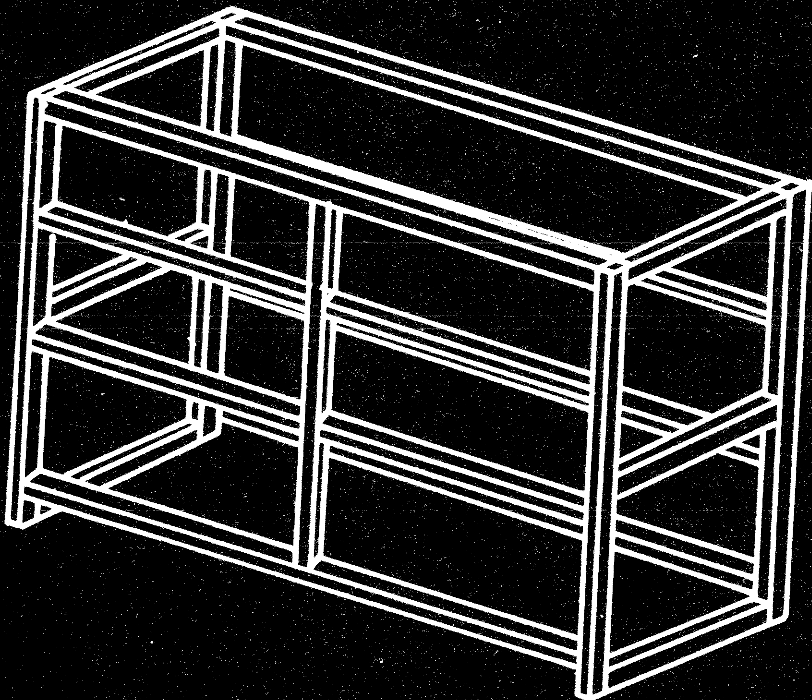
# An Automated Rough Mill for the Production of Interior Furniture Parts



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USDA FOREST SERVICE RESEARCH PAPER NE-335
1975
FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE
NORTHEASTERN FOREST EXPERIMENT STATION
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MANUSCRIPT RECEIVED FOR PUBLICATION 13 MARCH 1975

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**ABSTRACT**

An automated rough mill layout has been designed for manufacturing interior furniture parts. Designed to reduce human decisions and mistakes that can be costly when converting lumber into parts, the mill is based on a manufacturing sequence in which lumber is first gangsaw-ripped into standard-width strips before being crosscut to remove defects and cut to specific lengths. It is also expected to reduce manpower requirements, provide coordinated materials handling, provide better production control, and ensure consistently good yields. Standardization to one or a few widths permits maximum efficiency and yield. A major furniture manufacturer has built a mill based on the design.

**Keywords:** furniture manufacturing, automatic control

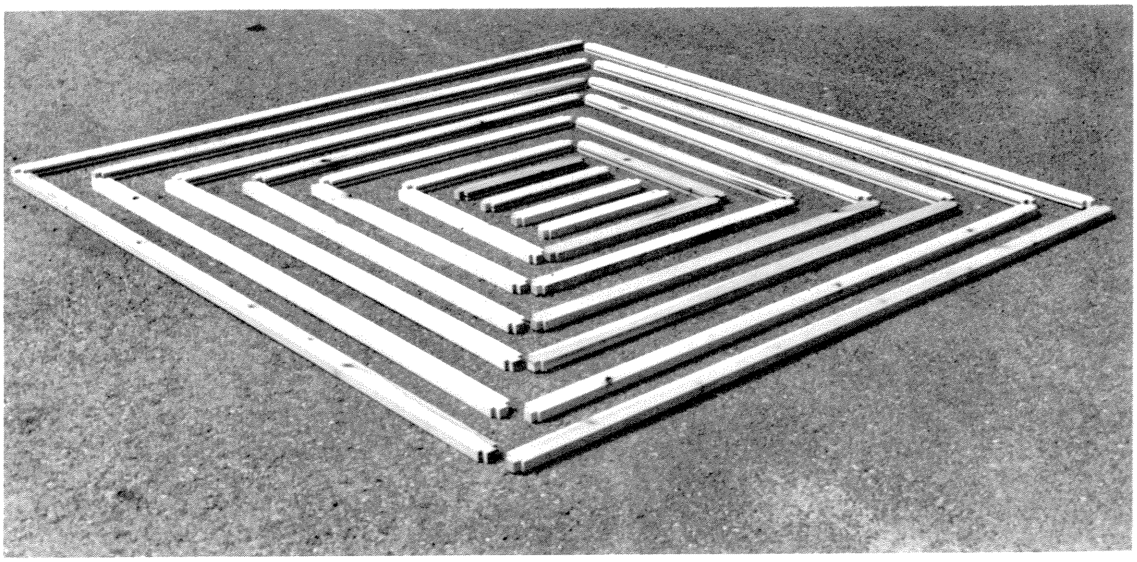


Figure 1.—Interior furniture parts. All of a standard thickness and width, but of different lengths, these parts have been tenoned and grooved and are ready for use.

# A NEW KIND OF ROUGH MILL

AT PRESENT, INTERIOR furniture parts are generally produced in conventional rough mills where the lumber is first *crosscut* into the desired *lengths*. A major disadvantage of this method is that conventional rough mills are set up to produce many different sizes of exterior parts rather than the more standardized interior parts. Excessive manpower is needed in a conventional rough mill to produce interior parts, and undercutting and overcutting the number of parts required is always a problem. Furthermore, all cutting decisions are made by human operators, and wrong decisions reduce yield and are costly.

Interior furniture parts (fig. 1) are usually required in a few standard sizes. Hidden from view, these parts are primarily structural. They can contain defects that do not greatly reduce strength, except on the ends, where machining is required.

Our studies of sawing methods *(Lucas and Araman 1975)* led us to design an automated mill for producing these parts by first *ripping* the lumber into the desired *widths*. We believed that, through automation, we could reduce manpower requirements and provide coordinated materials handling and production control.

Another benefit we looked for was a reduction in the number of decisions that are required of workers in a conventional rough mill. This would minimize the mistakes that can be so costly in converting lumber into furniture parts.

A major furniture manufacturer has built a mill based on our research and development. The ideas presented here can be used for any product of standard width such as strip flooring.

## ROUGH MILL LAYOUT

Our rough mill layout is based on a manufacturing sequence in which lumber is first gangsaw-ripped into strips of standard width and then is crosscut to remove defects and produce interior furniture parts of several desired lengths.

A computer simulation technique was used in designing the rough mill. With this technique, production problems and bottlenecks can be found and eliminated before a mill is actually built.

Our rough mill was designed to produce 4,000 net board feet of interior furniture parts per 8-hour shift from No. 2A Common yellow-poplar lumber. Simulated output ranged from 3,500 board feet from No. 2B Common lumber to 4,400 board feet from No. 1 Common lumber.

The mill was designed to perform four major actions in the manufacturing sequence (fig. 2):

1. The kiln-dried lumber is planed to a uniform thickness.
2. The lumber is gangsaw-ripped into strips of standard width.
3. Objectionable defects are removed from the strips by crosscutting.
4. The strips, now defect-free, are crosscut into several required lengths; the longest obtainable length is cut first.

In designing the mill, we used information provided by several equipment manufacturers. The equipment required is now available or could be devised from available components.

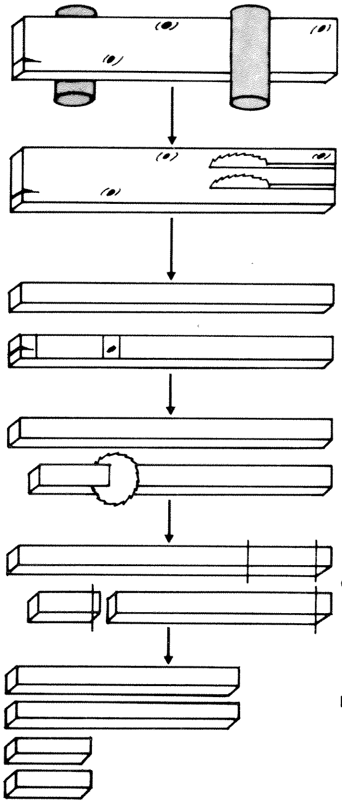
The mill requires a work crew of only three. Let's call them Al, Babe, and Charlie (positions A, B, and C in figure 3).

## ROUGH MILL OPERATION

The following sequence of operations is performed in this mill (fig. 3):

1. *Lumber Infeed*
   The lumber starts into the mill on a tilted breakdown hoist. It is rough kiln-dried 4/4 yellow-poplar, in random widths, and in random lengths up to 16 feet.
2. *Conveyor*
   The lumber is unstacked onto a cross conveyor one layer at a time.

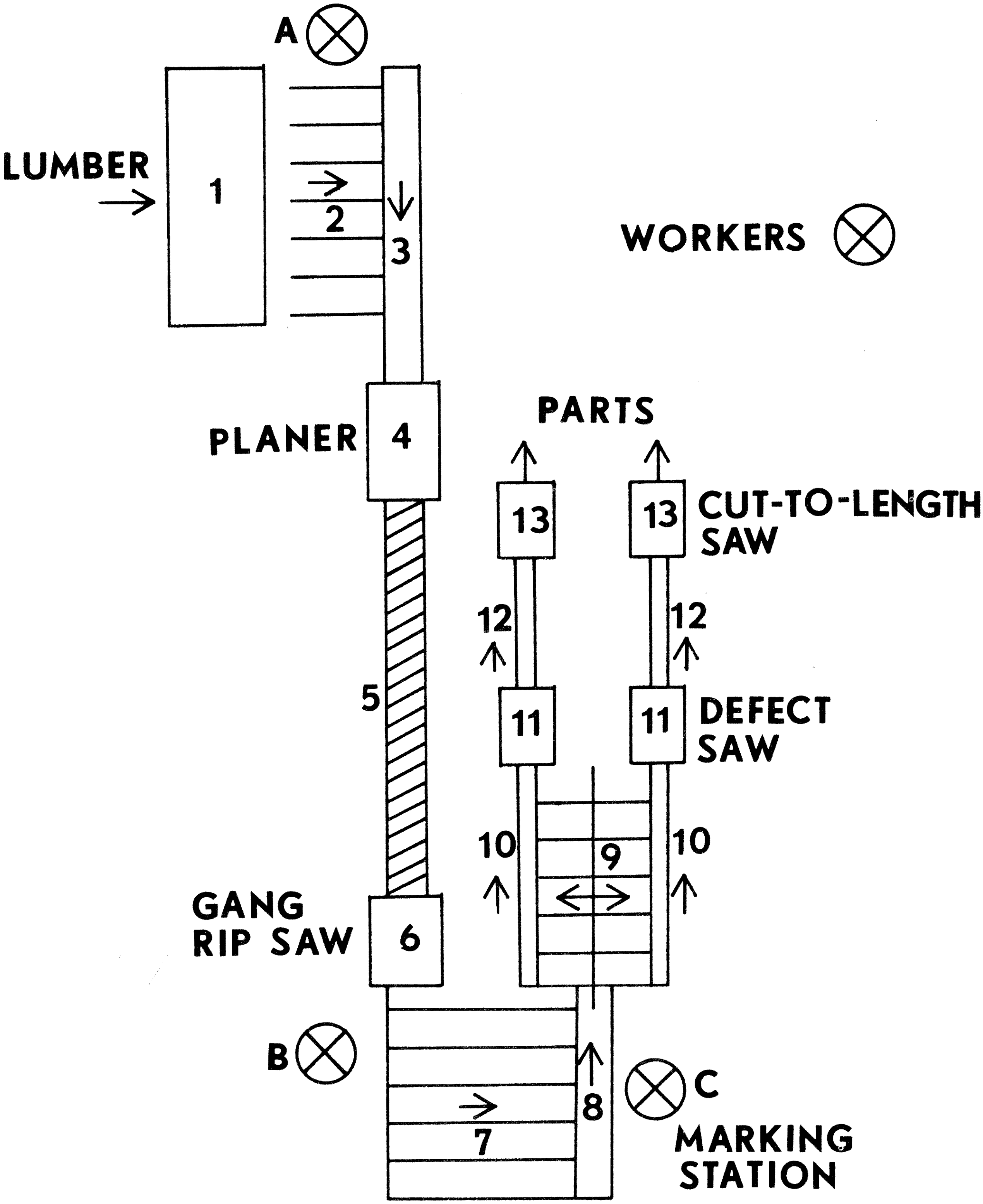
Figure. 2.—The basic operations in the automated mill. In this mill the first operation is to rip the boards into strips, whereas in a conventional mill the boards are crosscut first.




A. *Infeed Station*
   Al is stationed here. He feeds the boards one at a time onto the planer infeed belt at a rate of five boards per minute.

3. *Planer Infeed Belt*
   This is a belt conveyor, 20 feet long. The belt moves at the rate of 100 feet per minute to move the boards into the planer.
4. *Planer*
   The planer surfaces the boards on both sides at the rate of 100 feet per minute. The boards are skip-planed to a standard thickness.
5. *Canted Infeed Rolls*
   Coming out of the planer, the boards go onto a canted roller conveyor that alines

Figure. 3.—Flowchart of operations in the automated interior furniture parts mill.



the boards for feeding into the gang ripsaw. The canted conveyor is 24 feet long and moves at 100 feet per minute.

6. *Gang Ripsaw*
The gang ripsaw cuts the boards into standard-width strips at the rate of 100 feet per minute.

B. *Offbearer Station*
Babe is stationed here, at the tail of the ripsaw. Babe moves the edgings off and out of the way. (Wide edgings could be edge-glued and reprocessed or processed into cleat material.)

7. *Cross Conveyor*
From the tail of the ripsaw, the strips pass onto a cross conveyor that takes the strips over to the marking station. The cross conveyor, 18 feet wide, moves the strips at 25 feet per minute to the defect-marking station.

8. *Marking-Station Conveyor*
The strips move one at a time onto the marking-station conveyor. The strips are inspected while on this conveyor.

C. *Defect-Marking Station*
Charlie is stationed here. He quickly marks each strip where it is to be cut to remove defects. If a strip has a defect at the end, such as a split or a knot, he makes a single mark to show where the bad end is to be cut off. If the strip has a defect in the middle, he marks it on both sides for cutting out.
To mark the strip for cutting, Charlie uses a conducting type of electrolytic solution to make a mark or marks across the strip where he wants the defect cut. Charlie then releases the strip, which travels to one of the two defect saws.

9. *Splitting Bar*
As Charlie releases each strip, he positions it so the splitting bar guides it toward one of the two defect saws.

10. *Cross Conveyors*
The cross conveyors then move the strips to one of the two defect saw infeed belts. Two lines, each containing a defect saw and a cut-to-length saw, were required in the mill design (simulated) to achieve the production goal of 4,000 net board feet of interior parts per 8-hour shift from No. 2A Common yellow-poplar lumber.

11. *Automated Defect Saw*
As the strip moves onto the infeed belt of the defect saw, at 60 feet per minute, an electronic sensing device locates the marks that Charlie made. The fingers of the sensing device, as they feel the mark pass, trip a circuit that activates the automatic saw. The strip is stopped automatically as the mark reaches the saw line, and a clamp holds it momentarily while the saw automatically crosscuts the strip at the mark.

12. *Conveyor*
Now that the defects have been cut out, the strips are of many different lengths. Some are full length, many shorter. This conveyor carries them at 60 feet per minute to another automated saw where they will be cut to the various lengths needed for interior furniture parts.

13. *Automatic Cut-to-Length Saw*
The automatic cut-to-length saw can be controlled by a mini-computer or electronic circuit. Before a production run starts, the desired lengths and the number of parts of each length needed are programmed into the controlling device. No operator is required. Cutting is done automatically when a full-length strip or a shorter section of a strip arrives at the automatic cut-to-length saw. At the saw, the following operations are performed automatically.

1. The strip is advanced and is measured for the longest obtainable required lengths.
2. The strip is stopped automatically and crosscut.
3. After the first cut is made, the remaining section of strip is measured and cut to the next longest obtainable required length. This procedure is continued until the remaining section is shorter than the shortest required part.
4. After each cutting, the computer deducts one unit from the quantity needed for that length.
5. When no more cuttings are required, the counter for that length goes to zero.
6. When all cutting requirements have been satisfied, the system stops and is reset for the next run.

After the strips have been cut to the required lengths, they would be moved on to an automatic sorter (not shown in figure 2). Then the parts are shaped to final dimensions by moulding and tenoning.

## DISCUSSION

Though the design for this automated rough mill was developed through simulation, it is now at the practical stage for application. All the equipment and devices required are either available now or could be made from components that are available. One furniture manufacturer has installed a mill based on this design.

This automated rough mill design gives manufacturers an automated and highly efficient interior-parts operation. For example, dimension manufacturers who supply several customers, or furniture manufacturers who desire to supply assembly plants from a centralized location, could find it beneficial to establish an automatic cut-to-length interior-parts mill.

The mill has many benefits. In addition to labor savings, high volume, good yields from all grades, and good flow of materials, the mill provides good production control with no overcutting and consistent yields with little chance of operator error.

### REFERENCE

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