OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

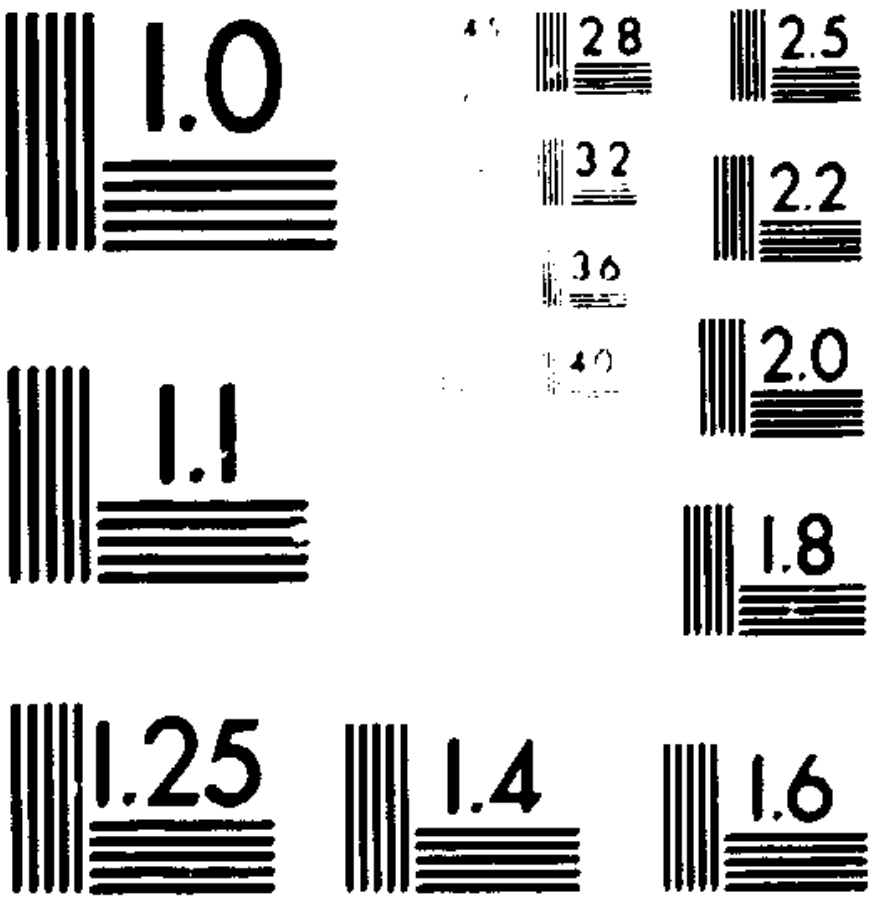
FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org



14463

Distr.
LIMITED

ID/WG.438/1
27 February 1985

ENGLISH

United Nations Industrial Development Organization

Workshop on Production Management of
Public Sector - Mechanical Wood
Processing Industries,
Ljubljana, Yugoslavia, 10-26 April 1985

WOODWORKING MACHINES AND EQUIPMENT PRODUCED IN YUGOSLAVIA*

Prepared by

Janez Gril**

3158

* The views expressed in this document are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. Mention of firm names and commercial products does not imply endorsement by UNIDO. This document has been reproduced without formal editing.

** Engineer, Import/Export Department, UNILES/LESNINA, Ljubljana, Yugoslavia.

V.85-23300

CONTENTS

1. INTRODUCTION

In the period between World War I and World War II woodworking machines and equipment were manufactured, in Central Europe, only in Germany and Czechoslovakia. In the territory of the present Socialist Republic of Slovenia, however, this type of equipment had already been manufactured by the Gustav Tines Company. This company had manufactured more than 70 different types of machines - from gang and frame saws to tool-sharpening machines. Later on, the company went bankrupt and, for a very long period of time, it was not substituted by a firm of a similar type. In the period from 1960 to 1970 the first partial production lines that included a number of linked technological operations appeared on the European market; at the same time the first woodworking machine manufacturing plants were established in Yugoslavia based on the former workshops. At the present time there are 35 small and large manufacturers in Yugoslavia whose annual output is about 6,000 to 7,000 tons of woodworking equipment, which accounts for some 20 per cent of Yugoslavia's total requirements in this field. The balance of machines and equipment needed must, therefore, be imported. Within the present framework of economic recession an ever increasing number of woodworking plants have been developing their own manufacturing lines for individual machines in their existing repair shops. Possibilities of co-operation in the field of the manufacturing of special machines for woodworking industries are at present being considered in Yugoslavia; only in this manner is it possible to bridge the gap in the levels of development between the West and our country in this specific production field. All companies of this type in Yugoslavia are members of their business association, similar to that of West German manufacturers (VDMA) or the one in Italy (ACIMALL).

PRODUCTION OF WOODWORKING MACHINES IN YUGOSLAVIA (IN TONS)

Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Yugoslavia	1742	1877	1764	1553	2960	2641	3358	3529	5224	7727
Bosnia/H									65	52
Croatia	926	906	883	808	2092	1086	1338	1313	2052	3052
Slovenia	247	322	224	197	168	163	336	224	1297	1329
Serbia	569	649	657	548	700	1392	1684	1992	1810	3294

NUMBER OF MANUFACTURERS

Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Yugoslavia	n.a.	n.a.	6	6	6	6	n.a.	7	9	9
Slovenia	n.a.	n.a.	3	4	4	4	n.a.	5	5	5
Croatia	n.a.	n.a.	2	1	1	1	n.a.	1	2	2
Serbia	n.a.	n.a.	1	1	1	1	n.a.	1	1	1

The production of the 35 manufacturers existing in 1984 may be classified as follows:

1. Production of basic machines
2. Production of bandsaws and sawmilling machines
3. Production of wood-drying machines
4. Production of transportation equipment
5. Production of varnish drying lines
6. Production of packaging machines
7. Production of exhausting devices
8. Production of power units for solid fuel and/or woodworking industry wastes.

The production of basic machines may further be classified as follows:

1. Saws
2. Sanding machines
3. Spindle moulders
4. Tenoners
5. Planing machines
6. Multi-edge profiling machines
7. Hydraulic and pneumatic presses
8. Other machines

2. SAWS

(a) Saws for angular sawing or a combination of a table circular saw

These machines are basically used as portable saws in construction sites and for purposes of finishing works and interior decoration in buildings. Using this type of saw wood pieces can be sawn at any angle; they can, on the other hand, also be adjusted to serve as table circular saws. The blade diameter may go up to a maximum of 300 mm, and the engine power is 1.5 kw.

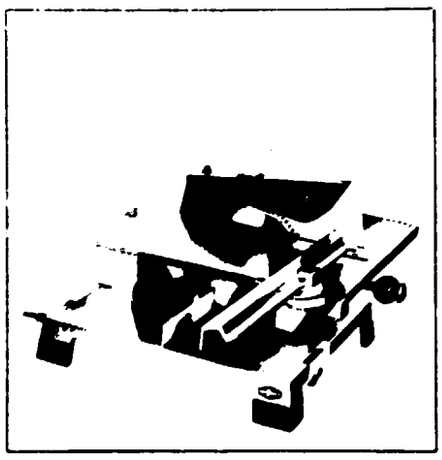


Figure 1. Saw under table, sawing as a table circular saw.

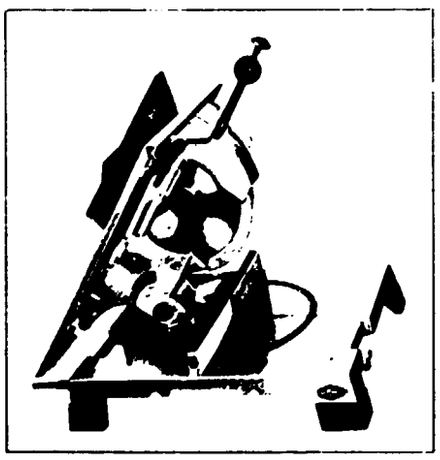


Figure 2. Table and saw lifted for sawing as a radial arm cross-cut saw.

(b) Circular table saws for cutting to size

This machine is supplied with a pre-cutter, which allows the high quality cutting to dimension of boards; this is particularly significant when cutting boards surfaced with a melamine or another type of foil. The main axle may be set for three different RPMs: 4,000 to 6,000. The saw blade may be inclined at an angle of up to 45^{o}, hence the possibility of angular edge cutting. This is a standard woodworking machine suitable for furniture and production of solid wood products.

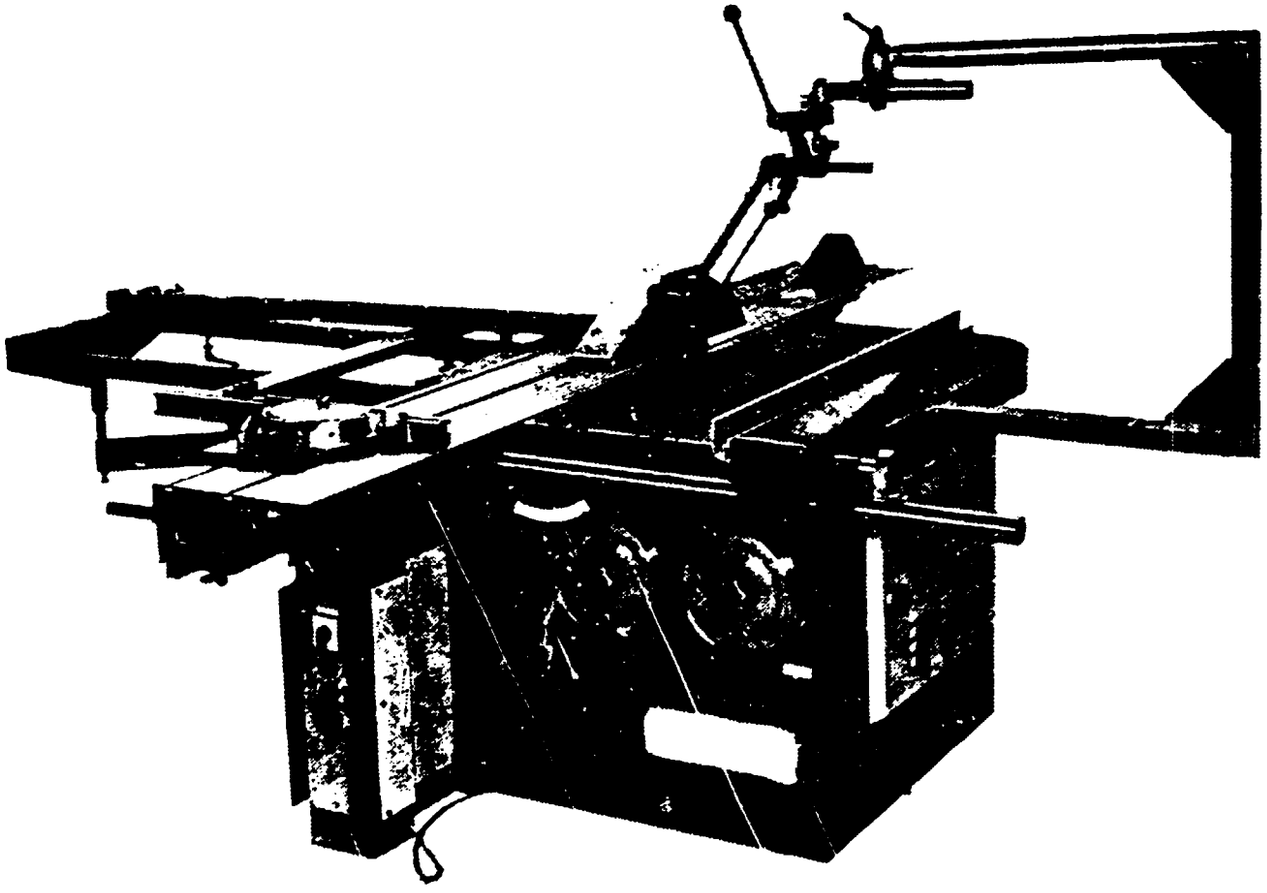


Figure 3.

(c) Circular saws for cutting to size (with manual setting)

The saw may be supplied with a pre-cutter for high precision sawing of surface improved boards. The maximum working width is 2,500 mm and the minimum is 250 mm. The power of the engine is 4.5 kw and that of pre-cutters 2.2 kw.

This saw can be utilized for the sawing of solid wood or boards.

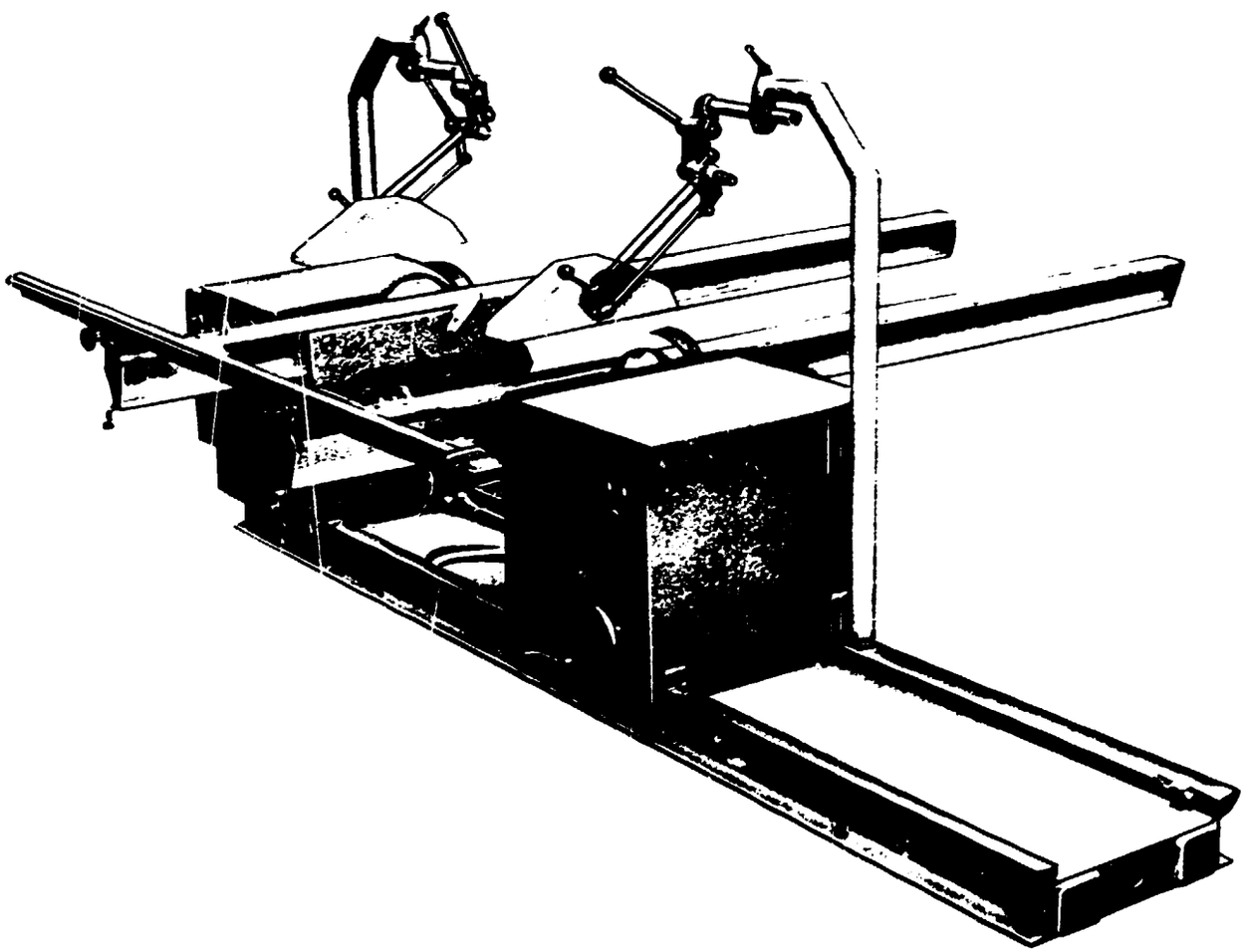


Figure 4.

(d) A combined woodworking machine

This machine can perform 5 different operations, namely:

- planing
- sawing
- moulding
- tenoning
- thickness planing to a predetermined thickness

Planing widths range between 410 and 610 mm and thicknesses from 5 to 190 mm. The cutter operates at 4 different RPMs, the maximum being 8,000 RPM.

This machine is exclusively used for individual tailor-made production lines and/or workshops for prototypes.

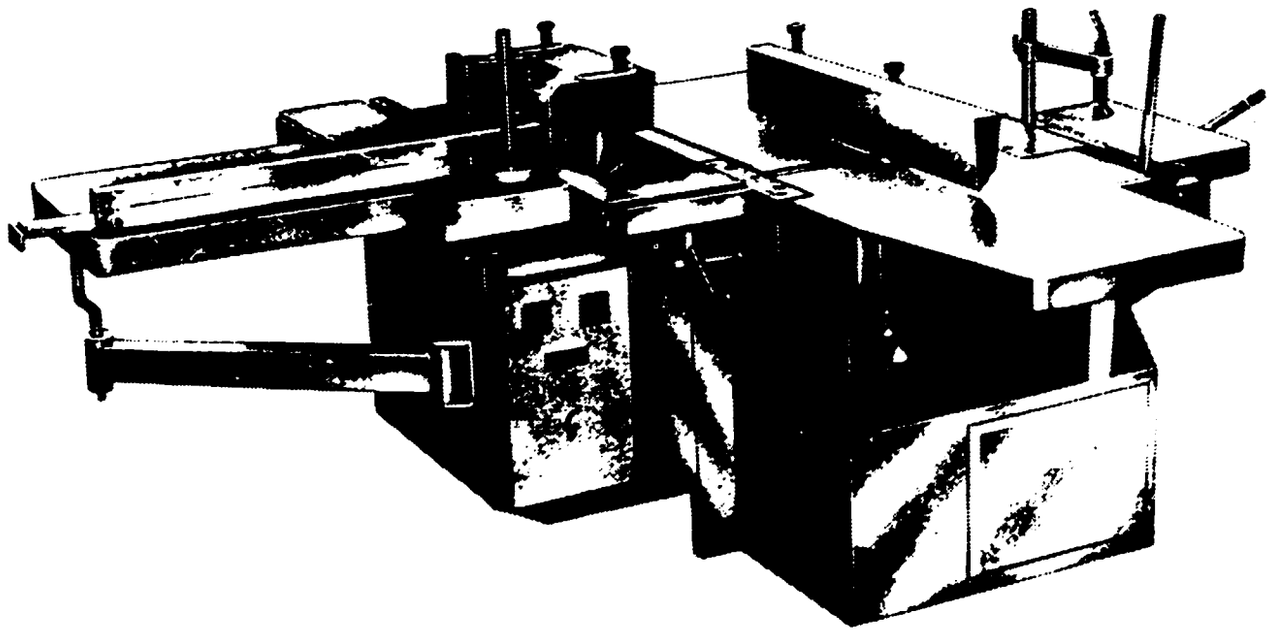


Figure 5.

(e) Vertical saw for cutting to size

This saw is available either as an automatic or a manual machine. Dimensions of this saw are 6,900 x 2,650 mm, and the machine is particularly designed for the cutting of large-size particle boards or other types of boards. It is not supplied with a scribing blade; therefore it is suitable for initial rough sawing only.

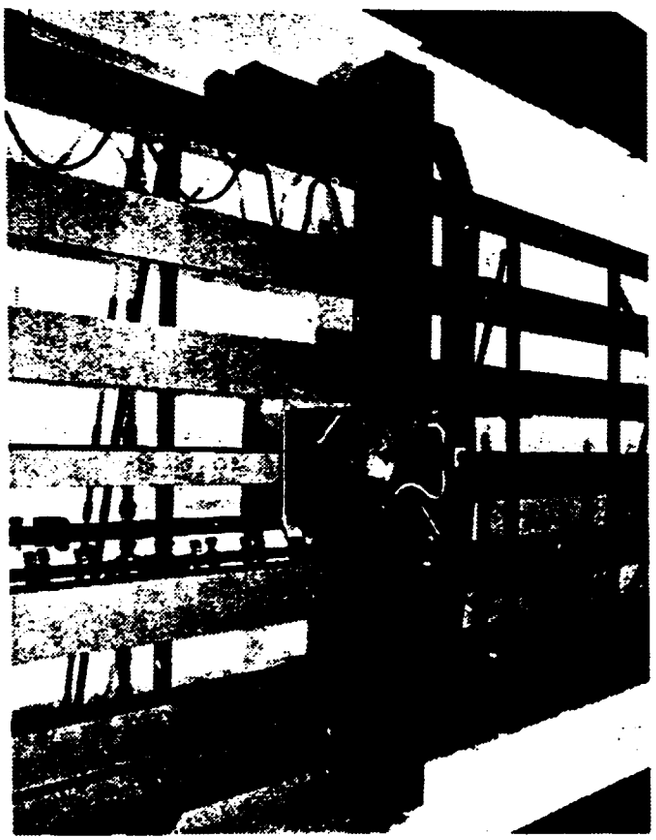


Figure 6.

(f) Double automatic circular saw for cutting to size

This is the largest among saws and/or moulding machines manufactured in Yugoslavia; it is used for automatic cutting to size and profiling of edges in a continuous process. Two saws of this kind may be combined into an angular or straight production line, which allows the processing of all 4 edges of a board without any need of idle movements. The machine

is usually supplied with 4 units on each side (pre-cutter, crusher, the first cutter and the second cutter). Maximum working width is 3,000 mm and minimum width is 176 mm. If it is necessary to achieve fine processing, the cutters' RPM may be as high as 7,000. This is feasible through the use of a high-frequency converter, whereas their usual RPM is 3,000. The units mentioned above can also operate at a certain angle.

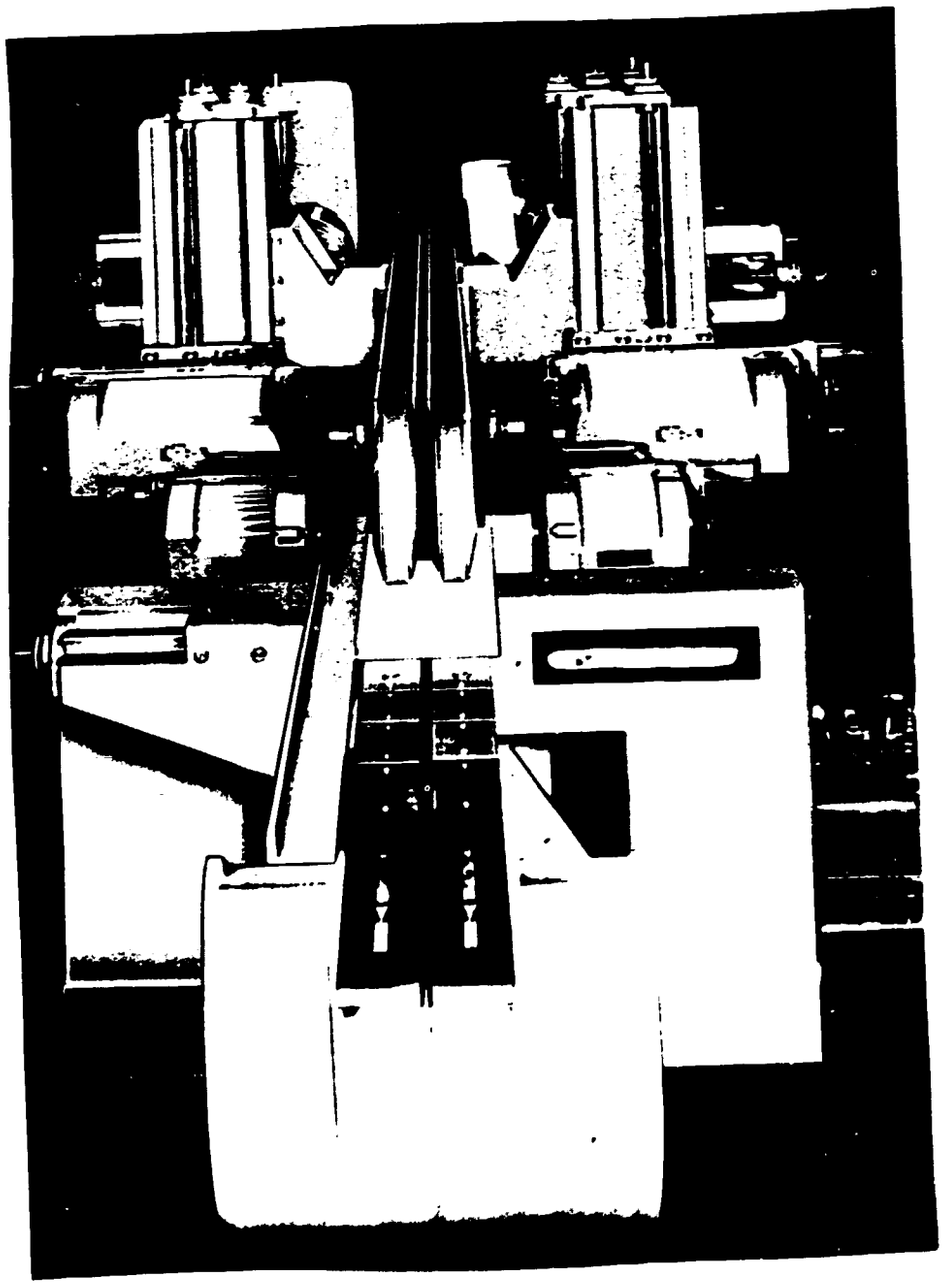


Figure 7.

(g) Portable hand saws

In addition to fixed saws Yugoslav enterprises also manufacture manual woodworking machines and equipment; they perform operations equal to those of the fixed machines, yet they are only used for manual woodworking processes. The Yugoslav industry of woodworking machiens and equipment manufactures electric saws, planing machines, tenoners, sanding tools, cutters, etc. These are produced partially on the basis of domestic know-how, and to a certain extent on the basis of co-operation with foreign partners.

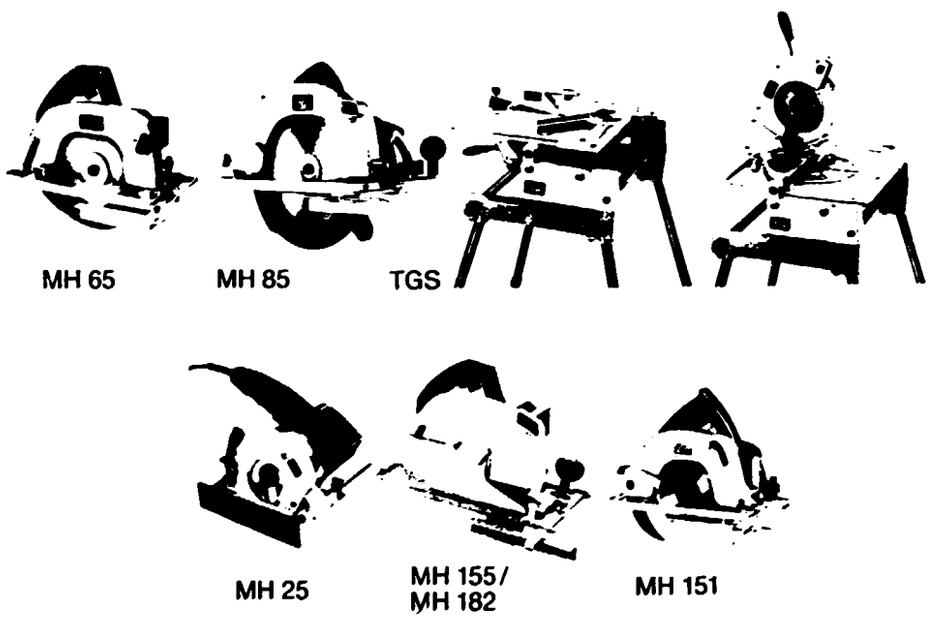


Figure 8.
Portable electric circular hand saws.

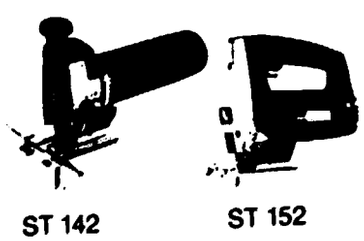


Figure 9.
Portable electric fret saws.

3. SANDING MACHINES

Apart from the usual band sanding machines the wide-bolt sanding machines with one or more operating units are also manufactured on the basis of co-operation with foreign partners. Working widths of these machines range between 600 and 1,300 mm. The following combinations are available: roller-cushion, roller-roller or cushion-cushion. The machines are suitable both for the levelling of boards and edge sanding of veneer-coated surfaces. Thickness regulation may be monitored electronically.

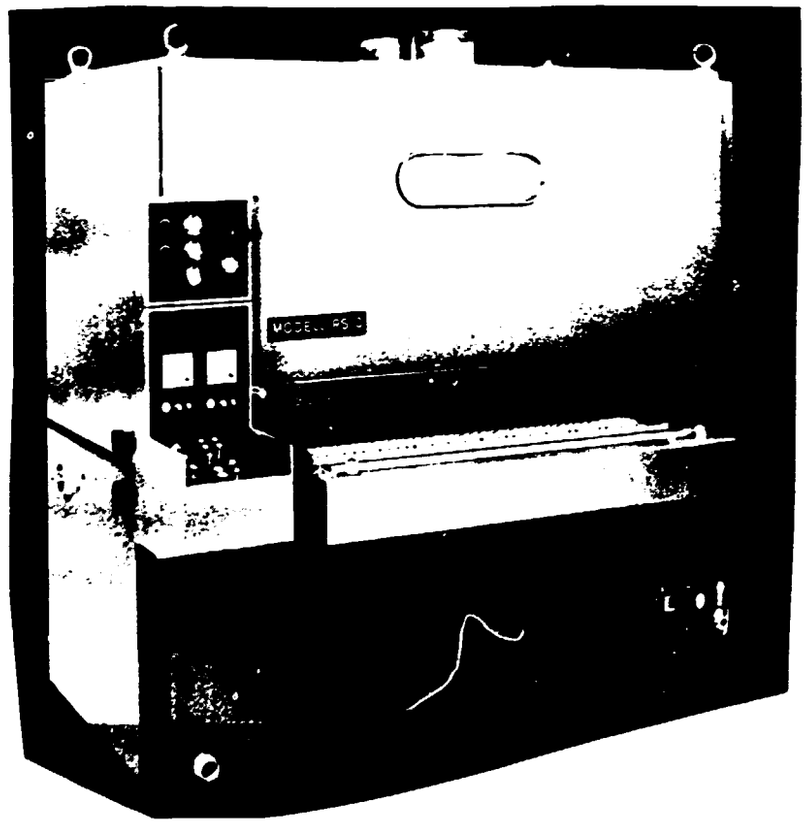


Figure 10.

4. SPINDLE MOULDERS

(a) Table spindle moulders are manufactured in varying designs and different RPMs of the main operating axle, which all depends on the type and quality of wood. Maximum number of revolutions per minute is 18,000. This type of machine is used mostly in the production of windows and doors.

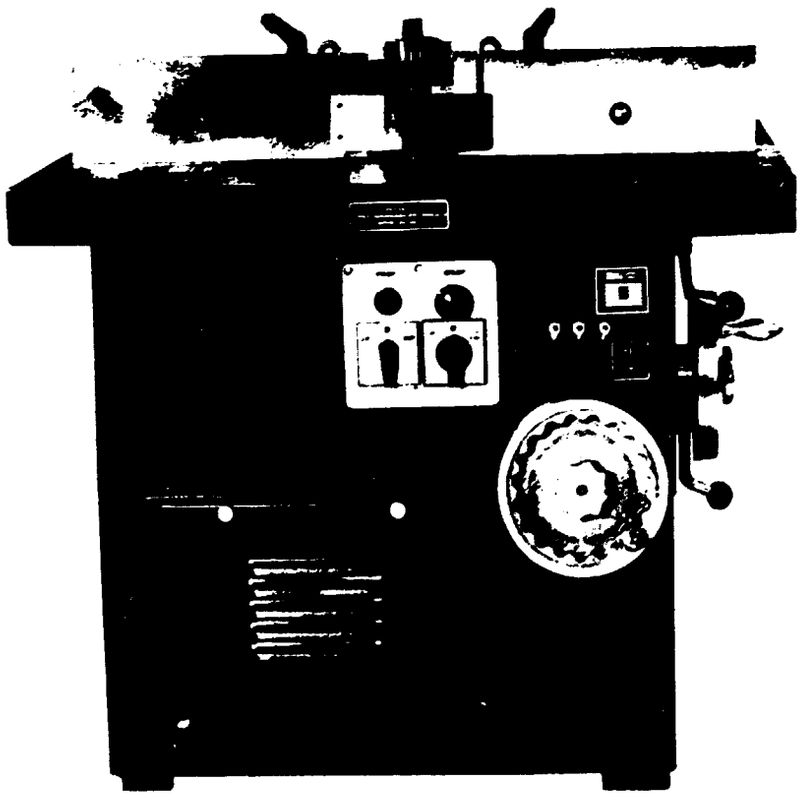


Figure 11.

(b) Routers

Machines of this type are produced in different designs in terms of:

- revolutions per minute
- method of operating the unit's lift
- number of cutting heads

Usually the number of revolutions per minute is 12,000/18,000, and the spindle may be lifted either pneumatically or mechanically.

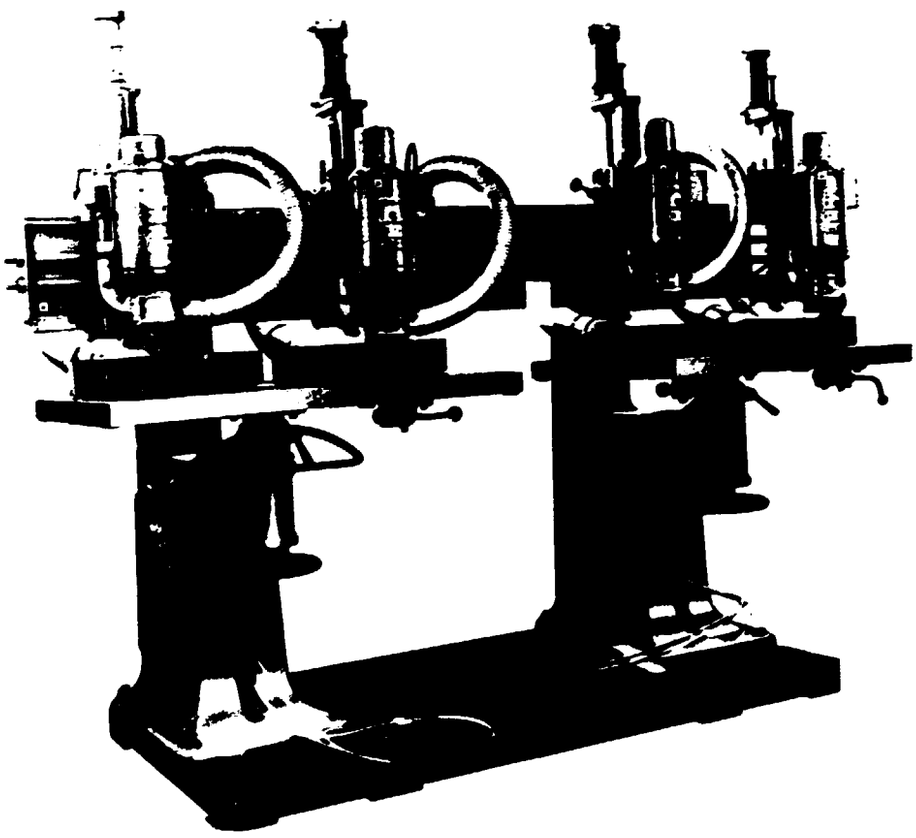


Figure 12.

(c) Oscillating boring and mortising machines

These 2 machines are indispensable primarily in the manufacturing of chairs; in Yugoslavia production of these machines was introduced a long time ago, and they are required to make notches and tenons for connecting elements in individual types of chairs.

The maximum boring depth that an oscillating mortising machine may reach is 100 mm, the number of oscillations being 200 per minute, and axle revolutions up to 1,000 per minute.

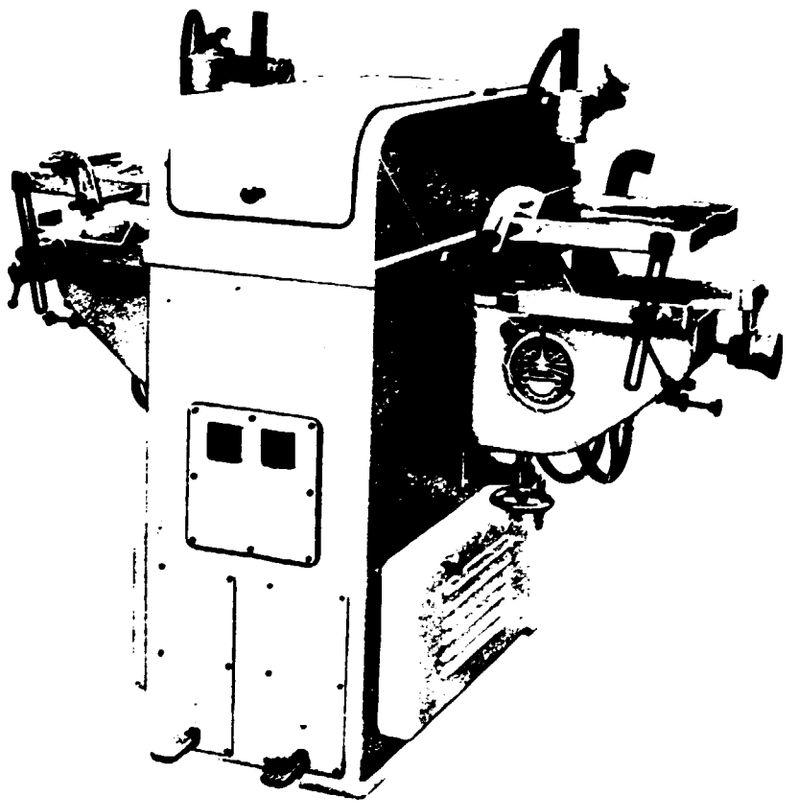


Figure 13.

5. MULTI-HEAD BORING MACHINES

(a) Electro-pneumatic multi-head boring units with a pneumatic lift

Through the manufacture of machines of this kind the woodworking industry, particularly that of solid wood furniture, has been provided with an opportunity to adjust the machine to its specific needs. One machine may be supplied with more than one (up to 16) horizontal and vertical boring units that may operate at the same time. The units may also be inclined at different angles thus allowing not only vertical but also angular bore-holes. The boring heads are supplied with one or more spindles.

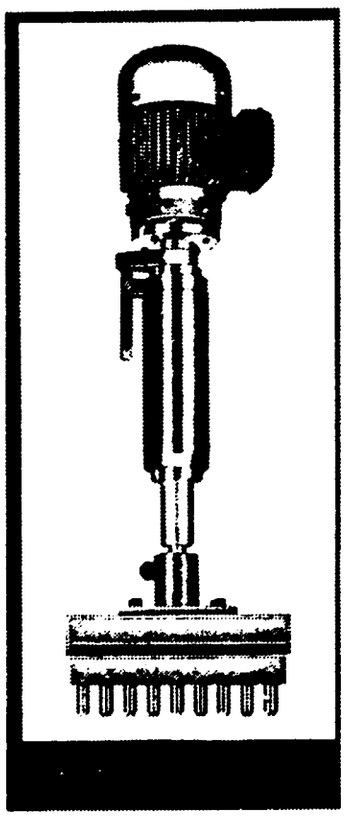


Figure 14.

(b) Dowel boring machines

The figure below shows a small machine with a horizontal and a vertical operating unit for boring dowel holes that are required in the manufacturing of casegoods. The machine has a pneumatic locking device and 20 spindle heads; the distance between individual spindles is 32 mm thus complying with an international standard. Yugoslav enterprises also produce dowelling machines with a number of operating units located at the bottom and used for vertical operation, and others located at the machine's sides that are used for horizontal boring; the units operate on a continuous basis and may be monitored electronically. To boost the quality of boring and clean the bore-holes the spindles of the horizontal operating units (heads) operate at 6,000 revolutions per minute, and those located on the vertical heads at 3,000 RPM.

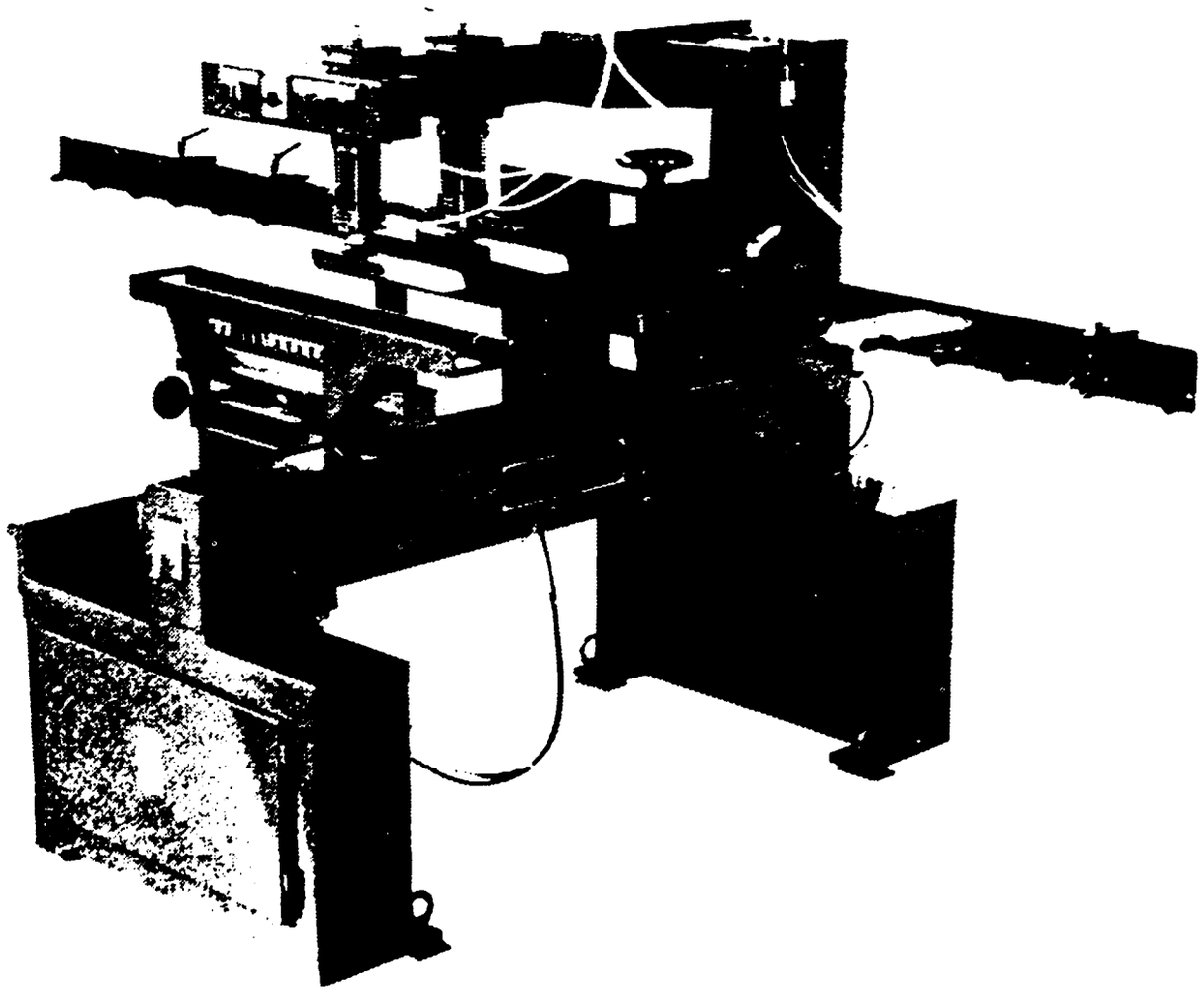


Figure 15.

6. WOODWORKING LATHES

In this field our manufacturers have only recently embarked upon their own production. Tests have been made with a lathe for circular elements, operating either manually or automatically.

The maximum diameter of the elements is 75 mm, and maximum length 750 mm. The capacity of the machine is about 3,600 pieces per hour for small pieces.

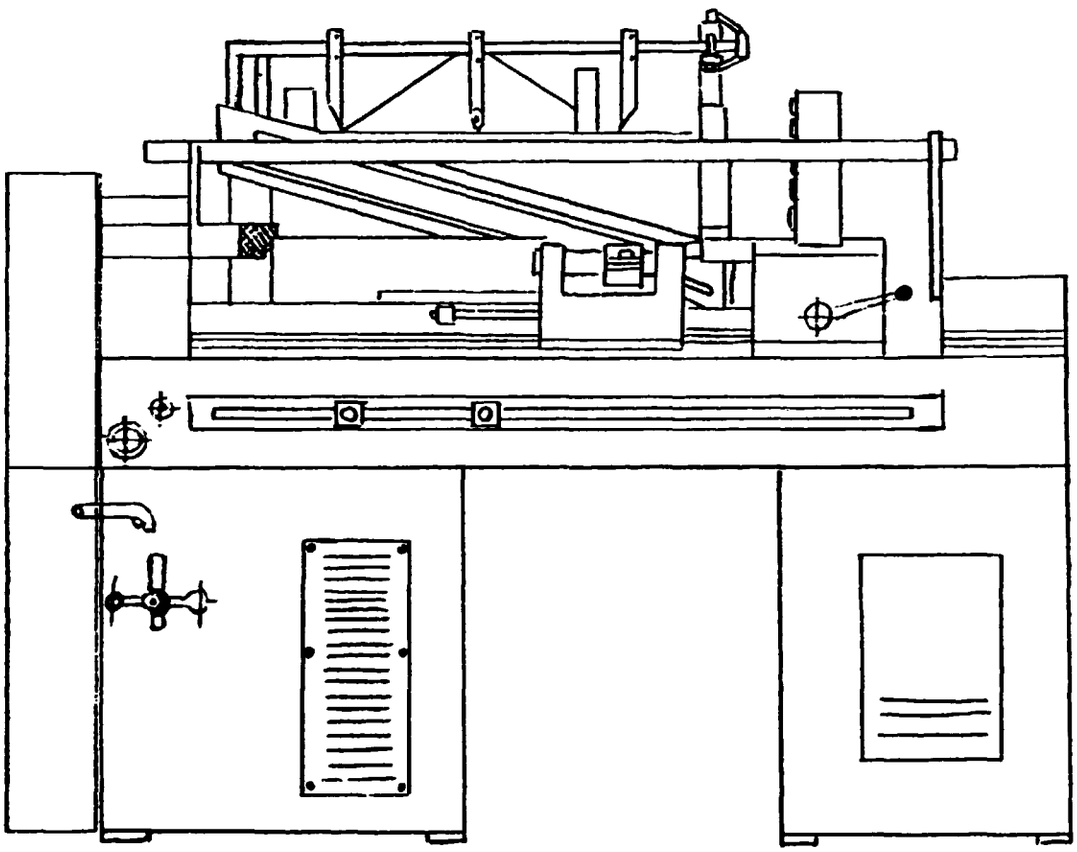


Figure 16.

7. 4-SIDE PLANING MACHINES

These machines are furnished with vertical operating units used for profiling, and horizontal units used for planing, either from the top or from the bottom. When necessary the machines can also be supplied with a guide, located on the table; it is thus possible to lead short elements of hardwood very accurately through the machine. When leaving the machines all 4 sides of the elements are machined (profiled). A four-side planing machine with a conveyor can be coupled to a double end tenoning machine. In a continuous process elements may thus be processed in both the longitudinal and transverse directions. When required, an automatic stacker can also be added at the end of this partial production line.

Partial production lines for the manufacturing of parquet fingers operate on the basis of a similar process.

Four-side planing machines can plane planks that are up to 170 to 220 mm wide, and the number of their machining heads ranges from 4 to 9.

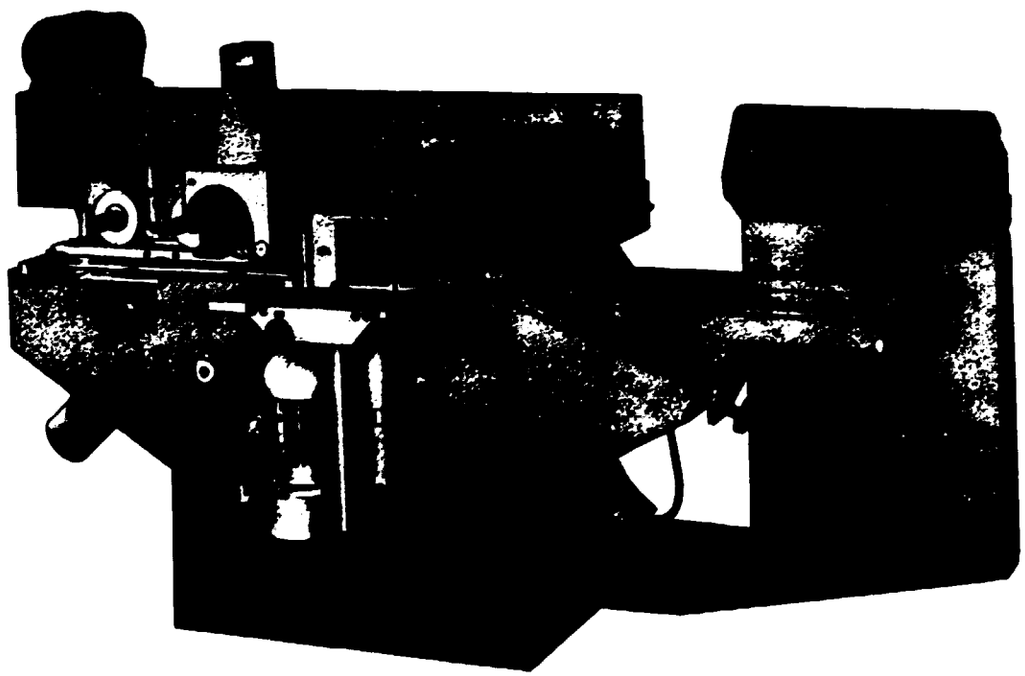


Figure 17.

8. HYDRAULIC AND PNEUMATIC HOT PRESSES

(a) Flat woodworking presses

These hot presses are designed either with electrical or steam heating of platens. They have one or more daylights into which elements can be inserted manually. Pressure monitoring is performed by a manometer and temperature control and regulation by thermostats that have a special clock mechanism built in, which allows one to set effective pressing time that depends on the type of glue and the gluing temperature required. Specific pressures at which the press operates range between 2 and 5 kp/cm^2.

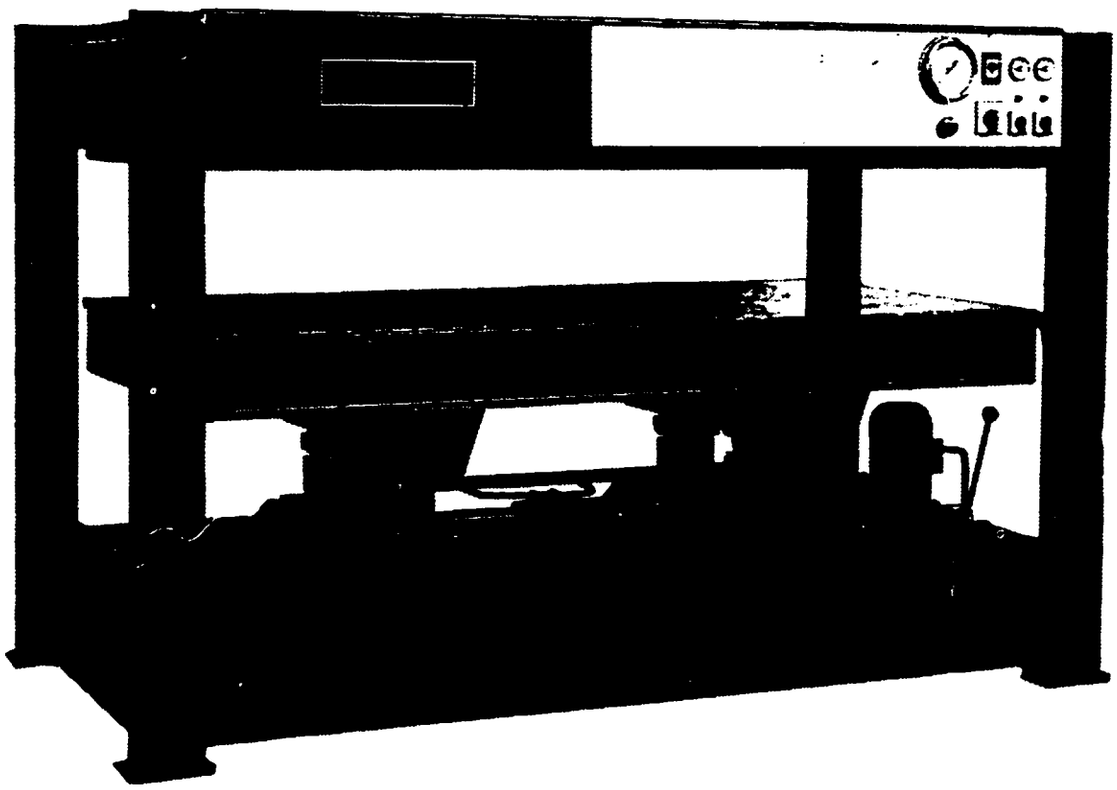


Figure 18.

(b) Form presses

These presses are primarily used for production of plywood required for pressed elements, such as chair seats and back-supports. The heating may be by steam, hot water or high-frequency electric current. The forms used with this press are made either of a light metal or wood. The pressure required for the operation of these presses is higher than that of woodworking presses, and may go up to 20 kp/cm^2.

Figure 19.

(c) Rotating clamping presses

Presses of this type are mostly used in the manufacturing of solid-wood seats for chairs where round-edge gluing is required. In view of the growing shortage of wood for laminated wood products and elements, presses of this type are also used to an increasing extent for construction, particularly for windows.

The number of pressing surfaces may be up to 12 and the dimensions of the basic surface ranges from 700 x 2,500 mm to 1,300 x 3,800 mm. The glues used are of varying types, initially, however, the animal glue type of adhesive was used. The pump's overall pressure is up to 40 bars.

Figure 20.

(d) A casegoods press

This press is a continuous line press: the elements to be pressed enter the machine along a conveyor. An electronic device, located in the middle of the switchboard, allows one to position the casegoods automatically into the very middle of the press. Maximum dimensions of pieces are as follows: 2,200 x 600 x 1,200 mm.

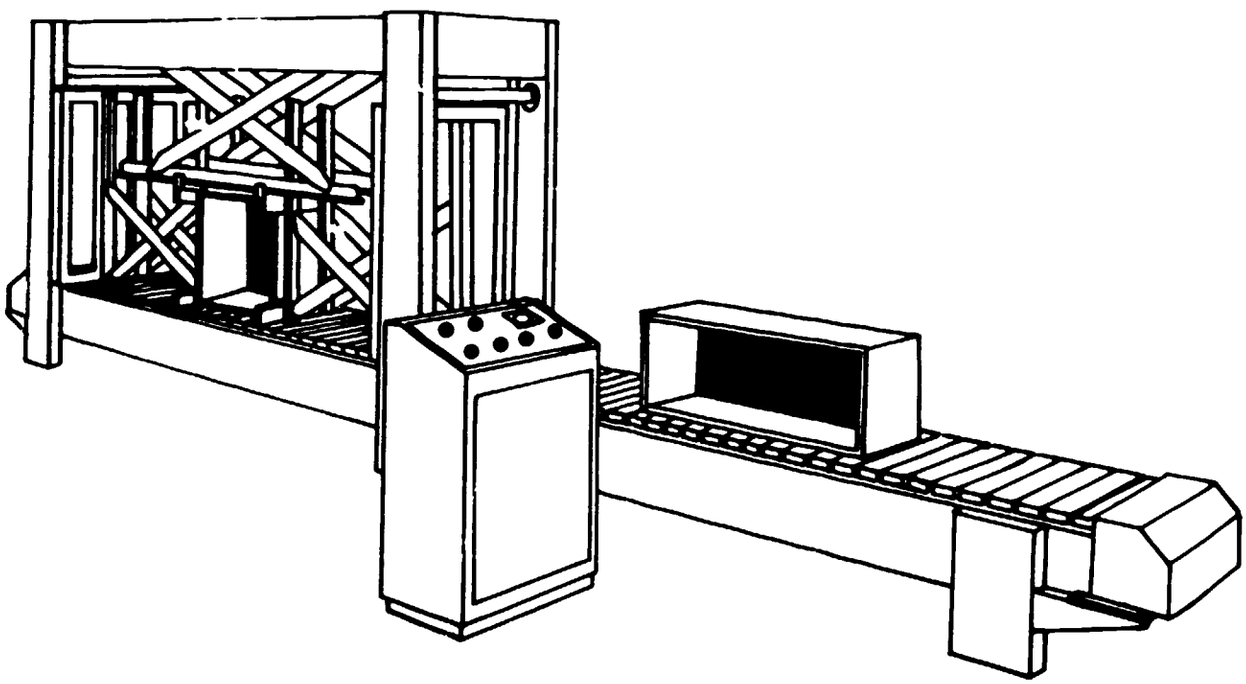


Figure 21.

.) Air-cushion press

This press is mostly used to glue a foil to a board, whereby basic cushion dimensions are 1,000 x 650 mm. Any number of cushions may be available with this press. The cushion may move 50 mm from one side to the other, and the pressing force of a 1,000 x 550 mm air cushion is 13 tons.

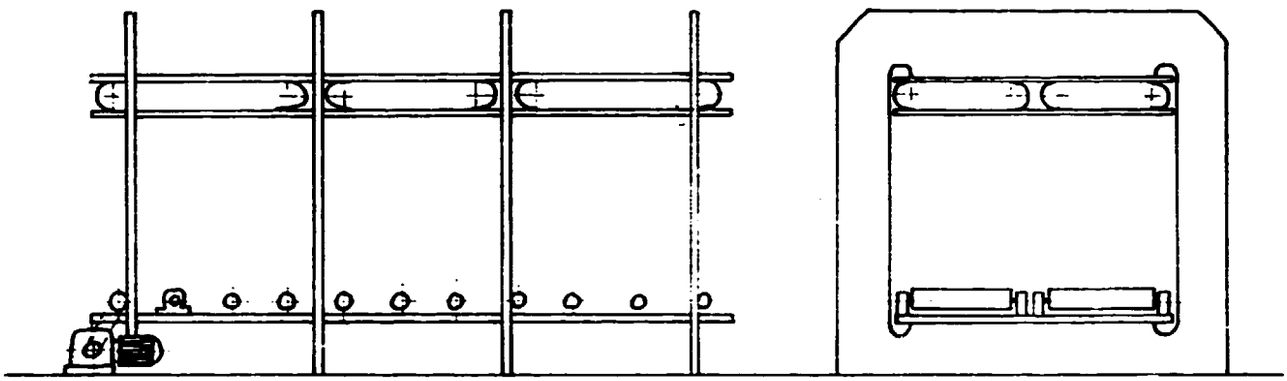


Figure 22.

9. OTHER MACHINES

(a) Brush sanding machine

This machine is used for the sanding of profiled and other small elements of hardwood. Sanding quality may vary, depending on the grain size of the sanding paper, on the one hand, and the brush type, on the other. Sanding width is 200 mm and the cylinder diameter is 350 mm.

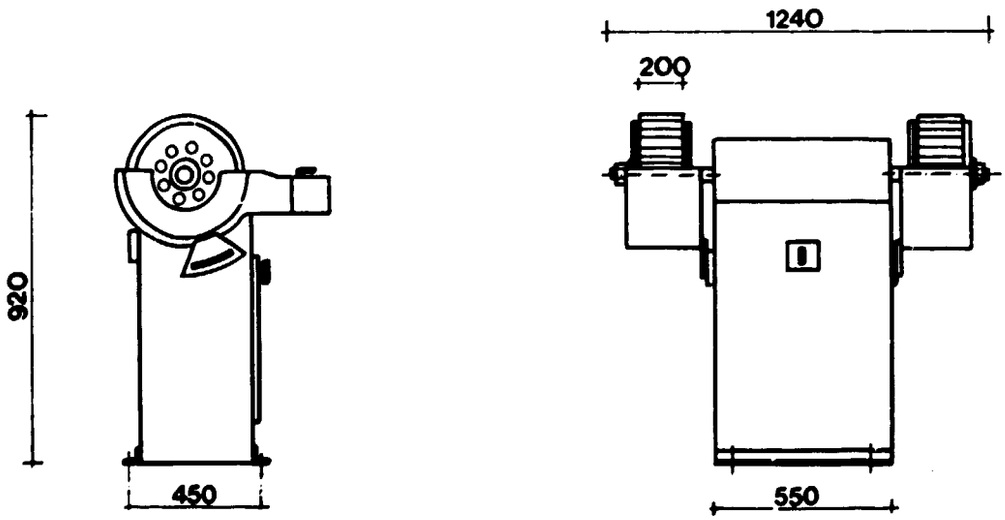


Figure 23.

(b) Hydraulic guillotines for veneer packs

The guillotines manufactured in Yugoslavia are 3,200 mm long and are furnished with a built-in device used to provide an additional cut for fragile veneer. Maximum height of a packet may be 100 mm and its maximum width 800 mm. A double safety device is built in this machine and it prevents accidents (the engine must be switched on by both hands and a photo-cell provides for additional protection).

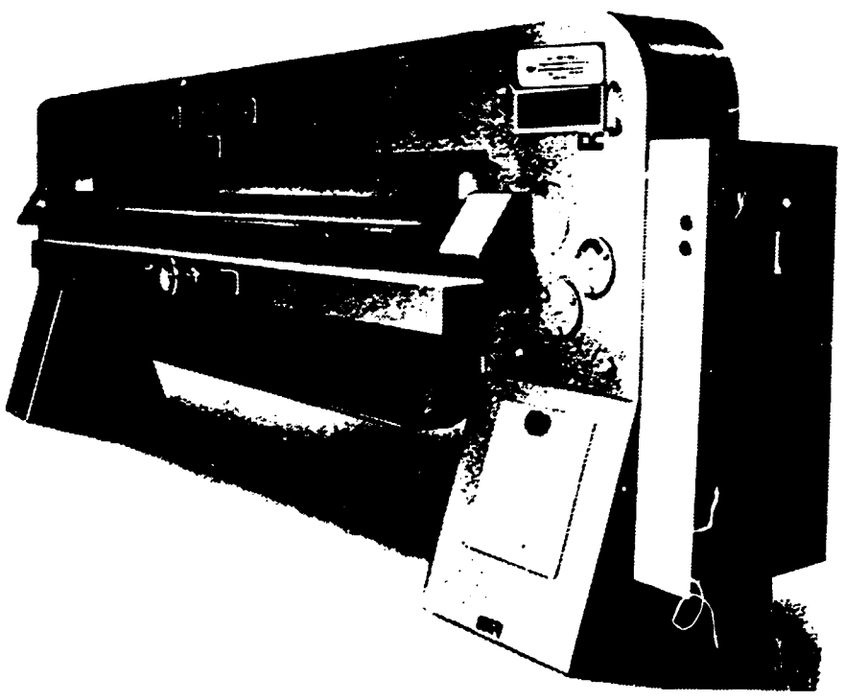


Figure 24.

(c) Veneer splicing machine

With this machine only splicing tape can be used. A new machine, however, that operates with a splicing thread is being developed. Splicing tapes are available in 2 widths: 12 mm and 15 mm. The thickness of veneer ranges from 0.3 to 2.5 mm.

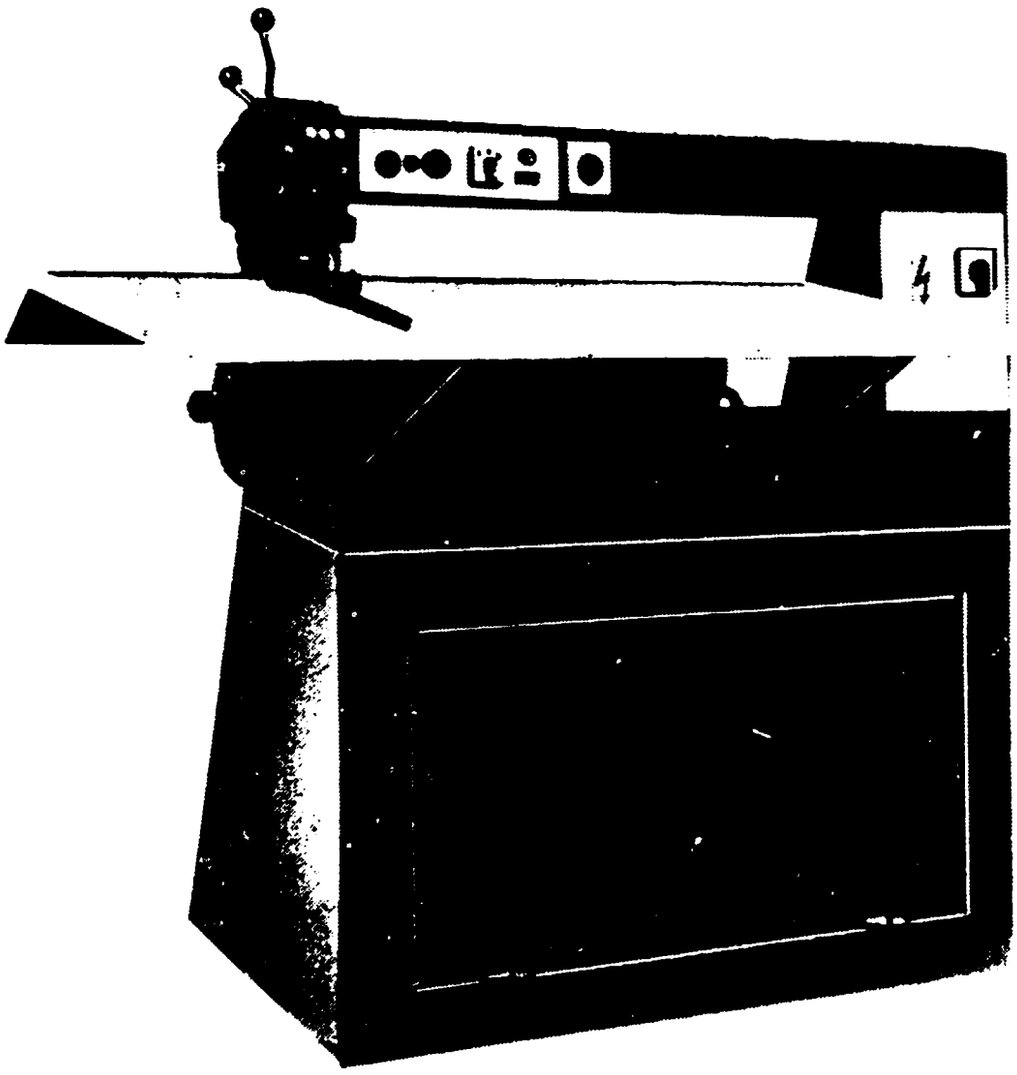


Figure 25.

(d) Feeding device

The device can be coupled to any machine (spindle moulders, table circular saws, etc.) which require automatic feeding of the elements. The feed speed may be regulated in the range of 2 to 25 m/minute, and its engine power is 0.5 kw.

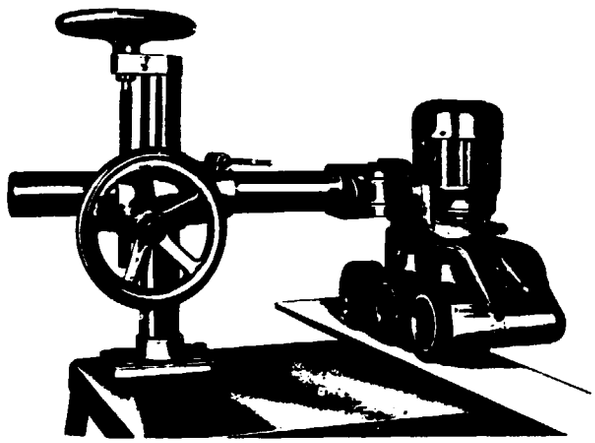


Figure 26.

10. MANUFACTURE OF BAND-SAWS AND MACHINES FOR SAWMILLS

At present Yugoslav manufacturers can supply and produce an entire sawmill with an output capacity of 5,000 to 10,000 m^3 of logs per year. The logs can be up to 8 m long and their diameter may range from 20 to 180 cm.

Within the framework of this programme the following machines are produced: log band-saws whose diameters are 1,100, 1,400, 1,600 and 1,800 mm; band saws with diameters of 900, 1,100, 1,500 and 1,600 mm, as well as hydraulically activated cross-cut saws, and single-blade automatic circular saws for longitudinal sawing.

Blade sharpening machines for the above saws and cutters are also manufactured in Yugoslavia. The wheel diameter for these log band-saws is 1,100 mm, maximum diameter of logs entering the saw is 500 mm, the engine power is 30 kw, and conveyor speed ranges between 0 and 60 m/min.

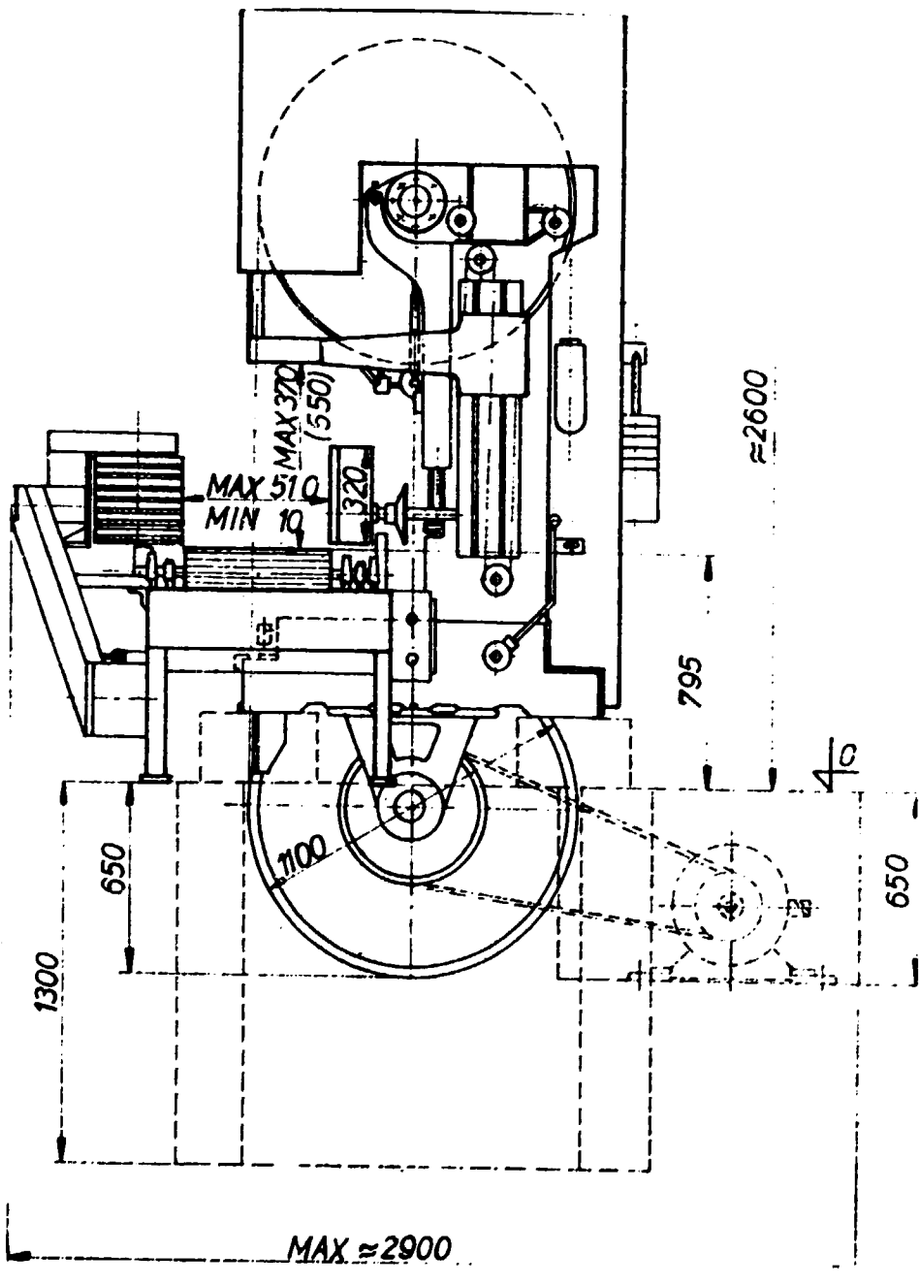


Figure 27.

11. WOOD DRYING KILNS

(a) Softwood drying kilns

Portable drying chambers of simple design and lateral axial fans are at present manufactured in Yugoslavia. The usual speed of the circulating air is 3 to 4 m/sec. Either steam or hot water are used to heat the drying chambers. Capacity of one chamber may go up to 25 m^3. The chambers may be furnished with a manual, semi-automatic or automatic control of the drying process.

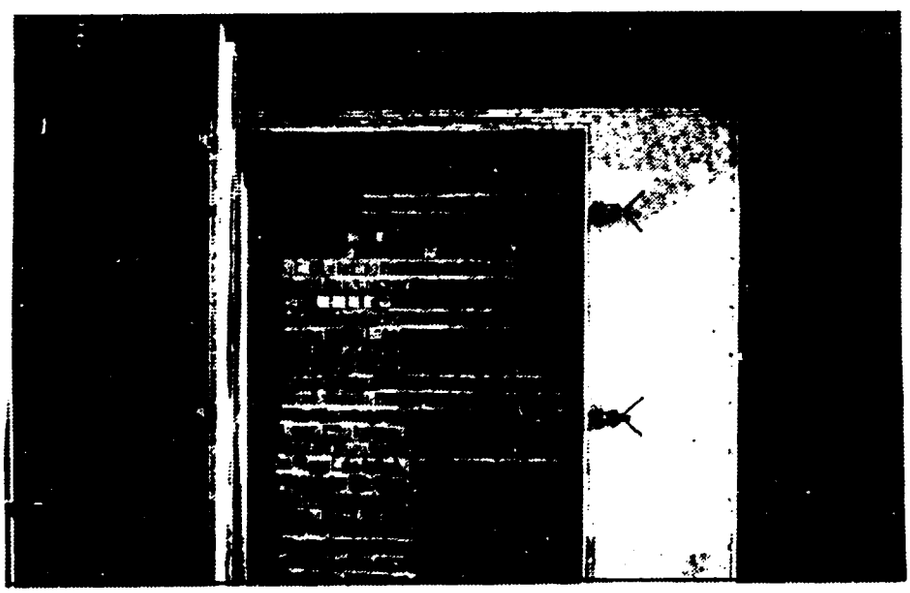


Figure 28.

(b) Hardwood drying kilns

These machines are available with one or 2 rails and/or one or 2 chambers with a volume of up to 48 m^3, as well as 4 chambers with capacity as high as 100 m^3. Axial reversible fans provide for adequate air circulation, and heaters located above the pallet on the opposide side of the fans provide for heat. The chambers may be furnished with a manual, semi-automatic or automatic control of the drying process.

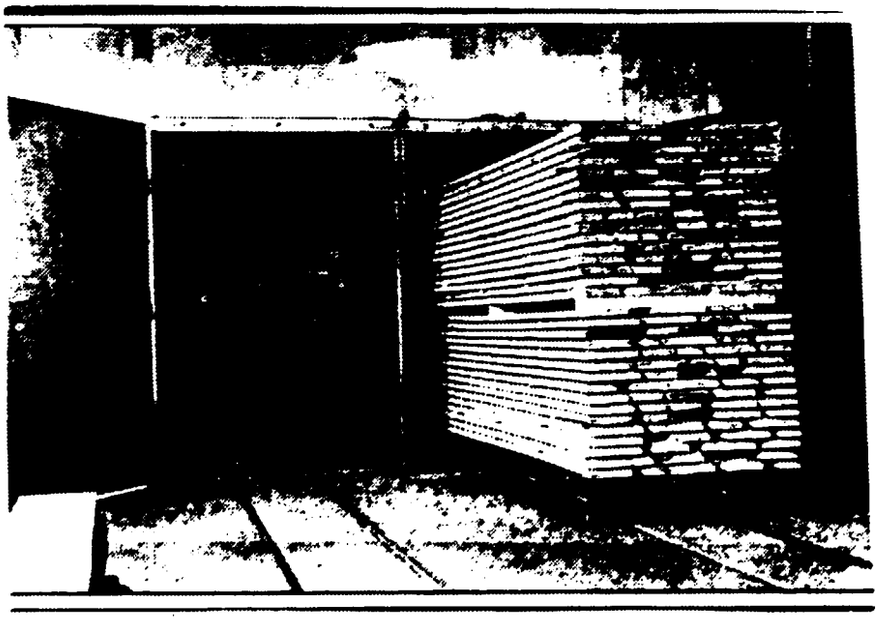


Figure 29.

(c) Pre-drying installations

These are utilized with the purpose of reducing natural drying time by up to 10 times. Velocities of air flow are small and do not surpass 2 m/sec, and the temperature is rather low, i.e., 40^{o} to 50^{o} C. Exposing wood to a pre-drying process may also improve the actual quality obtained in the drying process, which particularly applies to the drying of exotic and very hard wood species. The capacity of the machine may go up to 500 m^3. The control and monitoring of the drying process may be either automatic or manual. Machine feeding and materials transport are performed either by side loaders or forklifts.

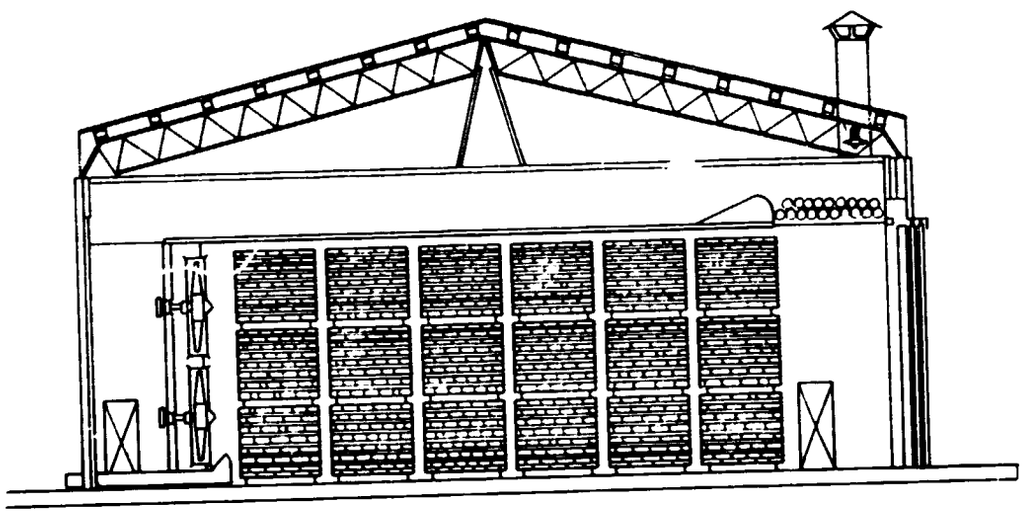


Figure 30.

(d) Wood moisture measuring device

The measuring range of this device is 4 - 60 per cent; maximum thickness of a wood element to be measured in 200 mm. Temperature compensation from - 10° C to + 80° C has been built into this device, which allows one to measure prior to, during and after the processing of the wood.

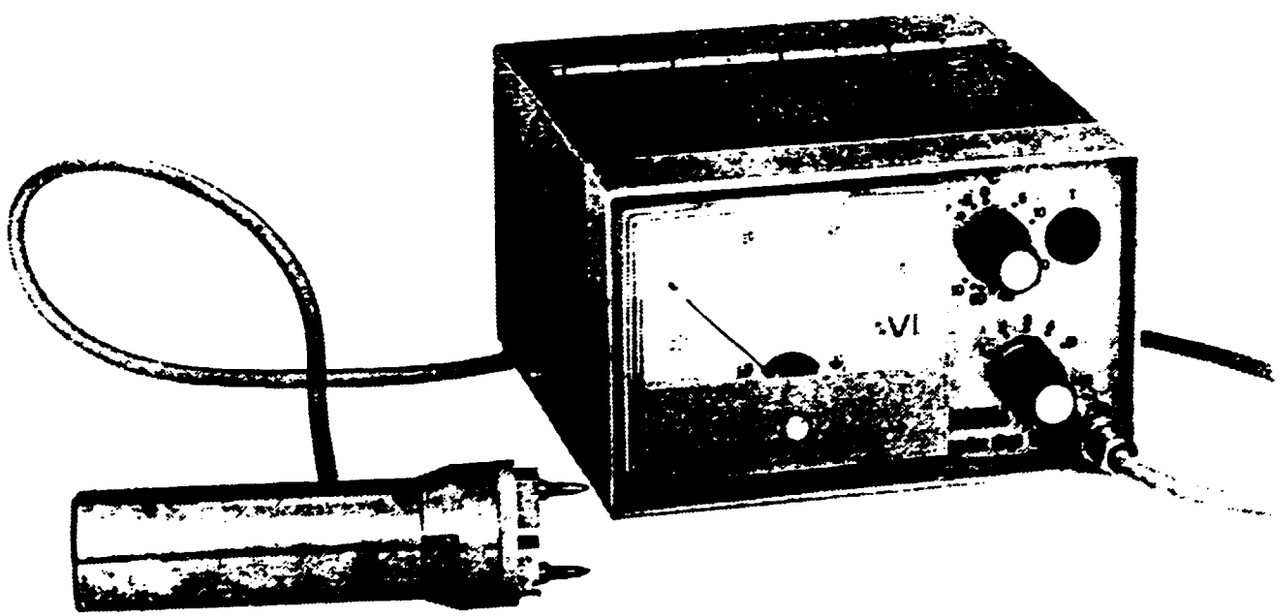


Figure 31.

12. MANUFACTURE OF TRANSPORTATION AND CONVEYING MACHINES

A number of Yugoslav companies produce conveying equipment which may be classified as follows:

(a) Heavy-duty conveyors (roller conveyors, belt conveyors, hand conveyors, etc.) used for the transport of materials in sawmills (Figure 32).

(b) Light conveyors of different design that are used in furniture plants (Figure 33).

(c) Lifting and elevating tables of varying bearing capacities and dimensions (Figure 34).

(d) Fork lifts.

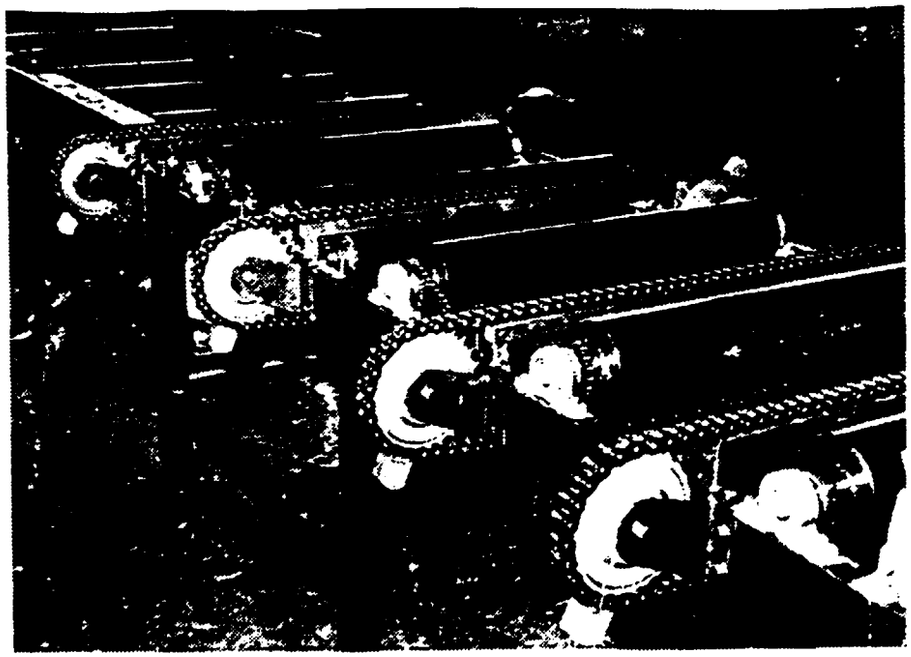


Figure 32. A heavy-duty longitudinal and transverse conveyor.

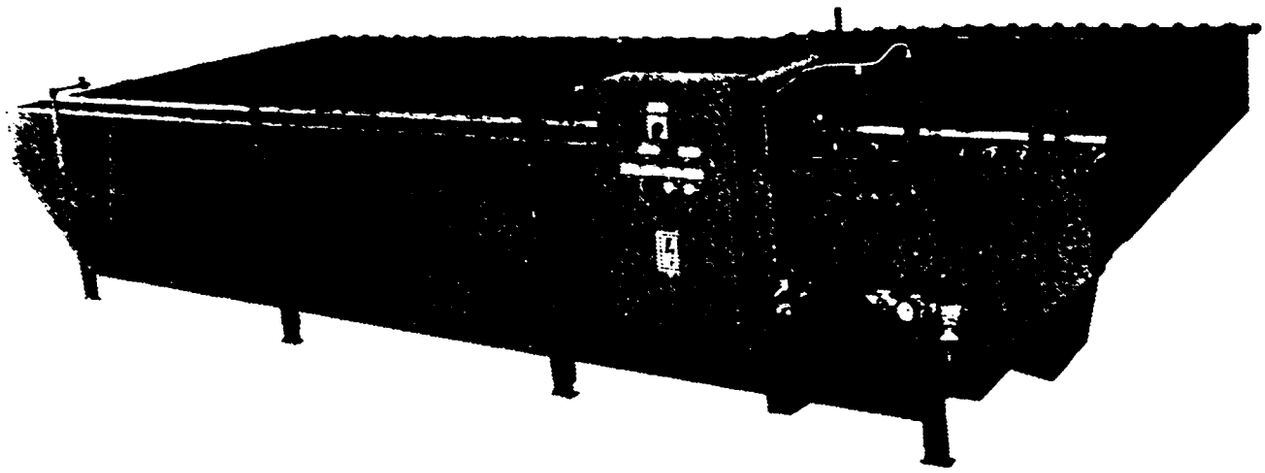


Figure 33. A board-turning device: turning angle is 90^{o}. Lateral turning is also possible. Maximum allowable dimension of the boards is 2,500 x 1,000 mm.

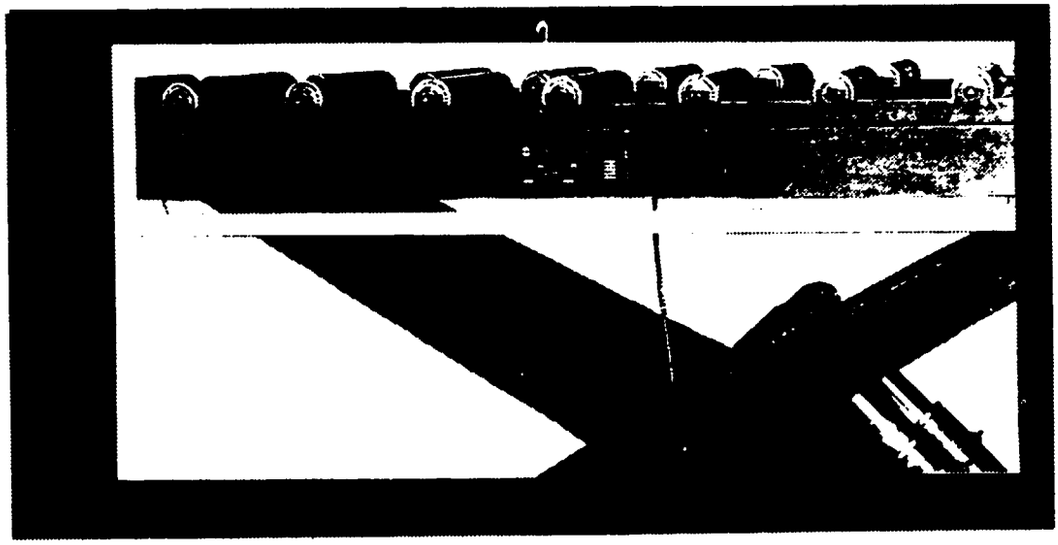


Figure 34. A lifting table, bearing capacity up to 5 tons; dimensions 3,700 x 1,500 mm.

13. MANUFACTURE OF VARNISH DRYING MACHINES

Highly specialized drying machines and/or drying lines required in surface treatment of wood are manufactured in Yugoslavia. Our enterprises produce the following drying lines:

(a) For the surface treatment of small profiled elements (e.g. elements used for wall panels, floors, etc.).

(b) Surface treatment of casegoods and/or assembled chairs.

(c) Surface treatment of boards for doors and elements for casegoods.

(d) Surface treatment of elements for colonial style chairs.

(e) Surface treatment of elements for the construction industry.

(f) Surface treatment of elements (for the construction industry) covered by glazed coatings.

(g) Tailor-made lines.

14. PROCESSING LINE FOR ELEMENTS USED IN THE MANUFACTURING OF COLONIAL CHAIRS

The line is made up of 2 parts:

(a) A line for the varnishing of wood curtain rails and planed elements with a single immersion.

(b) A line for seats and backs with a triple-immersion. The capacity of the line is about 150 pieces/h, the heating medium used is steam, hot water or oil. Twelve to 16 persons are employed in this line.

A processing line for surface treatment of elements for colonial chairs (output capacity: 150 chairs/hour) is given in Figure 35. The key to the numbers in Figure 35 is given hereunder:

1.	Suspended chain transporter
2.	Suspended carts with supports for elements
3.	Drying chamber
4.	Chamber with tub and immersing device
5, 6, 7.	Drying chambers
8.	Device for fixation of elements
9.	Device for removal of elements from supports

10.	Leaching chamber
11.	Tub with an operation grid and exhausting wall
12.	Varnishing chambers
13.	Traction chain transporter
14.	Carts used in different levels
15, 16, 17, 18, 19, 20	Exhausting walls
21	Drying chambers
22.	Cooling device
23.	Sanding tables
24.	Fresh air intake
25.	Electrical switching box.

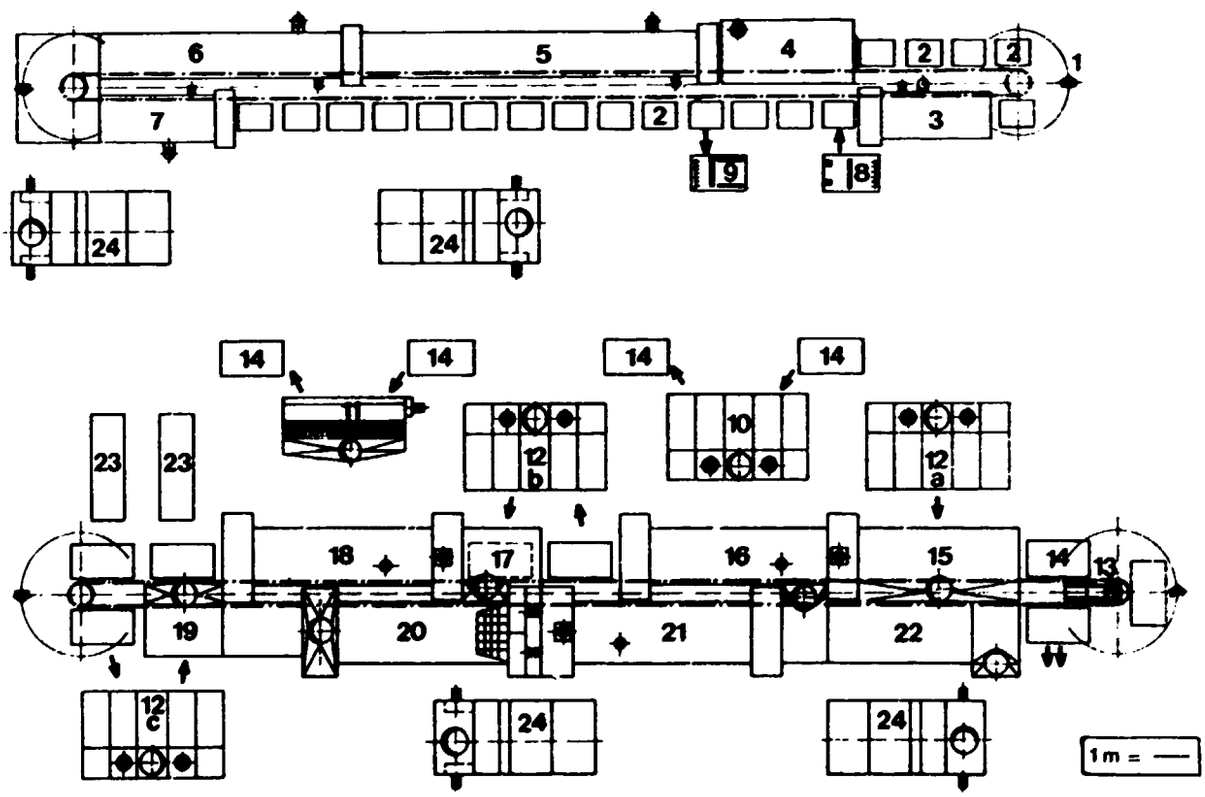


Figure 35.

15. MANUFACTURE OF PACKAGING MACHINES

Automatic machines for packaging in plastic foil are used by wood-working plants primarily when using carton boxes for furniture (made of solid wood or elements of casegoods), windows, doors, flooring, sawnwood, etc. A major advantage of an automatic machine lies in its large output capacity, bearing in mind that up to 5,000 packages can be prepared in 8 hours. Splicing tape is also the least expensive packaging material used for the above purpose. Fully automated packaging is, furthermore, possible.

Machines used for automatic packaging with a splicing tape

Conveyor belts may be attached to this type of machine, which results in improved and less complex handling, and increased output capacity. Maximem frame dimensions are as follows: 2,000 x 2,000 mm. Splicing tape widths available are 12 and 16 mm, and its thickness is 0.8 mm. Tape welding temperature is 190° C to 230° C and the machine's output capacity is up to 500 packages per hour.

Figure 36.

16. PRODUCTION OF DUST AND CHIP EXHAUSTING DEVICES

Filtering systems based on regeneration of exhausted air are manufactured in Yugoslavia. An advantage of the system lies in the fact that it provides for maximum fire safety; fire risk is thus limited to only a small area (1 or 2 filtering cells). In a classical system of exhausting, however, an entire exhausting system is usually affected by a fire. Other benefits of this system are as follows: a very high level of filtering, maximum safety of operation, and energy saving. The system is, furthermore, very flexible in terms of output capacity adjustments, and its operational costs are rather low.

The cells of the system with in-built filters have a capacity of 3,000 to 230,000 m^3 of filtered air per hour; in addition, 3 to 200 m^3 of solid material is eliminated per hour. A chain-conveyor system takes care of transport of wastes into a silo. When required, automatic fire extinguishing devices may also be built into the system. Filtered air is recycled from the cells into operational areas, resulting in considerable heat savings.

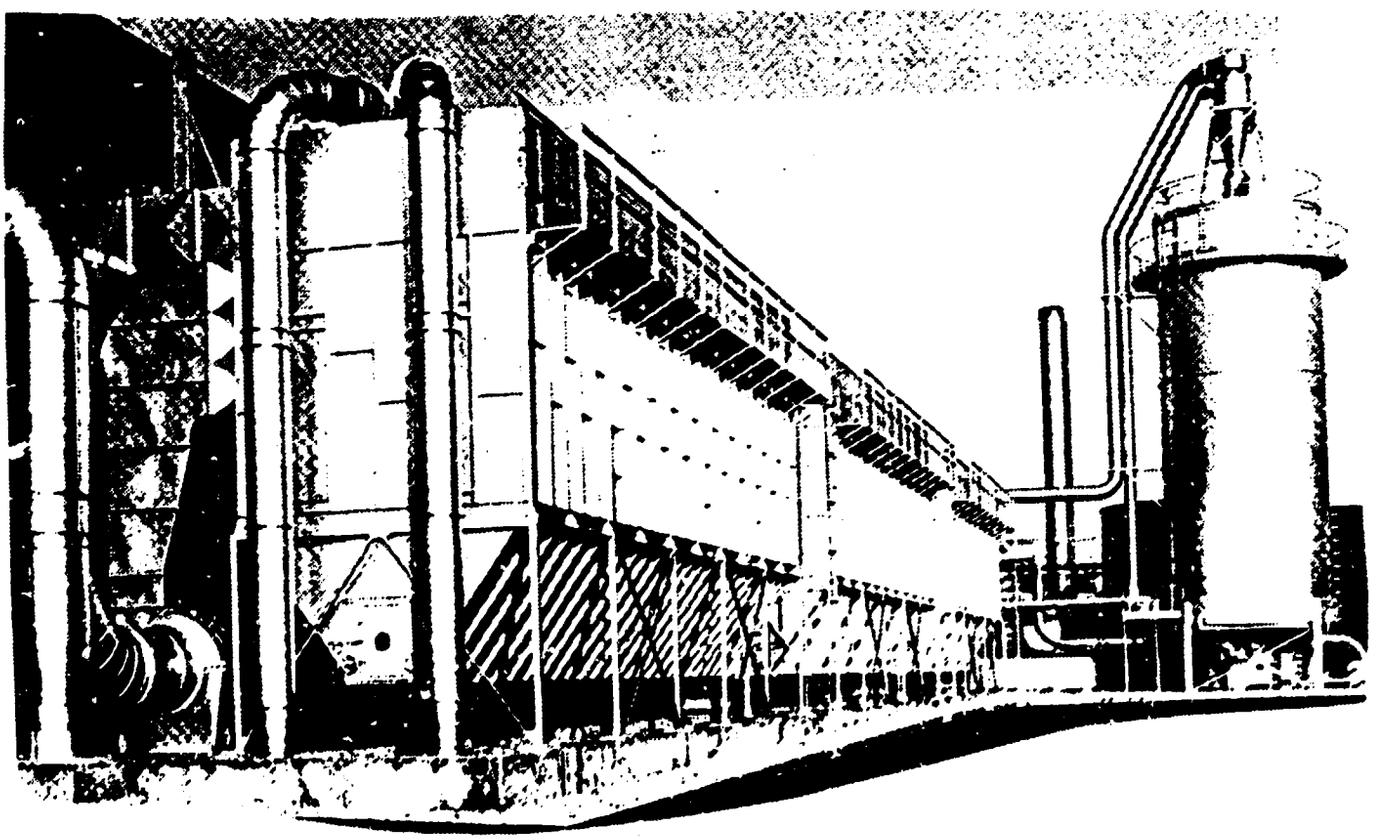


Figure 37.

17. MANUFACTURE OF POWER STATIONS FIRED ON SOLID FUEL AND/OR WOOD PROCESSING WASTES

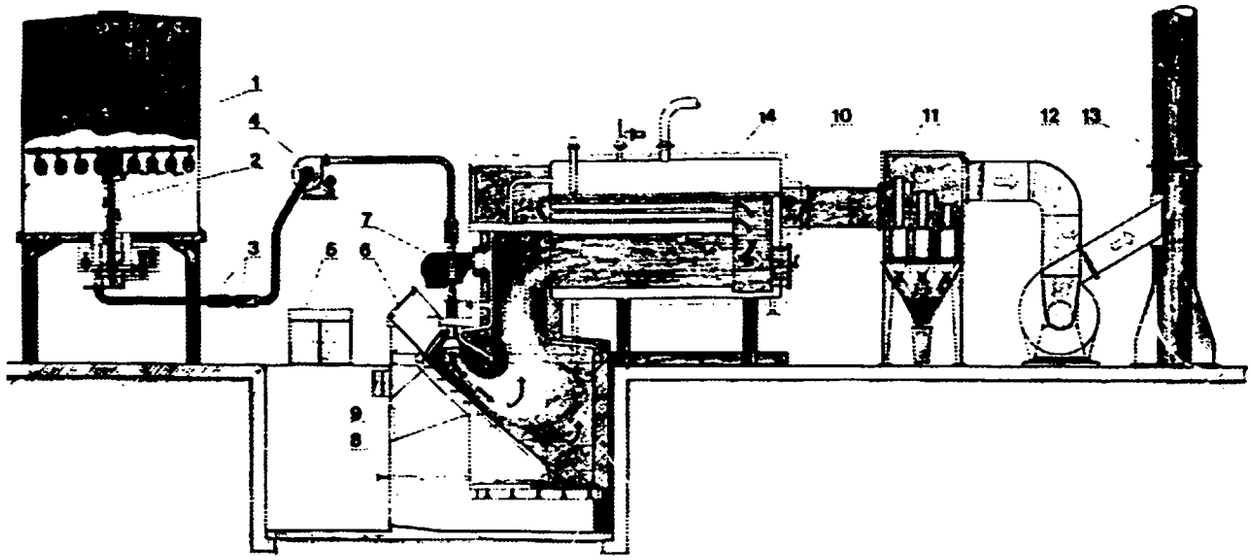
All sorts of wastes are obtained in the woodworking industry, such as: sawdust, wood powder, off-cuts, bark, etc. When fully automated incineration of wastes is aimed at, fuel storage (dozing, exhausting and ash removal procedures) has to be provided as well as an adequate boiler.

Fundamental parts of a simple waste incinerating device are as follows:

- A waste storage silo
- An unloading device
- A conveyor fan
- A boiler (that can be controlled and regulated)
- An exhausting device
- An exhausting fan
- A smoke stack

A number of other elements may also be used to safeguard viable and profitable operation of the system as a whole.

A layout plan of a power station fired on wood processing wastes is given in Figure 38 on the following page.



1. Silo
2. Cutter
3. Safety flap
4. Conveying fan
5. Switchboard
6. Door for pieces of woodprocessing waste
7. Burner
8. Transverse grid
9. Dozing nozzle
10. Smoke flap
11. Smoke filter
12. Exhaust gas fan
13. Smoke stack
14. Boiler

Figure 38. Layout of power station fired on wood processing wastes.