Equipment for measuring annual growth rings
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The "Dorschkamp" equipment for measuring width of annual growth rings

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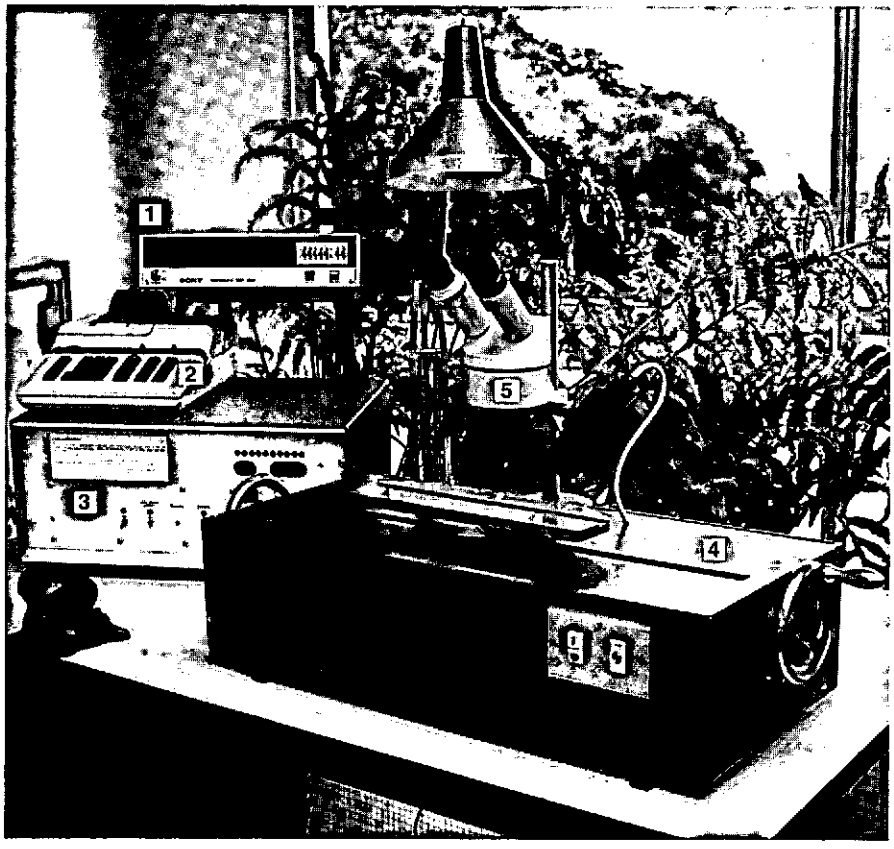
The measurement of annual growth rings in increment cores or stem discs is one of the most widely used methods of estimating the increment of sample trees and forests. Until recently, this procedure was highly laborious and subject to errors. The "Dorschkamp" equipment, a new method for measuring width of annual growth rings, has been devised in the last three years. It offers a quick and exact method of measurement.

Features of the "Dorschkamp" equipment:

- The measuring table with an object stage on which the increment cores or stem discs can be placed
- The "Wild" M 1 microscope, magnification 20 and 40, with illumination
- The "Sony Magnescale" SR 801 electronic ruler
- The "Sony Magnescale" LF 100-12 electronic digital counter
- The "Sharp Compet" 626 electronic calculator with printer
- An interface to convert the signals of the electronic ruler and counter. The converted signals could be distributed to the several functions of the device such as automatic reset, automatic counting, memory use and the addition of the measured data of the tree rings. The interface was built by the "Dorschkamp", Research In-



The "Dorschkamp" equipment for measuring annual growth rings.
1 digital counter
2 calculator and printer
3 interface
4 measuring table
5 stereo microscope

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stitute for Forestry and Landscape planning in Wageningen, Holland.

The "Dorschkamp" equipment for measuring the width of annual growth rings is just one of the developments in machinery in behalf of the dendrochronology research. The most well known designs are:

– The Swedish Statens Skogs-Forskningsinstitut machines for measuring annual growth rings designed by Bo Eklund and constructed in collaboration with the firms Aktiebolaget ADDO and Aktiebolaget STALEX. These machines consist in principle of a specially designed measuring microscope combined with an electric adding machine known as the ADDO-X.

– The electronic version of the above mentioned system completed with a modified 029 IBM keypunch. The keypunch receives the information from the adding machine via an electronic interface, the increment cores are held in special holders while being measured and are moved under the microscope by a motordriven mechanical stage.

– A modification of the Bo Eklund design by the East German Institut für Forstwissenschaften, Eberswalde built in cooperation with the firms VEB Carl Zeiss Jena and VEB Mess- und Zeichengerätebau Bad Liebenwerda.

In this design, the object carrier is moved by a spindle which is connected to a rotary scale which is attached to a converter with an output to an electronic calculator, a keypunch or a printer.

– The electronic annual growth rings measuring unit developed by the Austrian Institut für Ertrags- und Betriebswirtschaft der Forstlichen Bundesversuchsanstalt, Wien and produced by the Kutschenreiter Company in Vienna, Austria.

In this system a glass ruler with a hard-chrome coating determines the position of the object carrier by way of an electronic sensor. The data are read out by an electronic digital counter with a reverse option.

Description of the "Dorschkamp" equipment

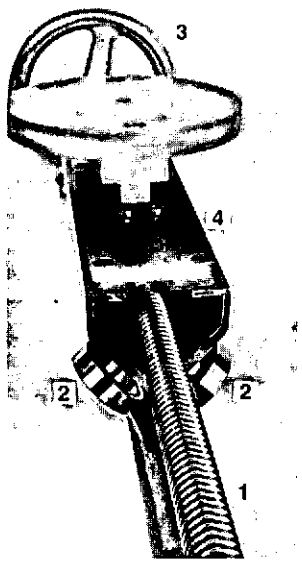
The main conditions were that the device should be operated easily and simply, semi-automatic and efficient in routine use and in order to obtain the possibility to rebuild the machine by anyone else, the unit had to be constructed with standard parts readily obtainable through the retail trade.

The main electronic principle of the equipment is based on the detection of a magnetic pattern, which is converted into an electric signal; equipment is available from the Sony Corporation of Japan as the Sony Magnescale digital measuring unit, which is primarily produced for the heavy industry. The measuring table is based on the device of Bo Eklund of the Statens Skogsforskningsinstitut in Sweden for measuring annual growth rings; it did not require the reduction gearbox, mechanical calculation nor the counting system. A home-made interface was necessary to convert the BCD (binary coded digits) signals into hexa-decimal coded signals. This signal conversion made it possible to connect the equipment to an electronic calculator, memory facilities or a micro-computer system.

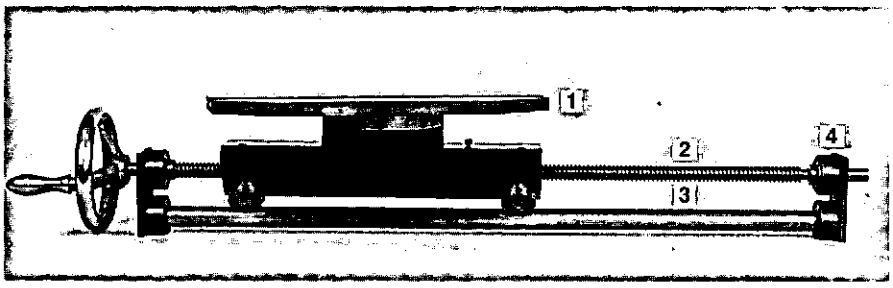
Operating procedure

The electronic ruler of the Sony Magnescale system is directly connected to the movable object carrier, a fastening device for increment cores or stem discs. The object carrier is moved by a hand-driven spindle without any measuring function. By turning the spindle, one could directly measure the linear movement with the ruler, independently of the turning of the spindle, as this cannot affect the accuracy of the measurement in any way. The linear measuring scale of the electronic ruler is connected rigidly to the object carrier. The object, an increment core or stem disc, is visible through the microscope with cross-hair disc. The microscope is fixed on the platform of the measuring table and can be moved horizontally and vertically.

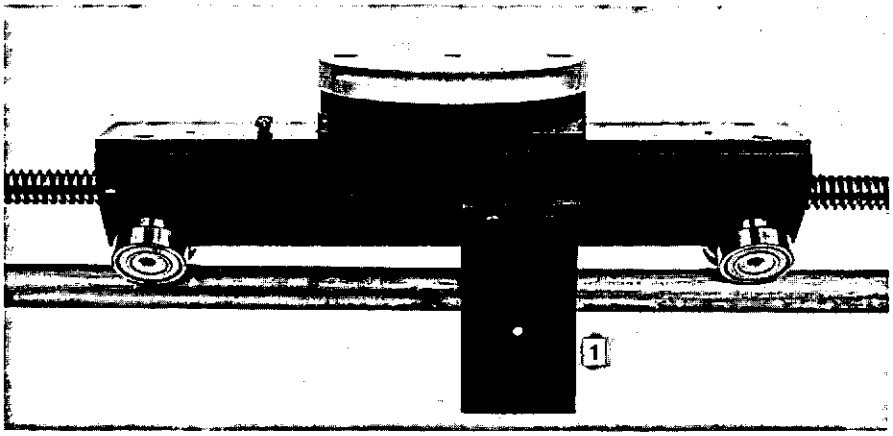
For large stem sections, up to 0.5 metre radius, the microscope is fixed on a support next to the measuring table. If the microscope is placed in this position, the digital counter can be set to zero in spite of the position of the slider on the electronic ruler. This characteristic of the Sony Magnescale system enables the user to replace the microscope, to measure from left to right or right to left, to count forwards or backwards without losing the original zero setting. It is based on the constant scanning of the magnetic pattern on the ruler,



View of object carrier.
1 Spindle
2 Ball-bearing
3 Handwheel
4 Stage for increment core holder



Object carrier and spindle.
1 movable object carrier
2 spindle
3 object carrier leader and support
4 ball-bearings



Front view of object-carrier.
1 Connector to electronic ruler, the connector is assembled with the slider of the ruler

even when stationary. By connecting the ruler, which is a part of the measuring table, to the digital counter, one could read out the linear position and movement in any direction of the object carrier.

The Sony digital electronic counter is connected to the interface which was assembled with a function control system to give the operator a choice from many facilities to read out and store the data. When the equipment is adjusted and the function-control system is switched on, it can be operated by pressing a foot-pedal. After each measurement, the operator presses the foot-pedal to read out, print or store the data in the way the operator wishes.

Measuring capabilities

The "Dorschkamp" system gives the opportunity to measure annual growth rings in 0.005 mm intervals up to a maximum ring width of 311.75 mm. By using an internal switch of the Sony Magnescale digital counter ring widths can also be measured in 0.01 mm intervals. The system enables the user to read out the result of each measurement after which the equipment will reset automatically to zero. Another possibility is to read out the result of a number of measurements, up to plus or minus 9999.99 mm or 999 measurements.

The "Dorschkamp" equipment can also handle stem discs up to 0.5 m radius, but the equipment is designed primarily to measure increment cores.

Accuracy of the equipment

The equipment and system accuracy are influenced by decreases in line voltage or disturbances in line frequency. This can result in erroneous measurement or output. In normal use the equipment does not need any adjustment, refocusing the microscope while measuring can result in an error of approximately 0.1 mm.

Experiences with the "Dorschkamp" equipment

During the last two years the equipment was used for more than 600 hours by a group of 16 users. Nearly each in the Netherlands growing tree species was subject of measurement.

After a brief instruction all the users were able to operate the equipment themselves. An experienced operator can measure approximately 20 increment cores in one hour. However, this number of measurements per hour strongly depends on the total number of annual growth rings per increment core. A rather difficult problem for the less experienced users was to recognize and detect the false rings.

As a great advantage should be mentioned the characteristic of the Sony Magnescale unit that there is no need of adjustment and the system is not influenced by temperature fluctuations or moisture.

As mentioned the system accuracy is influenced by decreases in line voltage or disturbances in line fre-

quency. To minimize these problems the equipment was connected to a separate electrical circuit.

In some cases the Sharp Compet 626 calculator with printer did not function. This was caused by an electrical signal from the interface. To prevent this kind of disturbances it is recommended to ground the interface separately.

Conclusions

The "Dorschkamp" equipment was constructed with standard parts readily obtainable through the retail trade. This fact gives future users of similar equipment the opportunity to construct an equipment for measuring annual growth rings after the "Dorschkamp" design.

From past experience in measuring increment cores of all sizes and many tree species, the "Dorschkamp" equipment has been shown to be fast, easy to operate and accurate.

In the near future the equipment will be connected to a micro-computer system.

Specifications

Sony Magnescale digital counter type LF 100-12

Output { 5-V, direct current
parallel, binary coded digits
Weight: 3.2 kg
Operating temperature: 0-40 °C
Storage temperature: −10 to +50 °C
Reset system: (a) One-touch resetting by a push button at any point on the scale.
(b) One-touch resetting by an external switch or an external electric signal.
Power supply: alternating current 100-110 or 220-240 V.
Potential difference tolerance: 10%
Frequency of power supply: 50-60 Hz.
Power consumption: 10 W.
Maximum response speed: 5/6 m.s. $^{-1}$
Maximum display range: ± 999.995 or 9999.99 mm
Number of display digits: 6 with plus or minus sign
Display Value: 5 mu/meter.

Sony Magnescale electronic ruler SR 801 type GP 55

Effective length: 550 mm
Total length: 780 mm
Maximum slide length: 600 mm
Accumulated scale accuracy: ± (6+3. 5L) mu (L=M)
Thermal expansion coefficient: (11±1) × 10^{-6} mm/°C
Operating temperature: −5 to +40 °C
Storage temperature: −10 to +50 °C
Pitch of scale graduation: 0.2 mm
Length of connecting cable: 3-10 m.

Wild M1 stereomicroscope

Lens magnification: 2
Ocular magnification: 10 or 20
Working distance: 71 mm
Field of Vision: 10.5 mm² or 6.5 mm²
Lamp: 6 V, 15 W, direct current.

Sharp Compet CS 626 Printing Calculator

Power supply: alternating current 110-120 or 200-240 V
Frequency of power supply: 50 to 60 Hz.
Capacity: 12 digits, 6 decimal digits
Calculation speed: 0.1 s
Components: 2 LSI
Operating temperature: 0-40 °C
Power consumption: 19 W
Weight: 4.5 kg.

Interface "Dorschkamp"

Power supply: 12 V, direct current (display); 5 V, direct current (integrated circuits)
Display: 3 light emitting diodes, counter; 5 light emitting diodes, measurement data.
Main components: IC 7475, 4 bits bistabile latch
IC 7485, 4 bits comparator
IC 7490, decade counter
IC 7493, 4 bits binary counter
IC 74141, BCD two-digit decoder driver, decimal mode
IC 74154, BCD two-digit decoder-driver, binary mode.

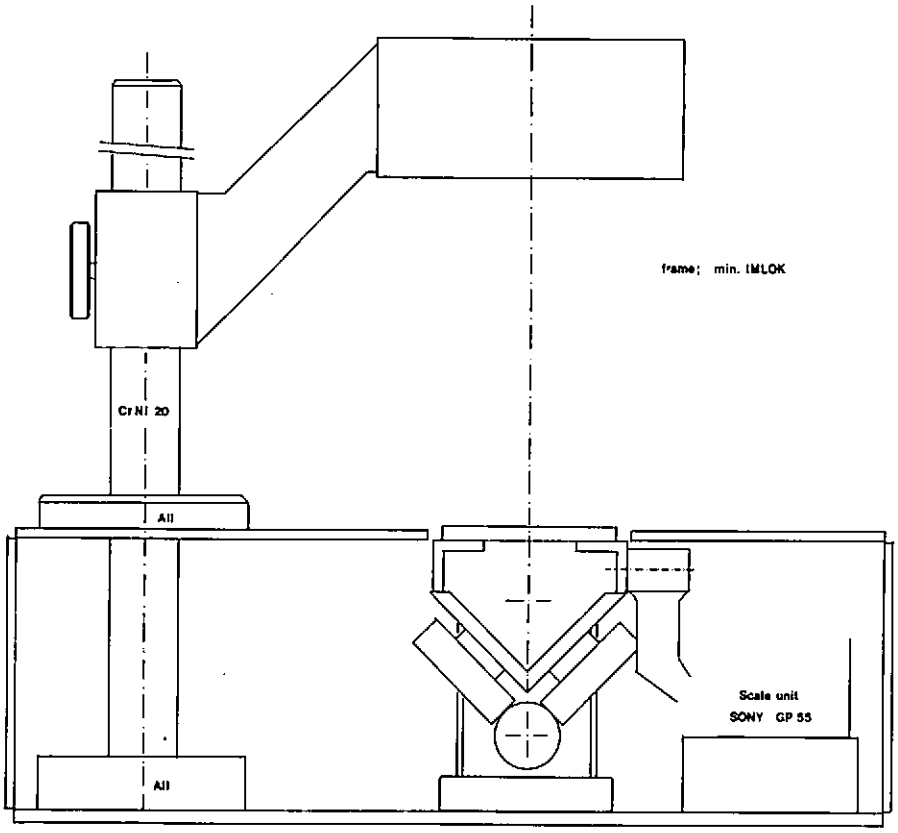
The Sharp Compet 626 Printing Calculator is replaced by the Sharp CS-2184S.

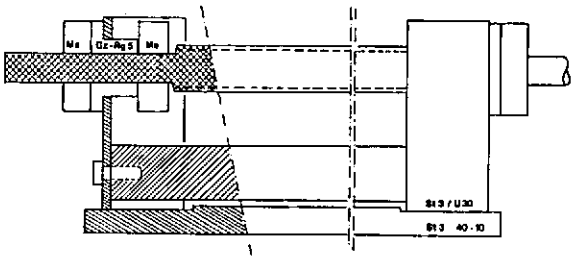
Price data

All prices mentioned below are indications. Prices do not include taxes and may deviate in other countries. The prices are in Dutch florins.

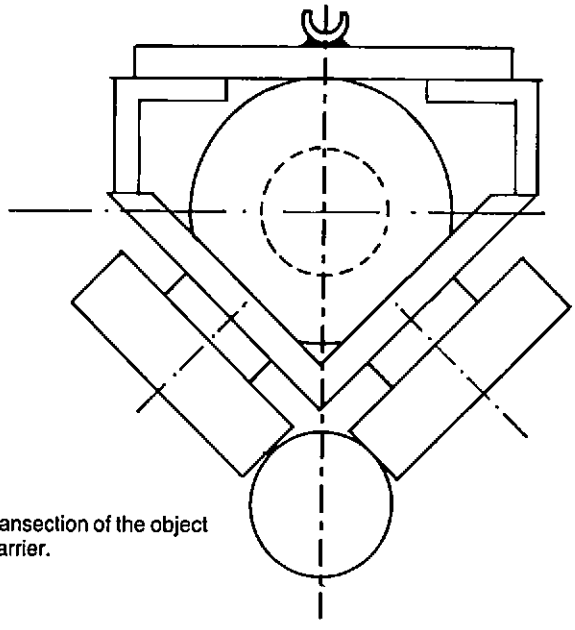
★	Measuring table	ƒ 250,—
★	Wild M1 microscope	ƒ 2500,—
★	Sony Magnescale ruler	ƒ 1300,—
★	Sony Magnescale counter	ƒ 2000,—
★	Sharp calculator with printer	ƒ 400,—
★	The interface	ƒ 750,—.

Transection of the measuring table with microscope mount.

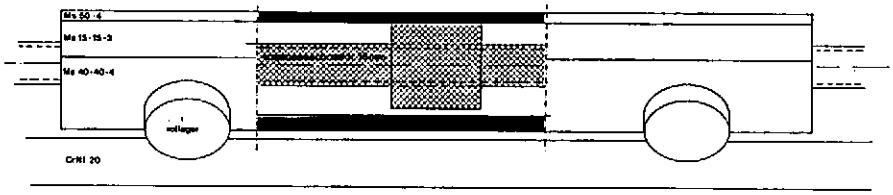




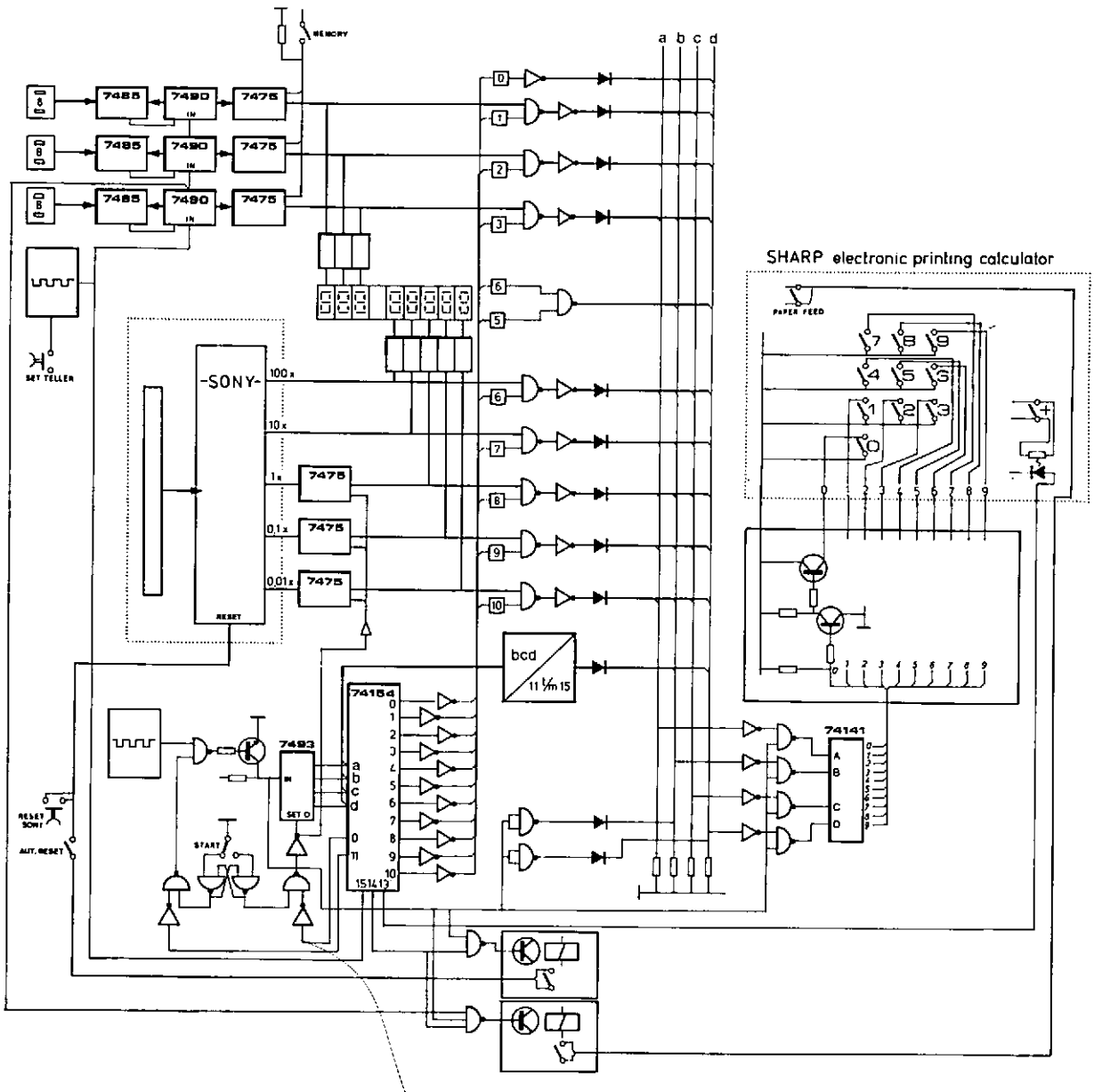
construction of spindle and support.



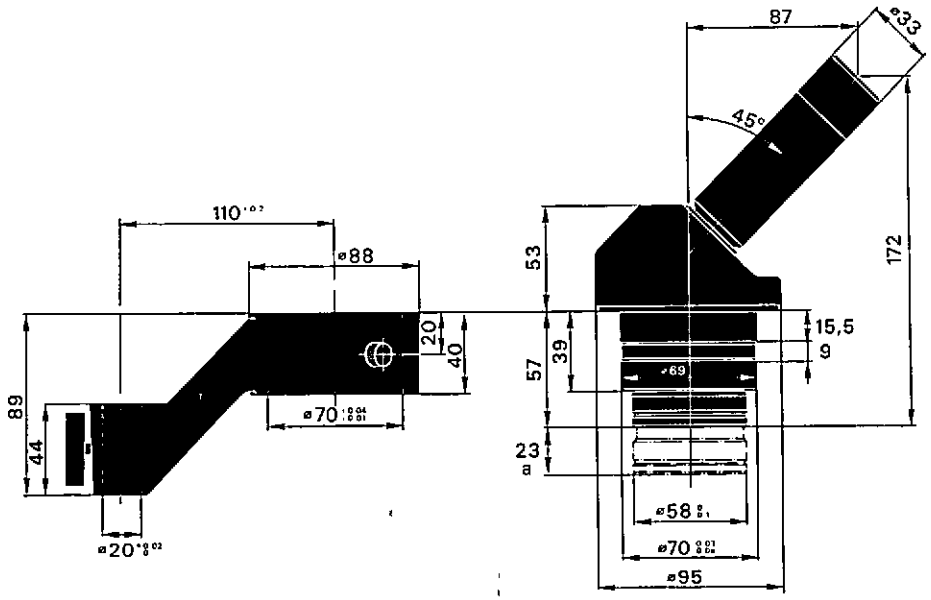
transection of the object carrier.



side-view of the object carrier.



scheme of electronic components



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