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

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards even though the best possible copy was used for preparing the master fiche.

CONTENTS

1) GENERAL CONSIDERATIONS

1.1 Given the constant progress of the last few years in research, as well as in the industry itself, wood-working and the manufacture of allied materials are in the process of changing from a typically artisan sphere of activity to a truly industrialized one.

1.2 Thus, the heavy demand for civil and industrial furniture that, initially, gave rise to considerable proliferation of small and medium-sized artisan firms, subsequently lead to the development of big factories, operating on an industrial scale.

1.3 The first big factories developed in the field of modular, interchangeable kitchen furniture, hand in hand with the growing demand for electrial household appliances (cookers, refrigerators, dishwashers etc.), which are normally located in the kitchen.

1.4 Later on, the module, interchangeable-unit idea was introduced and accepted by the public for all other rooms in the house, such as the entrance hall, dining-room, living-room, bedroom, bathroom etc.

1.5 The module concept has, indeed, been a determining factor in the mechanization and rationalization of the production cycle, as well as in the technologies relating to furniture production.

1.6 In fact, this concept makes possible the production of large quantities of standardized panels, which are components of furniture units that themselves have standardized

dimensions. The modular concept, therefore, takes in not only the furniture unit itself, but the individual panels that form it as well. The result is a twofold advantage in the production phase, due to the considerable reduction in working time and in the hidden costs involved in having to stock a very wide range of panels and furniture.

1.7 The fact of being able to feed into the production line large quantities of identical basic panels has meant a new working concept, and consequently the gradual design and construction of machinery able to operate in continuous line with other machinery at a relatively high rate of production.

1.8 In fact, these machines, as will be explained in detail later on, are linked with one another by means of automatic conveyors and handling equipment, thus obtaining smoothly-operating lines for each working phase.

1.9 Each line normally starts with an automatic feed, which picks up the panels from the pile and feeds them into the line, at the end of which an automatic stacker forms new piles.

1.10 This system, already widely used in other industries, has the major advantage of reducing and, in many cases, of eliminating the physical work of the operative, while the second advantage, which is far from negligible, lies in the fact that the production rate is made to depend on the effective capacity of the machines, and not on that of staff.

1.11 A second important concept in the new production systems, which also stems from experience gained in the manufacture of kitchen furniture, is that of surface finishing. For such furniture, which undergoes considerable wear and tear through continuous use, plastic lamination has been widely accepted as the facing material. These melamine laminated sheets are in fact very hard, and stand up well to most common chemical solvents.

1.12 In the past, each kitchen furniture manufacturer, using presses, himself applied the plastic sheeting on ready-sectioned panels slightly bigger than the finished furniture component.

1.13 With this in mind, the primary processing concerns, to simplify the preliminary operations of the manufacturers, devised a process to produce chipboard panels (even exceeding 10 m^2) with both faces already laminated with a thin layer of synthetic material (melamine, PVC etc.), requiring no further finishing.

1.14 The economic advantage of this for the manufacturers can easily be imagined, for this meant they had a raw material that greatly simplified preliminary operations and finishing. Moreover, the higher cost of the original laminated panels is still much lower than it would be if lamination and finishing were done by the individual manufacturer at his own factory.

1.15 So successful has this procedure been, that the concept

of large-sized panels with finished surfaces has been further developed, to extend its use as a basic material from kitchen furniture to the wider field of furniture in general, where products have hitherto been veneered with various kinds of more or less expensive wood, and then painted.

1.16 In this field, because of the growing cost and difficulty of finding high-quality wood, two parallel techniques have been developed:

- The first one, which is employed at the present time, consists in the use, as surfacing materials, of cheap veneers (even paper sheets or coats of filler), followed by printing, during the painting cycle, in the right colour, of a pattern reproducing the grain of high-quality woods.
- The second technique consists in forgetting about a wood veneer, and simply glueing on a suitably-processed sheet of paper, printed with an imitation grain pattern.

1.17 The second system has definitely ousted the first, due to its greater possibilities of improvement and development, its lower production cost, and the fundamental fact that it is more easily combined with the principle of large panels with finished or semi-finished surfaces.

1.18 Today, chipboard panels overlaid with printed paper sheets can be found on the market that look exactly like quality woods, with open or closed-pore finish, glossy or semi-matte surfaces.

In some cases, to obtain a better surface finish, laminated panels have semi-finished surfaces, to which a final coat of paint is added, depending on requirements.

1.19 What has so far been said regarding technological trends in the furniture field, does not, however, mean that in the future furniture will no longer be made of natural wood, since the imitation techniques mentioned are suitable for only a certain type of modern furniture, but not for other, traditional types (such as period reproduction), for which it will still be necessary to apply the traditional system.

1.20 The variety and quality of the optical effects, obtainable with traditional surface-finishing and its methods, which can be variously combined (veneers, stains, paints, different finishes etc.) is so wide and flexible, that it probably cannot be completely replaced by imitation products, which are relatively rigid in their variability and quality.

1.21 However, as regards imitation and substitution, it should be noted that the primary industry continues to make much progress, with considerable financial advantage for the whole furniture industry.
It may therefore be expected that such new forms of imitation will finally impose themselves, especially in mass furniture production, both for the individual purchaser (who has fewer and fewer prejudices) and for designers, who already use such products extensively.

1.22 Suffice it to look at the plastic industry, at one time universally despised — plastics were considered synonymous with shoddy — but whose products are now indispensable in certain technical fields — even in very sophisticated ones (substitutes for light alloys, glass, textiles etc.).

1.23 The purpose of all that has been said so far has been not only to bring the reader up to date with the present technological trends, but also because they serve as a logical preface to the question of introducing new machinery, itself a consequence of technological developments.

1.24 Thus, it can be said that the modular principle has led directly to the introduction by manufacturers of large-scale mass production, using panels with finished or semi-finished surfaces as the basic material. The following chapters, rather than speak of individual machines, will concern groups of machines and lines specially planned and improved for each smoothly co-ordinated working phase.

1.25 However, it must be remembered that this paper, because it covers such wide field, will be concise and refer only to the main machines. Detailed study of specific cases will be held over for subsequent discussion.

2. MACHINES FOR PRELIMINARY WORK

2.1 By preliminary work we mean those operations concerning preparation of the basic materials before they are fed into the production cycle proper.
Such operations may be sub-divided into the following three main groups:

- Solid wood working
- Panel processing
- Working thin sheets of wood

2.2 As far as solid wood-working is concerned, preliminary operations consist of the previous conditioning of the planks by means of a drier, followed by dividing up and cutting into pieces the right size. This may be defined as the logical continuation of the operations that are normally carried out at the saw-mills of the primary processing industry.

2.3 The machines normally used for solid wood are the following;

- Transverse circular-saw sectioning machines, with a free-cutting blade or under pressure, manually-operated or automatic, with or without lengths programmed to meet various requirements.
- Ordinary longitudinal sectioning machines or automatic, multiple circular-saws for large-scale production.
For this operation, band saws can also be used, but only for small-scale production.
- Single or double-cylinder planes when planks and strips have to be provided with precision or have a better finish than those obtained only by sawing.

2.4 As far as panel material is concerned, preliminary work consists mainly of cutting operations; that is to say in dividing up the large-sized panels into pieces with the required measurements.

- Panels may be made of chipboard, hardboard, plastic, plywood etc.

2.5 The machines normally used for panels are the following:

- Ordinary circular-saws or band saws, with a fixed blade material in motion in the case of small-scale production.
- Single sectioning machines under pressure, with a moving blade and stationary material in the case of medium production.
- Double sectioning machines for combined longitudinal and trasversal cutting, operated automatically in the case of large-scale production. These automatic machines are of various types, such as single-blade, multiple-blade, stationary material and moving blade or viceversa, or with both movements combined, with or without automatically programmed lengths.

  The attached Table "A" shows a complete sectioning system, with two combined orthogonal machines, complete with automatic loading and unloading and electronically programmed lengths. The sectioning unit is probably the best to be found on the market as regards automation, precision and finish of cut, together with a considerable rate of production.

2.6 As far as thin sheets of wood are concerned, working con-

sists mainly in the cutting and joining of scaleboard. Other sheet materials, such as PVC, resined paper and the like are dealt with separately, as mentioned later on, and then only in special cases, since the panels normally come ready-faced from the primary processing industry.

2.7 The machines normally used for thin sheets of wood are the following:

- More or less automatic cutters, for sectioning and trimming piles of scaleboard.
  These machines are of the mechanical or hydraulic type, and can also be equipped with various automatic devices to obtain perfectly accurate cuts.
- Automatic joining machines for the composition and joining of the basic sheets of veneer. There are many types of machine, depending on the material used for the joint, such as: adhesive paper, adhesive thread, glue only etc. . . . . Recently, the adhesive thread type of machine has been widely used for the many advantages it offers in specific applications.

3. MACHINES FOR WORKING SOLID WOOD

3.1 The considerable number of machines under this heading makes it difficult to classify them by type, function or specific technical characteristics, since machines have been designed and constructed specifically for every production sector. Those that are usually common to all sectors are those found at the beginning of the working

cycle or that are used for machining joints and accessories.

Generally speaking, and for the sake of simplicity, these machines will be listed, in the points that follow, according to the type of process or tool used.

3.2 Linear profiling machines.

The basic machine for this process is the planing and moulding machine, which combines the various operations that can be performed by conventional methods with separate machines. Those operations can be summed up as follows: single and double cylinder planing, lateral planing and profiling on each side, so as to obtain the required finished profile with a single pass. Even though the working principle is different, this group of machines includes profiling machines for pins, sticks, frame components, laths, and various other structural elements.

- When the cross-section of the piece is circular, the machine used is a lathe manually-operated, semi-automatic, or fully automatic lathe, with automatic loading and unloading of pieces.

3.3 Machines for curved profiles.

These machines are generally of the copy-milling type; that is, they work with the help of a template that reproduces the shape of the piece to be obtained.

For a small-scale production, conventional milling machines are used, and/or medium and large-scale production, automatic machines of the transfer type, with a single

piece or several pieces machined simultaneously.

- When the cross-section of the piece has no sharp corners, but is circular or ovoid, the machine used is a copying lathe with a rotating workplace and several pieces being machined simultaneously.
- If the cross-section of the curved profile is constant, straight line profiling is preferred, followed by sanding and finishing of the moulds, after careful preparation of the pieces.

3.4 Machines for decorative and artistic pieces of various shapes.

These machines too, are of the copying type. The basic type is the engraving copying machine, with multiple rotating tools. This machine generally enables pieces of any shape to be copied — for example, statuettes and decorations that, traditionally, are hand-sculptured.

- Today, in this sphere, various techniques are becoming widespread, such as those based on the use of heated dies, which burn the wood instead of removing it by means of tools; those based on the moulding of resin wood compounds, a close offshoot of plastics; those based on the deformation of wood without removing any of it; and those that completely ignore wood, using only various types of plastic.

3.5 Machines for working the extremities of pieces.

This includes all those machines that in general perform operations necessary for joining various combinations of structural elements. Some of the more outstanding mach-

ines of this type are the following:

- Automatic or semi-automatic drilling and broaching machines for making joints by means of pins.
- Automatic or semi-automatic tenoning and slo[illegible]ing machines for making joints by means of straight or rounded tenons.
- Machines for effecting joints with joggled pieces.
- Machines for cogged or dovetail joints.
- Machines for making special joint components.

3.6 Sanding machines.

This category includes a series of machines that, in general, operate on the same principle and in combination with the appropriate machines for the profiling and shaping of various pieces. The basic tool is abrasive paper and all its various forms.

The following belong to this category:

- Automatic or semi-automatic machines for sanding and gauging plane pieces, with single or multiple, parallel or crossed belts, upper or lower belts, upper and lower belts combined, single or combined rollers etc., — depending on requirements.
- Sanding machines for straight profiled pieces, with belts, or discs, or both, with vibrating buffers in simple or combined systems.
- Sanding machines for curved profiles with expanding roller, employing belt or disc.
- Sanding machines for turned pieces, with copying belts, buffers, or lamellar belts etc.
- Special sanding machines for specific uses.

3.7 Assembly and gluing machines.

This category includes a series of machines generally based on the principle of keeping under pressure the joints of various structural elements after the application of glue. The machines are of various types, shapes and sizes, depending on different pieces to be assembled, such as: drawers, chairs, various frames, windows, tables, trolleys etc. The more recent machines are equipped with special apparatus to speed up the drying of glues. Such equipment includes high-frequency generators, infra-red ray generators and the like.

4. PRESSING: LINES AND MACHINES

4.1 These machines are used for hot or cold gluing, under pressure of the flat pieces forming panels in accordance with various requirements. In general, except for special cases, pressing lines fall into two categories: one for the production of hollow (sandwich-type panels), and the other for facing of solid or hollow panels (gluing of thin decorative strips or sheets of wood veneer, paper or plastic. The points that follow describe these two types of automatic pressing line, widely used today wherever large-scale production is required. The attached Table "B" shows two types of pressing line.

In case of small-scale production, the operating cycle is the same, but with the machines used are non-automatic and have no mechanical hook-up with the various other machines.

4.2 Pressing lines for hollow panels.

These lines are characterized by the relatively long drying time (4-6 minutes) of the glues in relation to the thickness of the pieces.

The fact is a characteristic both of the main machine (the press) as well as that of the auxiliary machines used for the different structural components involved.

The machines that normally go to make up a pressing-line for hollow panels are the following:

4.3 Bench for setting up the frame, equipped with manual or automatic staplers for joining the various strips.

- For some years now, machines that automatically set up and staple frames, can be found on the market, so that the operative only has to keep the various automatic loaders supplied with strips.
- On the next roller bench, the "honeycomb" is inserted manually in the frame.
- An automatic parallel conveyor moves the frame on top of the press loading trolley.

4.4 Elevator plate with rollers on which the sheets of material (plywood, hardboard, chipboard etc.) to be glued to the frame are laid. The elevator plate serves to keep the flitch on a level with the glue-spreader.

4.5 Glue spreaders. This type of machine normally has 4 rollers and applies a coating of glue on one surface of each of the two sheets, which are fed in simultaneously.

4.6 Disc bench. This bench receives the glued sheets waiting to be picked up for "sandwiching". The discs, which have a knife edge, rotate with their lower part immersed in water, in order to eliminate any residual glue.

4.7 Automatic press. The hollow panel presses have a good production rate in spite of the relatively long gluing time; in general, they are of the multi-level type. Such presses are of two types: one with simultaneous opening or closing of all the levels and the other with independent opening or closing for each individual level. The second type is preferable to the first, since the panel can be fed into the press as soon as it is set up, without any delay, which may lead to serious trouble in certain cases.

The work cycle consists in picking up the first glued sheet from the disc bench and laying it down on the press loading trolley. The frame then moves forward from under the disc bench overlapping the first sheet, and finally the second sheet is picked up from the disc bench to complete the sandwich.

At this point the operative controls the automatic insertion of the sandwich into the automatic press, which simultaneously ejects the previous panel, duly pressed.

4.8 Automatic stacking machine. This machine automatically stacks panels at the press outlet by means of a roller conveyor. It requires no operator, except for removing

the stack when it reaches a certain level.

4.9 Pressing-line for faced panels.

These lines are characterized by the fact that the glu. drying cycle is in general relatively short (0. to 1 min.) in relation to the thickness of sheets to be glued. This is the characteristic of the main machine (the press), as well as that of the auxiliary machines, as will be mentioned later on.

The machines that normally form a pressing line for faced panels, are as follows:

4.10 Automatic feed, which picks up the panels from the pile and feeds them into the gluing machine. These feeds may be of the following kinds: the elevator platform type, with a pushing device; the vacuum transfer type; or a motor-driven roller conveyor, or the like.

4.11 Gluing machine like that described in section 4.5 above, with the difference that, in this case, the glue is applied to both panel surfaces.

4.12 Disc bench with functions similar to those described in paragraph 4.6

4.13 Automatic press. Since the gluing time is relatively short, presses for faced panels are in general of the single-level type. They can be divided into two categories, according to the piece loading and unloading systems: those having one belt conveyor, which enters the press compartment, and those having three belt conveyors.

- The second category is to be preferred because, during loading, panels do not fall on to the pressing area, nor, during unloading, scrape against it.
  This last point is very important when the sheets to be glued on have a finished surface.

4.14 Automatic stacking machine, similar to that described in section 4.8 above.

5. MACHINING: LINES AND MACHINES

5.1 This category includes all machines that perform mechanical operations on panels to give them the desired geometrical shape and complete all other accessory operations.
After this, the panels are ready for the surface finishing (painting), or even for assembly, in the case of panels that had finished surfaces from the outset.

5.2 This category includes the machines described hereunder:

- Double, automatic squaring-up machines, for the cutting and trimming of panel sides.
- Double beading machines, which perform flat or profiled beading (if required) of panel edges. For a few years now, combined squaring and beading machines, which have had considerable success for particular operations, have been available on the market.
- Automatic or semi-automatic modular drilling machines, which perform the drilling operations necessary for assembly of the furniture or fixing accessories.
- Double automatic breaching machines, which perform the

insertion and gluing of the pins required for joining various panels.

- Other machines of this category, which perform special operations, are described in section 6.

5.3 The above-mentioned machines are used individuall. : that is to say, not connected to each other in an automatic line unless relatively small-scale production (up to a maximum of about 1000-1500 panels per day) is required.

5.4 In the case of medium or large-scale production (3000-6000 panels per day) it is advisable to connect all the basic machines in a single automatic operating line. In this situation, the various machines are connected to each other by means of automatic conveyors and various handling equipment, which completely replace the operative.

Naturally, the fact of connecting different machines to each other (machines with moving panels, but at different speeds, or machines with fixed panels etc.) reduces the production capacity of the whole line below that of the faster individual machines. This disadvantage, however, is compensated for by a considerable reduction in staff, and by a constant level of both production and quality, due to mechanization. To day, generally speaking, slower machines (such as drilling machines) have been improved, and can reach a production of 30 panels per minute). Another typical disadvantage of automatic lines is the relatively long time required for setting up the various

machines when the sizes of panels to be produced vary. Machines that take longer to set up are the drilling machines. The solution for reducing this down time consists in using two mobile co-ordinate drilling machines, mounted on a truck.

In this way, while the first drilling machine works in the line, the second can be tooled and set up for the next operation, and inserted in the line at the right moment.

Table "C" shows an operating line like the one just described, complete with automatic feed and stacking machine.

5.5 In the case of very large-scale production, it is advisable to set up an automatic line, with an automatic feed and stacker, consisting of the same types of machine, or at any rate machines having the same production capacity. In this way, the maximum performance can be got out of the machines.

5.6 It should be noted that in the case of operations on panels requiring subsequent surface finishing with a thick coat of paint (e.g. polyester resins), it is advisable to split up the operations as follows:

- Perform the squaring-up and beading operations only before painting.
- After the undercoat, carry out the sanding, drilling, broaching and transverse gauging operations.
- Lastly, apply the final coat of paint.

This avoids paint running over the edges, inside holes and on to pins, thus obtaining better geometrical precision, which is very important in the case of interchangeable furniture.

6. SPECIAL PROCESS MACHINES

6.1 The machines and lines described in section 5 are used for a basic production; that is to say, for rectangular panels with accessory operations following a modular system.

6.2 However, in normal furniture production there are also panels with special shapes (e.g., not straight edges) or that require special working (e.g., slots and various kinds of cavity etc.) to be carried out on special machines not generally found in the automatic line.

6.3 This category includes, for example, the following machines:

- High-speed milling machines for curved and shaped edges.
- Beading machines for curved edges.
- Sanding machines for shaped and curved edges.
- Non-modular multiple-spindle drilling machines.
- Machines for working drawer components.
- Squaring-up machines, like those used in automatic lines, but employed individually for production of small quantities of pieces.
- Beading machines, used in the same way as the above-mentioned squaring-up machines.
- Machines for working accessories and decorative pieces.
- Machines for work connected with the fitting of metal

parts such as locks, handles, hinges etc.

7. SANDING LINES AND MACHINES

This category includes all machines that are, in general, used for surface finishing (of wood panels) before painting, as well as paint sanding.

The machines fall into three main categories: sanding machines for plane surfaces, sanding machines for edges, and special sanding machines.

Sanding machines, for plane surfaces, also include gauging machines, since both types are, in general, similar in structure and in working principle.

7.1 Plane surface sanding machines.

These machines are of various types, as will be mentioned later on, but all of them are based on the use of abrasive paper as the tool.

- Transverse narrow-belt sanding machines.

These are the machines of least recent origin: they range from the simplest types, with manual shifting of both the workpiece and the buffer, to the automatic machines, where those operations are completely mechanical. The operative has only to load and unload the panels; even these operations, however, can be eliminated if automatic feed and stacking are provided at either end of the process.

Because of their considerable width (3000 mm and over), these machines are able to sand, whether longitudinally or transversely, with only one abrasive belt.

- Wide-belt sanding machines.

These machines are of more recent origin and can sand the panel in a direction parallel to the feed motion of the panel itself.

In general, these machines are only of the automatic type, due to their working principle.

The belt width is naturally greater than the maximum width of the panel to be sanded. The maximum width of the belt most commonly used in furniture factories is 1350 mm.

The part that presses the abrasive belt against the panel may be of two types: a rubber-loaded roller or a sliding buffer. These elements are, in general, flexible enough to be suitable for panel surfaces that are not perfectly flat, being able to perform so-called contact sanding. Some of these machines also have a mobile supporting surface that adapts itself to the panel's irregularities. Obviously, the sliding buffer is the best for the contact sanding, and much has been done to improve these buffers, which have reached a level of considerable perfection.

The main characteristic of the rubber-coated roller type is that it is less suitable for dealing with panel unevenness, since it has a marked tendency to flatten.

It is mainly used to sand solid wood panels.

All that has so far been said about the sliding buffer is obviously also valid for narrow-belt sanding machines.

As regards obtaining the best in the sanding field, for the past few years, combined machines in various forms have been available on the market. For example:

- Sanding machines with several roller belts and buffers combined.
- Sanding machines with upper belts, lower belts and upper and lower belts combined.
- Sanding machines with wide belts and narrow transverse belts, to obtain cross sanding.

The above combinations vary, depending on the machine working operations and to the degree of finish required.

- Wide-belt gauging machines.

These machines are very similar to the previous ones, but they have special characteristics, depending upon the operations they have to perform. Since the panel to be obtained must be flat and of constant thickness, these machines have relatively rigid belt-pressing parts, and are therefore almost always of the roller type.

Machines with upper or lower belts can be found on the market, but the best ones are those with an upper and lower belt combined, arranged vertically.

The advantage of these machines compared to those having a single belt is evident, since the latter can gauge the first face, taking for reference the opposite face, which is still to be gauged and, presumably, not very flat.

7.3 **Edge-sanding machines.**

Machines in this category are of the bilateral type with

parallel belts and adjustable distance, having different groups for sanding on each side.
Naturally, there are monolateral versions and non-automatic types with manual shifting of the panel, which can be used when large-scale production is not required.
The sanding groups are of various types, each having its specific application. The following may be noted: belt groups for straight, vertical or sloping edges; belt or buffer groups for profiled edges, band groups for corners; and groups with a soft grinding wheel or abrasive disc for profiled edges etc.
It is to be noted that for simple veneered plane edges, sanding-belt groups are more economical, as is the disc-type sander for corner work, mounted directly on the beading machine.

7.4 Special sanding machines.
Machines of this category vary greatly, depending on their specific use. The types include: orbital abrasive buffer, pneumatic roller, belted cylinder, frontal disc, multi-purpose, profiled disc, portable types etc.

7.5 In modern furniture factories, there is also the tendency, for sanding, to assemble various machines in a single automatic line, as mentioned in section 5 for basic operations.
These lines are normally composed of the following machines:
- Automatic feed with motor-driven roller bench.
- First automatic sanding machine for working surfaces with top belts.

- Star-type turnover device, or equivalent, for turning the panel over on its other side, for sanding.

This system is preferable to the one without a turnover device and a second lower-belt sanding machine, since it allows for visual checking of the sanding operations on both sides.

- Second automatic sanding machine for working surfaces with top belts.
- Automatic longitudinal sanding machine for edges, with panel-turning device.
- Automatic transverse sanding machine with aligning device.
- Automatic stacking machine with motor-driven roller bench.

Table "D" shows an operating line like that described above.

8. PRE-ASSEMBLY MACHINES

8.1 Pre-assembly operations are those operations that are carried out on each individual panel after all finishing operations and before final furniture assembly.
Of these operations, the following may be mentioned: fitting of hinges, drawer guides, insertion of pins and joining devices for furniture that can be dismantled, locks, handles, decorative parts, nuts and bolts etc.

8.2 These operations, which have traditionally been performed manually, have been given careful consideration by machine designers, with a view to solving the considerable labour problem they represent, and consequently the

question of the production costs incurred by manufacturers.

In fact, due to the considerable progress achieved in the various working and machining departments, manufacturers are now in a position to have 60% (in some cases as much as 80%) of the factory staff employed in the final departments: that is to say, in pre-assembly, assembly, cleaning and packing.

8.3 There has consequently been a considerable proliferation of special machines to carry out those operations, and parallel to this, new hardware, specially designed for fitting mechanically, has been introduced on to the market.

8.4 Here is a description of some machines in this category:

- Hinge-fitting machines.

  These generally consist of a bench for clamping the panel and equipment for insertion under pressure, with automatic feed of the hinges. If hinges have to be fixed with screws, automatic screwdrivers are fitted, complete with automatic screw feed.

- Machines for fitting drawer guides.

  These consist of a bench for clamping the panel and equipment for inserting the guides, under pressure, in appropriate slots in the panel, with automatic guide feed.

  The machines can be equipped with automatic screwdrivers, as mentioned before, if required.

- Pin-fitting machines.

If this operation is not carried out in the line for any particular reasons, gluing and insertion of the pins is effected by automatic revolving insertion devices, which also automatically apply the glue.

- Lock-fitting machines.

The working principle is similar to that described for hinge fittings.

- Machines for fitting joining fixtures for furniture designed for dismantling.

The working principles vary, depending on the type of joint to be fitted. In most cases, fitting is effected by pressure. These machines are very much in demand, because of present tendency to produce dismantlable furniture, due to its obvious economic advantages, whether in production or in packing and transport.

8.5 In some cases, machines in this category have been further improved by equipping them with machining groups that make the slots in which fixtures or accessories will be fitted. This means that two machining passes are reduced to only one.

A further improvement is obtained by equipping the bench with automatic handling and clamping devices. In this case, all panel-moving operations, clamping, working and assembly are carried out automatically. The machine can thus be inserted in an automatic pre-assembly line.

9. ASSEMBLY LINES AND MACHINES

9.1 Recent years have seen the introduction into the furniture industry of the assembly line, on which not only all assembly operations are performed, but secondary and accessory parts are also fitted.

The line consists mainly of the frame assembly machine and the motor-driven conveyor (for conveying the frames), at the sides of which stand the staff whose job it is to complete the furniture.

9.2 Frame assembly machines.

These machines are used only in cases of non-dismantlable furniture, since, in the opposite case, the furniture is not assembled at all, or is assembled directly on the motor-driven conveyor.

The simplest machine in this category is the fixed pneumatic press. With this machine, however, frame production is relatively low because of glue-drying time.

- Machines that overcome this drawback fall into two categories: those based on several frame-pressing positions (multiple presses), and those based on reduction of the necessary glue-drying time.
- Multiple-position machines are nothing else but several mobile presses, combined in a single machine, which increases production as many times as the number of positions.
- Rapid pressing machines, on the other hand, consist of ordinary presses, but with the addition of subsidiary equipment that promotes rapid glue-drying such as:

high-frequency generators, metering of heat-melted glue etc.

In some cases, these machines reach a considerable level of complexity when they incorporate a system for handling the frame panels: for example, machines that use the FOLDING system, initially used only for drawers and now extended to all furniture frames.

3.3 Assembly line. The machine, in this case, is a simple belt conveyor or a rolling conveyor (with continuous or cyclic motion) whose only job is to move the frames in front of the various positions, each of the latter being equipped for a specific operation.

The operations normally performed are as follows:

- Removal of residual glue.
- Door assembly, which just means connecting the half-hinges previously fitted.
- Drawer assembly and adjustment.
- Fitting internal shelves and partitions.
- Fitting handles and accessories.
- Applying decorative parts.

For the efficient operation of an assembly line, the main problem is the rationalization of the operations to be performed, of the necessary units of time and of the equipment (generally portable) of each individual assembly position.

Generally speaking, an assembly line has a production of

150-200 furniture units per day (for the commonest lines) and it can produce as much as 300 or more units per day (for well-equipped lines and relatively simple units).

10. PACKING LINES AND MACHINES

10.1 Packing operations also include cleaning, labelling and padding for protection, as well as the fitting of separate parts and accessories such as clothes rods, shelf supports, and connecting screws for interchangeable furniture. Given the variety of types, shapes and sizes of furniture, machines of this category are still at an experimental stage, except for those special cases in which proven techniques from other fields have been introduced with success in the furniture industry.

10.2 As regards cleaning machines, the main problem is that, in general, external furniture surfaces, whether painted or faced with synthetic resin sheets, are electrostatically charged and attract the dust.

Much is being done to solve the problem, but it is to be expected that the cleaning of assembled furniture will always be done manually, even with the aid of portable devices to make the operation easier.

- With regard to the cleaning of panels, there are automatic machines (which can be inserted in the assembly line) that effectively clean and degrease by means of brushes, buffers saturated with solvents, and felted

rollers or the like, depending on specific needs.

10.3 Packing machines fall into the following two classes: those that, by mechanical means, put the product in the traditional corrugated cardboard box, and close it, and machines that use a different system.

- Machines that close the open sides of the box by means of adhesive tape or clips, belong to the first type; machines that turn over the box, which is already closed on one side, to close it from the opposite side, labelling machines etc. also belong to the first type.
- Machines that use, as a packing material, a thin film of plastic heat-shrinking material, belong to the second type. These machines are fully automatic, including the shifting of furniture to be packed.
  They consist mainly of: a first section, where the furniture is wrapped in heat-shrinking film, which is sealed, and a second section, which performs the heat-shrinking operation.
  This system, only recently introduced into the wood industry, is very suitable for certain types of furniture, especially upholstered furniture, while it presents some drawbacks with other kinds of furniture with sharp corners, which are also relatively fragile. It should be noted, however, that the system has certain advantages, such as absolute impermeability to

to external factors, the transparency of the material, which enables the packed furniture to be seen, and, lastly, the fact that it saves labour.

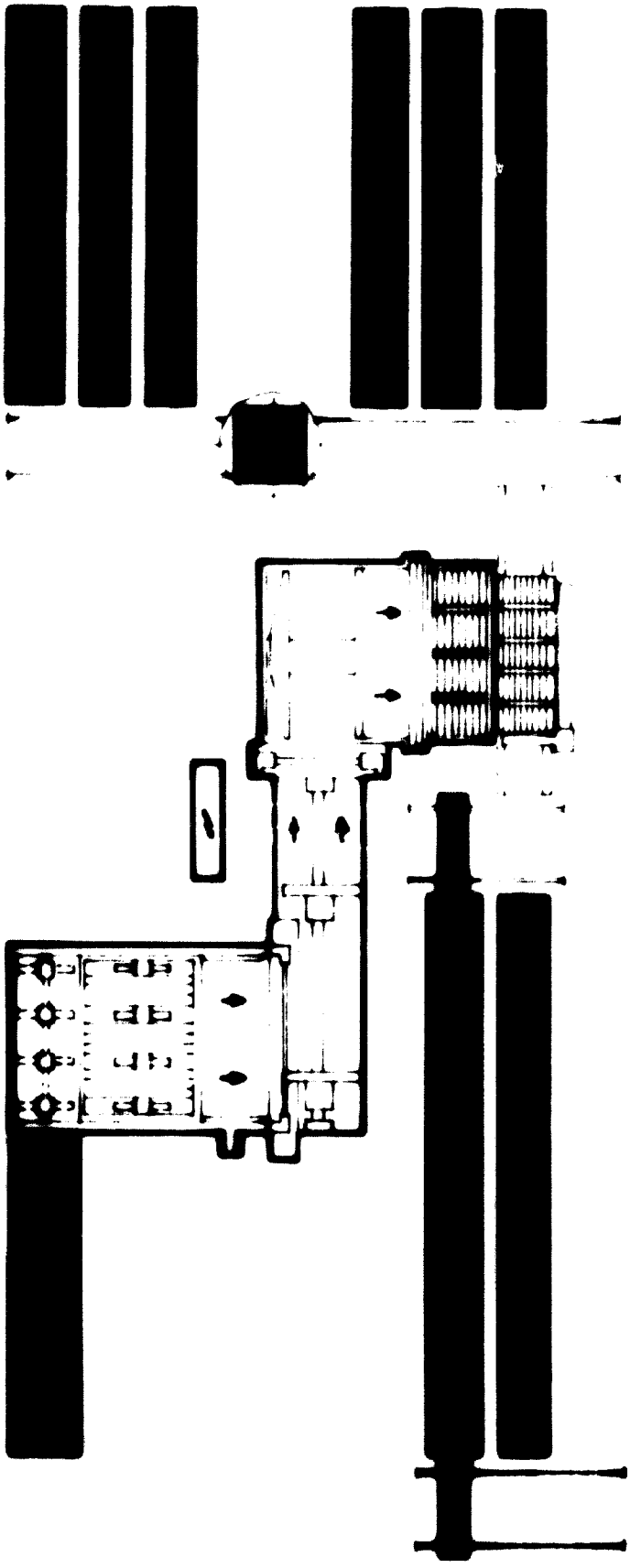
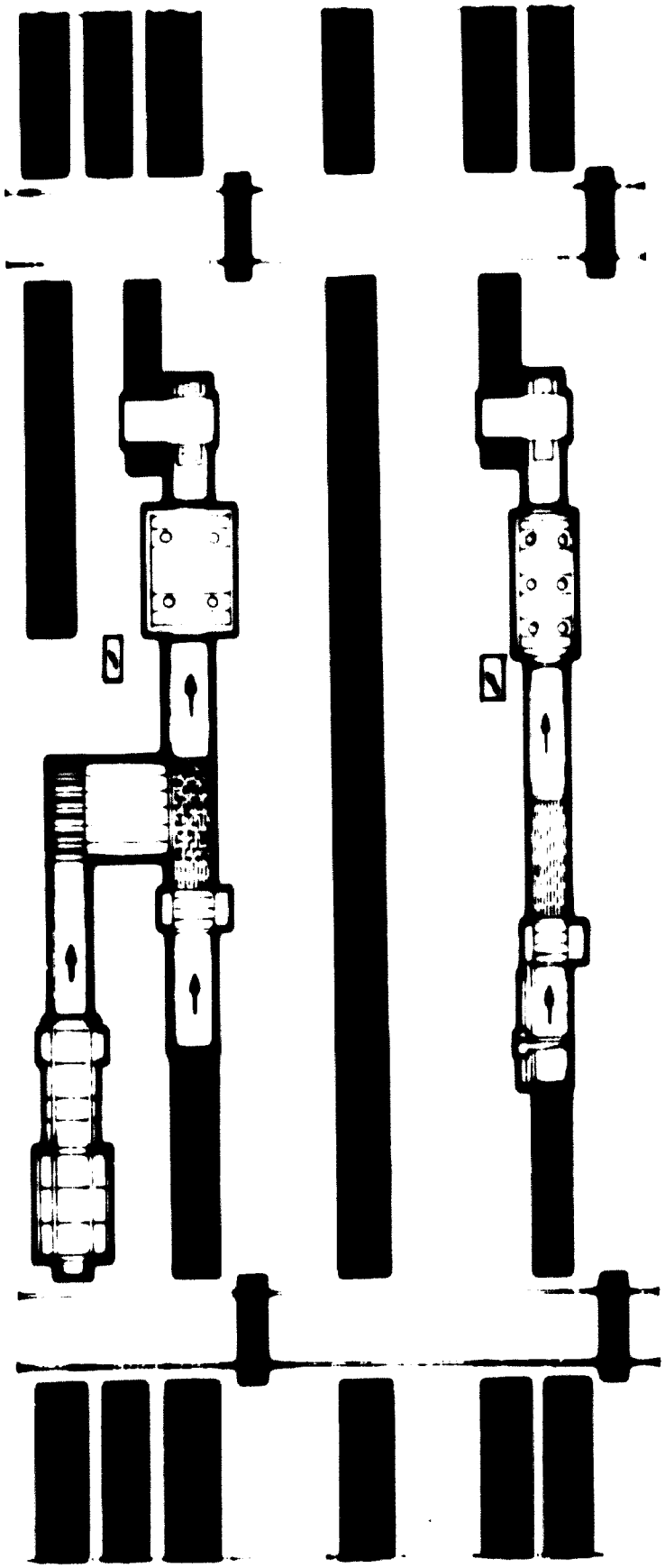


TABLE "A"



PANEL "D"

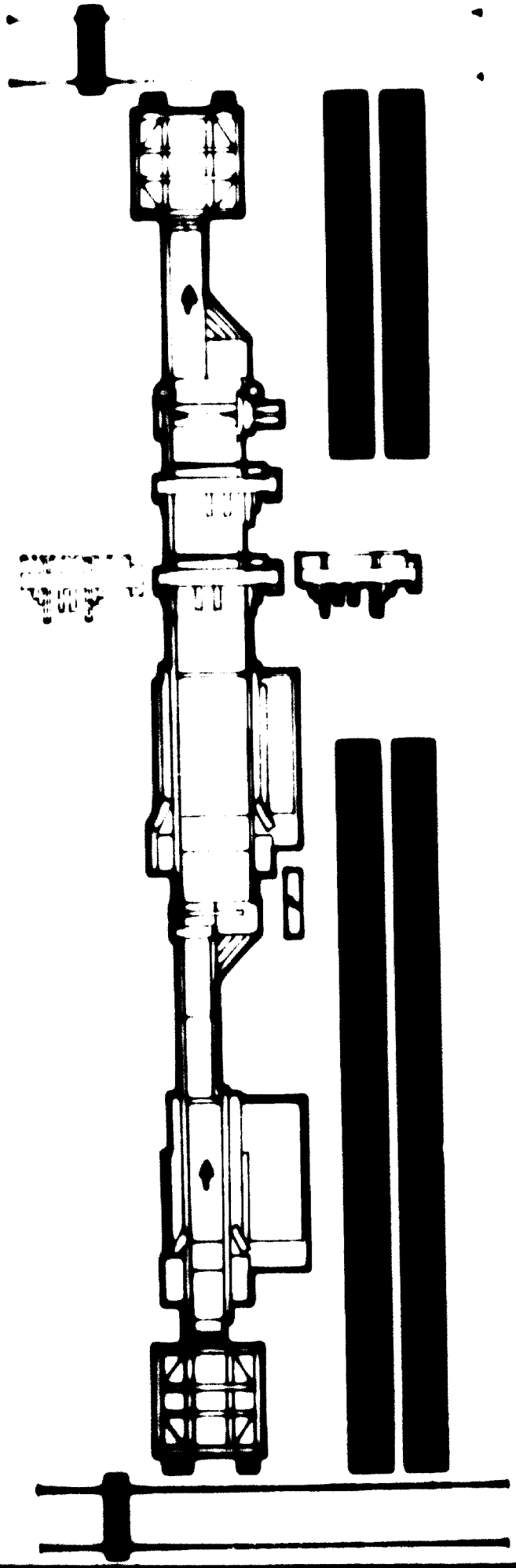
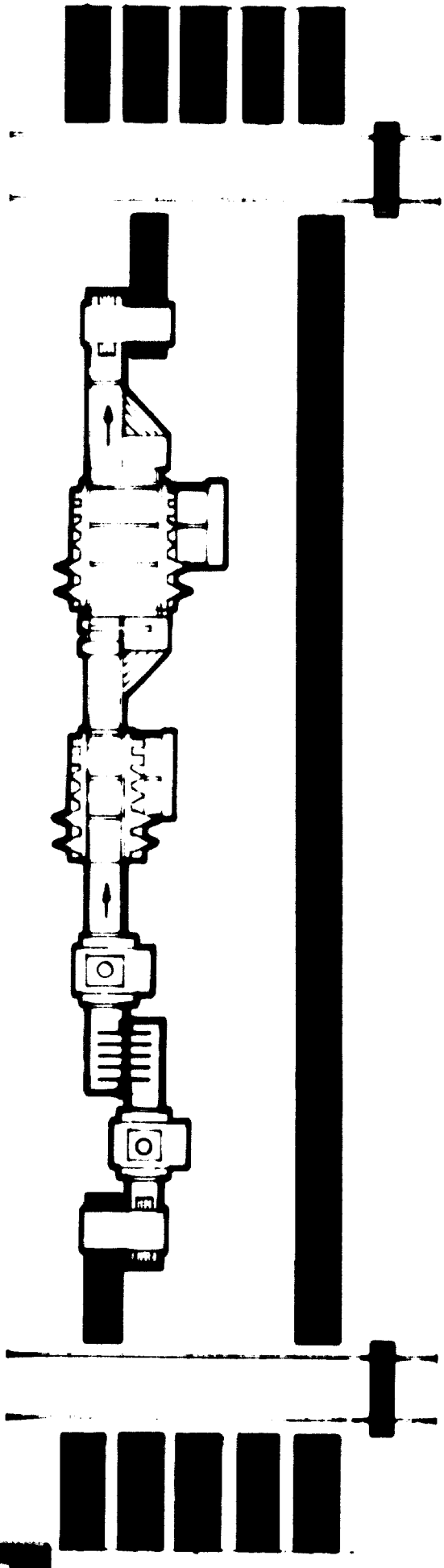
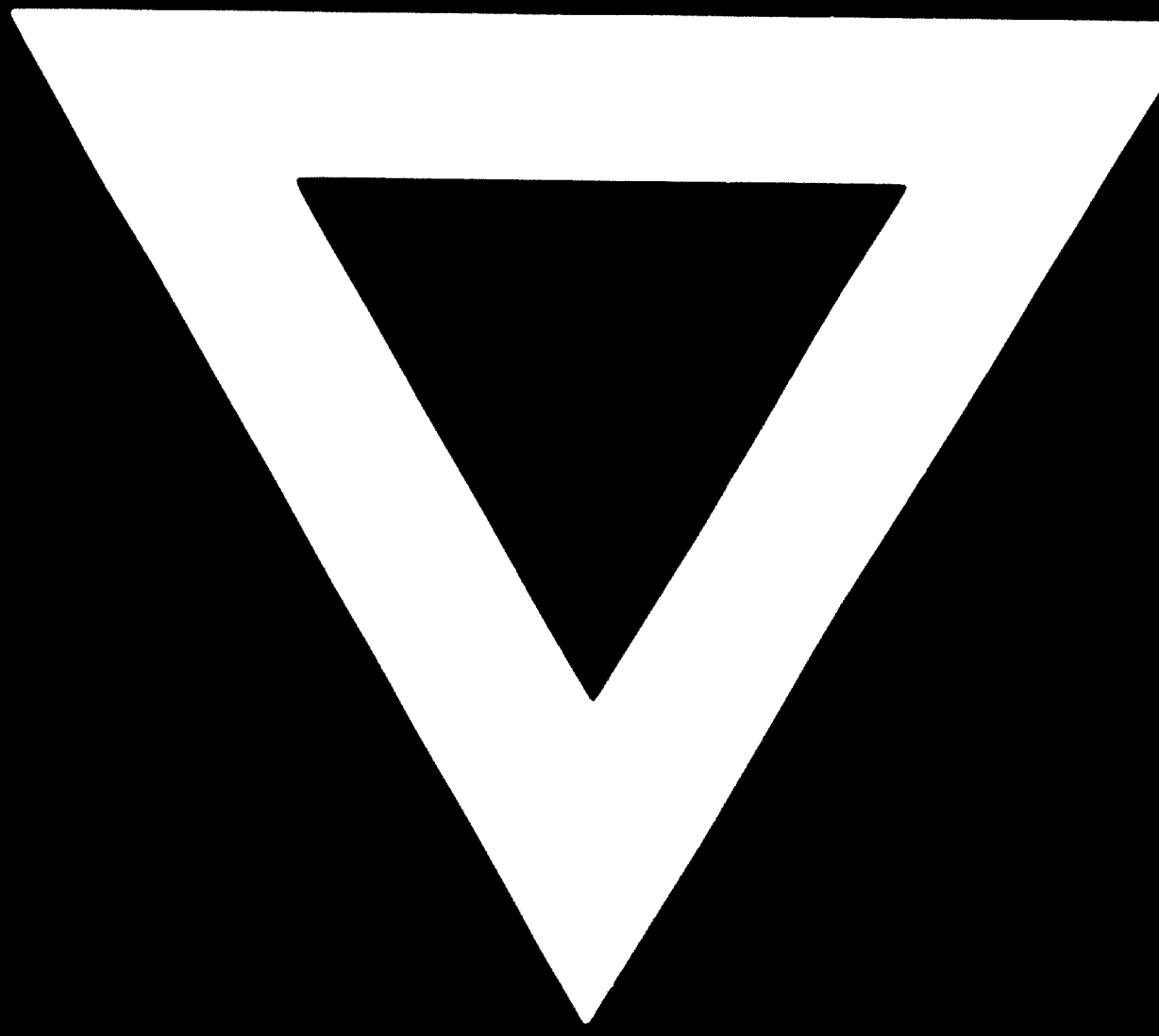


TABLE "B"





76. 06. 30