

Operating instructions

350 COMBI CNC

Chapter: 6.0

Description of the machine

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6.0 DESCRIPTION OF THE MACHINE

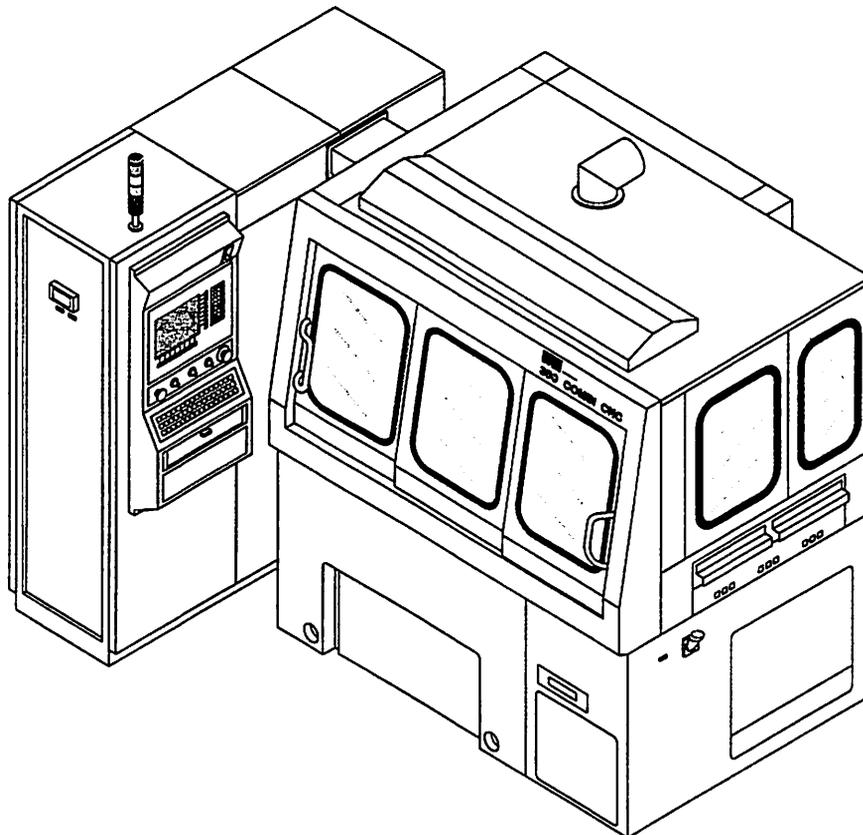
6.1. Full-protection hood

The machine is fully enclosed in a sheet metal hood complying to the relevant CE Standards.

Three sliding doors provide easy access to the grinding area and robot. Additional doors at the back of the machine provide easy access for maintenance purposes.

An efficient vacuum/suction device is installed directly above the grinding wheel. The customer simply connects this device to his vacuum system.

A lamp is installed inside the hood for good visibility.



6.2. Machine base

The base of the machine is a well proven compound ribbed, cast iron design on which are installed assembly groups, such as: grinding spindle head, rotary table, work-piece spindle head, automatic centralized lubrication, robot base with grinding-wheel dressing attachment, multi-prism and various options.

6.3. NC axes

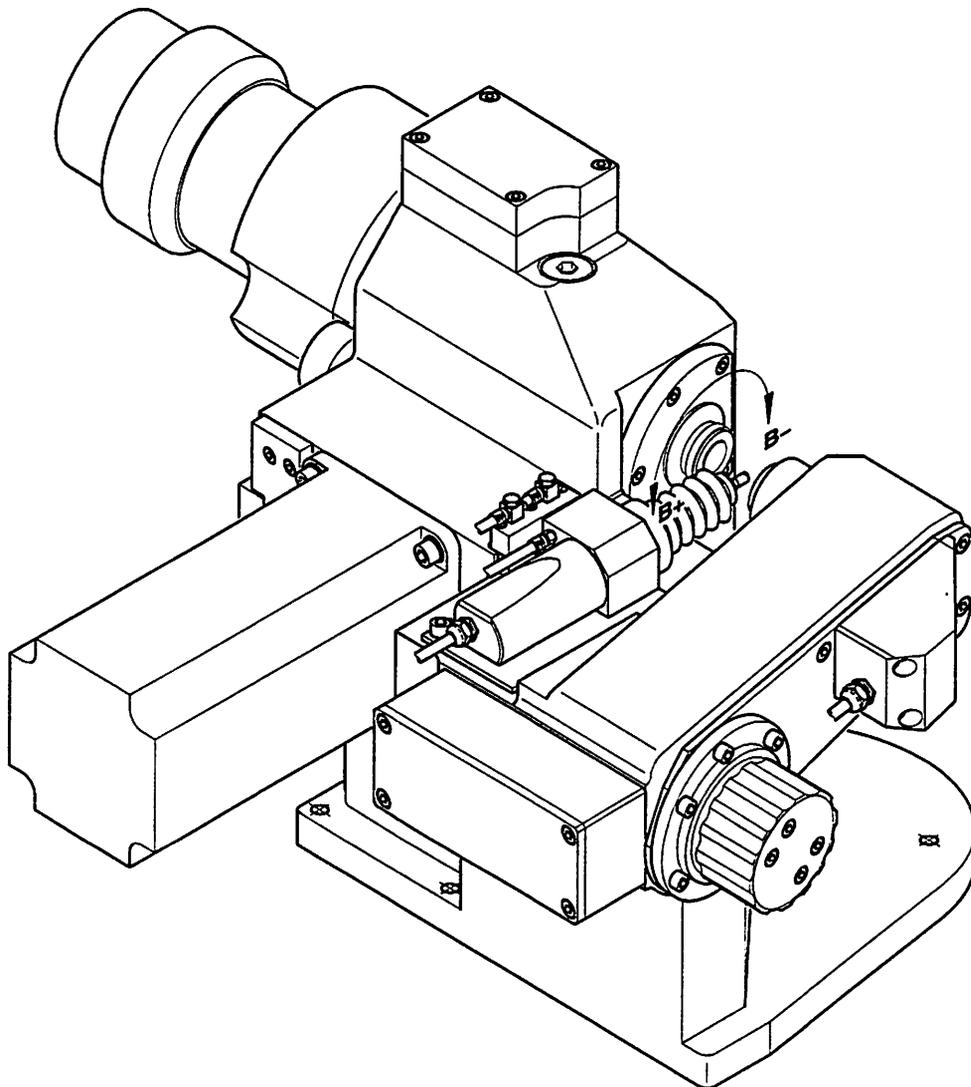
All the following listed NC axes are equipped with a digital direct measuring system.

6.3.1. B axis (workpiece spindle head)

The rotation movement of the inserts to be ground is transmitted to the B axis by an AC servomotor via backlash-free worm gear.

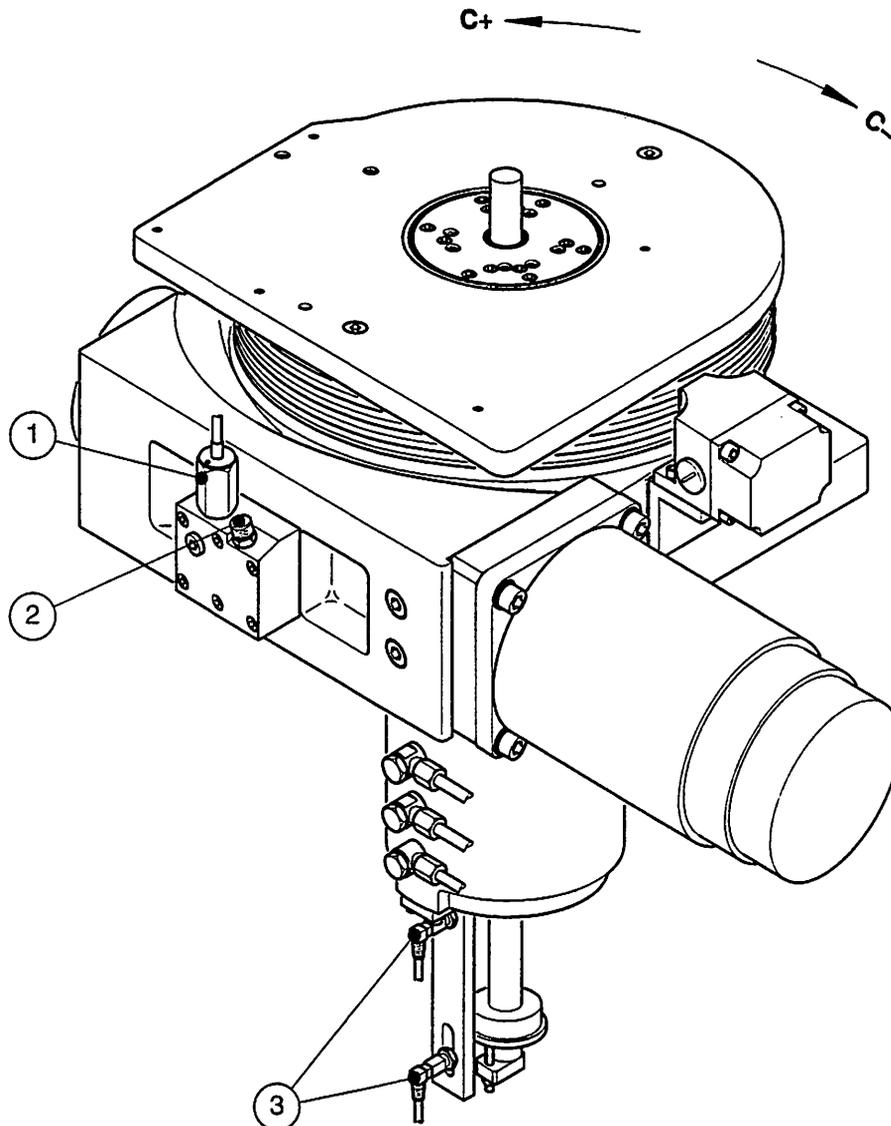
Other function elements, beside the B axis, are built into the workpiece spindle head:

- Workpiece clamping system,
- Hole centering,
- IC- and thickness-measurement,
- GAP system.



6.3.2. C axis (rotary table)

The rotary table supports the workpiece spindle head and enables the grinding of different clearance- and face-angles. The swivelling movement is actuated by an AC servomotor via backlash-free gear.



The oil level in the gearbox is monitored electrically (1). When the level is too low an error message appears on the screen and the machine is switched OFF.

MAN: The machine is switched OFF immediately.

SINGLE, AUTO: The machine is switched OFF at the end of the cycle.

Refill with oil (BP Enersyn SG-XP 220) at filling plug (2).



The two proximity switches (3) are set by AGATHON during machine assembly. This setting may never be modified.

6.3.3. Grinding spindle head

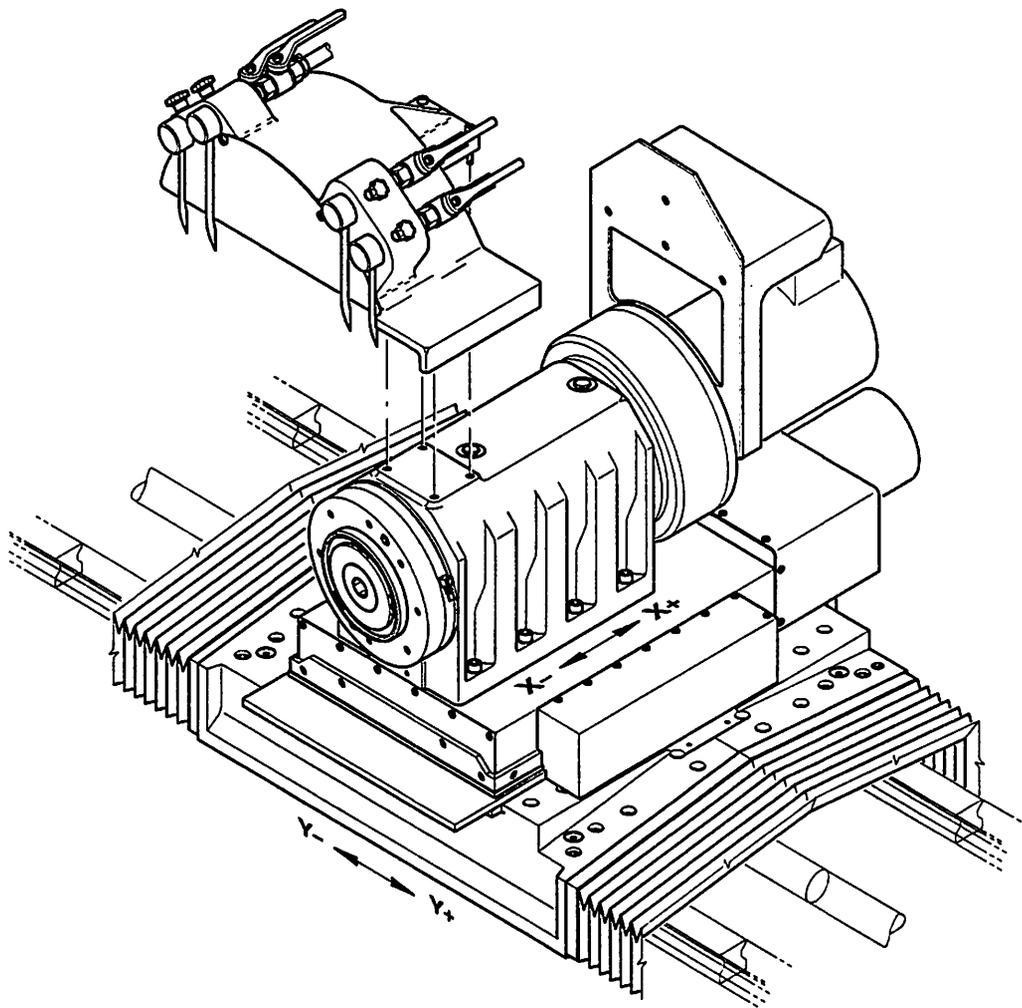
The grinding spindle head is installed on the X-Y slides.

The grinding spindle (equipped with 4 bearings) is driven via an elastic coupling from a liquid cooled asynchronous motor with variable speed regulation.

6.3.4. X-Y axis (X-Y slides)

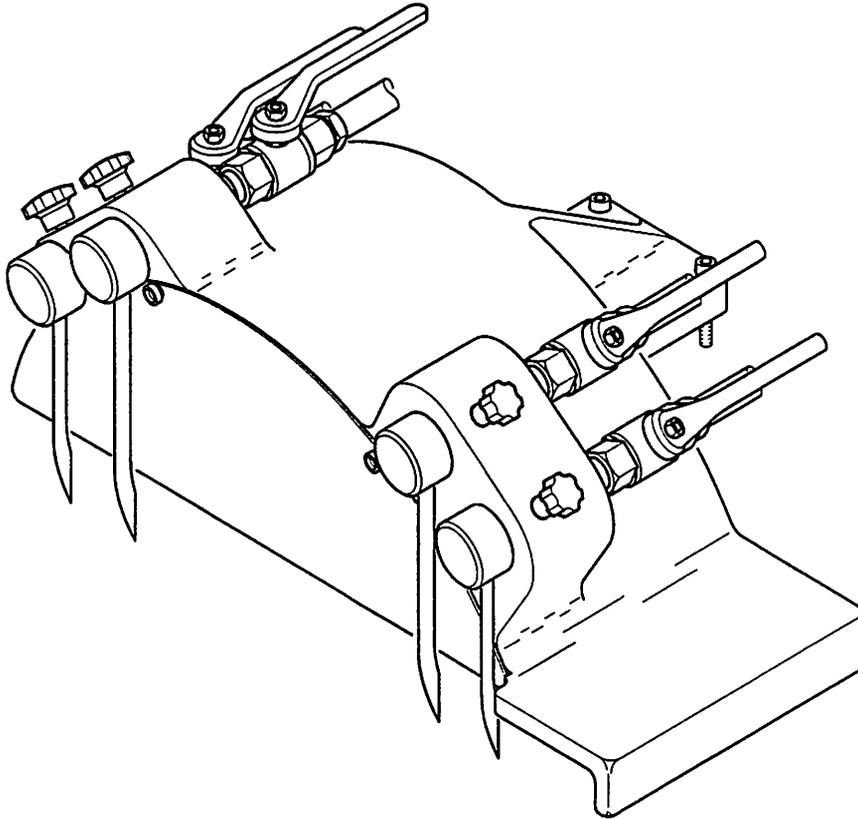
The Y slide is coupled to the base via preloaded roller guides and driven by a hydraulic NC axis.

The X slide is further coupled to the Y slide with preloaded needle roller guides and driven by an AC servomotor via a satellite roller spindle.



6.4. Coolant supply

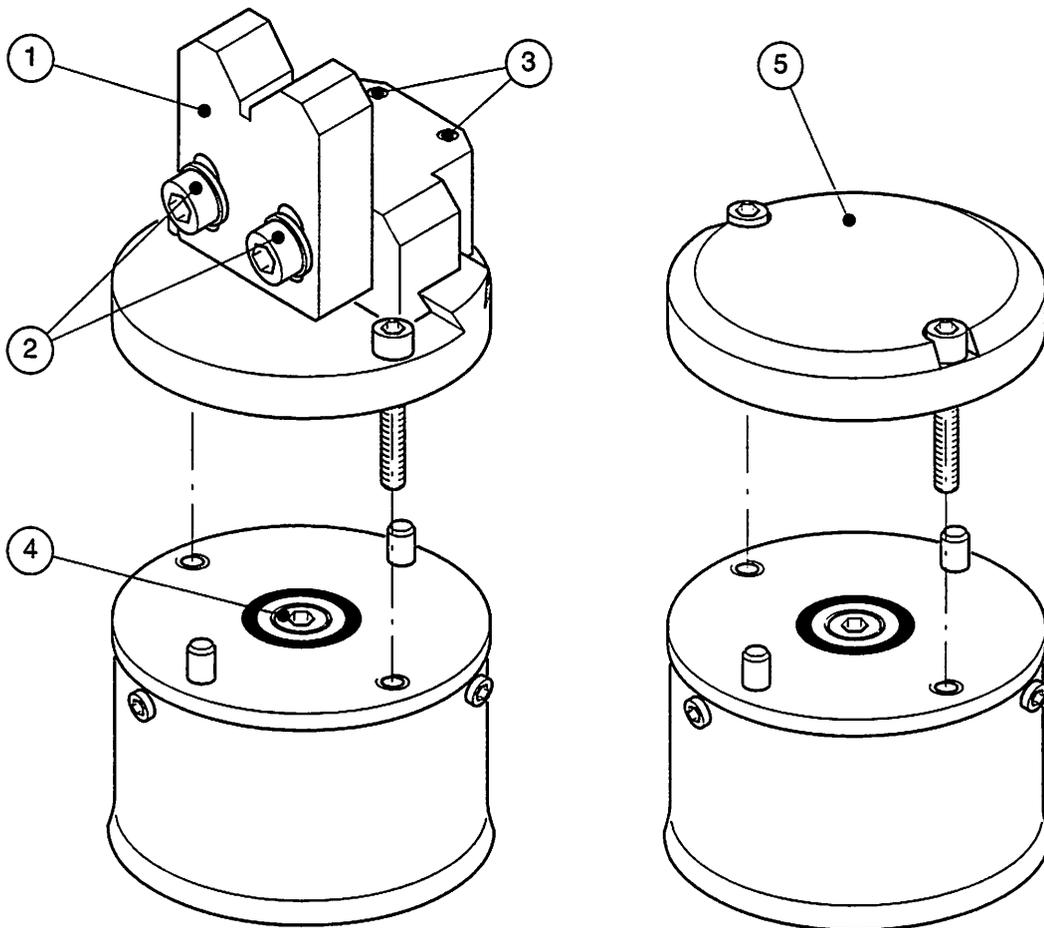
4 valves (located on the outside of the machine base) control the coolant supply to the machine. A flow controller monitors the coolant flow. 4 independently adjustable coolant nozzles (which can be customer specified) ensure proper distribution of the coolant in the grinding area.



6.5. Loading table, Loading device

The loading device is installed on the loading table. The loading prism (1) can be set horizontally when loosening screws (2) and vertically when loosening screws (3).

 When the loading prism is not used, cap (5) must be installed (contamination risk).



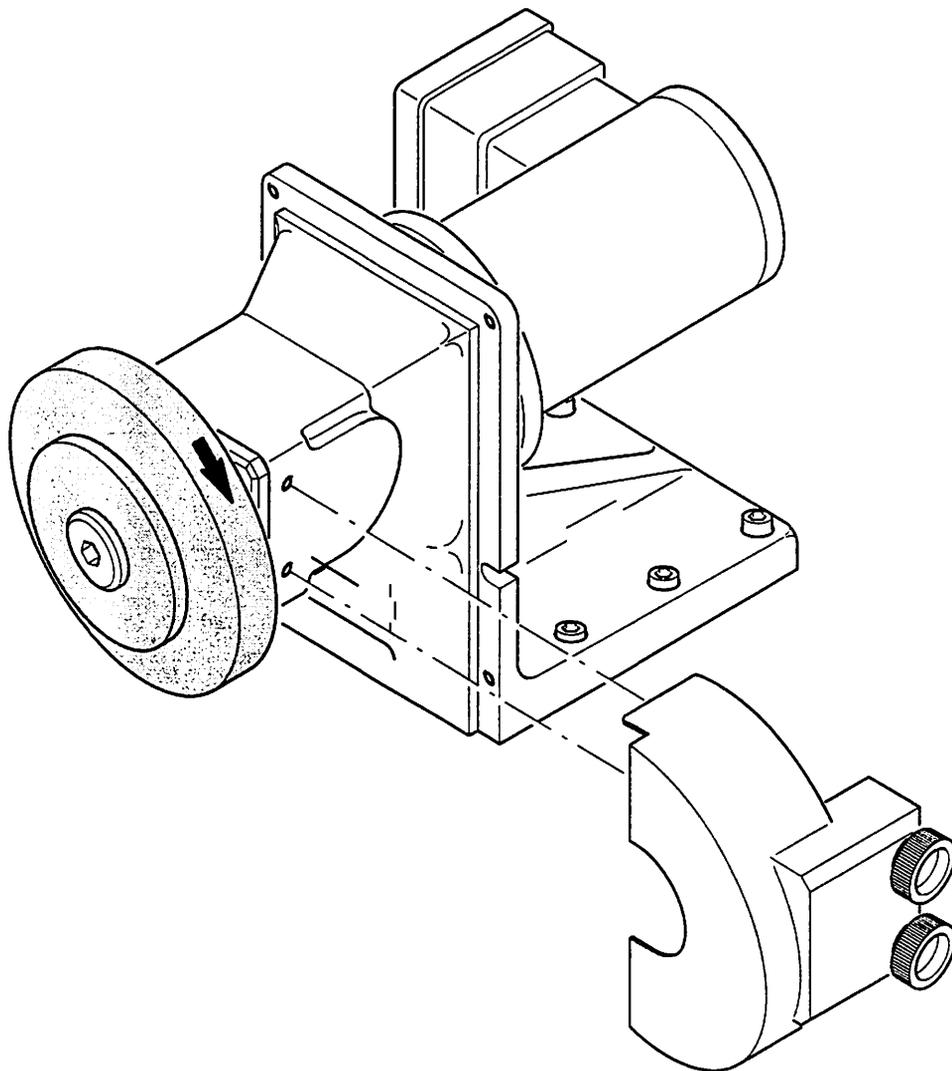
The loading table can be used either spring-loaded or rigid. Loosen screw (4) to set the resiliency. Maximum range of spring 2mm.

 The screw must not be jutting out after the loosening !

6.6. Grinding-wheel dressing attachment

The dressing attachment is installed on the robot's base and can be equipped with 2 different dressing wheels; one for the periphery-grinding rim and one for the chamfer-grinding rim. The speed ratio between the dressing- and grinding-wheel is determined via the speed regulation of the grinding wheel.

After a grinding wheel replacement, the first contact between grinding wheel and dressing wheel is done via the GAP sensor.



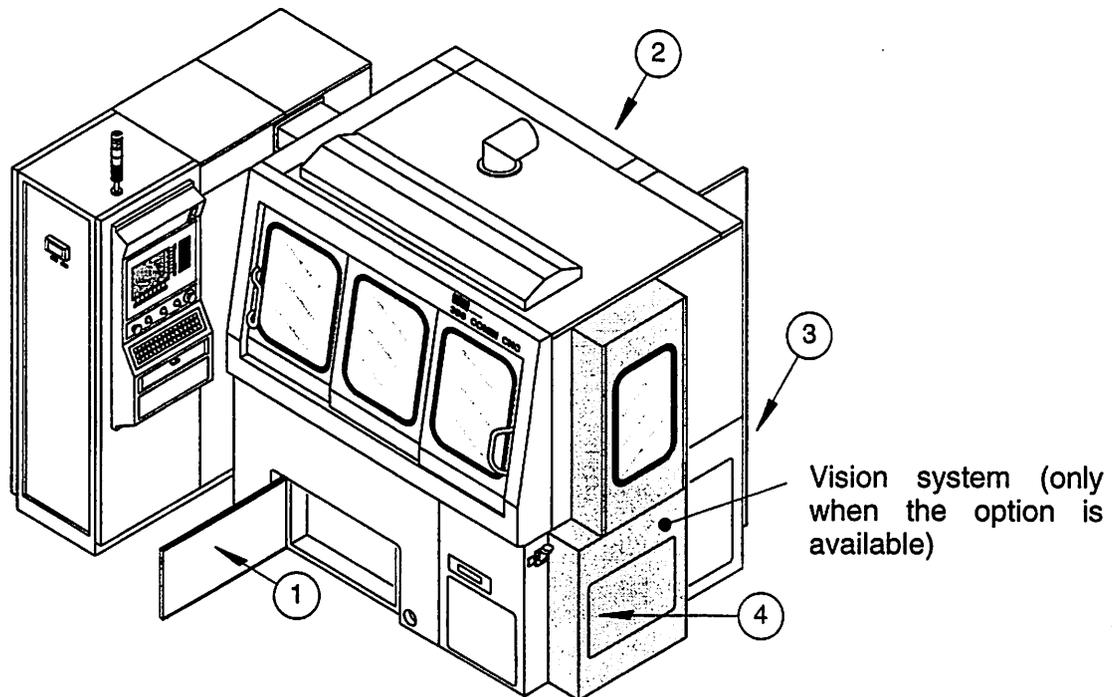
6.7. Pneumatic unit

The pneumatic unit processes the compressed air to be used on the machine. The inlet valve switches the compressed air ON when the installation is switched ON (key "Installation ON" on operating panel 3).

6.7.1. Compressed-air quality

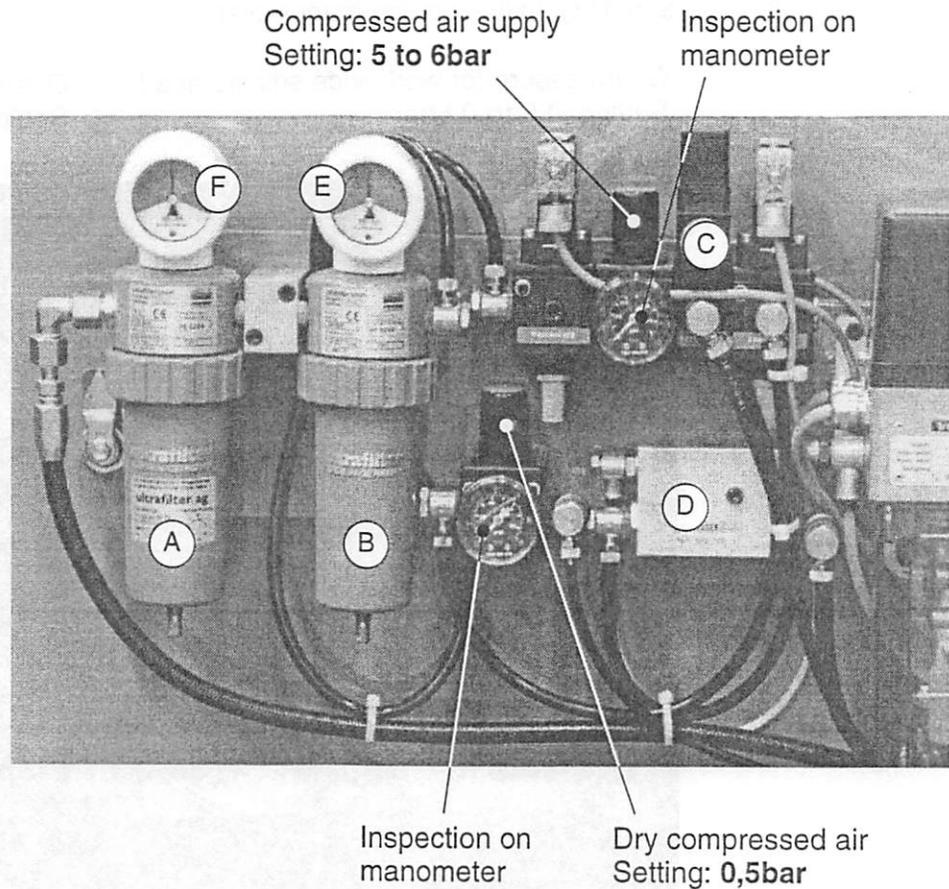
- | | | |
|---------------------|------------------------|--------------------------------|
| • Solid impurities: | Particle size: | max. 50 μm |
| | Quantity of particles: | max. 20 mg/m^3 |
| • Water contents: | | max. 10 g/m^3 |
| • Oil contents | | max. 25 mg/m^3 |

If these values cannot be obtained, the compressed air must be prepared!



Legend:

- ① Pressure settings (oiled and dry air).



The compressed air is cleared from oil, water and dirt in the two filters (A) and (B).

The contamination of the filter elements can be read on indicators (E) and (F). When the indicator is within the red area the filter element must be replaced (see chapter 16.0 "Preventive maintenance").

The pressure control-device (C) monitors the compressed air supply. If the pressure drops **below 4bar, an error message ensues**.

The compressed air is lubricated with oil drops in oiler (D). The oil quantity is set at AGATHON during machine assembly (the central lubrication does the oil supply).

Maintenance instructions



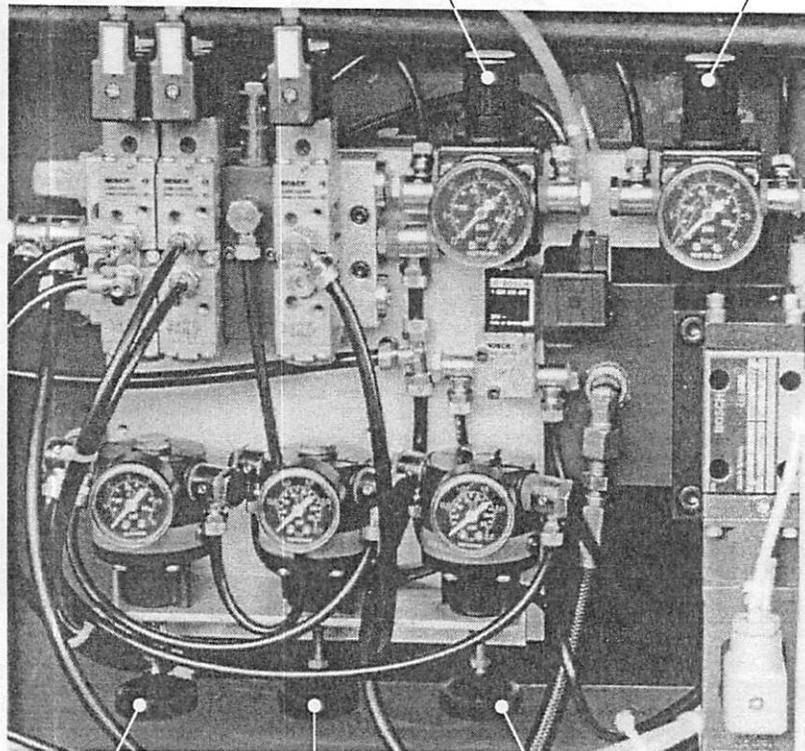
To guarantee a trouble-free operation of the pneumatic unit, observe and follow the **maintenance instructions in chapter 16.0 "Preventive maintenance" !**

Legend:

- ② Overpressure for workpiece spindle head, X/Y-slides and measuring system (DX). Inspection on manometer.

Overpressure for workpiece spindle head
Setting: **0,5 to 0,6bar**

Overpressure for X/Y-slides
Setting: **1bar**



Advance power for measuring probe, Basic setting: **1,55bar**

Supply pressure
Measuring system (DX)
Setting: **4bar**

Return power for measuring probe, Basic setting: **1,5bar**

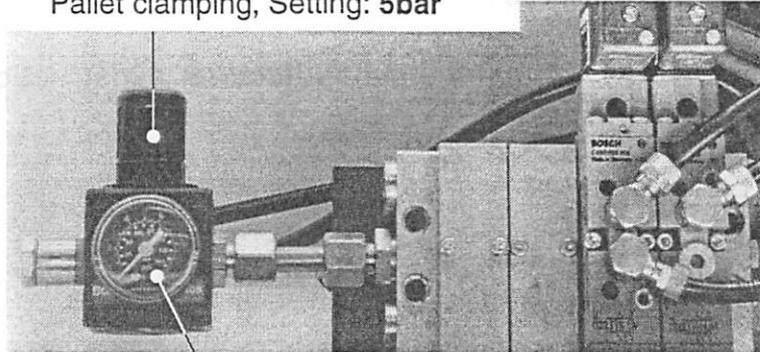


A correction of the advance/return power (increasing or lowering the measuring force) must be executed in accordance with diagram on page 05 – 9.

Legend:

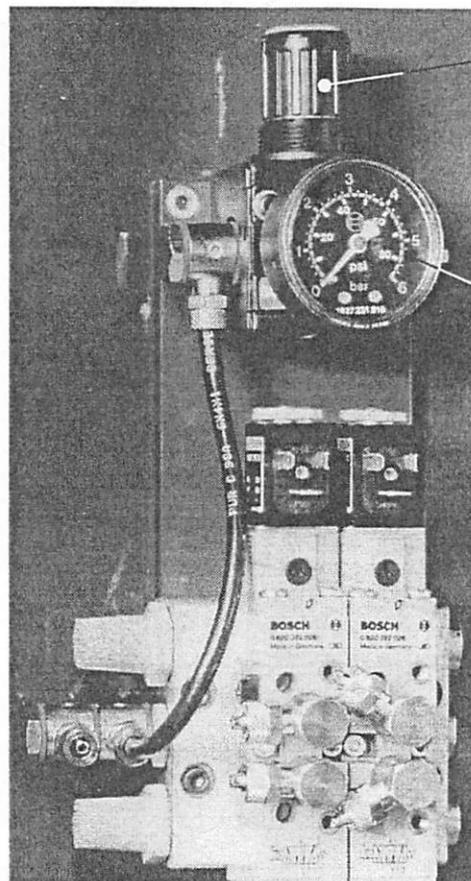
- ③ This setting is **only valid for Handling "B"** (multi-pallets stacking system).

Pallet clamping, Setting: 5bar



Inspection on manometer

- ④ Overpressure for Vision system (only when the option is available).



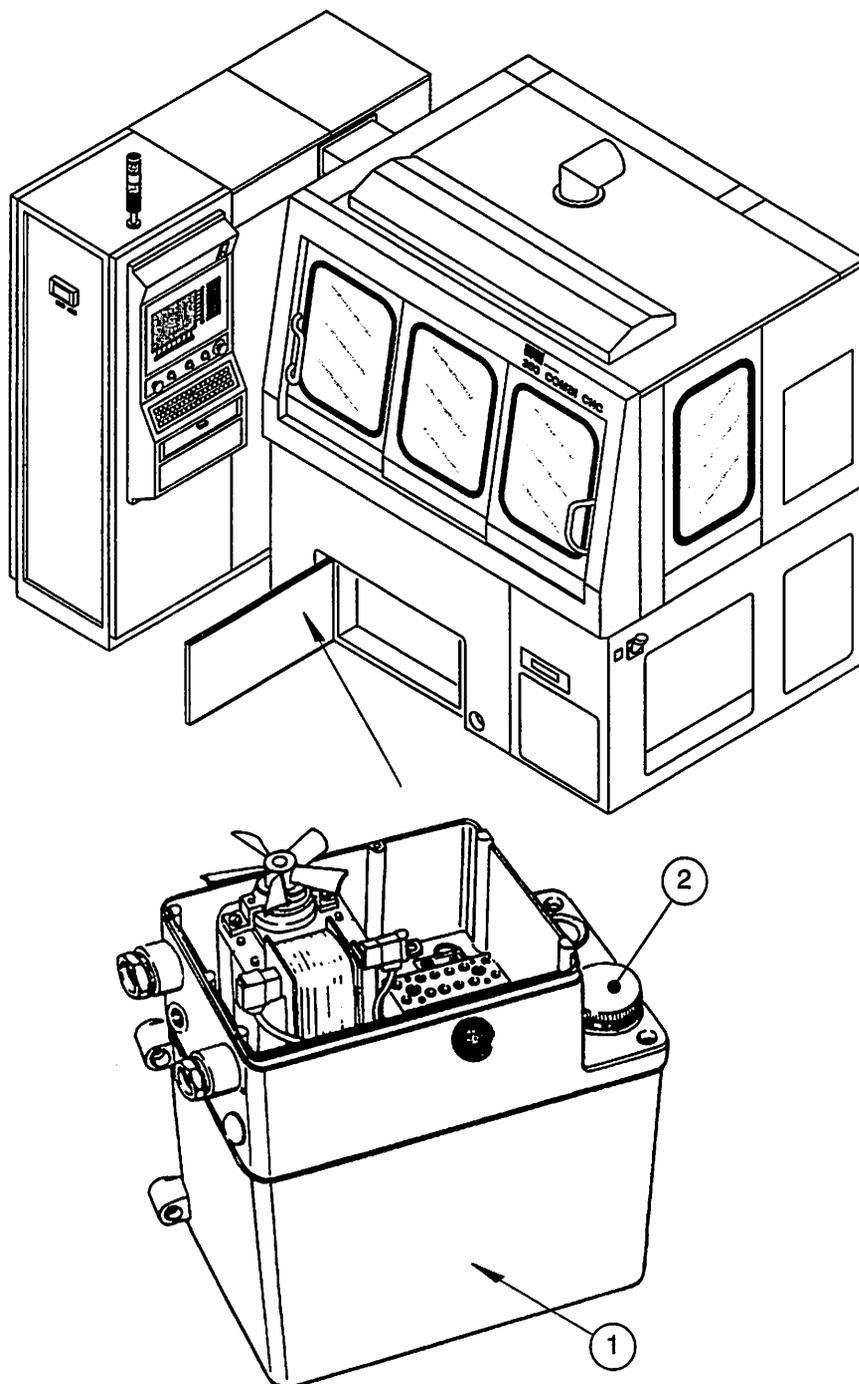
Overpressure for Vision system
Setting: 0,2bar

Inspection on manometer

6.8. Centralized lubrication

The centralized lubrication provides all the guides with grease. The oil consumption is set fix and cannot be modified.

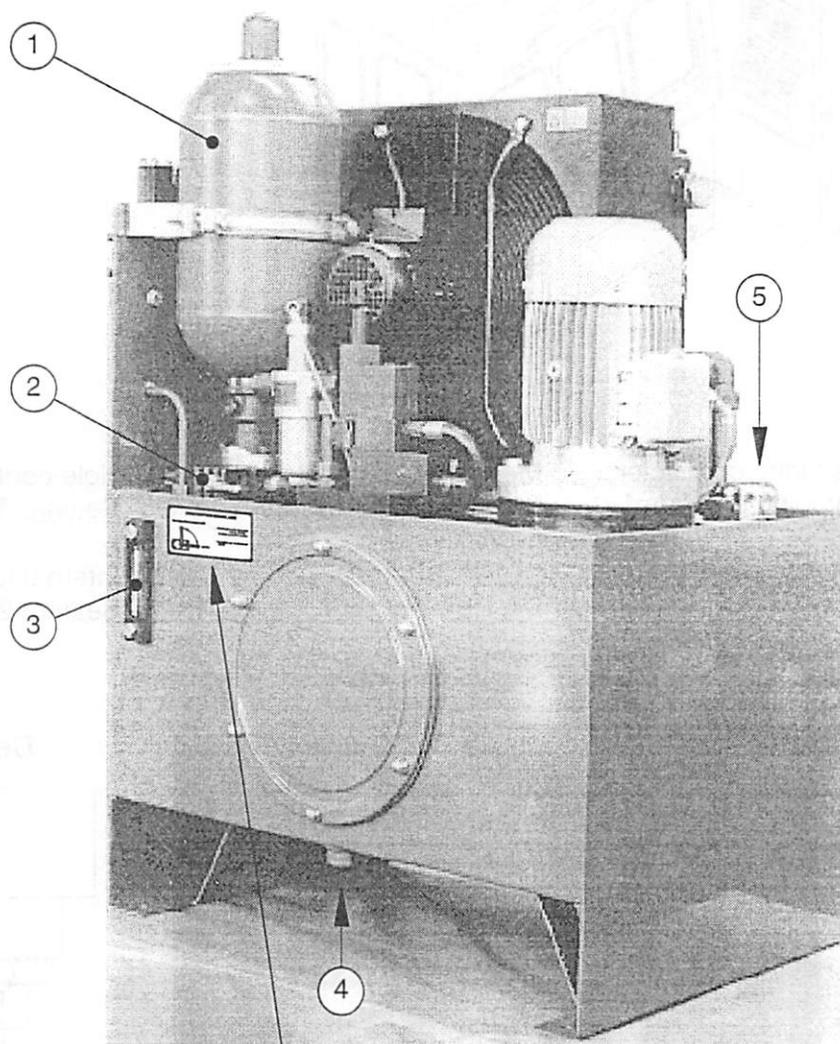
 **Always observe the manufacturer's instructions !**



The oil level can be inspected optically through housing (1). Additionally, the level is monitored electrically. The filling-up is done at oil filling plug (2).

6.9. Hydraulic unit

The hydraulic unit is free-standing and located beside the machine (in accordance with the floor plan). Flexible hoses connect the hydraulic unit to the machine. The unit is equipped with an oil cooler which, via a thermostat, keeps the fluid temperature stable.

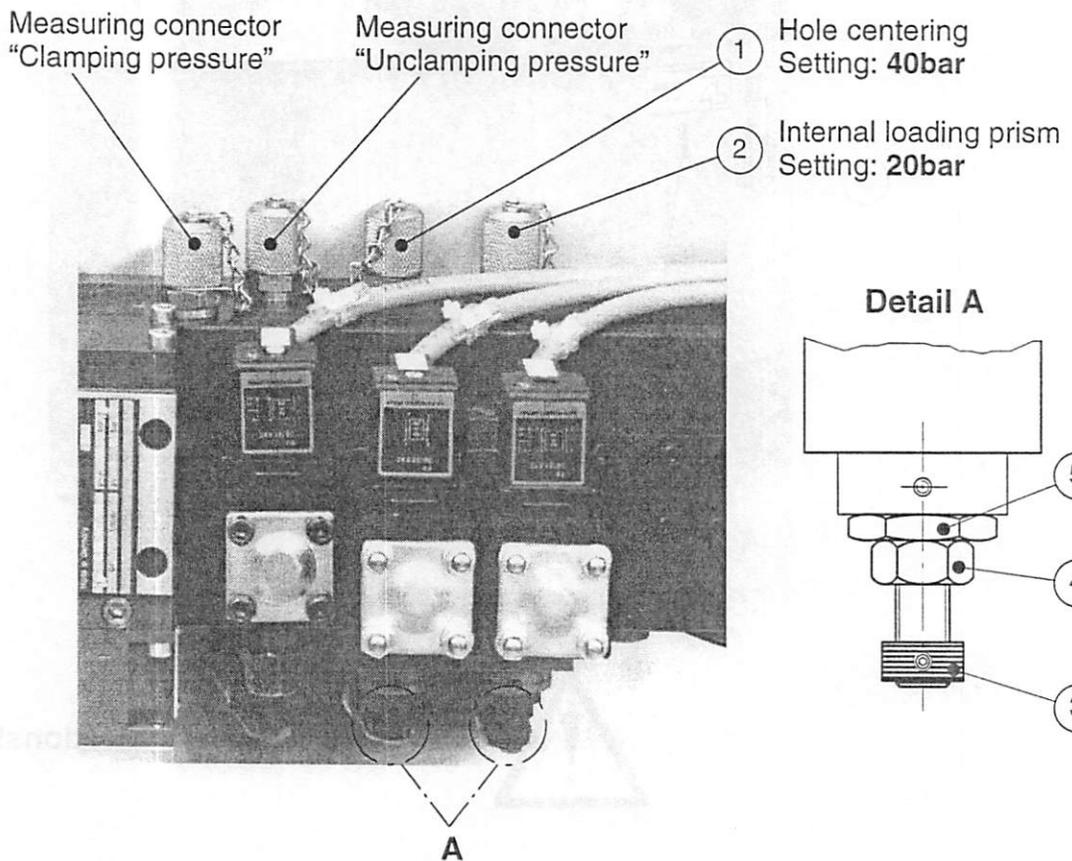
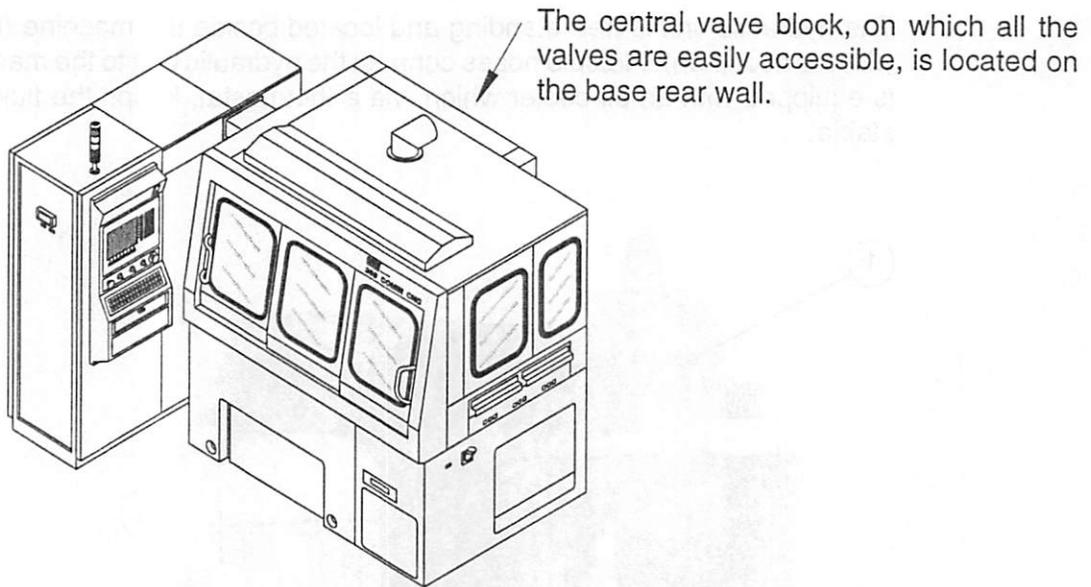


Observe the safety indications!

The accumulator (1) which is prestressed with nitrogen (70 bar) serves for the return movement of the hydraulic cylinder to its initial position in case of a power cut. The accumulator can be emptied via pressure relief-valve (2).

The oil tank is drained off at drain plug (4) and filled up at filler plug (5). Inspect the oil level at sight glass (3).

Pressure settings:



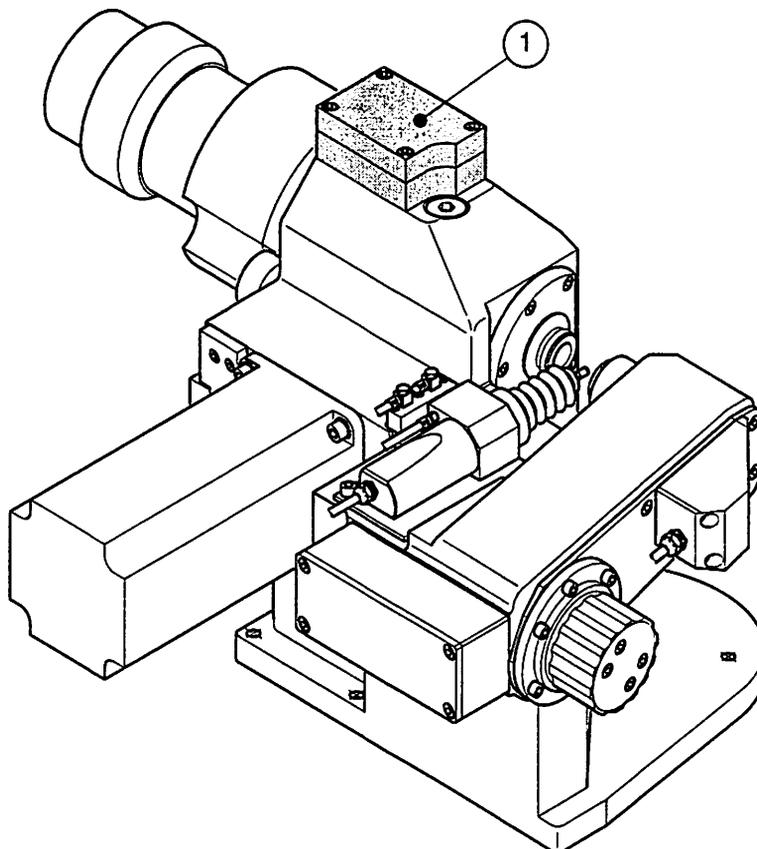
Turn knurled nut (3) clockwise to increase the pressure.

Connect the manometer to the corresponding connection (1 or 2) to inspect the pressure settings.

Once the setting-up is completed, tighten nut (5) and counter nut (4).

6.10. GAP System

GAP sensor (1) on the machine, GAP electronics and software in the control.



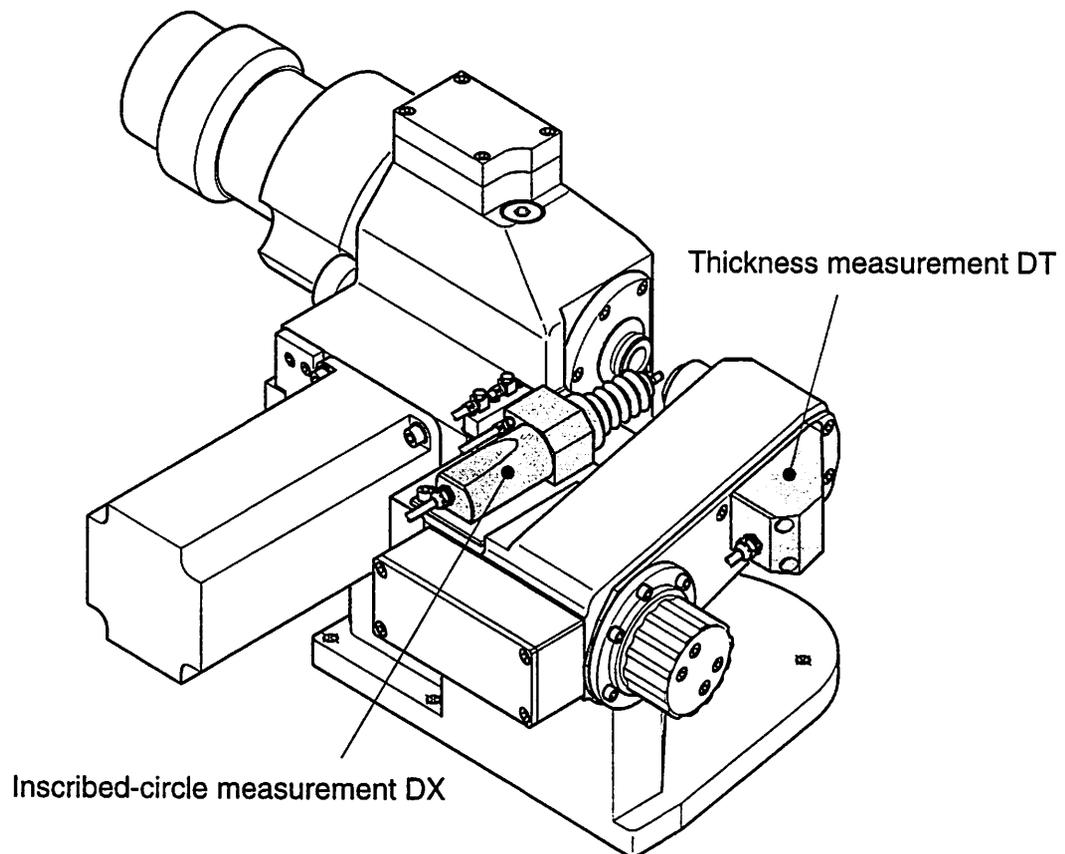
GAP provides:

- Air gap control to reduce the cycle time for blanks with varying stock removal. The grinding wheel approaches the workpiece rapidly and reduces its speed to the programmed working speed on contact with the workpiece. The GAP sensor is used for “Crash” monitoring during high speed axis movements, i.e. to stop the machine immediately by contact else than within grinding process.
- Autoset (automatic insert centering) enables the machine to automatically and very accurately center workpieces that are loaded off-center and to compensate the eccentricity within a defined batch-size during autonomous production. The control unit uses the master workpiece’s dimensions to calculate mathematically the eccentricity corrections necessary on the following workpieces.
- Angular centering (ECC-B) is similar to Autoset but only touches the workpiece on two corners. The control uses these two dimensions for the calculation, after which the angular correction is automatically implemented. This is a very helpful option when minimum stock is available, or if sintered-chip breaker grooves must be exactly parallel to the ground periphery.

6.11. Inscribed-circle measurement DX

Automatic measuring system (1) for monitoring the insert dimension (in autonomous operation) with programmable correction- and tolerance-limits. Different methods can be applied for the correction:

- constant programmed correction step,
- correction to "0",
- percental correction step,
- SPC statistical trend correction (option).

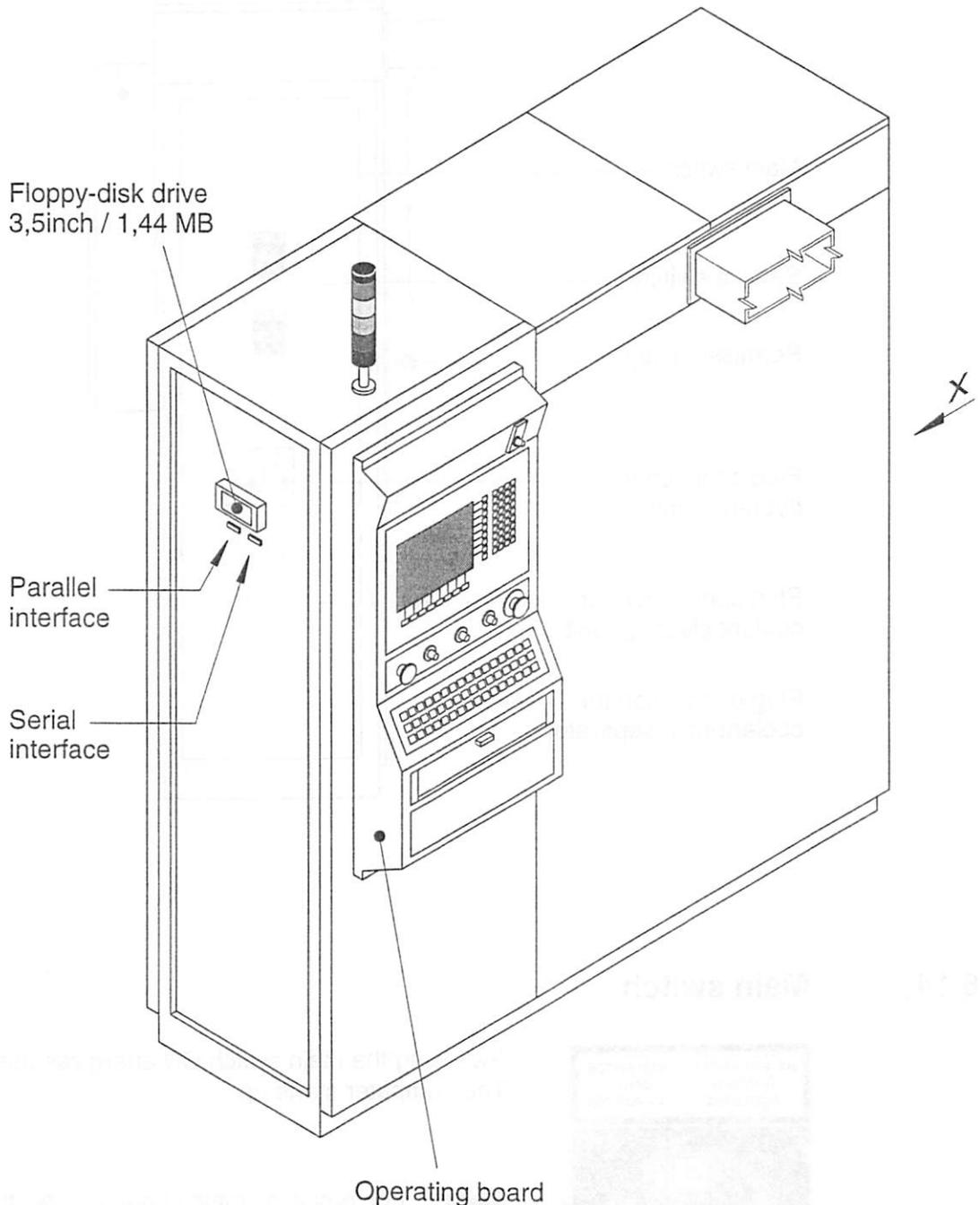


6.12. Thickness measurement DT

For automatic compensation of thickness variations with regards to the clearance angle. The insert thickness and the tolerances are programmable. When the tolerance limit is exceeded the insert is unclamped and unloaded in a separate tray.

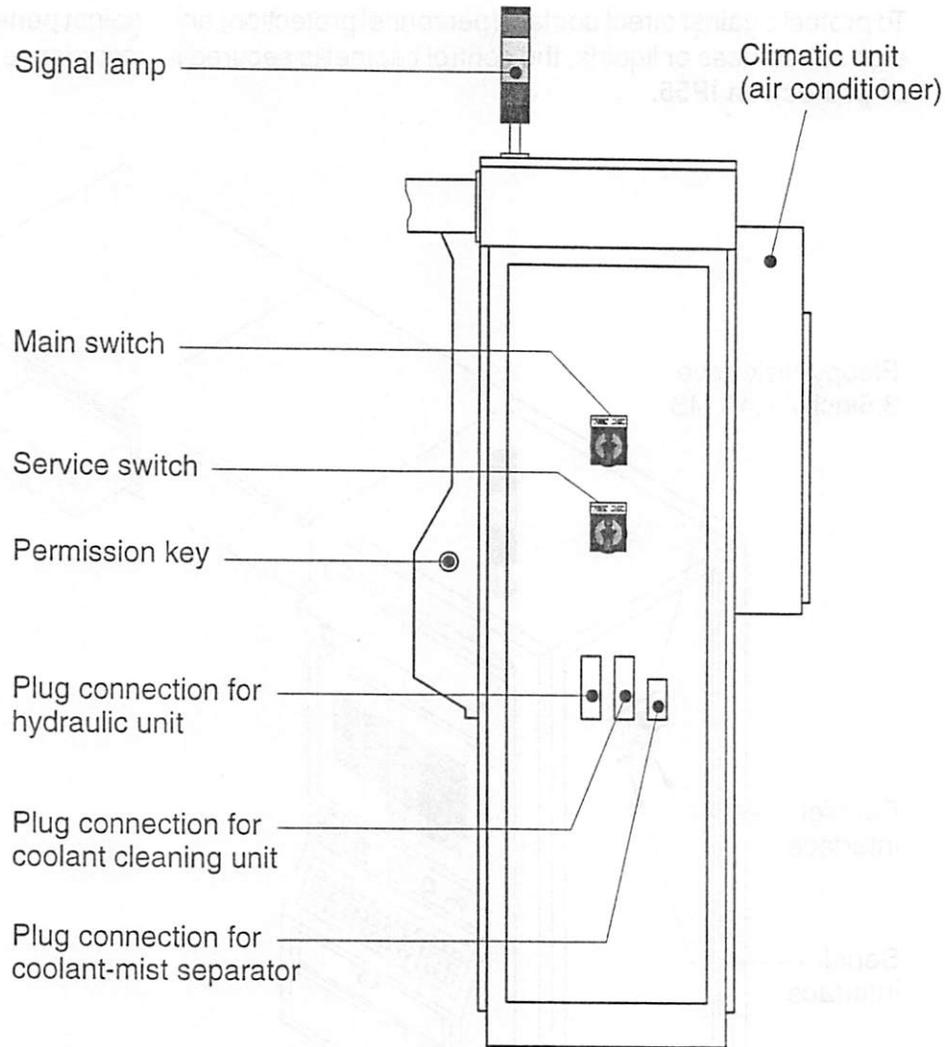
6.13. Machine control

To protect against direct contact (personnel protection) and against penetration of foreign substances or liquids, the control cabinet is secured in accordance with **System of protection IP55**.

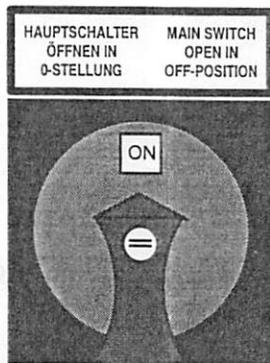


Close all the electrical covers as well as the control cabinet before switching the machine ON.

View X



6.14. Main switch

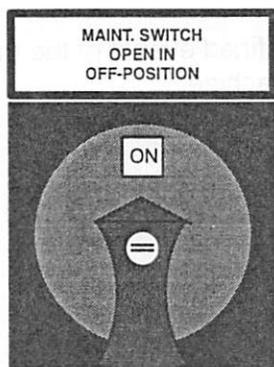


Switching the main switch ON energizes the control unit. The computer starts up.



For repair or maintenance work, turn the main switch to position "OFF". Secure the main switch with a padlock to prevent unauthorized manipulation. Cut the entire installation off the current supply.

6.15. Service switch



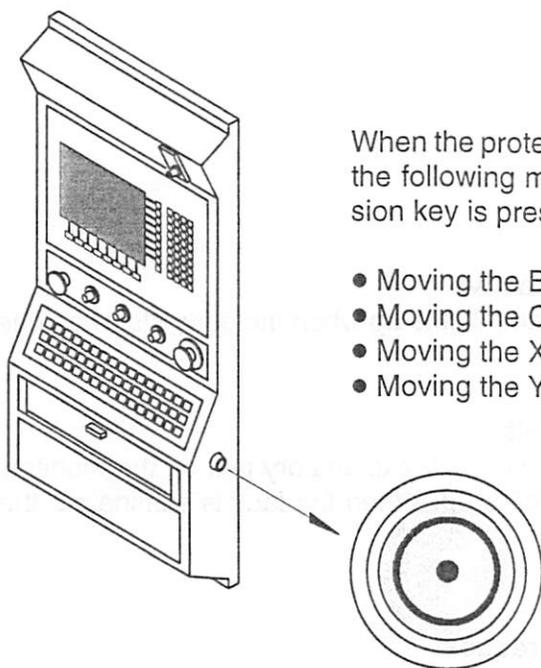
The service switch (MAINT. SWITCH) serves only for repair or maintenance work on the machine. Switching the service switch OFF interrupts the current supply to all the elements except for machine-control and robot-control. The machine is dead and unpressurized.



For repair or maintenance work, turn the service switch to position "OFF". Secure the service switch with a padlock to prevent unauthorized manipulation.

6.16. Permission key

The permission key is located on the side of the operating board. When the protection hood is open any axis movement requires a two-hand operation.



When the protection hood is open (operating mode: MAN) the following movements can be executed if the permission key is pressed.

- Moving the B axis
- Moving the C axis
- Moving the X axis
- Moving the Y axis



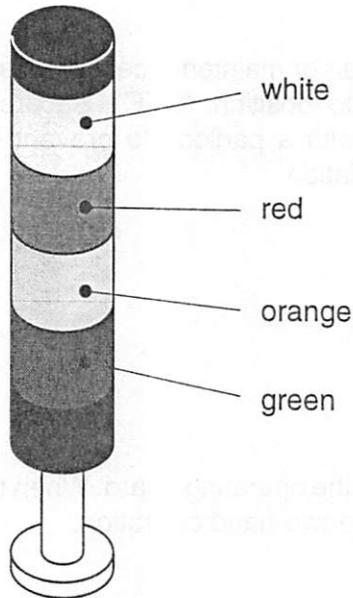
The machine **cannot be moved to reference position** when the protection hood is open.



The grinding-wheel motor **cannot be started up** when the protection hood is open.

6.17. Signal lamp

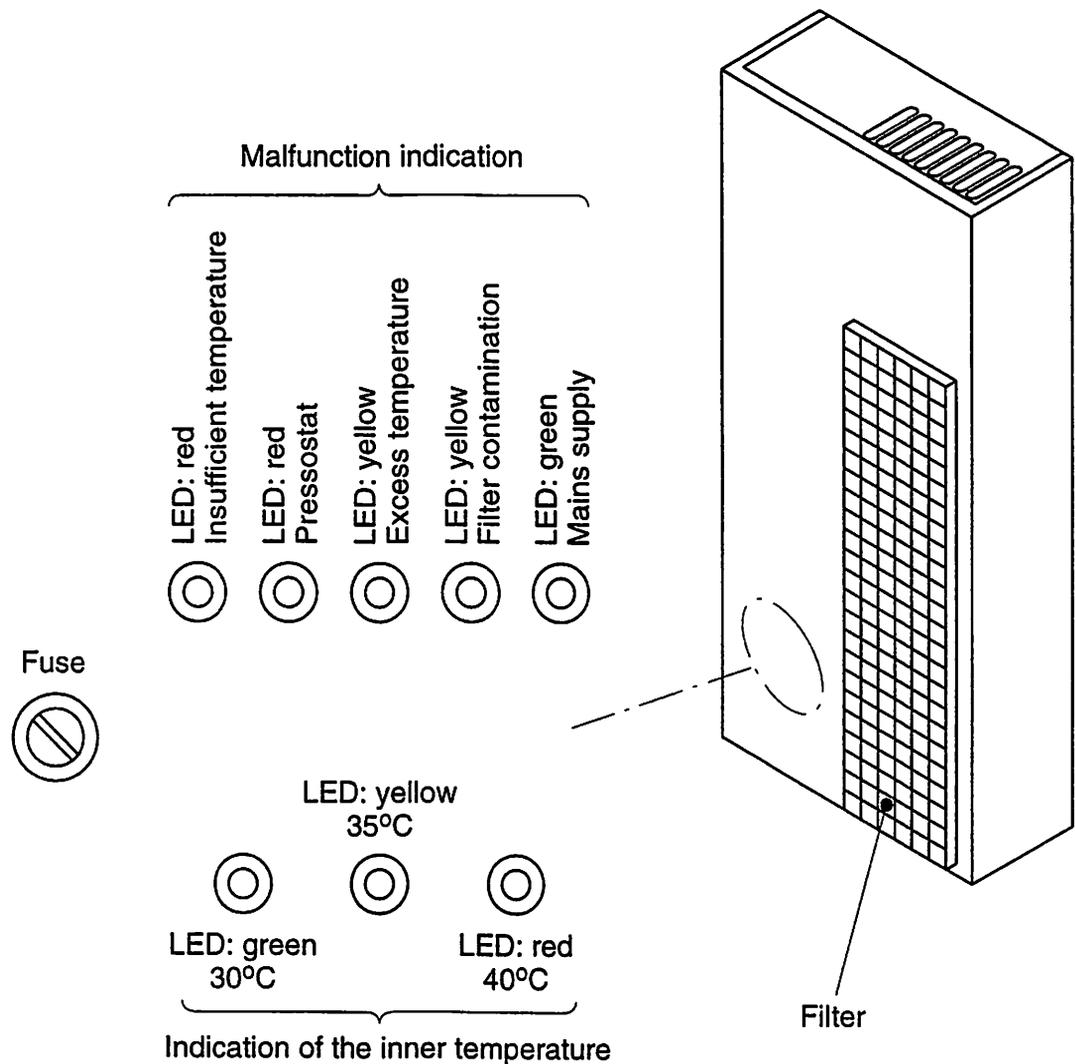
The colors of the signal lamp are associated to defined events of the machine. This enables to quickly see the current status of the machine.



Color	Remark
white	Early start active The white lamp lights up when the early start has been activated.
red	General fault The fault appears in explanatory text on the monitor, and the red roof-lamp lights up. When the fault is eliminated, the lamp extinguishes.
orange	Operation request The request appears in plain language on the screen. The key which has to be pressed flashes. The orange lamp lights up. The lamp extinguishes after the operation.
green	Cycle sequence The green lamp lights up during the cycle sequence in single-cycle mode (SINGLE) or in automatic mode (AUTO).

6.18. Air conditioner

An air conditioner is installed on the back of the control unit to ensure a constant temperature inside the control cabinet.



Light-emitting diodes are used to enable a quick detection of the malfunctions. Yellow = warning, Red = device standstill.

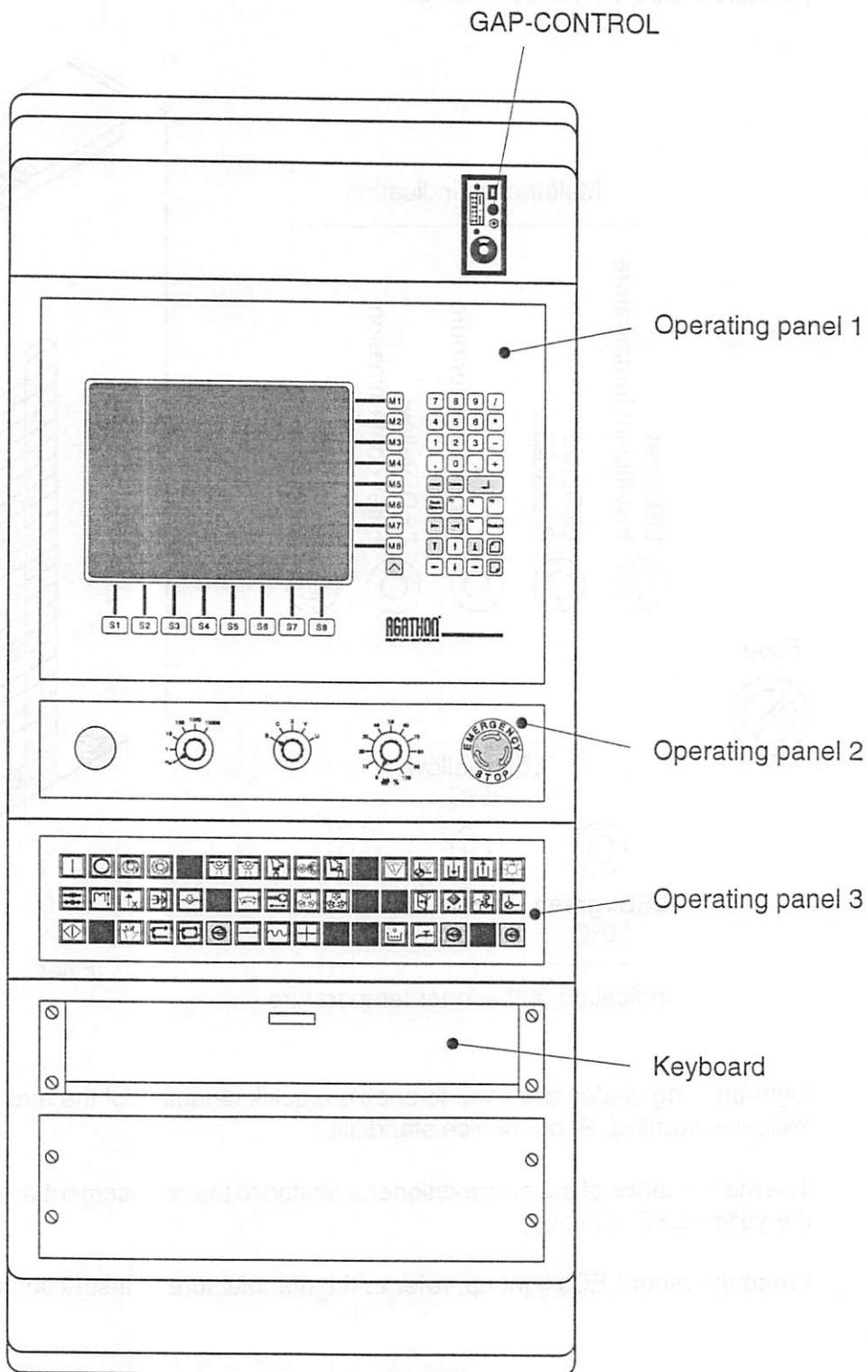
The maintenance of the air conditioner is limited to the replacement of the filter (when the yellow LED lights up).

When the other LEDs light up, refer to the manufacturer's instructions.

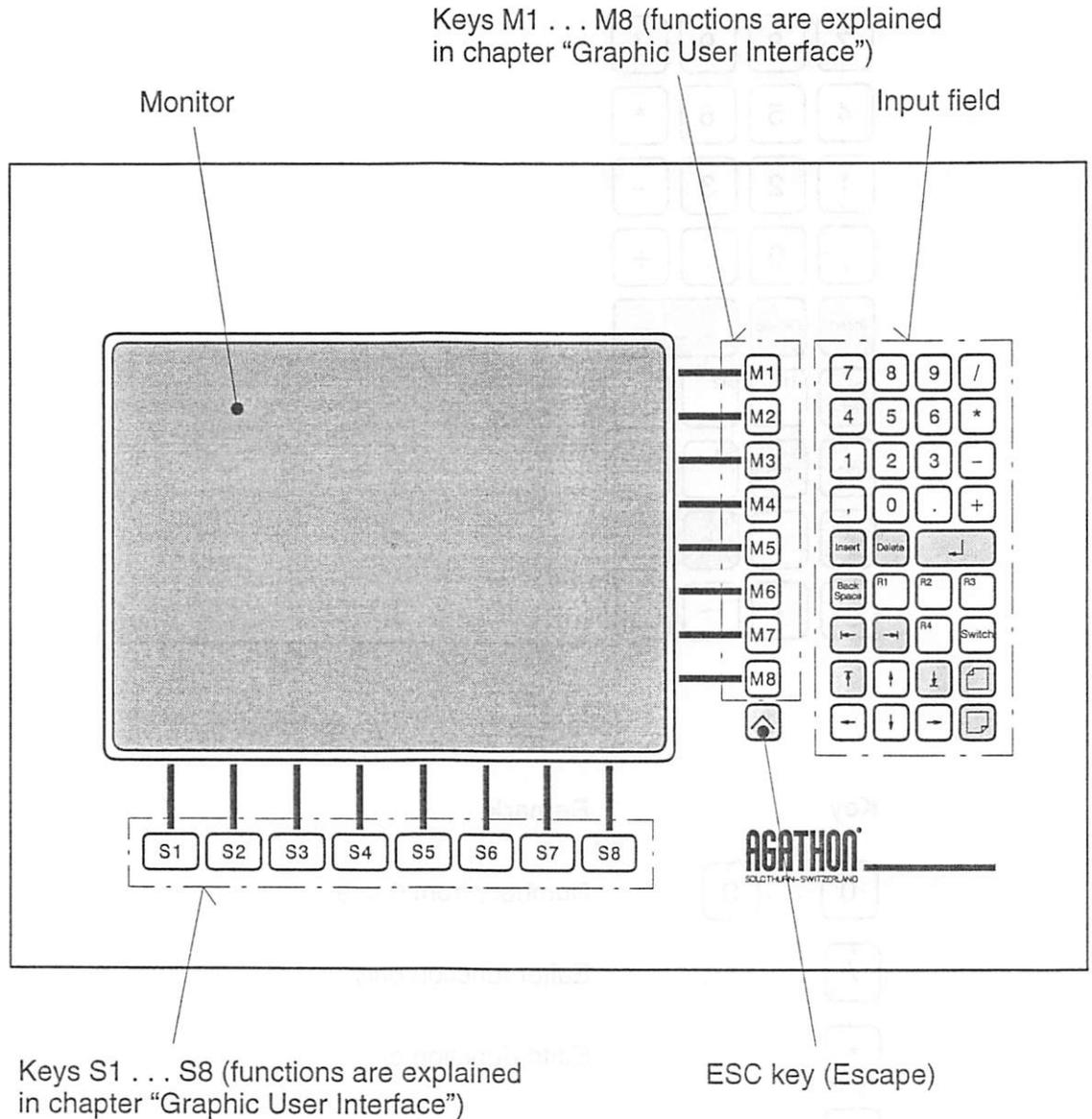


Always observe the manufacturer's instructions!

6.19. Operating board



6.20. Operating panel 1



6.20.1. Monitor

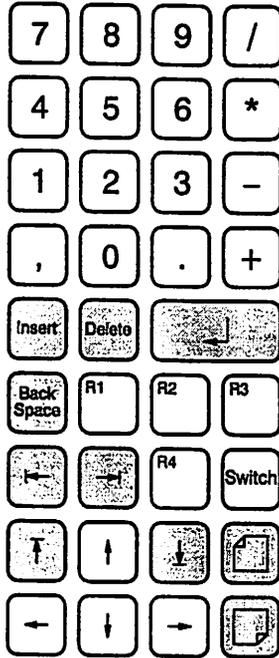
A 14inch monitor (64 colors) is available as dialog partner. The size of the picture is $250 \pm 5\text{mm}$ horizontal and $187,5 \pm 5\text{mm}$ vertical.

Operating modes, information, error messages, etc. are displayed on the monitor during the operation.



Always observe the manufacturer's instructions!

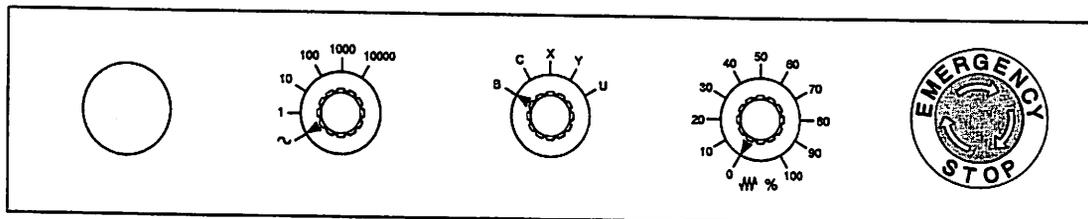
6.20.2. Input field



Key	Remark
0 ... 9	Numbers from 0 to 9
/	Editor function only
*	Editor function only
-	Input of negative values
,	Editor function only
.	Decimal point
+	Editor function only
Insert	Editor function only
Delete	Editor function only
↵	Quit dialog

Key	Remark
	Editor function only
	No function
	No function
	Editor function only (see CNC – Variables–Editor)
	Editor function only (see CNC – Program–Editor)
	Editor function only
	Previous input field
	Next input field
	Home (go to beginning of line)
	End (go to end of line)
	1 character left
	1 character right
	1 line up
	1 line down
	Go to first file (file selection)
	Go to last file (file selection)

6.21. Operating panel 2



Key



Remark

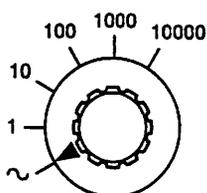
EMERGENCY STOP button

Pressing the EMERGENCY STOP button interrupts the current supply to the machine immediately (i.e. all started up motors are stopped immediately). The hydraulic is not under pressure.

The machine- and robot-control remain alive (there is no data loss).

When the EMERGENCY STOP button is released, the machine is supplied with current again. Press the "Installation and Hydraulics ON" key to start the machine up again and to move to reference position (inclusive Handling systems).

If a workpiece is clamped, unload it by hand.



Preselection switch for travel mode

Select the number of increments the selected axis should move.

- ~ : The selected axis travels continuously when one of the infeed keys (+ or -) is pressed.
- 1 : 1 increment per key operation
- 10 : 10 increments per key operation
- 100 : 100 increments per key operation
- 1000 : 1000 increments per key operation
- 10000 : 10000 increments per key operation

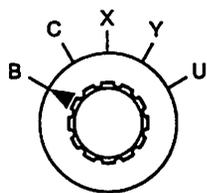
1 increment = 0,001° for the B axis

1 increment = 0,001° for the C axis

1 increment = 0,0001mm for the X axis

1 increment = 0,001mm for the Y axis

Key

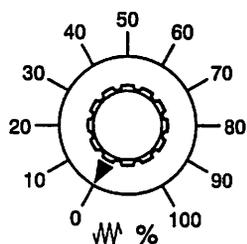


Remark

Axis preselection switch

Select the axis (B, C, X or Y) which should travel in manual mode (MAN). Only one axis can be active.

Switch position "U" has no function

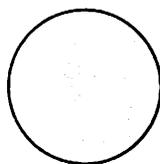


Axis-speed regulator

Set the speed with which the NC axes (B, C, X and Y) must travel. The setting is done globally. Every axis speed (also during the program sequence) will be travelled with the set percentage. If a speed of 60 mm/min (X axis) is programmed and the regulator is set on 50%, the axis will travel at a speed of 30 mm/min.

0 : Speed 0 (the axes cannot be moved).

100 : The axes travel with the defined speed.



Cycle STOP (yellow mushroom push button).

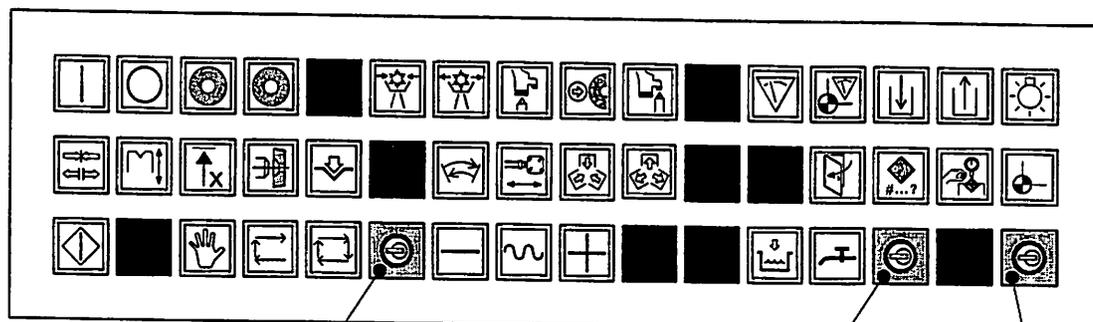
Pressing this push button interrupts the running cycle. The X axis moves to position X-REAR and the robot stops in the actual position.

The control unit switches over to manual mode (MAN).

The current supply to the machine is not interrupted. The motors (grinding-wheel motor, hydraulic unit, coolant cleaning unit, coolant mist separator) are not stopped.

A clamped workpiece must not be unloaded (the cycle can be restarted).

6.22. Operating panel 3

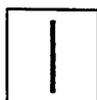


Key-operated
switch S37
RUN IN

Key-operated
switch S61
EDIT

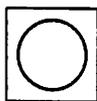
Key-operated
switch S67
NOT END

Key Remark



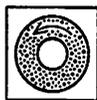
Installation and Hydraulics ON

Energizing the installation switches the hydraulics and the hydraulic-oil cooler ON, and makes the B, C, X and Y axes regulator alive. At the same time, the centrifuge motor of the coolant cleaning unit is switched ON and the input solenoid valve of the pneumatic unit is opened. **Axis movements are not possible when the installation is not switched ON.**



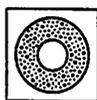
Installation and Hydraulics OFF

The power supply to the machine is interrupted. The control unit remains alive. When the key is pressed during the grinding cycle, the running cycle is first finished before the machine is switched OFF.



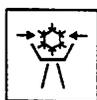
Grinding wheel ON (ccw rotation)

The axes must be in reference position before the grinding-wheel motor can be switched ON. **It is not possible to start up the motor when the protection hood is open.**



Grinding wheel OFF

Switches the grinding-wheel motor OFF.



Coolant valve ON / OFF

Switches the coolant valve ON and OFF in manual mode (MAN).

Key	Remark
	Coolant valve (chamfer rim) ON / OFF Switches the coolant valve ON and OFF in manual mode (MAN). The valve is generally switched ON in single-cycle (SINGLE) or automatic mode (AUTO).
	Dressing (periphery rim) START Execution of a dressing cycle in accordance with the workpiece parameter "Dressing". The grinding-wheel motor starts up automatically. During the dressing cycle, the peripheral speed of the grinding wheel is reduced to match the dressing speed.
	Dressing attachment motor ON / OFF Switches the dressing attachment motor ON and OFF in manual mode (MAN).
	Dressing (chamfer rim) START Execution of a dressing cycle in accordance with the workpiece parameter "Dressing". The grinding-wheel motor starts up automatically. During the dressing cycle, the peripheral speed of the grinding wheel is reduced to match the dressing speed.
	DX-Measurement ON / OFF When the function is switched ON the workpieces are measured, in automatic mode (AUTO), in accordance with the set interval entered in the measuring parameter, and the necessary corrections are executed.
	Reference position of DX measuring probe Manual setting of the measuring-probe reference position in manual mode (MAN). Function not active !
	Preselection of automatic loading If this key is not selected ON the workpiece must be loaded manually.
	Preselection of automatic unloading If this key is not selected ON the workpiece must be unloaded manually.
	Machine lamp ON / OFF This key enables to switch the light in the grinding area ON and OFF.

Key	Remark
	CLAMP / UNCLAMP workpiece Manual clamping / unclamping of the workpiece in manual mode (MAN).
	Loading prism (internal) UP / DOWN
	Position X-REAR Pressing this key makes the X axis move to the taught position. The position is set by AGATHON and cannot be modified.
	Centering attachment (for workpiece with hole) FRONT / BACK The centering attachment remains at the front as long as this key is held pressed.
	Positioning cylinder UP / DOWN Loading help, Tipmatic.
	Loading step of the B axis Execution of the loading step which is defined in the workpiece parameter "Load / Unload".
	DX measuring lever UP / DOWN
	Axes in loading position The function is used for the robot teaching procedure.
	Axes in unloading position The function is used for the robot teaching procedure.
	Unlock SPC door When this key is pressed the robot executes the actual cycle and moves to HOME position. The door is unlocked (key lights up). The actual grinding cycle is ground to the end also when the SPC door is unlocked. Once the door is closed again, it is automatically locked and the automatic cycle is resumed. Only on machines which are equipped with electrical locking.
	Selection of the insert No. Define which workpiece (e.g. insert No. 12), from the actual pallet, the robot should pick up first. If there is no input (no No. specified), the work starts on the first position. The No. must be entered on the hand-held programmer (PHG).

Key	Remark
	Parts inspection The next workpiece will be placed in the box for parts inspection.
	Machine in start position Move the B, C, X and Y axes to the start position. The machine can only be moved in start position when the protection hood is closed.
	Cycle START
	Manual mode (MAN) The manual mode serves to set the machine up. The coolant must be switched ON and OFF manually with key "Coolant valve ON / OFF".
	Single cycle mode (SINGLE) Processing a single cycle. The machine stops in the measuring position. The cycle cannot be started up when the protection hood is open. The coolant is switched ON and OFF in accordance with the CNC parameter "Coolant".
	Automatic mode (AUTO) Repeated process of the cycle until the requested number of workpieces is reached. The coolant is switched ON and OFF in accordance with the CNC parameter "Coolant".
	Infeed – (minus) Moving the selected axis (axis preselection switch) in the minus direction (B, C, X and Y axes). If the protection hood is open, an axis movement is only possible when the permission key is also pressed.
	Axis rapid travel When this key is pressed in combination with the infeed key (minus or plus), the selected axis moves in rapid-travel speed.
	Infeed + (plus) Moving the selected axis (axis preselection switch) in the plus direction (B, C, X and Y axes). If the protection hood is open, an axis movement is only possible when the permission key is also pressed.
	Pump of wash station ON / OFF (only active when the option is available) The key is active in MAN operating mode only. When the pump is switched ON, the valve "external supply" cannot be opened.

Meaning of the key lamp:

- Key doesn't light up: The pump is switched OFF.
- Key lights up: The pump is switched ON.
- Key flashes: The pump is switched ON, the lower level limit has been exceeded.

Key Remark



Valve “external supply” OPEN / CLOSED

(only active when the option is available)

The key is active in MAN operating mode only. When the tank is full (upper level limit) the key is not active.

Meaning of the key lamp:

- Key doesn't light up: The liquor level is between the upper and the lower limit.
- Key lights up: The liquor is at the upper level limit.
- Key flashes: The tank is being refilled.

Switch Remark



Key-operated switch S61 “EDIT” (editing protection)

This key switch enables to protect the program- and variables-editor against unauthorized editing (i.e. program and variables cannot be saved anymore). **Status: read only.**



Key-operated switch S67 “NOT END” (limit switch bypass)

Enables to move from a safety limit switch with reduced turning moment (for the C- and X-axis only).



Key-operated switch S37 “RUN IN” (multifunction)

Depending on the active operating mode (MAN or SINGLE), a special operating mode can be switched ON by means of key-switch S37.

MAN: Special operating mode “DRESSING”

Allows to dress the grinding wheel when the protection hood is open. This function is only active in combination with the operating mode MAN.



Pressing the “Dressing (periphery rim) START” or “Dressing (chamfer rim) START” key switches the grinding-wheel motor and the coolant ON and, after the termination of the dressing cycle, OFF automatically.

SINGLE: Special operating mode “APPROACH”

Allows to grind one cycle when the protection hood is open and without coolant. This function is only active in combination with the operating mode SINGLE.

The necessity of this operating mode is due to the grinding technology for indexable inserts, the size of the workpieces and the process optimization. This enables the operator to inspect the grinding process visually and to optimize the CNC-program.

The automatic loading/unloading is inaccessible.



In this operating mode, all the safety functions are inactive. Only skilled personnel may be authorized to use this operating mode.

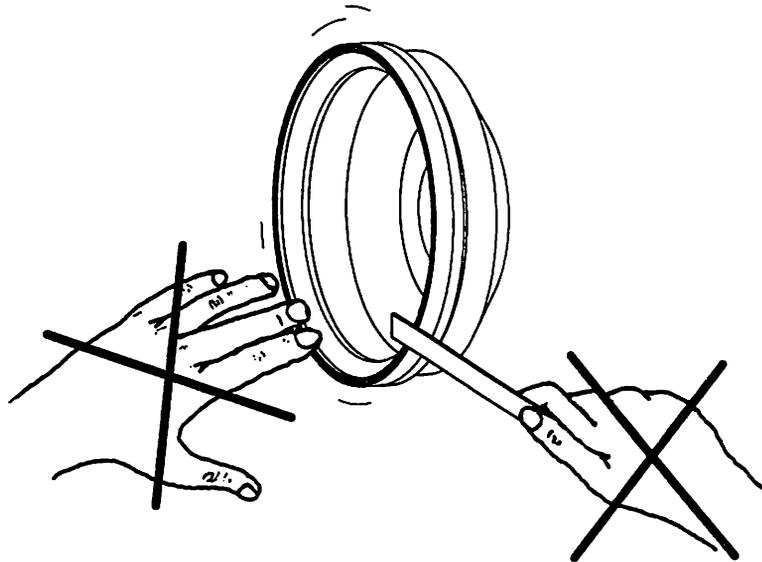
Basic conditions:

- The protection hood must be properly installed.
- Wearing safety glasses is compulsory.



DANGER

The turning grinding wheel may never be touched with the hands or with objects.

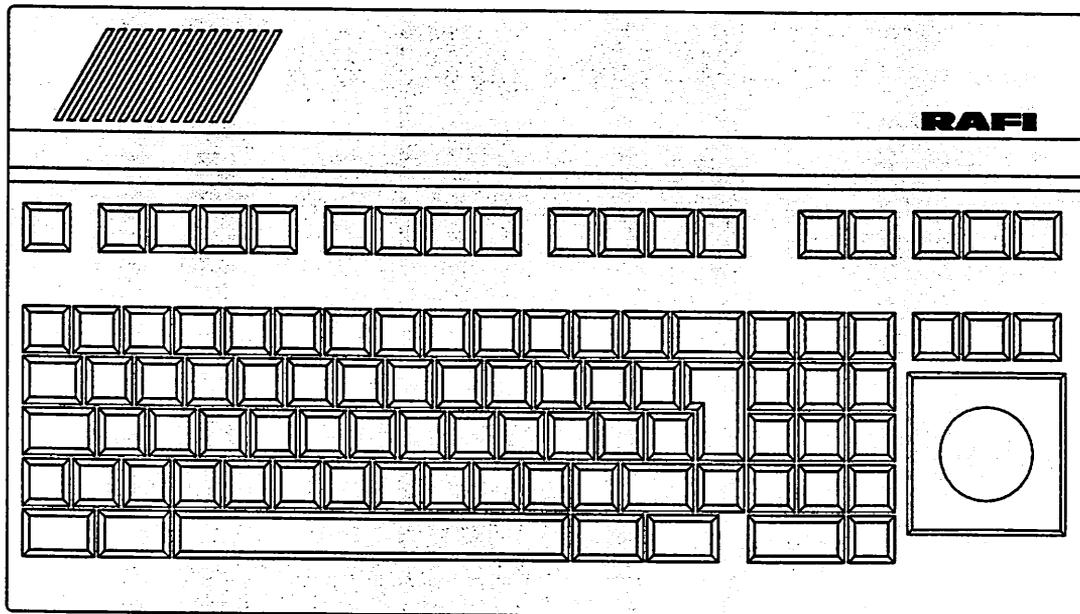


Risk of injury!

6.23. Keyboard

The keyboard is IBM PC/XT AT and PS/2 compatible and can be used in XT- or AT-mode.

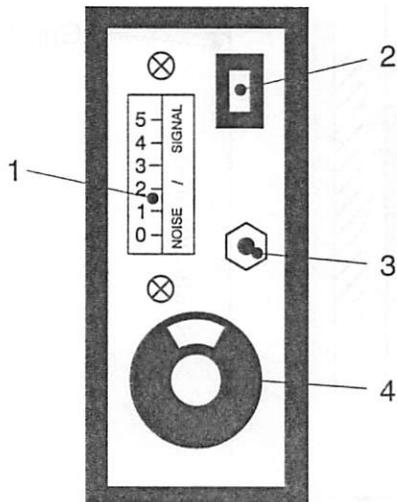
The keyboard consists of 108 mechanical keys and 1 integrated trackball.



 **Observe the manufacturer's instructions!**

6.24. GAP-CONTROL

The GAP-CONTROL evaluates the signals of the sound probe on the B axis.



The GAP-CONTROL is the basic equipment for the following function:

- Automatic reference-point setting.
- Air gap monitoring (air grinding).
- Automatic setting.
- Collision monitoring.

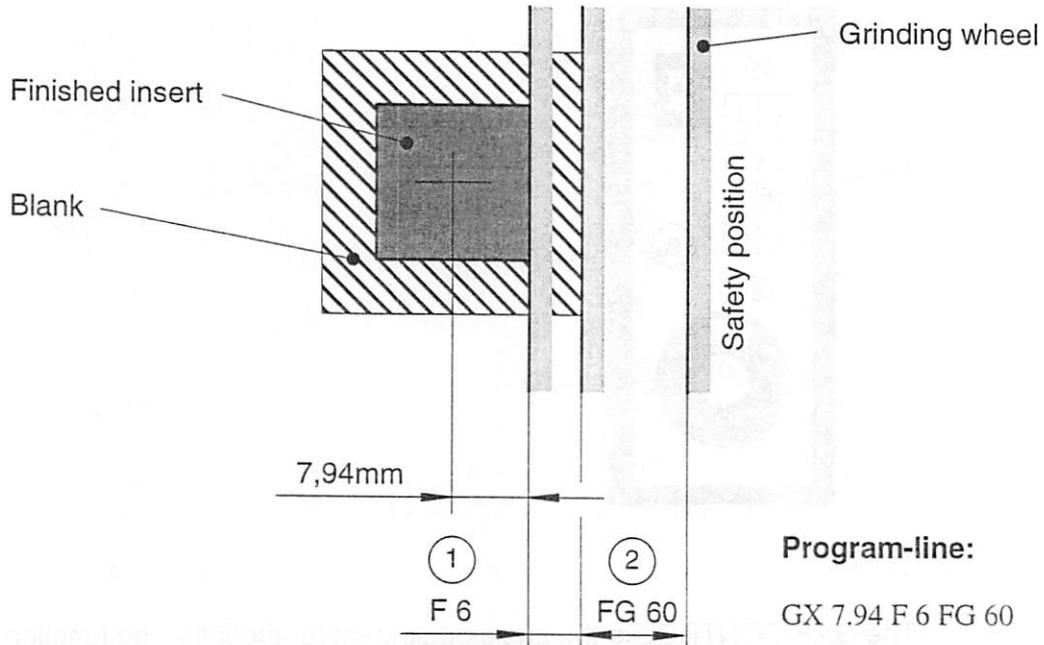
When the GAP-CONTROL function is activated, the indicator lamp (2) lights up during the infeed with the X axis. The indicator lamp extinguishes when the contact with the workpiece is made.

The signal level for automatic reference-point setting, air gap monitoring and automatic setting can be set to scale (1) at potentiometer (4). The basic setting is done by AGATHON during machine assembly.

The signal level for collision monitoring can be set at potentiometer (3).

6.24.1. Air grinding GAP-CONTROL

Acoustic control instrument to reduce the time spent grinding air gap on inserts with different grinding allowances.



Legend:

- ① Speed of the X axis (F 6 = 6 mm/min).
- ② Air-grinding speed of the X axis (FG 60 = 60 mm/min).

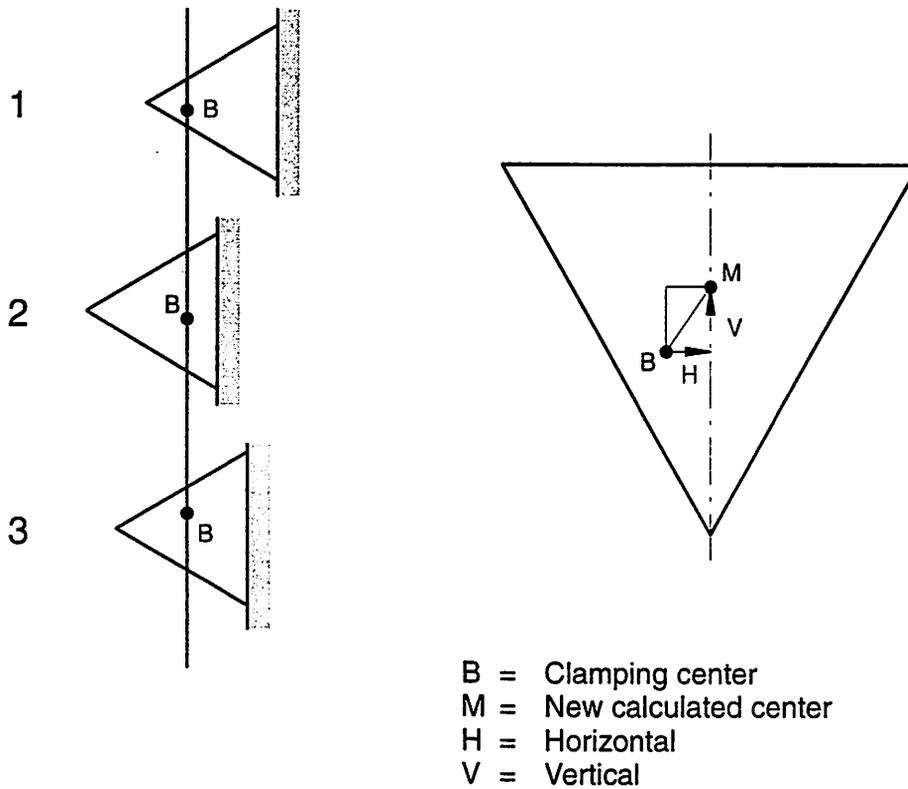
Because of the setting-up inaccuracies and different overmeasures of inserts, normally the grinding wheel approaches the insert with grinding speed. This results to relatively large non-cutting times during which the wheel does not touch the insert (air grinding).

When using the GAP-CONTROL unit which is integrated in the control, the insert can be approached with a much faster speed than the grinding speed.

As soon as the grinding wheel touches the insert, the sound probe sends a signal to the control, which switches immediately over to grinding speed. This reduces the air gap grinding-time and therefore the cycle time.

6.24.2. Automatic setting (AUTOSET)

In addition to the GAP-CONTROL unit, AUTOSET offers the unique possibility to fully automatic insert centering for inserts which have been clamped eccentrically and/or to compensate eccentricity variations between batch sizes during autonomous production (ghost shift).



All the influential faces of the determining insert are measured. Every insert is measured and the control compares the insert-values with the mathematically calculated pattern, then the insert is centered.

Because the inserts are not moved mechanically, a manual readjustment is not necessary.

