## SAW MAKING.

The manufacture of saws, from the plain hand-saw to the immense circular and gang saw, has been brought to such perfection by the firm of H. Disston & Sons, in this city, that a description of the process as carried on in their establishment, at Front and Laurel streets, might be of interest.

Their raw material consists of "blister bars," which are blistered from a particularly pure brand of Swedish iron.

These bars, together with steel scraps, are melted in crucibles; furnaces used for this purpose are of the ordinary construction. The melted steel is poured into moulds, and the ingots are forged out into blooms under a heavy steam-hammer.

In hammering, as well as in rolling, great care has to be exercised to obtain uniformity of density and tension, otherwise the hardness and temper could not become uniform, and there would be a tendency to buckling and consequent heating.

These blooms are brought under a train of rolls, similar to those used in plate mills, and, after having been re-heated several times, at last acquire the necessary thickness and width. It is of course important to make the saw blade as thin as can be for its work, so as to effect a saving in first cost, in the lumber to be cut, and in the power for cutting. (As a good sawyer can cut with a thinner saw than a poor one, it is but questionable economy to employ green hands.) After being annealed they pass to the trimming shears, where the ragged edges and all other superfluous material is removed, and they are then ready for teeth cutting.

The big coarse teeth of the larger circular and gang saws are cut out by punches; some of them are driven by power and resemble an ordinary punching machine, the punches and dies being formed according to the shape desired for the teeth. A number of hand presses are also used for some particular kind of work.

The machine for cutting the teeth of hand saws consists of a rapidly revolving disk, into which a steel cutter of proper shape is inserted. In front of it are four friction rollers, which take the steel blade between them and propel it past the revolving cutters at such speed that the proper pitch of teeth is attained. For small hand saws, with very fine teeth, a number of hand lever presses are still used, although they work much slower, and at greater expense, than the above power machine.

The angle and frequency of teeth must be adapted to the work to be performed, and consequently differ greatly; but a general rule is that they should be a uniform distance apart and all of equal length. Clearance or chamber space is required in large saws, to hold the sawdust until it can escape, and in some gang saws a special deeper clearance space is arranged after every second or third tooth. Soft wood, requiring greater feed, thus also necessitates more clearance. With large teeth the clearance space or gullet should have rounded outlines, to prevent cracks from starting, as they frequently do in sharp corners.

Another important point in shaping teeth is to adopt a form that will allow the greatest amount of sharpening (and refiling) with the least expenditure of material, labor, files and time, and diminish, in circular saws, their diameter, in gang saws their width, by the least possible amount, so that they can be used for a longer time with the same efficiency.

Messrs. Disston & Sons have adopted and patented a system for shaping teeth, in conformity with the above conditions, and their saws have lines marked on them, to serve as guides for sharpening and adjustment.

The saws now go to the hardening and tempering room where they are heated in ordinary reverberatory furnaces, and then plunged into an oil bath, which makes them hard and brittle as glass; sometimes they are also distorted and twisted out of shape. All this is to be corrected in the tempering furnace, to which they are now taken.

The tempering furnace is built around a hydraulic press, the head of the plunger being surrounded by the flames; this head is of such size as to take in the largest circular saw. When such a one, or a number of smaller saw blades are placed upon it, the pressure is put on, it rises slowly, and at last presses the saw blades against the top plate of the press, and holds them until the necessary temper is given. When the blades come out they are straight and surprisingly flexible. They are generally tested by being forcibly bent nearly double, and if any one should crack, or not return to its original straightness, it is rejected.

The principal requisites in hardening and tempering are that the metal be hard enough to cut well and to remain keen, while not so hard as to crack, to prevent swedging or to resist filing. It should also have sufficient stiffness, without brittleness, so as to permit setting.

The saws now go to the hammering benches, where they are placed upon iron straightening blocks and treated with peculiar hammers. These hammers have long narrow faces at both ends, parallel to each other, but at 45° to the direction of the handle; it will thus be seen that the marks made by one face will be at right angles to those made by the other, so that the hammerer can place his marks in almost any direction without changing his position.

This hammering process requires great skill, so as not to produce deep hammer marks, or create any unequal strains that might cause buckling.

The saws are now ready for grinding; some of peculiar shape, especially those that require a thicker cutting edge, are ground on ordinary grindstones by being pressed against them by the grinder. This is of course a very slow process and must be a terrible strain on the workmen.

There are several very ingenious grinding machines in use; in those for circular saws, a bed is placed across the face of the grindstone. A frame sliding on this bed contains a pivot pin, on which the circular saw is slowly revolving, and this is effected by two friction rollers (also attached to the sliding frame), which take the edge of the saw between them.

Opposite the grinding face of the stone the saw is supported by a set of rollers, and thus it is ground while it is slowly revolving, and moved along on the sliding bed. In another machine the saw moves between two grindstones opposite each other, and thus the two faces are ground at the same time. In another machine, destined for large gang saws, two grindstones are also used, one above the other, while the saw is slowly dragged between them horizontally.

Common hand saws are ground on a machine with one stone, the saw blades being placed in an arched block connected by arms with a swing shaft in front of the stone.

The arc of this block is described from the centre of the swing shaft, at the same time forming a tangent to the stone; the block, after the saw is put in being moved up and down, will insure a uniform thickness of blade.

After being ground the saws go into the polishing department; a rapidly revolving pulley, encircled by a leather belt, on which emery is glued, is the means by which small saws are polished. On some of these pulleys the emery is not glued on, but the article to be ground is wetted, dipped in emery, and then held to the polishing wheel. The circular saws are fixed on a shaft, which is then revolved at great speed, and a polishing block with emery is pressed against them.

In grinding and polishing, great care has to be taken to obtain a uniform thickness and a smooth surface, so as to reduce friction in sawing.

After being polished the hand saws go through the blocking process, that is, they are hammered on a block of hard wood, whereby any buckle or twist is taken entirely out.

Undergoing all these different treatments, the saws have become a little too loose and flexible, and it becomes necessary to give them a certain stiffness, which is done by heating them in a small reverberatory furnace until they attain a violet or blue hue. When they come out they are wiped with diluted muriatic acid, which takes off any color, leaving them bright and shining as before. The acid is removed by immersing them in lime water, and they are then put into saw-dust, which takes up all the moisture.

The grinding and polishing has still left some cross marks and irregular lines on the surface of the saw; to give them a smooth appearance with a uniform stroke of polish they are subjected to the *rubbing* process. A box, running on slides, is reciprocated by a connecting rod from a rapidly revolving crank-shaft; into this box the saw is put, covered with polishing powder, and a block fixed to a lever, which can be raised and lowered, is pressed hard down on it while the box is reciprocating; when taken out, the blade has a beautiful gloss, and a regular and uniform stroke of polish.

The saws are now taken to the work benches, where their teeth are set by hand with a small hammer; they are then put, two and two together, in a vise and filed, so as to give their cutting edges the proper bevel.

The teeth of large circular and gang saws are beveled by a machine with an emery wheel having a rim in accordance with the shape of the teeth.

The hand saws are now ready to have their handles put on; the necessary holes are punched, the blade is put into the slit of the wooden handle, and a number of brass screws are put in and tightened up by counter-sunk nuts. The saws are then again overhauled on the block and any little irregularity corrected by hammering.

They are now taken down to the storeroom, where they are again overhauled, cleaned and packed into packages, which are properly labeled and put into their proper places.

In the sample room of Messrs. Disston & Sons', their magnificent glass case exhibit, shown at the Centennial Exhibition, can still be seen. Innumerable drawers and closets contain samples of all the different saws and other tools manufactured by the firm, and their systematic arrangement clearly shows the spirit that pervades the entire management.

The transportation of materials, etc., throughout this entire establishment, is effected by means of small cars running on a railway of about 16 in. gauge; communication with the different floors of the building is kept up by several elevators.

To give an idea of the extent of these works, it may be stated that 1900 workmen are employed, and about 40 tons of new steel used up per week.

J. HAUG, M. E.

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The *Engineering News* says: When steam cars are once successfully introduced upon street railways, we shall look for the adoption next of traction engines for handling the heavy loads, which are now conveyed from foundries and iron working shops by the aid of large teams of horses, taking up much space and seriously interfering with public convenience. These engines have been used in considerable numbers in some of the cities of England and Scotland, but we believe the only shape in which steam appears in the streets of our American cities, except as previously noted, is in driving the heavy road rollers, so effective in consolidating the roadway.

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BLACK INK.—Nutgall ink writes very pale at first; manufacturers used to "age" it by keeping it several months, stirring two or three times daily, in order to darken the color. This time can be considerably shortened by blowing air through the ink, which can very conveniently be done by means of a soft rubber syringe. Since the idea is to oxidize the iron salt, the oxidation can be obtained in a short time by putting chlorate of potassa and cupric oxide (or powdered glass, or similar substance) in a test-tube; close the latter with a cork, through which passes a bent tube, and heat over a spirit lamp. Oxygen will be evolved, and five grains of the salt, equal to three fluid-ounces of oxygen, will considerably darken half a gallon of ink. The use of the addition of cupric oxide to the chlorate is merely mechanical, to facilitate its fusion. —*Drugg. Cir.*, xxi, 67.

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SPONGY GOLD.—From our contemporary, *Industrieblätter* (1876, 401) we glean the following method of obtaining the finely divided gold so much used by dentists. A solution of gold is made with *aqua regia*, not necessarily free from copper, is evaporated until the excess of nitric acid is driven off. Oxalic acid and carbonate of potassium are then added in such quantity as will retain almost all the gold in solution. An excess of oxalic acid is then added and the solution boiled. The gold is then precipitated, while such impurities as copper remain in solution. The precipitated gold is carefully washed until it is entirely free from acid. It is dried on filter paper and is then ready for use.

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An English engineering paper commences a lengthy illustrated article on "The Ashtabula Bridge," as follows: "When a bridge gives way suddenly under the weight of its ordinary working load, it may be taken for granted that there is something radically wrong in either the design or the construction, and the event cannot be called an accident." This is a proposition that can neither be flanked nor climbed over.—*Hardware Reporter.*

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HARDENING PAPER.—The French papers speak of a method of rendering paper extremely hard and tenacious by subjecting the pulp to the action of chloride of zinc. After it has been treated with the chloride it is submitted to a strong pressure, thereafter becoming as hard as wood and as tough as leather. The hardness varies according to the strength of the metallic solution. The material thus produced can be easily colored. It may be employed in covering floors with advantage, and may be made to replace leather in the manufacture of coarse shoes, and is a good material for whip-handles, the mountings of saws, for buttons, combs, and other articles of various descriptions. An excellent use of it is in large sheets for roofing. Paper already manufactured acquires the same consistency when plunged, unsized, into a solution of the chloride.