Reprinted from WOOD SCIENCE AND TECHNOLOGY, volume 1, number 3, pages 180-183. 1967.

History of Wood Machining

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The history of wood machining is closely tied to advances in metallurgy and power sources. It has been strongly and continuously shaped by prevailing economic forces and the rise and decline of other contemporary industries. This paper sketches a few of the highlights, with emphasis on developments in North America.

After learning to control fire more than 16,000 years ago, and after the final retreat of the ice sheet in about 9000 B.C., man was presumably able to split firewood with the shafted bone or stone axe he had invented by 6000 B.C.

Copper and bronze tools were known in the Middle East before 2500 B.C., and subsequently reached an advanced stage of development in Egypt. Direct reduction of iron ore—that is, the ability to remove the non-iron portion of the ore, but not the ability to melt iron—was discovered as early as 1500 B.C. Furnaces capable of actually melting iron first appeared in the 14th century. Although conscious knowledge of steel manufacture probably existed in the 9th to 5th centuries B.C., it was not until 1740 A.D. that the crucible furnace was developed for remelting and homogenizing iron with controlled amounts of carbon to make steel. These crucible furnaces produced most tool steels until they were superseded by the electric furnace invented in the late 1800's.

A list of important metallurgical innovations would have to include the STRAUSS patent on tungsten carbide, rights for which were puchased in 1926 by KRUPP Works in Germany; manufacturing rights in America were acquired by the GENERAL ELECTRIC COMPANY in 1928.

The natural abrasives—flint, emery, and garnet—were supplemented and eventually largely replaced by silicon carbide, first experimentally produced in the early 1890's, and by aluminium oxide, first created synthetically about 1900.

Development of tools accelerated with knowledge of iron. The fact that some Etruscan bed frames (circa 900 B.C.) had lathe-turned legs indicates the beginning of major progress. The Roman iron axe with shaft hole made its appearance between 500 and 200 B.C., as did the bow saw with stressed iron blade. The setting of saw teeth was probably originated by the Romans.

The earliest known planes, dating from before 79 A.D., are from Pompeii. Although the bow drill with copper awl was in use in Egypt by 2700 B.C., the auger had only rudimentary development by Roman times, as evidenced by the iron spoon bits that have come down to us.

The tools available at a given time and place depended on the local level of culture. The tool box of the urban Roman carpenter was probably more extensive than that of his European provincial counterpart 1000 years later.

Until the development of the windmill and waterwheel prior to 1300 A.D., all wood machining had to be powered by man or beast. Although the inventor and the time and place of the first water-powered pit saw are unknown, the development could have occurred in Europe between 1300 and 1500 A.D. What may have been the first water-powered sawmill in the New World was established in 1634 at the falls of the Piscataqua River near Portsmouth, New Hampshire. It employed a gate saw, a primitive progenitor of today's gang saw, and undoubtedly cut timbers for wooden ships. A census taken only 186 years later (1820) revealed 188 operating sawmills in this same small New Hampshire county.

Between 1790 and 1808 Sir SAMUEL BENTHAM and Sir MARC ISAMBARD BRUNEL revolutionized the building of wooden ships in England by inventing the principle of rotary cutting and a process by which block pulleys for the rigging of ships could be manufactured rapidly in a progressive series of operations. Between 1800 and 1808 English patents were obtained on a planing machine and on a circular saw designed to cut veneer. Although NEWBERRY's English patent on the band saw is dated 1808, practical application in North America was delayed until saws made from Swedish steel became available in about 1870.

Large circular saws were introduced to North America in 1814 and were in general use by 1860. The first practical inserted-tooth circular saw was invented in 1866. A number of planing machines with rotating heads had been patented by 1830, but the first practical machine was not built until 1850; in 1881 a double surfacer with power-driven feed was patented. A veneer lathe was patented by DRESSER of Stockbridge, Massachusetts, in 1840, and by 1875 a veneer slicer was in operation. In 1866 the first double-end tenoner was patented, and by 1900 an endless-bed, triple-drum sander had been patented.

The demand for rail cars—already heavy by the time of the Civil War and further stimulated by the 1869 completion of the first transcontinental railroad—resulted in the invention of railway cut-off saws, multiple-spindle borers, hollow-chisel mortisers, and machine combinations to accomplish both simultaneous and sequential operations on car frames.

The westward movement and the 1849 discovery of gold in California created a demand for wagon wheels, but it was not until 1904 that automatic machines to turn wagon spokes and hubs were well developed.

The very large Douglas-fir logs of the Pacific Northwest were first cut with steam-powered double circular mills having lower saw blades as large as 72 inches

with correspondingly wide kerf. The first practical large-log band mill was built in 1869. By 1885 a band mill with 9-foot wheels was in service, and carriages driven by steam engines and steam "shotguns" were in use, along with setworks, edgers, slashers, cut-off saws, steam-feed jump saws, and handling systems for sawmills cutting 150,000 board feet per day. The first electrically powered sawmill was set up in 1896. It was driven by a 100-horsepower electric motor, and carried a 14-inch-wide saw on 9-foot wheels.

The Alaska gold rush in 1898 created a strong demand for surfaced lumber for flumes, and in 1899 this need was met by STETSON's development of the "Ready Sizer", a machine capable of rapidly surfacing one edge and one side of random-width, random-thickness lumber as it came from the sawmill. In 1907 a planer and matcher combining the ideas of STETSON and ROSS was invented. It had removable cutterhead cartridges for quick pattern change, and jointing devices to fully utilize 6-knife round heads. Very large diameter feed rolls gave it the ability to feed lumber fast. The full practical potentialities of this machine —planer feed speeds in excess of 1,000 feet per minute with cutterheads carrying 20 knives—were greatly extended some decades later when BLOOD invented an automatic feeding table, and HORSTKOTTE together with ONSTAD developed a tilting elevator to rapidly deliver lumber to the feed table.

By 1906 direct-current motors belted to individual machines were beginning to replace line shafts powered by steam engines. In 1908 ball bearings began to be applied to woodworking machines, and, a year later, thin, high-speed steel knives mounted in round heads started to replace the less satisfactory thick knives and square cutterheads.

The development in about 1919 of the ball-bearing cutterhead with alternating-current motor mounted directly on the extended cutterhead spindle not only improved previous arbor designs but gave the machine builder flexibility in design.

The economic pressures of the 1930's caused a new spurt of innovation. PRITCHARD and F. W. NICHOLSON patented the "two-way thicknessing" planer so designed that it will not make a thin board thinner.

The chain saw, first introduced to North America in about 1915, was much improved in the late 1930's and has since gained almost complete acceptance for felling and bucking trees. It is probable that hydraulic shears, which have been in limited operation in the woods since 1960, will find increasing use—and to some extent—will perform harvesting work presently done with chain saws.

Increasing consumption of pulp and paper, and hence increased need for bark-free wood, brought important developments in bark removal equipment during the 20 years from 1935 to 1955. The drum barkers developed for cordwood in the Lake States and the Northeast proved not applicable to the large logs of the West Coast, and machines were invented that employed high-pressure water jets to strip bark from sawmill slabs and from whole logs.

The rotating-ring mechanical barker was simultaneously invented in about 1950 by B. NICHOLSON of Seattle, Washington, and by SODERHAMN of Sweden. It has proven to be a wood machining innovation of primary importance because it has vastly increased the supply (in the form of sawmill slabs and veneer mill clippings) of bark-free chippable wood available to the pulp industry.

The multiple-wide-belt sander that appeared in the United States after 1955 is noteworthy because it combines the economical sizing and smoothing action of

the drum sander with the quality of polishing attainable on the stroke sander —all at speeds well in excess of those attainable on a multiple-drum sander.

Since 1955, important progress has been made in converting wood into mechanical pulp. Stone grinding of cordwood, a process that is more than 100 years old, is being increasingly challenged by high-pressure disc-refining of chipped wood.

In 1962 it was demonstrated that it should be possible to slice relatively undamaged and very thick (3/4-inch) veneer—an idea with major implications. In 1963 it was demonstrated that wood can be cut with a laser and that it is also possible to saw with a water jet.

The years from 1963 to 1966 have seen the invention of chipping headrigs for small logs. These new headrigs convert a log into a cant without forming either sawdust or slabs. In 1966 the principle of inclined cutting was industrially applied in the form of an oscillating-knife veneer lathe. The same year saw the introduction of a tape-controlled routing and shaping machine, a development signalling the imminent application of computers to control various wood machining processes.

Prior to 1945 most advances in wood machining were the result of industrial trial and error; however, reviews of wood machining research published in recent years reflect results gained from formal laboratory research. It is expected that this new approach will accelerate change in the techniques of wood machining.

Additional Publications on Wood Machining

Except for the first item, which is available only by purchase from booksellers or the publisher, copies of the publications listed below may be had free on request to the Southern Forest Experiment Station, T-10210 Federal Building, 701 Loyola Avenue, New Orleans, La. 70113.

1. Koch, Peter.
1964. Wood machining processes. 530 pp. New York: Ronald Press.

2. Koch, Peter.
1964. Square cants from round bolts without slabs or sawdust. Forest Prod. J. 14: 332-336, illus.

3. Koch, Peter, and McMillin, C.
1966. Wood machining review, 1963 through 1965. Forest Prod. J. Two parts. I.—16(9): 76-82, 107-115; II.—16(10):43-48.

4. Koch, Peter.
1966. Straight studs from southern pine veneer cores. U. S. Forest Serv. Res. Pap. SO-25, 37 pp., illus. Southern Forest Exp. Sta., New Orleans, La.

5. Koch, Peter.
1966. A system for manufacturing straight studs from southern pine cordwood. Southern Lumberman 213(2656): 165-169, illus.

6. Koch, Peter.
1967. Straight studs are produced from southern pine cordwood. Forest Ind. 94(5): 44-46, illus.