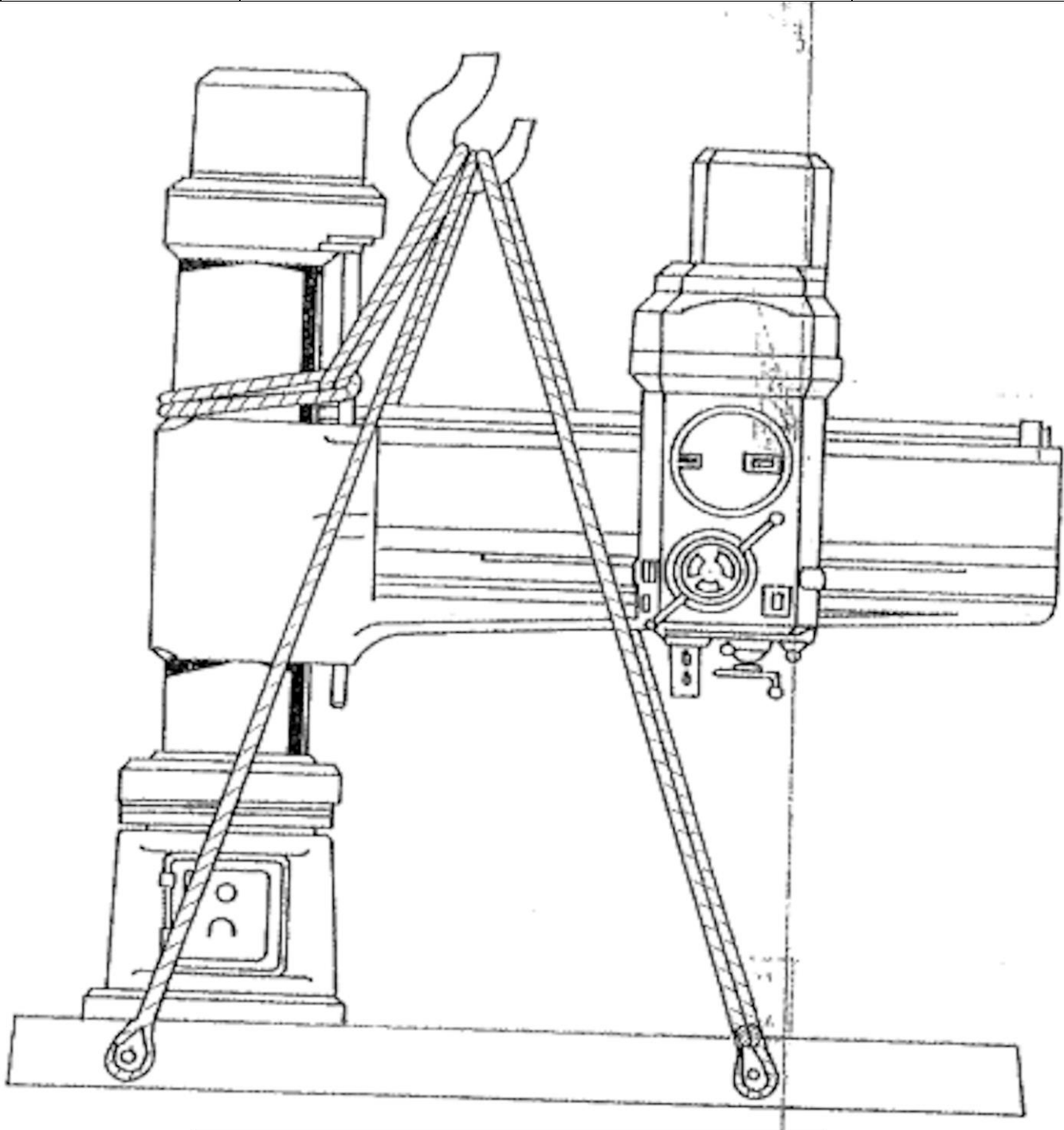
LEGEND:  
 A- CONSOLE (RADIAL ARM)  
 B- MAIN SPINDLE  
 Hs- THREADED SHAFT  
 V- MAIN COLUMN LOCKING SHAFT

Hw- LIFTING MECHANISM  
 S- MAIN COLUMN SHAFT  
 H- WOODEN LOG  
 G- MACHINE BASE



PICTURE 4.  
 MACHINE MOUNTING

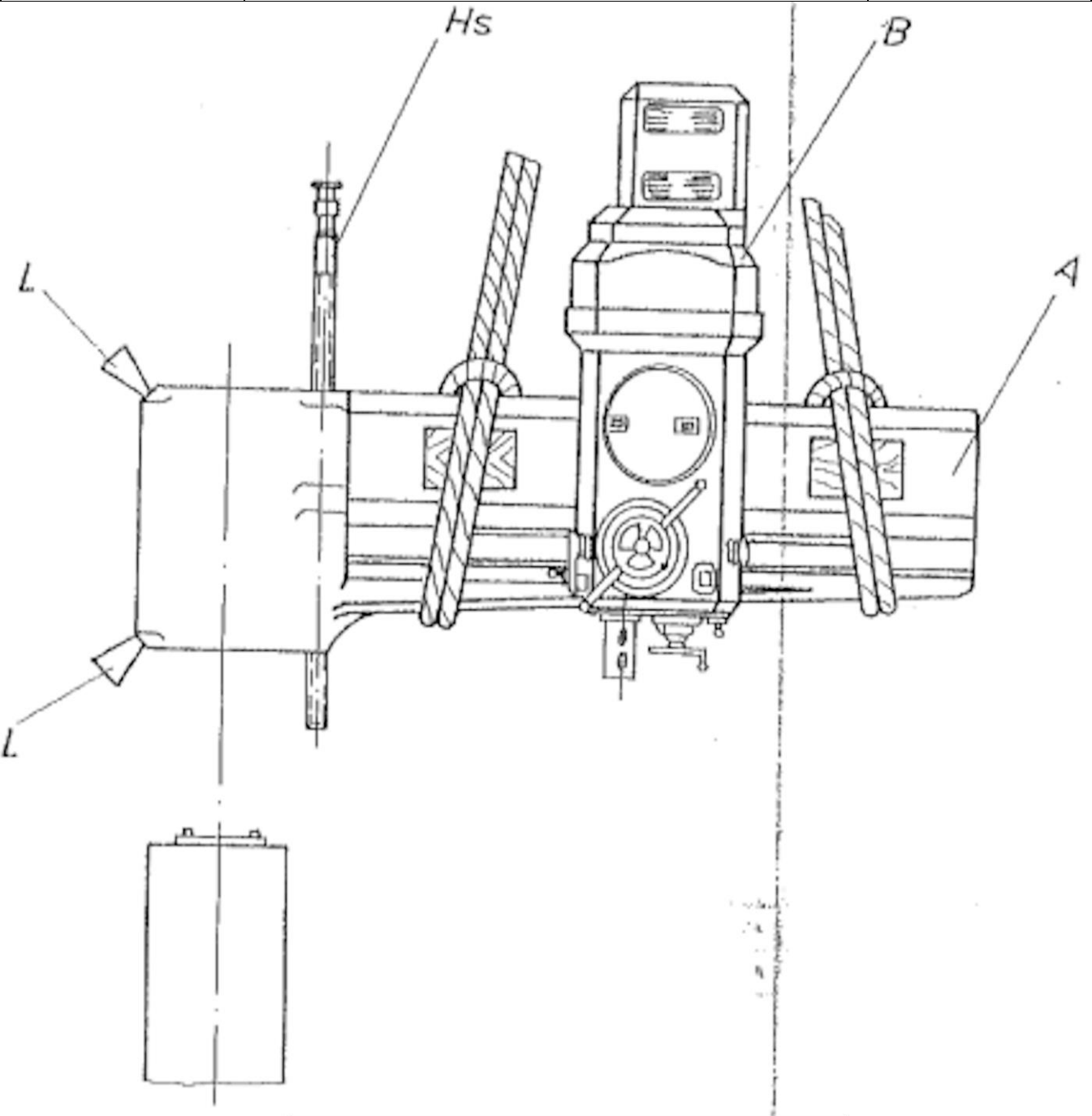
|  |                                |                           |
|--|--------------------------------|---------------------------|
|  | Name<br>RADIAL DRILL RB70-1600 | Number<br>22.0200.7001.04 |
|--|--------------------------------|---------------------------|



**PICTURE 5.**  
**HOW TO TRANSPORT MACHINE**

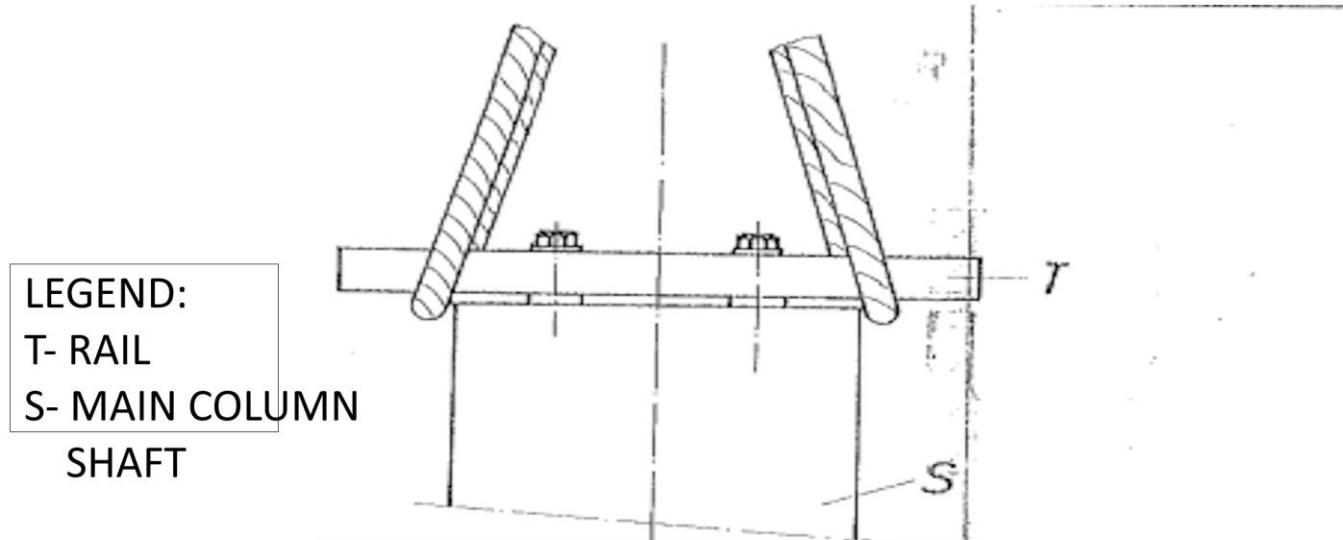
|  |                     |                     |
|--|---------------------|---------------------|
|  | Doc # BR-010 in Trp | page 24<br>pages 48 |
|--|---------------------|---------------------|

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|  | Name                   | Number          |
|  | RADIAL DRILL RB70-1600 | 22.0200.7001.04 |



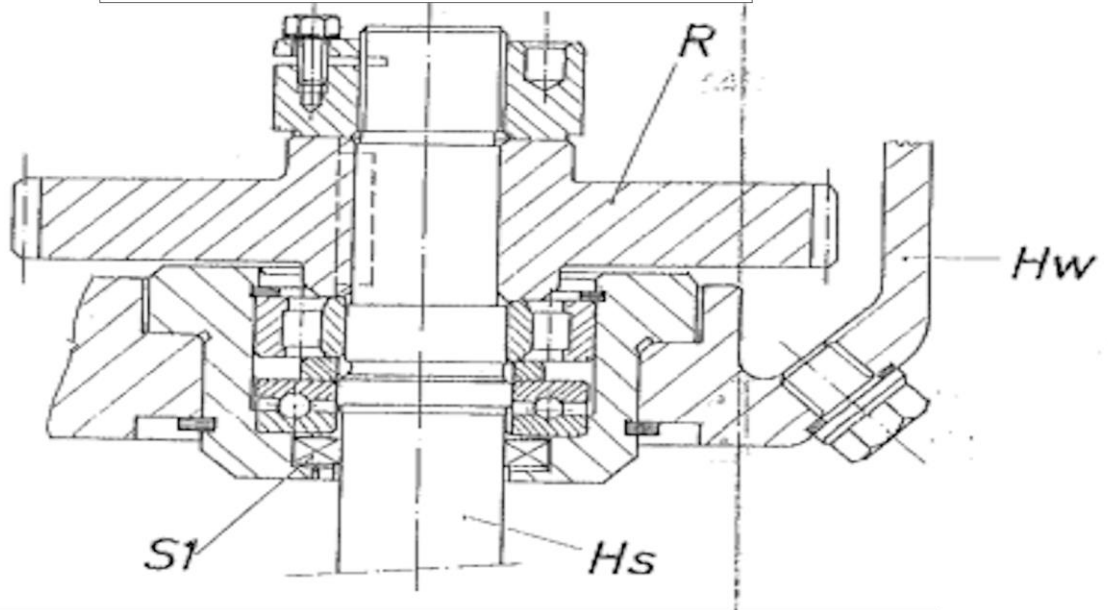
**PICTURE 6.**  
**MACHINE ASSEMBLING**

|  |                        |                 |
|--|------------------------|-----------------|
|  | Name                   | Number          |
|  | RADIAL DRILL RB70-1600 | 22.0200.7001.04 |



LEGEND:  
T- RAIL  
S- MAIN COLUMN  
SHAFT

**PICTURE 7.**  
**MAIN COLUMN TRANSPORTATION**

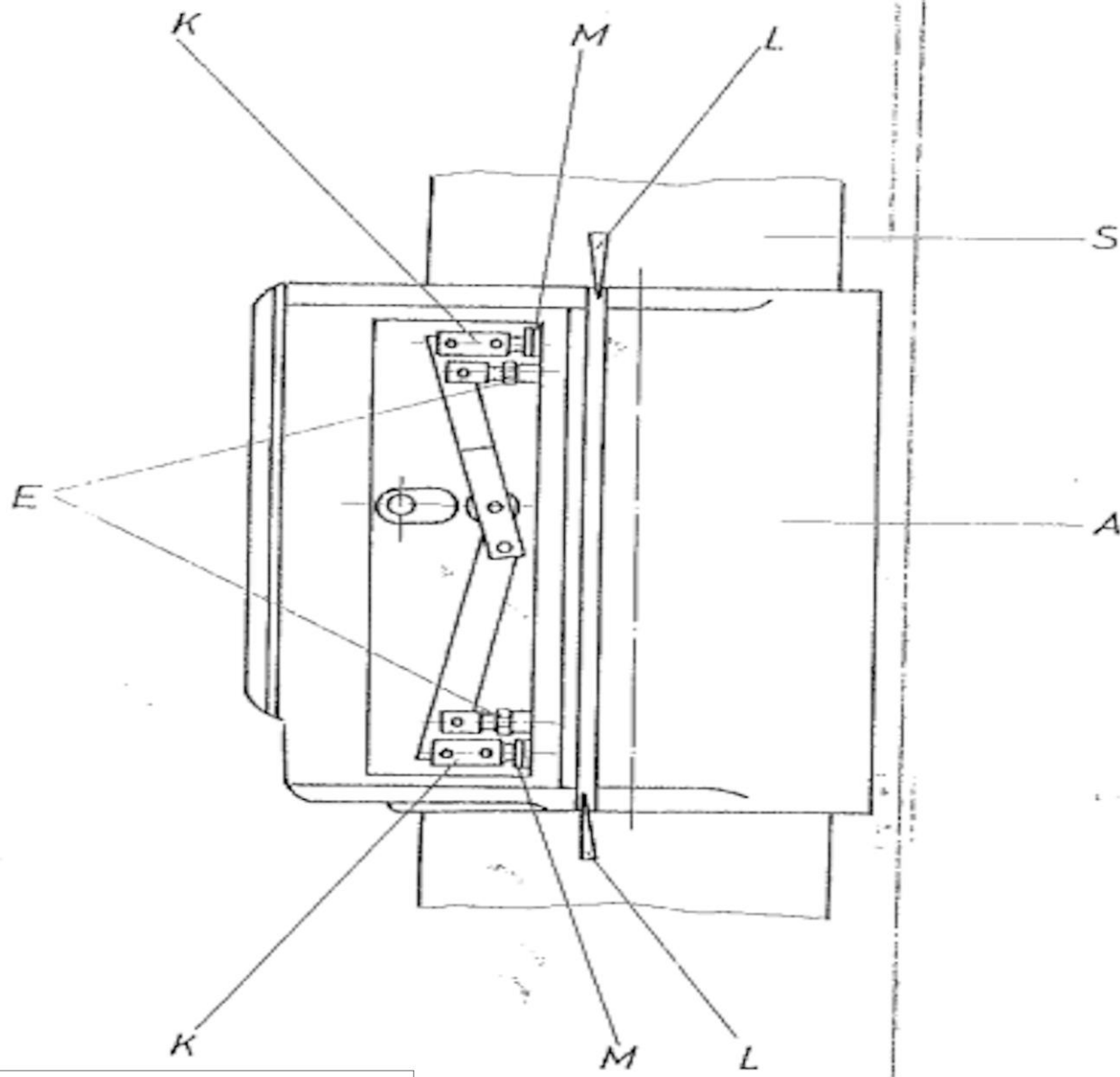


**PICTURE 8.**  
**SHAFT FOR LIFTING AND LOWERING CONSOLE ASSY**

LEGEND:  
Hs- MAIN COLUMN SHAFT  
Hw- PULLING MECHANISM  
R- GEAR  
S- SEAL

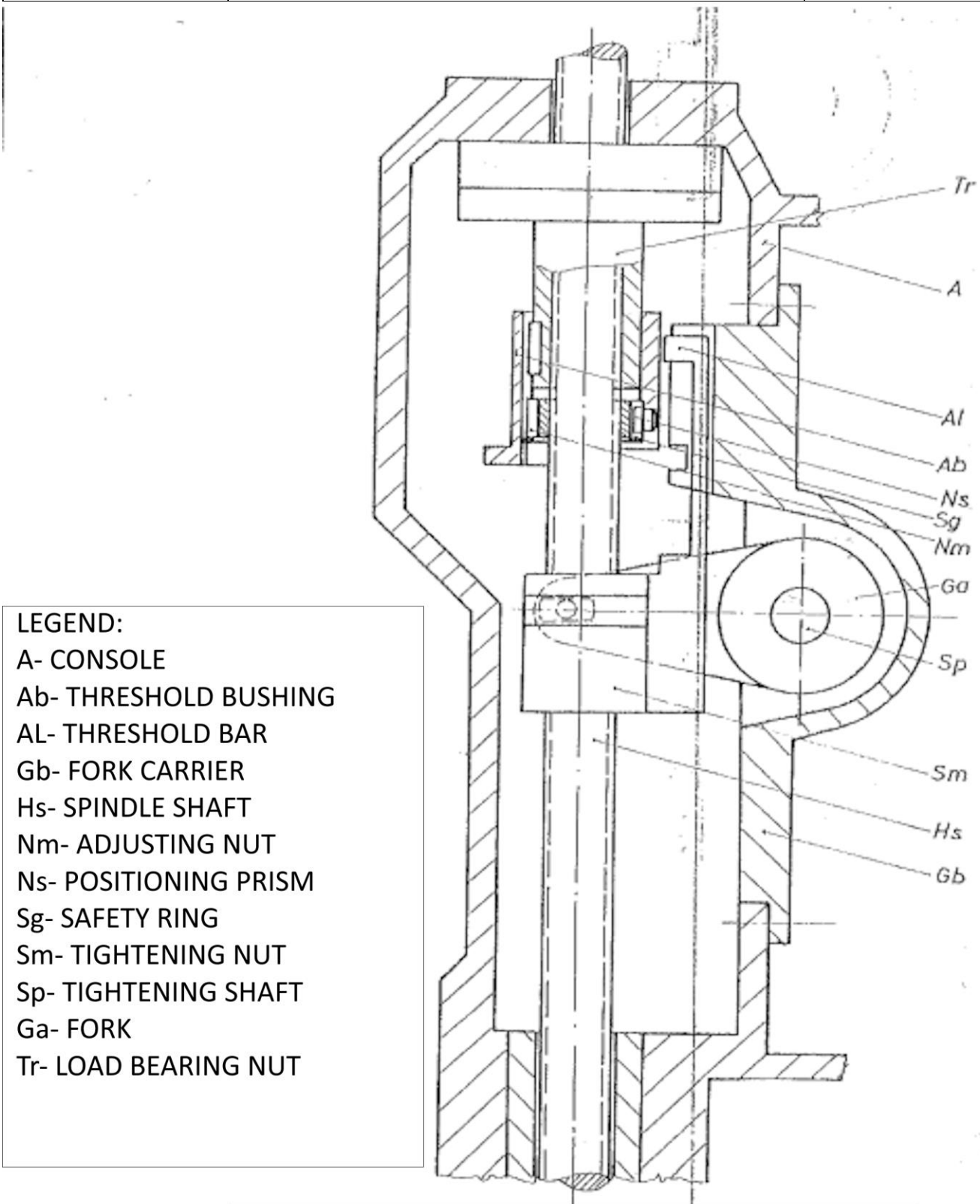
|  |                        |                 |
|--|------------------------|-----------------|
|  | Name                   | Number          |
|  | RADIAL DRILL RB70-1600 | 22.0200.7001.04 |

PICTURE 9.  
 MACHINE ASSEMBLY



LEGEND:  
 K- BOLT  
 M- NUT  
 L- WEDGE  
 S- MAIN COLUMN SHAFT  
 A- CONSOLE

|  |                        |                 |
|--|------------------------|-----------------|
|  | Name                   | Number          |
|  | RADIAL DRILL RB70-1600 | 22.0200.7001.04 |



LEGEND:

A- CONSOLE

Ab- THRESHOLD BUSHING

Al- THRESHOLD BAR

Gb- FORK CARRIER

Hs- SPINDLE SHAFT

Nm- ADJUSTING NUT

Ns- POSITIONING PRISM

Sg- SAFETY RING

Sm- TIGHTENING NUT

Sp- TIGHTENING SHAFT

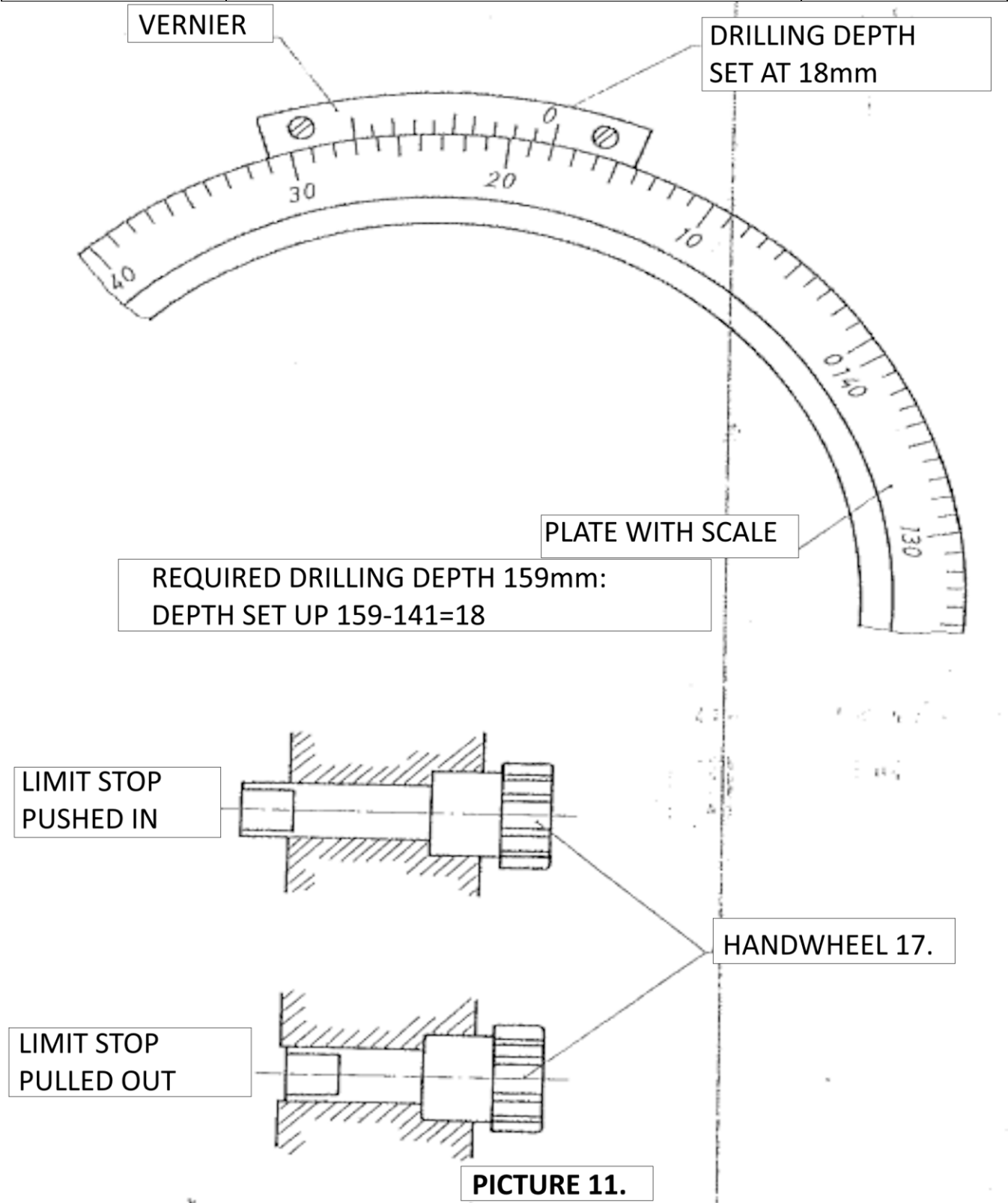
Ga- FORK

Tr- LOAD BEARING NUT

**PICTURE 10.**

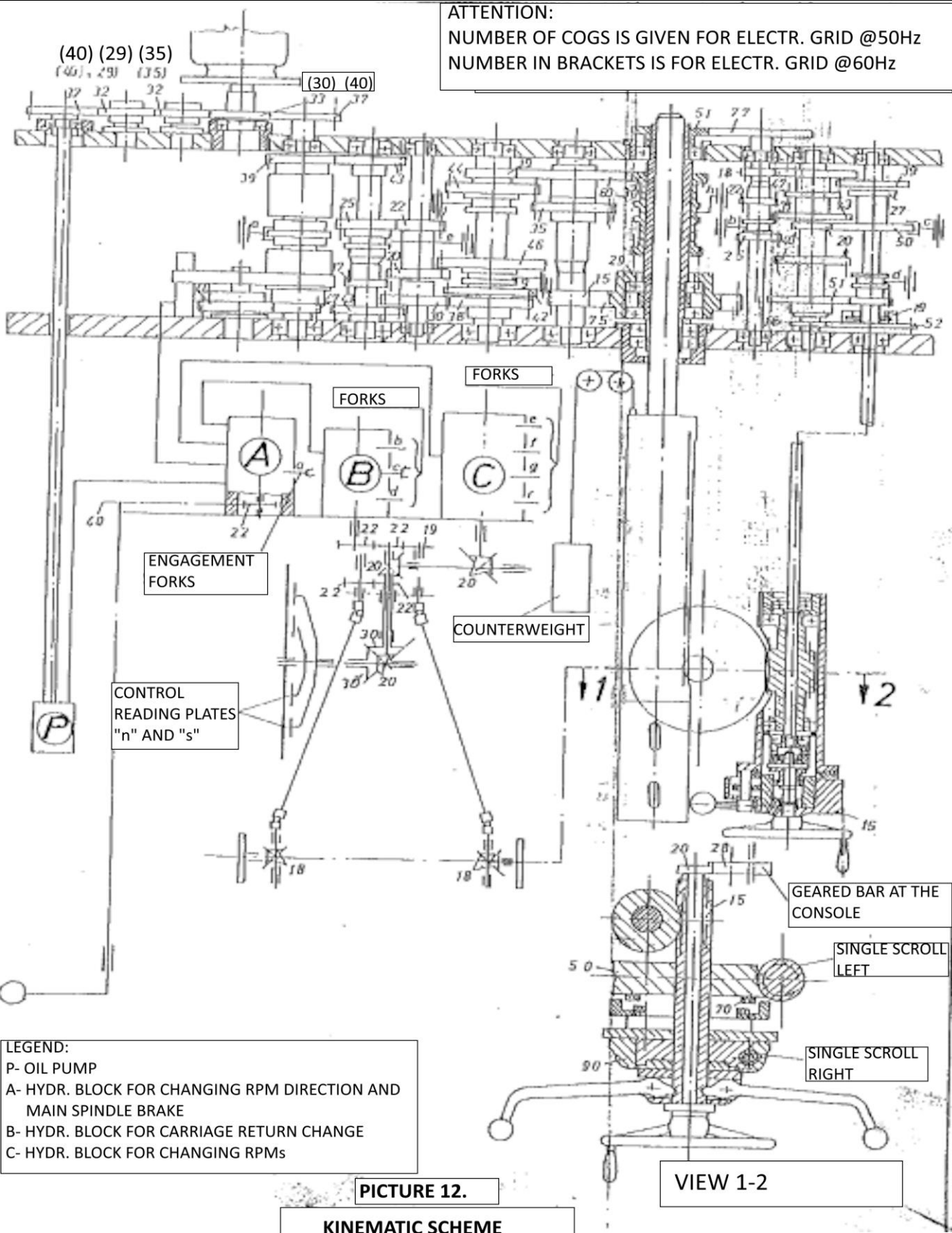
**INSTALLING THREADED SHAFT**

|  |                        |                 |
|--|------------------------|-----------------|
|  | Name                   | Number          |
|  | RADIAL DRILL RB70-1600 | 22.0200.7001.04 |

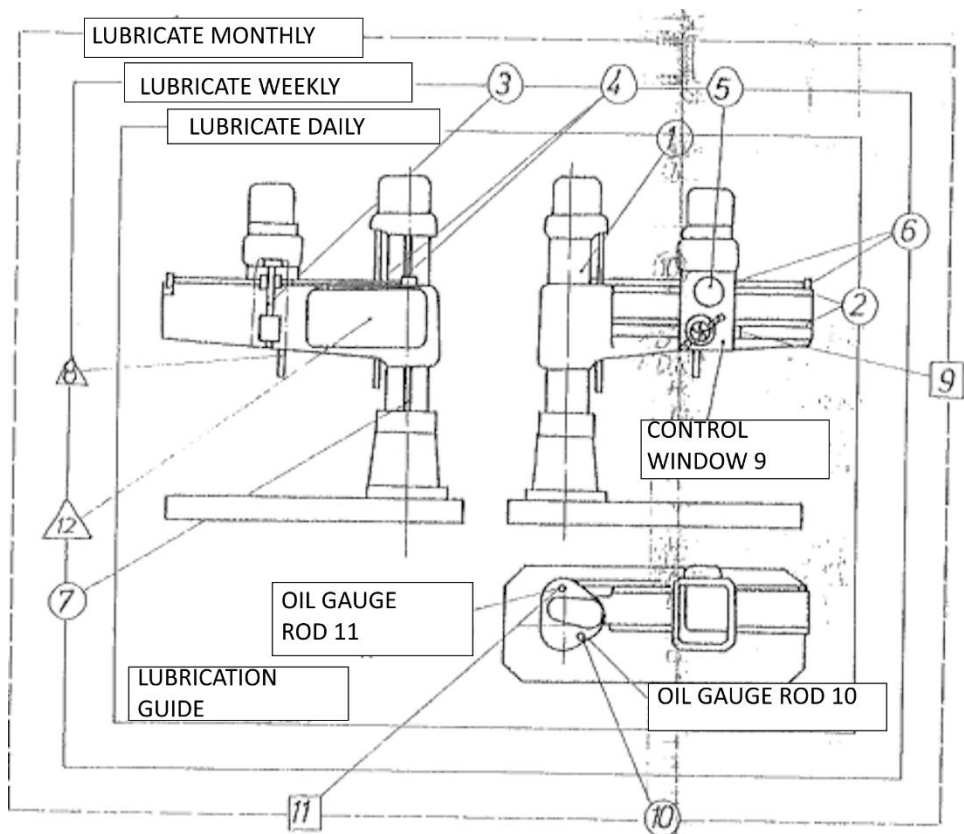


SETTING UP DRILLING DEPTH OVER 141mm, UP TO 275mm

|  |                                       |                           |
|--|---------------------------------------|---------------------------|
|  | Name<br><b>RADIAL DRILL RB70-1600</b> | Number<br>22.0200.7001.04 |
|--|---------------------------------------|---------------------------|



|  |                               |                 |
|--|-------------------------------|-----------------|
|  | Name                          | Number          |
|  | <b>RADIAL DRILL RB70-1600</b> | 22.0200.7001.04 |



| LUBRICATION PLACE | LUBRICANT          |                  |                   | SYMBOL | COLOUR | LUBRICANTS OVERVIEW FOR ONE SHIFT |                    |                                 |
|-------------------|--------------------|------------------|-------------------|--------|--------|-----------------------------------|--------------------|---------------------------------|
|                   | DIN CODE           | INA              | VISCOSITY         |        |        | LUBRICATION FREQUENCY             | QTY                | COMMENT                         |
| 1-2               | N36<br>DIN 51501   | HIDRAOL<br>50 HD | 5.25 °E/50°       | ○      | RED    | DAILY                             | 20<br>DROPS        | CLEAN AND<br>LUBE<br>CHANNELS   |
| 3-7               | N36<br>DIN 51501   | HIDRAOL<br>50 HD | 5.25 °E/50°       | ○      | RED    | WEEKLY                            | 6-8<br>DROPS       |                                 |
| 8                 | GREASE<br>DIN 5462 | LIS-2            | DRIPPING<br>TEMP. | Δ      | RED    | WEEKLY                            | 2<br>STROKES<br>OF | GREASE FOR<br>ROLLER<br>BEARING |
| 9                 | N36<br>5150        | HIDRAOL<br>50 HD | 5.25 °E/50°       | □      | RED    | WEEKLY                            | FILL UP<br>TO MARK | FOR<br>HYDRAULICS               |
| 10                | N36<br>DIN 51501   | HIDRAOL<br>50 HD | 5.25 °E/50°       | ○      | RED    | WEEKLY                            | FILL UP<br>TO MARK |                                 |
| 11                | N36<br>DIN 51501   | HIDRAOL<br>50 HD | 5.25 °E/50°       | □      | RED    | WEEKLY                            | FILL UP<br>TO MARK | FOR<br>HYDRAULICS               |
| 12                | N36<br>DIN 51501   | HIDRAOL<br>50 HD | 5.25 °E/50°       | Δ      | RED    | WEEKLY                            | FILL UP<br>TO MARK |                                 |

**PICTURE 13.**  
**LUBRICATION MANUAL**

|  |                                       |                           |
|--|---------------------------------------|---------------------------|
|  | Name<br><b>RADIAL DRILL RB70-1600</b> | Number<br>22.0200.7001.04 |
|--|---------------------------------------|---------------------------|

## DRILLING EFFICIENCY

**MOTOR** NOMINAL POWER  $N=5.5\text{Kw}$  ( $n=1440\text{ rpm}$ )

**MAIN SPINDLE – REV PER MINUTE**  $n [\text{min}^{-1}]$

22 ROTATIONS 14 ..... 1800  $\text{min}^{-1}$

COEFFICIENT  $\varphi = 1.25$

**RED** = R20 (*transl. footnote RED=no meaningful translation*)

RPM AT RETURN STROKE

$$n_p = 1.4 \times n$$

MAXIMUM ALLOWED TORQUE AT MAIN SPINDLE  $M_{\max} = 6300\text{ Kpcm}$  ( $1\text{Kpcm}=10.2\text{ Nm}$ ,  $1\text{Kpcm}=13.8\text{ftlb}$ )

|                      |     |     |      |     |      |      |      |    |    |     |     |     |     |     |     |
|----------------------|-----|-----|------|-----|------|------|------|----|----|-----|-----|-----|-----|-----|-----|
| $n[\text{min}^{-1}]$ | 14  | 18  | 22.4 | 28  | 35.5 | 45   | 56   | 71 | 90 | 112 | 140 | 180 | 224 | 280 | 355 |
| $n[\text{min}^{-1}]$ | 450 | 560 | 710  | 900 | 1120 | 1400 | 1800 |    |    |     |     |     |     |     |     |

CARRIAGE RETURN  $s [\text{mm/rev}]$

18 Carriage return 0.032 ..... 1.6  $\text{mm/rev}$

COEFFICIENT  $\varphi = 1.25$

**RED** = R20 (*footnote-no meaningful translation*)

|                  |       |       |       |       |       |       |       |       |       |      |      |      |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|
| $s[\text{mm/n}]$ | 0.032 | 0.040 | 0.050 | 0.063 | 0.080 | 0.100 | 0.125 | 0.160 | 0.200 | 0.25 | 0.32 | 0.40 |
| $s[\text{mm/n}]$ | 0.50  | 0.63  | 0.80  | 1.00  | 1.25  | 1.6   |       |       |       |      |      |      |

CARRIAGE RETURN FORCE  $F=1500\text{ Kp}$  ( $1\text{Kp} = 2.204\text{ftlb}$ )

## WORKING RANGE

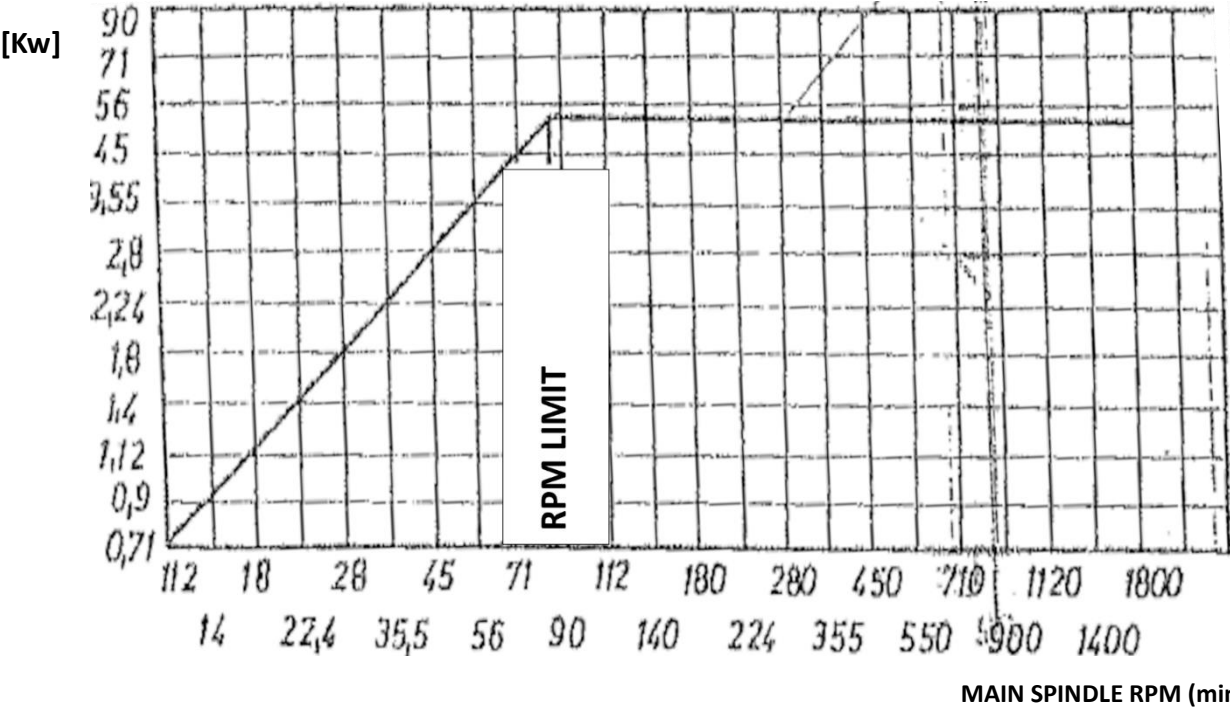
DATA IS VALIDATED FOR UNIFORMED (HOMOGENEOUS) MATERIAL AND APPROPRIATE TOOLING

|                                           | STEEL $G_A = 50\text{ kp/mm}^2$<br>$K = 200\text{ kp/mm}^2$ | GREY CAST $G_A = 25\text{ kp/mm}^2$<br>$K = 100\text{ kp/mm}^2$ |
|-------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------------|
| DRILLING SOLID MATERIAL                   | 56 mm dia                                                   | 70 mm dia                                                       |
| DRILLING WITH SMALL "s" $[\text{mm/rev}]$ | 65 mm dia                                                   | 80 mm dia                                                       |
| HOLE ENLARGEMENT                          | 45-90 mm dia                                                | 55-110 mm dia                                                   |
| HOLE ENLARGEMENT                          | 90-110 mm dia                                               | 110-130 mm dia                                                  |
| CUTTING                                   | 250 mm dia                                                  | 300 mm dia                                                      |
| METRIC FINE THERAD                        | M64 x 2                                                     | M76 x 2                                                         |
| WHITWORTH THREAD (imperial)               | 2"                                                          | 2-1/2"                                                          |

|  |                        |                 |
|--|------------------------|-----------------|
|  | Name                   | Number          |
|  | RADIAL DRILL RB70-1600 | 22.0200.7001.04 |

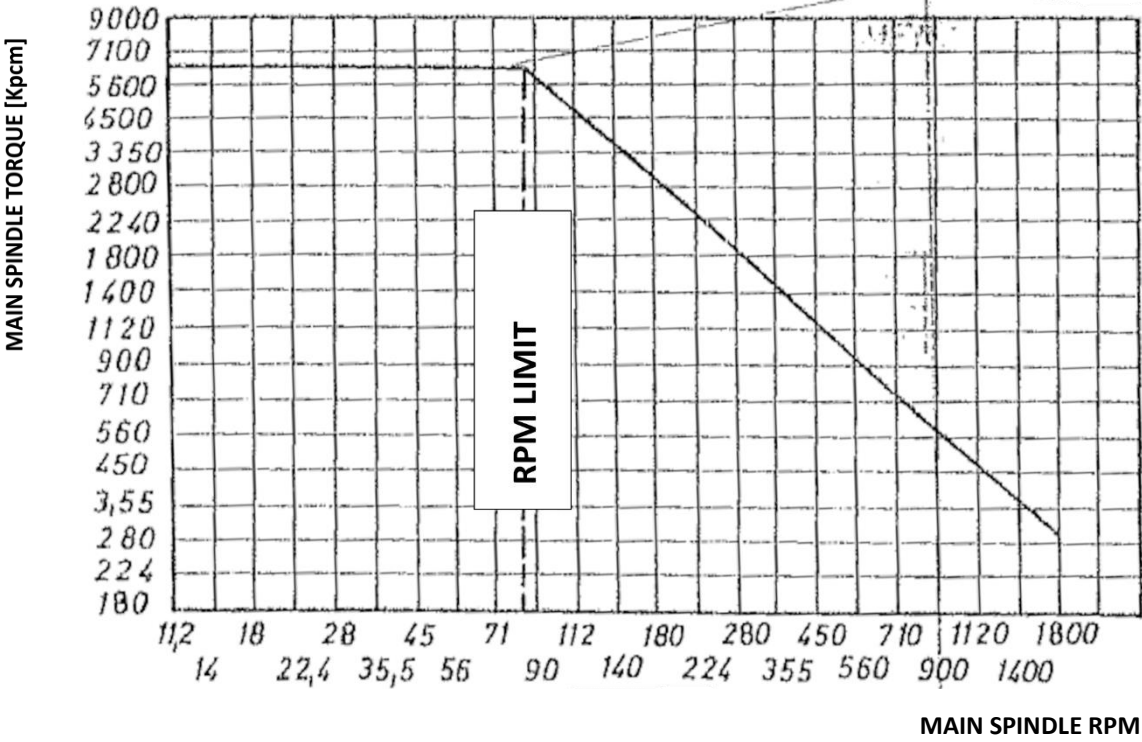
CHIPS REMOVING EFFICIENCY

DRILLING EFFICIENCY LIMIT cca 5.5kW



MAIN SPINDLE TORQUE

TORQUE LIMIT IS 6300 Kpcm



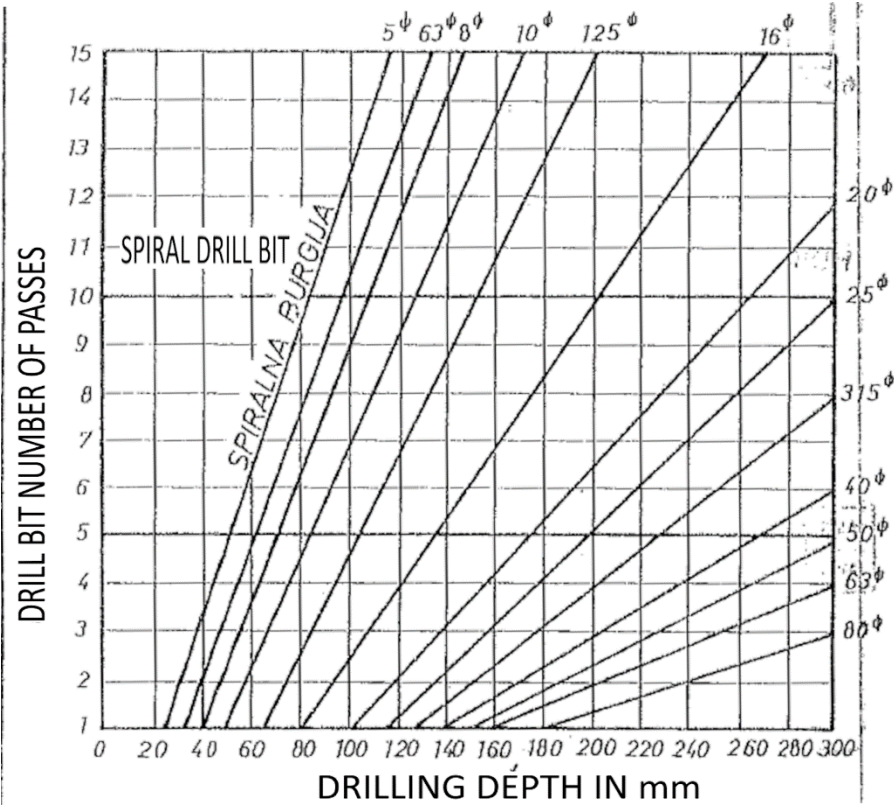
PICTURE 14.  
DRILLING EFFICIENCY AND TORQUE

|  |                        |                 |
|--|------------------------|-----------------|
|  | Name                   | Number          |
|  | RADIAL DRILL RB70-1600 | 22.0200.7001.04 |

FOR DRILLING THE FOLLOWING HOLES, MULTIPLE PASSES ARE NOT REQUIRED

|                         |             |
|-------------------------|-------------|
| Ø 20mm DRILLING DEPTH   | up to 100mm |
| Ø 31.5mm DRILLING DEPTH | up to 125mm |
| Ø 50mm DRILLING DEPTH   | up to 180mm |
| Ø 80mm DRILLING DEPTH   | up to 200mm |

DURATION OF A SINGLE  
IN-OUT STROKE FOR  
TAKING OUT CHIPS



| DRILLING DEPTH | TIME IN (min) |       |
|----------------|---------------|-------|
|                | 1             | 2     |
| 25             | 0.04          | -     |
| 31.5           | 0.045         | -     |
| 40             | 0.048         | -     |
| 50             | 0.05          | -     |
| 63             | 0.053         | 0.07  |
| 80             | 0.056         | 0.08  |
| 100            | 0.06          | 0.09  |
| 125            | 0.063         | 0.1   |
| 160            | 0.068         | 0.112 |
| 200            | 0.071         | 0.125 |
| 250            | 0.075         | 0.14  |
| 300            | 0.08          | 0.16  |

1. MANUAL CARRIAGE RETURN
2. MECHANICAL CARRIAGE RETURN

PICTURE 15.

NUMBER OF PASSES FOR FRILLING DEEP HOLES

|  |                        |                 |
|--|------------------------|-----------------|
|  | Name                   | Number          |
|  | RADIAL DRILL RB70-1600 | 22.0200.7001.04 |

| MATERIAL                                                      |   | HARD METAL DRILL BIT DIAMETER |      |       |       |       |       |     |       |      |
|---------------------------------------------------------------|---|-------------------------------|------|-------|-------|-------|-------|-----|-------|------|
|                                                               |   | 10                            | 12,5 | 16    | 20    | 25    | 31,5  | 40  | 50    | 63   |
| CONSTRUCTION STEEL<br>80-100 Kp/mm <sup>2</sup>               | n | 1800                          | 1400 | 1120  | 900   | 900   | 710   | 560 | 450   | 355  |
|                                                               | S | 0,04                          |      |       | 0,05  |       | 0,063 |     | 0,05  | 0,04 |
|                                                               | V | 56                            |      |       |       | 70    |       |     |       |      |
| STEEL CAST<br>57-70 Kp/mm <sup>2</sup>                        | n | 1120                          | 900  | 710   | 560   | 450   | 355   | 280 | 224   | 180  |
|                                                               | S | 0,04                          |      | 0,063 |       | 0,08  |       | 0,1 |       |      |
|                                                               | V | 35                            |      |       |       |       |       |     |       |      |
| STEEL ALLOYS<br>Cr Ni i Cr Mo<br>DO 100 Kp/mm <sup>2</sup>    | n | 1120                          | 900  | 710   | 560   | 560   | 450   | 355 | 280   | 224  |
|                                                               | S | 0,04                          |      | 0,06  |       | 0,063 |       |     |       |      |
|                                                               | V | 35                            |      |       |       | 44    |       |     |       |      |
| STEEL ALLOYS<br>Cr Ni i Cr Mo<br>PREKO 100 Kp/mm <sup>2</sup> | n | 710                           | 560  | 450   | 355   | 280   | 224   | 180 | 140   | 112  |
|                                                               | S | 0,032                         |      | 0,04  |       | 0,05  |       |     |       |      |
|                                                               | V | 22                            |      |       |       |       |       |     |       |      |
| TOOLING STEEL<br>180-200 Kp/mm <sup>2</sup>                   | n | 280                           | 280  | 224   | 180   | 180   | 140   | 112 | 90    | 71   |
|                                                               | S | 0,032                         |      |       |       | 0,04  |       |     |       |      |
|                                                               | V | 9                             | 11   |       |       | 14    |       |     |       |      |
| Mn HARDENED STEEL<br>14% Mn<br>90-100 Kp/mm <sup>2</sup> *    | n | 710                           | 560  | 450   | 355   | 280   | 280   | 224 | 180   | 140  |
|                                                               | S | 0,032                         |      |       |       |       |       |     |       |      |
|                                                               | V | 22                            |      |       |       |       | 28    |     |       |      |
| STAINLESS STEEL                                               | n | 710                           | 710  | 560   | 450   | 355   | 355   | 280 | 224   | 180  |
|                                                               | S | 0,032                         |      |       | 0,04  |       | 0,05  |     |       |      |
|                                                               | V | 22                            | 28   |       |       |       | 35    |     |       |      |
| GRAY CAST<br>UP TO HB=200                                     | n | 1800                          | 1800 | 1400  | 1120  | 900   | 900   | 710 | 560   | 450  |
|                                                               | S | 0,05                          | 0,08 | 0,1   | 0,125 | 0,16  | 0,2   |     |       |      |
|                                                               | V | 56                            | 70   |       |       |       |       | 90  |       |      |
| GRAY CAST<br>HB=200-400 *                                     | n | 900                           | 710  | 710   | 560   | 450   | 355   | 280 | 224   | 180  |
|                                                               | S | 0,032                         |      | 0,04  | 0,05  | 0,063 | 0,1   |     | 0,125 |      |
|                                                               | V | 28                            |      | 35    |       |       |       |     |       |      |
| SOFT BRONZE                                                   | n | 1800                          | 1800 | 1800  | 1800  | 1400  | 1120  | 900 | 710   | 560  |
|                                                               | S | 0,08                          |      |       |       | 0,1   | 0,125 |     |       | 0,16 |
|                                                               | V | 56                            | 70   | 90    | 112   | 112   |       | 112 | 112   |      |
| PHOSPHOROUS BRONZE                                            | n | 1800                          | 1800 | 1400  | 1120  | 900   | 710   | 560 | 450   | 355  |
|                                                               | S | 0,063                         |      | 0,08  | 0,1   |       | 0,125 |     |       |      |
|                                                               | V | 56                            | 70   |       |       |       |       |     |       |      |

TABLE - 1

TABLE : 1

LEGEND:

n - RPM [min<sup>-1</sup>]

s - CARRIAGE RETURN [mm/rev]

v - DRILLING SPEED [m/min]

\* - G<sub>1</sub> AND H<sub>1</sub>

|                        |                 |
|------------------------|-----------------|
| Name                   | Number          |
| RADIAL DRILL RB70-1600 | 22.0200.7001.04 |

| MATERIAL                                                              |   | HIGH-SPEED STEEL DRILL BIT DIAMETER |       |      |      |      |      |      |      |      |
|-----------------------------------------------------------------------|---|-------------------------------------|-------|------|------|------|------|------|------|------|
|                                                                       |   | 10                                  | 12,5  | 16   | 20   | 25   | 31,5 | 40   | 50   | 63   |
| CONSTRUCTION STEEL<br>UP TO 50 Kp/mm2                                 | n | 1120                                | 900   | 560  | 450  | 355  | 280  | 224  | 140  | 112  |
|                                                                       | S | 0,2                                 |       | 0,25 |      | 0,32 |      |      |      |      |
|                                                                       | V | 35                                  | 35    | 28   |      |      |      | 22   |      |      |
| CONSTRUCTION STEEL<br>50 - 70 Kp/mm <sup>2</sup>                      | n | 900                                 | 710   | 560  | 355  | 280  | 224  | 180  | 140  | 90   |
|                                                                       | S | 0,16                                |       | 0,2  | 0,25 | 0,32 |      | 0,25 |      |      |
|                                                                       | V | 28                                  |       |      |      | 22   |      | 18   |      |      |
| CONSTRUCTION STEEL<br>70 - 90 Kp/mm <sup>2</sup>                      | n | 710                                 | 560   | 450  | 355  | 280  | 180  | 140  | 112  | 90   |
|                                                                       | S | 0,125                               | 0,16  | 0,2  | 0,25 |      | 0,32 |      | 0,25 | 0,2  |
|                                                                       | V | 22                                  |       |      |      |      |      | 18   |      |      |
| STEEL ALLOY OVER<br>90 Kp/mm <sup>2</sup>                             | n | 560                                 | 450   | 355  | 280  | 224  | 180  | 112  | 90   | 71   |
|                                                                       | S | 0,125                               |       | 0,2  |      | 0,25 | 0,32 |      | 0,2  |      |
|                                                                       | V | 18                                  |       |      |      |      |      | 14   |      |      |
| CONSTRUCTION STEEL<br>AND STEEL ALLOYS<br>90 - 110 Kp/mm <sup>2</sup> | n | 355                                 | 280   | 224  | 180  | 140  | 112  | 71   | 56   | 45   |
|                                                                       | S | 0,1                                 | 0,125 | 0,16 | 0,2  |      | 0,25 |      | 0,16 |      |
|                                                                       | V | 11                                  |       |      |      |      |      | 9    |      |      |
| STAINLESS STEEL                                                       | n | 355                                 | 280   | 224  | 180  | 112  | 90   | 56   | 45   | 35,5 |
|                                                                       | S | 0,125                               |       | 0,16 | 0,2  |      | 0,25 |      |      |      |
|                                                                       | V | 11                                  |       |      |      | 9    | 7    |      |      |      |
| GRAY CAST<br>12-18 Kp/mm <sup>2</sup><br>(HB = 140-165 )              | n | 900                                 | 710   | 560  | 450  | 280  | 224  | 140  | 112  | 90   |
|                                                                       | S | 0,25                                |       | 0,32 | 0,4  | 0,5  | 0,63 |      |      |      |
|                                                                       | V | 28                                  |       |      |      | 22   | 18   |      |      |      |
| GRAY CAST<br>18-30 Kp/mm <sup>2</sup><br>(HB = 165-220)               | n | 560                                 | 450   | 355  | 280  | 224  | 180  | 140  | 90   | 71   |
|                                                                       | S | 0,125                               | 0,16  | 0,25 |      | 0,32 |      | 0,4  | 0,5  |      |
|                                                                       | V | 18                                  |       |      |      |      |      | 14   |      |      |
| BRASS<br>UP TO HB=50                                                  | n | 1800                                | 1800  | 1800 | 1400 | 1120 | 710  | 560  | 450  | 260  |
|                                                                       | S | 0,32                                |       | 0,4  |      | 0,32 | 0,2  |      |      |      |
|                                                                       | V | 56                                  | 70    | 90   |      |      | 70   |      | 56   |      |
| BRASS<br>OVER HB=50                                                   | n | 1800                                | 1400  | 1120 | 900  | 710  | 450  | 280  | 224  | 224  |
|                                                                       | S | 0,16                                |       | 0,2  | 0,25 | 0,32 |      | 0,25 |      | 0,15 |
|                                                                       | V | 56                                  |       |      |      |      | 44   | 35   | 44   |      |
| BRONZE                                                                | n | 1400                                | 1120  | 900  | 710  | 560  | 355  | 280  | 224  | 180  |
|                                                                       | S | 0,2                                 |       | 0,25 |      | 0,32 |      | 0,4  |      |      |
|                                                                       | V | 44                                  |       |      |      |      | 35   |      |      |      |
| FLAME HARDENED<br>LIGHT METALS                                        | n | 1800                                | 1800  | 1800 | 1800 | 1400 | 1120 | 710  | 560  | 450  |
|                                                                       | S | 0,32                                |       |      |      |      | 0,25 |      | 0,2  | 0,16 |
|                                                                       | V | 56                                  | 70    | 90   | 112  | 112  | 112  | 90   |      |      |
| TEMPERED<br>LIGHT METALS                                              | n | 1800                                | 1800  | 1800 | 1800 | 1120 | 710  | 560  | 450  | 385  |
|                                                                       | S | 0,25                                |       | 0,32 |      |      | 0,25 |      | 0,2  | 0,16 |
|                                                                       | V | 56                                  | 70    | 90   | 112  | 90   | 70   |      |      |      |

**TABLE 2**

n = RPM [min<sup>-1</sup>]

s = CARRIAGE RETURN [mm/rev]

v = SPEED [m/min]

|  |                   |                     |
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|  |                        |                 |
|--|------------------------|-----------------|
|  | Name                   | Number          |
|  | RADIAL DRILL RB70-1600 | 22.0200.7001.04 |

| MATERIAL                                              | TOOLING STEEL DRILL BIT DIAMETER |       |       |      |      |      |      |      |      |      |
|-------------------------------------------------------|----------------------------------|-------|-------|------|------|------|------|------|------|------|
|                                                       |                                  | 10    | 12,5  | 16   | 20   | 25   | 31,5 | 40   | 50   | 63   |
| CONSTRUCTION STEEL<br>UP TO 50 Kp/mm <sup>2</sup>     | n                                | 450   | 355   | 280  | 224  | 140  | 112  | 71   | 56   | 45   |
|                                                       | s                                | 0,1   | 0,125 | 0,16 |      | 0,2  |      | 0,25 | 0,32 |      |
|                                                       | v                                | 14    |       |      |      |      | 11   |      | 9    |      |
| CONSTRUCTION STEEL<br>50-70 Kp/mm <sup>2</sup>        | n                                | 355   | 280   | 224  | 180  | 112  | 90   | 71   | 45   | 35,5 |
|                                                       | s                                | 0,1   | 0,125 | 0,16 | 0,2  |      |      | 0,25 |      |      |
|                                                       | v                                | 11    |       |      |      |      | 9    |      | 7    |      |
| GRAY CAST<br>12-18 Kp/mm <sup>2</sup><br>(HB=140-165) | n                                | 355   | 280   | 224  | 140  | 112  | 71   | 56   | 45   | 28   |
|                                                       | s                                |       | 0,16  | 0,2  | 0,25 | 0,32 |      | 0,4  |      | 0,5  |
|                                                       | v                                | 11    |       |      |      | 9    |      | 7    |      | 5,5  |
| BRASS<br>UP TO HB=50                                  | n                                | 1800  | 1800  | 1400 | 1120 | 900  | 560  | 450  | 280  | 224  |
|                                                       | s                                |       | 0,25  | 0,32 |      | 0,4  | 0,32 |      | 0,25 |      |
|                                                       | v                                | 56    | 70    |      |      |      | 56   |      | 44   |      |
| BRASS<br>OVER HB=50                                   | n                                | 710   | 560   | 450  | 355  | 224  | 180  | 140  | 112  | 90   |
|                                                       | s                                | 0,125 | 0,16  |      |      | 0,2  |      |      | 0,25 |      |
|                                                       | v                                | 22    |       |      |      | 16   | 18   |      |      |      |
| BRONZE                                                | n                                | 560   | 450   | 355  | 280  | 180  | 140  | 112  | 90   | 71   |
|                                                       | s                                | 0,125 | 0,16  |      | 0,2  |      |      | 0,25 |      |      |
|                                                       | v                                | 18    |       |      |      |      | 14   |      |      |      |
| FLAME HARDENED<br>LIGHT METALS                        | n                                | 1800  | 1800  | 1400 | 1120 | 710  | 560  | 450  | 355  | 280  |
|                                                       | s                                | 0,16  | 0,2   | 0,25 |      |      | 0,32 |      | 0,25 |      |
|                                                       | v                                | 56    | 70    |      |      |      | 56   |      |      |      |

**TABLE 3**

**LEGEND:**

n – RPM [min<sup>-1</sup>]

s – CARRIAGE RETURN

v – CUTTING SPEED [m/min]

ATTENTION: It's typical for radial drills to have some machine vibrations (resonance) with certain drilling parameters, especially with small carriage returns. This is a case when forced (coercive) frequency is close (or not aligned) with console and spindle assembly own frequency. By slightly adjusting rpm and carriage return, it's possible to avoid resonance and consequently vibrations.

That's the reason why given values are approximate. By doing research and trials, you can achieve optimal drilling speed, carriage return and rpm of main spindle.

|  |                        |                 |
|--|------------------------|-----------------|
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| DRILLING SET UP TIME |            |                                                           |                                                                               |                                                                                                                                                                                                                                                    |
|----------------------|------------|-----------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| No.                  | Denotation | OPERATION                                                 | TIME (min)                                                                    | Operation instruction                                                                                                                                                                                                                              |
| 1.                   | AW         | Tooling placement                                         | 0.05 - 2                                                                      | Bring the tooling to working material and return it back to starting position “n” and then “S” to turn spindle on and off                                                                                                                          |
| 2.                   | EW         | Tooling adjustment                                        | 0.01 - 1 at the top                                                           | Retract man spindle, unlock main column and spindle, bring main console and spindle to designated position and mark the spot                                                                                                                       |
|                      |            |                                                           | 0.1 – 0.3 at casing                                                           |                                                                                                                                                                                                                                                    |
| 3.                   | EWA        | Tooling adjustment like in 2. with height console set up  | 0.35 – 1.5 at the top                                                         | Same as under 2.                                                                                                                                                                                                                                   |
|                      |            |                                                           | 0.3 – 0.5 at casing                                                           |                                                                                                                                                                                                                                                    |
| 4.                   | E Schw     | Inserting drill bit carrier which can be quickly replaced | 0.10 – 0.20                                                                   | Insert into main spindle                                                                                                                                                                                                                           |
|                      |            |                                                           | 0.05 – 0.10                                                                   | Take out of main spindle                                                                                                                                                                                                                           |
| 5.                   | Ww         | Tooling change                                            | 0.15 – 0.50 with conus                                                        | Take the tool out, place it in its holding place, take another tool and insert it into spindle or bit carrier, secure it, change rpm and carriage return<br>If the tool just needs to be inserted or taken out, the time needed can be cut in half |
|                      |            |                                                           | 0.20 – 0.6 with upper<br>Or lower guides                                      |                                                                                                                                                                                                                                                    |
|                      |            |                                                           | 0.1 – 0.2 with quick exchange drill bit carrier                               |                                                                                                                                                                                                                                                    |
|                      |            |                                                           | 0.15 – 0.25 with quick exchange drill bit carrier with upper and lower guides |                                                                                                                                                                                                                                                    |
| 6.                   | Boh        | Drilling tool or reamer with upper and lower guides       | 1.0 – 4.00                                                                    | Clean drill bit w /casing and place it in spindle conus, secure it and place the console with spindle into working position and lock it.<br>Clean drill bit with casing and place it in spindle conus, bring main spindle into working position    |
|                      | Bow        |                                                           | 1.6 – 6.3                                                                     | Lock the man column, console and spindle, set up rpm and carriage return                                                                                                                                                                           |
|                      |            |                                                           |                                                                               |                                                                                                                                                                                                                                                    |

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|     |         |                                                                                              |             |                                                                                                                  |
|-----|---------|----------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------------------------|
|     | Bo      |                                                                                              | 0.60 - 2.5  | Take drill bit w /casing out spindle conus and place it aside. Then bring main spindle into new working position |
| 7.  | Bw      | Replace drill bit casing                                                                     | 0.10 – 0.25 | Take casing out and install new one                                                                              |
| 8.  |         | Turning off depth                                                                            | 0.10        | Set up automatic drilling disengagement                                                                          |
| 9.  | Ausl    | Console height adjustment (including releasing and tightening main column)                   | 0.05 – 0.10 | Without machine set up                                                                                           |
|     |         |                                                                                              | 0.25 – 1.00 | With machine set up                                                                                              |
| 10. |         | Main spindle and column                                                                      | 0.10        | Release and lock up                                                                                              |
| 11. |         | Cooling water                                                                                | 0.03        | Turn on                                                                                                          |
| 12. | W and V | Secure processed piece (processed piece to clean up)                                         | 0.2 – 2     | Manual operation (with hand)                                                                                     |
|     |         |                                                                                              | 3 – 6       | Using lift, includes waiting for lift                                                                            |
| 13. | Wa V    | Take out processed piece (including tool cleaning, processed piece cleaning and disposition) | 0.15 – 1.5  | Manual operation (with hand)                                                                                     |
|     |         |                                                                                              | 2.00 – 5.00 | Using lift, includes waiting for lift                                                                            |
| 14  | Vorr    | Turn tooling ram lock                                                                        | 0.10 – 1.00 | Manual operation (with hand)                                                                                     |
|     |         |                                                                                              | 2.00 – 5.00 | Using lift, includes waiting for lift                                                                            |
| 15. | M       | Measuring                                                                                    | 0.10 – 1.5  | Drilled hole to control with gauge                                                                               |

### **ATTENTION:**

Before taking these data records, consider the following:

- The weight, in other words, diameter and length of tooling
- Required precision in distance between holes in regard to drill bit positioning
- The weight of processed piece and shape of clamping tool in regards to clamping and removing processed piece
- The size of the machine. Given time data includes tooling lubrication (tooling sliding surfaces)

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|                      |                                                                                                 |                                                 |
|----------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------|
| "POBEDA"<br>NOVI SAD | Name<br><br><div style="text-align: center;"> <b>RADIAL DRILL<br/>PRECISION ANALYSIS</b> </div> | Number (42 /48)<br>JUS M.GO.131<br>JUS M.GO.531 |
|----------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------|

## RECORD OF PRECISION ANALYSIS

### Machine data

Radial drill, mfg number:  
 Maximum drilling diameter:                      mm  
 Inside conus of spindle:  
 Maximum radial span:                              mm  
 Maximum drilling depth:                          mm  
 Machine type (precise designation):  
 Manufacturer:

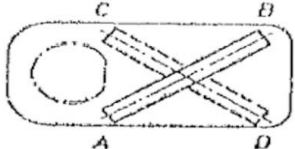
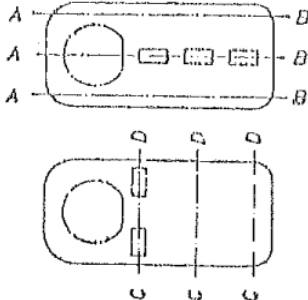
### General data

Date of analysis:  
 Place of analysis:  
 Room temperature:  
 Machine placement:  
 Other conditions that may affect analysis:

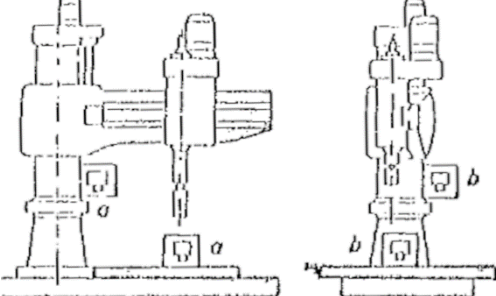
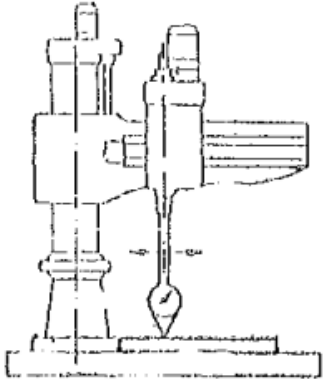
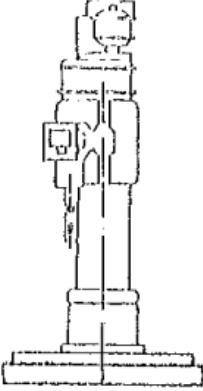
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|----------------------|--------------------------------------------------------|-------------------------------------------------|
| "POBEDA"<br>NOVI SAD | Name<br><br><b>RADIAL DRILL<br/>PRECISION ANALYSIS</b> | Number (43 /48)<br>JUS M.GO.131<br>JUS M.GO.531 |
|----------------------|--------------------------------------------------------|-------------------------------------------------|

### Checking geometrical precision

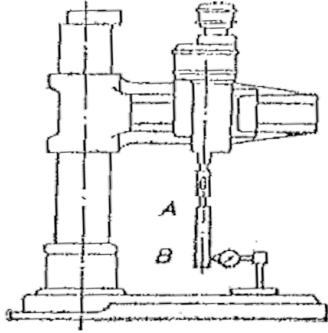
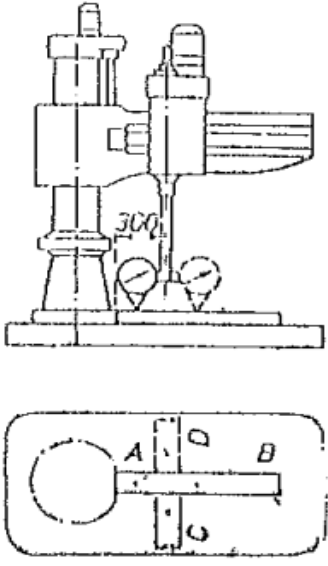
The results of geometrical precision check are given below, where numerical sequence is matching numerical sequence of related measures in JUS M.GO.131 standard.

| No | Subject of Measuring                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Deviation                                                                                                               |                                                                                                                                                                                                                                                                     |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Allowed                                                                                                                 | Measured                                                                                                                                                                                                                                                            |
| 1  | <p>Measurement: horizontal positioning of base plate working surface</p> <p>a) Diagonal direction A – B<br/>b) Diagonal direction C – D</p> <p>Measuring process:<br/>Bring the console at middle high position and into middle plane of base plate and spindle carrier to the middle of console. In spots A and B place shim plates equally thick. Place the ruler on them, with a level in the middle of the ruler and look at the level readout.<br/>Repeat the measure at C-D direction</p>                                                                                                                                                                                                                                            | <p>a) 0.1 mm/m<br/>b) 0.1 mm/m</p>                                                                                      | <p>a) <u>0.1</u> mm/m<br/>b) <u>0.1</u> mm/m</p>                                                                                                                                                                                                                    |
| 2  | <p>Measurement: base plate working area flatness</p> <p>a) A-B direction<br/>b) C-D direction</p> <p>Measuring process: Bring console and spindle carrier at the middle position, Place the level onto base plate working area, first in 3 longitudinal parallel A-B directions and then in 3 transversal parallel directions C-D; readout level bubble position. Distance between measured positions should be 300-500mm</p>                                                                                                                                                                                                                                                                                                            | <p>a) +0.05 mm/m<br/>b) +0.05 mm/m<br/>considering that<br/>working area is not<br/>curved</p>                          | <p>a) 1 ____; ____; ____ mm/m<br/>2 ____; ____; ____ mm/m<br/>3 ____; ____; ____ mm/m</p> <p>b) 1 ____; ____; ____ mm/m<br/>2 ____; ____; ____ mm/m<br/>3 ____; ____; ____ mm/m</p> <p>The entire base working<br/>surface is <u>not convexed</u> <sup>1)</sup></p> |
| 3  | <p>Measurement: perpendicularity of main column to the base plate working area, measuring at</p> <p>a) symmetrical plane of the machine<br/>b) perpendicular plane to the symmetrical plane of the machine</p> <p>Measuring process: Bring console and spindle carrier at the middle position. Place ruler at the base plate working area on symmetrical plane of the machine. Place frame level in the middle of ruler and read out bubble position. The place frame level on main column cylindrical surface at the same plane and readout again. The difference between two readouts will give you deviation.<br/>The same measuring should be done by placing ruler with level in the middle of the base plate in perpendicular plane to the symmetrical plane of the machine and placing level on the column side.</p> | <p>a) 0.2 mm/m but<br/>upper end of<br/>column could be<br/>slating only towards<br/>the base plate<br/>b) 0.1 mm/m</p> | <p>a) <u>0.2</u> mm/m<br/>upper end of column slating<br/><u>towards base plate</u> <sup>2)</sup><br/>b) <u>0.1</u> mm/m</p>                                                                                                                                        |

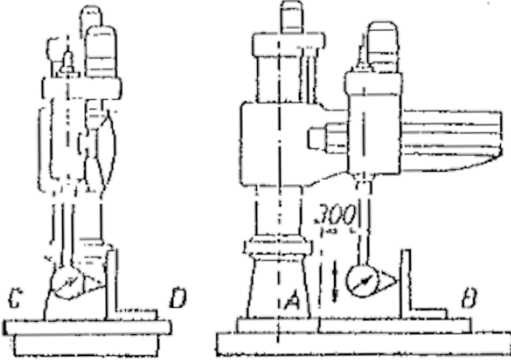
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| "POBEDA"<br>NOVI SAD | Name<br><br><div style="text-align: center;"><b>RADIAL DRILL<br/>PRECISION ANALYSIS</b></div> | Number (44 /48)<br>JUS M.GO.131<br>JUS M.GO.531 |
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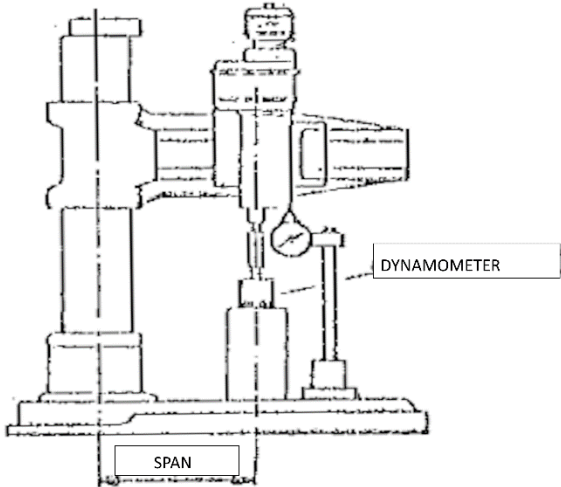
| No | Subject of Measuring                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Deviation                                                                                          |                                                                                               |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Allowed                                                                                            | Measured                                                                                      |
|    |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                    |                                                                                               |
| 4  | <p>Measurement: parallel positioning of spindle carrier to the base plate working area</p> <p>Measuring process: Bring console to middle position. Place ruler onto base plate parallel to the console. Clamp gauge dial into spindle conus while gauge pin should rest on the ruler. Move spindle carrier along the console all the way and read out gauge dial deviation, while moving ruler as needed.</p>  | <p>0.2 mm/m,<br/>considering that loose end<br/>of console could be<br/>slanted only downwards</p> | <p><u>0.2</u> mm/m,<br/>Loose end of console is slanted<br/><u>downwards</u><sup>3)</sup></p> |
| 5  | <p>Measurement: spindle guide straightness</p> <p>Measuring process: bring console and spindle carrier into middle position. Place frame level at vertical plane of spindle guide at console and read out level bubble. Distance between measurements 300 – 500mm</p>                                                                                                                                         | <p>0.1 mm/m</p>                                                                                    | <p>1 <u>0.1</u><br/>2 <u>0.1</u><br/>3 <u>0.1</u></p>                                         |

|                      |                                                        |                                                 |
|----------------------|--------------------------------------------------------|-------------------------------------------------|
| "POBEDA"<br>NOVI SAD | Name<br><br><b>RADIAL DRILL<br/>PRECISION ANALYSIS</b> | Number (45 /48)<br>JUS M.GO.131<br>JUS M.GO.531 |
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| No | Subject of Measuring                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Deviation                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Allowed                                                                                                                     | Measured                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 6  | <p>Measurement: the correct spinning of spindle conus, measured at:</p> <p>a) point A<br/>b) point B</p> <p>Measuring process: Bring console and spindle carrier to a middle position. Firmly place measuring pin inside spindle conus and place gauge dial at the base plate. Place dial sensor to gently touch the upper part of gauge pin, at spot A. Rotate working spindle and check gauge dial readouts. After that, place dial sensor at the bottom part of gauge pin, at spot B and repeat measuring.</p>  | <p>a) 0.02mm, for one rotation of spindle<br/>b) 0.03mm for one rotation of spindle</p>                                     | <p>a) <u>0.01</u> mm/m<br/>a) <u>0.02</u> mm/m</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 7  | <p>Measurement: perpendicularity of working spindle to the base plate working area, measured at:</p> <p>a) symmetrical plane of the machine<br/>b) perpendicular plane to symmetrical plane</p> <p>Measuring process: Bring the console to 1/3 of the height (from the bottom) and in the middle area of base plate. Place working spindle at 300mm from column base flange. Place firmly gauge dial on rotating end inside spindle conus.</p>                                                                    | <p>a) 0.2 mm/m, considering that bottom part of working spindle can be slanted only towards main column<br/>b) 0.1 mm/m</p> | <p>Console is positioned at 1/3 of the height from bottom, working spindle at 300mm from main column:</p> <p>a) <u>0.2</u> mm/m, the bottom part of working spindle is leaning towards <u>main column</u> of machine<br/>b) <u>0.1</u> mm/m</p> <p>Console is positioned at 1/3 of the height from bottom, working spindle at 2/3 of radial travel length:</p> <p>a) <u>0.2</u> mm/m, the bottom part of working spindle is leaning towards <u>main column</u> of machine<br/>b) <u>0.1</u> mm/m</p> <p>Console is positioned at 2/3 of vertical travel, working spindle at 300mm from main column flange:</p> <p>a) <u>0.2</u> mm/m, the bottom part of working spindle is leaning towards <u>main column</u> of machine<br/>b) <u>0.1</u> mm/m</p> <p>Console is positioned at 2/3 of vertical travel, working spindle at 2/3 of radial travel length:</p> <p>a) <u>0.2</u> mm/m, the bottom part of working spindle is leaning towards <u>main column</u> of machine<br/>b) <u>0.1</u> mm/m</p> |

|                      |                                                        |                                                 |
|----------------------|--------------------------------------------------------|-------------------------------------------------|
| "POBEDA"<br>NOVI SAD | Name<br><br><b>RADIAL DRILL<br/>PRECISION ANALYSIS</b> | Number (46 /48)<br>JUS M.GO.131<br>JUS M.GO.531 |
|----------------------|--------------------------------------------------------|-------------------------------------------------|

| No | Subject of Measuring                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Deviation                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                               |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Allowed                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Measured                                                                                                                      |
| 7  | <p>Place ruler at base plate working area in symmetrical plane, in direction A-B. Gauge dial pin gently place at ruler in spot A and read the gauge dial. Then turn the spindle for 180 deg and read the dial in spot B. After that, place ruler in transverse direction C-D and read the dial as described above, by reading dial in positions C and D.</p> <p>Move spindle carrier to 2/3 of radial travel length and read the dial as before, first by checking spots A and B in symmetrical plane and then checking spots C and D in transversal plane. After that, bring console to 2/3 of vertical travel and spindle at 300mm from main column flange. Take measures as before, by reading dial in symmetrical plane and then in transversal plane. Then bring spindle carrier to 2/3 of radial travel and repeat measuring as before, by reading dial at all 4 crossed-placed spots A, B, C and D.</p>        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                               |
| 8  | <p>Measurement: perpendicular position of working spindle to base plate working area, measured at:</p> <p>a) symmetrical plane of the machine<br/>b) perpendicular plane to machine symmetrical plane</p> <p>Measuring process: Bring console to middle height position and in middle of base plate area. Place working spindle at 300mm from main column flange.</p> <p>Place gauge dial firmly into spindle conus. Place angle gauge and ruler at base plate in symmetrical plane, direction A-B. Gently touch dial gauge pin to angle gauge arm and move spindle up and down and read out gauge dial. Then place ruler and angle gauge transversally, in direction C-D and read out gauge dial as before. Bring working spindle carrier to 2/3 of radial travel and repeat measuring as before, in directions A-B and C-D.</p>  | <p>a) 0.05mm for maximum drilling depth 150mm; <sup>5)</sup><br/>0.1mm for maximum drilling depth 300mm; <sup>5)</sup><br/>0.15mm for maximum drilling depth over 300mm; <sup>5)</sup><br/>Bottom part of working spindle can be heading only towards main column</p> <p>b) 0.025mm for maximum drilling depth 150mm; <sup>5)</sup><br/>0.05mm for maximum drilling depth 300mm; <sup>5)</sup><br/>0.075mm for maximum drilling depth over 300mm; <sup>5)</sup></p> | <p>a) <u>0.12</u> mm; bottom part of spindle is slanted towards <u>main column</u> <sup>6)</sup></p> <p>b) <u>0.07</u> mm</p> |
| 9  | <p>Measurement: machine stiffness under console static load</p> <p>Measuring process: Bring console to middle position and spindle carrier to the most radial travel position. Place dynamometer between spindle and base plate and gauge dial onto base plate working area. Place dial gauge pin gently at spindle carrier, and to the processed piece spot which is firmly secured. Move working spindle manually until dynamometer reads maximum allowed drilling force. If necessary, calibrate drilling load with adjustment device. Change drilling load several times until dial gauge read out is consistent.</p>                                                                                                                                                                                                                                                                                             | <p>1.5mm at 1000mm span, that is _____ mm</p>                                                                                                                                                                                                                                                                                                                                                                                                                       | <p><u>1.1</u> mm</p>                                                                                                          |

| "POBEDA"<br>NOVI SAD              | Name<br><br><div style="text-align: center;"><b>RADIAL DRILL<br/>PRECISION ANALYSIS</b></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  | Number (47 /48)<br>JUS M.GO.131<br>JUS M.GO.531 |                              |    |      |    |      |    |      |     |      |  |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------|------------------------------|----|------|----|------|----|------|-----|------|--|
| 9                                 | <p>Read out gauge dial difference between loaded and unloaded conditions. Maximum drilling force values, depending on maximum drilling diameter, are given in following chart:</p> <table border="1" data-bbox="207 422 846 617"> <thead> <tr> <th>Maximum allowed drilling diameter</th> <th>Maximum drilling force in kp</th> </tr> </thead> <tbody> <tr> <td>35</td> <td>1250</td> </tr> <tr> <td>50</td> <td>2000</td> </tr> <tr> <td>75</td> <td>3200</td> </tr> <tr> <td>100</td> <td>5000</td> </tr> </tbody> </table> <div data-bbox="261 636 818 1119">  <p>The diagram shows a radial drill setup. A vertical column is mounted on a base plate. A horizontal arm extends from the column, holding a drill bit. A dynamometer is attached to the drill bit. A label 'DYNAMOMETER' points to the device. A label 'SPAN' points to the distance between the base plate and the dynamometer.</p> </div> |  | Maximum allowed drilling diameter               | Maximum drilling force in kp | 35 | 1250 | 50 | 2000 | 75 | 3200 | 100 | 5000 |  |
| Maximum allowed drilling diameter | Maximum drilling force in kp                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                 |                              |    |      |    |      |    |      |     |      |  |
| 35                                | 1250                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |                                                 |                              |    |      |    |      |    |      |     |      |  |
| 50                                | 2000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |                                                 |                              |    |      |    |      |    |      |     |      |  |
| 75                                | 3200                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |                                                 |                              |    |      |    |      |    |      |     |      |  |
| 100                               | 5000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |                                                 |                              |    |      |    |      |    |      |     |      |  |

Remarks: with machines having several base plates perform analysis 1, 2, 3, 4 and 7 separately for each base plate.

For <sup>1)</sup> to <sup>4)</sup> and <sup>6)</sup> write down conditions under: <sup>1)</sup> "convex" or "concaved"; under <sup>2)</sup>: "towards base plate" or "opposite from base plate"; under <sup>4)</sup>: "towards column" or "opposite from column"; under <sup>6)</sup> "towards main column" or "opposite of main column", under <sup>8)</sup> strike out unnecessary.

Analysis is performed by request of:

Date and analyst function:

Novi Sad.  
(city)

29.06.81..  
(date)

signature  
(analyst signature)

## SPARE PARTS LIST BS-16

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| <u>Spindle</u>                                  | <u>Number</u> |
|-------------------------------------------------|---------------|
| 1 Spindle                                       | 110:01        |
| 2 ( <i>unreadable</i> )                         | 110:02        |
| 1 Ball bearing (radial clearance C15)           | 6006 DIN 625  |
| 1 Ball bearing (radial clearance C15)           | 6007 DIN 625  |
| 1 Axial bearing (radial clearance C15)          | 51207 DIN 711 |
| <br><u>Spindle transmission</u>                 |               |
| 1 Gear        Z=                                | 130:14        |
| 2 Ball bearing (radial clearance C15)           | 6007 DIN 625  |
| 1 Gear                                          | 130:07        |
| 1 Gear                                          | 130:05        |
| 1 Gear                                          | 130:06        |
| 1 Gear                                          | 130:13        |
| 2 Ball bearing (radial clearance C15)           | 6303 DIN 625  |
| 1 Gear                                          | 130:19        |
| 1 Gear                                          | 130:11        |
| 1 Gear                                          | 130:14        |
| 1 Gear                                          | 130:17        |
| <br><u>Carriage return transmission housing</u> |               |
| 1 Gear                                          | 140:08        |
| 1 Gear                                          | 140:10        |
| 1 Stepped gear                                  | 140:11        |
| 1 Gear                                          | 140:12        |
| 1 Gear                                          | 140:13        |
| 1 Gear                                          | 140:14        |
| 1 Gear                                          | 140:15        |
| 1 Worm screw                                    | 140:29        |
| 1 Axial bearing (radial clearance C15)          | 51104 DIN 711 |
| <br><u>Drive shaft (output shaft)</u>           |               |
| 1 Drive shaft                                   | 120:01        |
| 1 Worm wheel gearing                            | 120:02        |
| 1 Link (half)                                   | 120:03        |
| 1 Link (half)                                   | 120:04        |

ACCOMPANYING LIST

USER \_\_\_\_\_

PLACE OF SHIPMENT \_\_\_\_\_

TYPE – RADIAL DRILL “RB-70” RB.70-1600

SERIES 02

MFG NUMBER 02.81.048

PRODUCTION YEAR 1981

WAREHOUSE RECEIPT 30.06.71.

*STAMP*

TECHNICAL CONTROL  
Company “METALAC”

QUALITY CONTROL: *signature*

WAREHOUSE CLERK

NOVI SAD 29.06. 19 81 YEAR

DEBURR SHARP EDGES

SELECTING RPM

SELECTING  
CARRIAGE RETURN

OIL FOR BRAKE LUBRICATION

OIL FOR  
LUBRICATION

LEFT TURN

RIGHT TURN

BRAKE ENGAGEMENT

HYDRAULIC DRIVE FOR  
LOCKING DEVICE

LEGEND:

- A- RPM DIRECTION DISTR.
- B- CARRIAGE RETURN DISTRIBUTOR
- C- RPM SELECTION DISTR.
- D- DIFFERENTIAL DISTR.
- P- PUMP
- NV- DIRECTIONAL CHECK VALVE
- RV- TANK
- F- FILTER
- VS- SAFETY VALVE
- RP- FLOW REGULATOR

REMARK:  
THE REST OF LABELS  
IS GIVEN IN KINEMATIC  
SCHEME

|                  |      |       |       |      |       |       |      |       |       |      |       |       |
|------------------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|
| LEZEN            | BRUI | DATUM | POTPS | BRUI | DATUM | POTPS | BRUI | DATUM | POTPS | BRUI | DATUM | POTPS |
| HYDRAULIC SCHEME |      |       |       |      |       |       |      |       |       |      |       |       |
| No 70 X 1600     |      |       |       |      |       |       |      |       |       |      |       |       |