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PREREQUISITES FOR THE ECONOMIC EVALUATION OF FLUSH DOOR PANEL TO FRAME OPERATIONS *

by

Mr. Grimme**

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CONTENT

Introduction

Before discussing details of flush door manufacturing equipment used in industrial door production, basic facts have to be clarified and calculated before start-up of the door production.

1. Raw material requirement

The following description is based on a standardized door according to DIN-Standard ..18101.

A flush door is assembled in a panel to frame operation:

- bottom panel;
- frame with core material;
- top panel;

1.1 Frame and core construction

The frame is assembled by stiles and rails of a good quality of lumber straight grained to avoid stresses and with a moisture content of 10 to 12 per cent.

The selection of the core material is one of the main criteria in connexion with the panel material. Well known is in industrialized countries the honeycomb core which is best suited for an even and smooth surface.

Further advantages of honeycomb cores are:

- good support of the panels;
- sound and heat insulation;
- low door weight.

The smaller the honeycomb cell the better the support of the panel necessary for all which guarantees high subsequent panel surface machining operations. But considering the availability of core material in developing countries, solid wooden strips, chipboard or hardboard strips can be used to form a good core system. Sound

quality and stability is comparable to a long honeycomb core but the door itself will be heavier. This type of door proved to be satisfactory in service and is still much lighter than the solid door construction. The outer plywood face (three ply) or hardboard face should be of 4 mm (1/8") thickness.

The core system varies according to the materials available:

- ply or cardboard tubings;
- box type cardboard;
- expanded veneer strips;
- spiral wood;
- extruded chipboard;
- lumber strips;
- block cores.

1.2 Panel material

Selecting the door panel depends upon the material available:

- plywood;
- hardboard;
- chipboard;
- lamin skin.

Panels must be available in a sufficent quantity to guarantee a continuous production. But a price comparison should be made when different materials are available. Other features, viz.:

- paintability;
- machineability;
- veneering

can be of importance when considering the various markets.

The highly compressed hardboard is more resistant to moisture and has a good even surface. Chipboard is more sensitive to moisture and its surface is not as even as hardboard and lower in weight. Because of coarse chipboard structure the edges can hardly be painted or finished. Hardboard, because of its dense structure is suited

better for door panel material than chipboard or plywood.

Whatever the selection of panel material will be a high surface finish on the 3-layer door is important especailly when face veneering will be applied. Face veneering of flush doors requires high accuracy in production. A calibrating sanding operation should precede the veneering operation.

Flush door manufacturing is not complicated but the process applied is so manifold in connexion with the different materials so that the individual production needsto be well organized to establish an economic operation.

2. Selection of pressing equipment in dependance of the adhesives to be used

The development of press systems for flush doors has grown parallel to the demand of

- high quality of the product;
- high bonding requirements for the panel to frame construction;
- cost of adhesives;
- economic production.

The range of press systems from the machanically operated blockpress, introducing hydraulics, adding loading and unloading units; from single daylight presses to multi-daylight presses and automatic cycling daylight presses with feed belt system.

The investment costs ranging from DM 100.000 to 1,500.000 depend on the stage of automation.

2.1 The block pressing process (Annex 4.1) or(cold press process)

The door production is based on the cold pressing process. The door elements are set together at the lay-up station in front of the press. Laying the panel - the frame - inserting the core material and laying the panel in top is done manually.

The plant consists of:

- roller glue spreader;
- disc roller way;
- lay-up trolley;
- hydraulic block press;
- outfeed roller way.

The panels are glue spreaded, pass the discroller way, laid up with the frame/core and stakced in front of the press. For easy loading of the press roller bars are mounted to the lower table which drop down while pressing.

The advantage of the block press system is the low investment of DM 80,000 to DM 100,000, simplicity of operation, no heat required. A disadvantage is that the cold glue transfers a certain amount of moisture into the panel which causes rizing grain which does not allow for the settlement of the panel surface. Curing and hardening of the glue takes a long time, sometimes even after the finishing operation. This means that the whole door can undergo changes causing tension and cracking on the panel surface. The cold pressing process requires for a mixture of urea-formaldehyde and PVAc adhesives compared to the hot press process where ureaformaldehyde with hardener is used.

This means higher adhesive costs in the cold pressing process compared to the hot pressing process and the door is not water resistant.

When applying the cold press system on piled door stacks the sizes have to be the same of each rough blank.

2.2 The hot pressing process (Annexes 4.2, 4.3, 4.4)

The hot pressing process is the most applied technology in door production and is used in

- multi-daylight presses with manual loading and unloading;
- multi-daylight presses with automatic loading and unloading devices;

- cycling single daylight presses with endless feed belt system.

Before comparing the multi daylight press and the automatic single daylight press the adhesive technology applied has to be mentioned once more as under the influence of temperature an absolute fixing of surface swelling takes place as well as an absolute drying out of the door as a consequence of adhesive curing. The mixture of urea formaldehyde with built-in hardener is less expensive than that applied in cold pressing.

The door is pressed at a temperature of 105 degrees C. at a relatively long press cycle of 2.5 to 3 min. When doors are pressed under a higher temperature, evaporation in the hollow core system leads to collapese or blow-out of door panels. The temperature should also, if possible, be raised slowly to build up a temperature balance in the door to avoid evaporation.

At this stage one should assess the different press systems: the technology of the multi-daylight and the automated single daylight press.

At a 10 daylight press (Annex 4.2) the open time is very long. The doors are resting relatively long in the assembled stage without pressure and temperature. Assuming that in this system a door is laid up in 15 seconds face veneer - panel - frame/core - panel - face veneer, the open time will be approximately 3 min. while the first door is laid up longer and thus has a longer open time. A long open time can cause curling the face veneer which means that the door cannot be loaded without a hold-down attachment. In case of the multi-daylight press one has to add the mechanical dead time which is more than 30 seconds which results in a final open time of 4 min.

2.3 <u>The automatic cycling single daylight press</u> (Annex 4.3)

In the development of presses for panel to frame operations as in the flush door production, or veneering of full-size particle boards, the manufacture of blockboard, plywood or furniture components, lamination of particle boards, plywood or other core material, the automatic cycling single daylight press with endless loading and unloading belt achieved high performance within the secondary wood

processing industry and has some advantages which should be mentioned:

- panel to frame operation of various sizes in flush door production (flexibility);
- avoiding different load of different sizes;
- loading area in front of the press;
- door assemblies and similar products are fed in by an endless conveyor belt separated from the conveyor belt within the press area but with synchronous speed; As soon as the press belt stops the pressing operation starts within two seconds at equal load to all components of the charge which is important for settlement of each door panel;

The longer the length of the press area the longer the open time of the door material. In case of a five ply door with high quality face veneers a water atomizing device is built in to spray an even wet layer to the veneer surface.

The result is the wetness balance of the face veneer glue spreaded on the bottom side and wet sprayed on the top side to keep the veneer flat and even.

The automatic single daylight pressing process has the advantage of simplicity but is equipped with a complicated infeed and outfeed device.

The press does not need any pit or heavy foundation. Operators have not to change any position; they remain at the assembly station between the disc roller at the end of the glue spreader and the press.

The automatic press system does not require any skilled labour or maintenance.

2.3.1. The conveying system for the automatic single daylight press

Because of a long open time fibre swelling is caused, which as a consequence, will lead to long pressing cycles in order to achieve the fixing of the swelled fibre. When pressing doors of varying width, the specific load varies which is caused by loading from one side. To

cite
size an example: in case of a door width of 930 mm in the lower or upper daylight the pressure is adjusted at 2.5 kp/cm2. If other daylights contain doors of 630 mm or 730 mm width, the specific load will be higher than on the door which is 930 mm wide.

These pressing systems are mostly not equipped with a simultaneous closing adjustment, this means that the total weight of the upper press platen and doors will rest on the lowest door. The result is, that rails and stiles of the frame show through the face panel. Thus, in a multi daylight press will be doors of varying quality. The efficiency and capacity of a multi daylight press is very low because of a long press cycle.

The conveying system has already been mentioned but has to be detailed for better understanding:

- the infeed station;
- the pressing station;
- the outfeed station.

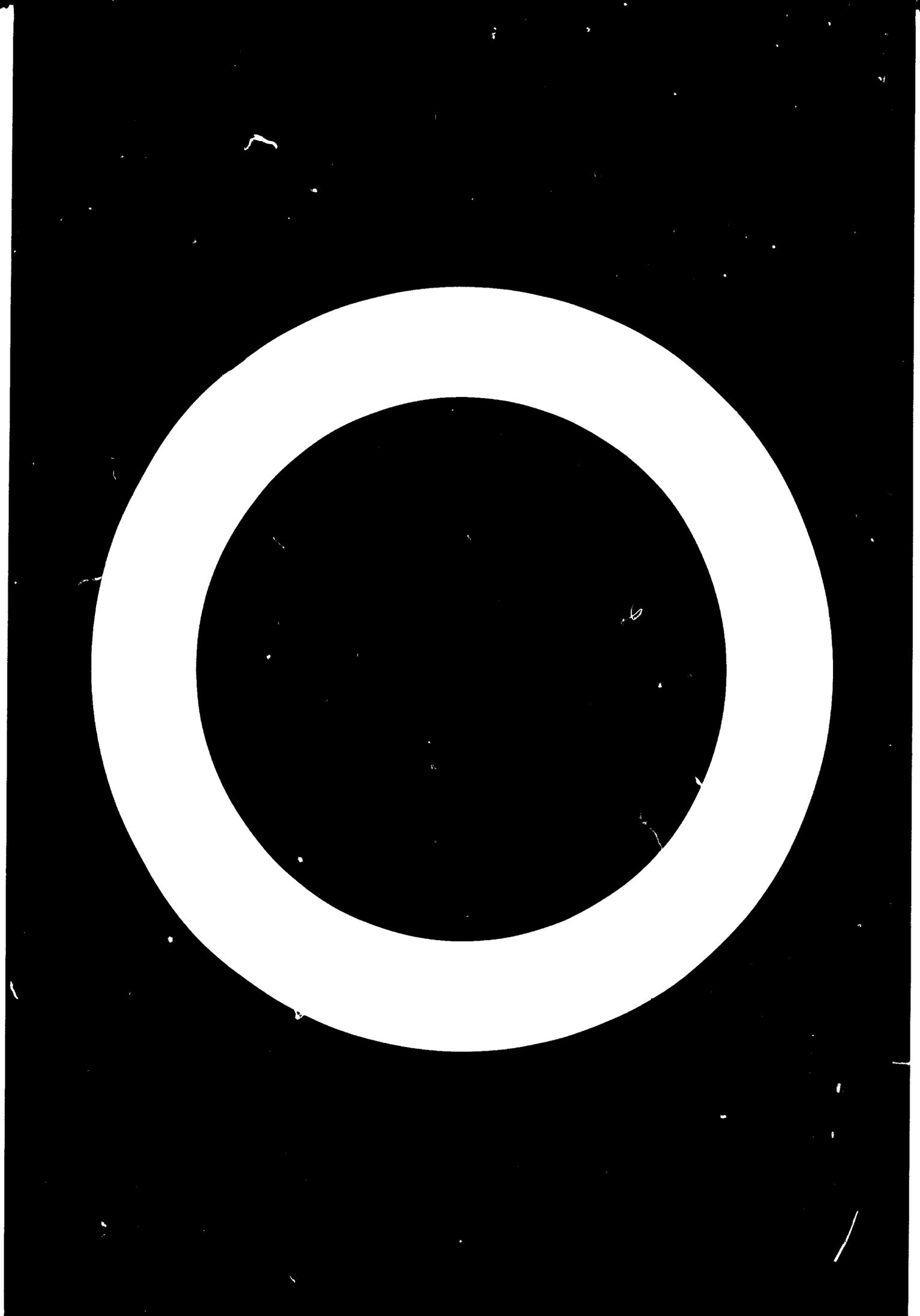
The feeding station does not differ much when instead of a single daylight two, three or four daylights are built in. A double daylight press with automatic in and outfeed devices is shown in Annex 4.4 which includes a travelling loading unit. This system is, however, reasonable when the individual press units are operating with up and down stroke action - the centre plate has a fixed position. Logically, such a press can operate on the base of two daylights only. If pressing units of three, four or five daylights are used double side pressing action cannot any more applied which results in the same disadvantages than on a multi-daylight press.

The advantage of the automatic single daylight press is the possible installation of the modular system with two, three or more presses side by side to increase the production capacity.

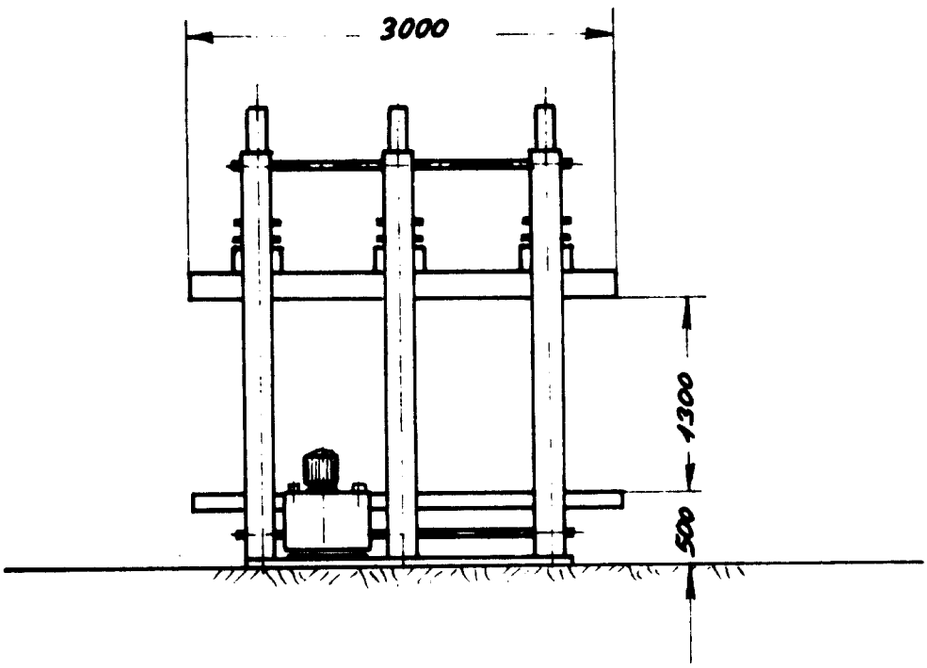
Since the investment costs are very high the operation structure has to be discussed in detail.

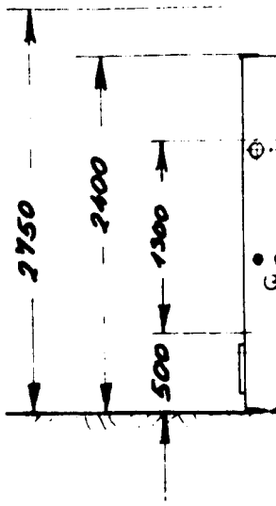
3. Summary

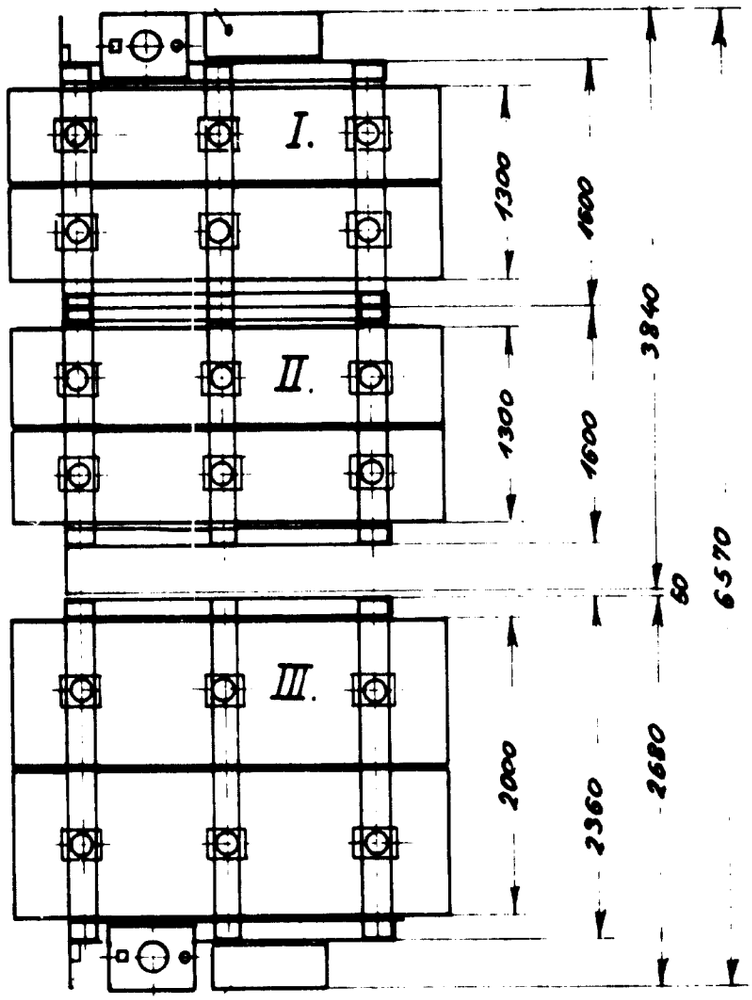
Whenever planning the production of flush doors, the capacity will influence predominently the selection of the equipment and technology to be applied. But in any case, most of the flush door productions in developing countries are based on their material resources which do not justify the use of honey comb core material at the start up. Comparable flush door quality can be based on strip or spiral cores. In both cases a huge amount of waste material can be used to build up an industrialized production with an intermediate technology.



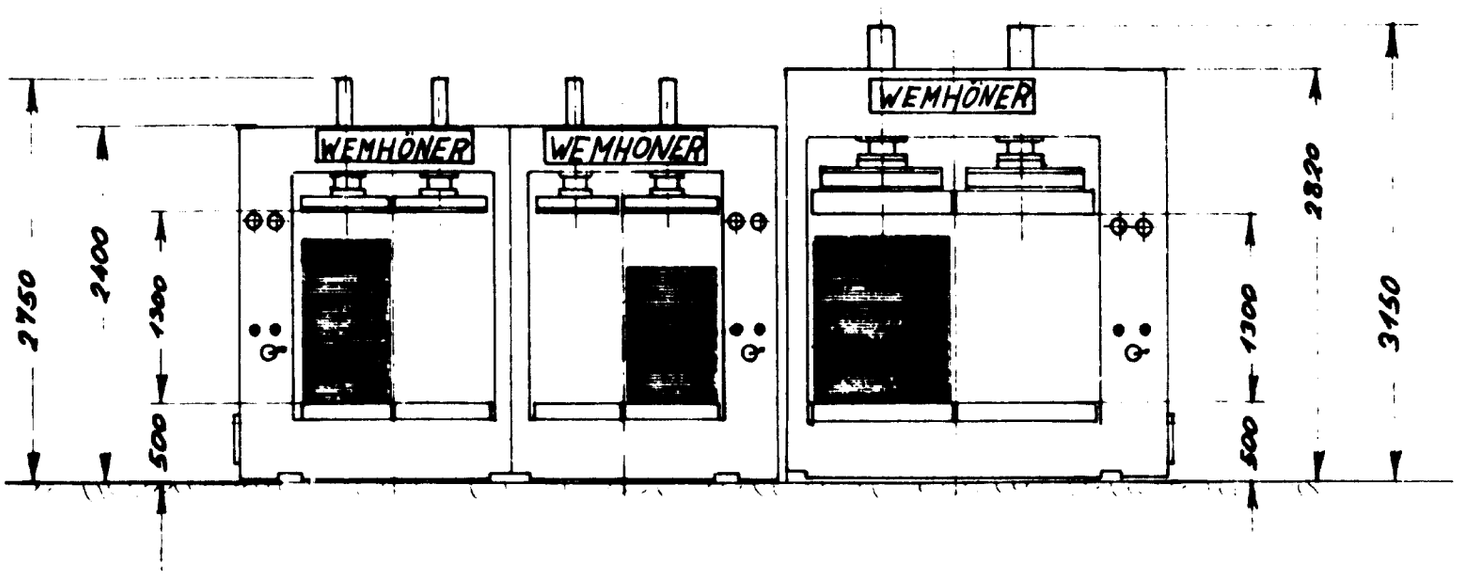
ANNEX 4.1 - THE BLOCK PRESSI

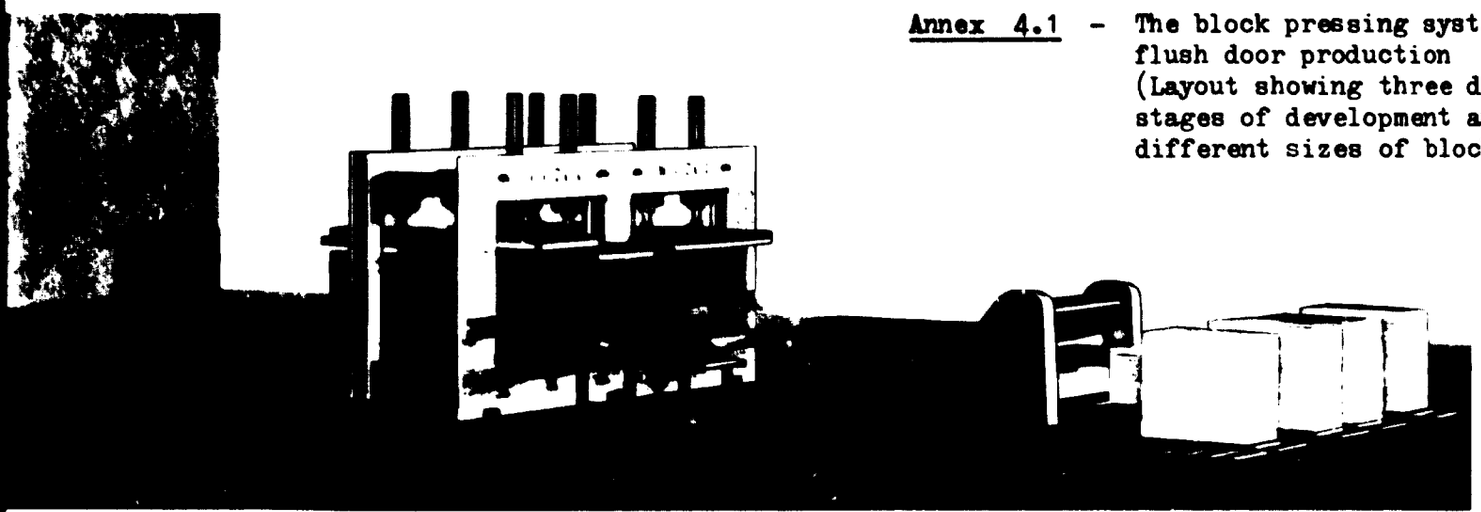




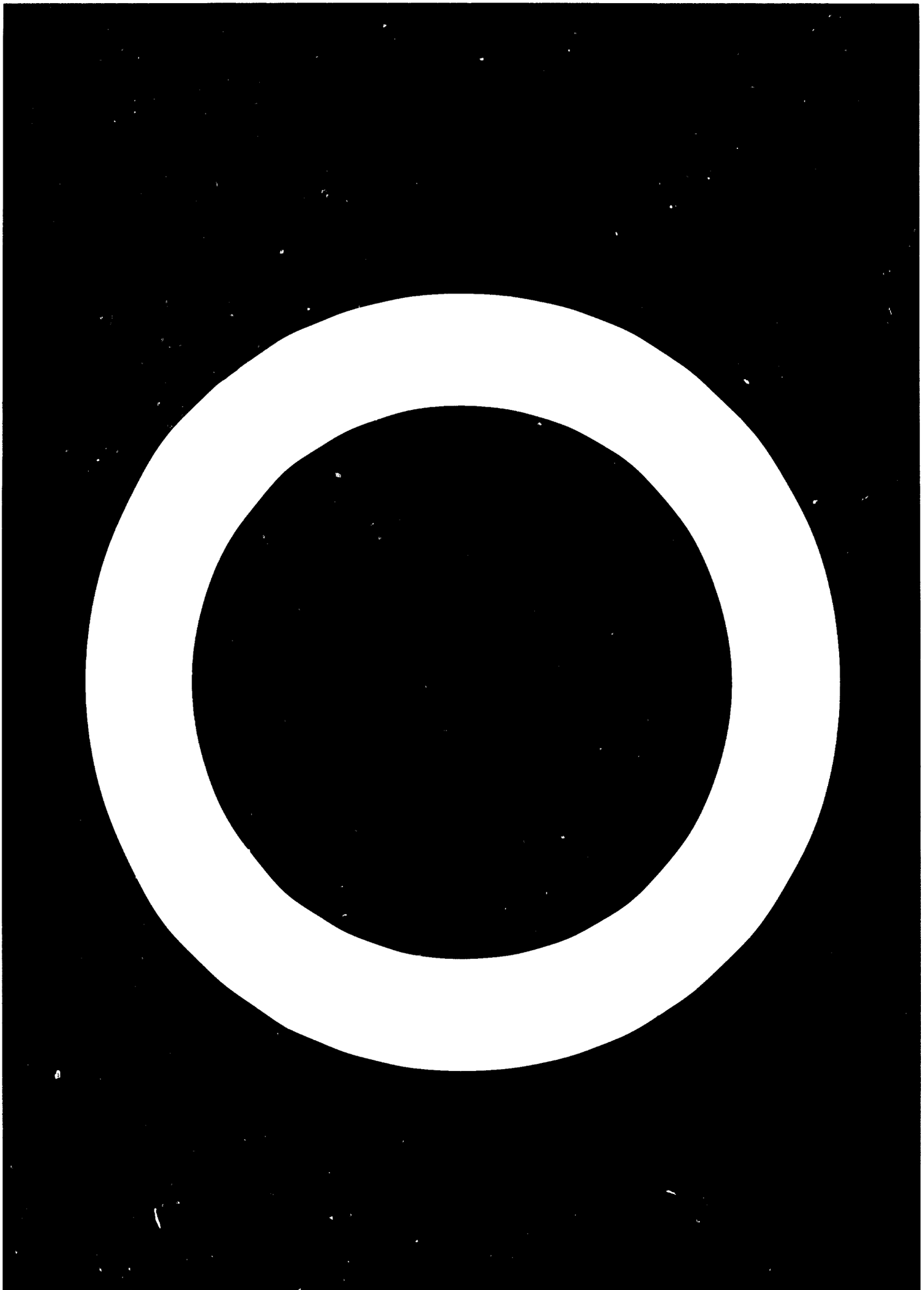


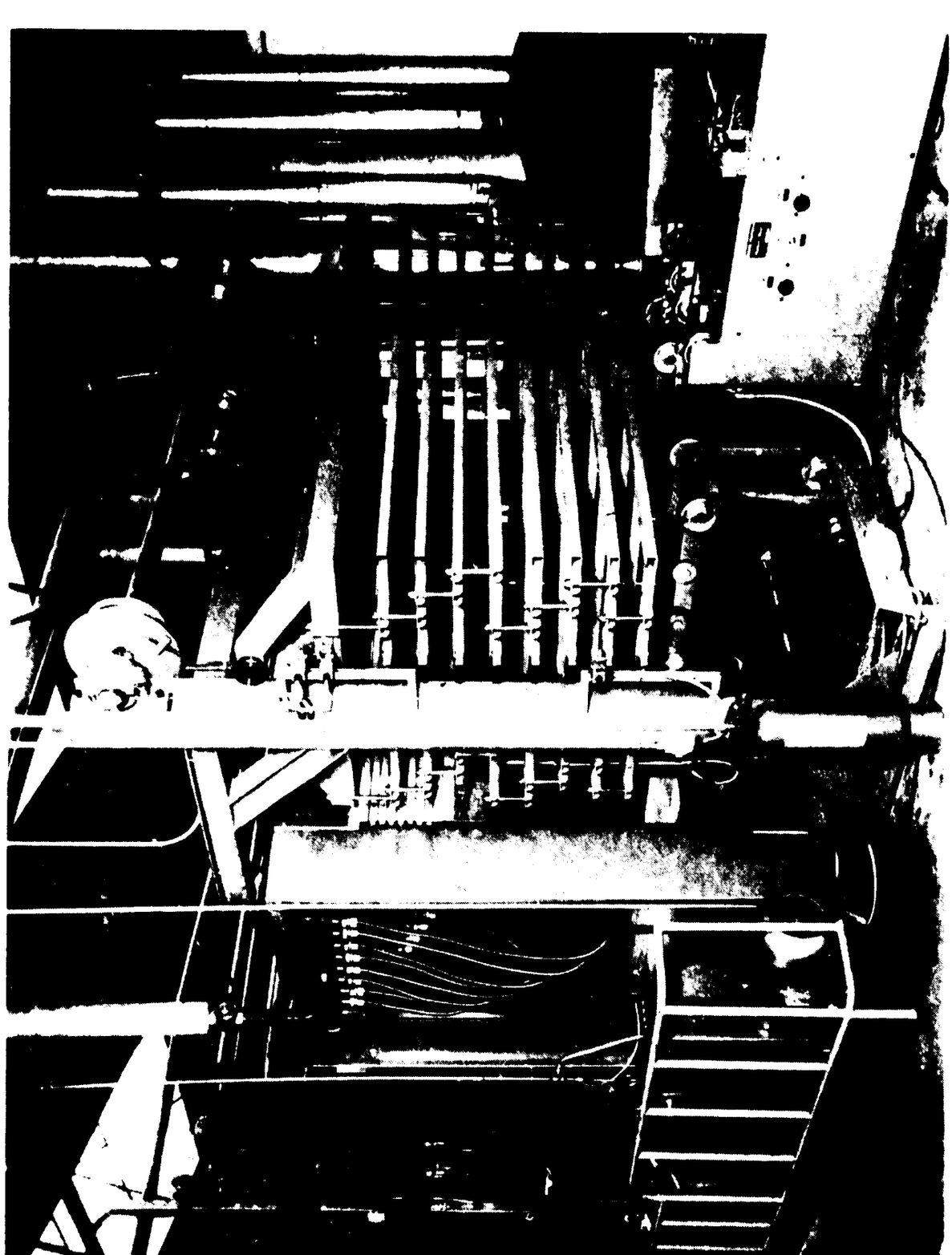
EX 4.1 - THE BLOCK PRESSING SYSTEM



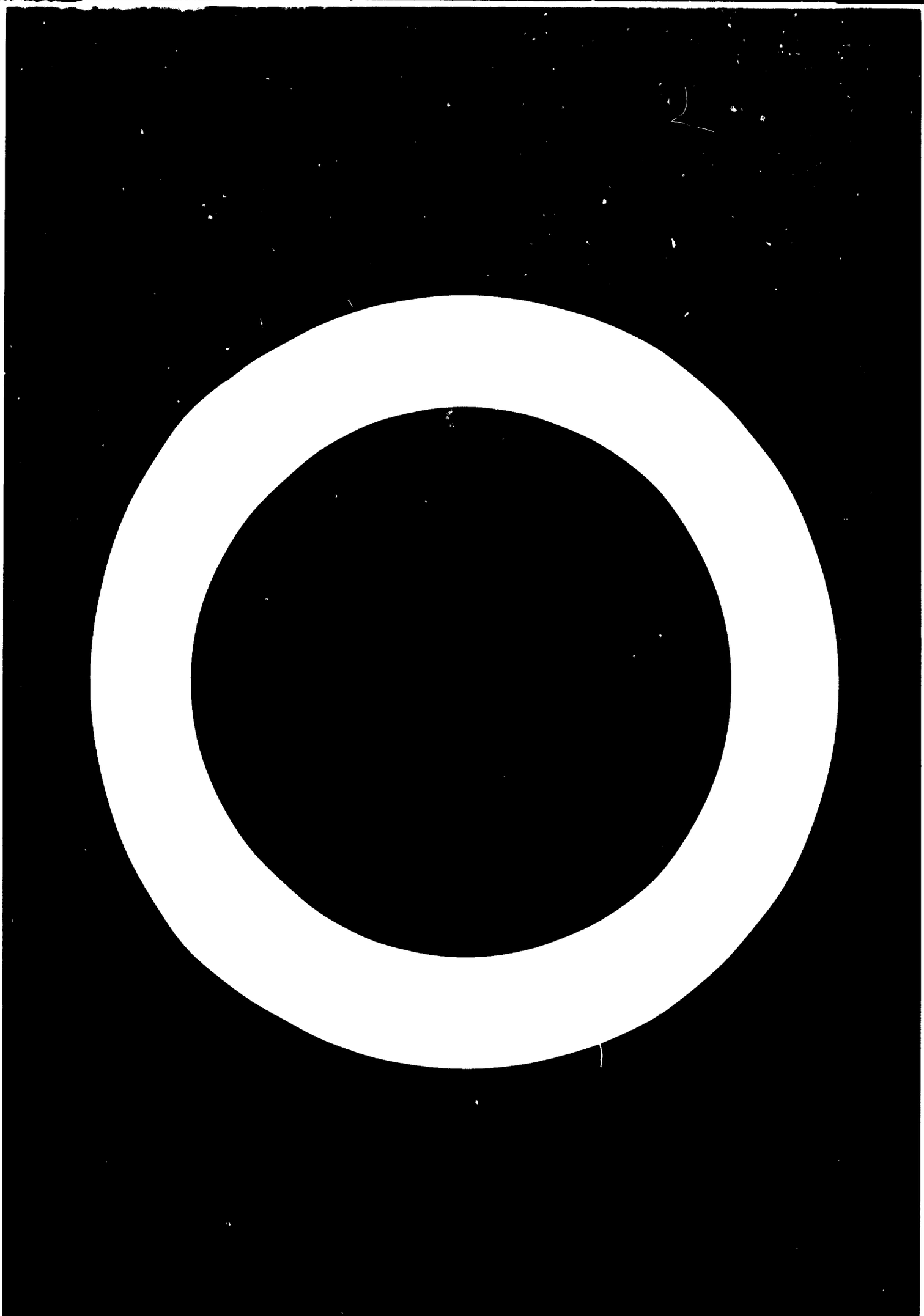


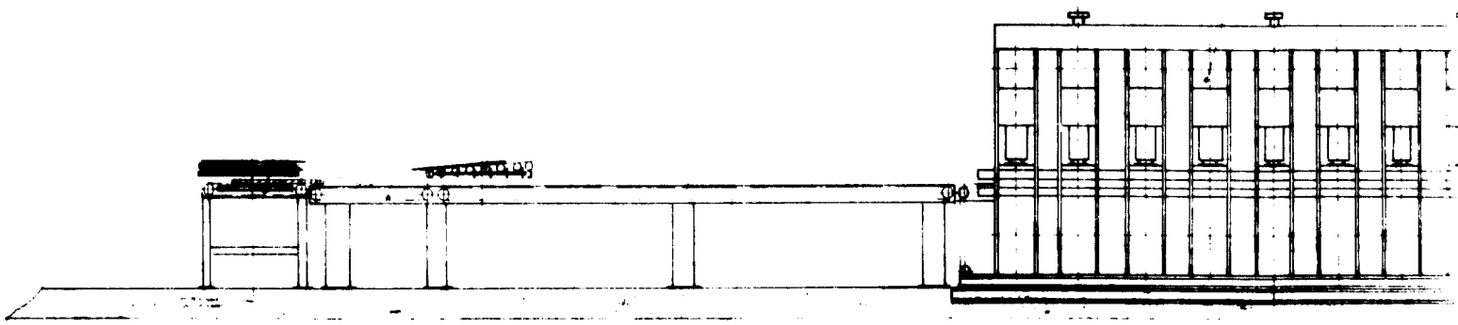
Annex 4.1 - The block pressing system for flush door production (Layout showing three different stages of development and different sizes of block presses)





Annex 4.2 - The multi-daylight hot pressing system (Close up view of infeed loading system)

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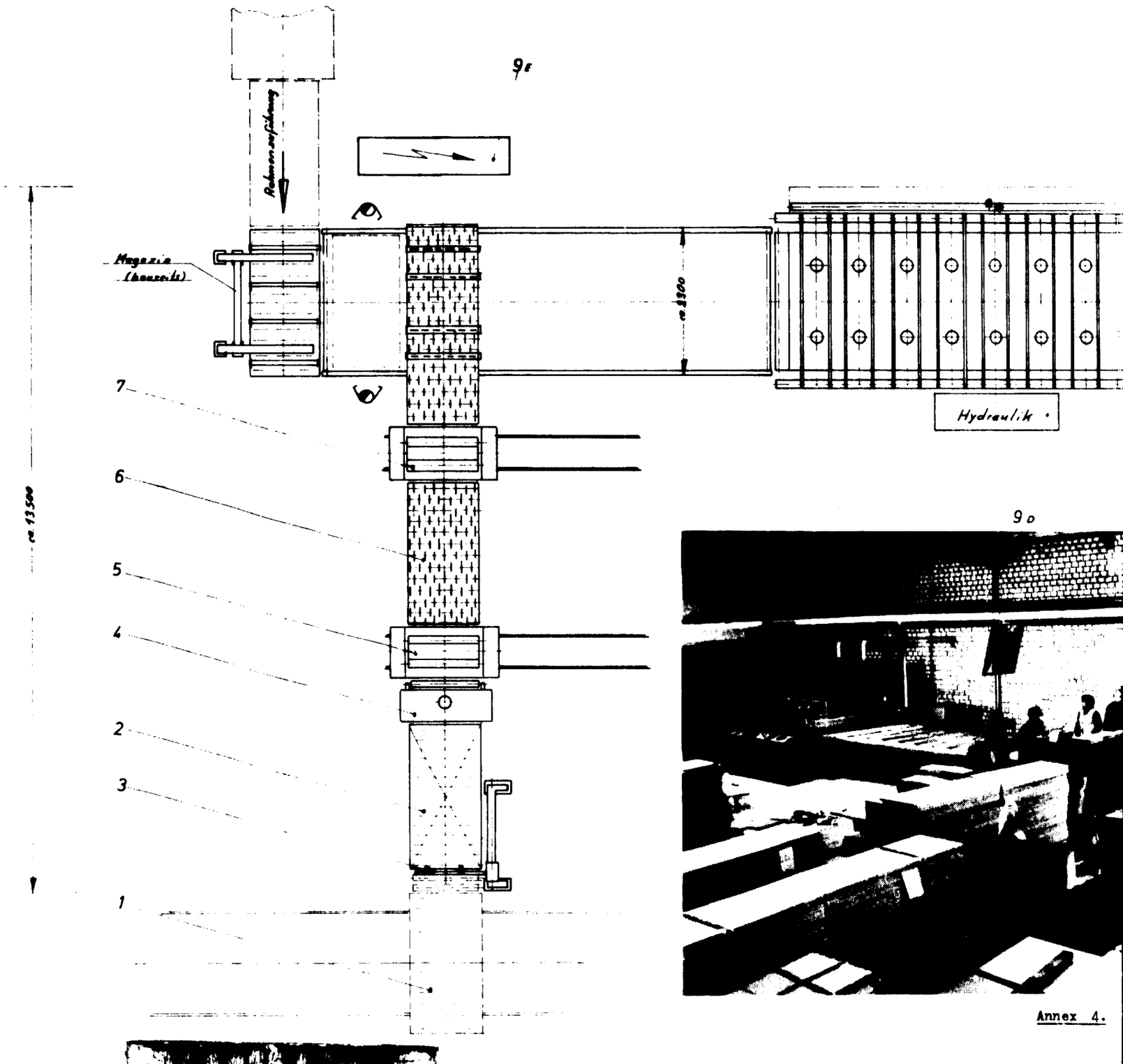
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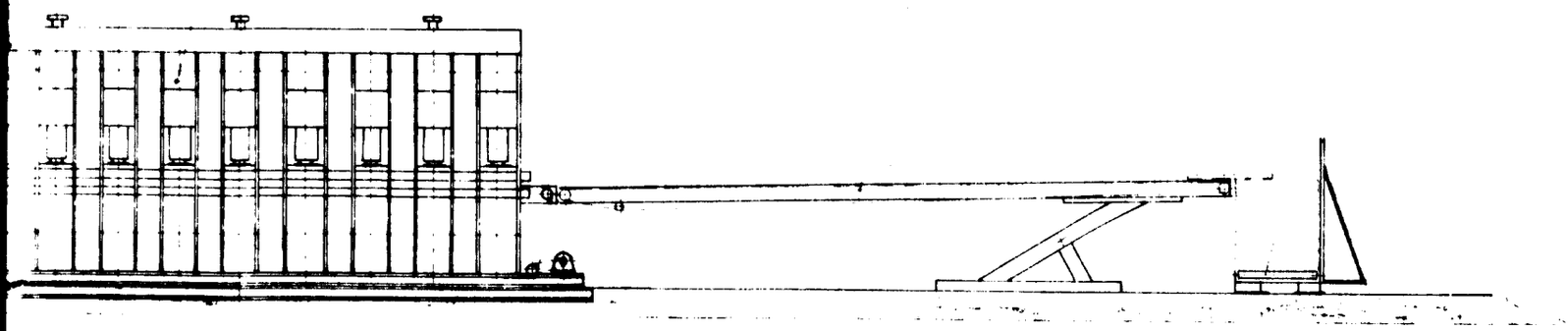

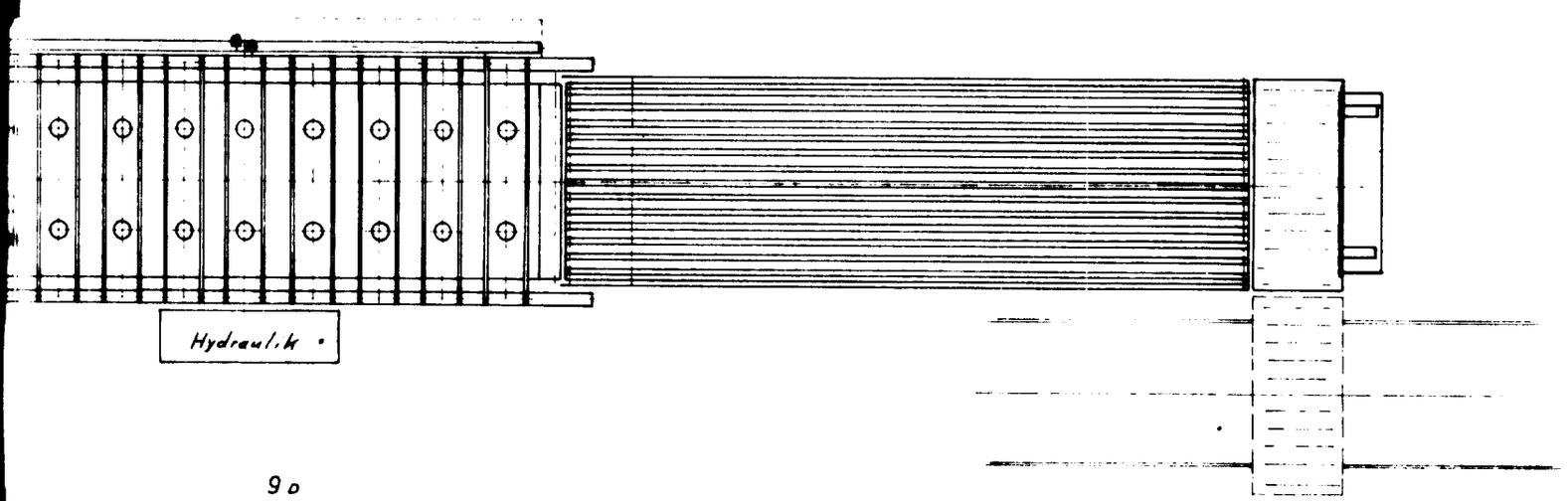

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Annex 4.3 - Installed automated cycling single daylight pressing line

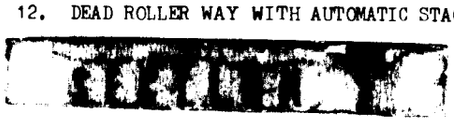
ANNEX 4.3 - LAYOUT OF AN AUTOMATED CYCLING SINGLE DAYLIGHT FLUSH DOOR PRESSING LINE

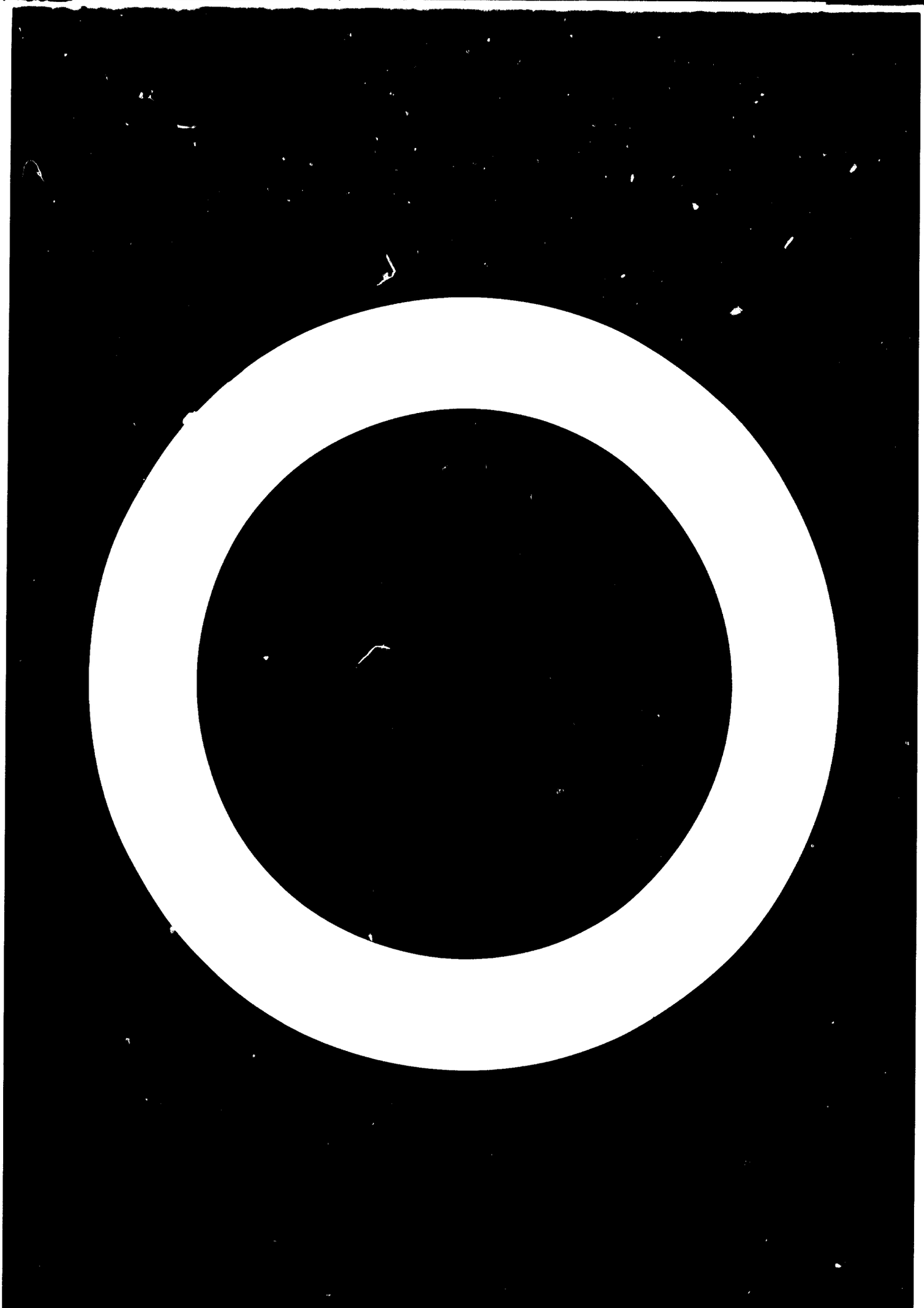
LEGEND

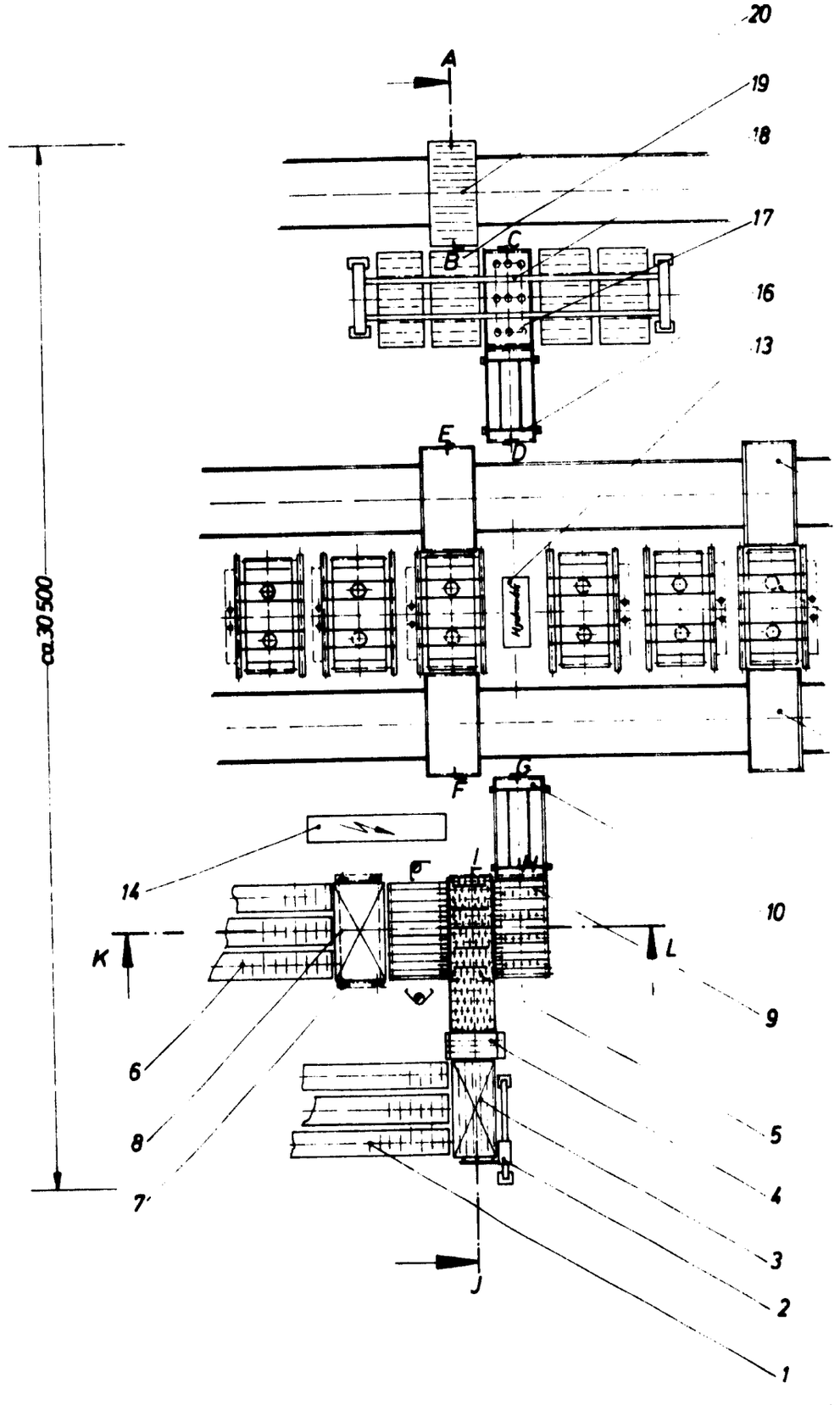
1. CROSS FEED DEAD ROLLER WAY
2. HYDRAULIC SCISSORS LIFT WITH DEAD ROLLER WAY
3. AUTOMATIC INFEED DEVICE
4. SURFACE BRUSHING MACHINE WITH SET OF ROLLER WAY
5. LACQUER COATING MACHINE ON RAILS
6. LIVING DISC ROLLER WAY
7. GLUE COATING MACHINE ON RAILS
8. LIVING DISC ROLLER WAY WITH CROSS TRANSFER

9.a. PRE LAY UP STATION
9.b. FINAL LAY UP STATION
9.c. HYDRAULIC SINGLE DAYLIGHT PRESS
9.d. HYDRAULIC CONTROLS
9.e. ELECTRICAL CONTROL CABINET

10. CROSS TRANSFER
11. AUTOMATIC UNLOADING BELT CONVEYOR
12. DEAD ROLLER WAY WITH AUTOMATIC STACKING UNIT







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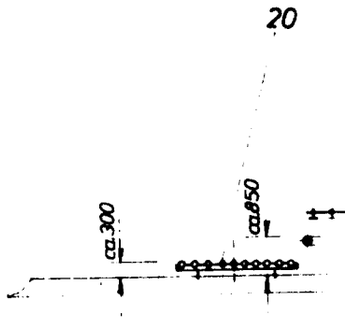

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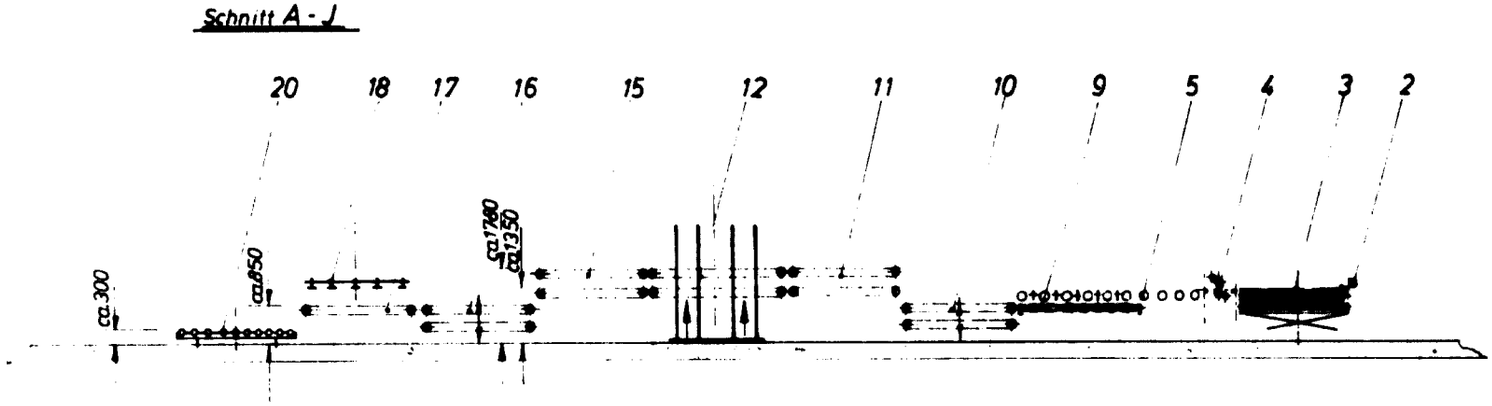
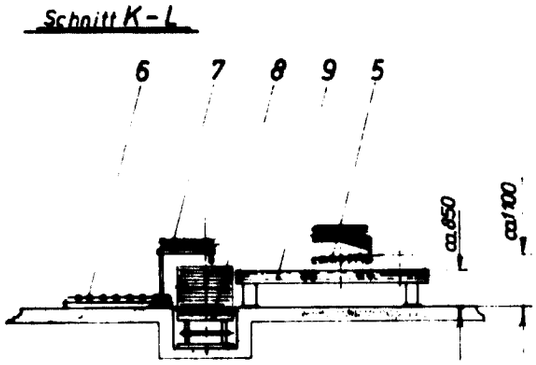
ANNEX 4.4

LEGEND

1. STORAGE ROLLER WAYS OR CR
2. AUTOMATIC INFEED DEVICE
3. HYDRAULIC SCISSORS LIFT
4. GLUE SPREADER
5. LIVE DISC ROLLER WAY
6. STORAGE ROLLER WAY OR CR
7. TRAVELLING SINGLE DECK VE
8. HYDRAULIC SCISSORS LIFT
9. THREE SECTION CONVEYOR W
10. DOUBLE DECK LIFT CONVEYOR

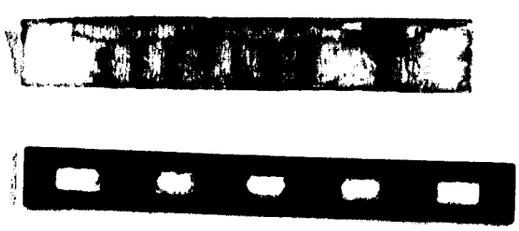




ANNEX 4.4 - LAYOUT OF AN AUTOMATED CYCLING DOUBLE DAYLIGHT PRESSING LINE FOR FLUCH DOOR PRODUCTION

LEGEND

1. STORAGE ROLLER WAYS OR CROSS-VEYING TRUCK
2. AUTOMATIC INFEED DEVICE
3. HYDRAULIC SCISSORS LIFT
4. GLUE SPREADER
5. LIVE DISC ROLLER WAY
6. STORAGE ROLLER WAY OR CROSSVEYING TRUCK
7. TRAVELLING SINGLE DECK VENEER HOPPER
8. HYDRAULIC SCISSORS LIFT
9. THREE SECTION CONVEYOR WITH CROSS TRANSFER
10. DOUBLE DECK LIFT CONVEYOR BELT
11. DOUBLE DECK LOADING TRUCK
12. HYDRAULIC DOUBLE DAYLIGHT PRESS
13. HYDRAULIC CONTROL SYSTEM
14. ELECTRICAL CONTROL CABINET
15. DOUBLE DECK OUTFEED CONVEYOR BELT
16. DOUBLE DECK LIFTING CONVEYOR BELT
17. UNLOADING CONVEYOR BELT
18. VACUUM STACKING DEVICE
19. STACKING ROLLER WAY
20. CROSSVEYING TRUCK



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