

Modern Equipment Used in the
Manufacture of Douglas Fir
Plywood

by
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PREFACE

In this paper I will attempt to discuss the various types of machines used in the Douglas fir plywood industry from the standpoint of purpose, design, efficiency and specifications of the machines. Out of necessity it is impractical to describe the detailed construction and design of each machine and I have failed to do so here. I have, however, described the lathe from all aspects, including installation, construction, setting up, and maintenance because I consider this operation to be one of the most critical in the entire plant. Failure to produce good stock from the lathe renders all succeeding operations inefficient and results in a poor product.

Many of the machines described herein were designed by certain plant engineers to meet the needs of that particular plant. Their intimate details are kept a secret but in many cases modifications are present throughout the industry.

I wish to express my appreciation to Mr. Calvin Bamford of the Globe Manufacturing Company, to Robert Wise of Cascades Plywood Corporation, and to Assistant Professor J. D. Snodgrass, School of Forestry, Oregon State College, all of whom contributed material and a number of ideas incorporated in the text. I also wish to express my gratitude to Professor J. B. Grantham, School of Forestry, Oregon State College, for his advise and counsel in the

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УЧЕБНО-МЕТОДИЧЕСКОЕ ПОСОБИЕ

ПО КУРСУ «ИСТОРИЯ»

1988

INTRODUCTION

Douglas fir plywood is said to have been first manufactured in the northwest in 1905 at a plant located at St. Johns, Oregon. This first plant was closely followed by others in McCleary, Sedro Woolley, and Tacoma, all located in the state of Washington.

The first plywood plants were largely in the nature of plywood departments of door factories, producing little plywood beyond requirements for their own immediate use.

A few Douglas fir panels were exhibited at the Lewis and Clark Centennial Exhibition in Portland in 1905. These panels were handmade at Portland in manually operated presses using animal glue that was spread with a brush. Mechanical production of plywood panels began about 1910, but the distinctly structural plywood that has carried the name of Douglas fir plywood all over the world did not appear until about 1920.

Actually, the earliest known evidence of the art of veneering was discovered in the sculptures of Thebes, dates as early as the time of Thothmes III (1500 B.C.). It is quite evident that the rudiments of woodworking and the practical use of glue were well understood at that date. The thin veneers were hand hewn from contrasting colored woods, spread with glue, then superimposed upon each other, and weighted down with sandbags in lieu of clamps or presses. It seems evident that they understood

the application of heat as a catalyst because records show that in some instances they heated the sandbags before placing them on the glued sheets of veneer. The glue was broken up from flakes or lumps and softened by heating over a fire. It was undoubtedly a primitive kind of what is now known as animal glue.

Most of the evidence of the early use of veneer lies in the furniture made during the time of the early Egyptians, classical Greece, the Roman Empire, France in the 17th and 18th centuries, and other period furniture types. These types still supply the background and graceful design for the large part of the better furniture that is made today.

The early machines used for the production of veneers were a primitive type of the machines we know today. Most of them were powered by hand with a few of the later ones utilizing water power.

The earliest mechanically operated saw (developed in 1650) was of the reciprocating blade type with man as the source of power. This was built in single or gang units. One of its uses was undoubtedly cutting thin boards for veneers.

The first patent on a circular saw appears to have been granted in England to Samuel Miller, August 5, 1777, but it did not reach the point of much utility until about 1805 shortly after the advent of the steam engine. It did not come into wide use until about 1840 when the art of

inserted teeth greatly widened its application to industry.

Band saws, continuous or endless, could be made of much thinner steel than circular saws, and their invention is first recorded in the English patent of William Newbry in 1808.

The first distinct veneer cutting device was a modified turning lathe on which an American patent was taken out by John Dresser of Stockbridge, Massachusetts in 1840. This is described as having a strong wood or iron frame upon which rested two iron strands supporting an arbor or mandrel which turned against a knife, and cut veneer in a continuous sheet. It was further specified that, "water, steam or horsepower may be used to propel the machine or a hand crank upon the cog wheel".

A veneer slicer, known to have been in use before 1875, was apparently the last of the veneer-production machines to be developed. Its cutting mechanism was very similiar to that of the veneer lathe, but was actuated by a pawl or ratchet device to feed the knife into the flitch, at the same time regulating the thickness of the sheets of veneer.

Machinery used in plywood manufacture is being improved upon constantly. Even as this paper is written, changes are being made which make present equipment outmoded. At the present time the industry is experiencing a healthy

market and is striving in every way to take advantage of this condition by an increased production with lower production costs. Highly mechanized and efficient equipment is one of the better ways to make this possible.

The United States has vast forests to support the manufacture of plywood. The major forests of commercial importance grow in Washington, Oregon, and northern California. Some of the ancient stands of Douglas fir are such that the logs cut will average 4 to 6 feet in diameter, the larger logs being in the state of Washington and the smaller ones in the state of Oregon. The age of some of these trees runs up to 600 or 700 years. It is the availability of logs of this size that permits our plywood factories to run on a production basis which makes Douglas fir plywood competitive throughout the world.

Until recently fir plywood was manufactured with a soya bean and meal glue in cold presses, but within the last few years a number of hot presses have been installed. Fir plywood is now available, manufactured with phenolic and other synthetic resins, for exterior and other uses.

The growth of the fir plywood industry is indicated by the following figures:

Plywood Production*

Year	Production	Year	Production
1925	153,000,000	1937	725,000,000
1926	173,000,000	1938	650,000,000

1927	206,000,000	1939	1,000,000,000
1928	276,000,000	1940	1,200,000,000
1929	358,000,000	1941	1,600,000,000
1930	305,000,000	1942	1,800,000,000
1931	235,000,000	1943	1,438,000,000
1932	200,000,000	1944	1,440,000,000
1933	390,000,000	1945	1,175,000,000
1934	384,000,000	1946	1,390,000,000
1935	480,000,000	1947	1,600,000,000
1936	700,000,000		

*In terms of square feet of 3/8", 3-ply, rough thickness.

The production of Douglas fir plywood is largely supervised by the Douglas fir Plywood Association; the work which this association has accomplished accounts for the uniformity of grades and the high standard of quality which has been maintained.

Although the United States can pride itself on the use of the finest mechanical equipment in the manufacture of its products, we are forced to admit that we have lagged far behind Europe in the manufacture of plywood. Hot presses have been used in Europe for years, but we have not adopted them until fairly recently. Now, however, many ingenious machines have been developed, such as the log barker, which is a good sized plywood plant, saves the work of eight to ten men and also presents the log to the lathe with the high spots and grit removed, thus permitting the lathe to peel more rapidly. Attached to many of the conveyor systems are automatic clippers working with extreme rapidity on single sheets of veneer. There is, also, an ingenious tapeless splicer, quite different from the conventional type, in that it operates on a revol-

ing drum bringing out a continuous sheet of veneer which is then reclipped permitting the use of narrow strips which would otherwise be waste material. The fir plywood industry also employs unique and efficient patching equipment.

The future of plywood throughout the world is bright. World War II brought plywood into such prominence that it is receiving the attention of the best technical brains. It will find its place for use in many interesting and unique ways but fundamentally its progress is based on the replacement of lumber to an ever increasing extent. It wastes much less raw material, it is more stable, and it permits the use of light-weight wide boards with greater ease and less expense.

The case of plywood vs. lumber leaves little doubt that the former will more and more replace lumber not only because of its physical attributes and its ease of application, but because of the yield from the log, quantitatively as well as qualitatively, is much superior.

BARKERS

This is the first process in the actual manufacture of Douglas fir plywood. It is necessary to remove the bark in order to remove the high spots and to eliminate gritty substances which could harm the knife and slow down production.

There are several types of barkers in use today the most important of which will be discussed here.

Rotary Traveling Head Barker

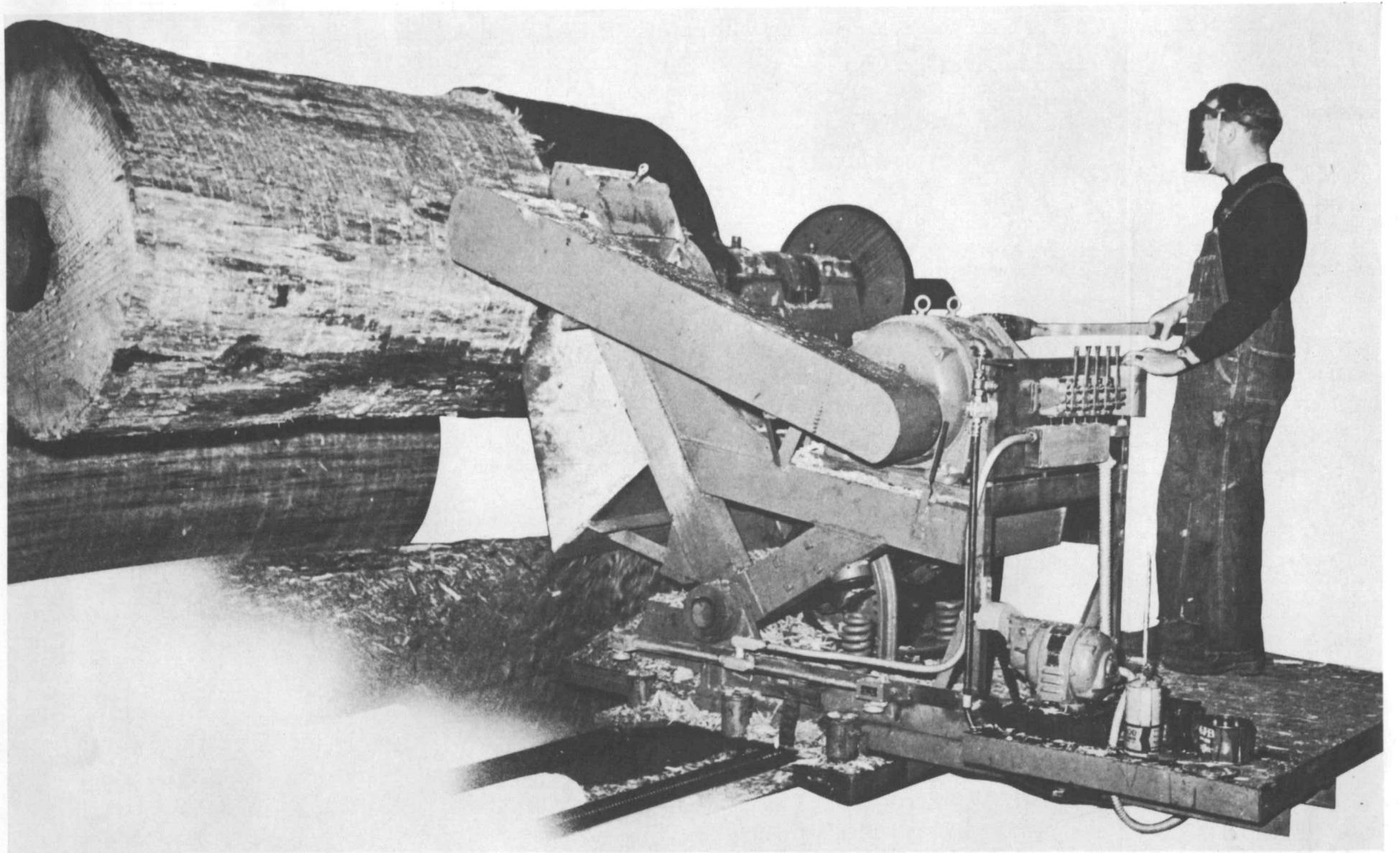
The operating principle of this machine is similiar to that of a gigantic wood lathe with a traveling high speed cutter head acting as the tool. Bark and foreign matter which might damage costly veneer knives are quickly removed by the ten blades of the cutter head.¹

Operation

This barker will efficiently remove bark from logs between five and twelve feet in length, and up to 120 inches in diameter. Logs to be barked are swung into position by individual motors. Dogging is accomplished by a powerful electric motor which drives the dogging spindle against the end of the log with sufficient force to set both dogging chucks simultaneously. The log is then slowly revolved, the rotating cutter head is brought to bear on the log, and the bark is rapidly removed. Control of the cutter head is accomplished by means of a handle which can be seen near the operator's position. An alternate manner of controlling the cutter head is by means of an air cylinder which is actuated

¹

See Figure 2



with a special air valve in connection with speed control valves on the end of the cylinder. Deep, heavy, or light cuts may be obtained by decreasing or increasing the pressure on the handle as desired. The accompanying illustration serves to point out the basic design of this type of barker.

The average west coast fir block takes only one cut across and one cut back to be prepared for peeling. The average six foot block requires approximately five minutes to complete the operation from floor to floor.

Design

The barker consists of massive headstock and tailstock sections mounted on a heavily reinforced steel base. The cutter head section is mounted on a separate base of heavy steel construction.

To drive the barker there is a power unit contained in the headstock. High or low speed selection is provided by means of a shifting lever and a lever lock. The headstock spindle is motor-driven to provide rapid positioning of the chuck for dogging, while the tailstock unit contains the power-dogging unit.

The cutter head is supported on a carriage which moves parallel to the log. Travel speed of the cutterhead carriage is controlled by the operator. A power crossfeed positions the cutter head with respect to the diameter of the log being barked. The depth of cut is governed by the operator's manual

guidance of the cutter head tilting control which permits the cutter head to follow the contour of the log.

The power requirements of this machine are as follows:

Power requirements on the lathe:

10 H.P. motor for rotating the log

15 H.P. motor for the chucking block

3 H.P. motor for the adjusting spindle

Power requirements for the barker:

25 H.P. motor for the cutter head drive

3/4 H. P. motor for the adjusting cross compound drive (this is to accomodate various diameter logs).

1/2 H.P. variable speed transmission is used for the longitudinal feed.

Lathe Type Barker

This is a machine very similiar to the standard veneer lathe-type peeling machine.¹ The log is mounted in the machine between two chucks just as in the rotary traveling head barker. The dogging is accomplished by means of a powerful electric motor which drives the dogging spindle against the end of the log with sufficient force to set both dogging chucks simultaneously. After the log is secured in position, the log is revolved against a large knife which is set in a horizontal plane. The knife extends the full length of the machine on the inside of the frame and is regulated to even cutting by a pressure bar. The knife carriage is moved into the log by

¹

See Figure 2

automatic feed screws revolving at a speed which controls the thickness of the cut. The R.P.M. of these feed screws is adjusted by a series of changeable gears.

Customary lathe speeds are from 30 to 60 R.P.M. Some veneer mills utilize a series of fixed speed such as 24, 30, 36 and 48 R.P.M. and set these speeds (by change gears or belts) for each log, or in case of large logs, interrupt the operation to change speeds. Variable-speed motors have been adopted for such a program with fair success, but many types of motors will race unless approximately fully loaded, which is objectionable when entering or leaving a cut. The variation in power demand between different thickness cuts also causes racing and is a handicap to variable speed motors. Frequency changers are preferable, giving greater flexibility and more constant speed under varying loads.

Compressive Type Barker

A new method of barking logs has been developed by the Weyerhaeuser Timber Co. and is now in use at the Weyerhaeuser plywood plant at Longview, Washington.¹ The new equipment removes bark by compression and shearing action. It gives a clean separation which leaves the block free from bark without cutting into the outer sapwood.

One man operates the Weyerhaeuser machine from a carriage which moves the bark-removing compression head across the log which is turning in a lathe. Controls, mounted upon the carriage,

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"Weyerhaeuser Develops New Log Barker", The Timberman", Vol. 49, No.3, P. 176 (January, 1948).

guide a rotating wheel which compresses and tears off the bark. An air cylinder and piston furnish the power for the compression head which automatically follows the log contour.

The machine was designed on the simple principle that it requires less force to crush bark than it does to crush green wood. When the force is right, the bark separates automatically at the cambium layer thus securing wood-free green bark as one product, and bark-free logs as the other product.

The clean bark removed by the machine furnishes raw material for silvacon, a new bark product used as an ingredient in plastics, insecticides, magnesite flooring and many other products.

Average barking time for an eight foot log of 40 inch diameter is 1-3/4 minutes. The compression cylinder and shearing head may be mounted upon standard rosser barkers now in use.

Hand Barking

In some cases, logs possess excessive taper or are irregular or crooked. As mechanical barking is best accomplished on logs which are smooth, straight, round and well tapered, most of the work of hand barking is done on logs which do not possess these desirable characteristics. The equipment used is mostly axes and flat chisel-like bars. This process is slow and is not at all widely applied to production plants in the industry.

VENEER CUTTERS

In general, rotary veneer lathes account for nearly 100% of all veneer production on a superficial area basis. It has been proved that rotary cutting is the most practical on a production line basis, and it has been widely adopted by the industry as a result.

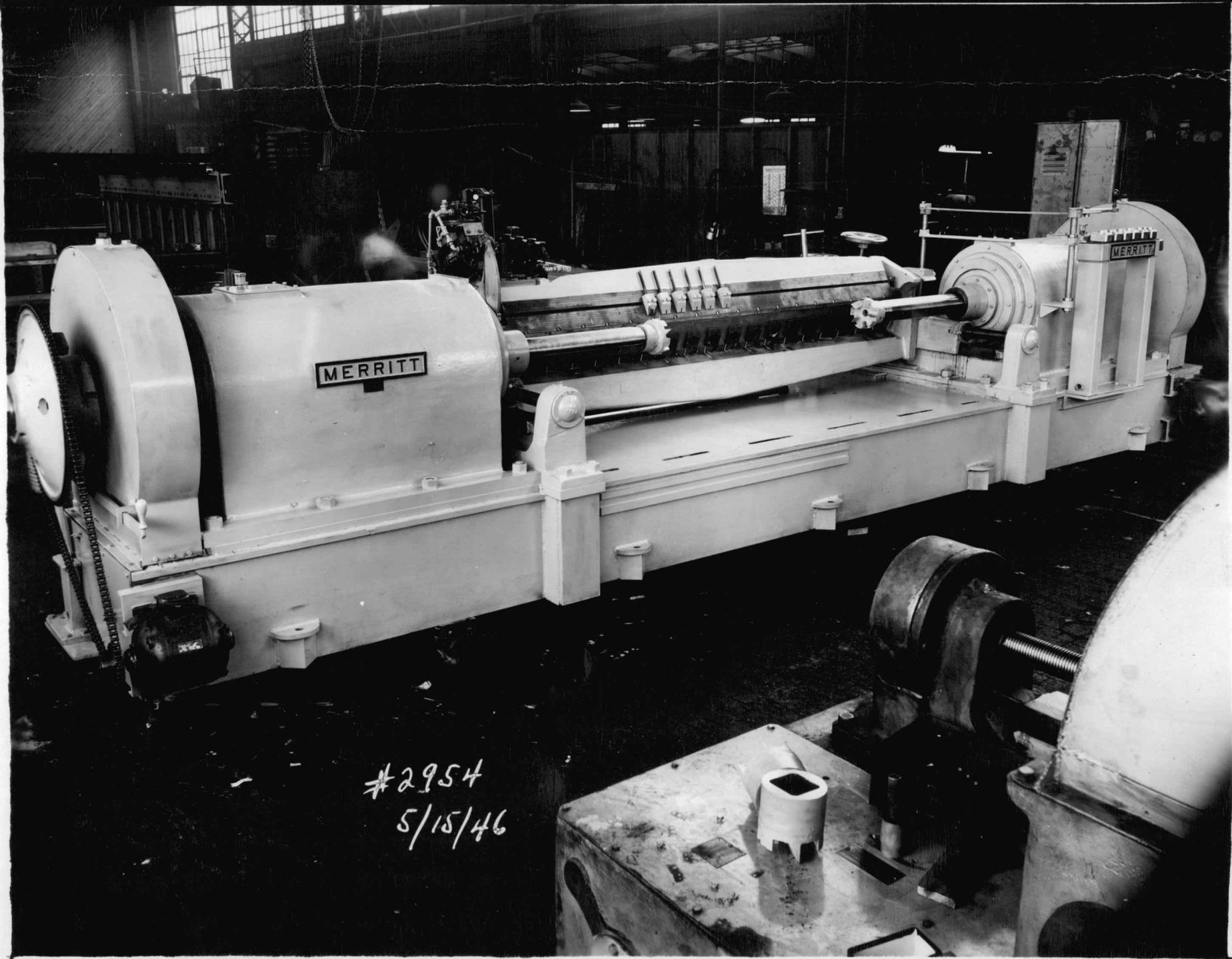
The bulk of veneer lathes produce veneer 8 feet in length, although ten foot lathes are not uncommon. A few lathes are in service that produce twelve and sixteen foot veneer, but long, straight, and clear logs are difficult to obtain. Another consideration is the longer the log, the greater the core that must be discarded. Logs are cut to veneer lengths with adequate trim allowances (approximately 6 inches) on a drag saw of circular, reciprocating, or band saw types. This cutting to length immediately precedes lathe cutting to prevent end checking which may be serious in warm climates. These shorter logs or bolts are usually cooked in hot water or steamed for a matter of hours to bring the wood fibers into the best condition for clean smooth cutting.

Standard Lathes

This type of lathe is very similar to the rotary type barker described previously.¹ It consists generally of a heavy steel bed on which is mounted, at each end, a frame work for the support of the bearing shafts. The shafts are provided with chucks for gripping the log and can be lengthened or shortened as necessary. The log (or block) is hoisted by

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See Figure 2 and 2A



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power, usually an overhead crane arrangement, and inserted in the lathe from either the front or the top. The knife extends the full length of the machine on the inside of the machine, and is regulated to even cutting by a pressure bar.

The cutting is accomplished by revolving the log against the knife; the veneer is then peeled off in a continuous sheet very much like unrolling paper. The knife carriage is moved into the log by automatic feed screws revolving at a speed which controls the thickness of the veneer. The R.P.M. of these gears is adjustable by means of a series of changeable gears. Veneer is cut in many thicknesses ranging from $1/40$ to $5/16$ inches. For special purposes it is cut as thick as $3/8$ inch and as thin as $1/110$ inch. The common thicknesses cut on the rotary veneer lathe are $5/16$ ", $1/4$ ", $1/8$ " and $1/20$ ". Other thicknesses cut in considerable quantities are $1/5$ ", $1/6$ ", $5/32$ ", $1/7$ ", $1/9$ ", $1/16$ ", $1/12$ " and $1/30$ ".

As the veneer comes from the lathe it is received on a table or carrier, torn or clipped into convenient lengths for handling, and later clipped again to eliminate defects and to bring the sheets to the desired dimensions. Rotary cutting is a comparatively simple operation but it requires an experienced and capable operator to get the best results. In fact, much of the success in cutting veneer by any process depends on the skill of the operator.

Rotary cut veneer has a firm side and a checked side. The

side next to the knife or log is only slightly broken but the entire effect on the sheet is so pronounced that, as the sheet is taken from the log, it tends to be flat or at times to curl in the opposite direction from that in which it is held in the log. The care used in the preparation and cutting of the logs has a great deal to do, however, with the amount of checking. Rotary cut stock is flat-grained because of the manner of cutting.

Customary lathe speeds are from 30 to 60 R.P.M. An experienced crew can handle veneer at the delivery rate of 150 to 200 feet (lineal) per minute.

The modern rotary-cutter, worked by a skilled operator is a remarkably efficient machine which will produce thick or thin veneer, smoothly cut, and uniform in thickness. To produce such veneer, however, it is essential that the knife be kept sharp and properly ground and that the pressure bar be correctly positioned in relation to the cutting edge of the knife throughout its entire length.

The function of the pressure bar is to prevent splitting by exerting compression on the wood as it is fed toward the knife. The pressure should increase gradually and reach its maximum when the actual cut is being made. The thinner the veneer to be cut, the closer should the pressure bar be set to the knife.

The pitch of the knife, as determined by the angle which the bevel of the knife makes with a perpendicular line drawn

Through its cutting edge, should be varied for logs of different diameters. It follows, therefore, that in order to make a smooth cut throughout the pitch, the knife should be adjusted as the diameter of the log decreases. In the latest Coe machines the necessary adjustment is automatically controlled.

Although the veneer and plywood industry depends primarily upon electric motors for virtually all of its many machines required to peel and process veneers into panels, it still has many adherents of steam when it comes to lathe drives.¹

High starting torque, and the ability of the steam engine to produce smooth, continuous power, and to maintain constant R.P.M. on the lathe, are the virtues claimed by adherents of the steam drive.

In the fir industry, steam is still available since it is required in the operation of the dryers and hot plate presses.

One of the most widely used steam engines for the lathe drive is the verticle two-cylinder model produced by the Ajax Iron Works of Corry, Pennsylvania. Requiring but a minimum of floor space, the Ajax has a variable cut-off for ease of power control and steam economy. It is coupled to the lathe by direct connection, or by single or double speed chain drive arrangements as developed by lathe manufacturers.

The Ajax steam engine is a one-piece semi-steel casting with double bored cross-head guides, fully machined to assure perfect alignment of cylinders crossheads and crankshaft.

The forged steel, double throw, counter-weighted crankshaft is mounted on double row, heavy-duty tapered roller bearings. Combined force feed and splash lubrication assures continuous oiling for all the wearing surfaces.

The crankshaft extension being the same at both ends, and the engine operating in both directions of rotation, the Ajax unit can be mounted in either a right hand or left hand position. An Ajax double-seated balanced throttle valve is used for controlling the speed of the engine to suit the desired cutting speed of the lathe.¹

¹
"Steam Veneer Lathe Drives", The Timberman, Vol. 48,
No. 3, P. 160 (January, 1947)

Directions and Suggestions Relative to
Setting and Operating Standard Veneer Lathes¹

Foundation

The piers which support the end frames should be of good quality concrete with sufficient bearing in the soil to insure a good footing. If it is difficult to get a good footing for the piers, it is a good plan to make them together in one solid block. The 3/4" bolts which secure the lathe to the foundations should be set in 3" pipe with good foundations at the bottom. After setting the lathe on the foundations and leveling it, the top of the foundation should be grouted with cement which, after hardening, will prevent any possible shifting. Leveling is done by using a good spirit level (or mason's level). The level is laid onto the ways of the lathe, that is, the finished surface which the knife bar assembly travels on. Small steel wedges or sheet metal plates should be used for blocking under the lathe and frames until they show perfectly level both ways. The ways are used to level the lathe crosswise and the spindle or drive shaft and feed shaft may be used for leveling the lathe lengthwise. It is also suggested to check the spindle for misalignment. This is done by stretching a silk line or other thin line from one end frame to the other. The spindle should be parallel with the taut line.

After the lathe is perfectly leveled, as suggested above,

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Directions and suggestions relative to Setting and operating Standard Veneer Lathes, Bulletin, No.23 (1938) Coe Manufacturing Co. -19-

there should be about $3/4$ " space between the base of the lathe and the foundation. The lathe is now ready for grouting and after the grout is hard, the lathe should be permanently bolted down.

The decimal gear box should be carefully lined up and grouted in a similiar manner. Particular attention should be given to the sprocket coupling. The two halves of the sprocket should be concentric and should have about $1/64$ " between them.

The grouting should be done by flushing a good grade of concrete mixed to a consistency that will allow it to be worked under the lathe with a small stick, also being sure to fill the pipes in the foundation into which the foundation bolts were set.

Knife and Pressure Bar

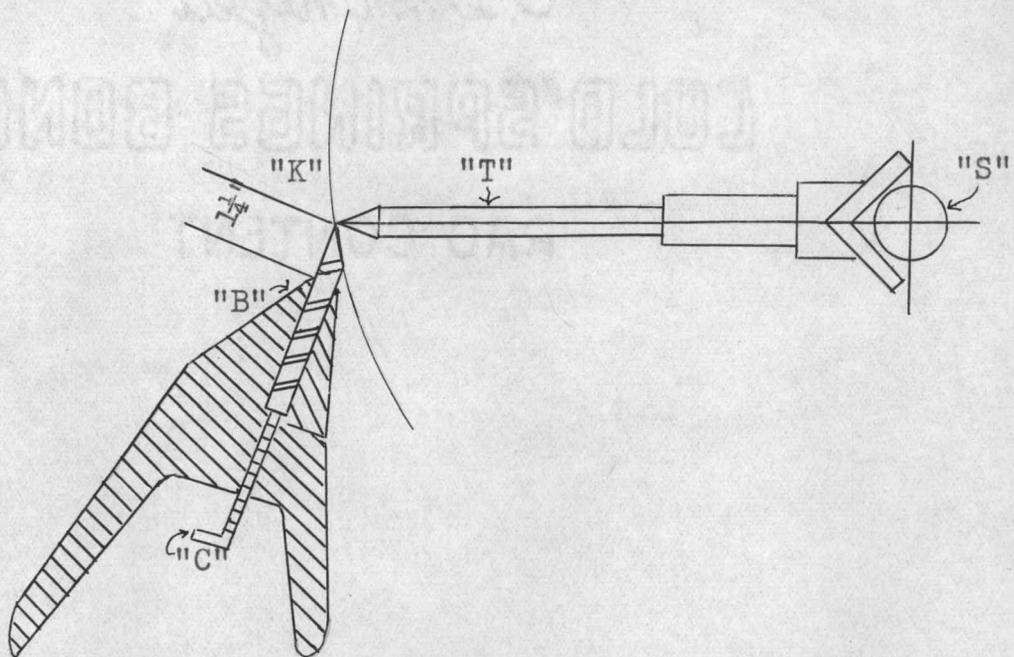
The next thing to do is to look over the knife and nose bar. The lathe knife shipped by the knife company is not ground ready for use. It should, therefore, be put in the grinder and ground to have a $1-3/4$ " to possibly $1-13/16$ " bevel and a concave of approximately $1/64$ ". After grinding, the knife should be carefully honed and then it is ready for use. It is also suggested that the knife bar be ground to approximately a 12 to 15 degrees bevel. The nose bar is now ready to be put in the approximate position, and the pressure bar and knife should be dropped into the knife bar. The cutting

edge of the knife bar should be set to project 1-1/4" above the finished surface of the knife bar. It should also be perfectly straight and project the same height the full length of the machine. After this is done the nose bar may now be lined up with the knife so as to set perfectly parallel with the knife cutting edge. Assuming that you wish to cut 1/16" stock, the nose bar should be set approximately 1/32" above the knife cutting edge. The opening between the nose bar and the knife should be somewhat less than 1/16" and the proper position can be finally determined after beginning to cut veneer. Having properly set the knife in the knife bar, the next step is to determine its proper pitch. Place the angle end of tram "T" against the spindle "S" and adjust the point against the cutting edge of the knife.¹ The clearance between the point of the tram and the bevel will indicate the pitch of the knife. When properly set, this clearance is a minimum at all distances of the knife from the spindle. It is clear that in order to maintain constant clearance as the knife advances into the log, the knife must be automatically tilted to conform to the varying curvatures of the log. An automatic knife tilting device accomplished this result.

Power Dogging

Dogging is one of the major operations in producing veneer from the block and should, therefore, be performed in the most economical way.

¹
See figure 3



- T = Tram
- S = Spindle
- C = Adjusting screw
- B = Finished edge of knife bar
- K = Point of knife

Cross section through knife bar

Figure 3

In using motorized lathes, the operator first places the tail spindle in the desired position by pressing the "in" or "out" button at the push button station. Next, the block is placed into position and the operator now presses the "in" station of the dogging motor until the chuck is pressed into the block. This will usually bring the high torque motor to a stop. The operator now removes his finger from the push button and starts rotating the block. Additional dogging may now be done while the block is rotating.

To undog, or drop the core, the operator merely depresses the "out" station of the dogging spindle and the spindle will recede enough to drop the core and make room for the next operation.

Starting

Assuming that the operator has chucked a block, the knife bar assembly should be brought into approximate position and then the pressure bar should be released by the quick release lever. It is also suggested that the operator shift the double thickness lever into position 2 which will then permit him to round up the log three times as fast as when he is actually cutting good veneer. When the log is fairly well rounded, the pressure bar should be closed. This may be done while the lathe is in operation or rotating.

Assuming that the operator set up to run 1/16" stock and he finds the veneer coming loose or open, this would indicate

a lack of pressure and would call for applying more pressure by the micrometer adjusting screw. Should a sliver or small obstruction lodge itself between the knife and pressure bar it will cause the block to develop a ridge commonly known as a "rubber". Whenever this appears, the lathe should be stopped, and the pressure bar released, and the obstruction cleared out.

Adjustment

In the event that the veneer shows indications of being thick or thin, the fault then lies with the knife not being properly angled into the log, and this indicates that the pitchways are setting too low causing the knife to tend to walk out of the wood until it develops enough pressure. Then it takes a heavier cut until it has cleared itself and repeats the walking out again. The remedy for this trouble is to raise the pitchways or steps until the veneer is leveled to uniform thickness.

The opposite condition from the above may appear and in this case the veneer is delivered more or less corrugated, or in short waves. This indicates that the knife is angled into the log too much, caused by the pitchways setting too high. The remedy for this would be to drop the pitchways. An approximate position for the pitchways is about 3/4" or 1" lower toward the center of the lathe than it is near the delivery side of the lathe. This slight slope is for the knife to take care of the varying curvatures of the log from full diameter to core

diameter.

The knife may need honing occasionally which is done by using approximately a 3/4" x 2x6" honing stone. When honing the knife, the operator should always be sure that the stone rests at the cutting edge as well as at the bottom of the bevel; never in any circumstances should the hone be used in such a way that it makes contact with the cutting edge only; this would tend to back-bevel the knife and cause difficulty in cutting good veneer.

Core Lathe¹

Cores dropped from the big lathes, once a problem in disposal and utilization, are now being made to yield substantial quantities of additional core stock. The principle obstacles to running the core diameter down below 10 or 12 inches on the big lathes have been the large chucks, and the fact that material becomes increasingly harder to cut as the knife approaches the heart.

The problem of core utilization has been solved by the installation of small core lathes at a number of plants including that of the Springfield Corporation at Springfield, Oregon.

To be handled properly, the core must be cut down in length, for there is too much spring when the core gets down to 13 inches in diameter in the eight and ten foot lengths. The small lathe will handle stock up to 66 inches and will

¹ "Core Lathe Dividends", The Timberman, Vol. 46, No. 3, P. 140 (January, 1945).

peel a log or core up to 48 inches although this particular machine is used almost exclusively for the re-peeling process.

In the smaller diameters there is sure to be waste from splitting and checking unless the cores are steamed. It has been found that a four hour steam bath is about right to completely soak the 13 inch core. The cores are steamed in a 145 log vat measuring 10 x 71 feet. The cores move by the action of water intake and overflow in proper rotation to the lathe.

The core lathe is actually nothing but a small edition of the larger standard lathe. The capacity of the core lathe in an eight hour shift is about 18,000 square feet on a 3/8" basis. Cores can be peeled as thin as 1/10" up to 1/4".

The overall recovery from this operation is about six percent. The cost of recovery is higher on this small lathe for a comparable amount, but its use has been amply justified by the industry.

CLIPPERS

Many types of veneer clippers are in use today; some are controlled by hand or foot, others are partially or fully automatically controlled.

Manual or Guillotine Type Clipper

A typical clipper of this design consists of : (1) a sturdy iron frame carrying at each end vertical knife guides, (2) a cutting table, (3) a shear plate, and (4) a movable knife of sufficiently heavy section to render it free from any tendency to distort.¹ The lateral movement of the knife is controlled by the vertical guides, and it is vital to good workmanship that no play be allowed to develop at these points. The knife is counterbalanced by a weight which is raised by depressing a foot pedal, or by pressing an electrical switch, thereby releasing the knife which falls onto the veneer with a shearing action.

In certain machines, the knife passes the shear plate or bar when the setting of the knife to the plate must be as close as possible. In other clippers, a hardwood block is secured to the cutting table and the knife is so adjusted that in falling it clears the bottom veneer without actually penetrating the hardwood block. If the setting is not carefully controlled, the block will very soon become damaged, and as a result veneer cannot be cut with the sharp square edges so essential to good workmanship.

See Figure 4



MERRITT

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Machines of this type are relatively slow in operation and are used mainly in smaller plants and for reclipping operations.

Hydraulically Controlled Slicer

This slicer is, at the present, being used almost entirely in the battery separator and box plants, but because of its possibilities for use in veneer plants, it is worthy of mention here.

The machine, applied to veneer production, would consist of a knife clamped in a rigid knife bar and a pressure bar, both held in a frame and moved up and down on angular slides by a driving device, it would also have a feed for the stock, and tables for storage of stock to be cut, and for cut stock.

The slicer is adjustable for cutting stock of any size up to the rated length and width of the machine. To adapt it to plywood manufacture would require enlarging the machine to meet the needs of the industry. The feed can be connected to the main conveyor system and a continuous flow of material would be admitted. The down stroke is accomplished by means of a selenoid control and is connected to a foot or hand control point.

The knife descending on angular slides produces a draw cut and leaves the slice with a highly finished surface. During the cutting stroke the face of the veneer is slightly compressed by the pressure bar at the point opposite the edge of the knife insuring smooth and tight cutting.

Drive is by V-belts, further cushioning the shock loads and providing a quiet, efficient speed reduction.

The drive motor is of line start, squirrel cage type provided with dual ventilation, and having normal torque and low-starting current characteristics. The motor is mounted on a cast iron platform under the bed of the machine. The magnetic switch for the control of the motor is also mounted under the machine.

The hydraulic system is powered by a 10 H.P. motor driving a ball-bearing gear pump. The pressure in the hydraulic system is kept constant by a by-pass valve. A large oil reservoir is provided in the back leg of the machine. As it is now applied, the machines require 15 gallons of oil in its system.

The machine is capable of producing 240 cuts per minute.

Automatic Clippers

There are several types of automatic clippers in operation in American mills many having been built or improved by the mills own engineers.

The auto motor type of clipper is speedy in operation and is controlled by eight switch buttons which can be seen on the right hand side of any machine. Each button is connected in circuit with a contact which can be set at any desired distance from the knife up to a maximum of five feet. Any desired cut is brought in operation by the depression of any one of the control buttons and, as the veneer passing through

the machine touches the contact, the circuit is closed. This immediately releases the knife and severs the veneer at the desired distance from the point of contact.

Several varieties of automatic and very speedy clippers are operated by the Douglas fir plywood producers on the west coast.

The knife on one such clipper is controlled by a series of push buttons set an inch or two apart on an endless chain which runs alongside the conveyor table at the same speed as the belt carrying the veneer. The charge hand carefully watches the veneer as it passes before him and pushes home a button opposite the spot on the veneer where he wishes the cut to be made. As the button reaches the guillotine it operates a cam which controls the knife. A rapid stroke severs the veneer without even a momentary pause to its steady flow.¹

Clipper Synchronized with Lathe

To overcome the handicap of not having room for long veneer trays, an ingenious machine was designed by the Elliot Bay Plywood Co. mechanics.² To accomplish the task of being synchronized with the lathe, and not having long trays for storage space, they designed a machine that was very fast and highly selective. The perfected clipper embodying several new mechanical principles is operated with electrically controlled push buttons.

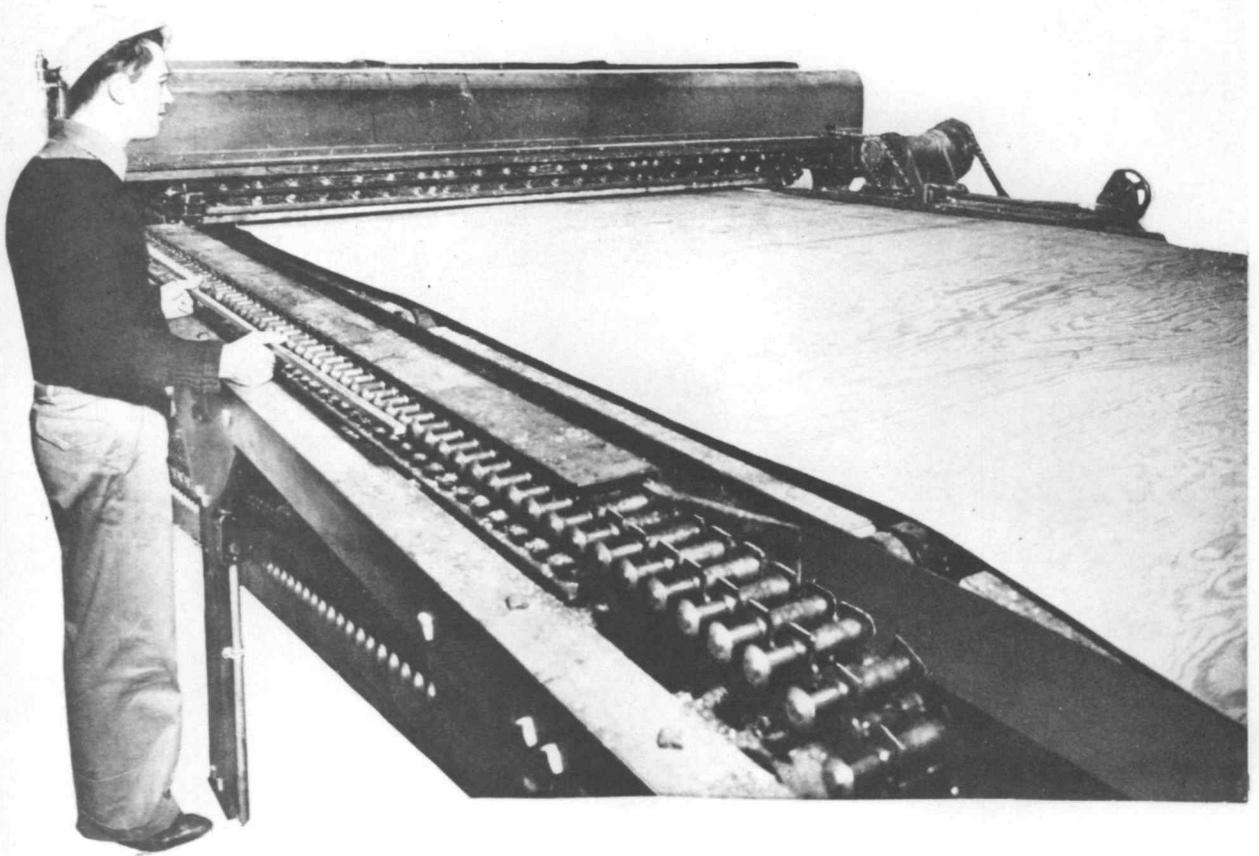
In the Elliot Bay plant, the clipper is set only 12 feet from the lathe with which it is synchronized. The speed of

1

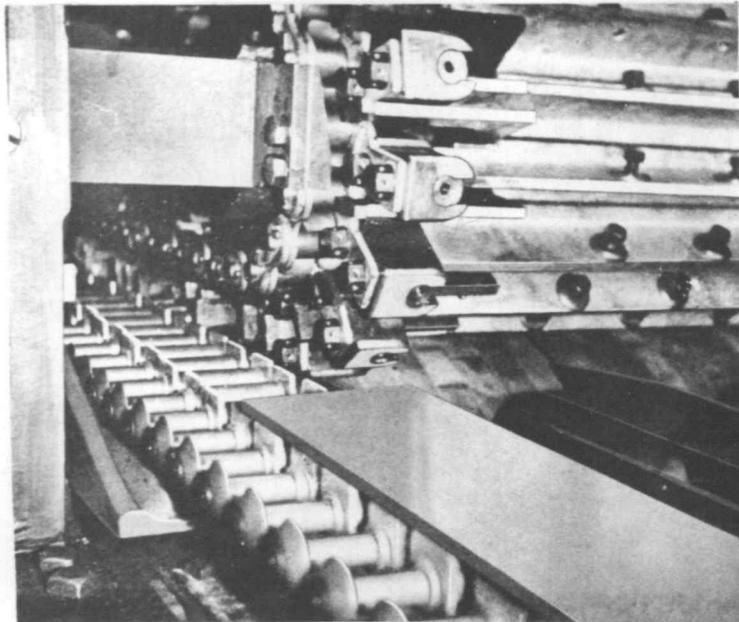
See Figure 5

2

"Veneer Clipper Synchronized with Lathe", The Timberman, Vol. 49, P. 166 (January, 1948).



View showing operator cutting out a defect on veneer



Close-up view of mechanism

Figure 5

operation developed by the automatic push button controls enables the lathe to run at a constant speed until the log is finished. There are five push buttons for the automatic measuring mechanism, four of which can be set to automatically clip widths up to 60 inches. The fifth button gives instant action when ever it is necessary to interrupt the automatic cycle to clip out a bad defect. The speed of the clipper can be set to fit the needs of the individual plants, but is usually run at an average speed of about 135 feet per minute.

One of the several new principles embodied in this clipper is a round clipper shear-bar riding in a steel saddly which in turn is kept in position by an inflated air hose on which it rests. The clipper knife strikes this shear bar just a little off center turning the bar slightly with each impact and giving the bar unusually long life- as long as four to six months. The veneer is cut off clean without any trace of tear. A notable fact is that the clipper knives are self sharpening until worn out.

Precise measuring of dimensions at the clipper stroke, regardless of the speed of veneer, makes this clipper adaptable to mills which at the present have the long conventional trays, or to new mills where it is desirable to save the room and expense required for long trays.

Large compressor capacity is not required for this machine. About 10 cubic feet of air per minute is sufficient to operate

the clipper. Heavy structural framework contains the mechanism in which steel castings are used in this machine. The entire machine is put together with bolts for easy dismantling. This clipper has been in continuous use for the past 6 years in the Elliot Bay Plywood Company's own plant in 6, 8 and 10 foot sizes.

VENEER DRYERS

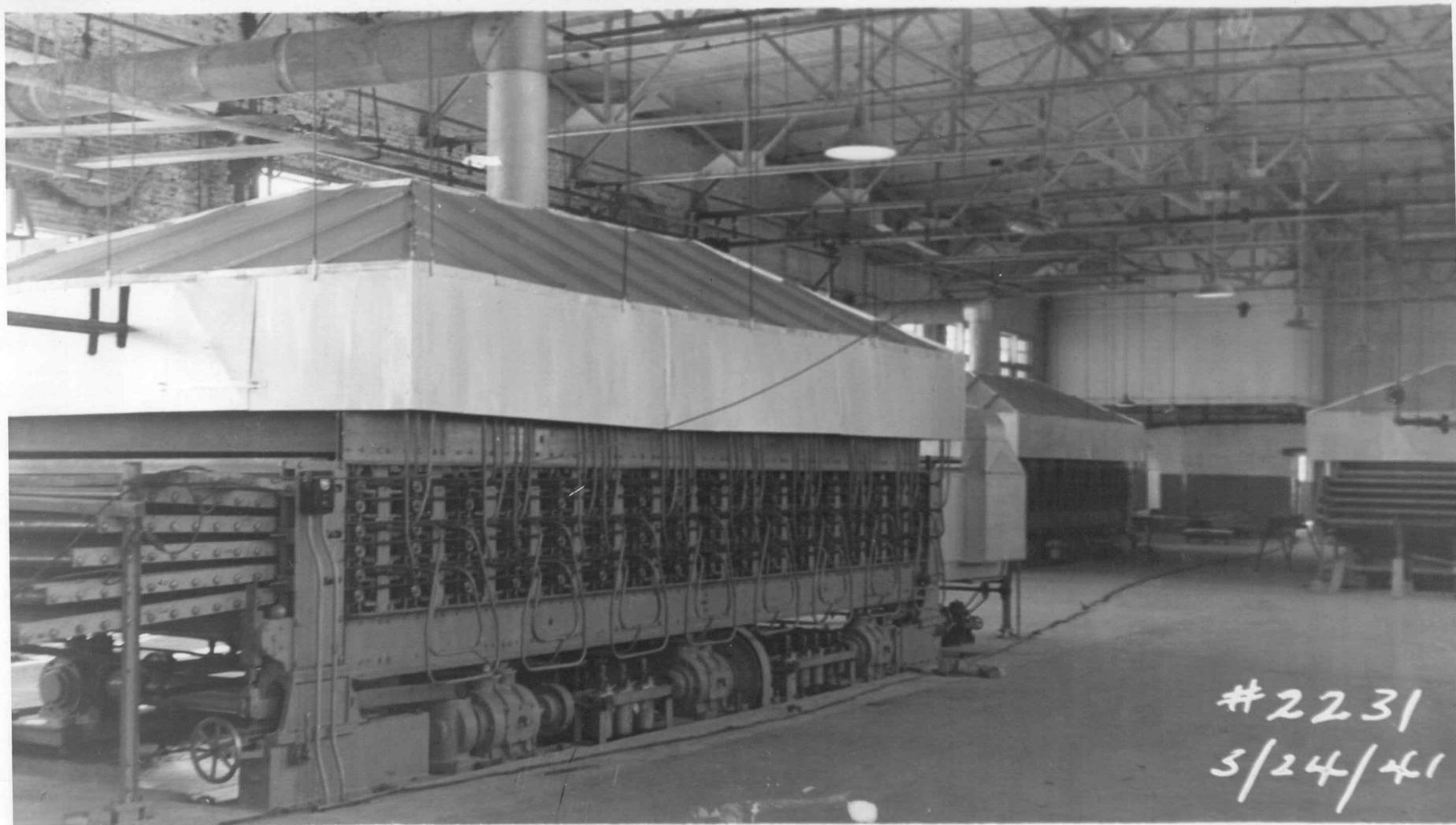
Veneer dryers, in general are long chambers equipped with rollers or belts to advance the veneer through the chamber.¹ Fans and heating coils are located along the sides of the chamber, circulating and recirculating back and forth across the chamber. From an ideal drying standpoint, veneer should move in one direction only, this permits the proper amount of drying power to be applied progressively along the side of the chamber so that a low temperature can be maintained at the start of the drying process, and drying condition can be changed to a high temperature and low humidity at the end of the cycle.

Most dryers are built with 2, 3, 4, 5 or 6 decks and can handle 10,000 board feet to 60,000 board feet (equivalent to 1" thick) of veneer in 24 hours. The standard width of rolls is 14 feet. Dryers are available in lengths of from 10 feet to 153 feet, depending on the demands of the plant. Most dryer manufacturers furnish the machines in sections. The sections are about five and one half feet long and are furnished to permit the installation of additional sections at any time to obtain additional drying capacity.

Most dryers now in use by the industry are of the double air system construction. As the recirculated air moves from the dry end toward the wet end, it is continually absorbing moisture from the veneer, which increases its humidity and reduces its temperature.

See Figure 6

FIG. 6



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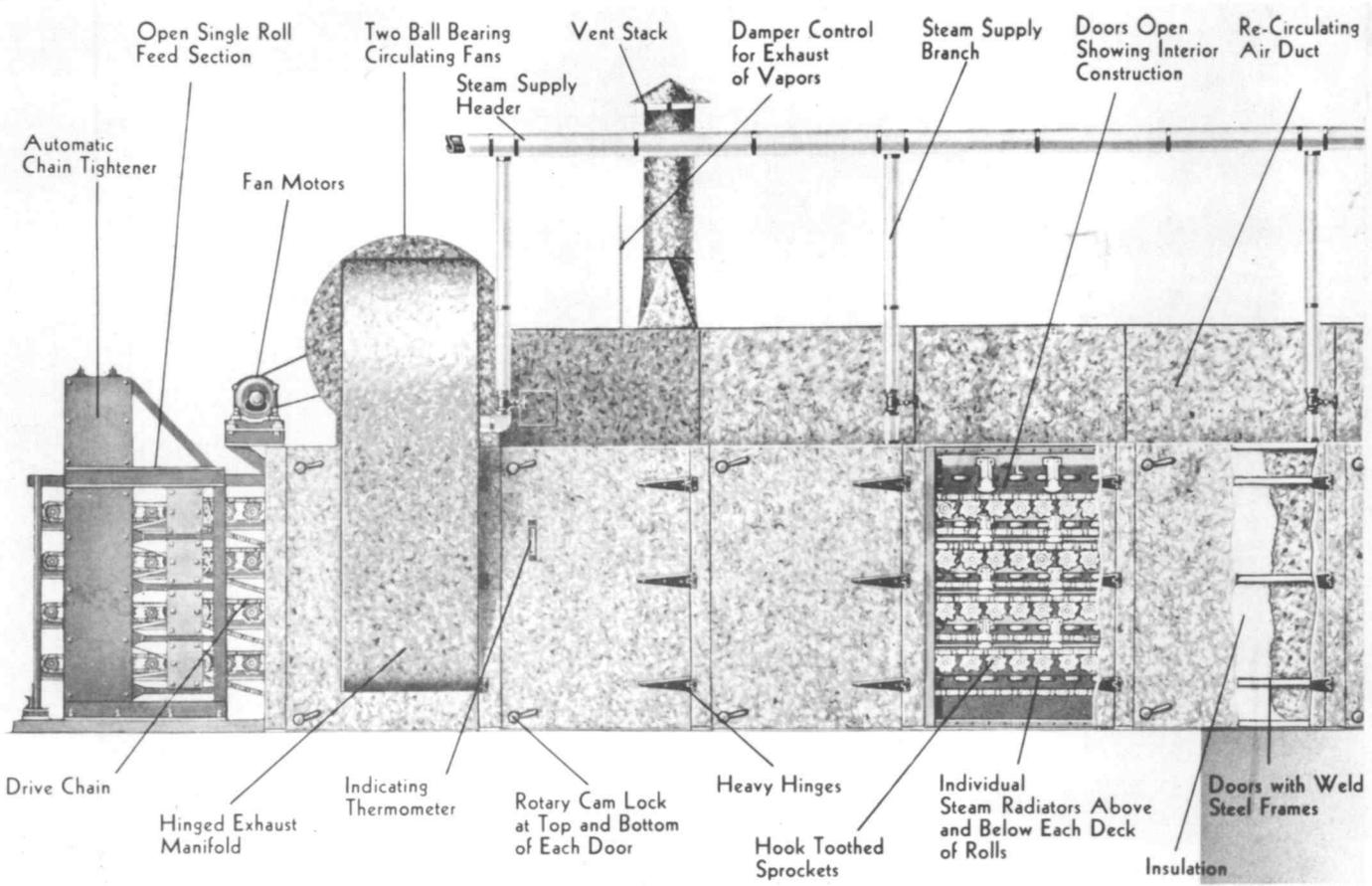
When the green veneer enters the dryer it encounters and is heated by this moisture laden air. Moving toward the dry end, and held perfectly flat by the rolls, the veneer encounters a progressively increasing temperature and dryer atmospheric conditions which eliminate the danger of casehardening and produce mellow, evenly-dried stock.

The veneer travels between top and bottom rolls with the weight of the top rolls on the veneer. Bot top and bottom rolls are positively driven. The veneer is free to shrink as it travels from one pair of double rolls to the next.

The air is usually uniformly distributed to and across each deck of the dryer by means of cross nozzles above and below each deck of rolls.

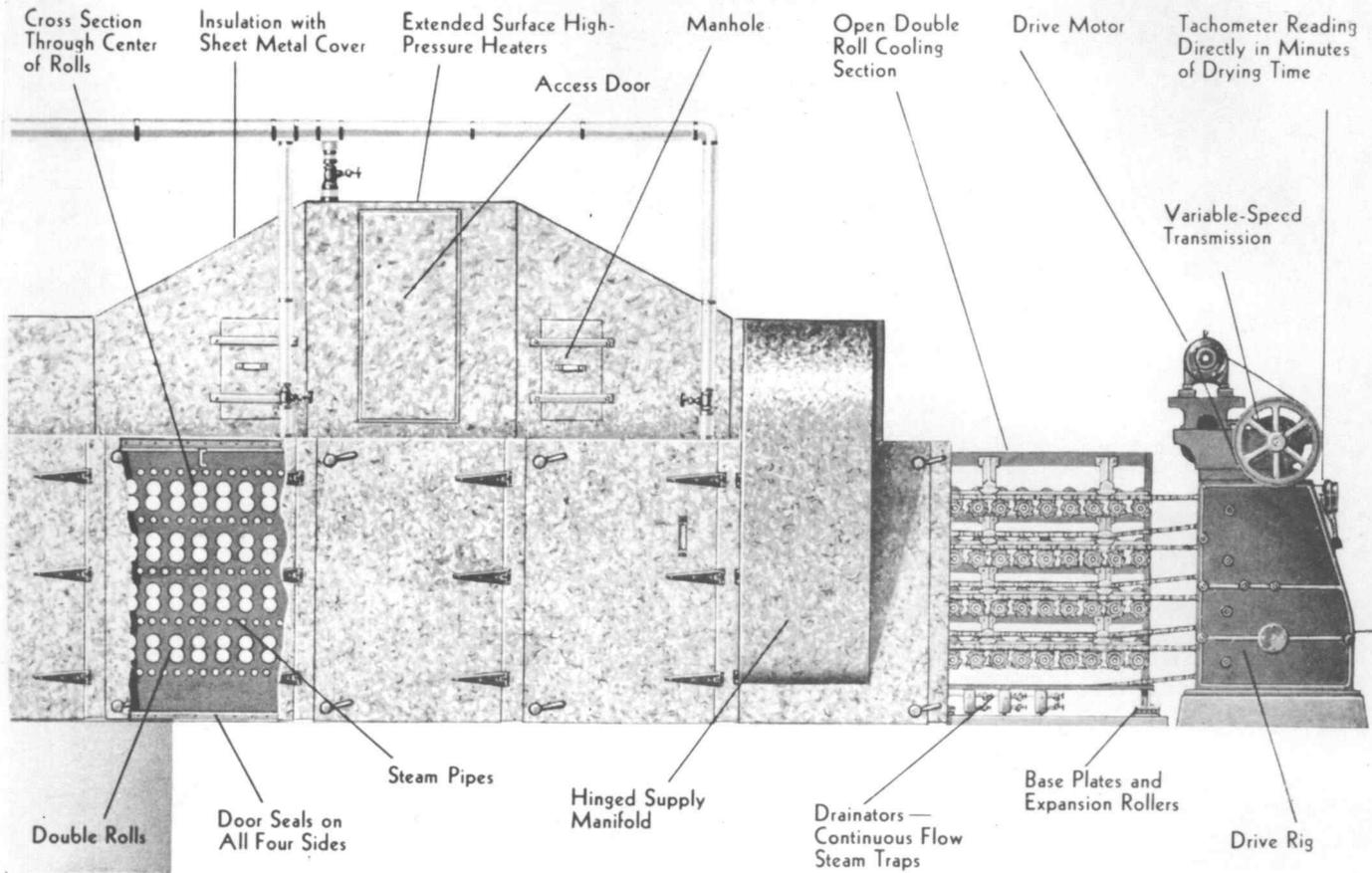
By the courtesy of the Coe Manufacturing Co. of Painesville, Ohio, a reproduction of a typical installation is presented on the following page. It will be seen that this dryer is divided into four decks. The bottom rollers of each deck are driven by a chain and sprocket and above each lies an idler roller. The veneer is held flat between these rollers and is thus propelled through the drying chamber. Laid across the dryer at regular intervals is the system of steam piping the heat from which is controllable and produces the requisite temperature. Between these pipes lie a series of air nozzles which diffuse the air under the veneer as it passes.

The whole heating chamber is enclosed in a heavily insulated



Reproduction of a typical

Figure 7



roller veneer dryer

Courtesy of Coe Manufacturing Co.

Figure 7

framework which prevents loss of heat by diffusion or radiation.

The water given up by the veneer is promptly converted into superheated steam which, when mixed with air, makes an excellent drying medium. This is kept in constant circulation by powerful drying fans and the veneer is subjected to additional heat from the coils and rolls by radiation, convection, and conduction. The speed of travel through the drying chamber can be controlled as necessary by the charge hand according to the thickness of the veneer, the amount of moisture to be removed, and the ultimate moisture content desired. On leaving the dryer, the veneer travels through a drying cooling chamber.

The latest type of Proctor dryer consists of six decks through which the veneer is carried on perforated metal containers being held flat on these by a series of floating rollers spaced evenly throughout the length of the drying chamber.

In many mills, with a view to reducing the risk of damage, out-feed conveyors receive the fragile, dry veneer as it leaves the dryers and carry it before a line of inspectors who select it according to grade and size. Veneer which is unsuitable for faces is taken directly to the core room where it is cut into suitable sizes.

A platen or breather dryer is generally used for core stock over 2 mm and for redrying veneer. It consists of a number of steam-heated plates which move together and apart at regular intervals. The plates are so coupled that when one pair is closed

the alternate surfaces of these two particular plates are free. The veneers are flattened with a slight even pressure when the platens close, and at the same time the moisture in the veneer is converted to steam which escapes as the platens open. Veneers can be quickly dried on the breather dryer down to 6 to 9 moisture content without any fear of casehardening or buckling.

Dry Kilns

There are several types of veneer drying kilns being used today most of them working on the progressive drying principle. These kilns consist of insulated compartments frequently constructed within the factory and located close to the veneer cutters. One such type requires the sheets of veneer to be piled with stickers (1/2 to 7/8 inch thick) on kiln trucks. When loaded the trucks are pushed into the green end of the drier. Steam coils at the opposite end heat the incoming air which is forced by a large fan to circulate through the piles of veneer toward the opposite or green end. The veneer, therefore, enters at the green end where it is humid and warm and moves intermittently toward the opposite end where it is hot and dry. The warm humid air is usually exhausted at the green end and the fresh air supplied continuously at the dry end.

Instead of blowing the air straight through endwise, some kilns are provided with air ducts beneath or at the sides so that the air is let into the kiln through louvres at the sides or bottom uniformly distributed throughout the length of the room.

PATCHING EQUIPMENT

Some sort of provision must be made to patch the characteristic defects that occur in the plies. In the past the industry was faced with the prospect of having to throw away or hand patch a large quantity of core stock because it was not sound enough for use in exterior grades of plywood. Since that time, however, machines have been perfected that effect a great saving in material and produce stock that can be used for faces, backs, or cores for both exterior and interior grades with a minimum of manpower loss. The most important of these machines will be discussed below.

Patch Machines

This machine is used for the mass production of plugs which are used to cover the characteristic defects that occur in the plies. These plugs are machined from strips cut from various thicknesses of stock that is being incorporated into the plywood. The strips are cut a uniform width of 2-1/2" and are stacked into a hopper-like feed. Each strip is automatically fed from the bottom of the stack across two concave saws approximately 30 to 36 per minute. The plugs are then stacked in a special rack and sprayed with a resinous glue and left to dry, ready for use.

There are two types of machines in use to accomplish this purpose. One machine produces a round or "cookie" patch and the other machine produces a boat-shaped patch. The "cookie" patch

is used for knots and round defects, and the elliptical patch is used for longer defects.

The diameter of the saws used in the boat patch cutting machine is 9-1/2" and the radius of the saw is 18" and requires power of one H.P.

The plugs that are produced have a beveled edge that provides a greater gluing surface, and prevents the plug from falling out when being glued into place.

The maximum size of the boat patch is 1-3/4" at the widest place and six inches in length, while the "cookie" patches are 3" in diameter.

Machines of this type are in use throughout the industry, and while some are modified to meet the needs of the plant, all are essentially of the same design.

Defect Cutters

This machine is used to rout out or cut out the defects which occur in the plys in such a manner that they exactly correspond to, and fit the plugs which are made by the patch machines. Again, there are two types of machines to cut out defects to correspond to the "cookie" and boat patch types.

The machine employs a cutter head which is automatically fed into the stock to such a depth share that it will exactly correspond to the size of the plug that is being made on the patch machine. The operator merely places the piece under an opening in the throat of the machine and presses a foot switch,

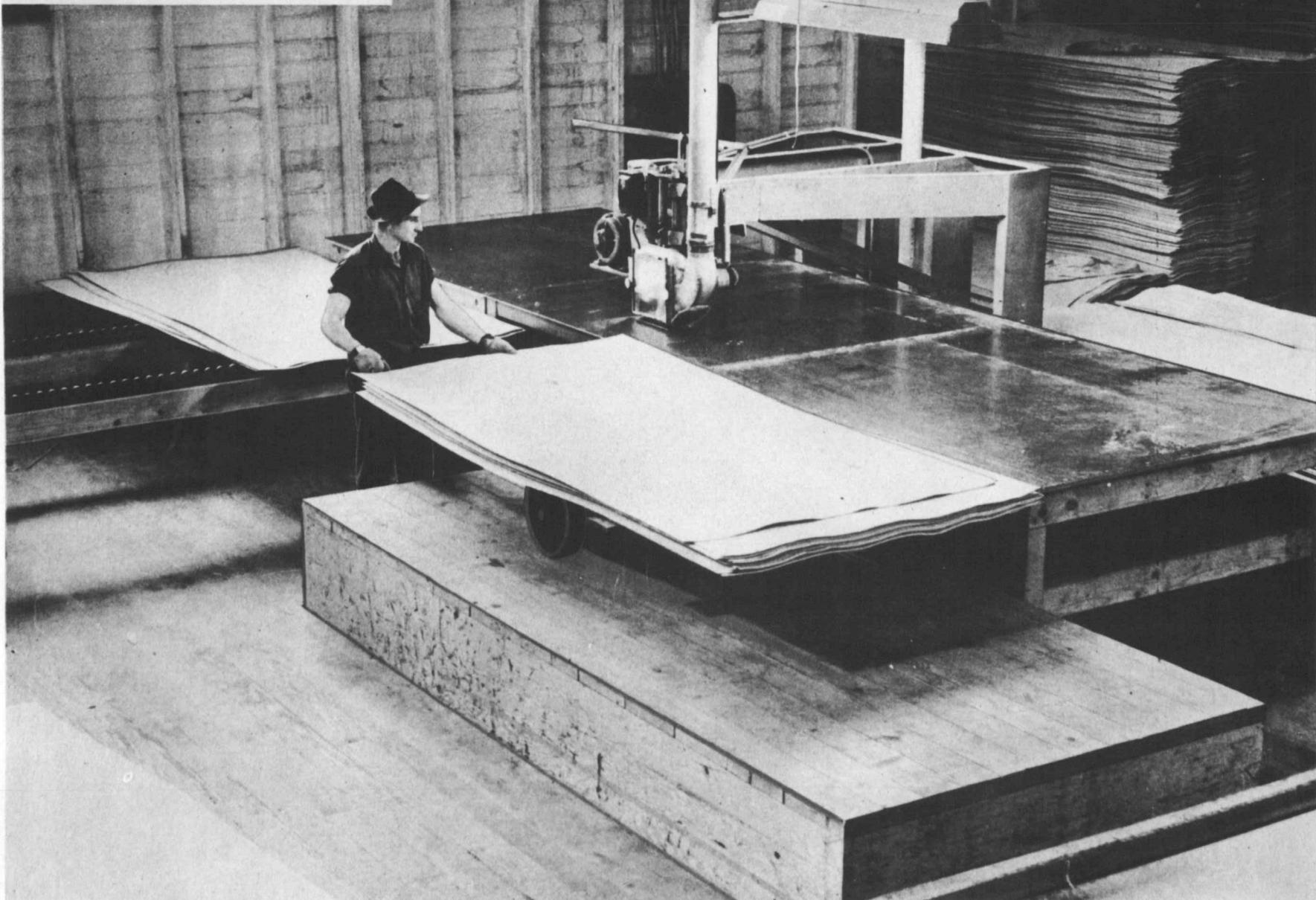
See Figure 8

American MANUFACTURING COMPANY

PLYWOOD - SAWMILL
MACHINERY
DESIGNED AND
MANUFACTURED

TACOMA, WASHINGTON

M-137



and the cutter head is fed into the stock with the aid of a 2 H.P. 3600 R.P.M. motor which is mounted on the top of the machine. The motor operates a cam which controls the speed to which the cutter head is fed. This cam is so designed that it will feed relatively fast in the beginning of the cut, and then dwell momentarily at the end of the cut to produce a fine finish. The cam is started and stopped by means of a selenoid-operated, one revolution clutch which accomplishes one cycle of the operation.

The cutter head arbor runs on precision ball bearings and the arbor itself is accurately machined of alloy steel. This machine will cut a maximum of 30 holes per minute. The power requirement on the feed is $1/3$ H.P. The depth of the throat from the cutter head is 54".

In most plants, the cutter heads are checked for accuracy daily to assure tight and true fits of the patches into the holes.

Hot Patch Setter

After the sheets have had the defects routed out on the defect cutter they are transferred to the hot patch setter. It is on this machine that the plugs made on the plug machine are put in the holes made by the defect cutter. They are then placed between two hot plate platens on the hot patch setter and pressed in under considerable heat and pressure to make a permanent bond with each other.

The heat is usually supplied by electrical power in the platens

and is 600 or 800 watts, or a total of 1400 watts, 110 volts, and 60 cycles in each platen. The heat in each platen is controlled by thermostats hooked to copper elements inserted in each platen. Some machines are heated directly by steam, but this is not universal because of the necessity of maintaining a steam source which is expensive unless employed throughout the plant.

To operate this machine the operator places a patch of proper size in the hole in the sheet and places it all on the hot pad or platen. The operator then presses a foot control and the press or head moves down and makes contact with the sheet. After applying heat and pressure for about three or four seconds the bond is completed and the sheet is removed. When the color and grain on the sheet and plug are matched it is practically impossible to detect the patched area.

Multiple Shim Cutting Machines

This machine is used for machined shims for patching cracks and pitchpockets which occur in the built-up plywood. Some plants alter the size and shape of the shim but the majority of plants use a shim which is approximately 1/8" wide and tapered slightly at the bottom. The stock used in this machine is strips which are cut from the same thickness of ply as that on which the shims will be used. The strips are stacked in a hopper at the right and rear of the machine and fed one at a time from the bottom of the stack. A maximum of fifteen shims can be manufactured at one time as the strips run across the

cutter head which is in the approximate center of the machine.

The cutter head arbor is driven by a 2 H.P. motor at approximately 7200 R.P.M. This makes for a fine finish, so necessary for this type of material.

Repatching Plug Cutter

In the building up of plywood it has been discovered that certain defects are overlooked in the patching process, or that some of the patches are defective. For this reason it has been found desirable to repatch the panels after they have been finished. The hollowing out of the defect is done with a set of specially made concave hand chisels, and those defects that remain are removed by hand.

The repatching plug cutter is designed to furnish a plug to insert when the defect has been removed by hand chisels. Three separate sizes of plugs are made on this machine. The plug sizes are $3/4$ " x $2-7/8$ ", $17/32$ " x $2-7/16$ " and $11/32$ " x 2". Here again, the plugs are made from stock of the same thickness as that being patched. The strips are fed into the machine by hand and about 90 plugs per minute can be produced.

The plugs are formed by a set of dies which are held in a round or turret-shaped carriage. The three sizes of plugs are obtained by simply rotating the turret to the desired die size.

The cutting mechanism is powered by a $1/3$ H.P., 60 cycle motor.

Automatic Face Stock Patcher

A machine of this type has been developed by the Aberdeen Plywood Corporation. The machine will insert a glued plug with sawed cut and .008 pressed fit suitable for face stock. The machine consists of a 1 H.P. motor of 3600 R.P.M. mounted vertically on a base movable in machined beveled sides. The saw head is bored to fit over a one inch motor shaft and is slit and threaded on a taper to receive a collar which clamps onto the shaft in the manner of a collet chuck. The saw cuts 1800 perfectly round plugs per hour from strip stock. By changing saws it can be made to cut either beveled edge or straight edge plugs.

The plugs are removed by suction and are flipped by a plug ejector on the saw into a suction tube underneath the table.

The plug inserter consists of a plunger and a magazine of plugs. Plugs are brushed with glue in the magazine and extra magazines are kept filled for quick changes.

The actual gluing operation, consisting of gluing under pressure and temperature, is essentially the same as that described for the hot patch setting machine.

Automatic Veneer Patcher

Another fully automatic veneer patcher developed by Peter Skoog of Associated Plywood Mills in Olympia, Washington actually performs seven operations all in one.¹ This air operated machine is automatically controlled by a single valve.

¹
"Peter Skoog's Veneer Patcher", The Timberman, Vol. 46,
No. 3, P. 134 (January, 1945).

Here is what happens when the operator steps on the trigger: the outer cylinder drops down, pinioning the sheet of veneer to the die or circular cutting device. Then the tool within the shaft drives downward, punches a three inch round hole in the sheet, and cuts out the knot or other defect to be patched. a sliding bar rakes out the waste, and at the same time deposits a square wooden plug blank under the die. Lastly, an underside punch presses upward and cuts a round plug from the blank and fits the plug snugly into the hole.

The upper and lower tools drive into the die from 12 to 15 thousand times a day with unerring accuracy.

High Frequency Veneer Patcher

This new unit developed by Woodwelding, Inc., is a notable advance toward economical and fast patching operations.¹

The entire patching unit consists of a five foot high pedestal and a revolving arm six feet long that moves the patcher to the desired spot over the sheet of veneer.

The patcher itself is a block of laminated hardwood and micalex 2-1/2" wide, 8-1/2" high that has electrodes imbedded on the underneath side.

Other parts of the unit are the 1 K.W. wood welder mounted on top of the pedestal base, and the new automatic tuning unit atop the end of the arm directly above the "patcher". The generator and tuning unit are placed close to the work for easy accessibility and movement with the swing of the arm.

1

"Plastic Wood Patching Machine Perfected", Timberman, Vol. 49, P. 158 (January, 1948).

In its operation, the patcher presses downward on the patch being welded to a sheet which is held firmly on the table. An air cylinder in the head of the arm supplies a maximum pressure of 300 psi against the patch. Less than 5 seconds is required for the cure.

The method of "curing" the patch is the main improvement of this unit.

JOINTERS

It has been found that, in the process of manufacture, many pieces of veneer are produced that are not large enough to make up a full sized panel. To utilize this stock, the veneer edges are jointed, and the smaller pieces then taped together to form sheets of sufficient size to be used for layup in panels. The jointers used in this process will be discussed below.

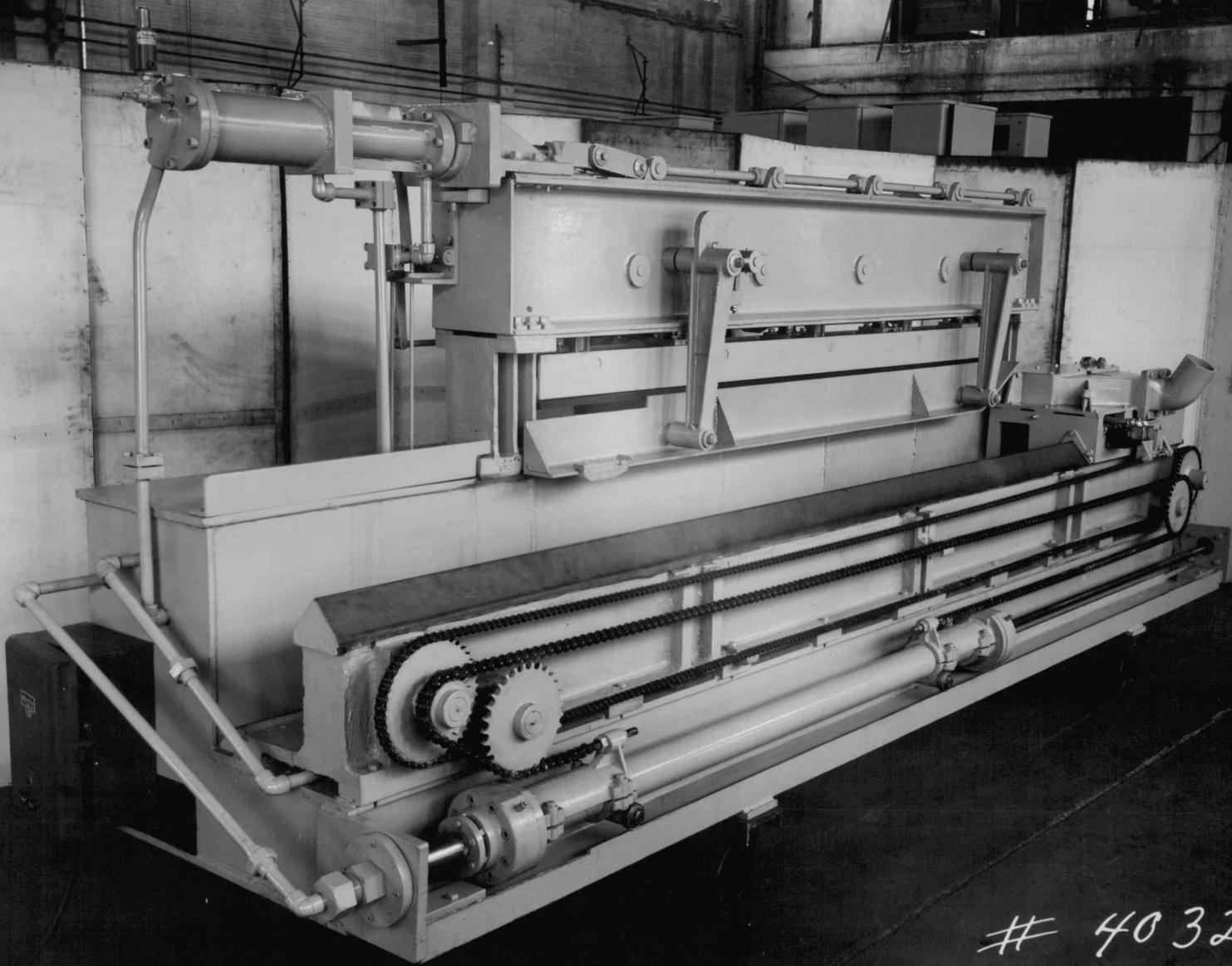
Traveling Head Veneer Jointer

Veneer jointers of this type are built of two main components.¹ One component is a substantial, rigid bed with an accurately machined top, and the other is a heavy carriage which travels on a track or guides which are machined into the solid bed. The carriage must be secured to the track in such a manner that all lateral movement and vibration is prevented. Otherwise, the smooth cutting so vital to this work will not be accomplished.

In operation, the veneers are piled on the table to a maximum depth of about 1" and are clamped hydraulically with a 6" width of bearing surface extending the full length of the veneer pile. The pile must be clamped with sufficient force to press the veneers together until the edge of the mass exposed to the cutters has all the appearance of a solid block of wood.

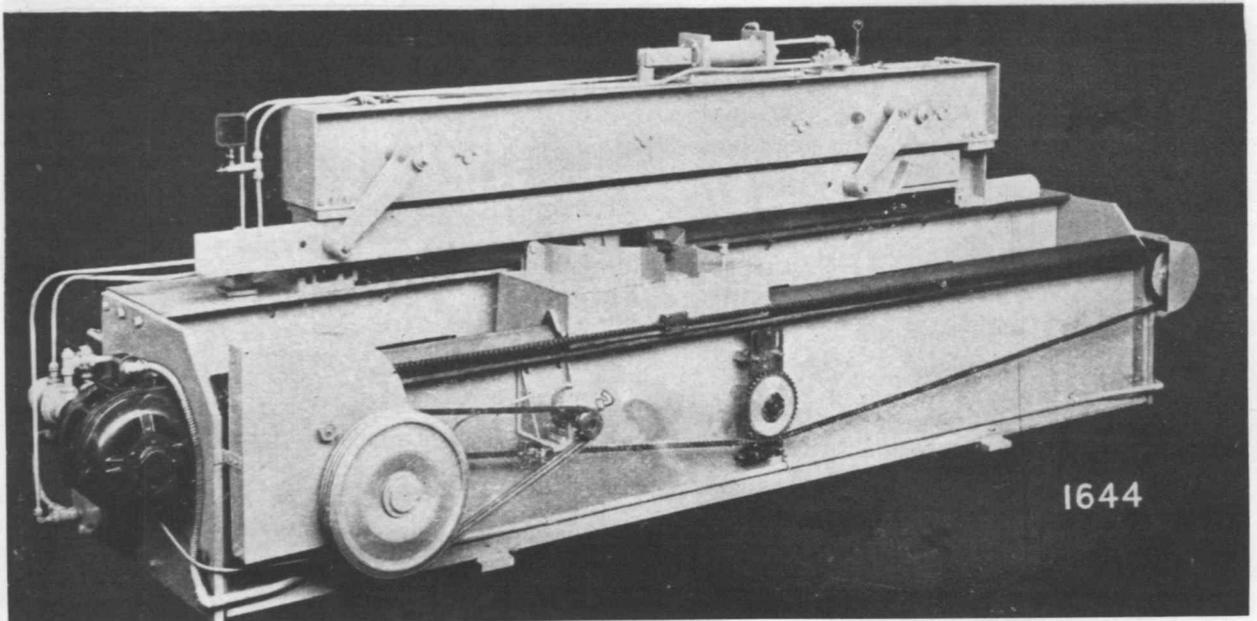
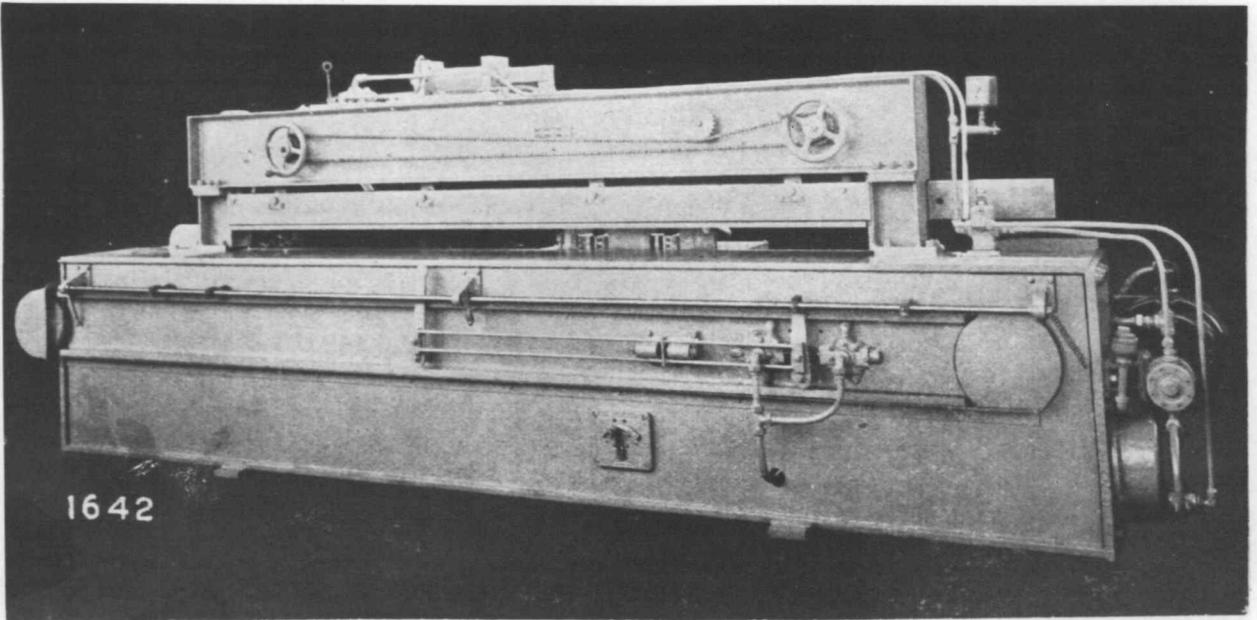
After having been clamped, the veneers are ready to be jointed. This operation is accomplished by a traveling carriage on which

¹
See Figures 9 and 10



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Figure 9



Two additional views of travelling head veneer jointers

Figure 10

are mounted two cutter heads. The cutter heads are designed to provide a roughing cut (roughing cutterhead) and a finishing cut (finishing cutterhead). The finishing cutter head is usually set to provide a cut of 1/16".

The two cutter heads are attached directly to the armature shafts of ball bearing motors making about 3600 R.P.M. using a current of 60 cycles, and 220/440 volts, and they are three phase. The cutter heads are 2" face or 3-1/4" face depending upon the maximum depth of veneer the machine is specified to joint. The cutters with the wider face are attached to a 5 H.P. motor while 2-1/2 H.P. motors are sufficient for the 2" face.

The traveling carriage is operated hydraulically. This type of motor delivers a variable speed to the forward traverse without shock or jar. The forward feed ranges from 10-75 feet per minute and the return is made at 75 feet per minute. The outfit consists of an electrically driven pump, a hydraulic motor and control valves.

Some machines joint by means of a traveling table instead of a traveling carriage. Machines of this type however, require much heavier construction and more floor space. Also, because of the pressure required to hold the veneers flat on the table, the press members are often distorted and this will cause the table not to run true on the ways, thus true wood joints cannot be produced.

The same arguments apply, in even greater measures, to the

continuous feed machines. They present a serious problem when it comes to making accurate joints on veneers which are moving on an endless conveyor, and are clamped under a moving clamp, both of which are more or less flexible.

VENEER SPLICERS

Once the veneer has been cut on the veneer jointer, it is advisable to proceed with the next operation as quickly as possible to obviate the risk of any change in the moisture content taking place. Especially is this of importance when working on veneer with irregular grain.

This operation temporarily joins small pieces of veneer together until they can be laid up into panels. This brings about a big saving in material and man hours and results in a greatly improved product.

Taping Splicer

A typical taper is one in which the two leaves of veneer to be joined together are fed to leading rollers which are set in such a manner that they force and hold the edges of the veneer together. A roll of pre-gummed tape is positioned above the machine, and as the tape is led toward the veneer it passes over a roller which moistens the glue. The tape is then automatically laid over the joint and pressed against the joint by an electrically heated roller which partially sets and dries the glue.

The table for such machines should be extended to a length that will support the entire length of veneer when it is completed. This eliminates the risk of the veneer breaking loose with handling after having been taped.

Many plants incorporate a small circular saw on the off-bearers side of the machine which automatically trims the sheet to

the correct width as it leaves the machine.

Tapeless Splicers

Tapeless splicers are becoming more commonly used throughout the industry. The design is relatively simple and the operation is fast and efficient.¹

The feed rollers are arranged in pairs, being secured to a top head. The two pieces of veneer are fed into the leading rollers and thereafter are automatically controlled until discharged from the machine. The edges are first pressed against rollers moistened with glue and then held in close contact while the veneers pass between heated platens and rollers which finally set the glue.

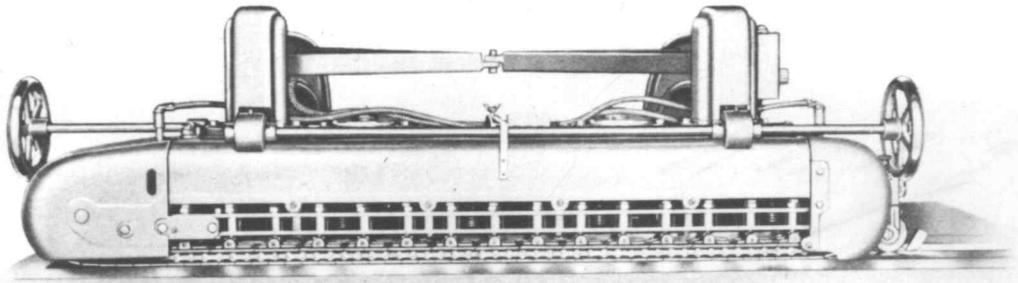
Excellent results are obtained with this type of splicer provided that the veneer has been carefully cut and is of uniform thickness.

A typical tapeless splicer, made by the G.M. Diehl Machine Works, will be used in the analysis of machines of this type.

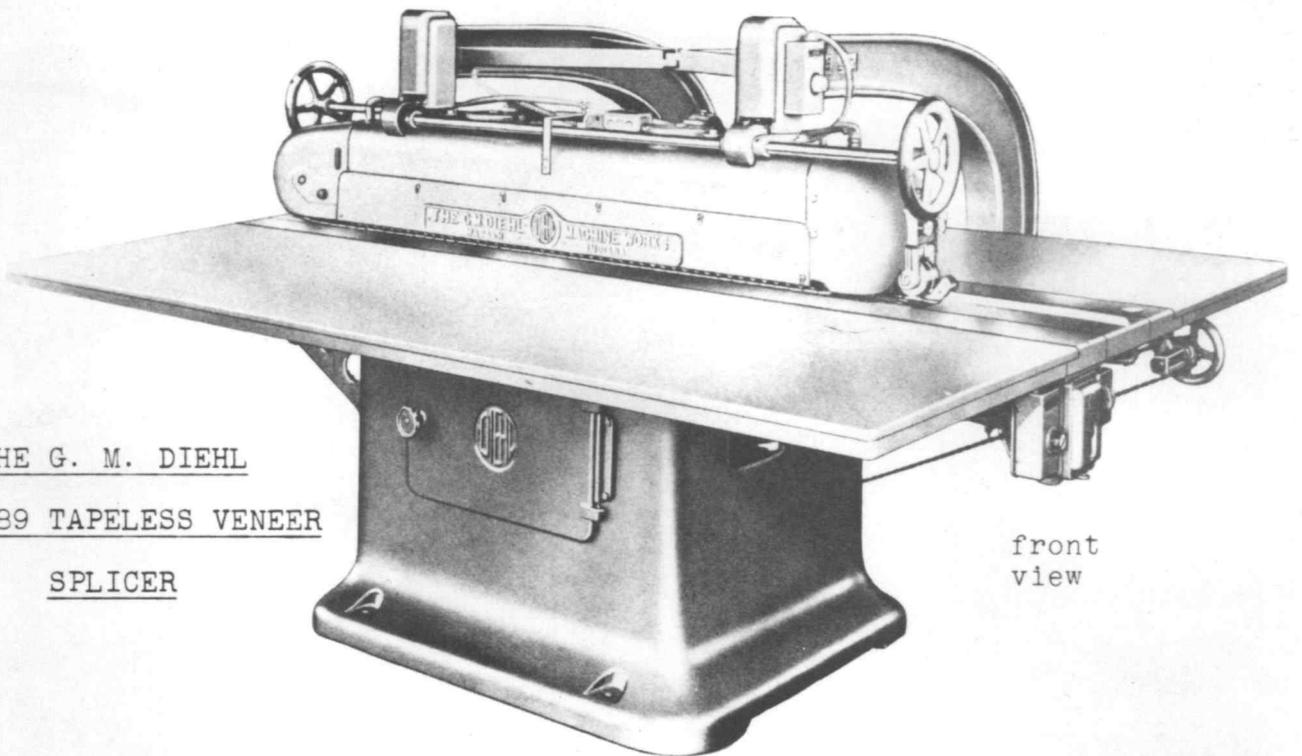
The frame is a heavy, cast iron, one-piece unit providing a rigid base for table, pressure bar arms, and other mechanism. The feed motor, speed control, speed reducer, feed chain, etc, is enclosed.

The pressure bar is suspended from two heavy arms spaced widely apart and rigidly braced to prevent rocking. The two pressure chains roll on special "V" roller chains serving as anti-friction bearings.

¹
See Figures 11 and 12



NO. 89 PRESSURE BAR WITH SIDE PLATE REMOVED TO SHOW SPECIAL PRESSURE AND "V" ROLLER BEARING CHAINS (Patent 2305525)

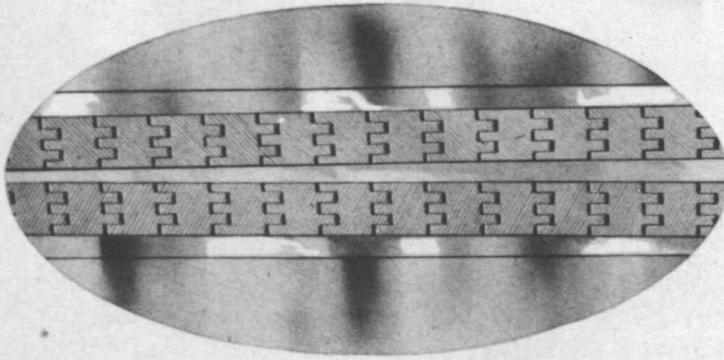


THE G. M. DIEHL
NO. 89 TAPELESS VENEER
SPLICER

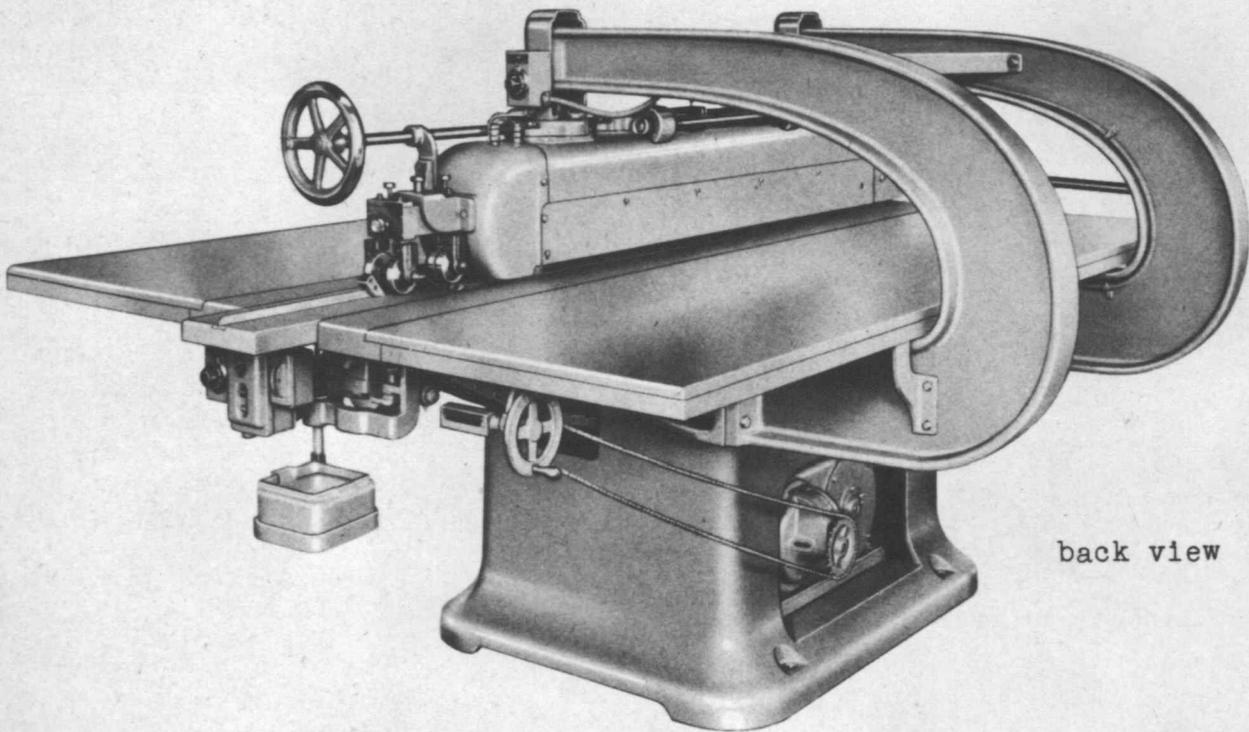
front
view

The G. M. Diehl Machine Works, Inc. * Wabash, Indiana

Figure 11



VIEW SHOWING LEAD IN OF
FEED CHAINS AND TAPERED
HEATER BAR IN DIRECT CON-
TACT WITH STOCK.



back view

THE G. M. DIEHL NO. 890

TAPELESS VENEER SPLICER

The G. M. Diehl Machine Works, Inc. * Wabash, Indiana

The heater bars are placed one above and one below in direct contact with the stock. The pressure of the heater bars is automatically adjusted according to the pressure on the stock. The heat is automatically controlled by individual thermostats. Power consumption is about 5 K.W. with standard machine heat of 220 or 440 volt units.

The drive is from a 1-1/2 H.P. motor and the speed of feed can be adjusted to give a feed of 15 to 85 feet per minute as desired.

The machine will handle veneers of from 1/100 to 3/16 inch thickness. The range may be extended if the veneers are flat and of the proper moisture content.

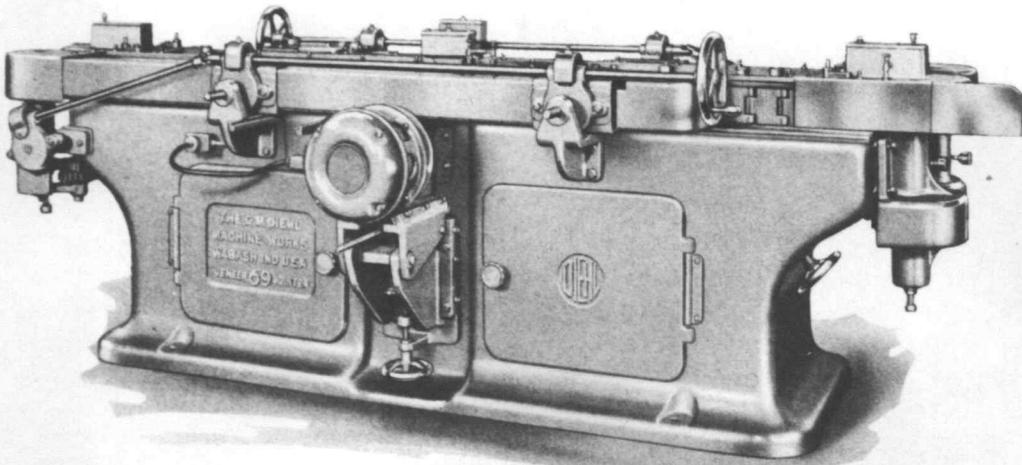
Veneer Jointer and Edge Gluer

This machine is unique in that it combines the two operations—jointing and splicing.¹ It is a precision machine designed for large production operations. It is especially designed for the production of plywood for furniture plants, aircraft factories, and marine users. It makes a perfect joint on veneer strips and deposits a uniform application on the edges in one operation.

Again we will use a Diehl machine as an illustration of a machine of this type.

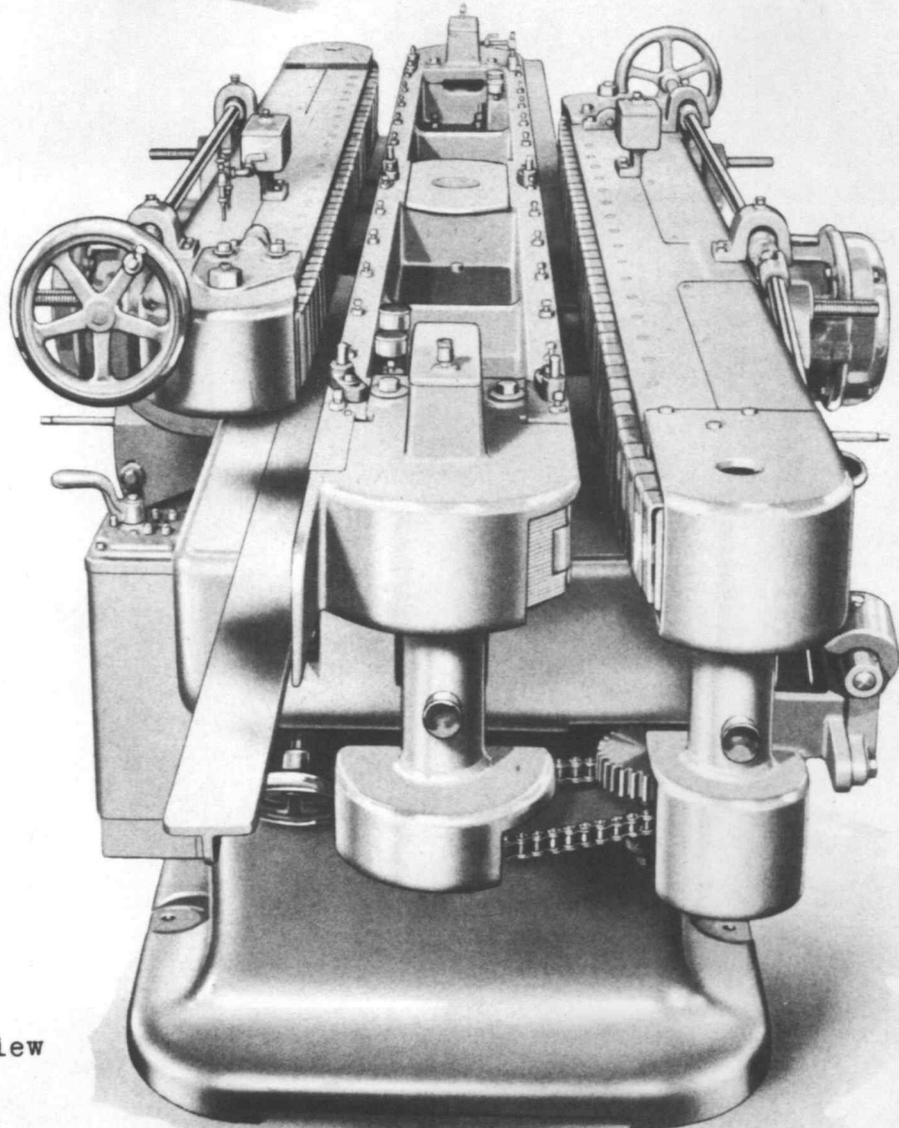
The cutters are actually two complete units, one for each side. The machine has eight-knife round veneer-type heads, heavy arbors, and direct connected 5 H.P. motors. It has, incorporated in it, a vertical and horizontal alignment and a 15 degree tilt.

¹
See Figure 13



side view

THE G. M. DIEHL
NO. 69 VENEER JOINTER
AND EDGE GLUER
PATENT NO. 2242179



end view

The G. M. Diehl Machine Works, Inc. * Wabash, Indiana

Figure 13

The machine has an infeed from both sides simultaneously. Drive is from a 5 H.P. four speed motor through a worm transmission to block-link type feed chains. The transmission runs in oil. Feed speeds of 16, 25, 33 and 50 feet per minute are easily obtained on this machine.

Each side has a built in glue pot electrically heated and the temperature is controlled automatically. Driven glue rolls in each pot, apply glue to the edges only of the veneers.

This machine takes mixed widths of strips without adjustment in bundles up to 2" thickness.

CORE SAW

This machine is used for the cutting of core stock prior to the gluing up operation. This machine is usually located near the glue machine and the batches of stock from this machine are conveyed directly to the glue roll operator.

The stock is simply placed on the table of the machine and a foot operated air valve sets a saw in motion to make the cut across the stock. Two rolls are set into the bed to make the stock easily maneuverable, and two foot-operated push rods are used to push the stock from the table of the machine in order that the operator may get a firm hold on the stock to transport it across the table. A ruled gauge is provided in the front of the machine to indicate where to place the stock for the desired length of cut.

The size of the saw is 24" and the speed is 1600 R.P.M. Power for driving the saw is provided by a 7-1/2 H.P. motor with 1800 R.P.M. The stroke of cut is 54" and the size of the table is approximately 48" x 104".

GLUE MIXING ROOM

An elevator is usually provided for transporting glue, caustic soda, soda ash, etc. to the glue mixing room which is generally above the main production floor. In plants that buy the resin in bulk, some measure of storage is necessary. At least two storage tanks are necessary, each with a capacity of one tank car of resin. The storage tanks should be provided with some means of cooling in order to maintain a sufficiently low temperature to prevent the glue from setting while in storage. This temperature range is usually between 50° and 60°. In addition to the pumping equipment to deliver the glue to the storage tank from the tank car, there must be pumps and piping to deliver the glue to the glue mixing room and to the spreaders.

The glue mixers are strong, sturdily built, open drumlike vessels with a tapering bottom, and provided with revolving blades to stir the mixture. There are two types, single or double blades on a vertical shaft, and a semi-circular bar on a horizontal shaft turning inside each other. Most mixers are jacketed for both heating and cooling purposes. The glue storage tanks are located directly below the mixers so that when a batch of glue is mixed, the glue can flow by gravity from the mixer to the storage tank.

The glue mixing room contains equipment for the premixing of the lime and caustic soda to be used in mixing glues. This equipment consists of a large, open, drum-like vessel, with a slow action agitator.

The mixers should be cleaned daily as recommended by the glue manufacturer. The mixers should also be cleaned when changing from interior to exterior type glues, however it is not necessary when changing from exterior to interior type glues. A good procedure for cleaning the mixer is to add about 30 pounds of caustic pre-mix to a mixer full of hot water, and run the mixer for about 30 minutes, drain, wash down with cold water and steam off any old glue remaining.

The glue storage tanks should be scraped down preceding the dropping of a new mix of glue into the storage tank. The storage tanks are usually water-jacketed to circulate cool water during the summer time when the heat is apt to cause the glue to spoil. Some glues require constant agitation in the storage tanks making necessary slow motion agitators within the storage tanks.

SPREADERS

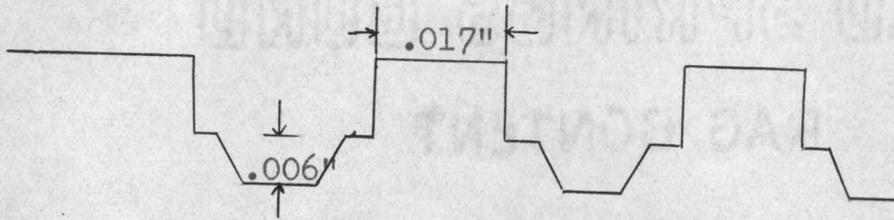
The type of spreader used in the industry is a double roll with a single pass with either steel, rubber, or a combination of steel and rubber rolls, and with a variable speed drive spreader.

Nothing definite has been established as to whether roll rubber or steel is the most desirable. The rubber rolls are most generally preferred for exterior glues because it is possible to have good light spreads. For the more bulky interior glues, the rubber rolls will give better coverage than will the steel rolls. They will not, however, stand as much use without regrooving as will the steel rolls. By having better coverage of the core stock fed through the spreader there will be less core thrown out and less glue wasted.

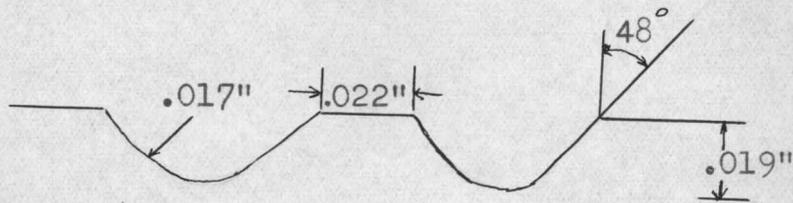
There has been continuous effort to find a suitable grooving pattern for spreader rolls that will give a good spread pattern and permit good control of the amount of glue applied. From the existing experience with spreader grooving it would seem that a grooving pattern suitable to all glues is practically impossible. The grooving must be different for the interior and exterior glues because of the widely different rates of spread and because of the viscosity of the glue. The basic types of grooving for spreaders is shown in figures 14 and 15.

There is apparently no set rule for spreader speed. The limiting factor in most plants seem to be the maximum speed of

SPREADER ROLLS

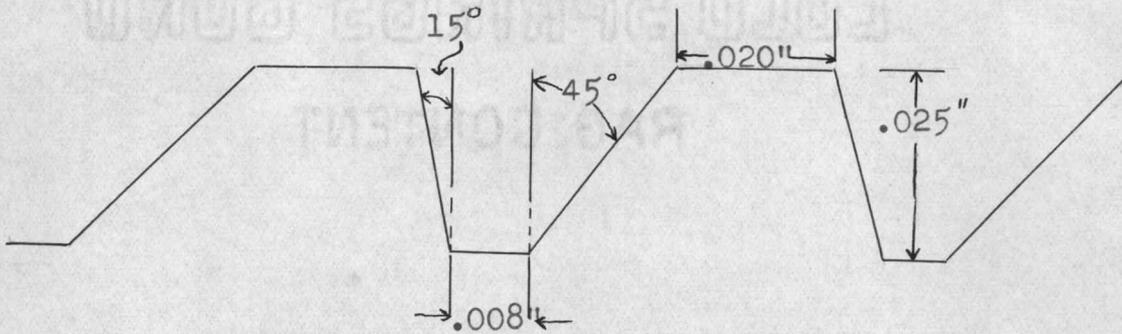


Lauck's grooving for interior glues
(steel rolls)



Lauck's grooving for exterior glues
(steel rolls)

Figure 14



16 grooves per inch
 Longitudinal grooves every .75"
 Longitudinal groove depth .012-.015"

This grooving could be used with interior type glues by increasing the depth of the groove to .030".

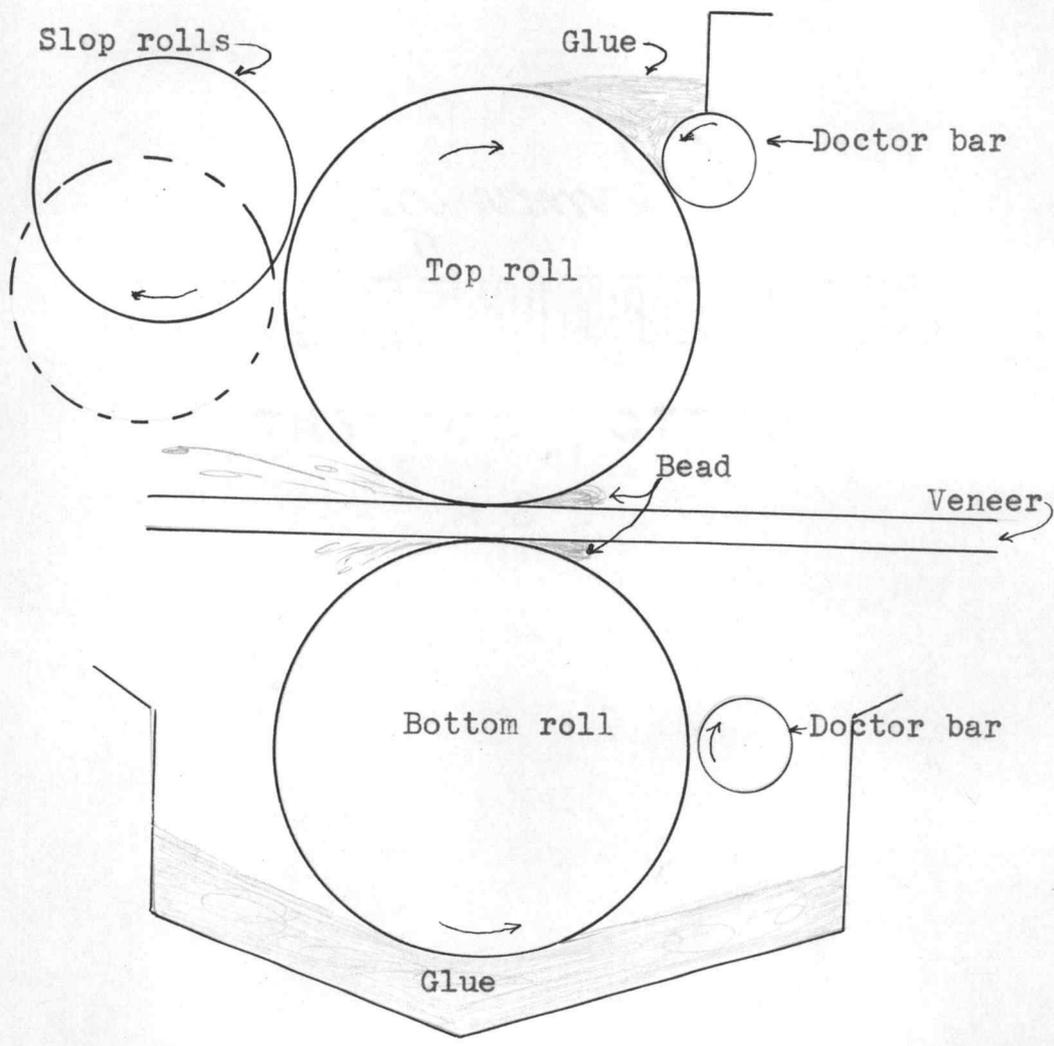
Rubber roll grooving for exterior resin glues

Figure 15

the machine. Beyond that, of course, there must be limiting factors such as the viscosity of the glue and the ability of the glue to cover the core. High spreader speeds will cause excessive glue slop resulting in glue wastage and blisters at the hot press. Some companies have made various attempts to stop the glue slop from getting on the core through the addition of other rolls as shown in figure 16. Spreader speed should be measured in lineal feet per minute as revolutions per minute have little meaning because of the different diameters of the rolls. Spreader speed up to 600 lineal feet per minute have been successfully used.

Spreader adjustment is of prime importance is securing good glue bonds and quality panels. Basically, there are only three spreader adjustments: (1) spreader speed, (2) the upper and lower doctor bar, and (3) squeeze (relative position of spreader rolls to each other).

The amount of spread is governed by the amount of glue carried on the spreader rolls and the amount of roll pressure carried on the veneer. The amount of glue carried on the rolls is regulated by adjustment of the doctor bar; the closer the doctor is to the spreader roll, the less glue is allowed on the spreader roll. The greater amount of pressure applied by the spreader rolls to the veneer in passing between the rolls, the less glue is allowed to adhere to the core. Through the proper control of the glue on the rolls, and roll pressure or squeeze on the



Glue spreader layout

Figure 16

core, the amount or rate of spread can be controlled. Keeping the roll pressure down will materially increase the time the roll may be used without regrooving.

Spreader maintenance calls for daily cleaning. This can best be accomplished by washing down of the spreader after it is shut down. Hot water and steam will do a satisfactory job on spreaders with steel rolls. Only warm water should be used on rubber rolls, however. All the old glue must be removed from the rolls and doctor bars as well as knots, sticks, etc.

The rolls should be changed when worn to the point that the desired spread pattern is no longer apparent or the control of the rate of spread is affected. There is more wear in the center of the roll due to there being more veneer pressed through this point. When the difference in spread between the ends of the spreader and the center of the spreader becomes more than five pounds per 1000 square feet, the rolls should be changed or regrooved. Frequently the rolls will get out of alignment. This is indicated by more roll pressure on one side of the spreader than on the other side. This can be easily checked by opening the rolls to the point where a piece of veneer can be forced between the rolls in opposition to the direction of rotation of the rolls. If one end is opened more than the other it will be indicated by differing ease and difficulty with which veneer goes between the rolls on each end. This condition can be corrected by a mechanic.

PRESSES

The modern hot press is a multi-platened, hydraulic press,¹ with steam heated platens or plates. The platens are usually rolled steel plates drilled with numerous holes in intersecting gridiron patterns for steam distribution. In some presses, the platens are cast steel, drilled, milled flat and covered with sheet steel. The latter type platen is less affected by abuse. There may be as many as twenty openings in a press. The maximum press dimensions are approximately 128 x 70 inches. The opening and closing of the press, and the press pressure is accomplished by oil pressure from a positive displacement pump. The oil pressure is exerted on two sets of rams or pistons. The jack rams are small in diameter and are used for closing the press rapidly. After the jack rams have closed the press, oil pressure develops under the pressure rams exerting the pressure under which bonding takes place. The press is equipped with a pressure gauge to show the pump pressure. Pump pressure is the force exerted against the pressure rams. The correct pump pressure to give the correct specific pressure can be calculated from the following formula:

$$\text{Pump pressure} = \frac{\text{panel area in square inches} \times \text{Specific pressure per square inch.}}{\text{total ram area in square inches.}}$$

A pressure control schedule should be made up for each press

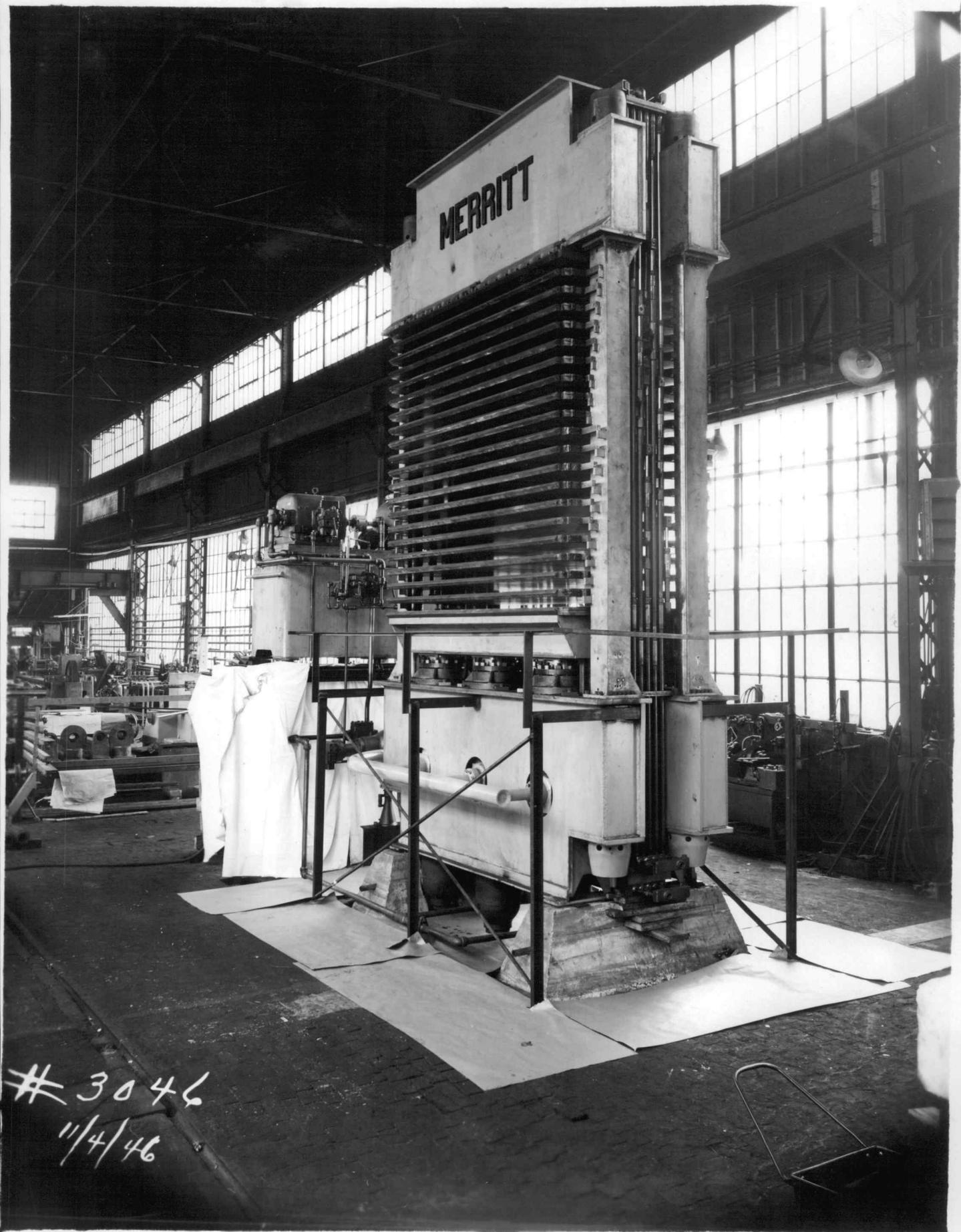
¹ See Figures 17 and 18

and for the specific pressures used in pressing. The schedule should be made available to the operator at all times.

Proper control of the platen temperature is essential to good bonding. Since the platens are heated by steam, the temperature regulation will be in effect be regulation of the steam circulation within the platens of the press. Plant pressure of about 150 per square inch should be reduced through a pressure reducing valve to about 60 to 90 per square inch in order to maintain a press temperature of between 200° and 320° F. The steam then passes through a trap where any condensate from the main line is removed. From the steam trap the steam passes through a thermostatically controlled and operated valve to control the press temperature. The steam lines should be arranged to permit rapid circulation of steam through the press for heating the press and blowing down to remove condensate from the press platens. Some presses have a steam trap on each plate to keep out condensate. Water standing in the platens tends to produce areas of low temperature. These low temperature areas may result in irregular bonding. Condensate may be particularly bothersome in the lower temperature ranges of 215°-240° F.

In addition to pressure gauges and temperature control devices, most presses are equipped with an electrical timing mechanism. This timer may operate from the start of closing the press or from the time the press is closed.

The press should be checked occasionally for temperature.



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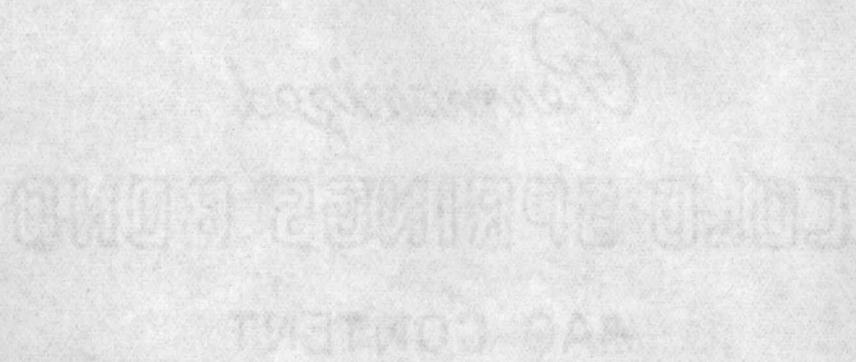


Figure 18. View of 20-opening hot press showing loading rack and elevator. This press is shown as in actual operation

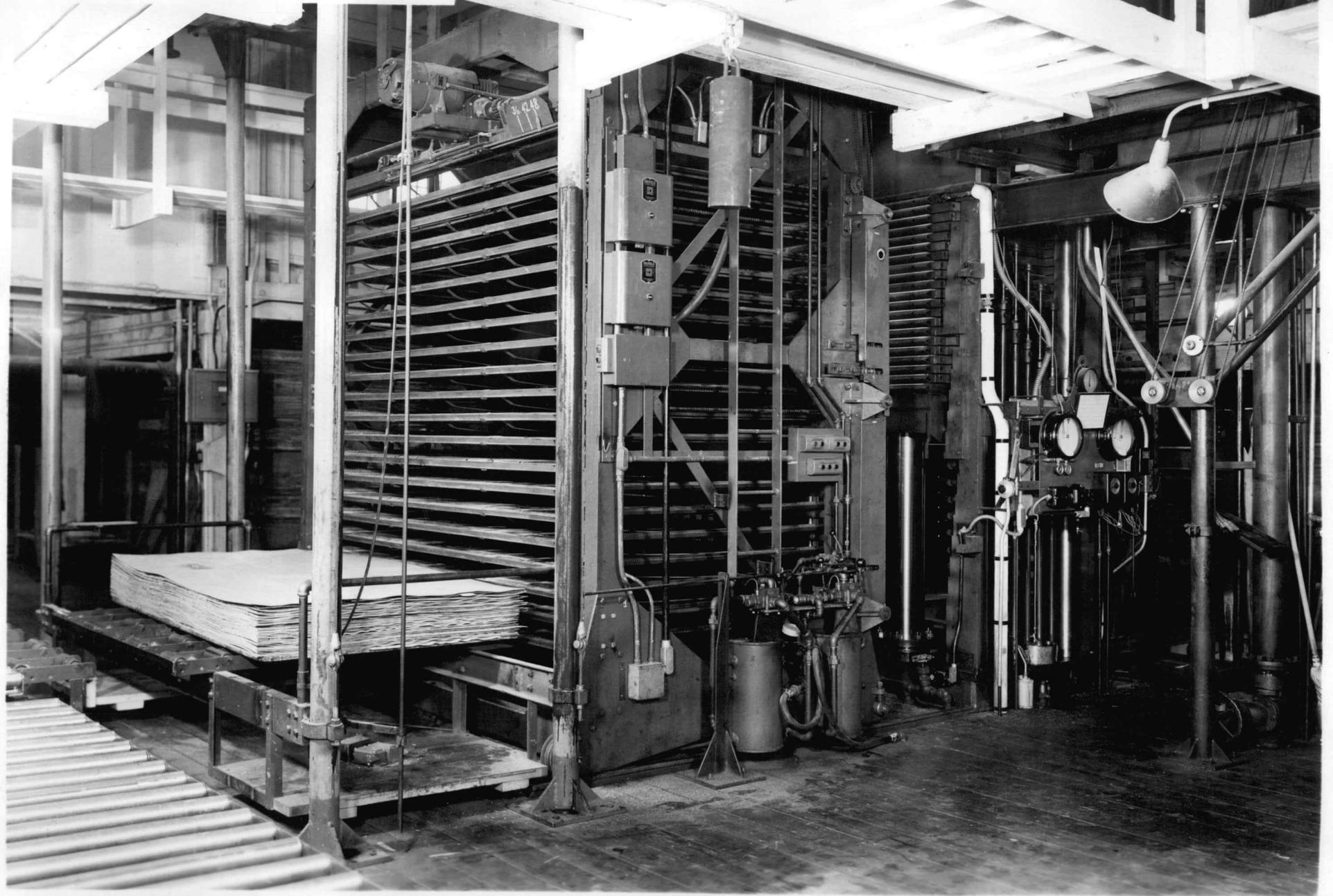
Courtesy American Manufacturing Co.

American MANUFACTURING COMPANY

PLYWOOD-SAWMILL
MACHINERY
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TACOMA WASHINGTON

M-476



This can be done with a pyrometer and a thermocouple inserted between the press platens and a panel being pressed. The press temperature should run within five degrees of the desired temperature. Condensate collecting in the platens may sometimes result in the temperature falling off gradually while the press is in use. Blowing down of the press will frequently eliminate this trouble. Blowing down every four hours is a good practice.

Sometimes press platens will warp and a warped platen may mean uneven pressure on the panels and produce panels of uneven thicknesses. A check for warped panels may be done by measuring the thickness of the panel upon removal from the press. If the panels show a consistent variation in thicknesses in the same area it is reasonable to assume a warped platen is present.

The platens should be cleaned once a week to remove any old glue. After cleaning, waxing the platens with paraffin while the press is still hot will keep the glue from sticking and will help in slipping the panels in and out of the press.

Cold Presses

Presses of this type, as the name indicates, are designed to operate without the application of heat. Their basic design is the same except for the fact that they do not, as a rule, have hot plate openings. The material is placed in the one opening in a bundle and presses as such.

The operation of these presses is usually simple. The unit is usually equipped with an automatic pressure control on which

the predetermined line pressure is set. When the desired pressure is reached, the pump is automatically cut out; if the pressure should fall below the predetermined setting, the pump automatically starts again. A manually operated pressure release valve, when opened, quickly returns the platen to the starting position.

The pumping unit is usually mounted on top of the press and consists of a duplex pump driven by a single motor. The standard closing speed of presses of this size is about 36 feet per minute but this may be increased to meet special conditions.

Cold presses are either up-stroke or down-stroke models. Sizes are usually indicated by the 36" x 36" nominal platens widths increased by 6" increments and lengths by 12" increments.

The standard daylight opening is 48" with a ram stroke of 26" but these specifications may be varied depending on local conditions.

Units such as these are furnished to operate a 100, 150 or 200 pounds per square inch pressure over the entire platen area.

Cold presses are much easier to maintain and to operate. There are less pipes to develop leaks and cleaning is greatly eased by the absence of numerous platens.

High Frequency Bonding

The first application of the high-frequency electrostatic method to plywood manufacture on the Pacific coast was made at the plant of the Albany Plylock Corporation at Albany, Oregon

where two units are in full time service since their installation in 1941.¹

To better understand the process it may be necessary to briefly review the method. Going back to our high school physics, we are reminded that when molecules are disturbed, as when they rubbed against each other, the resultant friction produces heat. High-frequency electrostatic heating consists merely of taking electricity and converting it to a form that will cause the molecules in a substance to distort and rub together thus setting up friction which produces heat, the chief reagent to successful bonding.

High-frequency electrostatic heating does not cause changes in the plywood itself. The electrical energy reacts on each molecule in the wood and causes each one to change shape. When the direction of the field is reversed, the molecules change shape with each reversal. In actual practice the field is reversed millions of times per second thus creating a tremendous amount of energy.

The plywood to be treated is placed between plates or electrodes and the high frequency energy is applied. Assuming a fifty percent overall efficiency of the machine, each kilowatt of input produces 17,000 B.T.U. of heat.

One high-frequency electrostatic heating unit is said to easily handle the output of two modern glue spreaders working constantly.

1

"High Frequency Plywood Bonding", The Timberman, Vol. 34, No. 3, P. 56 (January, 1943).

The method is highly advantageous from many aspects. The equipment is simple to operate; it allows for the constant production of a constant volume of panels per unit of time regardless of thickness or the area of the panels; there is no redistribution of moisture in the panel and no surface checking; there is no danger of blistered or steam-exposed panels; and lastly, output from the veneer dryer can be greatly increased because veneers can be accepted with a much higher initial moisture content.

DIMENSIONING

The equipment used in dimensioning plywood is closely related to that employed by the woodworking industry. In general, any sawing on plywood is partly crosscutting and partly ripping due to the alternate grain direction. This requires a circular saw blade with groupings of fine teeth for the cut across the grain, alternating with larger teeth and deeper throats for cutting with the grain. In the case of a band saw, a compromise type of tooth is required.

The most common machines used for this process will be discussed below.

Panel Rip Saw

This machine is used to rip the panels after they have been glued and pressed into plywood.¹ This is the first process that is necessary in sizing the panel and also the most important one. If the panels are not accurately cut and parallel, all subsequent sawing or cutting will also be inaccurate.

The stock is conveyed to this machine and laid on a feed table. Usually a stack of panels approximately 1" to 2" thick is run through at one time. A guide is present on the side of the machine which enables the operator to set up for the size of the panel being ripped. The top section of the machine is raised or lowered to accommodate the various thicknesses that are being cut. To facilitate raising and lowering, the mechanism is motor driven. A clutch is usually used to disengage the motor

¹
See Figure 19

GLOBE HIGH SPEED HEAVY DUTY PANEL RIP SAW

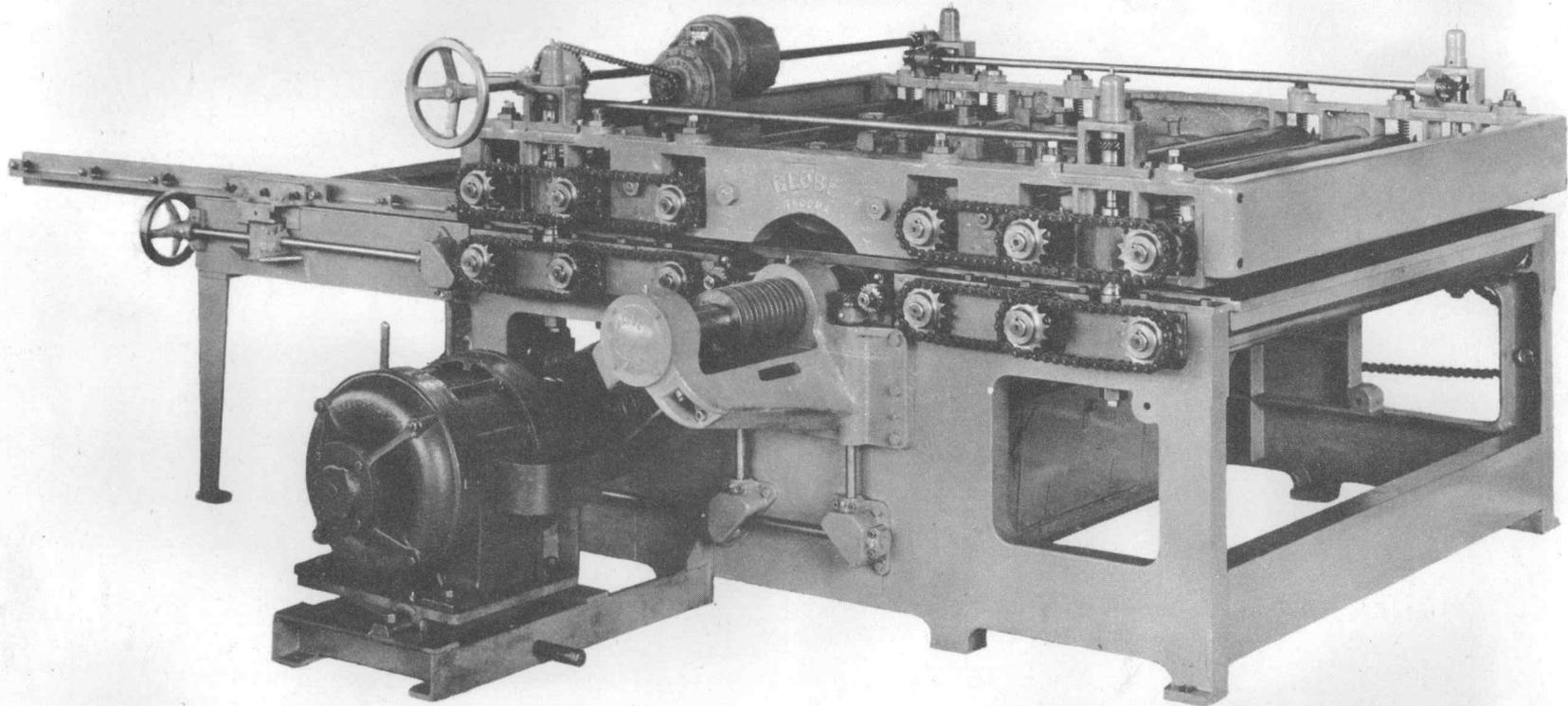


Figure 19

GLOBE MACHINE MFG. CO.

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power so that the hand attachment may be used for close tolerances.

A separate motor is used for the feed arrangement. This is a special gear head motor which operates the feed at 111 feet per minute. Usually, separate sprockets can be obtained which will increase this speed.

The arbor is driven by a 30 H.P., 1800 R.P.M. motor and the power is transferred by a series of twelve V-belts which rotate the arbor at approximately 4300 R.P.M. The capacity of the machine is 60" widths and thicknesses of 3". The diameter of the saws is 14". The stock is fed through a series of twelve machined and heavily built rolls.

Equalizers

After the panel has been ripped it is conveyed to an equalizer.¹ This machine is standard equipment in nearly all plywood plants.

In operation, the panels are placed on the table of the machine and lugs carry them across the saws. The saws may be spaced according to the dimensions of the panels that are required. This is accomplished by turning a crank that is usually located at the top of the machine which moves the saw pedestal back and forth to the desired place. Usually, a conveniently placed scale is used to locate the pedestal at the proper cut.

The saws are powered with a 20 H.P. directly connected motor. A 2 H.P. flanged gear motor is used to operate the feeding mechanism.

A top bar and spring assembly is used to exert pressure on the panel to hold it against the bed of the machine while the panel is

¹ See Figures 20 and 21

being trimmed. These machines are commonly 4-saw models but some plants use a 5 or 6-saw model. Usually additional saws can be obtained at any time to fit on the machine.

The saws used on these machines are 14" in diameter and the speed of the saw is 3400 R.P.M. The average speed of feed is 60 feet per minute.

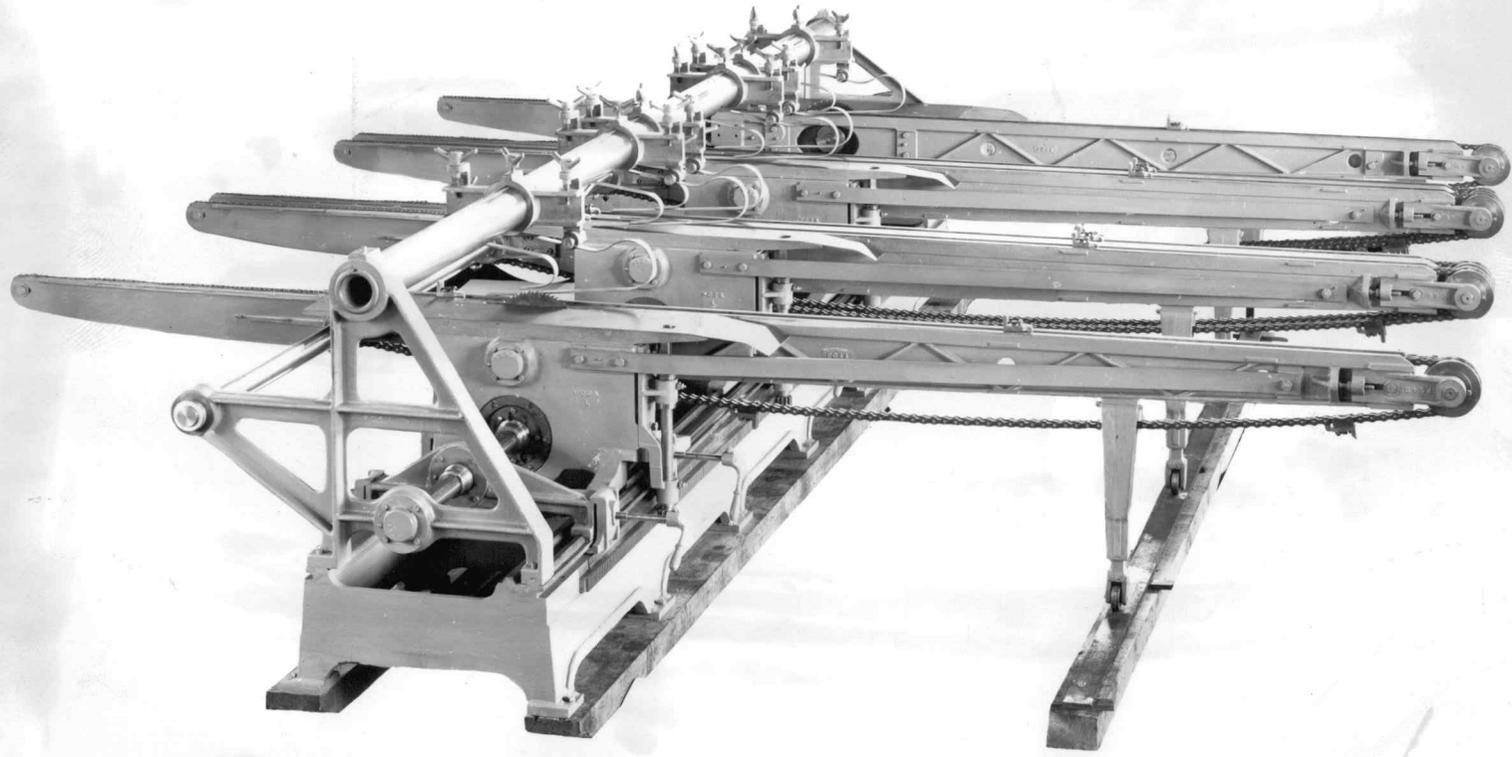
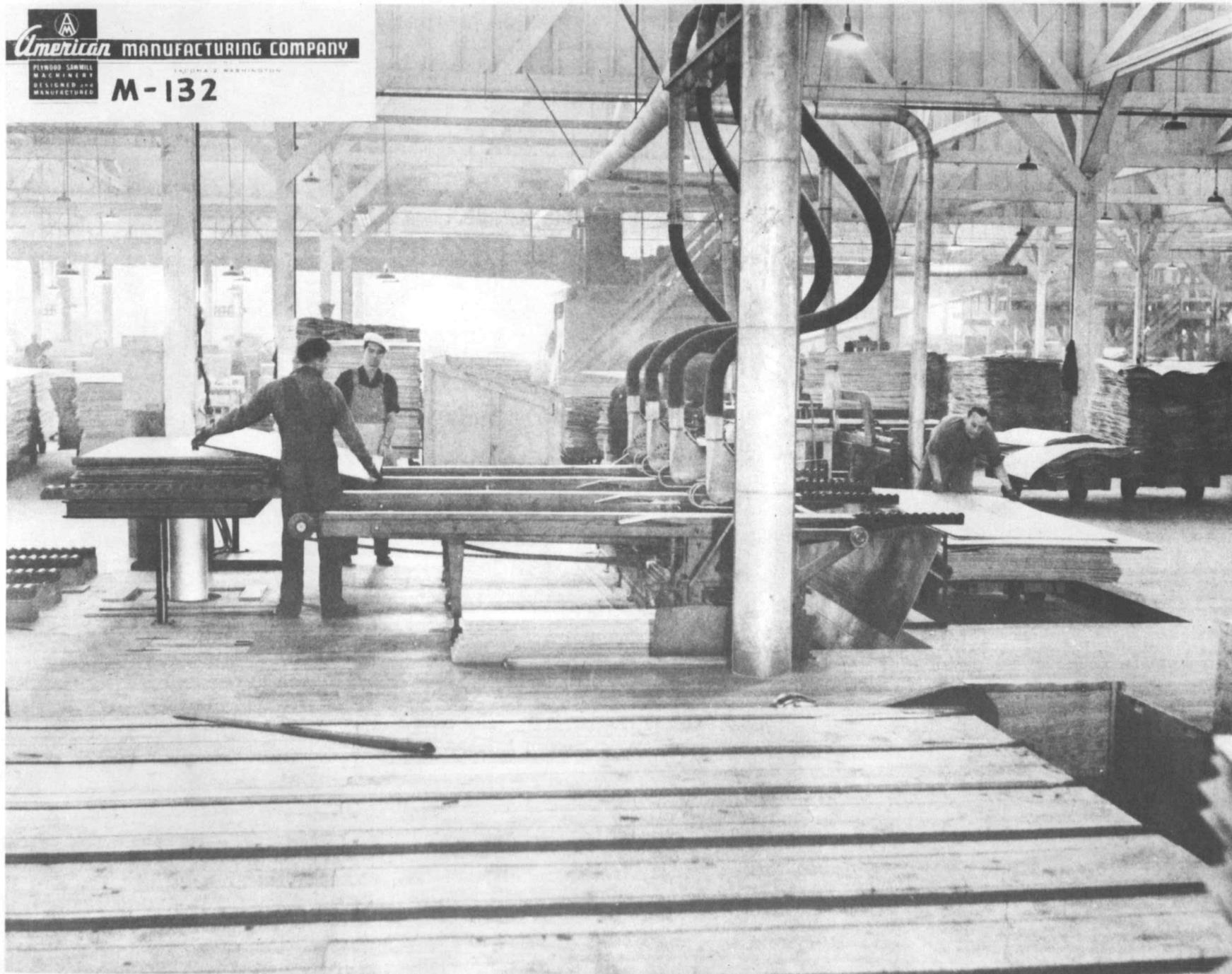


Figure 21. Another view of a panel equalizer shown in actual operation in the plant.

Courtesy American Manufacturing Co.

American MANUFACTURING COMPANY
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12



SANDING AND RESANDING

This operation, like dimensioning, is essentially the same on plywood as on lumber and requires few special suggestions.

In the case of structural grades of plywood, such as produced in the Douglas Fir region, it is customary to sand both sides simultaneously.

Drum Sander¹

Machines of this type are in use throughout the industry and are relatively simple in operation and design. They are similar in every respect to those used by other sections of the woodworking trades. They may consist of two, three, or more drums of the roll feed, or endless bed-feed types.

Triple drum sanders with rubber studded chain bed-feeds are most efficient tools and yield a large output so vital to every plywood manufacturer.

Each sander must be provided with an efficient dust extractor serving all drums, otherwise the machine will soon clog up.

The sander drums are positioned above and below the table and are given a lateral and reciprocating movement in addition to the rotary action. The thickness control can be regulated with great accuracy. Each roller is covered with felt which gives a cushioning effect between the roller and the abrasive paper. The latter is spirally wound around the periphery of the roller and must be carefully adjusted. The first roll carries the roughest paper, the second a finer one and the last

1

Perry, Thomas D., Modern Plywood, Pitman Publishing Corporation, New York-Chicago, 1942.

a finishing grade.

The rolls must be kept in good condition if a good product is to be produced. The condition of the paper is also important as, for example, if a worn paper is used on the last roll a glossy surface will result.

The felt on the sanding roller is apt to thicken in spots and should be examined and trued up as may be necessary when the papers are renewed.

When sanding on the endless-bed machines, the panels should be fed squarely to the rollers, one sheet following the other as closely as possible. This reduces the risk of rounding the leading edge as it is engaged by the rollers. In the roll-feed machines, panels should be entered at a slight angle to obviate similiar troubles. Only one side is surfaced at a time on machines of this type. The back side of each panel should be sanded first as this will provide a level surface which will insure accurate surfacing of the face veneer.

It is generally a mistaken policy to pass a veneered surface through a triple drum sander more than once. If, however, it becomes necessary to do so it should be born in mind that a better durface will be obtained by making two light cuts than by making one heavy one. When the excessive pressure required to make a heavy cut is applied, a rippling "washboard" effect generally results from the sandpaper cutting more deeply into the softer parts of the wood.

Scraper

The machine scraper is used largely in plywood mills and gives a finish to the sheets very similiar to that obtained by the woodworker when cleaning off solid wood with a hand scraper.¹

The plywood is carried by a series of feed rollers against a fixed knife of special grade of steel the keen edge of which has been turned to a specified angle. This edge projects a fraction of an inch above the surface of the knife stock which, when in position, is secured to the bed of the machine.

The knife stock or carrier is built in two sections with a small opening between the knife stock to allow the shavings to pass down through the opening and out of the way.

A continuous shaving is removed from the sheet as it passes through the scraper. The thickness is uniform and may be adjusted to meet requirements.

The uniform thickness is obtained by means of a pressure bar on the top of the veneer, which holds it well in position.

Sheets which have been well scraped are preferred for veneering and for high class enamel work as the pores of the wood are free of sander dust and surfaces are entirely free of the "wash-board" effect already referred to. Also, there are no rounded off or cut-away edges.

Belt Sander

This is generally used to remove any uneven surface not cleared by the drum sander or the scraper, whichever is employed.

¹

Andrew Wood & Thomas Linn, Plywoods, Pittman Publishing Co., Brooklyn, N. Y., 1943.

This machine consists of a 20 to 25 foot horizontal abrasive type, flat belt running directly over a table on which is placed the sheet to be retouched. The operator simply places a block, which is usually strapped to his wrist, on the upper side of the lower layer of belt and holds the belt onto the section to be refinished. The belt, traveling at a moderate speed, quickly removes any defect present.

Power requirements for this type of sander are usually small. A drop-belt can be run from a line shaft if such an arrangement is present. Otherwise, a separate motor must be provided.

Hand Sander

In some plants, small hand sanders are used to remove small rough spots not perfected by the other machines mentioned. This machine is usually powered by a small motor (1/4 H.P.) on the shaft of which is mounted a pad of abrasive paper of various grains according to the needs of the operation.

SCARFERS

Machines of this type are designed to produce panels of average width and of any desired length. Conception of the idea of joining standard panels to form panels of any length arose from constant observations of the handicaps and shortcomings of square joints between abutting plywood panels.

Harbor Plywood Corporation of Hoquiam, Washington designed just such a machine that is both efficient and practical.¹ There are many variations of this type machine but all revolve around the same basic principle and therefore Harbor's design, as a common illustration, will be used.

The three main items in the procedure are the scarfing machine which bevels the panel edge to be jointed with extraordinary precision, the gluing press, in multiple units to achieve reasonable operative economy, and the glue, compounded especially to meet the dual requirements of fast setting and avoidance of glue stain at the joints.

The machine consists of a substantial bed of heavy I-beams on which are precisely laid machine ways. On this machine the carriage is nine feet wide capable of taking a panel 8 feet wide and of any length. The carriage is actuated by a Reeves variable speed drive so that movement of stock through the scarfer may be adjusted according to the thickness of the panel.

The scarfing unit consists of a heavy duty, 3600 R.P.M. electric motor, with a direct, mounted, 10-knife planer head;

1

"Harbor Scarf Joint Method", The Timberman, Vol, 46, No. 3, P. 89 (January, 1945).

The whole assemble is mounted on a heavy rigid bed casting. The important factor is mounting the scarfing unit at the proper angle of cut so as to cut across all the layers of plywood. The shaft is mounted at exactly 45 degrees to the scarf edge in order that a sheet of plywood can be scarfed on either edge. In actual practice, scarfing is done at a 1-12 bevel which allows a thickness of 1/64" at the edge. Feathering is avoided and a perfect joint results.

The gluing assembly includes a small four opening hot plate press, with supporting arms bolted to the three top plates to carry the weight of the panels, and 60 feet of bed platform at off-side of the press.

The plates are 108 inches long and 18 inches wide and are heated with steam. A combination of oil and hydraulic rams are used to apply pressure while setting glue joints, and to raise the plates to release the work. In order to keep the bottom panel level with the conveyors platform, the plates are movable upward, and pressure is applied from above by a battery of oil rams. There are seven rams, with control valves which permit the use of the center three, or five or the entire battery depending on the width of the stock being glued. A motor driven oil pump operates continuously to provide pressure for the oil rams. Pressure is governed in operation according to the width of the stock being glued, and a pressure table for each width has been worked out to meet the needs of the operation.

For stock ranging from 36" in width to 108" the table shows ram pressure ranges of from 240 pounds, using three rams, up to 310 pounds for wide stock using all 7 rams.

FANCY STOCK

Machines have been designed to manufacture fancy veneer stock from the standard plywood panel, as known by the industry. The panel comes out in a special ribbed pattern which is ideally suited for decorative panelling and for many other uses.

The Cascade Plywood Corporation of Lebanon, Oregon installed just such a machine last year. They are enabled, through this machine, to turn out 5/16" and 3/8" interior and exterior panels 48" x 96" and 84" x 120".

The machine outwardly resembles a small pony planer, common in woodworking plants. The machine has eight cutter heads with special knives and scarfs to a set pattern providing special ribbed panel finish.

The material is fed face downward into the machine and is held in place by an upper pressure bar. The depth of the cut is governed according to the thickness of the face ply.

Two men are required to operate this machine, a feeder and an offbearer.

ELEVATORS

Elevators are great time and labor saving devices and are being employed more and more throughout the industry. Their use is varied and to fully illustrate my meaning the following photographs are presented.

An important change, not shown, has been made however, and should be noted. The change obviates the danger of pre-curing the panels in the automatic charger waiting to be put in the hot press. To eliminate this danger, a lateral power unit was put under the charger to move it away from the press while the press was closed and the charger was being reloaded. The charger is moved approximately 30" away from the press and, by this means, the pre-curing of the panels is prevented.

Photographs M-129, M-130 and M-206 show three positions of hydraulic dryer feed elevators. These elevators are controlled by hand-operated control valve. The extension rod and operating lever are installed on the right hand side. This elevator is built to accommodate two green loads of veneer on 85 pounds of water pressure. When this elevator is installed in connection with a 5-line dryer it usually works out that a 6' travel is determined. In connection with a 4-line dryer, a 5' travel is used and with a 6-line dryer, a 7' travel is used. In most cases these elevators operate from one centrally located water pumping unit. This pumping unit provides water and pressure to whatever rams are located in the plywood plant; however, in some

cases, individual pumping units may be used.

Photograph M-208 illustrates a hydraulic elevating table of the general type which may be used for various purposes and for many applications throughout the plywood plant. This installation pictures a 10 1/2" piston diameter ram having a 48" travel. The platform of this elevator is fitted with gravity roll sections and is singly stabilized. When this platform is down, loads can be pushed on from two different ways.

Photograph M-138 shows a hydraulic elevating table installed on the offbearing side of a glue spreader. This type of installation makes it possible to keep the newly laid up packages at an easy working height for the offbearing operator behind the spreader.

Photograph M-221 shows an assembly of an automatic charger and an electric feed elevator used in connection with a 10 opening hot plate press, size 4' x 8'.

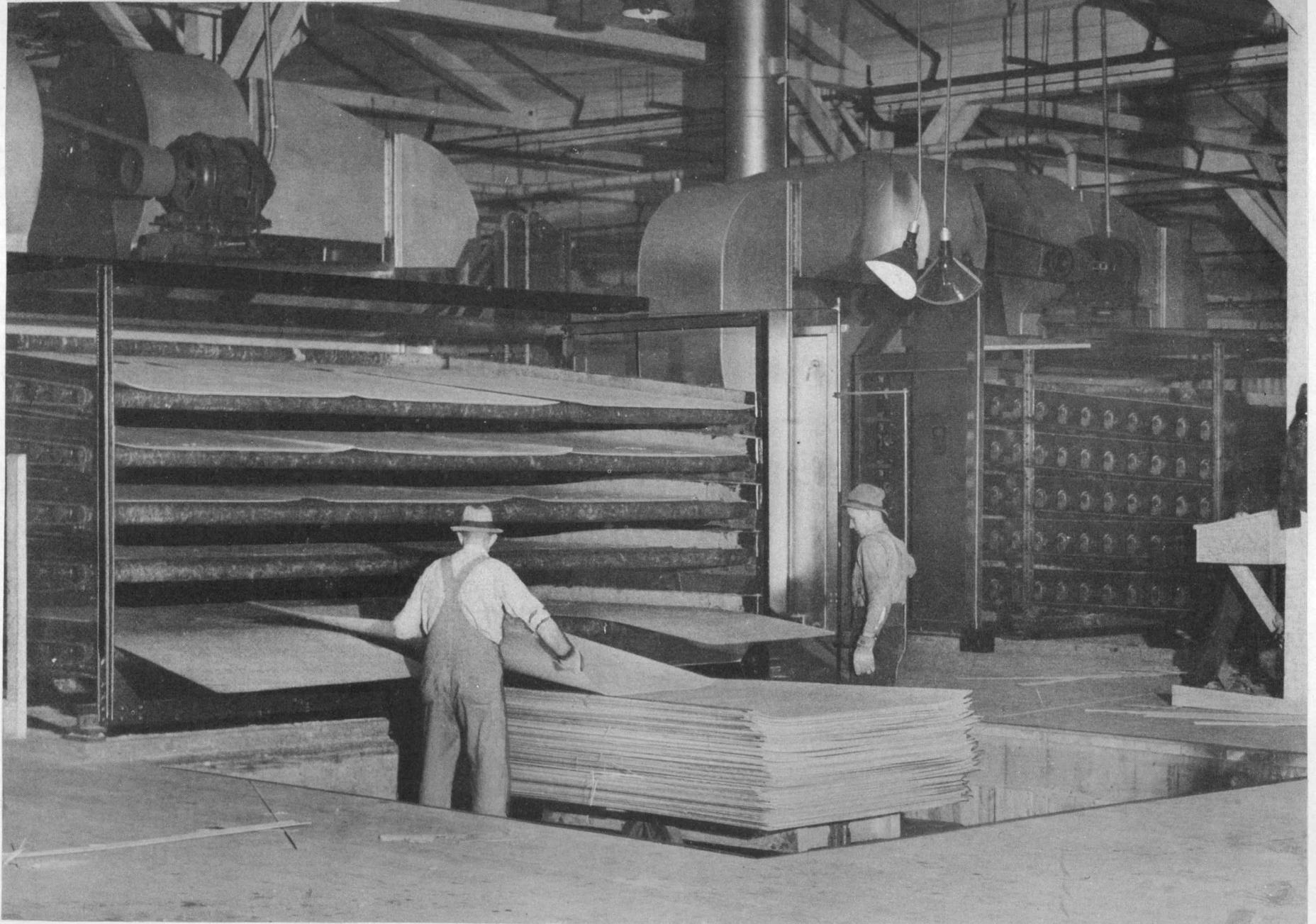
Photographs M-115 and M-126 also show the use of hydraulic feed elevator used in connection with hot plate presses. These units can usually be used with either hand operated, or electrically operated control valves.

Photograph M-122 shows another use of a hydraulic elevating table. This particular installation is being used as a box car loader elevating loads of material to the floor height of the box car. The installation shown is operated with a hand control valve.

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M-129



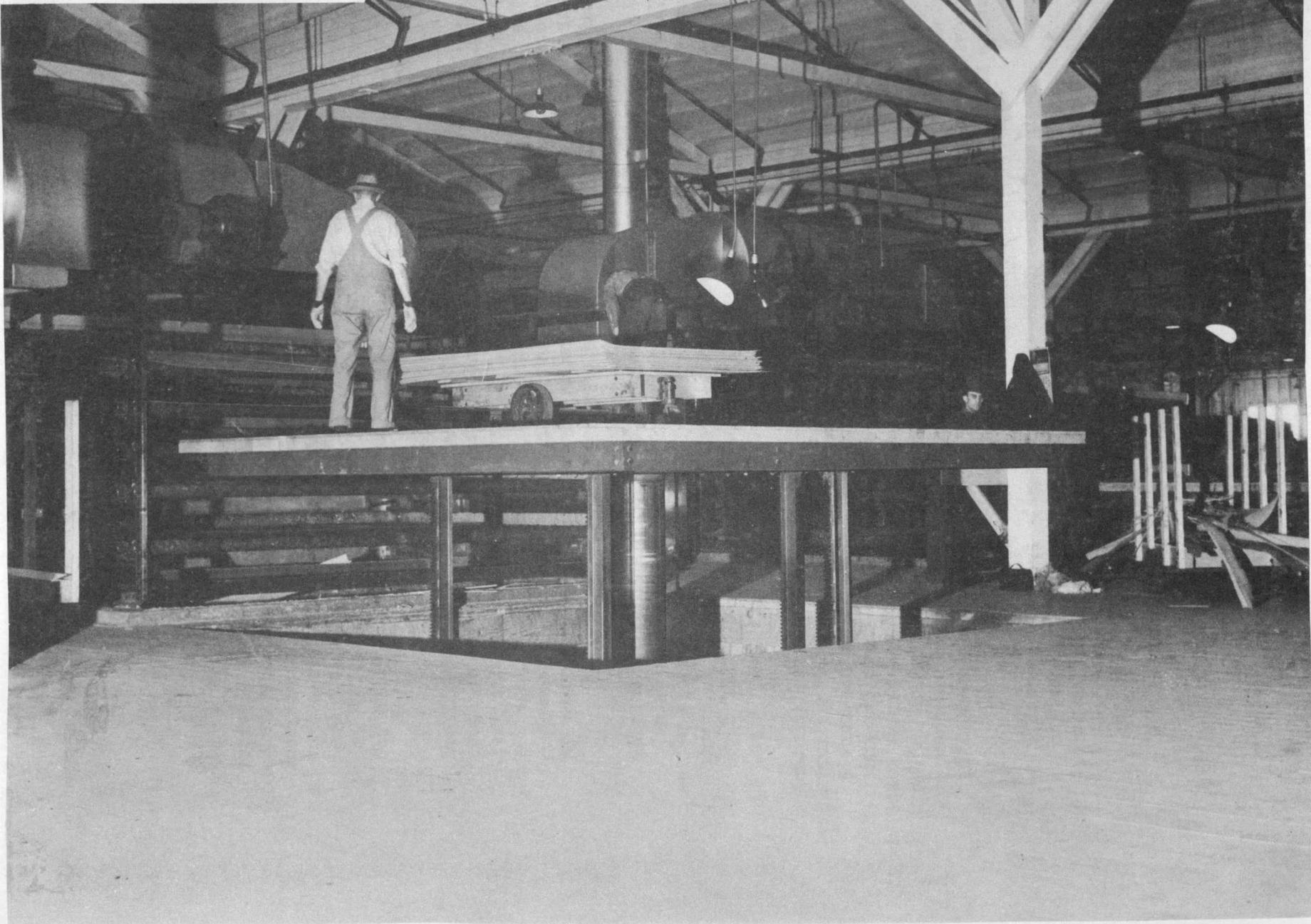


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**ELEVATORS
for
EVERY LIFTING
REQUIREMENT**

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M 130



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M-206

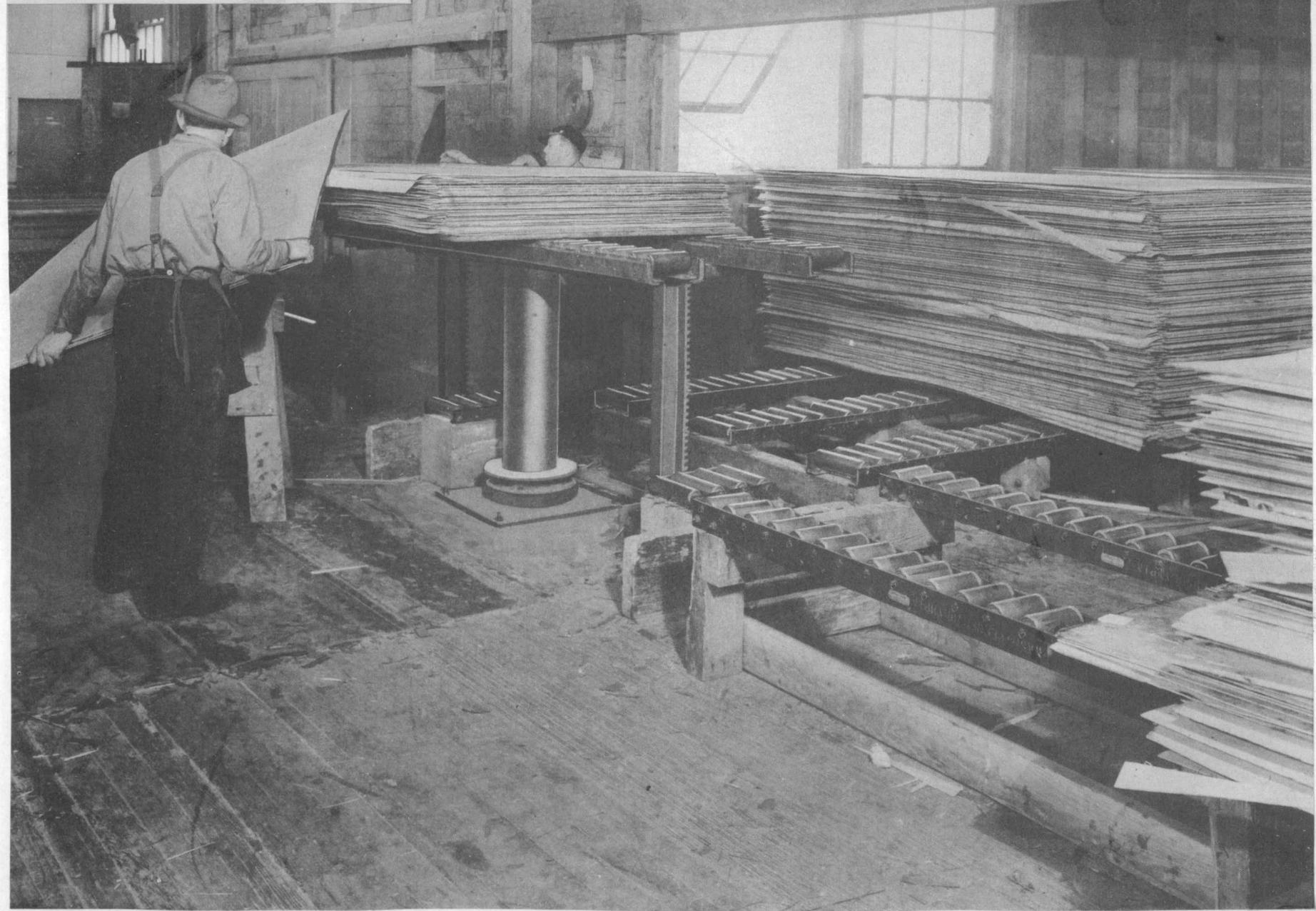


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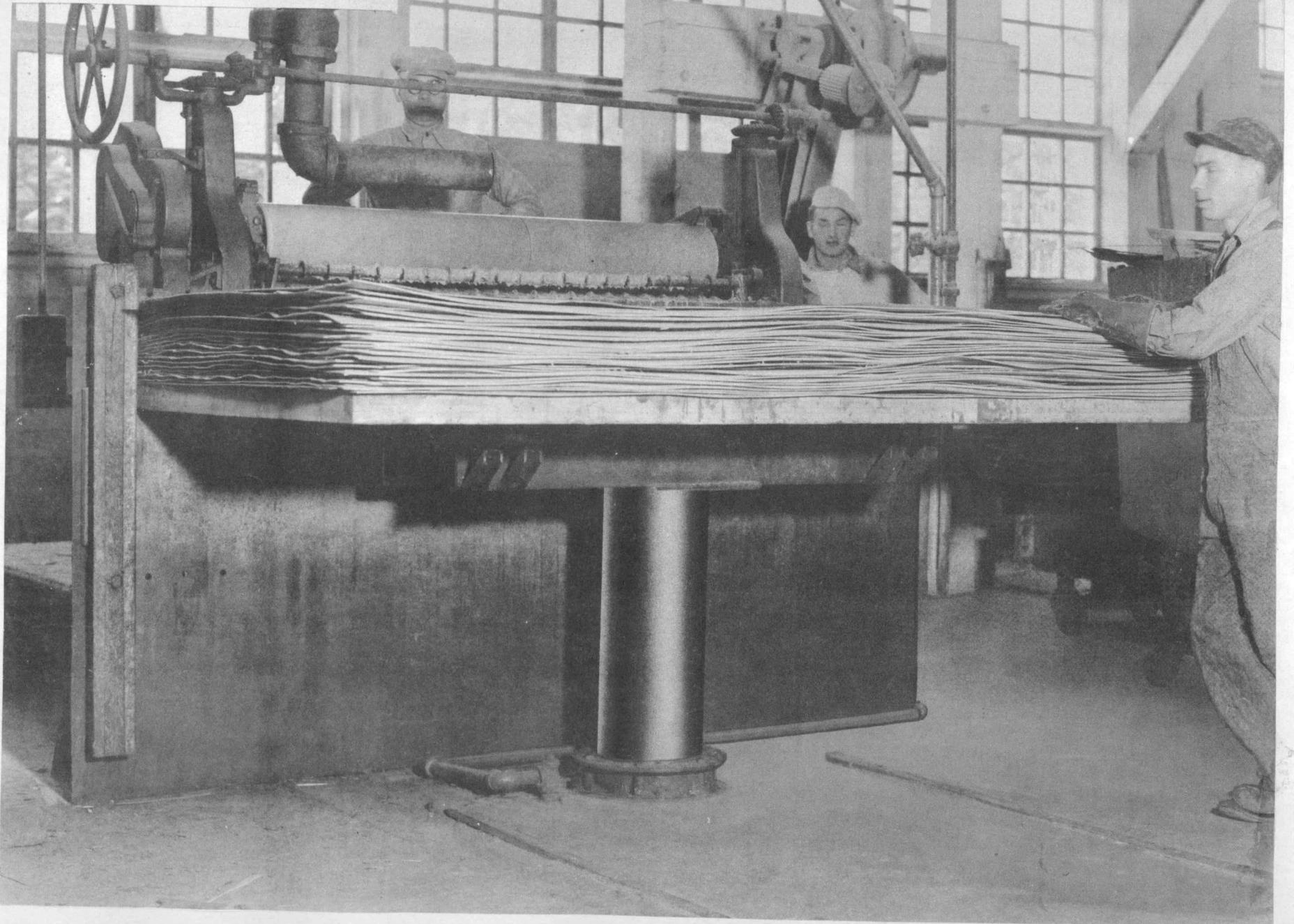
M-208



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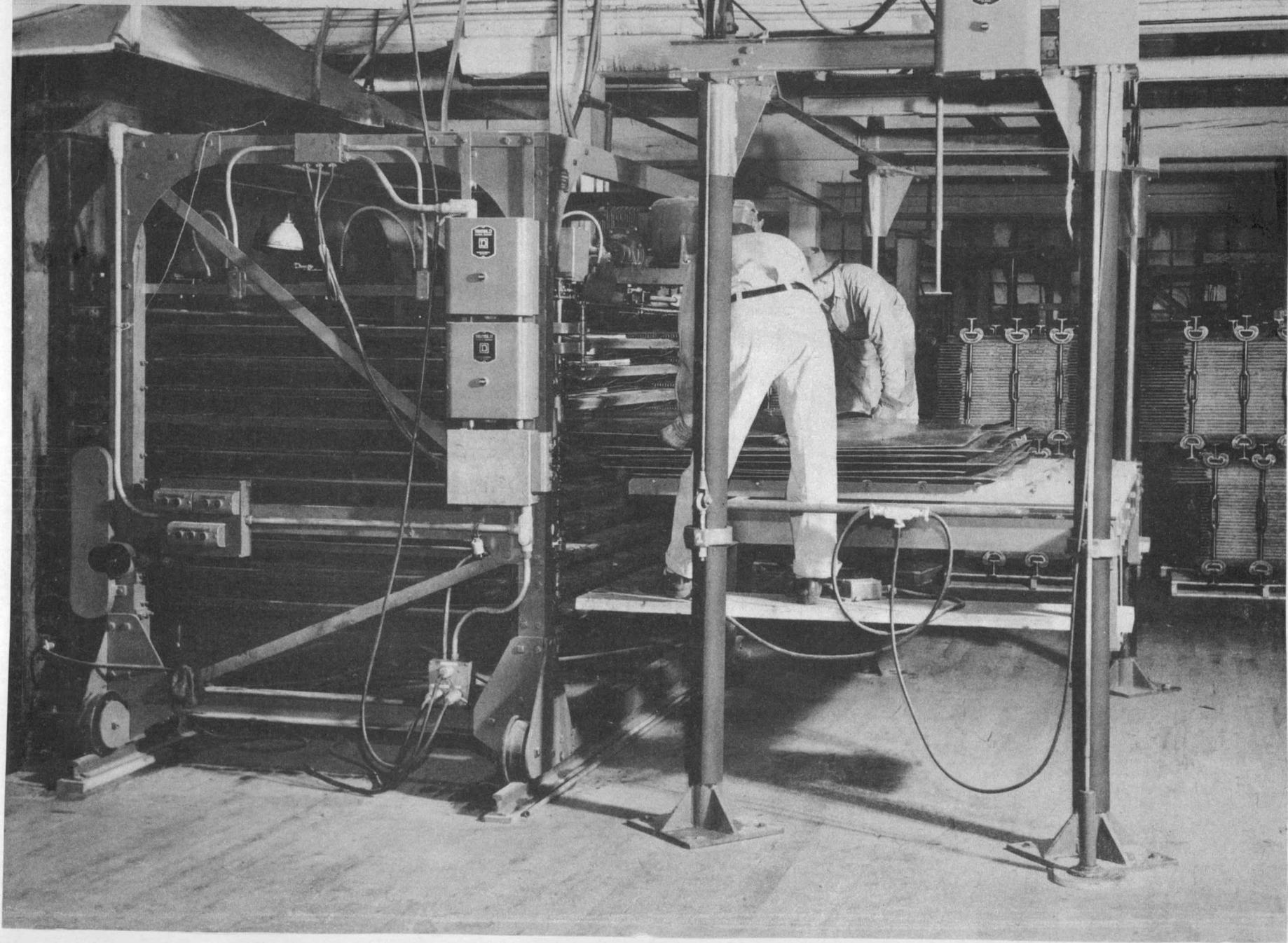


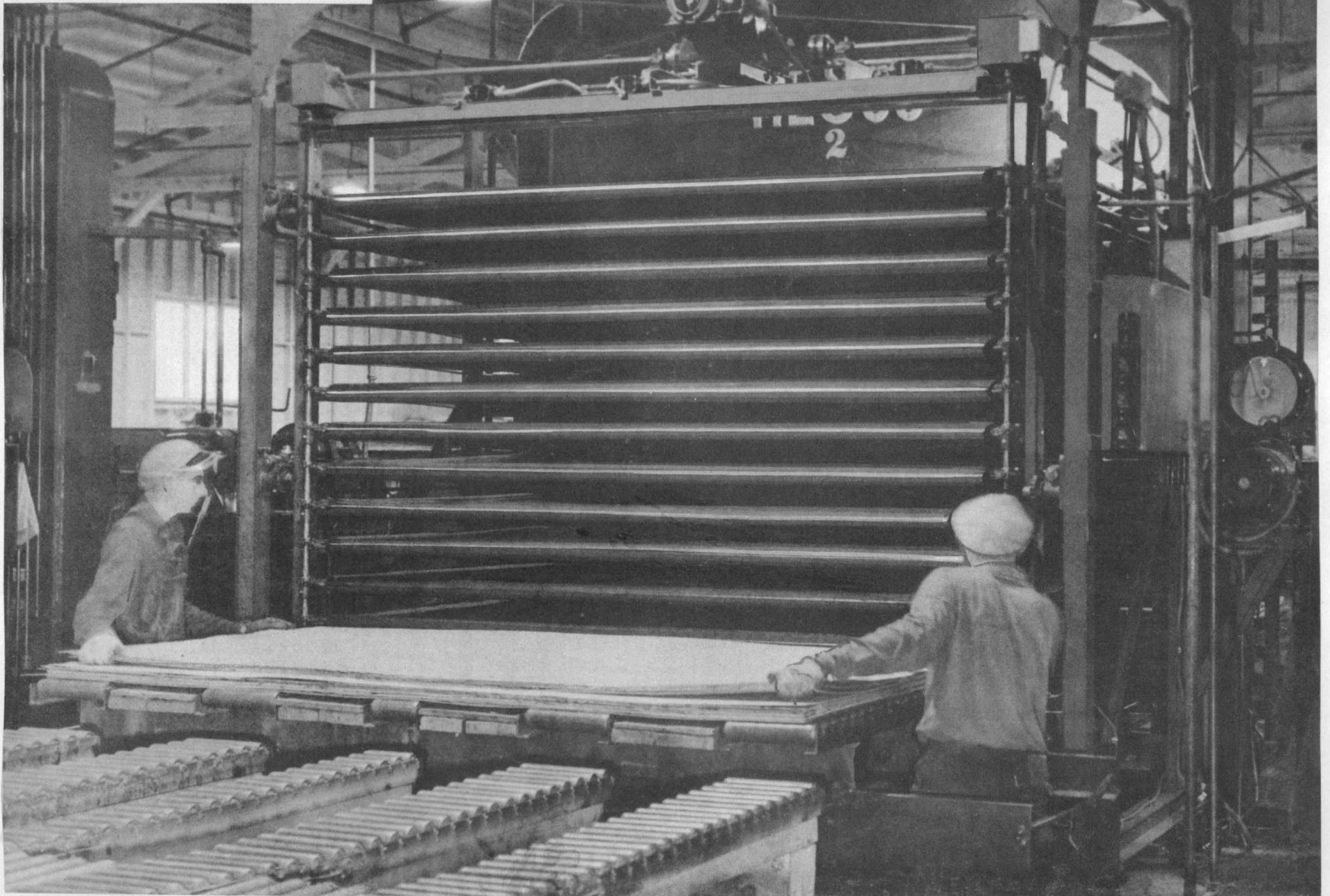
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M-221

18



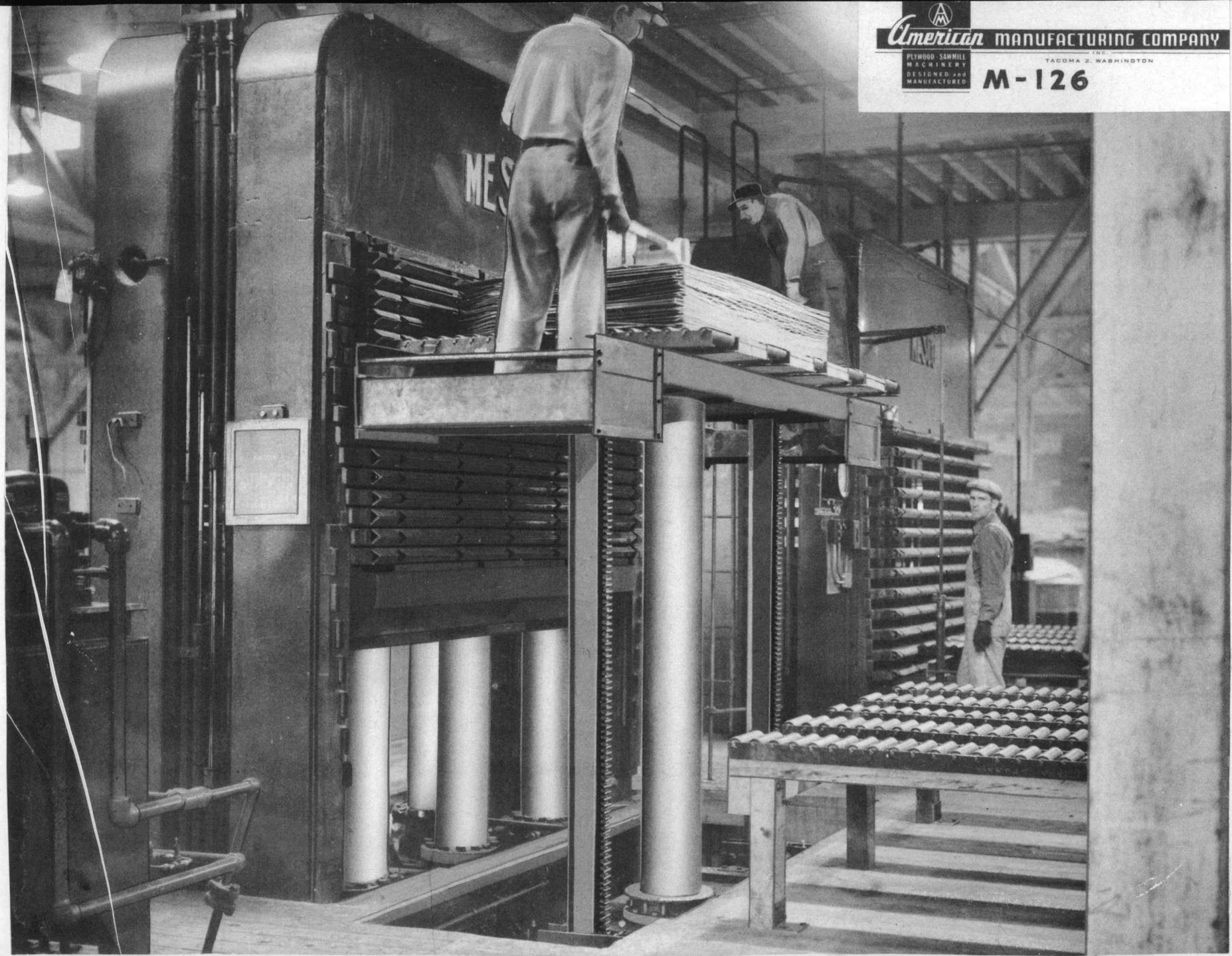


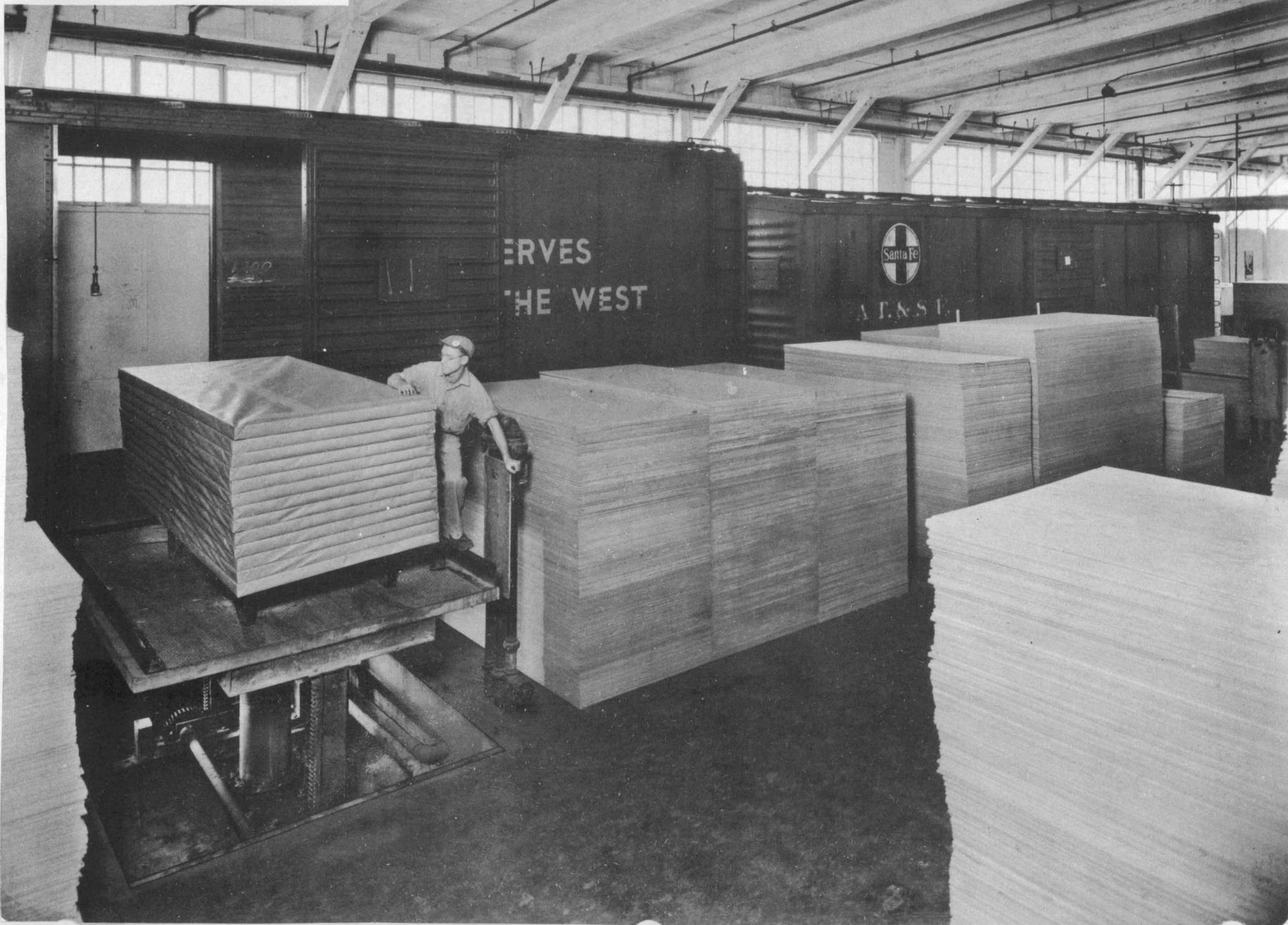
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M-126





SUMMARY

Machines used by the plywood industry are constantly being improved upon. The machines we recommend today will be regarded as obsolete tomorrow because of the changes and improvements being made in machinery design and efficiency. Actually this improvement is a good indication of the vigor of the industry. Only through its ability to meet the demands of the consumers for better products at lower costs is the industry able to actively compete with other building materials such as steel and fiberboard.

Another serious consideration is our dwindling stores of quality raw material. To off-set this condition the industry will be forced to adopt new methods of manufacture which will permit utilization of the lower grades of raw materials. Improved equipment will be heavily called upon to meet this problem of more complete utilization.

The future of the industry is bright indeed contrary to the doubts of some people. New problems will undoubtedly arise and will have to be met but the industry is fortunate in having in its membership many competent men, Peter Skoog being but one example, who are well equipped to meet this challenge and overcome it.

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