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PLANT REQUIREMENTS FOR MANUFACTURE OF PLYWOOD

TECHNICAL AIDS BRANCH
INTERNATIONAL COOPERATION ADMINISTRATION
Washington, D. C.

A.I.D.
Reference Center
Room 1656 NS

FOREWORD

This brochure is one of a series of reports resulting from overseas technical inquiries on factory or commercial establishments, operation, management, and engineering. The report is designed to provide only a general picture of the factors that must be considered in establishing and operating a factory of this type. In most cases, plans for actual installations will require expert engineering and financial advice in order to meet specific local conditions.

Mention of the name of any firm, product, or process in this report is not to be considered a recommendation or an endorsement by the International Cooperation Administration, but merely a citation that is typical in its field.

Industrial reports prepared for ICA under special contract are customarily reviewed and edited before publication. This report, however, like other technical inquiry replies, has not been reviewed; it is the sole responsibility of the firm that prepared the report.

This brochure was prepared in September 1957 by the George H. Andrews Engineering Associates, Inc., Washington, D. C.

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For further information and assistance, contact should be made with the local Productivity Center, Industrial Institute, Servicio, or United States Operations Mission.

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Examination of this brochure was provided by:

Mr. E. Chat Shanks,
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His valuable suggestions are greatly appreciated and have been incorporated.

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PLYWOOD

INTRODUCTION

The small plywood plant described in this brochure is intended to manufacture plywood panels in a foreign country, where there is sufficient demand for these products and where such a local operation would be practicable.

The machinery, equipment and methods shown in this brochure are modern and capable of making all grades of veneer and plywood, including marine plywood. The plant will operate equally well with either hard or soft wood.

GENERAL ASSUMPTIONS

In order to make realistic estimates, certain assumptions must be made. These are:

1. All costs, such as those for building, equipment, materials and supplies are based on prices in the United States.

2. The operating costs, including labor used, are taken from the actual experience on similar operations in the United States.

3. Adequate power and water are available at the plant site.

4. Adequate transportation facilities are available at the plant site.

5. All estimates are based on one 8-hour work shift per day, 5 days per week, or 40 hours per week, except the dryer, which will operate two shifts per day.

6. Several more workers than are shown in the estimate will be required during the training period and peak production is not likely to be attained until the whole organization is thoroughly trained. It is estimated that this training will require from 3 to 4 months.

7. The logs will be available for procurement locally. A few varieties for special work may have to be imported, but the estimates are not based on such special operations.

8. A market analysis has proved that annual sales of at least 5,000,000 square feet of plywood are possible.

9. The following items cannot be estimated realistically:

   A. Land value,
   B. Freight in and out,
   C. Distribution and sales cost,
   D. Taxes, interest, insurance and other burdens.

While general estimates will be made of each of these items, for the purpose of completing cost estimates, adjustments should be made in accordance with actual local costs.

In fact, all costs contained in this brochure should be adjusted to conform to actual local conditions.

PRODUCT SPECIFICATIONS

The principal products which this small plywood plant is adapted to produce include veneer and plywood. Veneer is a thin layer of wood cut from logs in a lathe, or by a saw, or by slicing. Veneer cutting in this plant is all done in a lathe. Plywood is made by gluing sheets of veneer together, with the grain of the wood crossing at right angles in alternate layers, or by gluing sheets of veneer to a lumber core.

The thickness of veneer, the number of plies, the species of wood, and the quality of the product will vary according to the customers' requirements, set forth in the specifications. The specifications may require clear veneer for front and back, if both sides are to be exposed. Table tops, desk tops and case goods tops for furniture are usually made with a lumber core. The exact specifications are governed by the end use.

Specifications usually include, but are not limited to, requirements with respect to the following items:

Species of wood
Thickness of veneer
Number of plies
Thickness of core
Thickness of finished plywood
Length of panel
Width of panel
Grade or quality of product

The descriptions of manufacturing operations and the cost estimates included in this brochure are based on the manufacture of three-ply, hot-pressed, hardwood plywood, with a sound core or center, a clear face and a defective back. The sound core may contain defects, such as sound knots.

In the back sheet, open knot-holes and splits are permissable. The dimensions of the finished plywood panel are 1/4 inch thickness, 4 feet width and 8 feet length.

MANUFACTURING OPERATIONS

LOG STORAGE AND HANDLING

Many large plywood manufacturing companies have their own timber lands and conduct their own logging operations. Most of the smaller plywood companies purchase the logs they need. This brochure is based on securing such logs as are required, specifying the species of trees from which the logs are cut, the length of log desired, and the quality of logs acceptable. Logs are purchased and paid for on the basis of the number of board feet in the log. The lathe in the plant herein described will use logs 9 feet long, having a diameter not more than 48 inches. The larger the diameter of the log, the greater will be the number of square feet of veneer that can be produced per board foot of log purchased. They should be as large as possible, up to 48 inches in diameter. Logs less than 18 inches in diameter should not be purchased for this purpose. The reason for setting this minimum is that it is impracticable to turn the smaller logs, since there is always a core about 6 to 8 inches in diameter that can not be made into veneer. The core constitutes only 1/64 of a 48 inch log, but it is 1/9 of an 18 inch log. However, the cores are not a complete loss. They may be sold to make paper pulp, or they may be used for fuel in the plywood plant, if there is not enough other waste to supply the fuel requirements.

To manufacture 4-foot by 8-foot plywood panels, on which this brochure is based, the logs should be cut to 9-foot lengths. This allows for cutting off the ends where end-checking occurs. It allows also for shrinkage and trimming of the veneer. If smaller panels are made, the logs should be cut to corresponding specified lengths, according to requirements, with due allowance for checking, shrinking and trimming. Care in determining these lengths will avoid unnecessary waste and insure economy in the purchase of logs.

Since it is assumed that the logs will be purchased for the plant described in this brochure, the process of cutting trees and getting the logs out of the forest will not be described. The log handling begins when the logs are delivered at the log storage yard. There they should be unloaded and piled in orderly, accessible piles, on sills composed of long poles about 6 inches in diameter to keep the logs off the ground. Often the logs are stored in a pond. This is a very desirable arrangement. When piled, logs of similar species and lengths should be piled together. Logs are moved in the storage yard and to the cooking vat by a crane.

COOKING:

Hardwood logs will require cooking to soften the wood. This process, which is also called heating, takes place in vats of hot water. The vats may be made of plank, but concrete vats are recommended. The heating is done by live steam from the boiler room or by exhaust steam from the engine. The temperature maintained is just below the boiling point. The time required for cooking may vary from 6 hours to 24 hours, depending on the species of wood, the size of the logs and other factors.

When the cooking process has been completed, the logs are removed from the vats with the crane or the chain hoist and monorail, as required, and placed on the floor for peeling, also called barking.

PEELING:

Logs are taken from the cooking vats and placed on the floor, where the bark is removed and any limb stumps are trimmed down smooth. The bark is removed by hand tools, the rosser or the spud. This work may be done by a mechanically operated rosser, or the bark may be left temporarily to be removed by the first few turns of the lathe. Hand peeling is recommended for the operation described in this brochure.

TURNING

The log is picked up by a chain-fall on a monorail and placed in the lathe centers. It is important to have the log exactly centered in the lathe to avoid waste. The log is then rotated as the knife is brought against it. The first few turns of the lathe produce imperfect sheets, called skirts. When the log has become cylindrical in shape, the knife cuts a continuous sheet full width. The log is turned down to a minimum core about 6 to 8 inches in diameter.

REFUSE HOGGING

Log ends, bark and first cuttings from the lathe, are transferred by conveyor to the hog, where they are cut to chips and blown to the fuel storage. Skirts are held until they may be trimmed to salvage usable veneer. Cores may be stored and sold for pulp wood unless needed for fuel. If they are needed for fuel, they, like the waste from any other part of the process, are transferred to the hog.

WET CLIPPING

As the veneer comes off the lathe, it moves by conveyor to the wet clipper, which clips, or shears the veneer sheet into desired widths. As the sheets emerge from the wet clipper, they are sorted and placed on skids.

MATERIALS HANDLING

Skids are used for the movement of materials throughout the plant. Skids are raised platforms, which are moved about with hydraulic hand lift trucks. The skids may be built at the site of the plywood factory.

WET VENEER STORAGE

The capacity of the veneer dryer is only one half of the capacity of the veneer lathe. Therefore, the veneer dryer must be operated two 8 hour shifts per day to dry all the veneer produced by the veneer lathe. The excess veneer produced by the lathe in one 8-hour shift is stacked on skids and stored for drying during the second 8 hour shift of the dryer.

DRYING

The sheets are placed singly on a conveyor, which carries them through the dryer. The dryer reduces the moisture content of the

veneer, to not less than 6, or more than 8 percent. The speed of the conveyor and the temperature are adjusted according to the thickness of the veneer and the type of wood. Recording charts on the outside of the dryer are checked frequently to avoid the production of brittle or warped veneer.

DRY CLIPPING:

As the dried veneer emerges from the dryer, it is stacked on skids to be moved to the dry clippers, where the sheets are cut into sizes that eliminate defects. The sheets are then sorted into grades, according to quality standards and again placed on skids.

EDGING:

All sheets of veneer are passed on to the edging machine, where their edges are dressed to a smooth straight surface in preparation for the splicing operation.

SPLICING:

The narrow pieces of veneer are passed through the splicer under heat and pressure, which glues the edges firmly together. This operation is repeated until a sheet of full width is made. Occasional open seams are closed with a hand iron. The completed panels are placed on skids.

GLUE MIXING:

The glue used most in modern plants is synthetic resin, one of which is urea-formaldehyde. Although the cost of such glue is more than that of some others, it is highly water resistant and its use is good practice in any plywood plant, where a good bond is required. It is considered uneconomical to use less expensive glue, if it is of inferior quality. This glue is made by several firms in the United States and is shipped overseas in the form of powder. It has a life of a year or more in powder form.

In order to reduce the glue cost, this glue may be extended by adding low grade flour or chalk. These additions have no appreciable bonding qualities, but do serve to reduce the cost of glue without adversly effecting the bond. To this is added catalyst and water as required, depending on atmospheric and other conditions, such as length of time required to use one

batch of glue. The length of time per batch of glue may be increased by mixing the glue in a water jacketed machine.

It is recommended that the glue mixer be located at the right hand side of the glue spreader, about 6 feet up from the plant floor. In this position, a trough can be extended from the glue mixer directly over the glue spreader. This will eliminate any delay in glue delivery, since the gluing operator can release glue onto the rolls at any time by pulling a conveniently placed lever.

GLUE SPREADING:

The core, or center sheet, is passed through the glue spreader and glue is spread evenly on both sides.

Face and back sheets are placed one on each side of the core. After several panels have been glued, the pile is pushed on a gravity conveyor to the hot press.

PRESSING:

The hot press is a large hydraulic press with several flat hollow plates, which are heated with live steam. The glued plywood panels are inserted into the openings between the plates. After each opening in the press is loaded, the press is closed and left under pressure until the bond is completed. Bonding 1/4 inch, 3-ply plywood, requires from 3 to 4 minutes. For marine plywood of the same size, about 7 to 10 minutes will be required. The press is then opened and the plywood panels are removed and placed on skids.

PANEL SIZER:

The panels are taken from the skids and cut on the sizer saws to length and width. Both edges and sides are cut to be sure that each edge and side is smooth and straight and that the panel is square.

DRUM SANDER:

The panels are moved on skids from the sizing saws to the drum sander and are run through this machine, sanding one or two sides, as specified.

INSPECTION

Each panel is inspected as it leaves the drum sander. Panels with defects are sent to the table sander. Panels that pass inspection are sent directly to the packaging and shipping department. If all operations performed prior to drum sanding have been done correctly, only a small percentage of the panels will require further work at the table sander in order to pass inspection.

TABLE SANDER

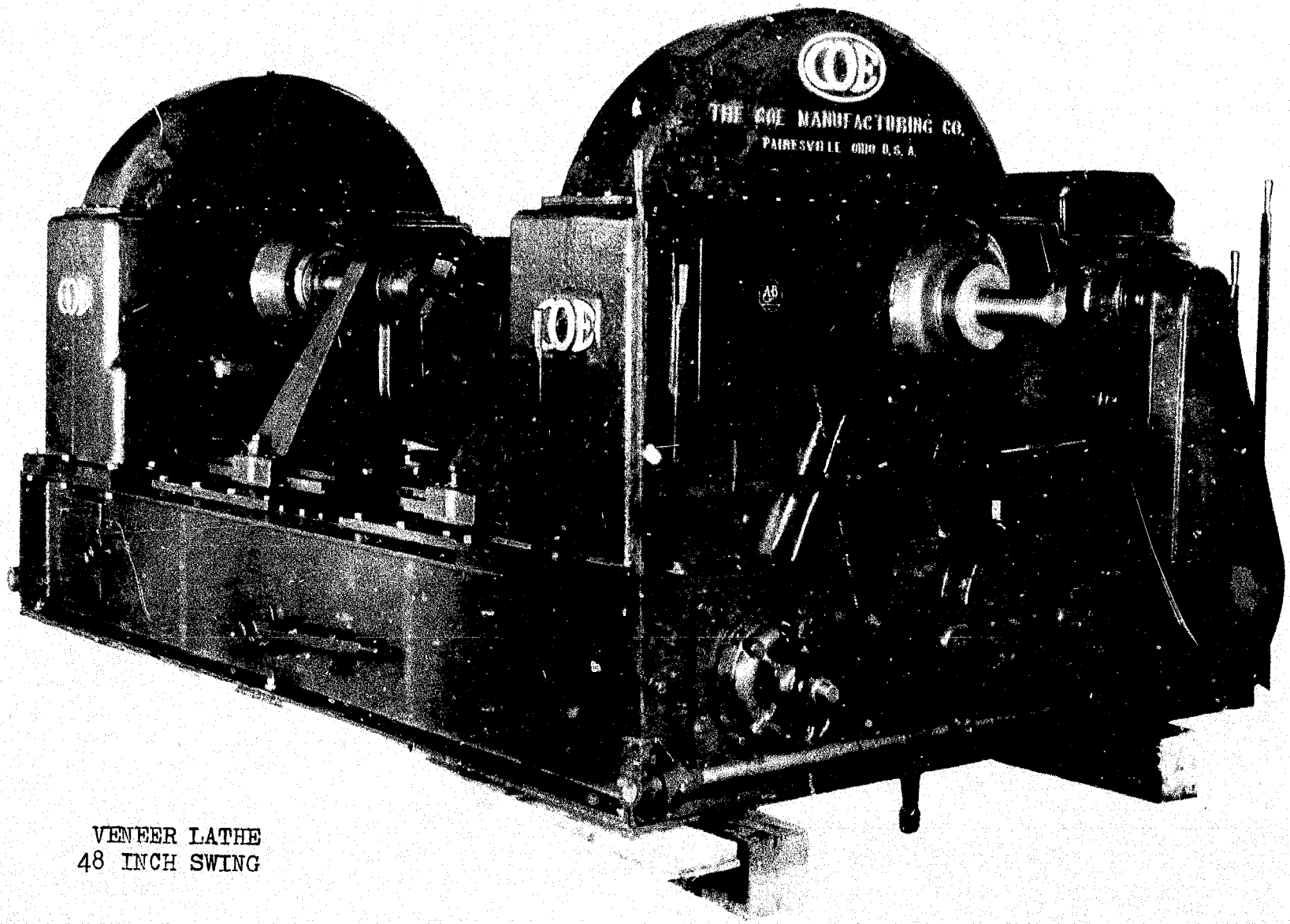
All panels having defects are repaired at the table sander. The repairs may consist of just sanding a small area that was missed by the drum sander, or of repairing a small dent or hole in the panel. In some cases, a patch may be required. After the defects are repaired, the panels are again inspected and upon passing inspection, are sent on skids to the packaging and shipping department.

PACKAGING

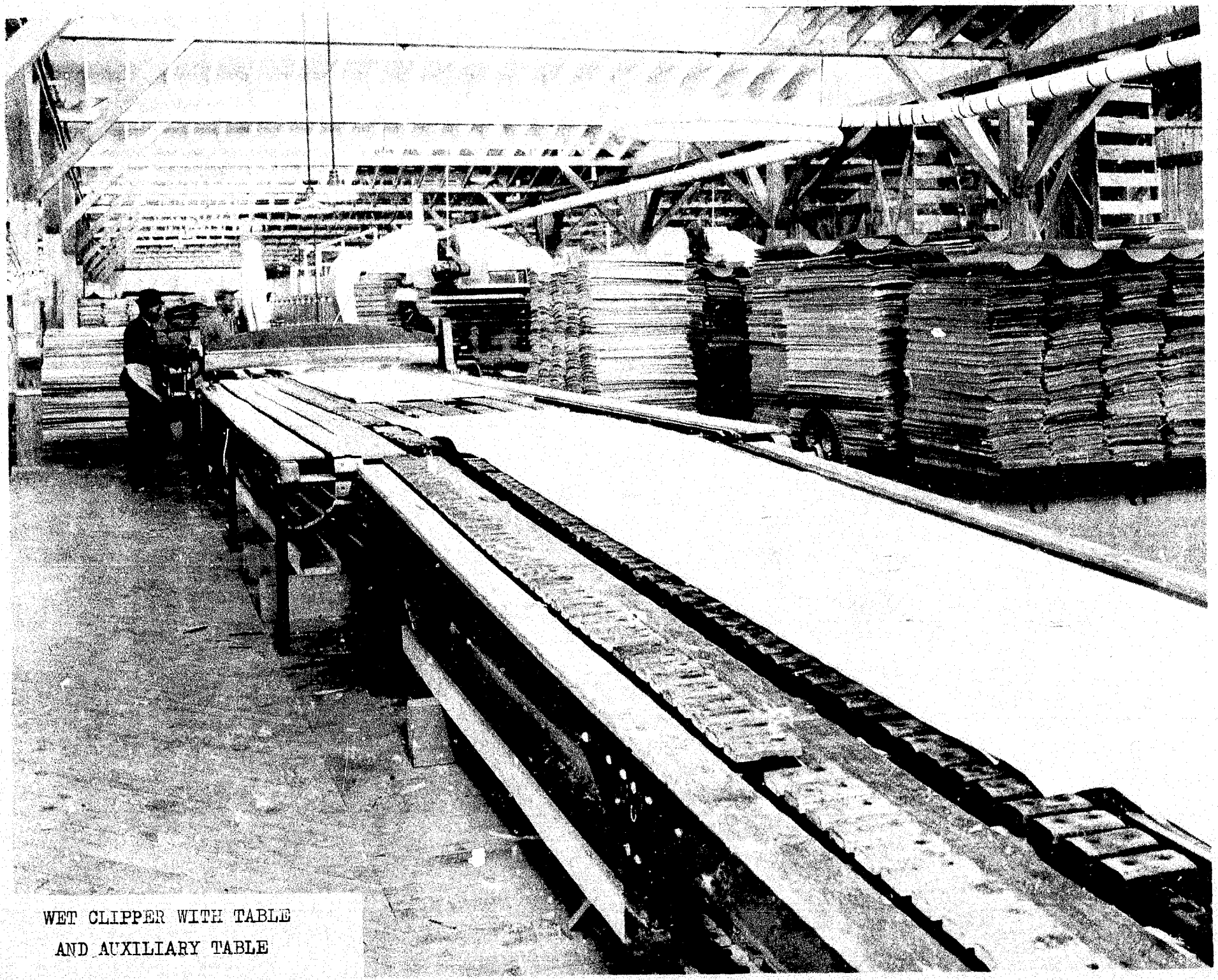
The plywood panels are packaged in stacks about one foot high. The number of panels per package depends upon the thickness of the panels. Sticks about 1 inch thick by 1 1/2 inches wide are placed lengthways on the package. The ends of these sticks are fastened together with pieces of strip steel.

SHIPPING

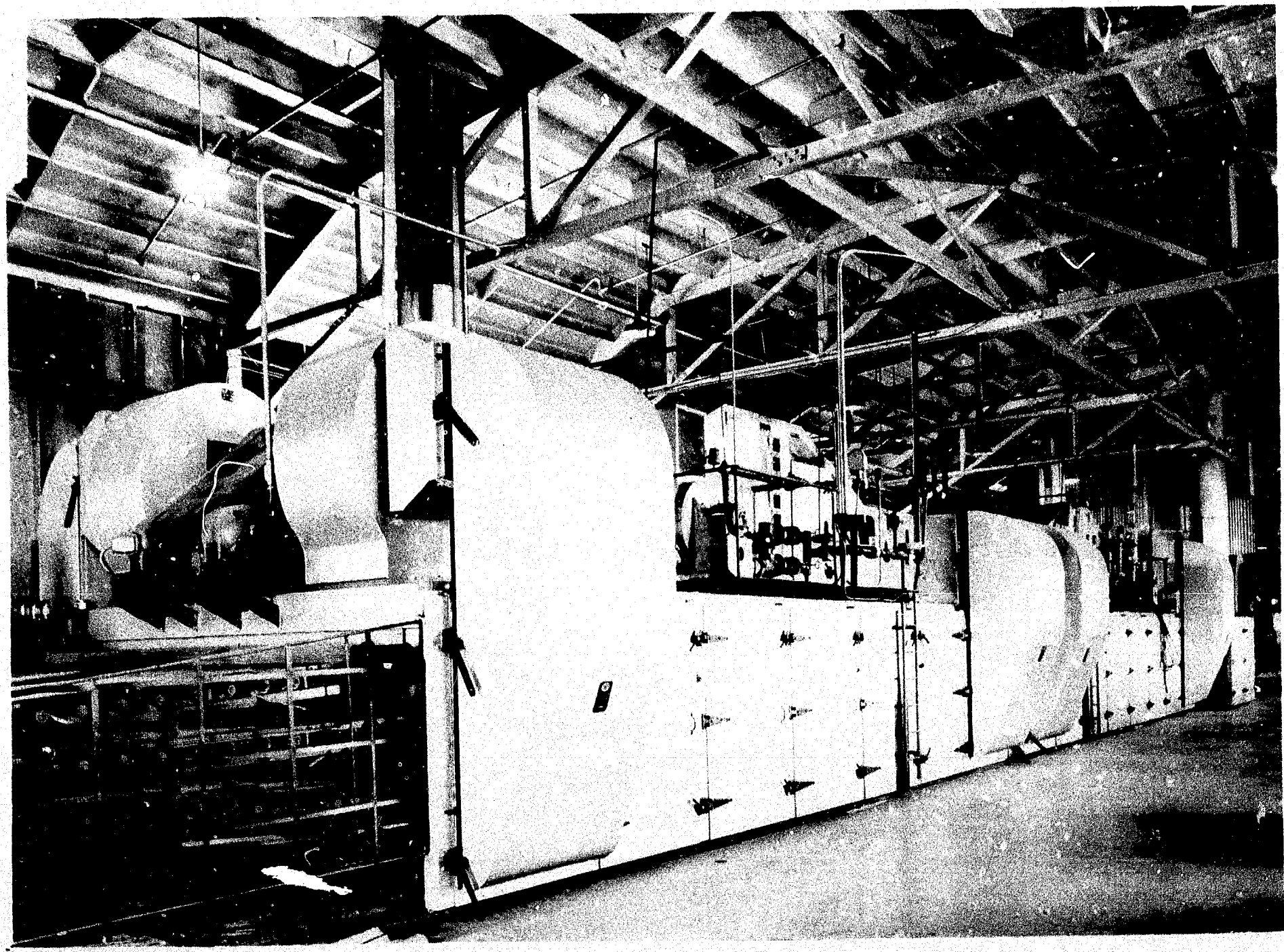
Shipping may be by rail or truck. The drawing of the plant layout shows a railroad track adjacent to the shipping platform. A road, not shown on the drawing, should be available at one side with room for trucks while they are being loaded.



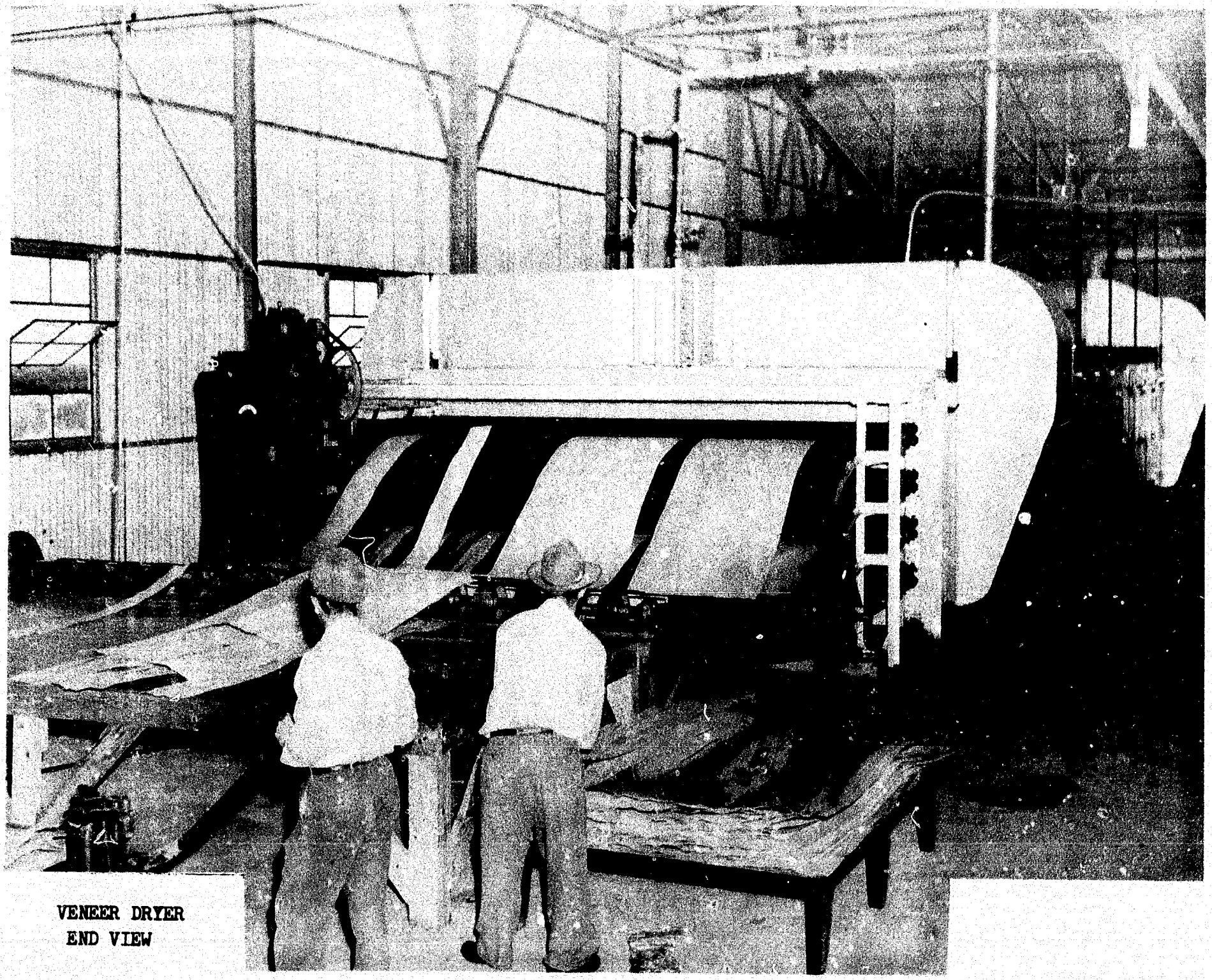
VENEER LATHE
48 INCH SWING



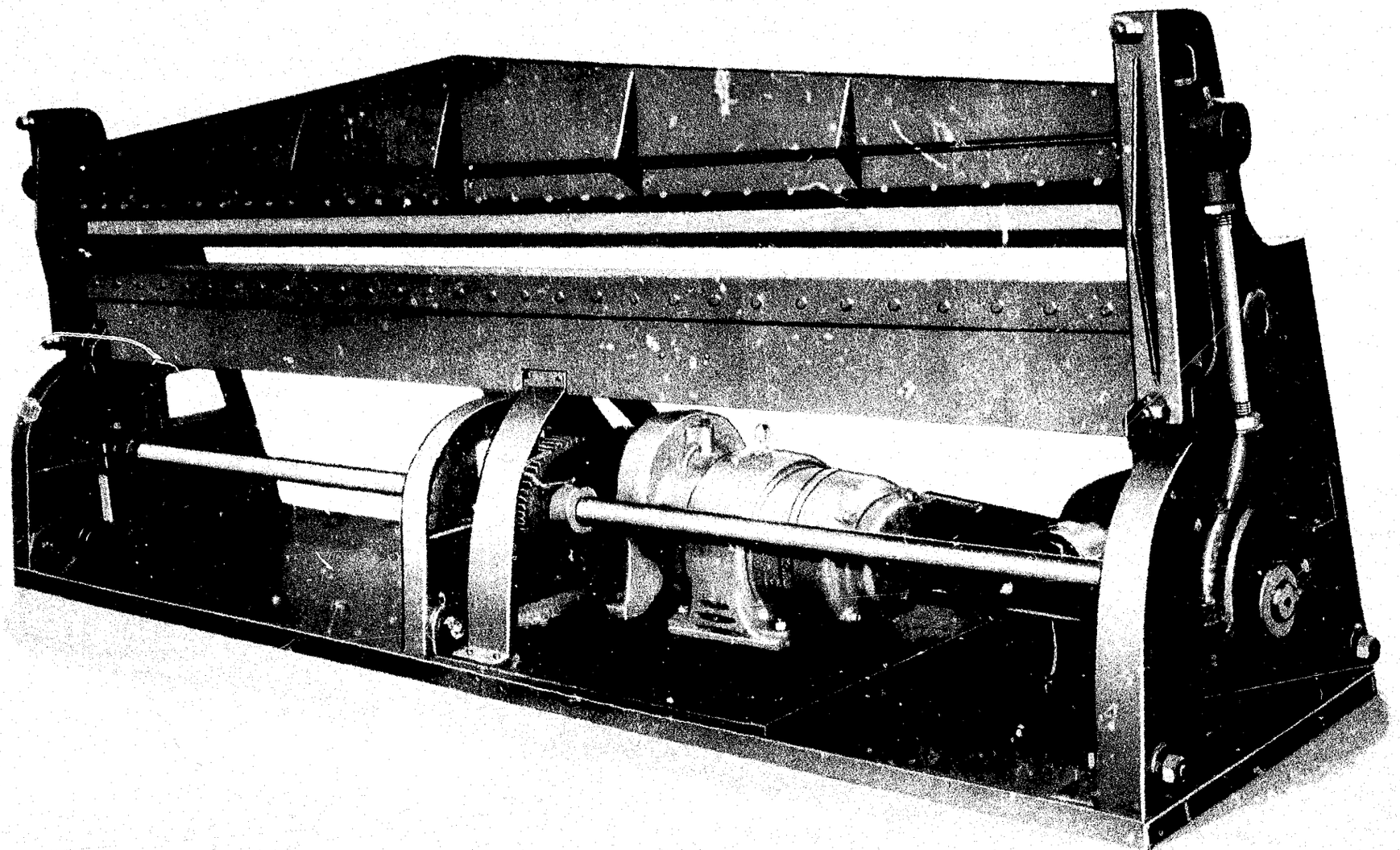
WET CLIPPER WITH TABLE
AND AUXILIARY TABLE



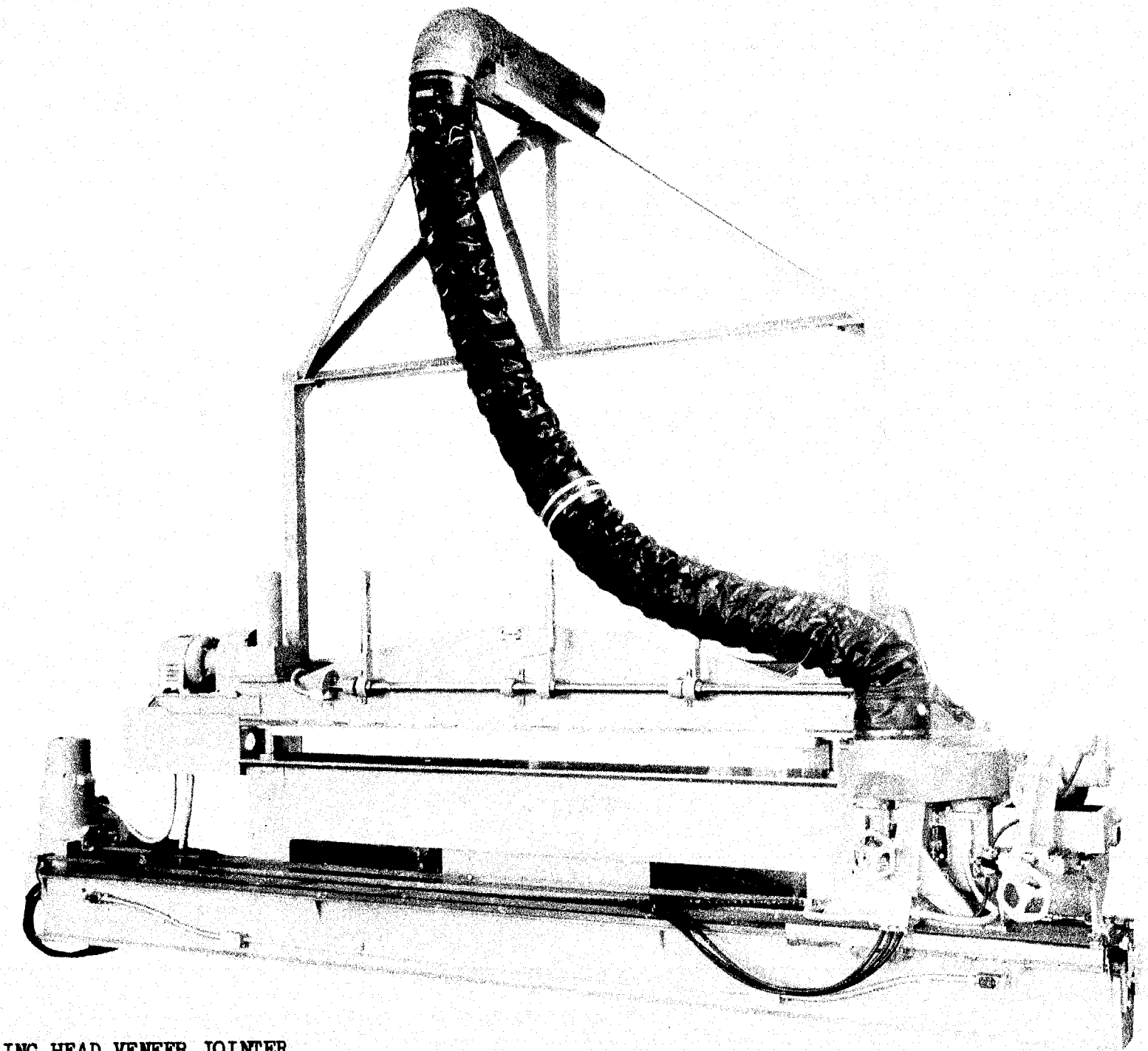
VENEER DRYER
SIDE VIEW



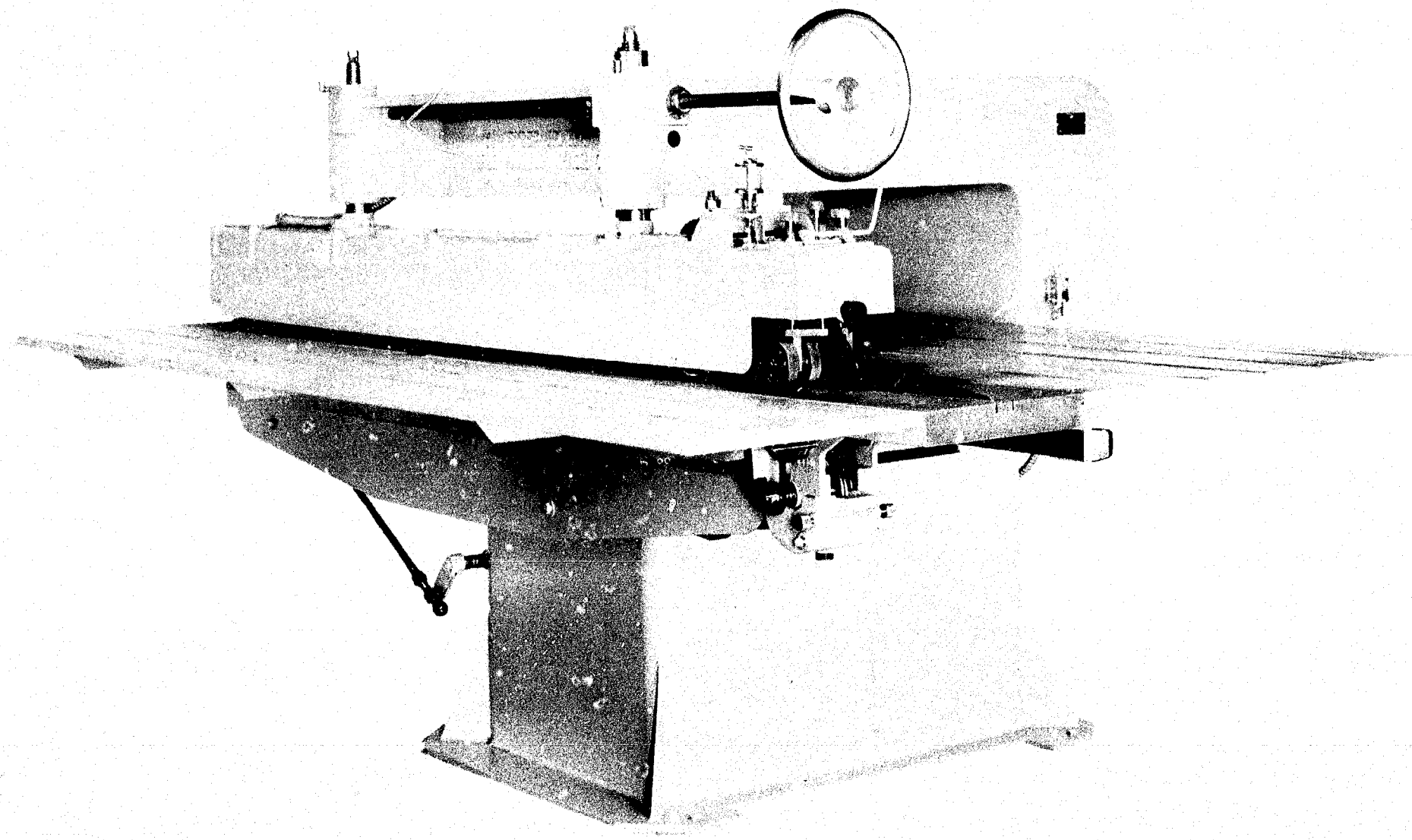
VENEER DRYER
END VIEW



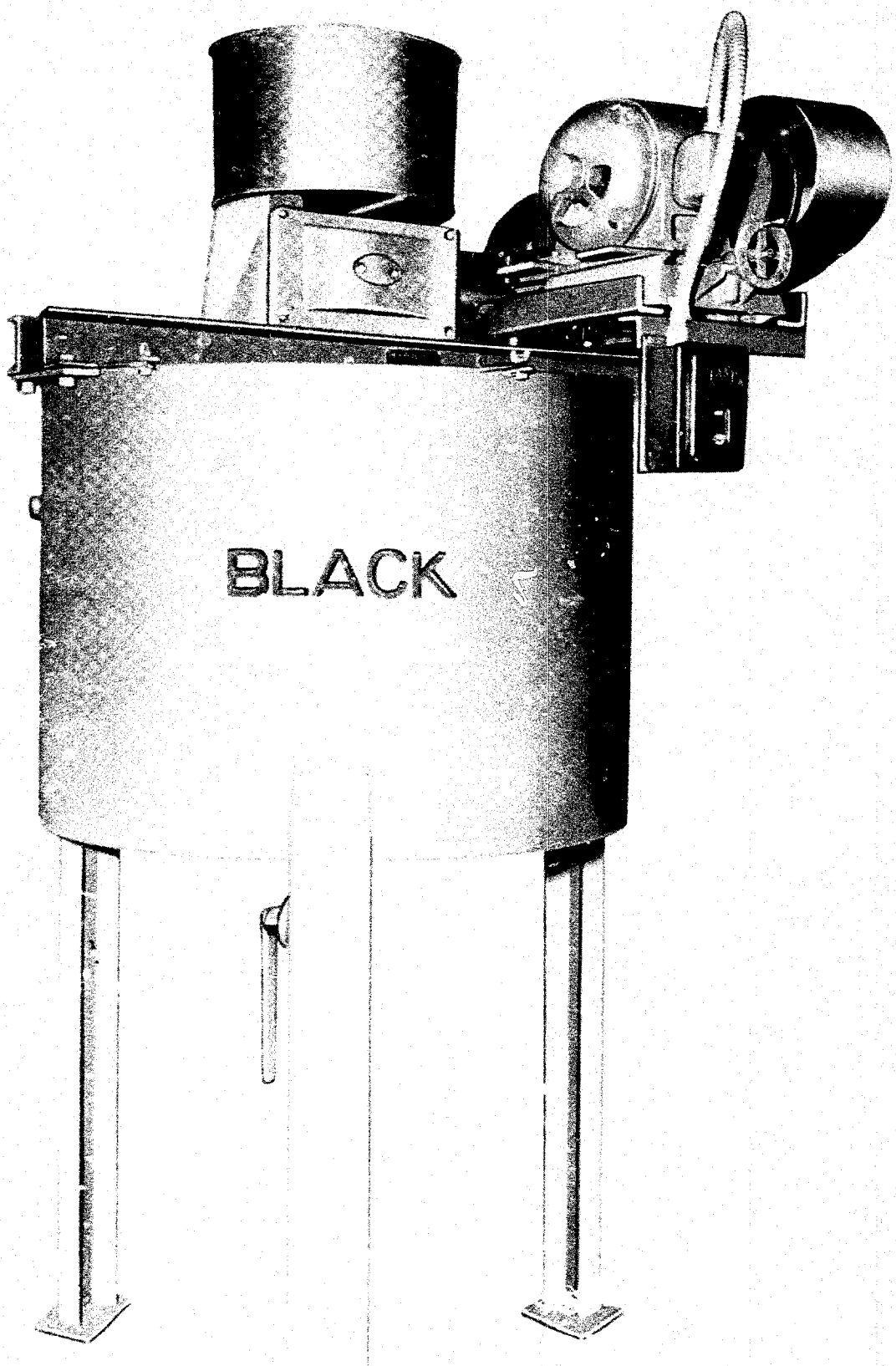
DRYER CLIPPER



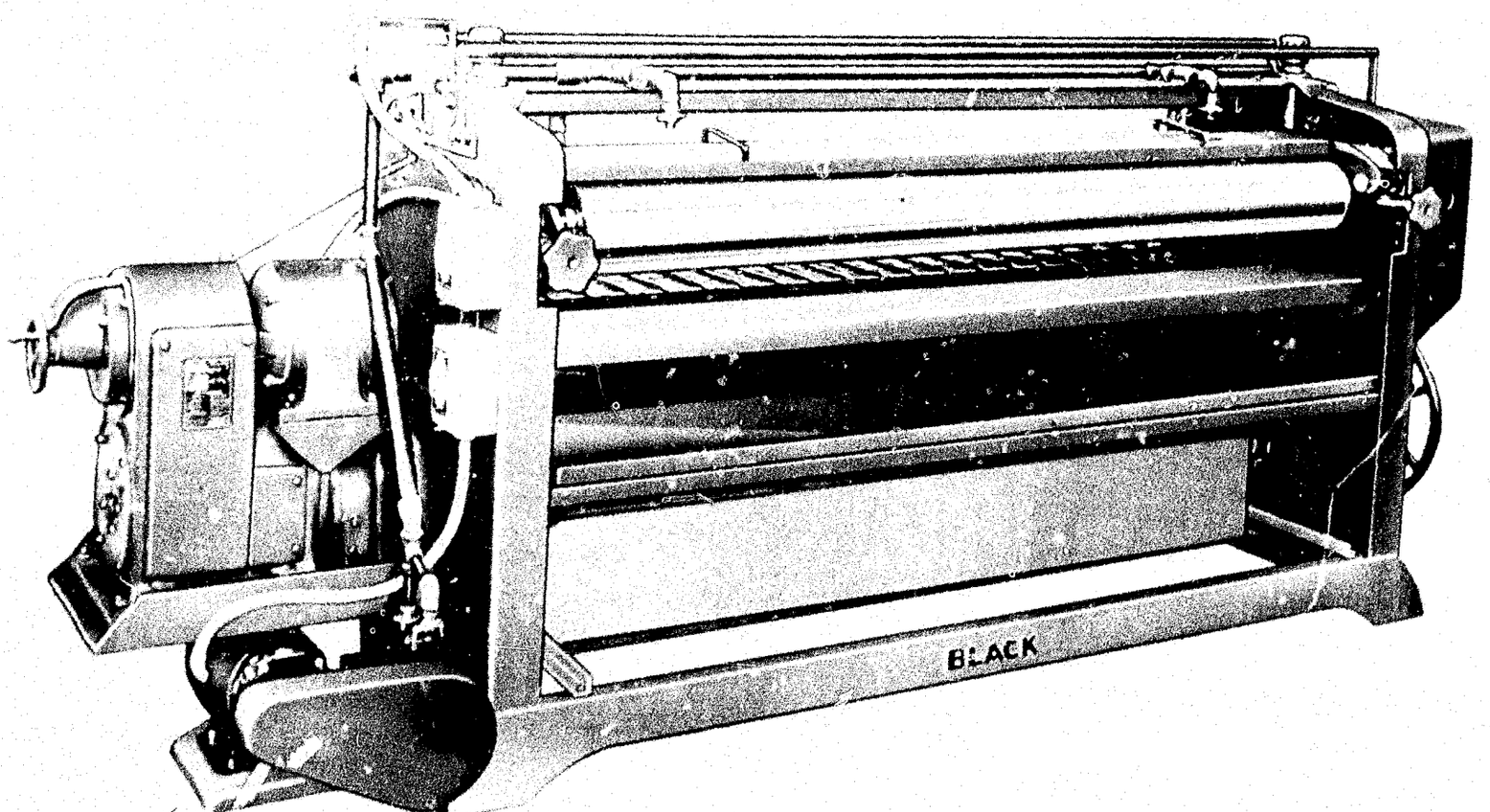
TRAVELING HEAD VENEER JOINTER



VENEER SPLICER

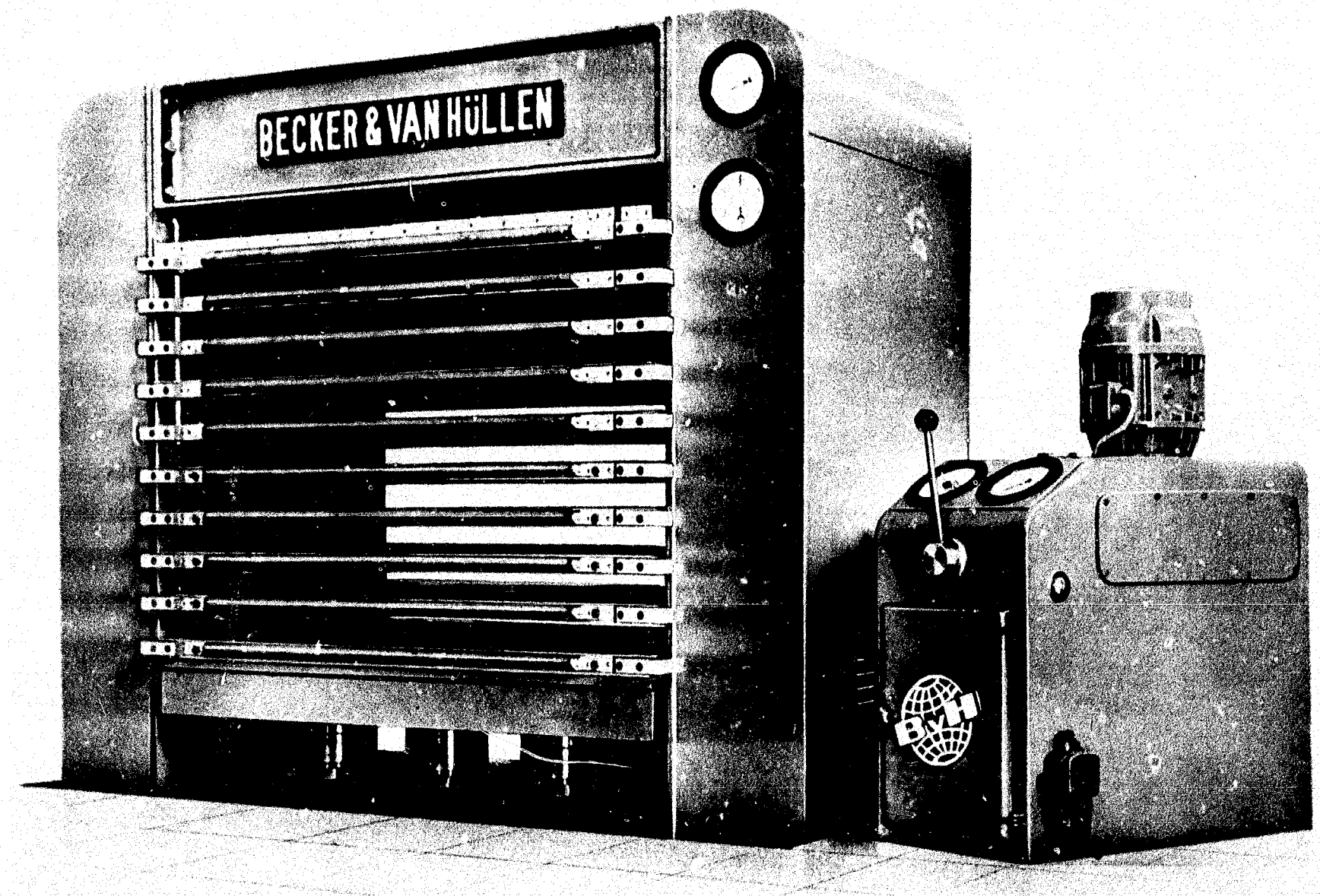


GLUE MIXER

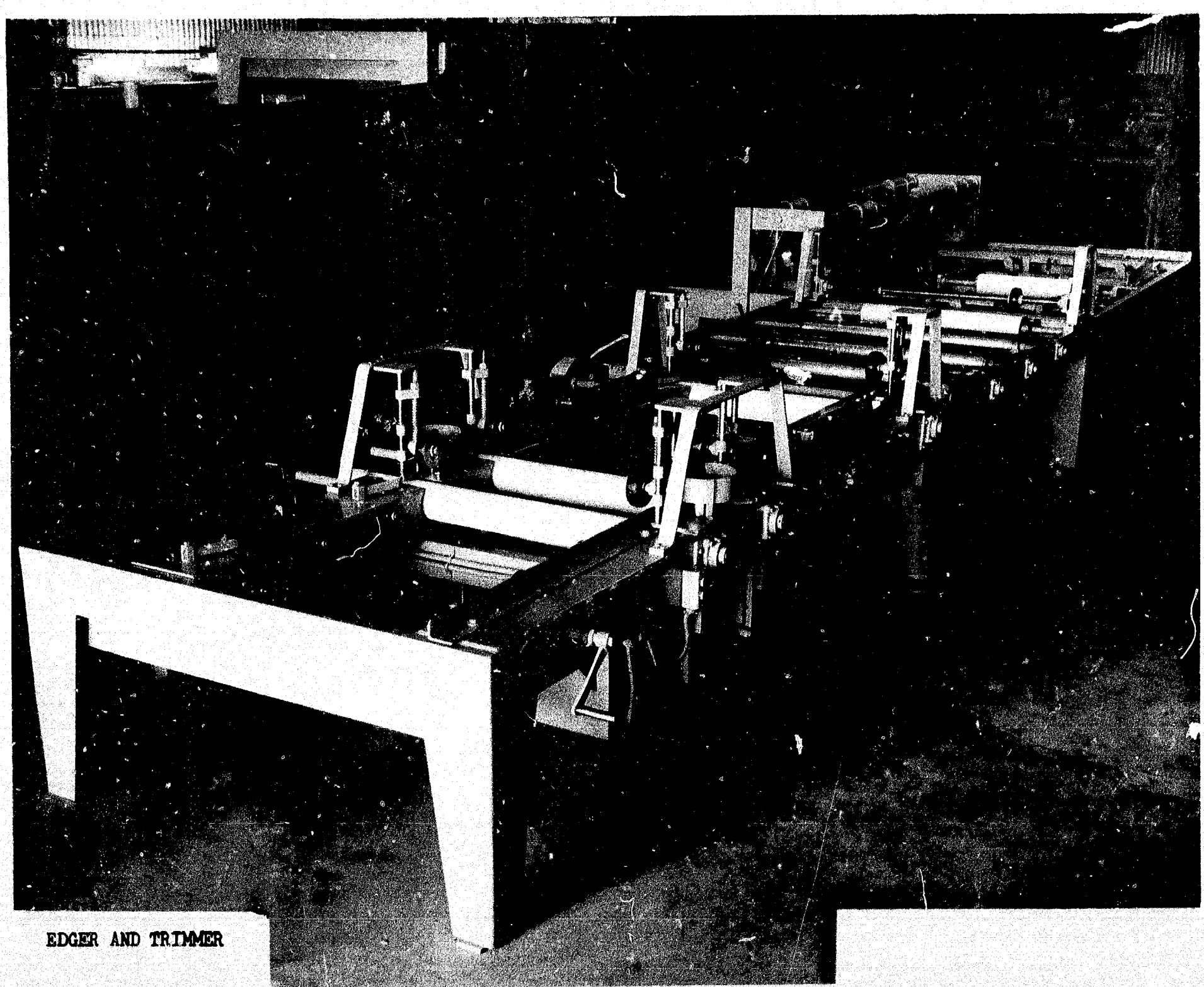


This view shows the infeed side of the machine, complete with variable speed motor drive and circulating pump unit.

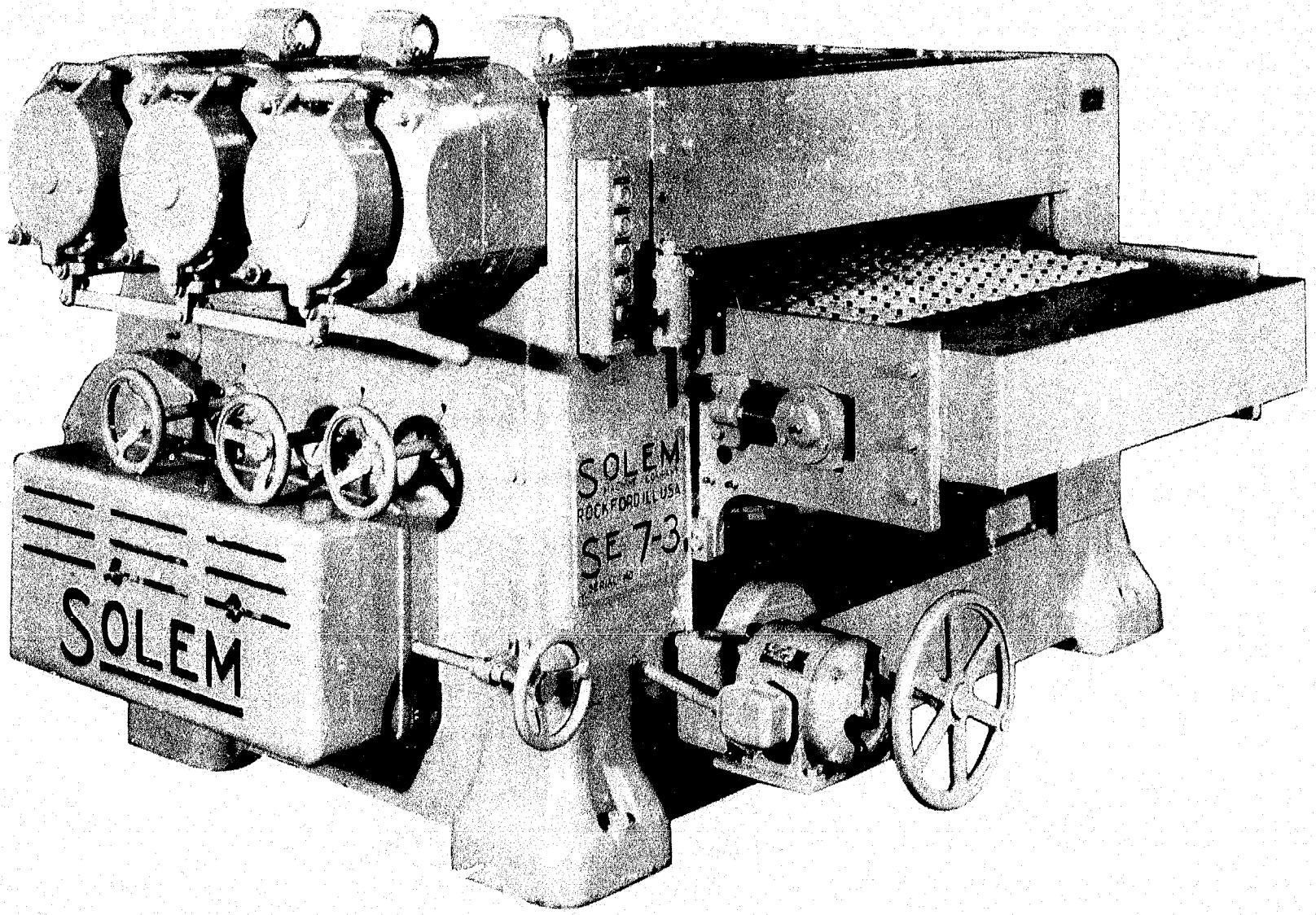
GLUE SPREADER



PLYWOOD PRESS



EDGER AND TRIMMER



THREE DRUM SANDER

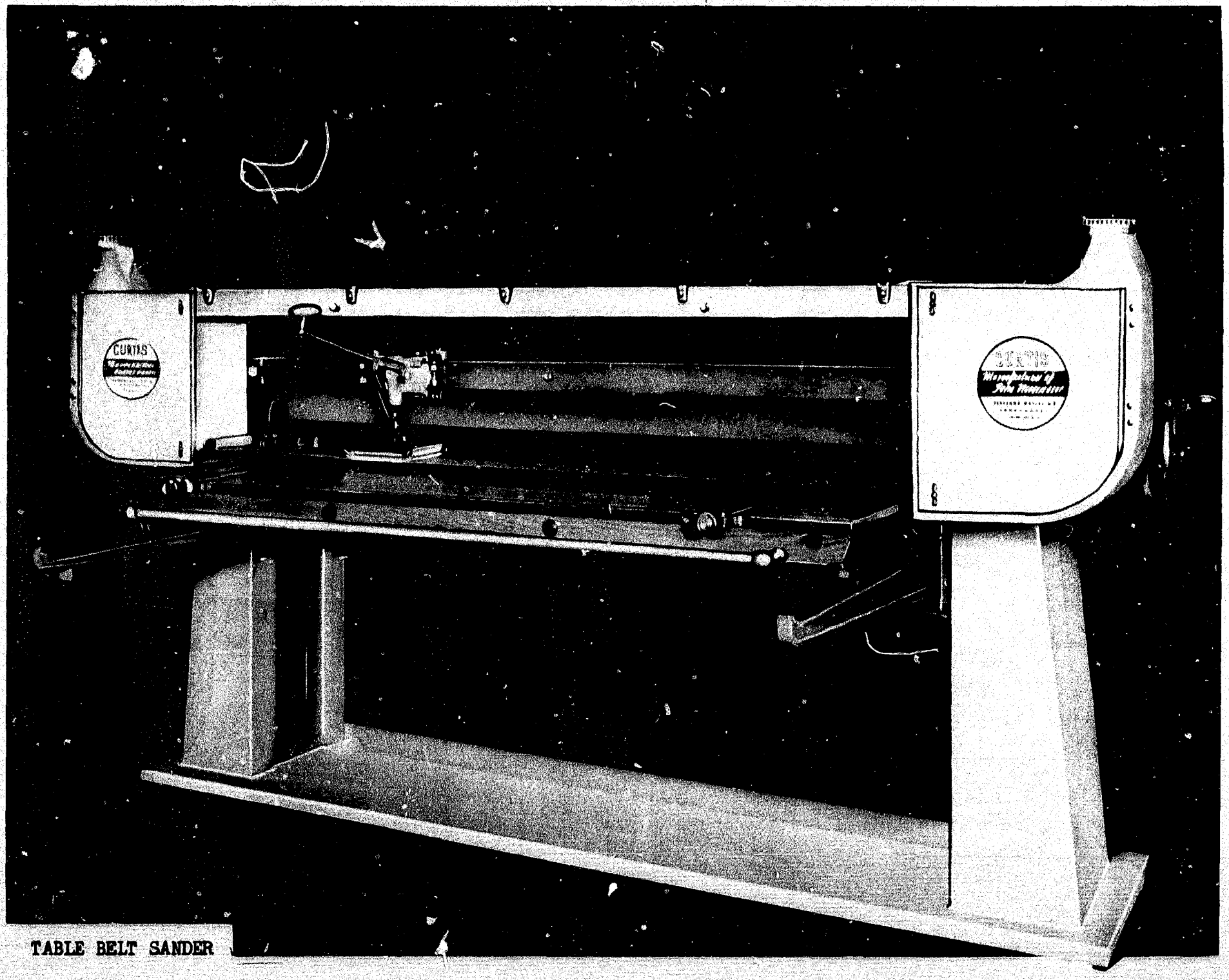
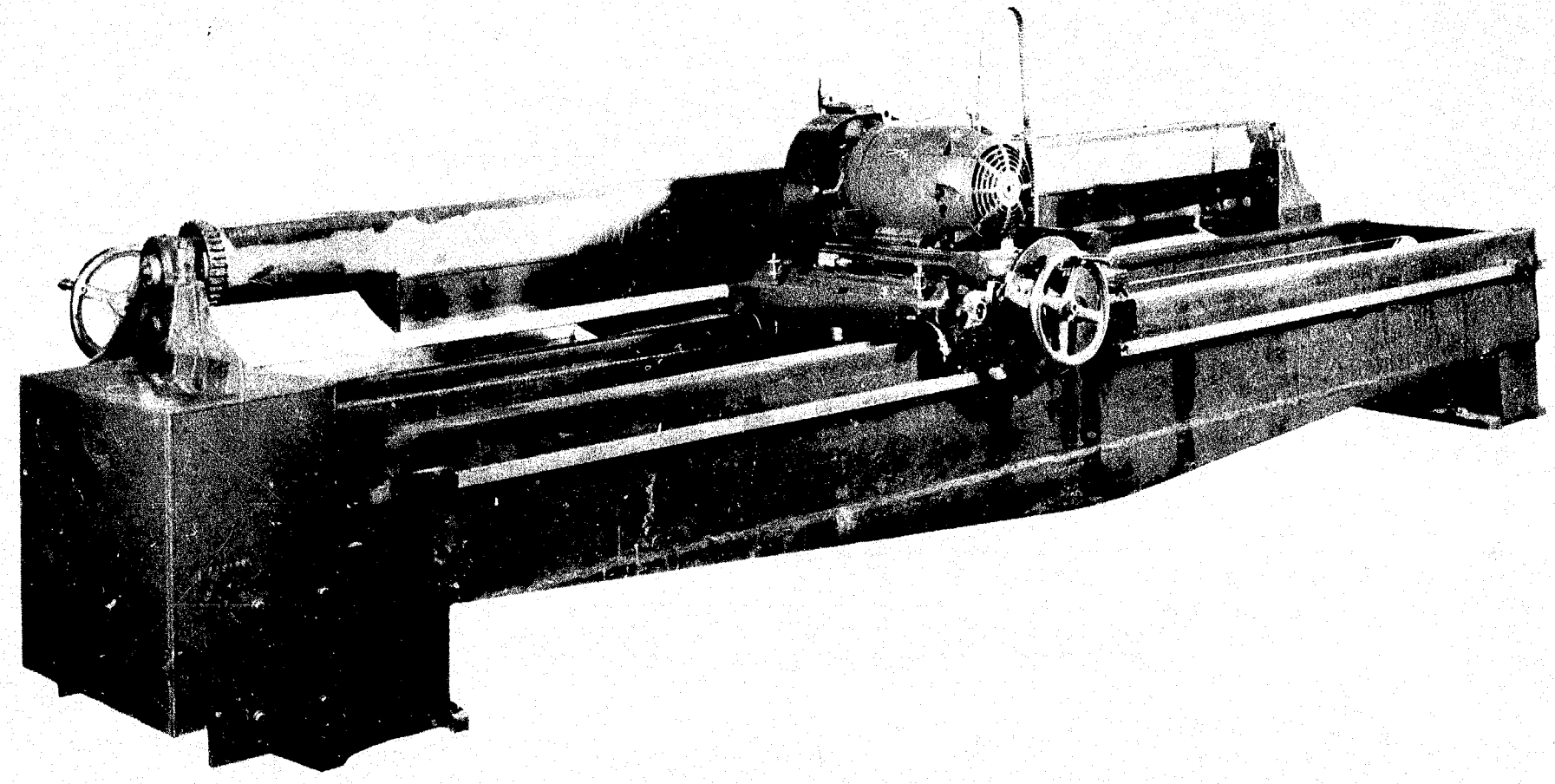


TABLE BELT SANDER



KNIFE GRINDER

PRODUCTION CAPACITY

The production capacity of the plywood plant described in this brochure is 20,000 square feet of 1/4 inch, 3-ply plywood per day, when the plant, with the exception of the drying operation, is operated on a single shift of 8 hours, 5 days per week. For this production, the dryer and boiler plant need to operate two shifts. Other conditions required to maintain this rate of production are that the logs shall be large and the quality shall be up to a good standard.

The production capacity of the plant depends on the capacity of the dryer. By working the dryer three shifts instead of two, the plant capacity can be increased 50 percent. Appropriate arrangements would have to be made for the operation of the rest of the equipment. No additional fixed capital would have to be invested.

PLANT SITE

To provide for eventual expansion and for adequate log storage, about 5 acres of level, well drained land is required. The site should be as advantageously located as possible with respect to transportation facilities, power, water, sources of labor and markets. The estimated cost of the necessary land is ... $2,000.

BUILDINGS

The building to house the plywood plant should be U-shaped. In order to provide for some expansion, the main building should be 300 feet long by 40 feet wide, with a wing at each end forming a U.

One wing, 100 feet by 40 feet, is intended to house the veneer lathe and wet clipping operations. The wing, 100 feet by 60 feet, is intended to house the finishing and shipping operations.

Two lean-to buildings are required, one at each back corner of the semi-enclosed area. One lean-to, 20 feet by 40 feet, is required to house the knife and saw grinders and the other, 20 by 40 feet, is required for the office. Wash-room facilities will be installed in both of the lean-to buildings.

Another small building, 20 feet by 40 feet, in the semi-enclosure near the veneer wing, is required to house the steam boiler. The total building area would be 24,450 square feet.

These buildings are all of simple frame construction. The estimated cost, including any necessary preparation of the site and roadway and vats, is ..... $122,000.

FUEL

No purchased fuel is required. The trimmings from the plywood should provide all the fuel needed, according to the usual experience in plywood plants in the United States.

TRUCKS

A one-ton, cab, pick-up truck will be required for general utility purposes. The estimated cost of this truck is .$2,400.

The cost of fuel and oil, repairs and replacements and other items of truck expense is estimated at .....$ 500.

POWER

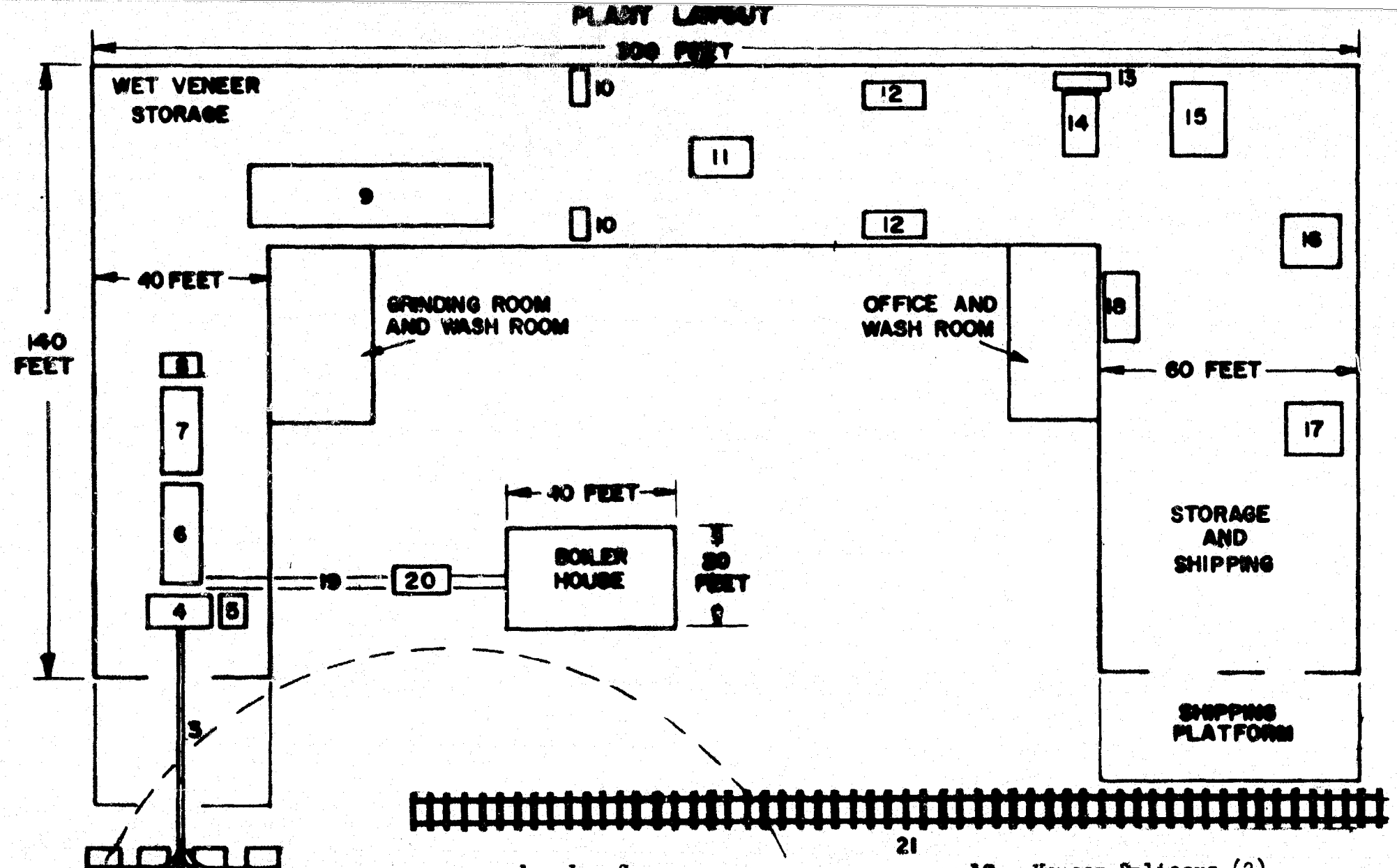
It is assumed that a dependable supply of electricity is available from previously installed power lines. The estimated total connected load of all motors used is about 200 horsepower. Not all of these motors are operated at the same time, nor at full capacity. The peak load will probably not exceed 150 horsepower. The estimated annual cost of electricity is .....$3,000.

WATER

No great quantity of water is required. Water for the boiler, where steam is generated, and for the vats, where logs are cooked, and a small amount of water for mixing glue, is the only process water needed. Water will be needed for fire protection, sanitary facilities, and for drinking purposes. It is estimated that the total water required will cost approximately .....$ 500.

EQUIPMENT REQUIREMENTS

		Estimated Cost	Actual Cost
1	Crane (log yard)	$ 4,000	$
1	Chain saw	1,000	
1	Monorail with electric hoist	3,000	
1	Lathe - 109 inch knife	27,000	
1	Steam engine drive for lathe	9,000	
1	Infeed table, motorized, 20 feet long by 110 inches wide	1,800	
1	Wet veneer clipper - 110 inch knife with 20 foot infeed table	6,300	
1	Dryer - 4 decks with 14 feet 6 inch rolls, recording and controlling instruments. Drying capacity 50,000 square feet of 1/10 inch veneer in 8 hours	58,000	
2	Sizing clippers - 110 inch, $2,800 each	5,600	
1	Traveling head veneer jointer, 106 inch	9,000	
2	Veneer splicers, $5,500 each, with veneer mending equipment	11,000	
1	Glue mixer, 30 gallons, water jacketed	700	
1	Glue spreader, 104 inches, with extra spreading roll	6,600	
1	Hot press in 10 opening panels for 4 feet by 8 feet panels, 200 pounds pressure per square inch	25,200	
1	Automatic edger and trimmer	11,500	
1	Endless bed, three drum sander, drums 55 inches long	16,000	
1	Hand block table belt sander, 8 foot table	1,500	
100	Skids	4,000	
7	Hydraulic hand lift trucks at $600 each	4,200	
1	Knife grinder	5,600	
1	Waste hog and blower	5,000	
1	Waste conveyor, from lathe to hog	4,000	
1	Steam boiler complete with fuse box	10,000	
	Steam pipes, valves and wiring	5,000	
	Cost of installation	15,000	
	ESTIMATED TOTAL COST OF PLANT EQUIPMENT	$ 250,000	$



1. Log Saw
2. Log Boiling Vats
3. Log Hoist and Monorail
4. Veneer Lathe
5. Steam Engine
6. Veneer Conveying Table
7. Veneer Conveying Table
8. Wet Veneer Clipper
9. Veneer Dryer
10. Dry Veneer Sizing Clippers (2)
11. Veneer Jointer
12. Veneer Splicers (2)
13. Glue Mixer
14. Glue Spreader
15. Glue Press
16. Panel Sizer
17. Three Drum Sander
18. Table Hand Block Sander
19. Waste Conveyor
20. Waste Bag
21. Railroad Spur
22. Yard Crane

FLOW SHEET

The flow of the material in process from the log storage yard to the shipping department is direct, with no back tracking, as shown below:

1. Log yard to cut off saw
2. Cut off saw to vats
3. Vats to peeling
4. Peeling to lathe
5. Lathe to conveyors
6. Conveyors to wet clippers
7. Clippers to skid storage
8. Skid storage to dryer
9. Dryer to skid storage
10. Skid storage to dry clipper
11. Dry clipper to edging
12. Edging to splicing
13. Splicing to glue spreader
14. Glue spreader to hot press
15. Hot press to panel sizer
16. Panel sizer to three drum sander
17. Three drum sander to inspection
18. Inspection to packing, or table sander
19. Table sander to packing
20. Packing to shipping

FIXED ASSETS

	Estimated Cost	Actual Cost
Site	$ 2,000	$
Building	122,000	
Plant Equipment	250,000	
Office Equipment	1,600	
Truck	2,400	
TOTAL FIXED ASSETS	$ 378,000	$

DEPRECIATION

	Estimated Cost	Life Years	Annual Depreciation
Building	$ 122,000	20	$ 6,100
Plant Equipment	250,000	15	16,667
Office Equipment	1,600	10	160
Truck	2,400	4	600
TOTAL ESTIMATED ANNUAL DEPRECIATION			$ 23,527

DIRECT MATERIALS

Logs constitute the principal direct material used in making plywood. The estimated cost of logs to produce 20,000 square feet of hardwood plywood per day, or 5,000,000 square feet per year, is $150,000

Glue and glue additives constitute the only other direct material entering into the production of plywood. The estimated cost of glue and glue additives is ..... $ 40,000

TOTAL ESTIMATED ANNUAL COST OF DIRECT MATERIALS IS..... $190,000

SUPPLIES

	Estimated Cost	Actual Cost
Lathe knives, saws and other cutting tools	$ 2,500	$_____
Sand paper	1,000	_____
Grinding wheels	500	_____
Hand tools	600	_____
Lubricants, packaging materials, office supplies and other	2,500	_____
Machine and equipment parts	900	_____
TOTAL ESTIMATED ANNUAL COST OF SUPPLIES	$ 8,000	$_____

INDIRECT LABOR

	Estimated Cost	Actual Cost
1 Manager	$ 10,000	$_____
1 Stenographer	4,000	_____
1 Bookkeeper	6,000	_____
1 Clerk	4,000	_____
1 Night-watch and boiler man	3,000	_____
1 Maintenance man	4,000	_____
1 Truck driver	3,000	_____
TOTAL ESTIMATED ANNUAL INDIRECT LABOR	$ 34,000	$_____

DIRECT LABOR

		Hourly Rate	Estimated Cost	Actual Cost
1	Superintendent	$	$ 8,000	$
1	Yard man	1.50	3,000	
1	Automotive hoist operator	2.00	4,000	
2	Boiler operators (one on second shift)	1.50	6,000	
1	Knife grinder	2.00	4,000	
1	Chain-Hoist operator	1.50	3,000	
1	Peeler	1.50	3,000	
1	Lathe operator	2.50	5,000	
2	Lathe off-bearers	1.50	6,000	
1	Wet-clipper	2.00	4,000	
2	Wet-clipper helpers	1.50	6,000	
4	Dryer feeders (2 on second shift)	1.50	12,000	
4	Dryer off-bearers (2 on second shift)	1.50	12,000	
2	Sizing clippers	2.00	8,000	
2	Sizing clipper helpers	1.50	6,000	
1	Veneer jointer	2.00	4,000	
1	Veneer jointer helper	1.50	3,000	
2	Veneer splicers	2.00	8,000	
2	Veneer splicer helpers	1.50	6,000	
3	Glue spreaders	1.50	9,000	
2	Glue-press operators	1.50	6,000	
2	Sawyers	1.50	6,000	
2	Drum-sander operators	1.50	6,000	
1	Inspector	2.00	4,000	
1	Table-belt sander	1.50	3,000	
2	Storage and shipping room	1.50	6,000	
45	TOTAL ESTIMATED ANNUAL DIRECT LABOR		$ 151,000	$

KEY MEN

The key men in this plant include:

Superintendent
Lathe operator
Wet clipper
Sizing clippers
Veneer jointers

These men should all be experienced in the production of plywood and be willing and able to help teach the other employees. If experienced men cannot be secured locally, they should be secured wherever possible and retained until all the employees are fully trained.

SAFETY

There is danger of injuries from scalding in this plant unless special precautions are taken. Steam is used in the log-cooking process and special care should be exercised where the logs are lifted into, or out of, the vats.

If the log comes loose from the tongs, or if it is dropped too rapidly into the vat, the resulting splash of hot water may drench and severely burn any workmen standing near by. Heat is also used in the dryer and in the press.

Saw and knife cuts also may occur. Careless handling of logs, heavy plywood bales and mechanical equipment could cause accidents. In addition to constant watchfulness to make sure all practicable safety precautions are taken, first aid supplies should be readily available. One complete first aid kit should be maintained near the manager's office. Thus the manager can take immediate action in case of accident. Several other kits should be well placed in the plant. The manager and one or more of the other personnel should be familiar with first aid action.

The manager should take some specific action at least once each month to bring to the attention of each employee the importance of safety precautions and intelligent first aid. Some machines have safety appliances and the manager should see that these are in good operating condition and that the operator is using them.

The glue spreader should always be opened wide for cleaning to avoid accidents. A brush should be used, since a cloth could pull a person into the machine. The spreader should be cleaned immediately after it is used. There are safety attachments on the glue spreader.

ANNUAL DIRECT OPERATING COST

	Estimated Cost	Actual Cost
Logs	$ 150,000	$
Glue	40,000	
Power	3,000	
Water	500	
Direct Labor	151,000	
TOTAL ANNUAL DIRECT OPERATING COST	$ 344,500	$

ANNUAL INDIRECT OPERATING COST

	Estimated Cost	Actual Cost
Supplies	$ 8,000	$
Truck Expense	500	
Indirect Labor	34,000	
TOTAL ESTIMATED ANNUAL INDIRECT OPERATING COST	$ 42,500	$

WORKING CAPITAL REQUIREMENTS

It is assumed that the logs used in this plant will be procured locally. The glue and part of the glue additives may have to be imported, as well as some of the supplies. Allowing 30 days for sales collection, it is estimated that 3 months working capital will be sufficient. Three months working capital will amount to approximately $92,000

TOTAL CAPITAL REQUIREMENTS

FIXED ASSETS	$ 378,000
WORKING CAPITAL	92,000
TOTAL CAPITAL REQUIREMENTS	$ 470,000

SALES

SALES METHODS

In most plywood manufacturing plants, sales may change in character as the volume of manufactured products increases, and various new types of products are requested by customers. For this reason, it will be desirable to have a sales arrangement and a sales organization which can be readily adapted to the sales requirements as they arise.

OUTLETS

Retail lumber yards, building contractors, and department stores should be the initial outlets. Special outlets should be developed. Furniture manufacturers constitute a very important group of customers for the plywood producer.

VENEER USES

Plywood has many uses. It is used extensively in the manufacture of furniture. Relatively thin plywood can be used for the unexposed parts of furniture, thus greatly reducing the weight and cost. Exposed parts of the furniture are often made up of plywood with beautiful and expensive wood used for the veneered places that are exposed. Such plywood is made with less expensive core and back. Table tops and desk tops are made by veneering the exposed side only of a wood core. Flush plywood doors have become much more popular than panel doors in house construction. The obvious advantages of no shrinking, cracking nor warping are rapidly gaining world wide acceptance of plywood. In many places substantial premiums are being paid for veneered plywood.

Plywood is also being used in other ways in house construction, not only for interior work, but for areas exposed to the weather. Structural members of buildings have been built of plywood, thus successfully supplanting the more expensive steel construction. Marine plywood has been found quite satisfactory for the construction of the hulls of small boats.

Plywood and veneer have both been used exclusively in container construction for freight shipments. All of these uses combined have a very considerable effect in conserving the forest products by making use of much lumber that would otherwise be waste. At the same time, it brings the most beautiful and expensive woods within practical cost limits.

There is also a wide market for veneer that has not been made up into plywood. Such veneer may be used for making orange crates, berry boxes, hampers and baskets. The selection and packaging of such veneer will depend on the particular end use.

In some cases, this type of further manufacture may be carried on adjacent to the plywood plant. Veneer sales would be profitable, but are not included as part of the sales of the plywood plant described in this brochure.

COSTS AND PRICES

Many years of experience in the operation of a small plywood mill in the United States provide the manager of a new plant with a vast amount of valuable data on which to base his estimates of cost of operation and the prices he should charge in order to make a fair profit when his plant is in full operation.

For a small plywood plant in a foreign country, the United States experience is not quite so applicable. The actual costs incurred and the scale of prices that can be charged for veneer and plywood will not differ to the same extent in all places from corresponding costs and prices in the United States.

It will be necessary for a plywood plant in a new location to have a schedule of prices. Such a schedule will show the variations for corresponding varieties of the size and thickness of plywood panels made, the species and grades of wood and other factors. For the purposes of this brochure, however, a single price has been used as though it would be applicable to the total output of the plant. A detailed price sheet would not be particularly useful and might be misleading.

TOTAL SALES

The estimated annual production of the plant described in this brochure is 5,000,000 square feet of plywood.

It is assumed that, based on the various qualities and thicknesses of plywood likely to be ordered and produced, the selling price will average about $120 per 1,000 square feet. At this price, the annual sales will amount to $600,000.

RECAPITULATION OF COSTS, SALES AND PROFITS

	Estimated Costs		Actual Costs
Annual direct operating cost	$ 344,500		$
Annual indirect operating cost	42,500		
TOTAL ANNUAL OPERATING COST		$ 387,000	$
Annual depreciation	23,527		
Interest on loans	6,000		
Insurance	3,000		
Legal and auditing	5,000		
Unforseen expense	25,473		
ANNUAL BURDEN COST		63,000	
SALES COST, INCLUDING FREIGHT		50,000	
PROFIT BEFORE TAX		100,000	
ANNUAL SALES		$ 600,000	$

BUDGET CONTROL

A requisition form follows, which is designed to provide accurate records and control of costs, both direct and indirect, with the least amount of time and effort.

This form has an account number for each type of the various expenditures which the manager will review in detail, monthly or oftener, in order to control his expenses. Some items, such as power, water, etc. are usually under contract and are easily checked by reference to monthly bills. For simplification, such items (marked with an asterisk on the attached list) are omitted from the purchase requisition. Variations in the labor costs are easily reviewed by examination of the payroll. The simplified type of control thus provided mades certain that the manager can control expenditures promptly.

It is essential to maintain accurate control of costs with as little clerical work as possible. On the volume of business as low as would be considered for a small plywood plant, even minor losses could wipe out a large proportion of the estimated profit. Likewise, an unwieldy and expensive method of accounting would reduce profits quickly. For this reason, a purchase requisition has been designed, and is shown on Page 36. This will provide a simple method of checking all expenditures. The budget method suggested is based on an annual sales volume of $600,000. If business should fall below that level, or increase above it, the budget should be lowered or raised to conform.

BUDGET CONTROL ACCOUNTS

		Monthly Expenditures	Monthly Budget	Annual Budget
10	Administrative	$	$ 1,166	$ 14,000
20	Sales, including frieght		4,166	50,000
30	General plant, machine and equipment parts		75	900
* 31	Power		250	3,000
* 32	Water		41	500
33	Truck		41	500
34	Cutting tools		208	2,500
35	Sand paper		83	1,000
36	Grinding Wheels		41	500
37	Hand tools		50	600
38	Lubricants, packaging materials, office supplies, other		208	2,500
40	Logs		12,500	150,000
41	Glue		3,333	40,000
50	Unforseen expense		2,122	25,473
* 60	Indirect payroll		2,833	34,000
* 61	Direct payroll		12,583	151,000
70	Special Projects			

Note: Number 10 includes interest on loans, insurance, legal and auditing.

PURCHASE REQUISITION	COMPANY NAME	DATE:

INDICATE BELOW THE DEPARTMENT OR PROJECT IN WHICH THE MATERIAL WILL BE USED:

( ) 10 ADMINISTRATION	( ) 32 TRUCK	( ) 37 HAND TOOLS
( ) 20 SALES	( ) 34 CUTTING TOOLS	( ) 38 LUBRICANTS ETC.
( ) 30 GENERAL PLANT MACH-EQUIP PARTS	( ) 35 SAND PAPER	( ) 40 LOGS
	( ) 36 GRINDING TOOLS	( ) 41 GLUE

INDICATE BELOW THE USE OF MATERIALS:

( ) DIRECT MATERIALS
( ) MAINTENANCE MATERIALS
( ) MAINTENANCE SERVICES
( ) OPERATING SUPPLIES

( ) 50 UNFORSEEN EXPENSE

( ) 70 SPECIAL PROJECT

NUMBER
TITLE

PLEASE ORDER THE FOLLOWING MATERIALS OR SERVICES: | DELIVERY WANTED

QUANTITY	DESCRIPTION	UNIT	TOTAL	

QUOTES FROM

REQUISITION BY

APPROVED BY

ORDER PLACED WITH

ORDER NO. | ORDER DATE

SUMMARY

A small plywood plant built and operated to make plywood panels aggregating an annual sales volume of $600,000, according to the assumptions made in this brochure, would be a profitable undertaking.

There are some determinations, however, that should be made before a decision is reached to build and operate such a plywood plant. Among the necessary determinations to be made are those with respect to the following items:

SALES

Will the potential annual sales of the kinds of plywood produced by the plant amount to at least $600,000?

COSTS

After revising the estimates of costs and earnings shown in the brochure so they conform to actual local costs, where it is proposed to build the plant, will a profitable operation be indicated?

COMPETITION

Is there potential conpetition which will reduce the revenues below a profitable level, either by lowering the prices, or by reducing the volume of sales?

ORGANIZATION

Is there reasonable assurance that experienced men will be available for management, and for other key posts, to initiate operations?

Will suitable trainees be available for the permanent organization?

The men in the key posts should be trained in advance of the initial operations of the plant.

A small plywood plant, such as described in this brochure, when installed and operating, will serve as a good nucleus for a much larger industry when a larger plant is justified. The transition can be made by gradual growth.

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2916 Sidco Drive,
Nashville 4, Tennessee.

ENGINEERS

The services of professional engineers are desirable in the design of a plywood plant, even though the proposed plant is small. A correct design is one which provides the greatest economy in the investment of funds and establishes the basis of operation that will be most profitable in the beginning and will also be capable of expansion without expensive alteration.

The addresses of professional engineers who specialize in industrial design, some of whom may be willing to undertake such work on low cost projects overseas, can be secured by reference to the published cards in various engineering magazines. They may also be reached through their national organizations, one of which is the

National Society of Professional Engineers,
2029 K Street, Northwest,
Washington D. C.

Manufacturers of industrial equipment employ engineers familiar with the design and installation of their specialized products. These manufacturers are usually willing to give prospective customers the benefit of technical advice by those engineers in determining the suitability of their equipment in any proposed industrial project.

The equipment manufacturers also know, and can recommend, professional engineers in private practice, who are willing and able to provide appropriate consulting services.