

# WOODWORKING MACHINES

March 1948



No. R1706

(Reports)

UNITED STATES DEPARTMENT OF AGRICULTURE  
FOREST SERVICE  
FOREST PRODUCTS LABORATORY  
Madison 5, Wisconsin  
In Cooperation with the University of Wisconsin

## WOODWORKING MACHINES<sup>1</sup>

By EDWARD M. DAVIS, Wood Technologist

-----

Woodworking machines are made to do a wide variety of jobs. For any one job there are usually a number of makes, sizes, and styles of machines from which to choose. They are not standardized. Only a brief classification and outline of specifications for fairly typical machines of the more important types is attempted here. Small light machines of the home workshop size are not included.

Woodworking machines may be divided into three broad classes based on function; sawmill, planing mill, and industrial plant machinery. The function of sawmill machinery is to cut the log into rough, green lumber. The planing mill takes the rough lumber (usually dry), and prepares it for general construction uses, such as flooring, siding, shiplap, or framing. The industrial plant cuts up lumber and makes it into doors, furniture, boxes, or other fabricated products.

### Sawmill Machinery

Several types of sawmills are available for making the log into lumber, and the type that is most suitable in any given instance will depend upon such factors as the size of the timber and the desired output. Nearly all the cutting in the sawmill is done parallel to the grain. In the United States this is done with saw teeth of the chisel type with cutting edges that are square both on top and on the front. The teeth are widened at the cutting edge usually to about 6 gages thicker than the rest of the blade for softwoods and 4 gages thicker for hardwoods. The first saw for cutting parallel to grain that the log encounters when it enters the mill is referred to as the headsaw, regardless of whether it is a band saw or a circular saw. There may or may not be several other saws depending upon the size of the sawmill.

---

<sup>1</sup>Prepared as a chapter in a mechanical engineers' handbook.

## Band Saws

The band headsaw is in common use in most medium and large mills today. Band saws may be provided with teeth on both edges, but this is the exception. A band mill of the size used for making logs into lumber seldom has wheels less than 6 feet in diameter, blades less than 7 inches wide, or weight less than about 12,000 pounds. Band mills used for large West Coast timber may have wheels 10 feet in diameter, blades 18 inches wide, and a weight of 50,000 pounds. The horsepower required varies from 50 to 150, and the speed of the motor is so adjusted as to give the saws a speed of about 10,000 feet per minute. Dimensions of typical sawmill band saws are as follows:

<u>Width of</u> <u>saw blade</u> <u>in</u> <u>inches</u>	<u>Gage</u>	<u>Tooth</u> <u>spacing</u> <u>in</u> <u>inches</u>	<u>Tooth</u> <u>depth</u> <u>in</u> <u>inches</u>
8	16, 17, 18	1-3/4	5/8
12	13, 14	2	7/8
16	11, 12	3	1-3/8

The band saw blade is thinner than that of the circular saw, and consequently it produces more lumber and less sawdust per unit of logs.

## Circular Saws

Nearly all small sawmills, as well as many of the medium-sized ones, use the circular saw to break down the log. The saw blades may be either of the solid-tooth or inserted-tooth type, but the latter are much more common owing to greater ease of upkeep. Dimensions of typical inserted-tooth circular saws are as follows:

<u>Diameter</u> <u>inches</u>	<u>Thickness</u> <u>gage</u>	<u>Number of teeth</u>
16	10	12 to 16
24	9	18 to 24
36	8	24 to 38
54	7	40 to 58
72	6	56 to 80

Portable circular mills.—Portable sawmills are generally used where the amount of timber available is too small to justify a permanent mill and where the timber is small to medium in size. They usually vary from 48 inches up to 60 inches in saw diameter, from 6 to 60 in horsepower, and from 3,000 to 5,000 pounds in weight. The daily output varies from 2,000 to 15,000 board feet. The headsaw is usually the only saw in the smallest portable sawmills. Much of the lumber made in this country today is sawed by portable circular mills.

Stationary circular mills.--Stationary circular mills may be made with one arbor for small to medium timber, or for fairly large timber they may have two arbors, one above and sawing in the same plane with the lower one. Mills of this type carry saws up to 72 inches in diameter and weigh up to 8,000 pounds; horsepower is 150 to 175, and the capacity is from 40,000 to 50,000 feet per day. Circular mills of this type nearly always have some auxiliary saws, such as edgers and trimmers.

### Gang Saws

The gang saw cuts by means of a series of parallel saw blades mounted in a frame that moves up and down as the wood is slowly fed through the machine. Typical gang saws turn out well-sawed lumber with a minimum of waste. They are, however, one of the less common types of saw because there are many plants where they cannot be used to advantage.

Round log type.--The Swedish, or log type, gang saw is a type of headsaw that is generally used for small to medium logs of sound type. It is sometimes provided with a small cutterhead that gives the log a narrow, flat face on the lower side as it passes through the machine. The lumber as it comes from the machine is necessarily bark-edged. A typical round log gang saw designed for logs up to a maximum of 18 inches in diameter has a 16-inch stroke with a maximum of 375 strokes per minute. Feeds up to 1 inch per stroke may be had depending on conditions. From 50 to 75 horsepower is required, and the shipping weight is 16,500 pounds.

Cant type.--In the United States, the most common type of gang mill is the cant type, which is generally used in connection with band saws in large operations. The band saws slab suitable logs on opposite sides, and these are then gang-sawed into lumber. Large logs may also be broken down by the band saw into cants of gang-saw size. With the larger gang saws several cants can be sawed simultaneously. Typical heavy gang mills vary from 30 inches to 48 inches in width, with a 14-inch depth of cut, and may carry up to 40 blades in the frame. Saws vary from 6 to 31 inches up to 8 by 37 inches. There are usually from 240 to 275 strokes per minute with a feed rate up to 3/4 inch per stroke. Shipping weight varies from 20,000 to 48,000 pounds in different models.

### Resaws

The function of the resaw is to saw one thick piece into two thinner ones. Many of the larger sawmills cut very little material thinner than 2 inches on the headsaw, and produce their 1-inch boards by passing thicker material through resaws. Nearly all modern resaws are band saws, which may operate in either a vertical or horizontal plane. The resaws described here are sawmill machines. Resaws are also used in factories but in somewhat smaller sizes.

Band resaw, vertical. Feeds, 8 rates from 19 to 210 f.p.m.; horsepower 50 to 60; wheel diameter 60 inches; saw width 7 or 8 inches; rim speed 7,000 to 9,000 f.p.m.; maximum capacity 33 inches high by 22 inches wide; weight 11,000 pounds net; floor space 66 inches by 112 inches.

Band resaw, horizontal or slab. Feeds, 40 to 175 f.p.m.; horsepower 40 to 50; wheel diameter 54 inches; saw width 8 inches; rim speed 7,000 to 9,000 f.p.m.; maximum capacity 13 inches by 24 inches; weight 10,600 pounds net; floor space 66 inches by 126 inches.

### Edgers

The edger is used to square up lumber by removing bark edges, to reduce it to standard widths, and sometimes to rip extra wide material to narrower widths. Like headsaws, edgers vary widely in size and capacity. They usually have one stationary circular saw and one or more circular saws that can be moved laterally on the arbor so as to permit ripping different widths. Saws may be either solid-tooth or inserted-tooth.

A typical small edger has two 14-inch saws, will saw lumber up to 3 inches thick, takes 10 to 15 horsepower, and weighs 1,800 pounds. Heavy edgers for big timber carry several saws up to 30 inches in diameter, can rip lumber as thick as 9 inches at 250 f.p.m. and may weigh up to 16,000 pounds.

### Trim Saws

Unlike the preceding saws, trim saws cut at right angles to the grain. They are used to square the ends of lumber, reduce it to standard lengths, and trim out some of the more serious defects. Smaller sizes, such as those that carry two 20-inch diameter saws, can trim lumber up to 6 inches thick, require 15 to 20 horsepower, and weigh 3,000 to 4,500 pounds. Some of the larger trim saws carry 10 or more saws up to 36 inches in diameter, can saw timbers up to 12 inches thick, feed at 80 to 100 f.p.m., require 20 to 25 horsepower, and weigh 6,000 to 8,000 pounds. The gage ranges from 8 to 12 according to the diameter.

Trim saws and other cross-cut saws are filed so that the top and front of alternate teeth are bevelled in opposite directions, instead of having chisel points like rip saws. They are solid-tooth saws, and clearance is obtained by "setting", that is, by bending the points of alternating teeth slightly outward in opposite directions.

### Slashers

Slashers are circular saws usually from 36 to 42 inches in diameter and usually mounted at 4-foot intervals on an arbor. The purpose is to cut slabs and edgings into 4-foot lengths for manufacture into lath or for use as fuel. The gage varies from 6 to 8.

## Planing Mill Machinery

Most large softwood sawmills have planing mills in conjunction, but in addition there are many independent planing mills. As a minimum the planing mill is usually equipped to resaw, rip, and crosscut the lumber and to put it through some type of planing machine. Since these machines and others are described in some detail under sawmills and industrial plants, they are merely mentioned here in passing.

## Industrial Plant Woodworking Machinery

Woodworking plants use a wide variety of machines and make products varying in quality from boxes to pianos. Such plants refine their product much farther than do planing mills. Some typical machines of the more important types are briefly described in the following paragraphs.

### Circular Saws

Most circular saws in industrial plants are the solid-tooth type. They average considerably smaller than sawmill circular saws, and may be fitted for ripping, crosscutting, or combination work. The size of the saw naturally varies widely according to the type of work it is required to do.

<u>Diameter,</u> <u>inches</u>	<u>Approximate</u> <u>cutting limit,</u> <u>inches</u>	<u>Gage</u>	
		<u>Spring set</u>	<u>Swage set</u>
8	2	18	—
12	4	15	13
16	6	14	12
20	8	13	9
24	10	11	8

Rip saw, self feed. Feeds, 56, 85, 103, 154; horsepower, 10 to 15; saw, 10 inches to 16 inches in diameter; speed, 3,600 r.p.m.; maximum capacity, 5-1/2 inches thick, 18 inches wide, weight, 2,400 pounds net; floor space, 51 by 54 inches.

Rip saw, self feed, gang type. Feeds, 100 to 300 f.p.m.; horsepower, 40; saws, 14 inches in diameter; speed, 3,600 r.p.m.; maximum capacity, 4-3/4 inches thick; weight, 5,000 pounds net; floor space, 60 to 68 inches.

Rip saw, straight line. Feeds, 62, 93, 124, 168 f.p.m.; horsepower, 10 to 20; saw, 9 inches to 14 inches in diameter; speed, 3,600 r.p.m.; maximum capacity, 4 inches thick, 24 inches wide; weight, 6,550 pounds net; floor space, 6 feet, 2 inches by 6 feet, 5 inches.

Variety or universal saw, tilting arbor, hand feed. Horsepower, 3 to 5; saw, 12 to 20 inches in diameter; speed, 3,600 r.p.m.; maximum capacity, 3 to 4 inches thick; weight, 1,400 to 2,700 pounds net; floor space, 40 by 50 inches to 60 by 84 inches.

Radial saw, hand feed. Horsepower, 1 to 10; saw, 9 to 22 inches in diameter; speed, 3,425 r.p.m.; maximum capacity, 2 to 6 inches thick.

Cut-off saw, straight-line type. Horsepower, 5; saw, 16 inches in diameter; speed, 3,600 r.p.m.; maximum capacity, 4 inches thick; weight, 1,150 pounds net without tables; tables, 800 pounds.

Cut-off saw, swing type. Horsepower, 5; saws, 12 inches to 16 inches in diameter; speed, 3,600 r.p.m.; maximum capacity, 3-1/2 inches to 4-1/2 inches; weight, 750 pounds crated without tables.

#### Band Saws

Scroll bands. Horsepower, 2 to 5; saws, spring set; wheel diameter, largely 30 inches to 42 inches; speed, 600 to 900 r.p.m.; weight, 1,200 to 2,400 pounds net; floor space, 30 to 50 inches to 40 by 64 inches. Dimensions of typical narrow band saws are as follows:

<u>Gage</u>	<u>Thickness,</u> <u>inch</u>	<u>Width of Blade,</u> <u>inches</u>	<u>No. of points</u> <u>per inch</u>
22	0.028	1/8 to 1/4	7
21	.032	3/8 to 7/8	4 to 6
20	.035	1 to 1-3/4	3 to 4

Band rip saw. Feeds, 6 rates from 55 to 225 f.p.m.; horsepower 15 to 25; wheel diameter, 44 inches; saw width, 4 inches and 5 inches; motor speed, direct drive 720 r.p.m.; rim speed, 8,000 to 9,000 f.p.m.; maximum capacity, 30 inches wide by 10 inches high; weight, 6,600 pounds; floor space, 60 by 70 inches.

Band resaws. Both the vertical and horizontal types are used in industrial plants. They are similar to the resaws already described under sawmill machinery, except that they are generally somewhat smaller machines.

#### Jig Saw

Horsepower, 1 to 2. Saw width, 1/4 to 5/8 inch; speed, 1,200 r.p.m.; weight, 1,500 to 1,700 pounds crated; floor space, 48 by 48 inches.

#### Planing Machines

Hand planer and jointer. Horsepower, 5 to 7-1/2; speed, 3,600 r.p.m.; maximum capacity, 12 to 30 inches; weight, 1,900 to 3,200 pounds crated.

Facing planer. Feeds, 20 to 60 f.p.m.; horsepower, 10; speed, 3,600 r.p.m.; maximum capacity, 30 inches; weight, 10,000 pounds crated; floor space, 56 by 118 inches.

Single surfacer, light. Feeds, 20 to 60 f.p.m.; horsepower, 7-1/2; speed, 3,600 r.p.m.; maximum capacity, 8 inches by 24 inches; weight, 3,000 pounds net; floor space, 40 by 66 inches.

Single surfacer, heavy. Feeds, 25, 40, 50, 80 f.p.m.; horsepower, 15, 20, 25; speed, 3,600 r.p.m.; maximum capacity, 8 by 30, 36, and 42 inches; weight, 7,600 to 8,600 pounds net; floor space, 75 by 75 inches to 88 inches.

Double surfacer, heavy. Feeds, 30, 45, 60, 90 f.p.m.; horsepower, 20 top head, 15 bottom, 10 feed motor; speed, 3,600 r.p.m.; maximum capacity, 8 by 30 by 36 inches; weight, 20,000 pounds crated; floor space, 84 by 96 inches.

Planer and matcher. Feeds, 75 to 200 f.p.m.; horsepower, top 40, bottom 20, side heads 15 and 20, profilers 10 to 15, feed motor 15; speed, 3,600 r.p.m.; maximum capacity, 8 by 15 inches to 8 by 24 inches; weight, 16,000 to 17,000 pounds net; floor space, 12 by 6 feet to 12 by 7 feet.

Moulder, light. Eight feeds from 23 to 160 f.p.m.; horsepower, 5 for top, bottom, and feed, 3 for side heads; 5 speeds, 3,600 to 7,200 r.p.m.; maximum capacity, 4 by 6 inches; shipping weight, 8,500 pounds, floor space, 44 by 84 inches.

Moulder, heavy. Twelve feed rates; horsepower, 20 and 15 for top and bottom, 7-1/2 for side heads and feed; speeds, 3,600, 4,800 r.p.m. and up; maximum capacity, 6 by 16 inches; shipping weight, 14,000 pounds; floor space, 63 by 144 inches.

### Sanders

Three-drum, endless-bed type, 55-inch size. Feeds, 12, 18, 24 f.p.m.; horsepower, 10 and 15 for drums, 2-1/2 for feed; speed, 1,200 and 1,800 r.p.m.; weight, 15,000 pounds net; floor space, 110 by 118 inches. (Other sizes from 31 to 85 inches.)

Six-drum roll-feed type, 55-inch size. Feeds, 12 to 36 f.p.m.; horsepower, 10 and 15 for drums, 5 for feed; speed, 1,200 and 1,800 r.p.m.; weight, 24,000 pounds; floor space, 98 by 137 inches. (Other sizes from 49 to 73 inches.)

Belt, hand-block type. Horsepower, 3; belt speed, 4,500 f.p.m.; motor, 1,200 r.p.m.; maximum capacity, 32 by 96 inches; shipping weight, 2,200 pounds; floor space, 72 by 126 inches.

Double belt, automatic power and hand stroke type. Horsepower, 10; belt speed, 3,200 f.p.m.; 60 to 120 strokes per minute; maximum capacity, 100 inches; shipping weight, 7,850 pounds; floor space, 60 by 176 inches.

### Shapers

Two-spindle, medium; horsepower, 4; speed, 7,200 r.p.m.; table size, 36 by 60 inches; weight 2,500 pounds net.

Two-spindle, heavy; horsepower, 7-1/2; speed, 7,200; table size, 40 by 84 inches; weight, 3,300 pounds net.

### Routers

Light. Horsepower, 1; speed, 20,000 r.p.m.; table size, 20 by 24 inches; weight, 680 pounds net; floor space, 24 by 54 inches.

Heavy. Horsepower, 3; speed, 10,000 and 20,000 r.p.m.; table size, 24 by 36 inches; shipping weight, 1,800 pounds.

### Tenoners

Single end, hand feed. Horsepower, 1-1/2 or 2 for cut-off saws, tenoning units, and cope units; speed, 3,600 r.p.m.; maximum capacity, 24 inches wide; weight, 2,450 pounds; floor space, 64 by 80 inches.

Double end. Feed, 17 to 60 f.p.m.; horsepower, 5; speed, 3,600 r.p.m.; capacity, 48 to 192 inches long by 28 to 92 inches wide; weight, 15,000 to 17,500 pounds net; floor space, 11 by 11 feet to 16 by 17 feet.

### Mortisers

Hollow chisel-type, single spindle. Feed, 15 to 70 strokes per minute; horsepower, spindle 4, feed, 2; speed, 3,600 spindle, 1,800 r.p.m. feed; maximum capacity, 1-inch chisel, 4-inch stroke; weight, 1,400 pounds net; table size, 6 by 36 inches.

Hollow-chisel type, 5 spindles. Feed, 7 to 21 strokes per minute; horsepower, spindle 2 to 4; speed, 3,600 spindle; maximum capacity, 1- to 1-1/2-inch chisel, 4- to 6-inch stroke, 8-inch width; weight, 5,000 to 6,000 pounds net; floor space, 63 by 68 inches to 63 by 90 inches.

Chain type. Horsepower, 3 to 10; speed, 900 r.p.m.; capacity, mortise 1/4 to 1 inch wide by 1-1/2 to 2-3/4 inches long by 4 to 6 inches deep; weight, 800 to 1,500 pounds net; floor space, 24 by 54 inches to 47 by 67 inches.

## Borers

Single-spindle, hand-feed type. Horsepower, 2; speed, 1,800 and 3,600 r.p.m.; maximum capacity, 9-inch stroke; weight, 1,350 pounds net; table size, 24 by 32 inches; floor space, 32 by 48 inches.

Single-spindle, heavy-duty, hydraulic feed. Feed, 2 to 35 strokes per minute; horsepower, 3 to 5 for spindles; 1 for feed; maximum capacity, 12-inch stroke; weight, 2,400 pounds net; table size, 22 by 32 inches; floor space, 32 by 55 inches.

Multiple-spindle, hydraulic feed. Feed, 2 to 35 strokes per minute; horsepower, 5 to 10 for spindles, 1-1/2 for feed; maximum capacity, 16-inch stroke; weight, 35,000 to 41,000 pounds net; table size, 18 by 48 inches to 84 inches; floor space, 52 by 48 inches to 84 inches.